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A report based on the program participants of the Building Research Institute Conference in the fall of 1962 on school building research whose aim it is to make contributions to building science. Major topics discussed are--(1) definition of school building needs, (2) developing the stragegy for meeting future school building needs, (3) comprehensive campus planning--case studies of design for long-range planning, (4) recent research for school facility design, equipment, and services, and (5) recent research on the management and operation of school facilities. Also included is a conference summary and the need for further research. (RK)

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SCHOOL BUILDING RESEARCH

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Inquiries concerning School Building Research or other publications resulting from the BRI 1962 Fall Conferences may be directed to the Building Research Institute, 1725 De Sales Street, N.W., Washington, D.C. 20036. The other publication resulting from these conferences is:

Finishes for Metals: Paintability of Galvanized Steel and Corrosion Resistance of Metallized Coatings

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ACKNOWLEDGMENT

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Elementary School Facility Needs

By Jean M. Flanigan, National Education Association

Abstract: It is possible to make predictions, within wide limits, for elementary school needs on the national level through 1968. Breakdowns by states and districts are much less certain because of the variable of migration, and projections to 1980 are uncertain because of the difficulties of estimating birth rate. This paper explores elementary school building needs in the immediate and foreseeable future as they are likely to be affected by these and other variables.

ANY NATIONWIDE PROJECTION of school building needs is directly related to the expectations of the country as a whole. A growing economy, or a stagnant economy; an all-out attack upon social ills, or no such effort; many dynamic changes in knowledge, or few such changes -- all of these factors will affect the need for elementary school construction. Economic and social trends, now unpredictable, may interfere with the projections we now make on the basis of available data, yet we must make such predictions because we remember two catastrophic periods in school building: the depression of the 1930's, when many school districts found that they had too many classrooms, and the period following World War II, when classrooms were frequently too few.

However, to some extent, a surplus or lack of elementary classrooms can be avoided if construction is planned on the basis of the demographic, economic, and social information now available. To explore the elementary-school building needs in the immediate and foreseeable future is the purpose of this paper.

ELEMENTARY SCHOOLS

The grade pattern in elementary schools varies widely. Some consist of kindergarten through grade 8, others of kindergarten through grade 6; some schools have no kindergarten; others terminate the elementary grades at 5 or at 7. The traditional grade 1 through 8 pattern is still associated with the central cities and rural areas. Table 1 shows the grades included in the typical, public urban elementary-school organization in 1958-59 (1).

Two sets of population figures are needed to represent both major types of elementary school organization. The population aged 5 through 13 is associated with the traditional kindergarten-grade 8 school, and the group 5 through 11 with the school that

FLANIGAN, JEAN M. Research Associate, Research Division, National Education Association.

ends with grade 6. There is another dimension, or mix. This is a result of schools housing both elementary and secondary grades either as a temporary expedient because of overcrowding, or because of planning.

TABLE 1 -- GRADES INCLUDED IN TYPICAL ELEMENTARY-SCHOOL ORGANIZATION IN URBAN SCHOOL DISTRICTS, 1958-59

Grades	Population of school district						All districts (weighted estimates)	
	500,000 and over	100,000-499,999	30,000 99,999	10,000-29,999	5,000-9,999	2,500-4,999	Number	Percent
1-5	. . .	. . .	. . .	1.9%	3.1%	. . .	55	1.6%
1-6	69.2%	80.5%	84.6%	80.1	1.3	66.7%	2,661	77.0
1-7	7.7	3.9	1.3	3.1	1.6	. . .	68	1.9
1-8	23.1	15.6	14.1	14.9	24.0	33.3	673	19.5
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	3,457	100.0%
Number of districts reporting	13	77	311	161	129	48	. . .	. . .

Building Needs

Here we must determine when a need is really a need. And we must rule out what might be called "public extravagance," as well as quonset huts, half-day sessions, and the like, as the solutions to the need for additional school housing. We must also assume that need can be created by physical obsolescence caused by deterioration; by population shifts, both within and among school districts; shifts in the boundaries of districts; and changes in curriculum organization.

Time Span

The time span of recent population projections of the Bureau of the Census carries through to the years 1965, 1970, 1975, and 1980. Highly accurate projections can be made for the nation as a whole through 1968, since most pupils who will be in school in those years have already been born. Breakdowns by states and districts are much less certain, because of the variable of migration, and projections to 1980 are uncertain because none of the elementary pupils of the late 1970's has yet been born.

Limitations of Data

In many cases, we can do little more than make educated guesses about pertinent data on the profile of the existing supply of elementary classrooms in terms of age, condition, and expected date of obsolescence, adaptability to a modern program, or location in population centers. A nationwide school facilities survey, conducted in the early 1950's, produced some data of this nature, but the estimates of need became involved in the political issue of federal aid for school construction. There is a limited annual survey of numbers of classrooms in existence (elementary and secondary combined), numbers built in the preceding year, and numbers planned for the next year.

ACTUAL AND PREDICTED POPULATION

The Bureau of the Census has recently revised two of a series of population projections by age group (3). Series II is based upon the assumption that fertility will remain constant at the 1955-57 level through 1980, and Series III assumes that fertility will decline to the 1949-51 level by 1965-70 and remain at that level through 1980. These data are shown in Table 2.

TABLE 2--CENSUS BUREAU PREDICTIONS OF POPULATION AGED 5-13 AND 5-11 BASED ON VARIOUS FERTILITY LEVELS

Year	Series II		Series III	
	Population 5-13	Population 5-11	Population 5-13	Population 5-11
	(thousands)		(thousands)	
April 1950	22,281	17,774	22,281	17,774
July 1960	33,057	25,583	33,057	25,892
July 1965	35,685	27,892	35,685	27,892
July 1970	38,637	30,375	36,881	28,619
July 1975	42,988	34,080	38,065	29,858
July 1980	48,940	38,851	42,106	33,423

Table 3 shows the population increase that will take place in the same age groups.

TABLE 3--CENSUS BUREAU PREDICTIONS OF POPULATION INCREASE IN AGE GROUPS 5-13 AND 5-11 BASED ON VARIOUS FERTILITY LEVELS

Decade	Increases			
	Series II		Series III	
	Population 5-13	Population 5-11	Population 5-13	Population 5-11
	(thousands)		(thousands)	
1950 to 1960 . . .	10,776	7,809	10,776	7,809
1960 to 1970 . . .	5,578	4,792	3,824	3,036
1970 to 1980 . . .	10,303	8,476	5,225	4,804

It can readily be seen that this variance, in terms of fertility level, will have a profound effect upon elementary-school facility needs in the coming decades. A year ago, there was little doubt that the high birth rate of the 1950's would continue, but now there are grave doubts that this will be so. The number of births for 1962, January through July, is down 2.9% or 71,000 from a comparable period in 1961 (5). The birth rate for the first seven months of 1962 was 110.7 compared with 116.0 in 1961.

Many factors are thought to influence the birth rate: business cycles, family size preference, and the extension of family planning. However, the potential for another baby boom is present in the number of young adults in the population. The size of this age group will bring an increasing population, even if the fertility rate declines.

ELEMENTARY SCHOOL ENROLLMENTS

Public and private elementary-school enrollments are now almost universal among the noninstitutionalized population (4). In October 1961, 66.3% of five-year-olds were in school as were 97.4% of those aged six; 99.4% of those aged seven to nine; and 99.3% of those in the 10 to 13 age bracket.

Kindergarten

More five-year-olds are being enrolled as the number of school systems supporting kindergartens increases. Between 1951 and 1961 the percentage of five-year-olds enrolled in school increased from 53.8-66.3% -- more than did the college-age group. If the same percentage of five-year-olds had been enrolled in school as six-year-olds in October 1961, elementary-school enrollments would have been almost 1.3 million larger than they actually were.

The cost of instruction and facilities in kindergartens is usually less than the cost in other grades. Half-day sessions permit a classroom to accommodate two classes a day. According to an NEA survey of kindergartens in 1961, nine out of ten public kindergartens did this. Eight out of ten were in main elementary-school buildings, and seven of ten were in rooms specifically designed for kindergartens.

Kindergarten attendance varies widely throughout the states. In April 1960, more than 80% of the five- and six-year-olds in six states were enrolled in school: California, Connecticut, Hawaii, Michigan, New Jersey, and New York. In ten states in the South, and in Idaho, Montana, and North Dakota less than 50% were enrolled.

Nursery Schools

Downward extension of the elementary school to the nursery school level reached a peak in 1945 because of a high employment rate among mothers. Federal funds were provided, but aid was withdrawn in 1946. Recent legislation to re-establish such aid failed, and there is little pressure at this time for public nursery schools. The possibility of a national labor shortage, or the establishment of programs to offer remedial work to culturally deprived children, makes it necessary for us to consider the nursery school in long-range planning, even though it is doubtful that increased enrollments will come from the age group under five years.

Grades 7 and 8

Over the past decade, the trend has been to incorporate grades 7 and 8, and to a lesser extent grade 6, as junior high school classes on a secondary basis. Therefore, the proportion of public-school pupils in grades 7 and 8 in schools organized as elementary grades declined from 50.4% in 1951-52 to 38.4% by 1958-59. This has reduced the need for elementary facilities, and has provided certain educational advantages.

A slight downward trend in reorganizing grades 7 and 8 into junior high school type programs occurred as the postwar wave of children passed on to crowd secondary-school facilities at all grade levels. It is our opinion that the educational advantages inherent in secondary-type organization for grades 7 and 8 will cause this downward trend to be reversed.

ENROLLMENT PROJECTIONS

Enrollment surveys by the Bureau of the Census show the enrollment status by level of school, and by age group for noninstitutional population. This information is given in Table 4.

TABLE 4 -- ENROLLMENT BY SCHOOL LEVEL AND AGE GROUP FOR NONINSTITUTIONAL POPULATION

School Level	Age 5-13		Age 14-17		Age 18-20	
	1950	1950	1950	1960	1950	1960
K-8	91.1%	93.2%	12.5%	8.8%	0.2%	...
9-12	1.7	1.9	68.6	79.5	6.7	0.1%
College	...	...	2.2	2.0	...	6.8
Total enrolled	92.8	95.1	83.3	90.3	...	...
Not enrolled	7.2	4.9	16.7	9.7	...	...
Total	100.0%	100.0%	100.0%	100.0%	...	...

A recent study by the NEA projected elementary enrollments for fall 1969, based on the following estimates:

Grades	Age groups 5-13	Age groups 14-17
K-8	97.5%	5.5%
9-12	2.0	...
K-12	99.5	...

This projection represents near-maximum enrollment in the elementary schools.

The projected enrollment in public and private elementary schools for fall 1969 totals 31 million -- 5 million in private schools and 26 million in public schools. This estimate is based on the assumption that 16.5% of the elementary pupils will be enrolled in private schools in fall 1969, and that 80% of the enrollment in grades 7 and 8 will be in secondary schools. This is an increase of about 2 million pupils, or 8%, over the fall enrollment in public elementary schools in 1959. For average classes of 30 pupils, 67,000 additional elementary classrooms would be needed, and for classes of 25, 80,000 classrooms would be needed under this estimate.

Obsolescence and Overcrowding

The bulk of today's need for elementary classrooms stems not from additional pupils, but from large classes and obsolete facilities. In the past, a depreciation rate of 2% per year has been set, on the assumption of a 50-year life-span for school facilities. This is probably low. Estimates of construction needed to replace obsolete structures have been running at the rate of 5% per year of the available classrooms, and, since 1957-58, classrooms needed to replace obsolete facilities have outnumbered those needed because of increased enrollment.

About half of all existing elementary and secondary classrooms were built after World War II. Most of these will continue in service throughout the foreseeable future. Little is known of the expected date of retirement of the rest.

We estimate that about 60% of the classrooms in use are elementary. We cannot generalize about the percentage built after World War II. The need for elementary classrooms, because of enrollment growth, was greatest in the 1950's but, because many communities built junior high schools instead of additional elementary facilities, elementary enrollment was siphoned off by removing grades 7 and 8 from the community elementary schools. In addition, elementary school buildings are probably over-represented in the total number of schools which are obsolete, for many have been kept in service long after they were scheduled for abandonment. Remodeling has no doubt postponed the obsolescence of many elementary schools. A guess is that one-fourth of the elementary classrooms in 1961, or from 150,000 to 200,000, will need to be replaced or remodeled by 1970.

Many classrooms are far too overcrowded for good instruction. The median elementary classes in March 1962 ranged from a high of 33.1 pupils in the 18 largest school districts to a low of 20.5 in the smallest urban districts (2). If all classes in excess of 25 could be regrouped in classes of 25, we would need 115,000 additional classrooms. If children in classes of more than 30 could be regrouped in classes of 30, the requirement would be 35,000.

SUMMARY

From 252,000 to 395,000 classrooms, new or remodeled, will be needed by 1970. This wide range of figures indicates the futility of estimating nationally the results of decisions to build or remodel, which must be made locally. If national estimates are really needed, some way to establish contacts with the local school districts must be found. Even a sample of from 400 to 500 local school districts could provide information for projecting nationwide figures.

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Secondary School Facility Needs

By Stanton Leggett, Engelhardt, Engelhardt and Leggett

Abstract: The need for school facilities on the secondary level is contingent upon the rate of population increase, population mobility, the degree to which high schools will continue to hold their enrollment, and the use of changing educational techniques, such as television. This paper considers these factors and presents census estimates for students enrolled in high school through 1980. These range from a low of 14,752,000 to a high of 17,388,000, depending upon the future crude birth rate.

NO REASONABLY ACCURATE ESTIMATE of the need for secondary school facilities can be made for any extended period. There are too many variables that cannot be assigned accurate values. The problem of estimating future needs on the secondary level involves facets ranging from the matter of estimating future enrollments, to a gauge of the changing capacity of school plants, to the use of student and faculty time. The major factors involved in determining the need for secondary school space are presented below.

INCREASE IN POPULATION

Dr. Frank Notestein, at a meeting of the American Association of School Administrators (3), placed the rate of growth of the United States at the average of the world, or 1.7% per year, and stated "if we are to continue to grow at the rate of 1.7%, three-fourths of the babies born this year will live long enough to be part of a United States population of half a billion. A few of them will survive to be members of a United States population of one billion." Within this framework, the United States will double in population every 40 years.

In September 1962, there were an estimated 11,700,000 students in grades 9 to 12 in all types of school in this country. This was an increase of 900,000 over enrollment in 1961-62 which, in turn, had been some 700,000 larger than that of the preceding year. The expectation (4) is that in September of 1963 there will be an increase of 600,000-700,000 students, and in September 1964 a further increase of 500,000.

LEGGETT, S. ANTON. Partner, Engelhardt, Engelhardt and Leggett, Educational Consultants; member, American Association of School Administrators, National Society for the Study of Education; Fellow, American Association for the Advancement of Science.

The U.S. Bureau of the Census estimates for future enrollments in high school are given in Table 1. These data are for all schools, public and private, and include grades 9 to 12 only. Because of the variation in what is considered secondary education, and because the Census Bureau projections are based upon age alone, there is a gap between the estimates of elementary school need through grade 6, and the estimates of secondary school need here stated for grades 9 to 12. The latter figures can be used as an index of the need for space, rather than as an absolute figure covering all grades, 7 to 12.

In Table 1, the Roman numerals refer to projections (5) into the future for the total population that involve, in turn, estimates as to the crude birth rate in the future. The II series is based on a continuation of the fertility level to 1975-80. The III series assumes a decline in fertility levels from the 1955-57 level to the 1949-51 level by 1965-70, and then a constant level to 1975-80.

TABLE 1 -- PROJECTIONS OF SCHOOL ENROLLMENT FOR THE CIVILIAN NONINSTITUTIONAL POPULATION FOR HIGH SCHOOL GRADES 9 TO 12 BY PROJECTION SERIES

Year	Projection Series			
	II A	II C	III A	III C
	(thousands)			
1960 (Est.)	10,249	10,249	10,249	10,249
1961	11,044	10,919	11,044	10,919
1962	11,842	11,587	11,842	11,587
1963	12,568	12,197	12,568	12,197
1964	13,040	12,586	13,040	12,586
1965	13,226	12,711	13,226	12,711
1966	13,484	12,915	13,484	12,915
1967	13,817	13,194	13,817	13,194
1968	14,198	13,519	14,198	13,519
1969	14,551	13,820	14,551	13,820
1970	14,894	14,110	14,894	14,110
1971	15,223	14,395	15,223	14,395
1972	15,486	14,615	15,486	14,615
1973	15,677	14,779	15,677	14,779
1974	15,851	14,925	15,817	14,890
1975	15,985	15,042	15,776	14,838
1976	16,126	15,178	15,674	14,729
1977	16,329	15,368	15,554	14,614
1978	16,624	15,664	15,509	14,584
1979	16,977	16,002	15,563	14,643
1980	17,388	16,385	15,678	14,752

SOURCE: Adapted from Table 1, U.S. Bureau of the Census, Current Population Reports, Series P-25, No. 232.

The letters A and C refer to percentage of children of high school age who are attending school. Series A assumes a continued increase in the percentage of students attending school. Series C assumes that the percentage of high school age students attending school will continue at the 1957-59 level through 1980.

It is roughly estimated that the high school enrollment in 1980 will be between 17 and 18 million. The rate of increase in high school enrollment is expected to slow down following 1964-65. The increase in 1965 is expected to be about 150,000 as compared to over 500,000 the year before and 900,000 in 1962. Through 1980, the annual increase is expected to be about 200,000 per year, if a moderate view is taken of Census estimates (4, p. 1).

In September 1962, the expected enrollment in grades 9 to 12 in all schools was 11,700,000. This consisted of 10,300,000 in public high school; 1,002,000 in parochial school; 100,000 in special schools, such as on Indian reservations, military posts, laboratory schools of colleges, etc.; and 298,000 in independent schools.

The U.S. Office of Education estimates that in September 1961, there was a shortage of 142,500 instructional rooms in the public schools. When broken down to secondary schools (as defined by each state) 34.2% were in this category, and 23,000 additional rooms were needed to make up for student loads in excess of capacity and to replace unsatisfactory facilities. The increase of over 2,000,000 students enrolled in grades 9 to 12 in all kinds of schools between September 1962 and September 1964 will require the construction of about 300,000 additional rooms. Subsequent to 1964, with about 200,000 more students per year in the same grades some 7,000 to 8,000 more instructional rooms will be needed annually.

This picture is far from complete, for other factors than population change influence the use of school facilities. We can say that on the secondary school level, from 1962 to 1964, we will see a great increase in the need for more facilities. Following a peak in the middle 1960's, the need for increased facilities will continue, but at a reduced rate, if only population pressures are considered.

CHANGES IN ENROLLMENT RATES

In making estimates of future enrollment, it is necessary to evaluate to what extent eligible students will attend school. The holding power of all secondary schools was 83% in 1958-59, as compared to 24% in public high school after World War I. "The best available estimate is that only about 60% of those who were in fifth grade seven years before actually graduate from high school each year." (1, p. 5)

The demand for trained manpower is such that a nongraduate from high school can be at a real disadvantage, but the strengthening of the academic nature of the secondary school program may serve to alienate many who remain in high school, although marginally.

When high school emulates college, it may inherit the regrettable washout rate found in colleges. Another factor affecting enrollment is the repeal of compulsory attendance laws in some states in the South. When the total picture is considered, it does not seem likely that the gap between school eligibles and school attendees will narrow much.

POPULATION MOBILITY

The net increase in enrollment in secondary schools may have little relationship to need for facilities. The net increase is frequently a result of decline in areas where adequate facilities exist, and of heightened increases in areas where facilities are inadequate. It is likely that, with the urbanization and suburbanization of the country, and the decline of the older population centers, the need for secondary school facilities may not drop as sharply as the forecasts of total enrollment indicate. Rather, the displacement of people, urban renewal, development of new suburban areas, and growth in various regions may compensate in good part for the actual drop.

A special case, in a number of northern communities, is the integration of schools in areas that are not integrated residentially. This has vast implications in the already intricate problem of providing school housing. In New York, it was found that leaders among the children tended to accept the chance to attend school outside their own residential areas, with side effects upon the schools they had left (2). Increasingly, smaller communities have sought, under this kind of pressure, to reduce the choices and place all pupils of one grade level in one school, regardless of location. The ultimate expression of this idea is in the "school-city" which would have children transported by bus to superior sites or locations, and to concentrate there, in a planned fashion, educational facilities for a large number of children.

REORGANIZATION OF SCHOOL DISTRICTS

A study of public secondary schools (1, p. 22) made for the U.S. Office of Education has shown that "80 per cent of the high schools in 1958 had less than 90 students in the graduating class." Although obviously a small percentage of the total number of high school students are involved in this statistic, there is still a need to reduce the number of overly small high schools. The same study (1, p. 7) showed that, between 1952 and 1958, the number of public secondary schools serving some of the grades from 7 to 12, with enrollments of less than 200, had dropped from 13,142 to 9,466.

At the same time, the number of secondary schools of 200 enrollment and over, had increased from 10,599 to 14,756.[1]

While some of the change is occasioned by schools increasing from less than to more than 200 in enrollment, the greatest change is caused by the consolidation of small schools to form larger ones, and the closing of smaller schools as the rural population dwindles. Much remains to be done in the consolidation of schools to form larger educational units.

On the other hand, some of the urgency for formation of larger schools has been removed by the development of new teaching aids such as television, particularly where terrain and sparcity of population make transportation difficult.

CAPACITY OF THE SCHOOL PLANT

The capacity of a school is a variable reflecting the nature of the educational program it provides. Typically, a high school decreases in capacity throughout its life, given no additions to the building, as spaces become more specialized and therefore less utilized. Changes in emphasis in the use of buildings have also been a factor, as in the decline of numbers of girls electing homemaking, or boys electing shop, as the emphasis becomes increasingly academic. As more students tend to take more subjects, it is likely that the capacity of the secondary school plant will continue to shrink. It is unlikely that an increase in capacity through summer operation and a staggered schedule will materialize, not only because this schedule would interfere with family life, but because schools will be offering so much of value educationally during the summer period that the voluntary attendance will approach 100%.

UPGRADING EXISTING BUILDINGS

The need for school facilities on the secondary level is also related to the improvement of the existing plant. We are currently engaged in this kind of operation, with surprisingly large sums involved, in areas where increases in enrollment are of lesser moment, but where the necessity of retooling the buildings for modern education is of paramount concern.

In summary, there is, and will be, a continuing need for new facilities for secondary education; more so, perhaps, than the long-term student population projections indicate. Throughout, however, it is the teachers and teaching that count. The facilities that we have been discussing must, to a greater extent than ever, support rather than hinder the on-going educational processes.

[1] The two comparisons cited are not comparable since the first includes only schools with graduating classes, while the second includes many large junior high schools.

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Higher Education Facility Needs

By W. Robert Bokelman and E. Eugene Higgins
U. S. Office of Education

Abstract: Major efforts must be made to increase the service, residential, and instructional facilities of the nation's colleges. In making these efforts, there must be an evaluation of changing facility utilization; recognition of a need for increased research facilities; and consideration of special residential requirements, as for married students. It is concluded that approximately $31 billion will have to be spent on physical facilities for higher education from 1962 to 1975.

THE CERTAINTY OF A LARGER COLLEGE-AGE POPULATION, a vastly increased emphasis on advanced study and research, and a backlog of obsolete buildings in need of replacement and repair, form the basis for the projection of needed physical facilities in institutions of higher education.

It is difficult to assess how much rising costs will be offset in the future by the development of cheaper construction techniques and better utilization of plant facilities. These and other developments may emerge to alter estimates of unmet needs.

Physical facilities, as considered in this paper, include costs of equipment for the buildings, site development, and items such as sidewalks and parking lots, as well as actual building costs. In the past, physical facilities costs have accounted for about 20% of the total annual expenditure for higher education. Current annual expenditure for higher facilities approximates $1.25 billion.

In order to provide adequate physical facilities for the nation's colleges, major efforts must be made to increase residential, service, and instructional facilities; the accumulated backlog of worn out facilities now in use wiped out through rehabilitation, renovation, and new construction; and of research and graduate facilities and equipment expanded.

BOKELMAN, ROBERT W. Chief, Business Administration Section, and HIGGINS, E. EUGENE, Specialist for Physical Facilities, Division of Higher Education, Office of Education, U.S. Department of Health, Education and Welfare. Mr. Higgins is a member of American Association of School Administrators, Association of School Business Officials of the United States and Canada, Illuminating Engineering Society, and National Council on Schoolhouse Construction.

NEEDS FOR SPECIALIZED FACILITIES

Facilities needs are related to shifts in the proportions of resident and commuting, married and single, and graduate and undergraduate students, as well as to modifications in institutional calendars, scheduling, and space utilization. New techniques, such as television, also have an effect on the kinds of facilities that will be required.

Medical and dental facilities are not now sufficient to maintain current standards of service. To maintain a satisfactory population-physician ratio of 757 to 1, the output of physicians must increase (10). Between 14 and 20 new medical schools will have to be built if the existing ratio is to be maintained. The cost involved here is great, for a medical school requires a capital investment of between \$10 and \$20 million, depending on whether a teaching hospital must be included.

Related to the need for medical training facilities is the need for dental schools. According to projections, the number of dentists practicing in 1975 will be about 15,000 less than will be needed (11). To forestall such a shortage, facilities capable of graduating 6,180 dentists annually will be required by 1970. This will require a 75% increase in training capacity.

RESEARCH NEEDS

Colleges and universities have greatly increased their research activities since the end of World War II. In 1959-60, approximately 22.5% of their total educational and general expenditures went to support organized research (12). This is more than double the 10.6% so expended in 1945-46.

YEAR-ROUND USE OF FACILITIES

More and more institutions are operating all year. These will have to make greater capital outlays to counteract the more rapid deterioration of buildings and to provide a more satisfactory environment (such as air conditioning) for summer work.

RESIDENTIAL REQUIREMENTS

There is a growing need for housing married students and for associated auxiliary facilities, such as nursery schools and health centers. A study by the Association of College and University Housing Officers shows that nearly 40% of institutions responding to a questionnaire have constructed at least some facilities for married students' housing (1). The Office of Education's physical facilities survey reveals that 4.6% of college and university expenditures for new housing in 1951-55 was for married students (2).

Institutions estimate that during 1956-70, 9.7% of their expenditure for housing will be for married students. Since about 2-1/2 to 3 times as much residence space is required for a married student as for one who is single, and since there is an increasing number of such students, proportionate increases in housing expenditures are unavoidable. Further complicating the task of financing residential facilities is the increase in the proportion of women students, since dormitories for women are more expensive than those for men.

Urban universities must provide additional housing as they attract more students from outside their immediate areas. Additional residential facilities will also be needed by many junior colleges. In 1961, about 240 of 276 private junior colleges provided some residential facilities, as did a few of the 391 public junior colleges (7, 8, 9). The community junior college, however, with its proximity to students' homes, does not need dormitories and related facilities. An increase in the number of these institutions will continue to receive prime consideration by the states as a means of alleviating the crowded conditions in existing colleges. Students who complete the training at the community junior college will, if they then transfer to a four-year college, strain the instructional and residential facilities of the institution to which they transfer.

RELATED STUDIES

A study conducted by Long and Black (6) projects 1957-58 enrollments to 1970 and estimates the additional physical plant facilities required to accommodate the anticipated enrollments. The estimated increases over the 3,027,029 figure for 1957-58 enrollment range from 2,017,000 to 2,851,000 in 1970. In addition to estimating the need for expansion of facilities, Long and Black consider the cost of replacing existing, substandard facilities. Using a replacement rate of 2% per year, they estimate the cost of replacement of facilities other than residential to be $240 million per year, and replacement of residential facilities, $80 million per year. Between 1957 and 1970, between $12.19 billion and $15.26 billion will be required for physical facilities, exclusive of land, equipment, and campus improvement.

The Council for Financial Aid to Education, in 1959, surveyed the plant needs of 885 colleges and universities from 1957-67 (4). The estimated cost of buildings, equipment, and improvements for the 820 institutions that responded was $6.04 billion. Based on this figure, it is estimated that the total cost of construction for all institutions of higher learning during the decade would be $11.5 billion, or approximately $3,834 per student increase in enrollment, exclusive of costs of acquisition and improvement of sites and of replacement for deteriorated buildings.

In the second of its five reports of studies dealing with physical facilities (3), the Office of Education included projections of buildings needed through 1970. This report estimates that for 1956-70 the cost of new construction to accommodate 2,823,000 additional students will be $12.36 billion. Of this sum, it is estimated that about $7.06 billion will be for instructional, research, general and auxiliary facilities, and $5.30 billion for residences.

Another Office of Education study (5) indicates that 42.7% of the college facilities first occupied between 1940 and 1949 are unsatisfactory and should be razed. This heavy rate of depreciation is largely due to the use of temporary buildings dating from World War II. The same study indicates that 18.6% of the buildings occupied for the first time up to 1899 should be replaced, as should 15.0% of those occupied between 1900 and 1919. Of those occupied between 1920 and 1939, 8.3% are badly depreciated and obsolescent.

Considering residential buildings separately, 24.8% should be replaced: 54.8% of the married-student apartments and 15.0% of the residence halls for men. The same study indicates that 6.7% of the college facilities first occupied between 1940 and 1949, 17.4% of the buildings occupied up to 1899 and still in use in 1957, 16.9% of those first occupied between 1900 and 1919 and 9.6% of those occupied for the first time between 1920 and 1939 need major rehabilitation. Considering residential buildings separately, 8.3% need major rehabilitation with 5.8% of the married-student apartments and 9.9% of the residence halls for men in this category. Thus, 21.0% of all college buildings need to be replaced, and an additional 9% need major rehabilitation. If these requirements for replacement and major rehabilitation are combined with those for modernization, the estimated cost of such measures during the period 1958-70 is projected as $4,782,650,000.

BASIC ASSUMPTIONS OF THIS REPORT

To determine the cost of needed facilities for any target date is a complex problem in forecasting. Continued use of substandard buildings has often delayed new construction. Too, a rational balance among types of facilities must be maintained: classrooms and laboratories, residence halls, office space, auditoriums, and other auxiliary facilities.

Reliable data have been established on two important factors in estimating future building requirements: the college-age population and the condition of buildings now in use. The proportion of the college-age population that will be going to college is reasonably predictable. Factors such as space per student and cost per construction unit can be established. It is difficult, however, to assess to what extent better utilization of existing campuses will affect the total estimated cost, or the proportion of the college population that will have to be housed. In projecting facilities costs, these and other factors can be used only through arbitrary assumptions based on the record of the past, and on one's best judgement of the future.

Assumptions for Projecting Costs

The assumptions that have been made in projecting to 1975 the cost of necessary expansion and improvement of the facilities of the nation's institutions of higher education are:

1. On January 1, 1961, the gross area of instructional buildings was 408.3 million sq. ft., and the gross area of residential building was 229.9 million sq. ft.
2. Because of obsolescence, 12.3% of the instructional buildings (50.2 million sq. ft.) and 10.5% of the residential buildings (24.1 million sq. ft.) need to be replaced. Related to this assumption is the percentage of buildings of different ages, as noted below:

Percentage of Buildings of Different Ages in Use
December 31, 1957

Built	Public	Private
Up to 1899	3.5	10.8
1900-1909	4.0	8.6
1910-1919	6.1	9.4
1920-1929	10.1	14.8
1930-1939	11.6	10.4
1940-1949	40.5	24.5
1950-1957	21.7	18.8
Not reported	2.5	2.7

3. In addition to the obsolete buildings mentioned above, 9.8% of instructional and related buildings (408,275,680 x 0.098) and 9.1% of residential buildings (229,925,000 x 0.091) are presently in poor condition and functionally obsolete. The number of additional square feet required for instructional and related buildings will be 40,011,017; for residential, 20,923,175.
4. Each additional full-time student will require an average of 160 sq. ft. of space for instructional and related purposes. This figure is developed from the 125 sq. ft. required per full- and part-time student (3, p. 23).
5. Any present excess capacity in residential facilities in some colleges is more than balanced by overcrowding in others.
6. Institutions will continue to provide housing for one-third of all full-time students.
7. Of full-time students, 90% will be single.
8. Of the additional students furnished institutional housing, 10% will be married.

9. Each additional, single student housed in institution-owned dormitories will require 237 gross sq. ft. of space; each student family, 572 gross sq. ft.
10. Construction costs of buildings will increase at the rate of 1.8% per year.
11. Other capital costs, including costs of land, equipment, furniture, and campus improvements, will amount to 50% of building construction costs.
12. The cost of replacement of obsolescent and substandard buildings will rise at the same rate as constructing a new facility.
13. The cost of returning buildings to satisfactory condition will be 50% of the cost of new construction.
14. The cost of facilities for health-related programs and specialized research will require capital outlays of $4.5 billion.
15. Obsolete and substandard facilities, and those functionally obsolete, will be remodeled, modernized, or replaced by 1970.
16. In addition to space expected to be remodeled, modernized, or replaced by 1970, 1% of the space in use between 1961 and 1970 will require modernization each year, and the rate will increase to 2% each year in 1971.

Assumptions Pertinent to Enrollment Projection

1. Fall enrollment will increase from 3,610,000 in 1960 to 8,677,000 in 1975. This compares to 4,207,000 in 1962.
2. During this time, the proportion of full-time enrollment will decrease from 65% in 1960 to 60% in 1975.
3. Total full-time enrollment will increase from 2,347,000 in 1960 to 5,138,000 in 1975.

FACTORS THAT MAY ALTER THE PROJECTIONS

Many unmeasurable influences may have marked effects upon the projections resulting from the assumptions stated above. Factors that may reduce the need for facilities include more effective space utilization through changes in scheduling patterns, summer use, and weekend use; the development of cheap building materials; the development of more economical construction techniques; advances in design; the interinstitutional sharing of facilities; and increased use of new instructional media, such as television, and of new instructional methods.

Increasing needs for and costs of facilities may be such factors as inflation, as it is reflected in increased costs; additional functions assumed by institutions of higher education, such as adult education; the emergence of new areas of study and research; and the need to accommodate increased numbers of foreign students.

In considering the possible effects of any of the foregoing factors on reducing the needs for facilities, account must be taken of delays in communication, the lag in adopting new approaches, and the length of time responsible officials will require, to give careful consideration to questions of change. They cannot, without abdicating their responsibilities, entirely substitute the experiences of others for their own in matters of capital outlay. Therefore, most of the factors which may reduce facility needs are likely to become influential only in the later stages of the projections. Factors that may increase facility needs are likewise intangible, and can be applied only to the longer-range projection.

Based on the assumptions previously stated, Table 1 indicates that approximately $31 billion will have to be expended from 1962 to 1975 for higher education physical facilities.

TABLE 1 -- PROJECTION OF CUMULATIVE TOTAL COSTS OF NEEDED FACILITIES, 1962-75

(millions of dollars)

1962	$ 2,261	1967	$13,893	1972	$24,819
1963	4,555	1968	15,942	1973	27,329
1964	6,899	1969	18,558	1974	29,093
1965	9,031	1970	20,657	1975	31,106
1966	11,343	1971	23,034	Annual Avg.	$ 2,222

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School Building Needs

The School in the City: A New Look

By Jonathan King, Educational Facilities Laboratories

Abstract: City schools generally copy the architecture of schools in the suburbs and do not utilize space in an economical manner. This paper expresses the view that the problems of central city schools are unique and require different solutions. Joint occupancy is suggested as one solution to this problem. Schools sharing physical facilities with other users, such as offices and apartments, are described.

TODAY WE FIND THE PRESTIGIOUS SCHOOLHOUSE located outside the cities. An examination of the architectural journals does not reveal that almost half the public school children in New York State go to school in New York City, nor that Chicago's capital outlay for school housing exceeded $130 million in a recent five-year period (3). The typical city school now seems almost as uncomfortable on its site as the school in the country did early in this century. The image of the ideal school is now suburban-exurban, and city schools are, in general, suburban schools squeezed and forced into insufficient sites, but without grass and trees. There is also some question as to the economics of two- and three-story schools in areas where only the school board can afford to build buildings so low.

OFFICE BUILDING-HIGH SCHOOL COMBINATION

There are some new types of school buildings which take a very different approach to urban education than would be reasonable or economic in a suburb or small town. The New York Board of Education has studied the feasibility of building a combination office building and commercial high school in mid-Manhattan. Cost estimates indicate that substantial economies will accrue to the Board through the project when it is completed. Based on an estimated eight floors of school, topped by about 30 floors of commercial office space, the schoolhouse will be totally paid for over a 40-year period and there will be a residue of from $1 million to $1.5 million remaining for the city in the form of tax revenue. The financing is to be a joint undertaking, with the city paying for the schoolhouse portion, and a private builder for the commercial portion. Cost of excavation, foundation, and those

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KING, JONATHAN Secretary and Treasurer, Educational Facilities Laboratories; member, American Society for Testing and Materials, Acoustical Society of America, BRI.

construction costs essential to both users of the building will be divided. Maintenance cost will be charged to each of the users on the basis of apportioned space.

The office occupants should not suffer from having a school downstairs, since separate entrances and internal traffic patterns will be provided, and the children should not suffer from having offices above them. Neither will the city suffer from having a commercial high school in a commercial area, for that is where it belongs. And if, over a 40-year period, rather than costing some $10 million, the city receives some income from the project, there are unlikely to be any substantial protests from the taxpayers.

The usual economic debate on the schoolhouse centers about square foot costs and, occasionally, maintenance factors and depreciation. This joint-occupancy plan throws the discussion into a totally new arena. This school is described at length in another paper in this volume, "Incorporating Educational Facilities in Buildings with Other Types of Occupancy," by Michael L. Radoslovich.

SCHOOL-APARTMENT HOUSE UNITS

P.S. 9 in Queens is not immediately recognizable as a school (1). It occupies the ground floor of three buildings in a public housing project. It was established in 1948 as a temporary measure, due to overcrowding of regular schools, which had come about largely because the project in which P.S. 9 is located was a low-rent project giving preference to families with children. Suffice it to say that the New York City Board of Education seems pleased with P.S. 9.

Some of the experiences gained in P.S. 9 will be used in a project designed with the school as an integral part. Concourse Village, a union cooperative for 1,900 families, is being constructed in the Bronx. The first section to be completed will include a one and one-half story community center and schoolhouse. The cooperative is paying for the total building cost of the schoolhouse, because it will also be used for adult classes and recreation. The Board of Education will pay for the operation and maintenance of the children's school, which will be a kindergarten and two grades, with at least four classrooms. Total capacity is contingent upon the project's population.

The second section of the project is now in the planning stages. When finished, the whole project will house 5,000 families. This section will have a kindergarten and six-grade school adjoining a 40,000 sq. ft. playground. Financing and operation will be handled in the same way as the school in the first section.

This concept of joint occupancy of space is not restricted to public schools. Two private schools in New York are currently engaged in serious planning of buildings designed for school and apartment use. A third example is reported on in another paper in this volume, "An Economic Evaluation of a Combined School, Apartment Building, and Medical Center Facility," by Stephen Shilowitz.

CONVERTIBLE SCHOOLS IN PITTSBURGH

The examples mentioned above are all in New York City, but similar programs are being conducted in other cities. One of the prototype joint-occupancy projects is LeCorbusier's Marseilles (France) block, which has a nursery school on top of the building. In a new residential development in Newark, New Jersey, designed by Mies Van der Rohe, there is a nursery school on the third floor.

The Pittsburgh (Pennsylvania) public schools have planned convertible structures that can be easily remodeled into single dwelling units or duplex apartments in a new Pittsburgh development. Originally, the possibility of fitting schools into residential structures was considered, but the structural module used for the residences in the development is not suitable for the standard classroom. The convertible nature of these schools is of value because often the city school is built at the peak of population pressures in the area, and sits partly empty thereafter. There are schools throughout the United States which are underutilized because the complexion of the neighborhoods has changed since the schools were built.

CHICAGO RENTS APARTMENT SPACE

The Chicago Board of Education is renting space in new housing projects for elementary school use in order to meet the population increase and to avoid the social problem of building projects to take people out of the slums and subsequently sending the children from these projects back into the slums to go to school.

Several years ago, contracts were let by the Chicago Housing Authority for the construction of 4,415 apartments in the Robert R. Taylor Homes, a slum-clearance project, and the Chicago Board of Education authorized construction of schools on sites within this and adjacent project areas. The housing project and schools were scheduled for completion at the same time; however, the housing was completed well ahead of schedule. This threatened to flood the area with children before the schools were completed.

In anticipation of the crush of enrollment ahead of schedule, Chicago planners met with Housing Authority officials before the apartment buildings were completed, and reserved 56 first-floor apartments in 19 buildings to be used as temporary primary-classroom space. In addition, nine apartments originally planned for use as community space were used as temporary classrooms.

The apartments have been leased by the Board of Education for two years at $110 per month. Partitions for the bathroom and one bedroom are in place; all other partitions are left out. The kitchen sink and cabinets have been installed for use in the classroom. Fluorescent lighting fixtures have been installed by the Board of Education, to be removed when they vacate. At that time, the Board will be responsible for finishing the apartments, adding the missing partitions, and otherwise leaving the premises ready for occupancy by a residential tenant.

The apartment units have much the same kind of advantages as P.S. 9 in New York, i.e., proximity to homes and easy transportation for the early grades. Disadvantages are present, too, particularly the administrative difficulties caused by decentralization.

SUMMARY

This is not intended to suggest that all schools should be part of structures also used for other purposes, nor that all schools should be built to be converted to other purposes. Rather, it is intended to suggest that research on school building has a broader context than is usually assumed. Many school systems have been exploring convertible structures, portable structures, and other ways of dealing with the changing numbers of pupils. These are not the only answers to city school problems. However, joint occupancy offers one avenue of attack on school housing problems which has received extraordinarily little attention until now.

There are those who reject without consideration anything other than the conventional one-, two-, or three-story schoolhouse in the city, feeling that the scale of anything higher is unsatisfactory, particularly for younger children. This is a difficult point to make or refute, since we know so little about the reaction of people to building scale, but we do know that the city presents a different setting for the building, and urban children have a somewhat different reaction to buildings, because their normal habitat is the city.

Those of us who have read Jane Jacobs' book, "The Death and Life of Great American Cities" (2), know that the city is not like the suburbs, and a solution for one is not a solution for the other. Increasing the density of city area is not necessarily a bad thing for the neighborhood, and may even contribute to the safety of the area for both the school children and others concerned. We may find, psychologically and from the standpoint of over-all community planning, that some of these approaches have more advantages than disadvantages.

A new kind of schoolhouse is looming up in the urban environment today. It may, along with other approaches to urban schools, lead to design and building changes which will return some architectural excitement to the city school, contribute to new urban planning solutions, and help solve some of the pressing social and economic problems of the city.

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Effect of Changing Educational Techniques on Design of Facilities

By Charles William Brubaker, Perkins & Will, Architects

Abstract: The design of educational facilities is ultimately a reflection of educational techniques. Team teaching, a trend toward smaller schools, individual study, and new teaching aids are all having an effect upon facility design. The trend is toward flexible and uncommitted use of space and away from departmentalization.

SCHOOL DESIGN IS CHANGING in response to new community needs, new materials and methods of construction and especially in response to changing educational techniques. This paper will consider some of these changing techniques in terms of their effect on the design of educational facilities.

EFFECTS ON CLASSROOMS

Many changing educational techniques are related to the team-teaching concept. Team teaching is an attempt to improve instruction by giving two or more teachers the responsibility for one group of students. These teachers use their combined talents along with the expanded resources made possible by the use of audio-visual equipment. The traditional, self-contained classroom concept suggested rows of identical rooms. Team teaching, however, suggests the need for more varied and adaptable kinds of space, because the team of teachers may wish to bring a greater number of students together for a special lecture or demonstration, or may wish to subdivide a large group into many small discussion groups. Therefore, new programs require new facilities: clustered spaces, as opposed to inflexible walls, and large and small group spaces as well as individual study spaces. The architect should recognize the need for new kinds of spaces that make teaching most effective for the teacher, and learning most effective for the student.

Some day every student may have his own, special, educational program and will progress at his own rate. At that time, non-graded schools will be required. The architecture of many new schools reflects this attitude. A freedom of space prevails, permitting the development of unknown future programs. The rigid

BRUBAKER, CHARLES W. Partner, Perkins & Will, Architects; member, American Institute of Architects, BRI.

school has been superseded; permissive school architecture is a significant new development.

Changing educational techniques inspire changes in existing buildings. At Evanston Township (Illinois) High School, we were asked to create new large-group rooms, seating 120 students, and new faculty office space, all within a building constructed 50 years ago. Fortunately, some large study halls existed which were no longer useful for newer programs. Remodeling each of these created one large-group room and one team headquarters (faculty office space and a resource center for educational materials).

The social science faculty cooperatively plans the teaching program. On some days, four regular classes of 30 students meet, but on other days, special lectures are prepared, so 120 students meet together in the large-group room. On still other days, perhaps 10 groups of 12 students are created for small discussion sessions. Thus, it is possible to remodel a school to accommodate changes in teaching and learning.

Movable walls, which change the sizes and relationships of spaces, can serve the concept of flexibility in educational programs. At the University of Chicago Laboratory High School, an interesting experiment is being conducted in which six rooms are interconnected by five different types of movable walls. Classroom sizes can be adjusted as needs change. Also of interest at this school are the carpeted floors, a high degree of flexibility for communications and power supply, and emphasis on a large library that is the study center for all students.

TREND TO SMALLER SCHOOL UNITS

In five years, through consolidation, 20,000 small schools in America were eliminated. The resulting schools are larger, more efficient, and provide more complete faculties and facilities; however, schools may tend to become too large. Therefore, new educational techniques are being tried in order to regain some of the advantages of the smaller schools, where the individual student can know and be known by every faculty member. In the schools-within-a-school concept, the large secondary school is subdivided to create a number of small units although certain facilities, such as the gymnasium, are shared by all.

The new high school at Newark, Ohio, is an excellent example of this type of organization (see Figure 1). Three "little schools" have been constructed, each to serve 600 students. To accommodate future growth, additional schools will be built on the property. Each school provides space for instructional rooms, a large-group room for assembly and dining, and a medium-group room for study and certain resource materials. The three schools share one central library, one administrative and guidance area, a physical education unit, a physics and chemistry unit, and one music and drama unit.

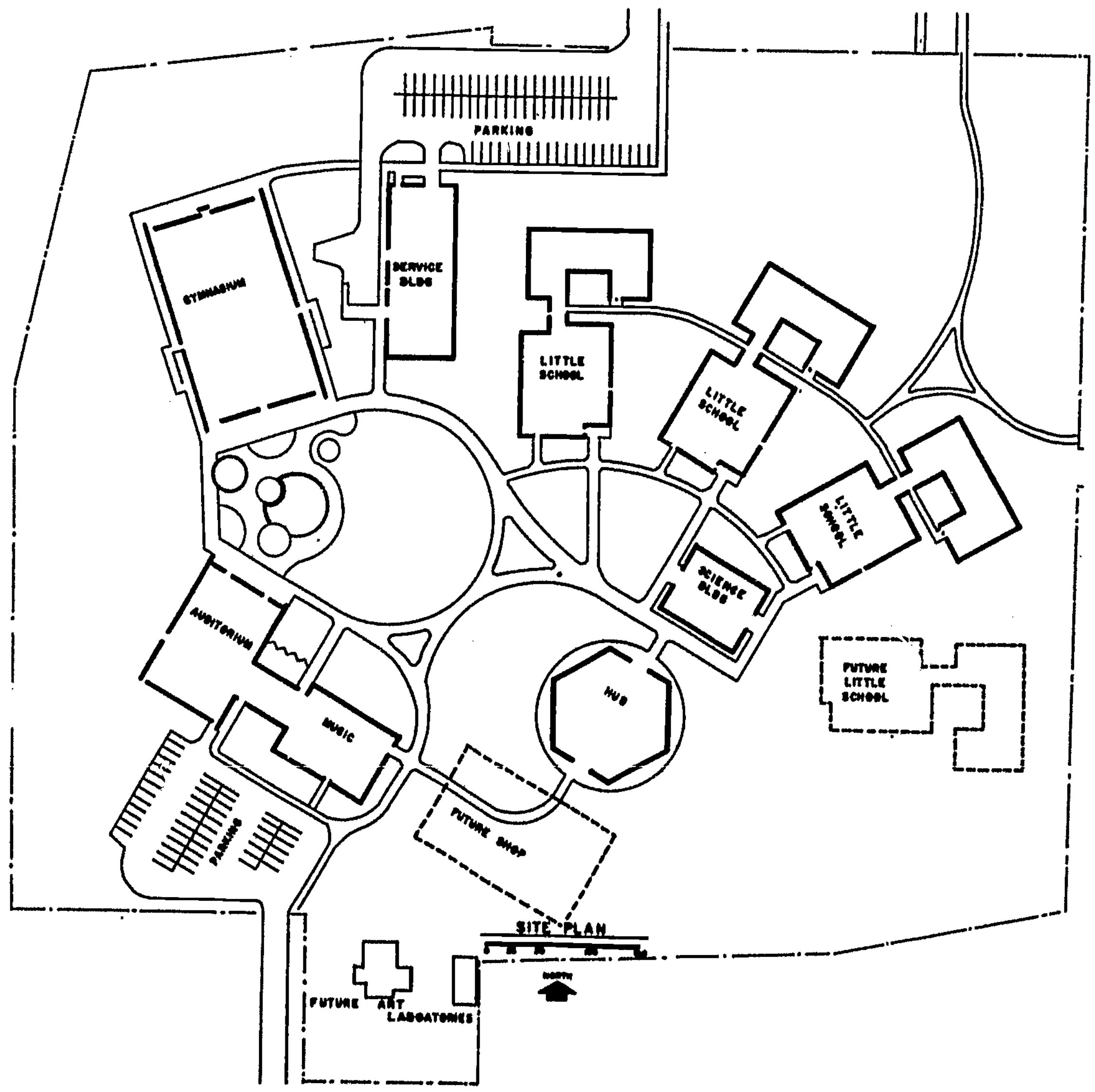

Figure 1 -- The schools-within-a-school concept illustrated at Newark (Ohio) High School.

INDIVIDUAL INSTRUCTION AND STUDY

Much attention is currently being given to the needs of the individual student. How does he learn most effectively? How much learning occurs in large groups, and how much when the student is working alone? Literature is filled with statements concerning our belief in the importance of the individual, but educational facilities seldom express this belief, although many new techniques are being explored. A few years ago, my partner Larry Perkins and I worked with educator and editor, Dr. Walter Cocking, to develop ideas in sketch form for individual study spaces. Some have since been built at Chicago Teachers College, where there are hundreds of study carrels now in use on an experimental basis. The college-age students seem to like studying in these individual places. They have an opportunity to leave books and materials there.

USE OF TEACHING AIDS AFFECTS SPACE

Chicago Teachers College also has a large lecture room-auditorium in which there is a two-screen, rear-projection system. It is possible for one teacher, or a faculty team, to plan and effectively present an illustrated lecture for a large number of students. Other uses of new media are changing educational facilities. Films, slides, tape, television, videotape, teaching machines, language and learning laboratories, all are new techniques which are creating new kinds of libraries.

Language laboratories, almost unknown ten years ago, have given many thousands of students listening and speaking experience formerly unavailable to them. Television, teamed with film, has become an important teaching technique, although we are reminded by John Scanlon of the Ford Foundation that "the television teacher complements, not replaces, the classroom teacher."

NEW CONCEPTS INFLUENCE DESIGN

One of the most significant changes has as its central idea the "wholeness of learning." Professor Jerome Bruner of the Harvard Graduate School of Education has said that the proper emphasis in education is "the structure of knowledge -- its connectedness and the derivations that make one idea follow another." In the new designs for a few colleges and universities we can see this concept exerting a new influence on building design and campus design, a trend away from departmentalization and the committed use of space. As the city office building is constructed to serve unknown future tenants, so can university facilities be built to serve unknown future educational programs.

Materials and Construction Needs for Future Educational Facilities

By John W. McLeod, McLeod and Ferrara, Architects

Abstract: In the United States, few of the materials used in school construction have been designed specifically for that purpose. The author examines the British CLASP system of school planning which is an effort to take advantage of mass production, modular coordination, and buying in quantity. It is suggested that there is a need for closer cooperation among industry, architects, and educators in this country, and a nonprofit, national building products test station is proposed.

FAR TOO FEW of the new products developed for use in the schools were developed specifically for educational purposes and based on solid research. Outside of specialized items such as chalkboards, lockers, science equipment, and unit ventilators, more school construction materials came to education by way of Madison Avenue than from any other source. Since educational building is now a major factor in total construction, this is unfortunate.

THE BRITISH CLASP SYSTEM

If these conclusions are valid, then consider what we would do if we could start from the beginning to develop a whole series of products, materials, and systems to fit a demonstrated and well-researched set of educational building needs. In our private enterprise system this would be a difficult task for education, architecture, and industry to perform. In England, however, such a thing has been going on for some years. Let us see if there are implications for use in their research and development program for school building--the highly publicized "CLASP" system of designing and building schools. The word CLASP is derived from "Consortium of Local Authorities Special Program."

I am not, in any way, advocating the adoption of such a system here, but I am citing it as an example of how others are solving their school building problems.

In information obtained from the British Information Service, the experiment is described as a system of school planning which began when a group of British local government authorities voluntarily pooled their resources to obtain the maximum benefit from a system of prefabricated construction. It has evolved informally

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McLEOD, JOHN W. Partner, McLeod and Ferrara, Architects; Fellow, American Institute of Architects; member, Adult Education Association, American Association of School Administrators.

and is a voluntary organization, although it includes interested government departments.

The design system utilized in CLASP is based on steel framing with a planning grid of 3 feet 4 inches. It was worked out by the Nottinghamshire County Council in 1955 as a means to a more efficient and economic school building program, and to overcome the current shortage of building labor and materials. The steel framing chosen as the method of construction was adaptable to many kinds of schools, and although all components were standardized for quantity production on annual contracts, architects were allowed considerable freedom.

The CLASP system is an effort to take full advantage of mass production, modular coordination, and buying in quantity. It does not contemplate the prefabrication of whole buildings but depends on the use of basic elements, standardized as to dimensions and detailed to coordinate with each other, while not limiting the architect's plan arrangement or exterior treatment.

Architects of local school authorities work together as a group and estimate the total annual need for each component. Manufacturers are then invited to bid on the annual program, with dates arranged for proper construction timing. When the individual project plans and specifications are put out for bids, the general contractors include in their bids the stated amounts of the previously contracted components. The prefabricated steel frame amounts to about 10% of the cost of the whole, and all of the components make up about half of the total project cost. While the CLASP system is based on light structural steel framing, other authorities have used prestressed and precast concrete frames, and timber. It is not necessary in the design of a project that the architect use every item on the component list.

This system has already spread to West Germany, and Italy is also interested in it. Two factors would operate against the adoption of such a system in the United States. The development of CLASP required a great deal of government intervention, and the small geographical area involved in Nottinghamshire and surrounding counties covered no great climatological problems of the variety that we experience.

BROAD SIGNIFICANCE FOR U.S. OF SUCH SYSTEMS

While the importance of component prefabrication systems may be insignificant in terms of our national goals, they have some attributes of international significance, now and in the future. School building needs, worldwide, pose a great problem. Underdeveloped nations look to the more fortunate countries for technical and financial help with their school building programs. Britain, with its CLASP system, and other nations with similar systems, have school building packages readily available which can be exported where needed. Further, most other nations have government

Ministries of Education which guide national school building activities. It is therefore possible for the underdeveloped countries to carry on their business at the governmental level, not dealing with private firms.

This poses a serious problem for our professional people and our building industry. If we are going to help other nations with their school building problems, we cannot afford to have our own building industry placed in a non-competitive position, simply because we have not given this problem sufficient consideration. In addition, if our expanding productivity is to have an outlet, we may have to look overseas. We need to examine this problem closely, and at once. I believe that we can find solutions which need not result in sterile designs, rigid controls, or the loss of competitive spirit.

LESSER ASPECTS ALSO IMPORTANT

Some of the lesser, but just as important, building products also need our attention. In the matter of chalkboards, for example, we have not kept pace with the times. In view of the growing demand for flexible instructional space, we cannot continue to use the fixed-in-place, traditional chalkboard. There are many excellent vertical sliding, rolling, folding, and even mobile chalkboards in Europe, most of them well designed and ingenious in operation. The trouble in this country, I suspect, lies more with teachers than with manufacturers, and is more a matter of economics than of disinterest. Nevertheless, flexible spaces and flexible walls are going to require flexible chalkboards, at a reasonable price.

An excellent example of cooperative research is found in the Educational Facilities Laboratories' program to create better, more sound-resistant, folding doors, or operable walls. The problem now is not with the products, but with the testing laboratories. If you look long enough, you can find a testing laboratory that will prove your door superior to all others. It might be a good idea to establish a nonprofit, self-supporting, national building product testing station in order to obtain unbiased data upon which to specify and evaluate new building products.

One area needing attention is that of floor coverings. Asphalt tile has done a good job and carpeting has been used, though it is thought of as a luxury. Research is needed to provide floor coverings which are durable and economical, but which have the sound-control qualities of carpeting. Research and development are needed in the sun-shielding of windows. Air conditioning is still another problem. We should not have to choose between air conditioning and no windows or windows without air conditioning. Instead, we should have the right to have both. We should also give some attention to the increasing complexity of our mechanical and control systems. It is not right to down-grade the educational and esthetic environment in order to provide for more and more electronic marvels.

Perhaps our trouble lies in lack of communication. For years, architects and educators have been meeting to try to solve their problems, and the school buildings of America are testimony to the fruitlessness of such excellent rapport. If architects and educators could sit down with industry, from time to time, there would not be the gap between the real need and the right products.

School Building Needs

Open Forum Discussion

Moderator: A. Benjamin Handler,* University of Michigan

Panel Members: Mrs. Flanigan and Messrs. Bokelman, Brubaker, King, Leggett, and McLeod

Mr. Handler: Why do we require a "prestigious" school? Why not build only to meet the need?

Mr. King: There is a fallacious cliché which states that school buildings don't teach; teachers teach students. I think any discerning individual who walks into any kind of building learns something from the building. He learns what kind of people go there, and what kind of enterprise it contains. There is something downgrading about having education conducted in slovenly, slip-shod, run-down, depressing buildings. Children should feel, when they enter a school, that they are in an institution that matters, that the community cares about. The emphasis on economy per square foot has stripped our schools to the point that many of them show that antisepsis, cheapness, and janitorial ease are the main goals of school building. We can do better than that for education. It deserves it and needs it.

Mr. Handler: What are the classroom needs of the 12- and 13-year-olds -- the junior high school group? What would this group add, quantitatively, to the number of classrooms?

Mrs. Flanigan: We are approaching the time when there will be eight million pupils in this age group, and the transfer of seventh and eighth grade children from the upper grades in elementary school into junior high school units will have a large effect upon classroom requirements at that level. This process, however, will solve part of the problem of constructing additional senior high school facilities.

James V. Latorre, Syracuse University: Do projections suggest that the increase in the number of students accommodated in public community or junior colleges, and high school advanced placement programs, may absorb most of the anticipated student

*BRI member

population increases, leaving colleges and universities to replace obsolete or temporary facilities?

Mr. Bokelman: The junior colleges are absorbing much of the increased enrollment. There is a tendency for the colleges and universities to become more the upper level and graduate schools. In many cases, freshman and sophomore enrollments have declined in our larger institutions. The junior colleges, as well as some liberal arts colleges, are "feeding" students into the universities. In actual practice, we know that the larger schools continue to increase in size.

In any university, there are a series of colleges, and it may be that eventually one cluster will have a total enrollment of 50,000, grouped in different units. Michigan State University is starting a pattern of putting classrooms in dormitories, particularly for the first and second year students, since much of the work is prescribed. This is an interesting development to be aware of in dormitory planning, particularly for institutions with large enrollments.

To answer the original question, in theory the larger institutions may be expected merely to replace existing facilities. But, in actual practice, institutions are becoming larger. I think that much of the increased enrollment in the future will be absorbed by the public community colleges.

P. R. Achenbach, National Bureau of Standards: Are the changes in the design of school facilities increasing the obsolescence factor in schools, and thus impeding our efforts to catch up, or keep up, with the growing school population?

Mr. Brubaker: No. A school that was a good school in 1920 is probably a good school today. If it was a bad school when it was built -- aesthetically bad, and cheaply built -- it is going to be a bad school 20 years from now. I feel very strongly that a good school does not get out of date quite that fast.

Fred Hildebrandt, Harley, Ellington, Cowin and Stirton, Inc.: What has been, or is being, done to encourage self-education? This could be a very important factor in meeting the "student population explosion."

Mr. King: In some of the newer and better secondary school programs, there is a great deal of emphasis on independent study, and at the same time new devices are being developed to make such study easier. The whole field of programmed learning deals with learning individually, not in groups. There is also a growing dissatisfaction with the school library, and attempts are being made to give the secondary school library more of a collegiate character. The development of machines that can be used by people one at a time, audio-visual equipment that can be used by individuals or small groups, programmed instruction, a more collegiate pattern of library use in the secondary school, all will help to generate more independent study and self-instruction.

P. R. Achenbach, National Bureau of Standards: What is the trend toward two-shift use of classrooms and to 12 months a year use of classrooms, to reduce the need for new classrooms?

Mrs. Flanigan: I see no trend in that direction, at this point, except in school districts that are overcrowded. The tendency for calendar-year use of schools is to use the summer months for time for enrichment and for special classes, rather than for purposes of space-saving or to reduce the need for additional facilities.

Frank G. Lopez, Educational Research Services, Inc.: Do you know of any attempts to evaluate student achievement resulting from large-group lecture rooms having projection facilities vs. other, less-expensive techniques?

Mr. Brubaker: No. I think this points out what a small amount of research is done in the field of education. It is a broad field, and a good one for more research.

Rhees Burket, Architect: Do the prefabricated components of the English CLASP system permit planning the flexibility of space so demanded by team teaching?

Mr. McLeod: They do. One of the points they particularly stress is that the CLASP system does not inhibit any kind of educational planning.

William Lukacs, Architect: With respect to the Chicago school of five rooms divided by movable partitions, are these soundproof enough for good instruction? I have heard of none that are satisfactory.

Mr. Brubaker: This particular example was experimental, and I think the conclusion has been that many of the partitions have been quite satisfactory. One has to recognize that you cannot just isolate the acoustical problem by itself. It depends on whether there is over-all noise in the building. For some reason, schools have traditionally demanded a lot more quiet than almost any other type of occupancy. Offices are noisy, as are banks, dining rooms, libraries, and other places which still afford privacy, yet we are urged to keep the classroom absolutely still, and this aggravates the problem. This is a question that can only be answered in terms of specific instances.

John H. Herrick, Ohio State University: In your summary, are residential facilities the only exclusions? What about power plants, service shops, nuclear reactors, farm buildings, etc., which are provided in considerable measure in the larger universities?

Mr. Bokelman: In the totals, we include the principal buildings. Outlying buildings, such as barns, shops, etc., are excluded. Our totals represent primarily the teaching facilities, the administrative facilities, the heating plant -- those things on the main campus that are needed to carry on educational activities.

George K. Garden, National Research Council of Canada: Are technical and business training schools classed as secondary schools? If so, is there not anticipated a far greater increase in these buildings than acadamic schools, due to the greater need for technical development in our future commercial and working forces?

Mr. Leggett: The technical and vocational schools are included with the secondary schools. As students shift from one kind of school to another, during times of high economic level, the schools become conservative: everyone takes academic courses. In times of depression, the majority take vocational courses. There will probably be a slight shift away from academic registration and toward a greater number of status-type shops, such as electronics. Much of the true technical training will be at the post-high school level.

J. C. White, Inland Steel Products Co.: Have EFL and Stanford established a module for school construction?

Mr. King: The School Construction Systems Development Project at Stanford University's School Planning Laboratory is in the process of doing this. The total problem of what a module is is a rather complex one. There are structural modules, mechanical modules, planning modules, and others. I think there will be several modules before the system is completely developed.

Mr. McLeod: The British CLASP system is based on the 3 ft., 4 in. module. However, they do have increments on the 4 in. basis for most smaller components. I believe they started with the 4 ft. module in the initial stages of the experiment, and then reduced it to 3 ft., 4 in.

Mr. Brubaker: We can learn a lot from the office building field. If you study the literature on what has been happening, or carefully look at the new buildings, you will see all sorts of fascinating modules. These are usually based on lighting, fixture arrangements, air conditioning, ceiling tile, etc., all very beautifully coordinated. In office buildings, there is good reason for doing this, because when the building is built you do not know where the partitions are to be located. I submit that this is going to happen more and more in the educational field, and particularly in universities. We are going to see more buildings constructed as empty buildings suitable for offices and classrooms. Then, certain departments will move in as tenants, use a floor for a year or two, and perhaps move to other spaces, providing a rotating kind of tenancy. With this system in operation, there is motivation to work out good electrical, structural, and mechanical modules.

Mr. Leggett: This strikes me as the real root of the matter. I think that education must come to the point where it makes some decisions, some declaration of where it stands. The typical money-making commercial office space in New York does not strike me as precisely the kind of space to inspire young people to learn. I submit that a good school building should have some spirit, the determination to stand for something, and not be just a great, anonymous movability.

Mr. King: As with most enterprises, there is an acceleration in the rate of change in education. We cannot continue to build buildings that are so monumental, so immovable, so unchangeable, that we will be stuck with 1962 or 1964 educational spaces for the rest of the life of the building. In the past, it was very difficult to build structures with any great degree of flexibility. They became obsolete in 50 years or less. The buildings we are erecting now may last for 200 years, and they will have to change inside. It is ridiculous to think that you can project, at this point, what your colleagues will be doing inside schoolhouses in the year 2000. You must build a school in such a way that you can accommodate education next year, ten years from now, and 50 years from now.

Mr. McLeod: I think the crux of the matter is this: in attempting to provide flexibility, unless we have a real goal, and make it understandable to our clients, we are apt to confuse them. We are given programs that make it necessary for us to build science labs and language labs, and then, as an afterthought, we are strongly impressed with the fact that we must provide flexibility in these areas. It is not impossible, but it is very difficult and expensive, to move laboratories around after a period of years. We need to think the matter of flexibility through a little further. We can provide a degree of flexibility, but the people in the school field must come to some decisions as to the extent of flexibility and the extent of change that will be necessary over the years.

Panel Discussion

Strategy for Meeting Future Needs

Moderator: Walk C. Jones, Jr.,* Walk C. Jones, Jr., Architects

Panel Members:

- William Chase, Specialist, School Plant Administration, School Housing Section, U. S. Office of Education
- Shirley Cooper, Deputy Executive Secretary, American Association of School Administrators
- Msgr. O'Neil C. D'Amour, Associate Secretary, School Superintendents' Department, National Catholic Educational Association
- Harold B. Gores,* President, Educational Facilities Laboratories, Inc.
- Frank G. Lopez, Vice President, Educational Research Services, Inc.
- John R. Miles, Manager, Education Department, Chamber of Commerce of the U. S.
- Wallie E. Scott, Jr., Partner, Caudill, Rowlett and Scott, Architects
- Julius Weinhold,* Director of Physical Plant, Department of Building and Properties, Cornell University
- Granville W. Woodson, Planning Engineer, District of Columbia Public Schools

Mr. Chase: In considering school facilities planning at the local, state and national levels, we must consider how these facilities are to be financed, and what part each of these jurisdictions will play. Too often we seem to forget that we have children in schools, right now, that need attention. First, though, I would like to take a look at the effective utilization of our existing facilities, and at the possibility of combining the use of spaces. There is something to be said for the multi-use, joint occupancy types of activity. The matters of combining various school activities, and of combining community activities with school activities, deserve consideration. There are administrative problems to be solved, but they can be worked out. Our first task is to meet our present needs.

*BRI member

We might also be more careful in long-range planning. We should do the necessary planning in such a way that we don't duplicate facilities, or provide inadequate accommodations. We hear a great deal today about team teaching, educational TV, and teaching machines. All of these must be considered in the planning of buildings. I think we should give some attention to where we can use them at this time.

Another way to improve our situation is to do more research. In one industry, it is estimated that $28 of gross profit is realized for every dollar that is spent on research. We, in educational circles, must get our funds from the taxpayers. However, if we would do more research, we could improve our programs to the point that we would have more efficient utilization of buildings. It is unfortunately true that there is a great deal of duplication in the research that is being done. In the Office of Education we are trying to establish a clearing-house activity to prevent this.

One other suggestion would involve reorganizing our school districts in such a way that we can obtain more efficient utilization of existing administration and services.

Mr. Cooper: America is committed to educating all children, each of whom is important. Every child has an inherent right to be treated with dignity. There is wide variation in the interests, aptitudes, and abilities of pupils; and the amount of information essential for effective citizenship is increasing at a tremendous rate. The skills people need in order to get and hold a job become more complicated and technical each year. These are the basic problems that everyone responsible for planning an educational program or a school plant has to face.

I recently met with a jury comprised of architects and school administrators to analyze and review 250 plans for school buildings now under construction, or built during the past three years. We met for the purpose of selecting the entries for the AASA school building architectural exhibit. These buildings represent the best and most forward-looking thinking in the entire country. As this jury analyzed these plans, it seemed clear that architects are struggling with many problems, one of them the problem of bigness.

Included were plans for 72 high schools, and of these a number had capacities of over 2,000. There were four plans for schools of over 3,000 capacity, and one for 3,800 pupils. To relieve noise and congestion, to reduce regimentation, to provide a safe environment, and to give each student a sense of personal identity when so many people are brought together are large problems for architects.

Our society tends to submerge the individual in great groups and big movements, so that he is in danger of becoming a unit with merely a name and number. Architects of big schools are struggling against this tendency. In the schools we are considering, much attention was given to space for personal guidance, for small conferences, and for individual study carrels.

Attention was also given to the use of the teacher's time. Almost three-quarters of the school budget is devoted to the salaries of instructional personnel. To fail to use to good advantage the time and energy of highly trained and competent teachers is a serious drain on the resources of the school community. Architects have given attention to innovations of instruction such as team teaching, and to the comfort and well being of the teaching personnel. There were in these plans an increasing number of office spaces, places where teachers could meet together to plan, work, and relax. Consideration was also given to the use of new instructional materials and mechanical aids.

Much attention was given to the total thermal environment. Only a few years ago the first completely air-conditioned school building was entered in the AASA architectural exhibit. In the plans submitted this year, air-conditioned schools were commonplace.

There was a growing emphasis throughout this planning on academic achievement. Every parent expects his child to excel in an academic program, and to be admitted to a prestige college or university. This is the kind of excellence upon which a high premium is placed today. However, not all children can live up to such expectations. For this reason, there is great diversity in instructional programs. The architects whose work we reviewed apparently were well aware of these developments and problems, for in almost every plan there were indications of studied efforts to design a plant with spaces, facilities, and total environment adaptable to these challenges, problems, and needs.

A few buildings stood out above the rest. Everybody on the jury recognized that these buildings would make pupils and teachers feel comfortable and at home, make their work easy and efficient, and that they would be usable and comfortable in the years to come. The jury wondered why such plans emerge so seldom. Are they happy accidents, or do they result from some deeper insight into the behavior of people? Perhaps more architects should give more careful thought to the psychology of teaching and learning. Psychologists tell us that every person has some capacity for creativity. The problem of the school is to release and encourage the creativity that is already in every person.

Msgr. D'Amour: There are times when the use of the word "strategy" can cause difficulty. Often, the layman feels that he is caught in a strategy concocted by architects and school administrators working hand in hand. Often, this is part of the reason for the rejection of bond issues. It may not be a legitimate reason, but it is a psychological reaction among the people.

The strategy for meeting our school building needs should be predetermined by the facts of our national life, society, and culture. Among these, I would emphasize the expanding school population, the teacher learning process being in a state of flux, and the increasing mobility of the American people.

We in Catholic education are particularly aware of the population problem. Between 1945 and 1960, Catholic schools expanded 102%. During the same period, public schools expanded 52%. Each year, we are forced to turn away thousands of students. Our people are trying to meet this need, but they are demanding economy. They want to obtain the most space at the least cost. School administrators, in reacting to this demand, must omit some of the niceties relative to air conditioning, heating, lighting, etc. We must struggle, in Catholic education, to have as many student stations as possible, because we must take in more students, and we must reduce our pupil-teacher ratio.

Not since the early days of the so-called Progressive Movement have education and the teacher learning process been so fluid, and no one today seems to have certain convictions as to the impact of developments like educational television, programmed learning, team teaching, etc. If these prove to be the wave of the future, or even if they fail to be effective, they are bound to have an impact on school building.

Again, there is the matter of shared time. Religion in education is a crucial issue in America, and shared time is the idea of restructuring American education so that the public schools would handle those things for the churches that the churches do not want to teach. This would involve serious changes in architecture because, for example, the public schools might teach all of the mathematics, science, and foreign languages. Very different types of buildings would be required if all of the children are taken away from the parochial schools, just for these very expensive courses which demand specialized resources.

Further, there is a question as to what the public expects of schools in the future. Americans have been demanding, more and more, that the schools assume duties previously performed by other elements of society. Whether or not this trend continues, one thing is definite: the architect, in planning school buildings, must emphasize flexibility. He must also emphasize economy, not by building cheap schools, but by building economical ones. This is because of the mobility of the population. We have all seen cities with beautiful school buildings in areas where there are no children, and a lack of facilities in areas where they are needed.

Mr. Gores: This country can have, and does get, anything it wants. Missiles, a moon landing, highways costing $50 billion, all are obtainable. We get hospitals when we want them, and we can get schools when we want them. Schools are seemingly of low priority, however, because the man in the street is not convinced that failure to produce enough schools for America's children will affect him personally.

The decision-making, in the matter of meeting future building needs, is done by the local voter who expresses himself in a local context. There are over 30,000 school boards, each possessing great autonomy. If we are to meet our school building needs, we must have further consolidation of the very small boards. By the same token, we must find a way to decentralize the larger boards so that more sensitive management can be provided in areas where the population is clustered. Where the present large school boards exist you will find most of America's half-day school sessions.

There is great variation from school district to school district in the matter of decision-making. For example, in New Haven, Connecticut, the board did not initiate the drive for new schools; it came from the mayor. On the other hand, voters in Levittown, New York, voted against a new school building some time ago, even though 90% of the cost would have been paid by the state. In Boston, the revitalizing of the schools stems substantially from the drive for urban renewal. Therefore, it is not the school board alone which supplies the educational leadership to a community.

We must, in general, give up the concept of the single-purpose school. The schools must serve everyone. We cannot merely educate small children in the daylight hours for 1,000 hours a year. Particularly in the cities do we need to create schools that will, in turn, create neighborhoods out of collections of rootless people. The schools in these neighborhoods should operate as much as 4,000 hours a year.

Secondly, we need to abandon the habit of referring to educational space in terms of classrooms. We must think in terms of zones of space. We need generalized space, made special by the introduction of specialized equipment. This will reduce the rate at which a building becomes obsolete.

Joint occupancy may be one solution to the space problem. Another may be mobile space. The latter, however, has always been thought of as a temporary thing, and has not been well-constructed. We need high-quality, transportable units which can be joined together so that a child has the sense of going to a school. If you have ten boxes in a row, you have not created a school, although you have ten classrooms, to be sure. A child has a right to go to a school which says to him, "This is something which your friends and neighbors have provided for you because they think you are important." Because the site on which it is located may be temporary, architects and educators have a tendency to consider it as a temporary solution; therefore, it can be a second-rate solution. We need a first-rate solution.

The notion that 30,000 school boards, many needing the same kind of facilities at the same time, should go on alone as though islands, is a fallacious one. We need to act in concert, and try to solve our problems together.

Designers should have no qualms or guilt feelings about pacing the design of a building ahead of its present occupancy, or ahead of prevailing practice. We need schools that are essentially inventions. The occupants should of course participate in the planning, but essentially the invention takes place apart from the moment in time when it is to serve.

School boards frequently do not sense that they are in a stream of change; they say they need a new school to solve a present problem. Rather, boards should regard the need for a new school as helping to solve the problems of the future. After all, the building will be in use until at least the year 2020. We should be encouraged to make an intelligent, well-motivated guess as to what problems a building will have at its half-life, which now is well beyond the year 2000. We tend, instead, to regard a building as a solution to a present problem. Many educators take pride in being able to wrap an envelope around this year's program. This is cultural arrogance which leads to a waste that a free society can ill afford, and hastens the obsolescence of what is done. We need to invent our way out of this impasse.

Mr. Lopez: I would like to talk about matters of tactics and, in particular, with reference to higher education. Our colleges are expanding at a great rate, and those in the city as well as those in the country are experiencing the same kind of growth problems. The size, as enrollment expands, means that the buildings virtually have to go up in the air, because travel time between classes becomes too great when they are too widely separated.

The problem of introducing high-rise structures onto a college campus is easy to solve, so far as residences are concerned. That is, the problems are fairly simple as far as transporting students up and down from the top floors of buildings over seven stories, or so. But these dormitory buildings then become like hotels, or motels. They don't seem like college buildings.

As soon as we begin to introduce collegiate characteristics into these structures, we find that the college housing authority, or the Housing and Home Finance Administration penalizes them. We can only have a certain percentage of a college residence hall that is nonrevenue-producing, because otherwise we can't borrow the money to finance it. This is a problem that needs to be studied.

When it comes to teaching space, we have the problem of vast numbers of students all moving from class to class at one time. Elevator systems will not handle this problem satisfactorily. Difficulties in the scheduling of classes are created. Such problems may be solved by techniques of management and operations if they cannot be solved by techniques of construction and equipment.

We also must measure space needs, based upon full-time-equivalent students and upon the number of weekly hours of instruction. However, many institutions don't know what their weekly load is. The norm for public, collegiate institutions in California is predicted upon this kind of basis. It is one of the few states in which there is a rational, understandable, scientific approach to determine the square footage necessary for higher education.

Another problem is that of enrollment. Is it necessary to provide square footage for all college students in the same quality and quantity? Again, California approaches this problem rationally. It has, even in the public institutions, a selective admission system. The junior colleges admit certain kinds of students; there are other admissions requirements for the college level and, in both instances, for terminal, professional, technical training, etc. This is no bar to the student's carrying on to a full four-year degree. He may enroll in a junior college and, if he is of sufficient calibre for a full degree course, he is admitted to a college or university. This is in contrast to other states in which public colleges must admit anyone with a high school diploma.

In considering the amount of space necessary, many arguments have been advanced in professional and educational journals about space utilization within college buildings themselves. In this connection, the word "flexibility" has been used. I prefer to talk about "adaptability," using a given space for several purposes.

When we talk about general-purpose teaching space, we find that a feeling has grown up among teachers in this country that a teaching space is "mine." We can understand that, but we cannot permit this situation to exist much longer. Such an attitude means that teaching space is restricted in its use. There is a growing tendency to treat general-purpose teaching space as a common facility which all may use. Then, it becomes necessary to give the teacher an adequate facility for his own use, where he may do research, study, and confer with students. This gives rise to the need for an increased amount of office space. However, office space doesn't occupy nearly as mu(square footage as is necessary for teaching.

Finally, I would like to emphasize the need to evaluate many of the new educational techniques that have developed. We are under pressure to use the products of our society in education.

However, we must be sure to evaluate the quality and limitations of the products that are available.

We had occasion recently, in pursuing a contract with a state college of education, to investigate the functions and capabilities of large-group instruction spaces. Nowhere could we find anything to disprove this statement: There is no evidence that the social or spatial environment of a 100- to 300-capacity teaching space, in itself, adds to ease of learning. The teacher may make a great difference, but we cannot prove the fact that space, or a social environment developed by a great number of students, increases learning capacity.

Research also indicates that there is no significant difference, in many subject areas, among lecture, demonstration, and discussion methods of teaching, as measured by subject matter tests. In other words, the little research that has been done -- and I have only seen a report of one objective experiment of this kind -- does not indicate that, when a great number of audio-visual aids accompany a lecture, achievement is any greater than it is in a small seminar with personal contact between the students and the instructor. We have, then, in the field of education, very little research as to what is good; in the field of equipment, materials, and construction, we have a tremendous amount of research as to what is feasible. This imbalance ought to be remedied.

Mr. Miles: I speak from the point of view of a person who has been in education for 40 years, and as a school board member. The immense amount of research and innovation possible in the field of education is only beginning to be understood. I spent approximately a year, following World War II, with the American Council on Education, trying to summarize some of the educational innovations which had been introduced during the war, and from which we should have profited. It was a source of dismay to me to watch countless college professors and school superintendents walk back into the same pattern of behavior that they had left in 1942-43, and begin again to do the same things in the same ways. Wartime demonstration that so much more learning could be obtained in so much less time seems to have caused little change in the structure of American education.

We have so many "sacred cows." These -- the pupil-teacher ratio, the four-year high school and the four-year college, the age at which children should start school -- all have to be reflected in the schools we build. I make no apologies for school boards. I believe them to be a necessary part of representative government. However, among the first things one learns when he serves on a board is that schools must reflect an understanding of the varying kinds of youngsters coming from different environments, with a variety of ambitions and potentials. The school building is either a means of revealing this, or of concealing it.

Therefore, the strategy that I would urge is an increased emphasis on the quality of the school boards, and on communication between the boards and the public. Anticipating the achievement sought in building a school is the essence of getting public support for it. I deplore the logic which says, "We don't need that kind of support; we can tell the public what they ought to have." The public has shown that it will move when it understands what is good for it, but this revelation must come from comprehension, conviction, and understanding; not from the decrees of professional groups.

School strategy means, to me, that we must anticipate the compulsions that are upon us, national and international, and one of these compulsions is not merely continuing education, but continuous education. This breaks with all of the sacred cows of which I spoke. Diplomas are almost out of date, and any architect who hasn't found that out today is not a very good architect.

Too, we should not discount the business community. I have met countless men who are on school boards, college and university boards of trustees, foundation groups, etc., and I find that they are quite willing to pay for good schools, provided they can expect better education. In the business world it is a simple dollars-and-cents matter to make the most of our resources. There are so many demands on our tax dollars that the only chance we have of getting good schools, roads, hospitals, urban renewal, and all of the other things that we want, is to find a way of doing it with maximum efficiency.

One of the first things I discovered, as a school board member, is that we must evaluate our achievements. We do need to evaluate the net worth of all such community efforts. When I served on the board in my community, I discovered that nobody had talked with the people of the community about the net worth of the community. After a bond issue for a water system had been approved, after several school bond issues had been adopted, what was the net worth? What had the community developed as a cultural pattern? The strategy lies right here; strategy begins at home. In other words, evaluation of community achievement needs to be converted into a public relations tool, to a degree that we have not begun to accomplish in the school field. This can be done, but it isn't a regular order of business with school boards or school superintendents. Too many of them are just too busy.

So, I would leave one thought with you: that in this technical age, when there is a continuing and rapidly accelerating rate of obsolescence in both material things and skills, we must prepare the people for a changing society in which flexibility and adaptability are the order of the day. This is not a new thought.

The statistics on mobility from 1940 to 1950 in the nine regions of this country, from sheer, crude census figures, show that the mobility of the people of this country is, in large part, a measure of their self-confidence, bred of educational achievement. Census figures show that in those regions into which most people moved, the educational level of the people advanced twice as fast as for the nation as a whole. In those regions from which there was a net migration in the '40s, the educational level of the people advanced only half as fast. Who moved from one region to another? By and large, it was those people who had the confidence to move into the new job opportunities of the plastics industry, the electronics industry, the aviation industry, the space industry -- in other words, the educated people.

This, then, is the strategy we should pursue: not only to convince people of the economic necessity and the security requirements of education, but also to show them how this economic value, this security requirement, can best be met by schools which will enable their youngsters to learn more in less time, to encompass today's rapidly exploding knowledge, and to put it to use for human needs and human wants.

Mr. Scott: There are three things that are basic to attacking the school problem, and these are the things that the architect needs to know most thoroughly. First, and most important, he needs to know the function of the place. In order to determine this, there must be communication between the architect and the educator, the school board, the citizens, and even the students. He needs to know what is going to go on in the building. When he finds out what its function is, he can create quite an imaginative shell around this concept.

Second, of course, he must get the very most for the school building dollar. However, sometimes we have become too economical in many respects, to the point that it has proved more expensive, in the long run, than if we had spent a little more originally. The janitor should have something to say about designing a school, but his certainly should not be the controlling voice.

The third consideration is the environment. The architect needs to have an idea of what kind of space is best for learning. I like the thought that children can learn more in a pleasant environment, in a beautiful building. Beauty is different to each of us, I know, but I think there is something to the idea that school should be a pleasant place to be. One should have a good feeling about it, and one should like to be there, and one should learn.

These are the three things that the architect needs to know. If we can make him aware of these things, and communicate clearly on these subjects, we will come much closer to being able to meet the total school building needs.

Mr. Weinhold: I am going to approach this problem from the viewpoint of a physical plant administrator of a large university. My institution has about seven million square feet of floor space, about 40% of which has been added in the past 10 years.

Our immediate objective is to plan for the next decade. We must not lose sight of the fact that college buildings, once built, remain with us for a very long time. They are not torn down and replaced except under extreme conditions. Therefore, let us build into our buildings as much flexibility or adaptability as possible, recognizing that during the next century there will be many changes in educational requirements and teaching techniques. Most probably, expensive remodeling will be needed at a future date.

We have remodeled buildings 80 and 90 years old, and we have remodeled buildings which were never intended for the purposes for which they are now being used. For example, we were able to convert a school for mechanical engineering, with all its laboratories, into a school for architects.

In my work, I am much concerned with the cost of our school plant program. It is difficult to obtain money for operational needs. The funds that we receive, in the final analysis, are provided by the American taxpayer. We get support from the federal, state, and local governments, all of which are supported by taxes. We receive gifts from alumni, the public, corporations, etc., yet most of these gifts are tax exempt, so the taxpayer enters the picture again.

With few exceptions, I am sure we are building to meet actual needs, and we are attempting to build as economically as possible. Initial cost is the control, but attention must also be paid to operation and maintenance of buildings. It is often stated that these costs are minor, but I find the approximate average spent by some 86 universities and colleges, for operation and maintenance, to be 78¢ per square foot per gross area per year. This represents about 9% of the total yearly budgets of these schools. If the floor area costs $20 per square foot to start with, in about 25 years we will have spent an amount equal to the original cost of the building. Some of the items for which this 78¢ is spent are: 19¢ for custodial service; 22¢ for heating, air conditioning, water and electricity; 14¢ for repairs and maintenance; 4¢ for grounds, trash and snow removal, etc.; and 5¢ for security. These figures vary from school to school, but they do illustrate the magnitude of operating costs. Any good design or plan should make it possible for the physical plant administrator to hold these costs to a minimum.

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We should not use new products until they have proven themselves. We should not install a lot of gadgets that, in the long run, add little to make the building more suitable for education. We should not build to meet concepts of unproven educational needs. Let us not cut first costs of the building at the expense of future maintenance. If our university has seven million square feet, and we save only 5¢ per square foot per year, a saving of some $300,000 will result. This could be used for higher faculty salaries, or for the tuition of a number of additional students.

Another cause of concern is how to make the best use of our land resources. Events during the last 10 years should give us some warning. The small school of today may be a giant 100 years from now. A city planner is almost needed today for the growing college campus, for these campuses are becoming young cities in themselves.

In our case, in the process of expansion, we have had to push out the boundaries of the campus to the point that a student is hardly able to move from class to class in the time alloted. The placement of dormitories is also limited by reasonable walking distances. Whereas, in the past, we could build structures of three or four stories, we must now go up in the air, or down into the ground. Vertical expansion should be considered in planning for the future.

With land becoming scarce, and traffic and parking problems acute, it might also be well to consider the multiple use of building sites, even on the campus. It might be desirable, for example, to put parking underground, with four stories of classrooms above, thus retaining the advantage of not having to move students by elevators. Possibly faculty administrative offices might be placed above the classrooms, and dormitories at the very top as has been done in some hotels with commercial offices below.

Some suggest that automobiles should be banned from the campus. This might add to the academic environment, but how far can the faculty, many of whom are not youthful, be expected to walk? This situation is accentuated if there is no mass transportation on the campus. It would seem well, when planning a campus, to lay out streets to meet future traffic needs. It is not possible to tell, many years ahead, what buildings will be needed, but at least advance planning provides a place to put them without having to tear up streets and utilities.

Finally, a word of caution to institutions with scientific research needs. An ample water supply must be assured. This is becoming a problem. Much new research apparatus requires cooling water in such quantities that the campuses have no means of providing it. Also, it is difficult to maintain electrical supply services of adequate size.

New research buildings should also be designed with great adaptability. The day to day uses of these buildings in the future are not now known. With these thoughts in mind, we may be able to provide buildings which will be more usable in years to come.

Mr. Woodson: The biggest problem in Washington, D. C., in connection with school plant deficiencies, results from deficiencies in revenue. This is not going to be overcome without concerted, determined, and overwhelming public pressure for additional money. I would say that the American public is apathetic. It does not react vigorously until a large portion of the populace is personally affected by a particular problem. Here in the Nation's Capital there is great concern today because we don't have a better teachers college plant. Aside from a few organizations such as the League of Women Voters, there has been very little public support for this college. Not until the American Council for the Accreditation of Teachers Colleges withdrew its accreditation of our local college did the public express much concern.

Another reason for this apathy is what might be called the fragmentation of our society due to the movement of the wealthy to the suburbs, and the lack of communication between the various economic segments of the population. Many of the wealthier people have withdrawn their children from public schools. The public schools are not of concern to them, yet these are the people who normally are, for the most part, better educated, and who have the greatest capacity for leadership.

This leaves us, in Washington, with a group of people whom we call the masses. The masses in today's social structure are people who are pretty well off, on the whole. They have many of the material things in life, but one thing they apparently don't have: enough appreciation for education and the spiritual and cultural things that have value for the nation. Leadership talent among this group is sparse.

As a result, the bulk of the people who need school facilities fail to demand them. In order to get public support, and revenue for new structures, we must find a way to increase the desire of these people for a better education. If there had been enough public support, an Aid to Education Bill might well have been passed by the 87th Congress.

We, in Washington, could use some aid. Our request for capital-outlay projects has been between $15 and $22 million a year for some years; we have been getting from $6 to $9 million. To put it simply, we must either raise taxes, find a new source of funds, or change the priorities on how we are going to spend the money that is available. Other things have been suggested as a solution to Washington's problem, some of which are being tried. We have experimented with team teaching, and this may save some money. On the other hand, it may not, for it is necessary to provide spaces, and these are not inexpensive. We might use more new construction methods, such as prestressed concrete. We might also use more modular construction, but until this is used commonly by all school systems, it is not provable to me that construction will be any cheaper than it is now.

Other things might immediately save money, such as the adoption of a trimester system which would enable the schools to be used all year. I don't know what reception the public would give this thought, but if we lengthened our school year to 11 months, we might be able to reduce the number of years of schooling. However, even with all of these ideas on schooling, in Washington we are going to have to build new buildings to accommodate a rising school population which does not show, yet, any signs of tapering off. Then, when we might possibly have enough seats to accommodate our present enrollment, we will be faced with the problem of replacement of our structures, some of which date back as far as 1869. I would like to say again that, in Washington, the biggest problem is that of school revenues.

Open Forum Discussion

Mr. Jones: Would you elaborate on the evaluation of the new teaching techniques?

Mr. Lopez: We are engaged in doing some programming for some teachers college research buildings. Although we do not know whether a large-group instruction space, automated and with all the projection facilities possible, produces better results, we are recommending such spaces in these buildings. We intend to test both children and college students who use these facilities, in contrast to a control group which will not be taught by means of such facilities. We will attempt to determine how far these groups advance, and how rapidly. I know of no similar experiment in evaluating just how efficiently the numerous aids now available to us are functioning. The real importance of large-group space may simply be in making it possible for large groups to be exposed to a superior teacher.

Mr. Jones: What do you do about the acoustics in these new schools?

Mr. Scott: We are doing a number of things. We are experimenting with movable partitions, no partitions, no doors, semi-partitions, etc., between areas and between groups of people, to facilitate a particular educational program. In some cases, virtually no partition at all between groups is working well, simply because the people want it to work. In other cases, we have partitioning systems that supposedly isolate areas for sound, and we still have complaints. This may be due to loud-voiced teachers, or the type of activity that goes on, but good acoustics is a very important thing. It also varies with the type of function you are trying to isolate, and with the people involved, should noise bother them. In one school, for example, the superintendent put in what he called "musical perfume," where soft music played all the time. This raised the noise level of the school, and seemed to work well. In other cases, such an approach might fail.

Stuart Silverstone, Carnegie Institute of Technology: The suggestion has been that it is often necessary to sacrifice architectural or esthetic desires in order to bring about economy in today's school plant. Why is good architecture synonomous with added expense or uneconomical design?

Mr. Scott: I think the best architecture is free. One of the challenges in architecture is to try to design a building that is a pleasant place. A school building, for instance, should be a very pleasant place. It should facilitate the functions you want to perform, and it should cost as little as possible. Such a building can still be good architecture. However, some architecture costs a lot of money, and is still not "good," while other architecture that is really very economical is often very good.

Mr. Jones: What about air conditioning, if students attend school 12 months of the year, particularly in the South?

Mr. Chase: It is necessary to know whether the air conditioning is to be used in new facilities or old, how it affects the educational program, and how it affects learning. We seem to think, in terms of a 12-month school year, that we need air conditioning only for the summer months. I have been in many schools in April, May, September, and October, when we could have used air conditioning just as well as on some summer days. The emphasis should be on how it benefits the program, and how we can get the best learning situation for the money we are spending. If air conditioning is one of the things that can do it, then it should not be thought of in terms of how much it costs, or what we can save. If we can recommend air conditioning on the basis of how it will improve the educational program, it becomes one of the facets of the learning situation, and one of the tools that is needed.

James Murfin, Kent State University: You have stated that we must guess about the future. This is fine, but isn't it a little ideal? Can we give a group, an architect, anyone, the free rein you have suggested? Will society allow us to attempt such a move?

Mr. Gores: It may be somewhat ideal, but what I failed to state is that the people should have maximum access to the facts. I know you cannot build schools much ahead of the people. My only plea is that better organized school boards can find a way of telling their story better. If the people are asked what kinds of schools they want, they answer, "what we have been getting lately." But give them some facts. Then they can make a choice from among reasonable alternatives. You can absolutely trust the choice of the people, if they are informed as to the range of choices.

A. J. Chiada, Baltimore Public Schools: Is there any set percentage of total educational space that may logically be constructed as so-called mobile or portable space?

Mr. Gores: This is being worked out. Los Angeles has a public policy that it will move toward 25% transportable space in its school system. If a very large high school, say for 2,000 or more students, were to be built, 25% of that high school space will be transportable. A common core would be constructed to serve as the monumental central facilities which speak for the building to the neighborhood, and then perhaps 25% of the capacity of that school would be housed in something that might be called "satellite space." This way, the school system can recover its equity at such time as the tide of enrollment ebbs. A recent survey in California indicated that, in a certain class of community, schools are using up to 16% transportable space. The practice will vary from place to place.

Joseph C. White, Inland Steel Products Company: The CLASP or modular approach to school construction seems to be one answer to building more schools for less money. How would this process get started in the United States? Would it be by the school boards, the architects, or the government?

Mr. Gores: In a free society it is always a problem whose job it is. One of the functions we think our organization has is to make risk capital available in the field of education. In this country there is no national system, as in England; we are grass-roots in our operational control, and we should remain that way. Could we, nevertheless, bring some cooperative, across-political-boundary action into play to determine what parts could be put together in a building and thereby constitute a saving?

Not in stock plans, or buying a whole schoolhouse in a package, nor in the hand-crafted, individually tailored, piece-by-piece building that is typical of the other extreme, but somewhere in the middle, lies the solution. For this reason, EFL made a grant to Stanford University to pursue the matter. In this project, an educator and an architect, working with a large committee consisting of people of various disciplines, have formed what will be the American free-enterprise equivalent, if possible.

John F. Wagner, Catholic Building and Maintenance Magazine: Have you any suggestions for implementing your tactic of achieving construction by acting in concert?

Mr. Gores: We don't know. We tried it and it didn't work in a case in which eight school boards, all with the same need at the same time, acted together in a consortium. We made a grant to a university to pull them together. We did prove some valuable things. We discovered that school boards will work together, and that architects will come together in the presence of school boards and superintendents, and that superintendents will meet in the presence of other school boards. We had not been sure that they would be comfortable in each other's presence. We were afraid that people would make odious comparisons, and the man with the most pleasant manner would charm everybody and get all the business. However, it did not work out that way.

Actually, what happened is that they shared consultants through the planning stage, but the pressure to get a new school in these towns was so great that the minute each building was ready to bid, they broke out of the consortium. The greatest hope for cooperative planning among school districts, architects, and industry lies in the School Construction Systems Development Project at Stanford University.

Mr. Lopez: EFL also put up money for experimentation in a small town in Mississippi which wanted a school. It was to be a much more advanced school than most in the state. There was an excellent opportunity, but they had no money for creating ideas; this was the purpose of the grant. The school board decided that this should be an air conditioned school. The architect and the school superintendent were enthusiastic, but the State School Finance Commission, hearing about the air conditioning, refused all state aid. This, of course, complicated the picture.

Some things were cut out of the school that it would have been nice to include, but they were actually extras. The basic concept was followed; there was no real loss in design. The school went out to bid, and we had estimated that the cost would be about $11 a square foot. The bids came in at slightly under $9 a square foot. In the interim, because of the complete information the community had received from the school superintendent and the school board, a bond issue to the absolute debt limit was passed. At $11 a square foot, it was calculated that they could build the school, but they would have little available for chairs and desks. When a $9 figure came in, $2 under the bond issue, they were able to build the school and equip it. To top off this story, about a month after the results of the bidding became known, the State School Finance Commission reversed itself and said that, hereafter, any school in Mississippi that was air conditioned would receive state aid.

James Murfin, Kent State University: We must educate the people; the population must be brought around to a realization, but how? You and I know that this is the greatest problem which exists with society: how do we educate them?

Mr. Miles: We in the Chamber lay down a constant barrage of propaganda on the value of schools: the economic value, the cultural value, the value to the development of and effective representation in government, and importance to the world of commerce. We ran a survey in 1961 to which 700 Chambers of Commerce replied. It dealt with 12 different types of public action, from bond issues to raising tax levies, to pushing through consolidation programs, to raising teachers' salaries. We asked, "Has such a proposal existed in your community in the last two years? If so, did you study the proposal? Did you take a position on the proposal? Did you oppose or encourage it? Did the issue win or lose?" We found in these communities that between 1,600 and 1,700 public issues had been raised in the previous two years, and that the Chambers of Commerce in those places had supported a little over 1,200. They had been noncommital on about 350, and they had opposed between 60 and 70. Strangely enough, the number that passed was about 1,200.

This suggests that the business community does have some influence, if it comprehends how and why you are trying to do what you are doing. In other words, there is a communications process available in most communities, if the people, including the architect, the school superintendent, and the school board will use it.

One of the things that bothered me, in a community in which I once lived, was that the school board and the school superintendent came to me after they had made up their minds what was good for me, and tried to sell me on it. They didn't succeed, because I wanted to be included in the planning from the beginning. This is the attitude of most people in community life. Some school superintendents don't like advisory committees; others think highly of them. Whatever the approach is, we must start communicating, evaluating, and converting our evaluations into a public relations program. Get the press, the radio, the TV, the men's and women's service clubs, and everybody else in the act right at the beginning, and the people will support the program.

Stewart Thompson, Architect: Imagine that you are the executive superintendent for a newly-formed regional school district that needs many new high schools. What specific teaching process would you recommend: team teaching, conventional, conventional with block periods, no grade, year-round, two-shift, etc.? Or would you choose some of these, or all of these, and above all make it flexible, for which you will get cones, hexagons, parallellograms and other fantasies of the nondirected architect?

Mr. Cooper: This question would be decided by the kind of teaching staff available, the program envisioned, the nature of the enrollment, and what the existing facilities are. We seem to believe that team teaching is something brand new, and that it is the solution for everything. Or, we assume that a self-contained classroom has something sacred and wonderful about it, or that some kind of conventional teaching method should be discarded. These are but devices, or ways to do a job.

The basic problem is to apply the ability that is in the teaching staff to the job of instructing children in the way you want them to learn.

The best way to do that is for the available leadership to consult with the teaching staff and work out methods for attacking the problem before them now and in the ensuing years. The architect should have enough vision to design a building that can be used for a wide variety of instructional procedures.

If I had even a few schools to build at once, the most sensible approach that I could make would be to prevail upon the board of education to employ a principal for each school before beginning construction. He, with his staff, could begin working with the architect. Then the architect, the educators, and the citizens of the community ought to come together, so there is a complete understanding of what is being done. Then, you begin laying the foundation for some design.

In addition to being a tool, an implement to permit people to work, the school building itself is a powerful instructional influence. Wherever we are, surroundings do something to us. They either make us hate the building, so we go out and throw rocks at the windows, or they make us love the building, so we cut the grass even though we are not asked to. An architect ought not lose sight of this.

James Murfin, Kent State University: To study the problems of the present situation of schools, and the relationship of the student body to these schools, is an ideal situation. To study and philosophize the solution, and then to apply this ideal to reality, is something else. Where must we establish a line between study and reality? How far can we go?

Mr. Cooper: I don't believe that any architect, any school board, or any community of citizens has constructed a school building anywhere within the last 100 years without some philosophy in their minds upon which to base what they did. They believed education was important, or they would not have spent the money to construct the building. Nobody lives without some sense of values.

How far can we go? We can go as far as our values are reflected as faith in humanity, as ideals, as the purposes that we want to achieve. Values do shift, but they shift very slowly.

Certain circumstances may come along which conflict with one or more of our values. Right now we have a conflict between universal academic excellence and the importance of each individual. Some children can't achieve academic excellence. We must balance this against our desire that everybody be smart and pass the College Boards with a score of 700.

The most effective influence in shaping school buildings in this country is coming from developments in industry, rather than from the educators. The air conditioning manufacturers, who have units to sell, are causing schools to be air conditioned. The mechanical aids to instruction that we are using are not receiving as much impetus as they should from the educators.

I have handled architectural exhibits for 14 years. When I first began dealing with school buildings, we had an epidemic of clerestory lighting. Any school that was worth anything had a clerestory in it. Then, we moved on to glass block, and no school that didn't have a few glass blocks in it could get into an architectural exhibit. Then, a bit later, we went into campus-site building. Then, we began pulling them together again, with covered corridors. Now, we are enthusiastic about air conditioning, and we are pulling the buildings back together again into little, compact units. Someone has said that this will be remembered as the royal period of school building architecture, because any building worthy of notice has a court in it somewhere in the interior. These things did not come from serious educational thinking. They came from the momentum generated by a good new commercial product that came on the market. We bought it, used it, got tired of it, and turned to something else. We must come back to the basic consideration of the purposes we want to achieve, of the abilities of the teachers, and hopes and ambitions of the students. These should be the point of departure in shaping a school building, rather than the quality of a product that happens to be on the market at the moment.

Unsigned question: Exception is taken by you to flexible planning, air conditioning, etc., as used by the public school systems, as being expensive or extravagant for parochial systems. Is this to be interpreted to mean that none of these can contribute to better teaching, better use of space in the parochial school system?

Msgr. D'Amour: I acknowledge the need for flexibility in planning. In respect to air conditioning, I feel that in some areas of the country it would be important and in other areas unimportant. However, in the parochial school system, our first concern must be the essentials. We need classroom space and we need teachers. You might say that it is a choice between goods. I am not deprecating the value of the luxuries in school building; I am merely saying that in all school districts, particularly in a parochial school area, money is limited and a choice must be made. Sometimes the expenditure of more money does not give a better school. I recall that once I built a school costing $10.20 a square foot. At the same time the public schools were building next door at a cost of about $20.00 a square foot. I would admit that the other school was prettier, having paneled interior walls and bilateral lights. However, as a building for education I do not feel it was better. Too often we equate a good school with an attractive building. I would emphasize that good teaching is the product of a good teacher. It is possible to have a very inferior building and yet have very good education.

James Murfin, Kent State University: You have suggested that it is economy and flexibility that will determine the schools of today and tomorrow. Do you feel that economy has dictated the flexibility? How far can we go in flexibility? Gymnasiums converted to classrooms through the use of folding dividing panels have not worked in the past. Will they in the future?

Msgr. D'Amour: A school building is designed with flexibility when it is adaptable to the various activities that are to go on within it. An architect should design his building so that it can be adapted to changes.

Unsigned question: It was intimated that Catholic educational building may be arbitrarily halted, or held to a set ratio of total kindergarten to grade 12 enrollment. Is this a real possibility?

Msgr. D'Amour: This has happened already in the Archdiocese of St. Louis. Officials there call it a policy of "containment." I believe that they will build new schools; however, the rate of expansion will be slowed to a considerable degree. I do not believe that this will be a pattern for the nation. After all, St. Louis is somewhat unique. The Catholic school system there takes care of 90% of the Catholic youth at all grade levels. Logically they can afford to curtail expansion. This may be true in other areas, but I do not believe curtailment will be generally true. After all, no one can say that it will take place, since every diocesan system of schools operates on its own. Again, we may have an expansion in one place, yet a containment in another. For example, I believe that there will be a rather significant expansion of Catholic schools in the New England area, because New England has been behind in Catholic education. Also, the swing of the Catholic population into Florida and California will cause an expansion. There will not be any national containment policy.

Comprehensive Campus Planning

Abstract: The case histories of four colleges and a system of public schools are considered from the point of view of comprehensive campus planning. Although the principles of campus planning are basically the same in any situation, their application may vary with different types of institutions. Included in the following detailed case studies of design in relation to long-range planning are two new, commuting-type state colleges; a small, private, church-related institution; a large, well-established state university; and a county school system.

Southern Illinois University, Edwardsville Campus

By Gyo Obata, Hellmuth, Obata & Kassabaum, Inc., Architects

THE PROBLEM WAS TO DESIGN a new university campus for 5,000 students, with provision for growth to accommodate 20,000 students eventually. The site of the new campus consists of 2,600 acres of gently rolling, wooded farmland along the bluffs of the Mississippi River southwest of Edwardsville, Ill. The new campus will initially be designed for an all-commuting student body, since all of the $25 million available from a state bond issue will be used for academic buildings, site work and utilities, and none for housing.

EDUCATIONAL PROGRAM

Facilities were required for a four-year program, with provision for a future graduate program. At President Delyte W. Morris' insistence, we designed the spaces to avoid "departmentalized architecture as we've had departmentalized education." Design of the new buildings had to provide functional, yet flexible, spaces in order that no building would become obsolete should the educational program change.

It is an easy task to develop an educational program, and to design buildings for specific needs, each department having its own functional, inflexible buildings and spaces. In many cases, the results of this type of design are inefficiency, low utilization, and even nonfunctional use of spaces, since programs change so quickly. To design a campus for a growing and changing curriculum requires

OBATA, GYO. Principal in Charge of Design, Hellmuth, Obata & Kassabaum, Inc., Architects; member, American Concrete Institute, AIA, American Society for Landscape Architects, Architectural Historians.

a great deal of research on the subjects of functionality and interchangeability of university spaces. In designing the campus at Edwardsville we studied and classified all kinds of teaching areas according to function.

DEVELOPMENT OF THE MASTER PLAN

Through a grant from the Educational Facilities Laboratories, Southern Illinois University organized a number of seminars. Each week, a different educator spoke to a group of SIU administrators, faculty members and the architects. At these meetings, we discussed various educational goals and their relation to campus design. A seminar called EPEC (Environmental Planning Edwardsville Campus) was also sponsored by EFL and the Maremont Foundation. At the seminar some of our early sketches were reviewed from the standpoint of esthetic environment. After these meetings, we began final sketches of the new master plan.

MASTER PLAN SOLUTION

Plans for future highways, in order to obtain major access from all directions, were developed in cooperation with highway officials. An outer loop to serve all areas of the 2,600 acre site was laid out, as was an inner loop for the main academic area of about 220 acres. Lakes were planned for three valleys on the site, for recreational use as well as utility use in connection with the air conditioning.

A clean distinction was made between the university proper and the parking areas. Studies showed we needed parking for 3,000 cars initially, and for 12,000 in the future. Two large parking areas, surrounded by landscaping, were established. Only special service vehicles will be allowed in the academic area.

The heart of the campus is a mall surrounded by the library, student center, communications center and administration center. Two clusters of instructional buildings radiate from these four central buildings. Figures 1 and 2 show the initial and final stages of the site plan. From six building groups for 5,000 students, Southern Illinois University can grow, within its 200-acre core, to a campus for 20,000 students. Outside the compact academic area, space is reserved for growth in the form of research area, professional schools, community center, continuation center, recreational area, physical plant and power plant, sewage plant, water treatment area, airfield, agricultural research area, conservation research area, and possible future residential areas.

DESIGN OF BUILDINGS AND BUILDING GROUPS

Library

The library is designed to be open-stack, with control points at two major entrances. The building is designed so that stacks,

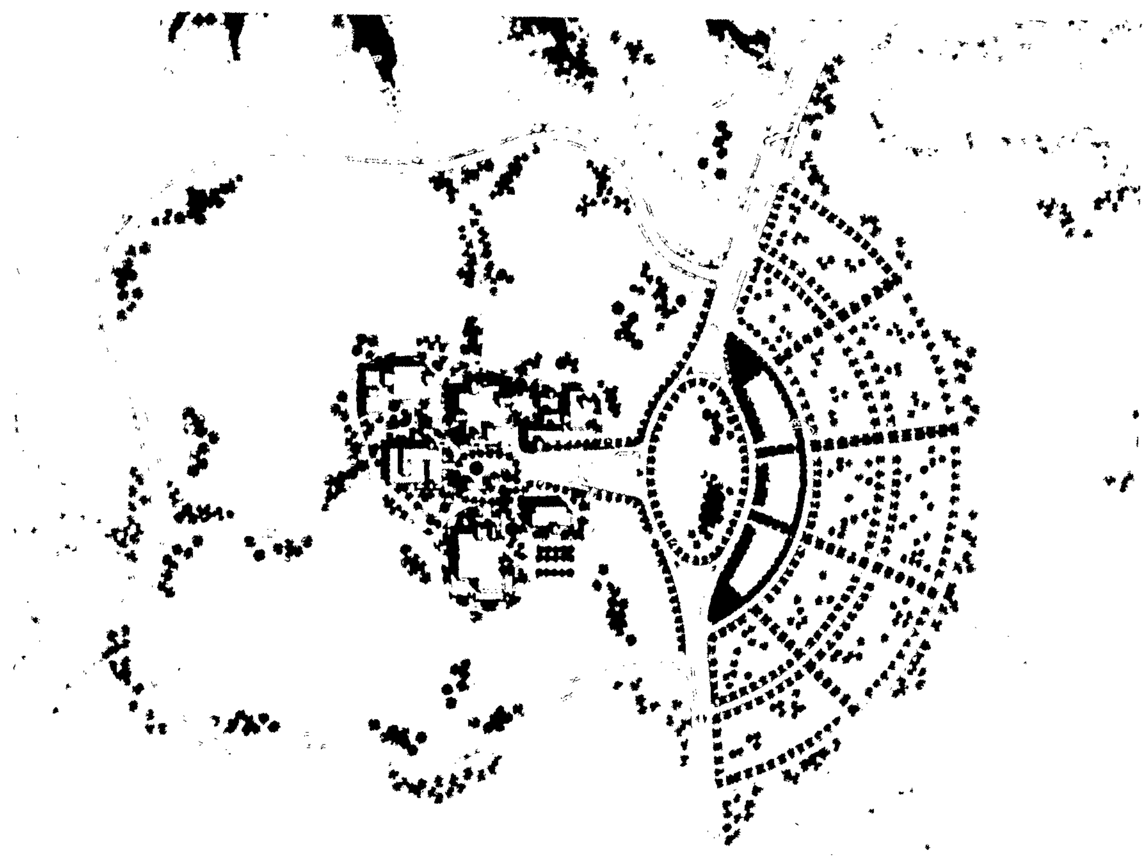

Figure 1 -- Initial stage of the site plan for the Edwardsville Campus, Southern Illinois University.

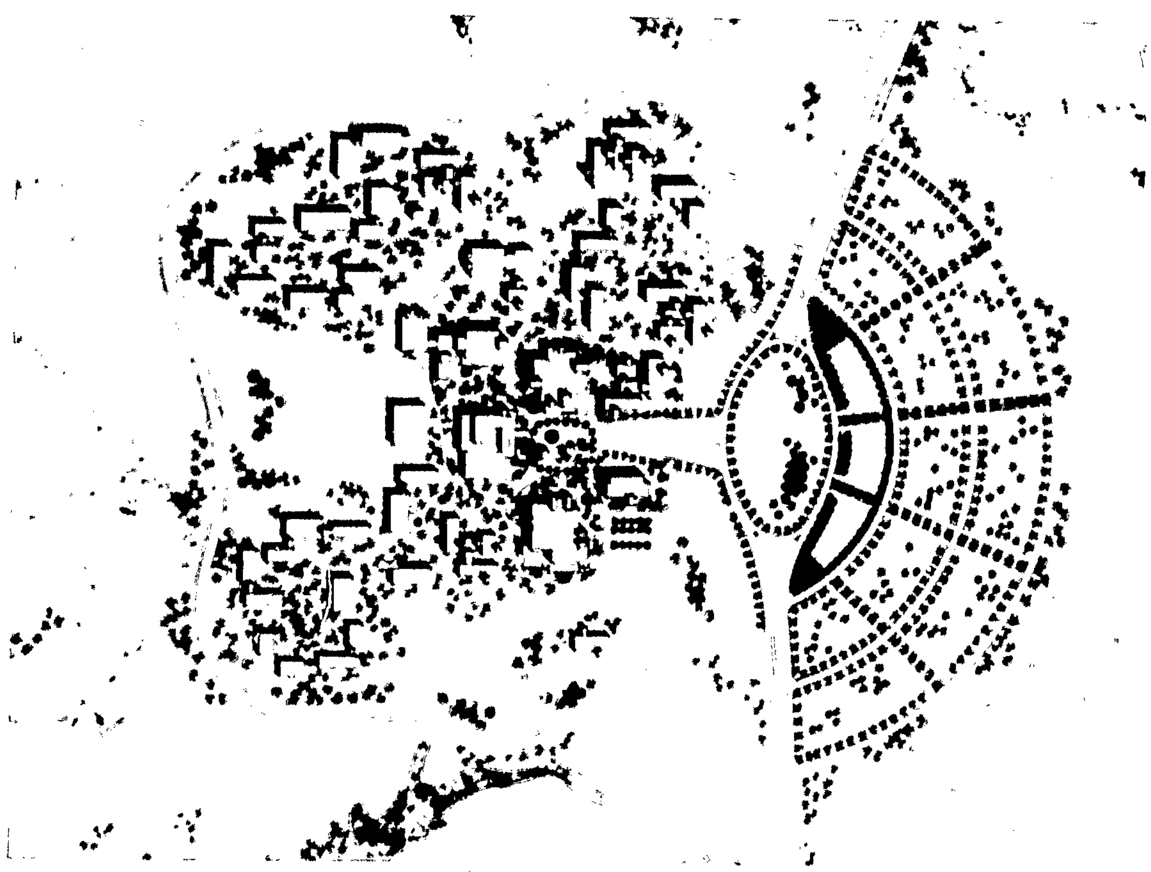

Figure 2 -- Final stage of the site plan for the Edwardsville Campus, Southern Illinois University.

reading areas, offices, and individual carrels can be placed anywhere in the building. A 30 ft. by 30 ft. waffle pan-reinforced concrete frame was chosen as the most economical and largest bay for a load of 150 psf. A 10 ft. by 10 ft. module was selected, with lighting and air conditioning available to each module for complete flexibility. All fixed elements in the building, such as elevators and mechanical rooms, are located at the sides of the building, so that the entire interior is free for a variety of uses.

In order to effectively utilize natural light, the east and west walls are staggered. Only north and south light is admitted. The north wall is completely glass. The south windows are provided with protective overhangs. Double glazing is used throughout in order to provide effective humidity control. A space was left above the ceiling for future installation of electric conduit. Space has also been left in the basement to house audio-visual and electronic retrieval equipment. Initially, this building will consist of three floors and a basement, but there is provision for expansion to seven stories.

To avoid long, horizontal loft spaces lacking architectural character, a 30 ft. by 30 ft. center bay was left open for three stories, with a skylight above, to create a central exhibit area. The exterior of the library reflects its functional aspects. The static elements of the stairs, elevators, etc., are covered in brick. All of the flexible spaces have exterior walls of precast concrete, faced with a one-inch quartz aggregate, or of glass. The library is the symbolic central focal point of the university. When its height is increased to seven stories, it will dominate the campus even more strongly.

Communications Center

The communications center consolidates, at one point on the campus, approximately eight TV studios and a 400-seat theatre. It will also house AM and FM studios and all of the data-processing equipment used on the campus. The building is designed so that a future auditorium for 1,500 students can be attached. A utility tunnel leads from the communications center to the library for transmission of audio-visual instructional materials.

Instructional Buildings

The instructional buildings are designed to contain nonspecialized classrooms, faculty offices and small seminar rooms, and highly-specialized facilities such as science laboratories and an art studio. The design approach was to place like functions in like buildings.

The nonspecialized building group houses all of the nonspecialized classrooms. The basic building has a 60 ft. span and is based on a 5 ft. by 5 ft. module, so that partitions can be placed on any module to create a variety of classroom spaces accommodating from 12 to 200 students. Each module will have lighting and air conditioning, and a suspended acoustical ceiling for easy placement of electrical conduits. This type of building also has all fixed elements on its periphery, so that the basic 60 ft. by 160 ft. space is completely flexible.

Attached to two of the 60 ft. by 160 ft. classroom areas is the faculty office building, also based on a 5 ft. by 5 ft. module. This building also is flexible, allowing for a variety of office arrangements. The entrance wing to this building contains lounges for students and faculty, a necessary adjunct in a commuting campus situation. By placing all faculty offices together with the nonspecialized classrooms, which do not require special utilities (except for electrical conduits), economy was achieved in construction. The utility towers in this building are of brick; the flexible area of concrete or glass. Only four major materials were used on the campus: brick, precast concrete, gray glass, and dark, anodized aluminum window frames. Therefore, consistent esthetic values are maintained.

Science, Laboratory and Faculty Office Building

This four-story building has been designed to house all laboratories of the scientific disciplines. All of the laboratories, and their furnishings, are completely interchangeable. At any 2-1/2 ft. interval, utilities can be brought through the floor, and there is a suspended ceiling providing space for all utilities. There is a fume-hood exhaust for each laboratory. The building contains 32 24-man labs and a variety of preparation rooms and lecture classrooms. Attached to the building are two large two-story, sloping science-lecture halls seating 300 students each, with faculty office space for each lecture hall. Through a grant from the Educational Facilities Laboratories, we have designed a laboratory furniture system that makes it possible to alter a chemistry laboratory for the use of another discipline, such as physics or biology, through a system of interchangeable parts. A mockup of this equipment will be ready for the Edwardsville campus in the fall of 1963.

University Center

The University Center will house all of the social, extra-curricular and food service facilities for the new, commuting campus. There is access from all four sides of this building into a central two-story lounge, hub of the campus. Off this skylighted hub are the book and variety store, music and reading lounges, the main ballroom and the student activities office. On the upper floor are 12 guest rooms for visiting lecturers, meeting rooms, and a restaurant. On the lower level, which opens onto a terrace, are a snack bar and dining facilities. Off the dining area is a "scramble feeding square" to facilitate the rapid serving of food. As designed, this facility will serve 5,000 students in two hours. The lower level also contains 16 bowling lanes and billiard and ping pong areas.

Administration Center

This building houses all of the administrative offices for the Edwardsville campus. There is a large two-story lobby garden through which visitors will pass when entering the campus. This area will be used for student registration at the beginning of each semester.

SUMMARY

After a two-year investigation of the design of this new campus, we conclude that the university educational program is a very complex one, and the buildings must be designed so that they can change with a changing educational program. They must have spaces designed to accommodate new technical equipment as it is developed. The architectural, mechanical and structural elements must be based on a flexible module, so changes can be easily made. Art must have a prominent place on the campus. We have developed a master-planned program of art work for the new campus. Areas have been chosen both inside and outside the buildings to display art that may be expected to become a real part of the campus and the learning experience. We feel that this is critical. In the visual and plastic arts, as in architecture, a unified and meaningful experience for the viewer is best achieved when esthetic questions are divorced from internal requirements. We should never be satisfied with merely designing a pretty façade, within which the functional program elements are stuffed indiscriminately.

Grand Valley State College, Allendale, Michigan

By Philip W. Buchen, Grand Valley State College

TODAY, HIGHER EDUCATION MUST IMPROVE THE MARKET for college campuses needed to serve students who live in areas not adequately served by existing institutions. College campuses are an expensive commodity. The overwhelming cost of constructing a new one is enough to make most state legislatures hesitate. Moreover, a college starting out with new students, and a new faculty and staff, requires years to make full use of a campus initially complete with all facilities. Buildings constructed to fill all of the different needs of a college, if they are made large enough to permit

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BUCHEN, PHILIP W. Vice President, Grand Valley State College; member, National Association of College and University Attorneys.

the enrollment to expand, cannot be used to full efficiency at the start, or during the period of expansion. Also, the extreme difficulty of forecasting, long before the college has matured, the types and quantities of space required in each special-purpose building is almost sure to result in major and costly errors of judgment.

FOUNDING THE COLLEGE

Grand Valley State College was created by the Michigan Legislature in 1960. It is located near Grand Rapids, outside the service areas of other Michigan state colleges and universities. It will admit its first 500 freshmen in the fall of 1963. Each year thereafter, the college will add new and larger groups and it expects, after 10 years, to have 8,000 to 10,000 students. Its program will provide a liberal education leading to an A.B. degree.

The college is dependent for its money upon annual appropriations from the state legislature, and upon private philanthropy. We have started with $1 million raised from private sources and a like amount from the state. We accept the prospect of having to construct our campus facilities in annual stages, at a cost no greater than likely annual appropriations or private grants, and of a size just adequate to meet imminent enrollment increases. In other words, we cannot now afford the complete facilities which we expect to have after 10 years.

CAMPUS SITE SELECTION

The college site embraces 770 acres. The area was acquired by selection from among 16 different sites. This selection involved offers of parcels already taken under option by the sponsors, so that the price of the winning location was established competitively before the winner was announced. This method allows for purchase at less cost than if negotiations for a price come after the selection is made.

The choice of the site was made on the advice of a committee composed of educators, landscape architects, building architects, and engineers. The qualities which prompted its selection were central location, ample size, moderate price, and its environmental situation and natural qualities. The site is in a rural area uncontaminated by urban development, yet readily accessible by highway.

The tract has a mile of frontage on the Grand River. A high bluff along the river is divided by deep wooded ravines. Between the ravines are small fingers of level land, backed by an expanse of gently rolling, open land, as shown in Figure 1.

After acquisition, Johnson, Johnson and Roy, landscape architects of Ann Arbor (Mich.), were engaged to plan the general campus development. They conducted studies of the terrain and determined suitable uses for each part of the site. The development pattern chosen makes primary use of the fingers of land, and places most buildings at the edges of the scenic, wooded ravines.

Figure 1 -- The plan for the general campus development of Grand Valley State College shows (1) entrances; (2) campus drive and parking areas; (3) areas on the plateaus between the ravines where learning centers and collegiate centers are to be located; (4) academic core for science laboratories, main library, and administration building; (5) service building area; (6) student athletic fields; (7) area below crest of bluff overlooking river; and (8) location of first learning center and first collegiate center.

CONCEPT OF FIRST UNIT

Following the choice of the pattern of site development came consideration of the design of the academic buildings. For this purpose, architects Meathe, Kessler and Associates of Grosse Pointe (Mich.) were employed to work with the college staff and its landscape architects. The only feasible plan was to design one building which would serve most, if not all, of the academic needs of the first year's students. For this purpose, a structure was needed in which students could attend all their classes and do all their studying. By including faculty offices in this building, we would have students and instructors associated in a continuous learning enterprise. This organization would constitute a small, self-contained college, offering good opportunities to correlate studies of different subjects. It would also make the instructional program flexible, and encourage independent work by each student under tutorial supervision.

We concluded that if one academic building offered these advantages to our first group of students and faculty, others like it would serve as well for additional groups of the same size, to be added as the college grew. We therefore agreed to develop the campus in annual stages, with functionally correct and adequately used buildings at every stage of its development. The prospect of preserving the virtues of a small college, even as we grow into a large institution, has encouraged us to carry this idea as far as it proves to be workable.

Critical literature on higher education raises the complaint that teaching at many colleges becomes depersonalized as enrollments increase. Without a scheme of internal decentralization for a populous campus, it is scarcely possible to avoid this criticism. Without architectural arrangements which allow small groupings of students and faculty in fairly continuous association, little chance exists for many thousands of students and faculty members on a single campus to achieve the desired scheme of internal decentralization.

SEPARATE LEARNING CENTERS

We expect to achieve this decentralization by having each building designed to serve most of the academic needs of a particular group of students and faculty. We tentatively call these buildings "learning centers." In every such building will be taught a variety of courses to meet the needs of the students assigned to that one learning center. The faculty in each building will be drawn from a variety of disciplines to teach the courses being taken by students at that location. Building assignments for students and faculty may have to change, but we shall try to avoid changing the composition of a group in one learning center until after it has continued together for at least an academic year.

When we have developed a full four-year program, and have a number of learning centers in operation, we will determine the most advantageous plan for assigning students and faculty.

DESIGN OF THE FIRST UNITS

The capacity of the first learning center is sufficient to accommodate 500 students and a faculty of 24. A second building like it is being constructed for eventual use as another learning center, but it will be used temporarily for administration offices, heating plant, science laboratories, exercise rooms, and other functions which will be centrally located in the few special-purpose buildings necessary under our plan.

Two lecture halls in the first building will each seat 100 students. Four smaller rooms will provide space for seminars, and a movable partition allows for combining two such rooms to form a small additional lecture room. Faculty offices are located near the classrooms so students can reach them easily for conferences and tutorial sessions. The learning center omits space for laboratory facilities, since laboratories can be more efficiently provided in a separate building. However, science lectures and seminars will take place in the learning center.

The rest of the learning center is devoted to study space for students. Study carrels permit each student to have a sound-protected desk, equipped with private locker and storage cabinet. Here, he is assured of better study conditions than are usually found in a library reading room or residence hall. Library materials will also be available within the study area.

The learning center is equipped with an integrated audio-visual system. A closed-circuit television facility will serve every lecture room and classroom, as well as the study carrels. The installation of complete audio-visual equipment should aid greatly in decentralizing the academic facilities. The separateness of the different learning centers, and of the student-faculty groups assigned to each, can be instantaneously overcome through the communications system. Lectures by a single instructor can be spread over any number of buildings. In this way, the partial breaking up of disciplines within the faculty by assignments to offices in different buildings will be counterbalanced by having instructors for each discipline drawn together through common use of the audio-visual system.

COLLEGIATE CENTERS TO BE ADDED

In addition to the learning centers, the campus will contain several "collegiate centers" to provide common areas for eating, student activities, and recreation. These will be added as enrollment increases, one such center for every three learning centers. In this way, the size of each collegiate center will be kept to enrollment scale, and there will be better student relations than if all had to congregate in a single, campus-wide facility.

At the outset, Grand Valley State College will serve only commuting students from within a radius of up to 40 or 50 miles. When dormitories do need to be added, they may be designed only as sleeping quarters. If so, study facilities will still be maintained in the learning centers, and eating facilities in the collegiate centers. Thus, a closer relationship should prevail between resident students and those who will live at home and commute.

OBJECTIVES OF THE PLAN

In planning the campus in this way our goals are to achieve both amenity and efficiency. Out of the financial necessity for planning an add-a-building campus have come the benefits of architectural arrangements which organize students into small, contiguous groups, closely associated with the faculty members involved in their instruction. Also, under this plan, a building can be put to intensive use as soon as it opens and for as long as it stands. We avoid the waste of overcapacity at any time, and we escape the risks of providing special-purpose capacity which may later prove to be too large or too small.

Ohio State University, Columbus

By John H. Herrick, Ohio State University

OHIO STATE UNIVERSITY has completed a three-year campus planning study conducted jointly by the architectural firm of Caudill, Rowlett and Scott and the University Office of Campus Planning. The final plan, adopted by the Board of Trustees in February 1962, provides a broad framework within which Ohio State or any of its parts can grow or change, as future needs dictate. This program will describe how we sought to relate the campus master plan to the educational program of the institution.

RELATING THE CAMPUS PLAN TO THE PROGRAM

It is axiomatic that the design of a building should provide optimum conditions for housing the activities conducted within it. This requires not only careful analysis of the present program, but also much prophetic vision. It is difficult to predict with accuracy the uses to which academic buildings will be put, and such buildings have no rapid write-off for depreciation to soften the impact of obsolescence.

A campus master plan resembles a building complex, with the individual structures representing rooms. It requires proper circulation among these "rooms," and it must provide for expansibility and adaptability within the total complex and within each of its parts. One of the earliest steps in our campus planning study was a classification of existing buildings based upon educational program information provided by department chairmen, and upon field investigation of many of the buildings. These inspections were to determine the suitability of existing structures for educational purposes, and to formulate preliminary hypotheses as to the types of educational uses to which each building could be put.

HERRICK, JOHN H. Executive Director, Campus Planning, The Ohio State University; member, American Association of School Administrators, American Society of Planning Officials, National Council on Schoolhouse Construction.

FACULTY INTERVIEWS PROVE FRUITFUL

Six principals of the consulting firm and three representatives of the University Office of Campus Planning interviewed approximately 300 faculty members, deans, department chairmen, and other administrators. These interviews were to ascertain the thinking of the educators concerning future programs of instruction, research and service. By this means, we were able to gain helpful insights into program changes being considered by individuals, departments, and colleges. Perhaps the most significant outcome was increased understanding, among the members of the entire planning team, of the many facets of educational thinking on the campus.

During the early interviews, and in subsequent conferences, the planning staff explored a number of patterns of educational organization. This was necessary because there had not previously been an organized effort to develop an educational master plan for the University. Among the patterns considered and rejected was the creation of a separate lower division, or basic college, in which all freshmen and sophomores would be enrolled.

These discussions of educational organization were seemingly inconclusive and the Phase I report of the study, published in August 1959, stated that there was "no probability of any substantial departure at any early date from the present educational organization." This conclusion produced a storm of objections. Its publication was one factor in persuading the Faculty Council that the University needed a permanent planning committee. The educational planning committee, thereafter established, produced its first report in June 1962, four months after the campus master plan had been adopted by the Board of Trustees. This committee proposed for faculty consideration the establishment of a separate "university college" in which all freshman and sophomore instruction would be coordinated.

This sequence of planning reports is not what most planners would consider ideal, but it is one which realistic planners must be prepared to face.

HINDSIGHT CREATES PROBLEMS

Other changes, proposed independently of the work of the Faculty Council committee, have been suggested by persons who participated in the planning conferences and interviews. It is possible that the interviews and other campus planning activities provided at least some of the stimulus that led to these tardy suggestions. To cite a few examples:

1. The master plan provides more space for physical education and intramurals than the department had reported as necessary, but the Men's Division of the Department of Physical Education now asks for three or four major structures not suggested in the plan.

2. We have a proposal for the splitting off of astronomy from the Department of Physics and Astronomy, and for the construction of a separate building for astronomy which the master plan does not include.

3. Soon after publication of the planning report, the dean of one of the professional colleges, who had insisted over our own protests that his college would not need additional space, requested that we include in our capital improvements budget for the coming biennium an expansion of his facilities to the extent of approximately 20,000 sq. ft.

These examples are given in order to show that the program of any comprehensive university is in a constant state of flux, and that no campus plan can succeed which does not have sufficient flexibility to permit substantial modification. For the most part, this kind of flexibility is in our master plan, but the accuracy of our judgment will not be tested for many years.

Let us examine some of the specific ways in which the approved plan is related to the educational program of the University. The term "educational program" covers the entire program encompassed by the goals of the graduate school, five professional colleges, five undergraduate colleges, and more than 80 departments.

PLAN FOSTERS INTERDISCIPLINARY ACTION

We have tried to merge the existing west campus and east campus, which are separated by a river and a four-lane highway, into a single campus that is unified psychologically, intellectually, and physically. After long discussion there was agreement throughout the University that the campus plan should foster this sort of unification. The strength of a comprehensive university is found in the vitality of interdepartmental and interdisciplinary research and teaching activities.

A second educational concept underlying the master plan is that the basic disciplines, the subjects which most students take regardless of the college in which they are enrolled, are at the heart of the campus. These are surrounded by the applied fields, such as engineering, law and medicine. Libraries, research facilities, and administration serve both the basic and applied disciplinary aspects of our program. Around the periphery of these areas of academic interest are residence halls, continuing education facilities, athletic facilities, etc.

Figure 1 shows how this concept was translated into a campus plan. The basic disciplines are well centered, and the applied disciplines are peripheral. The Main Library at the heart of the basic discipline area serve the needs of students in many fields, and provides technical services for other campus libraries. The second level of library service is provided by area libraries, covering

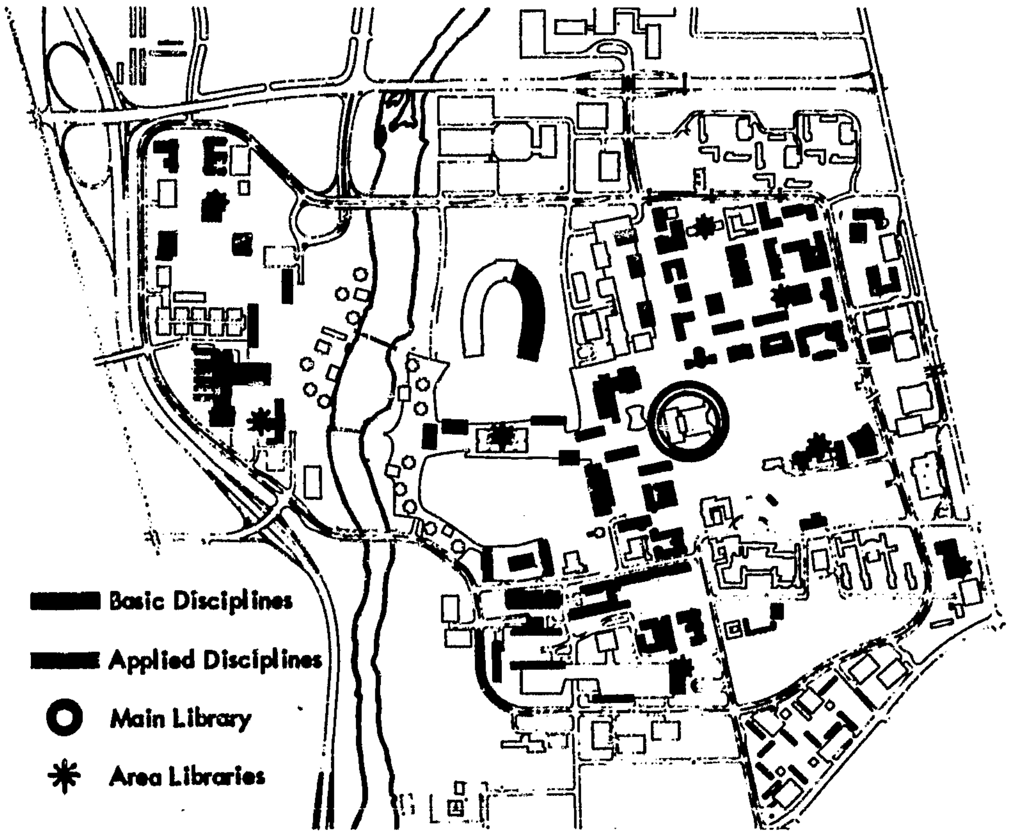

Figure 1 — Functional relationships and major academic groupings proposed in master campus plan.

groups of related disciplines such as engineering and the physical sciences. Departmental libraries, serving a single department, are not shown. There is currently much disagreement on the campus about the place of the area library, as distinguished from the departmental library. Since this issue has not been settled, we assumed for the purpose of our study that both would be provided. This was reasonable, for departmental libraries are so small that they would not unduly distort the building sizes used for the development of the general master plan. However, as we move into the construction of specific buildings, this issue will have to be resolved. Service buildings and other nonacademic facilities are to be moved from the central academic area to locations not shown in Figure 1.

SOLUTIONS TO TRAFFIC PROBLEMS

We sought in our plan to ameliorate the problems inherent in the increasing use of the automobile. This involved a separation of urban and campus traffic, with each moving on its own streets. The principal campus street is a loop that, for the most part, surrounds the central academic area.

Another goal was to separate vehicular and pedestrian traffic. This is accomplished by use of the loop road, and by zoning the campus for parking which, within the central area, is mostly below grade. Exceptions occur only where above-surface parking ramps can be entered without causing heavy vehicular traffic to cross pedestrian routes.

MASSING RELATED DISCIPLINES

We tried to bring related disciplines together, both basic and applied. The odd shape of two of the zones, as shown in Figure 1, reveals that some compromises were made necessary by the location of existing, specialized structures.

We also provided an increase in the amount of space devoted to research within the central academic area. This resulted from suggestions by many departments that research and instructional facilities should not be separated. While we have provided substantially more space for research close to the teaching areas, more remote facilities are available for research that would be inappropriate in a central location.

AREAS FOR RELATED OUTSIDE AGENCIES

The plan proposes three major areas for University-related agencies. North of the campus is a 48-acre site recently acquired by the American Chemical Society for its Chemical Abstracts Service. We hope that similar agencies can be attracted to this location, making it an information center of worldwide significance.

West of the campus we want to encourage the development of research-oriented industries. We have two buildings in this area, one of which is rented to an industry in the cryogenics field.

South of the campus is the Battelle Memorial Institute, a major research agency. We should like Battelle to have room to expand, and we hope that a number of new, related agencies will be established in the same vicinity.

SEPARATE "UNIVERSITY COLLEGE"

Finally, let us consider the idea of a separate organizational unit for freshmen and sophomores. In the early stages of our planning we concluded that there wasn't sufficient interest in such an organization to justify basing a master plan on it, although the educational planning committee later recommended consideration of such a unit. As recommended, the university college would have no buildings of its own, but would be limited to the planning and organization of curriculum, and the like. If the university college is thus defined, the approved campus master plan is not inappropriate.

If, however, a decision should be made to establish a separate lower division with its own physical facilities, major changes in the master plan would be required. Separate and cohesive groupings of lower division facilities, at a place where the present physical education facilities could be effectively utilized, would be needed.

It would be necessary to re-examine all building sizes used in the master plan, except for those buildings devoted exclusively to upper-division, graduate, or professional education. There would undoubtedly be some regrouping to make the most efficient use of existing buildings, and some cases of extremely low utilization. The whole concept of grouping like disciplines would be severely strained.

A decision of this kind would require that many aspects of the master plan be re-done, and the final plan might be significantly different from the one that has been adopted. It is not too late to make such changes, but the point of no return will eventually come when the University will find itself with no choice but to continue the present pattern of educational organization, or to pay a high price in wasted resources or educational inefficiency in order to make the transition.

This paper has attempted to describe how one institution has sought to relate the planning of its physical facilities to changing educational requirements. No attempt has been made to gloss over failures or difficulties. The important thing to remember is that the two facets of educational planning and campus planning are in constant interaction, and neither the educational plan nor the campus plan can ever be considered as final and fixed.

Elementary, Junior, and Senior High Schools, Hancock County, West Virginia

By William E. Kellam, Kellam & Foley, Architects

HANCOCK COUNTY IS THAT AREA of West Virginia which is situated between Ohio and Pennsylvania. The school district of Hancock County includes the City of Weirton, and covers the entire West Virginia area north of Weirton to the state line. The community is primarily industrial, with a limited amount of agricultural employment. The school program within this district has had an exceptionally good history of substantial support from the various industries, and from the populace as a whole.

A bond issue was passed in May 1961 for the purpose of constructing consolidated high school facilities in the county, temporarily incorporating a junior high program in a portion of one of the high schools, and beginning a new elementary center. The School Board retained the services of an educational consulting firm, Engelhardt, Engelhardt and Leggett, to establish the requirements and to make recommendations as to the future educational program within the county.

KELLAM, WILLIAM E. Partner, Kellam & Foley, Architects; member, American Institute of Architects.

Early in the program, it was established that the county school district would best be served by two new, consolidated high schools, one to be located in the southern part of the county and designed to accommodate 1,500 students initially. This high school is called South High School, and is located close to Weirton. The other high school, called North High School, will accommodate, initially, 600 students from the north and central county area. It is located near Pughtown.

A small portion of the financial program, but an important part of the educational program, is to be devoted to beginning an elementary center in the northern part of the school district, in the town of Chester.

FOOD SERVICE

Hancock is the only county in West Virginia not having a school lunch program. It was important that provisions be made to feed all of the public school children. Since no kitchens exist in the present schools, the most efficient and economical plan was to construct two central kitchens. One is to be located at South High School, and designed to prepare food for 5,000 students. The other will be at the new Chester Elementary School, and will provide food for the remaining 3,000 students in the county. All elementary schools will be served from these kitchens. The food and utensils will be trucked to the outlying schools, and the utensils returned to the kitchens for cleaning.

EDUCATIONAL PROGRAM AND PLANT DESIGN

Both high schools have similar educational programs, and are designed following the campus plan. In this paper, we will consider most closely the educational thinking, programming, and architectural planning of South High School. The school is being constructed to absorb the shock of a greater enrollment. Initially, it will receive only 1,000 high school students and 300 junior high school students. The first increases in high school enrollment will gradually absorb the space utilized by the junior high school, until the enrollment reaches 1,500 at which time the addition of a single academic building to the campus will increase the capacity to 2,000 high school students.

Three points should be noted regarding the background thinking on South High School:

1. The law in West Virginia permits the operation of a junior college branch in the county by a state institution of higher education, utilizing high school facilities. The South High School buildings are designed to accommodate a junior college program which will enrich the high school program by the inclusion of the facilities involved.

Figure 1 -- The campus at South High School, Weirton, West Virginia, includes (A, B, C) academic buildings; (D) gymnasium; (E) little theater, music, and industrial arts; (F) administration, home arts, art, and commercial; (G) library, languages, and sciences; and (H) service and kitchen facilities.

2. South High School will include a central kitchen for the preparation of food for 5,000 students.

3. The buildings and their facilities are designed to be readily adaptable to future educational programs. Changes in the program can be accommodated by virtue of the flexibility in the size of spaces, the several uses to which a single space can be put, and the absence of stereotype identity in the purely academic teaching stations.

Since this high school is to be a consolidation of existing schools, and considering the possibility of normal growth in the future, it was decided that the overall planning of facilities should follow the "little school" concept.

SITE SELECTION AND DEVELOPMENT

Due to the large amount of land required for South High School, shown in Figure 1, and the extremely hilly country around Weirton, the number of sites suitable for its location was extremely limited.

After careful study, a site of 56 acres was purchased by the Board of Education. It is adjacent to a relatively new residential development, in close proximity to the center of student population, and convenient to the community for various utilization for public functions. The topography of the site, together with the points listed above, dictated a campus type of plant for the school. The school's 1,500 students will be housed in a series of three academic buildings or "little schools" of 500 students each. The master program provides for a fourth "little school" when needed.

UTILIZATION OF SPACE

Each "little school" serves its student body for classes in English, mathematics, and social studies. The principal or prime administrator for the entire high school is located in a separate administration building. An assistant principal and administrative personnel will be housed in each "little school."

Probably the most interesting change in approach falls in the area of guidance. The guidance program is decentralized so that available guidance time is divided among the "little schools," and the guidance people, instead of being a branch of the administration, are members of the team of teachers to which they are assigned. Thus, the students have individual identities to the guidance staff.

Adjacent to the central administrative room in each "little school" are a teachers' workroom, lounge, and a conference room which will serve as a teachers' dining facility away from the multi-use space where students will eat.

It is hoped that teachers in the "little schools" will operate as a team and have common planning time. Such teachers are not assigned to classrooms. A staff center is located within the classroom area. Here, each teacher will have a desk, files, and storage space. Within this room is conference space for teacher and student, or for small group meetings. From this staff office, teachers will go to whatever classroom accommodates the class on his or her schedule.

Eight classrooms, each of which will accommodate 30 students, are located within each unit of the "little schools." Two classrooms are divided by folding partitions to provide for small-group teaching stations. Folding partitions are also provided between two of the large classrooms, in two instances, thereby increasing the capacity to 60 students where necessary. Groups of up to 200 can be assembled in the multi-use room, which also serves as a cafeteria. A small serving kitchen in each building will receive the food from the central kitchen. This simple kitchen facilitates the use of the multi-use room for community dining purposes.

The organization of the high school in this manner makes it easy for a branch college to utilize one of the academic buildings, for the classrooms are free of high school teacher-station apparatus. The two educational levels can utilize the same building without hampering the use of the facilities by either.

VERTICAL DIVISION OF CAMPUS

The campus is divided into two vertical levels. Public and automobile traffic enter the site on the upper level, on which is located the administration building. This building also houses home arts, art, and commercial subjects. Also on the upper level is the little theater building and the upper portion of the library-science building. On the lower level of the campus are a service building containing the central kitchen, a gymnasium, and the three "little schools," together with the lower level of the library-science building.

The central kitchen uses wheeled carts to serve the food to each of the "little schools." Academically, the "little schools" funnel the student traffic into the library, on the same level, and then it moves vertically to the second floor of the library building, where the science laboratories are located. From this level, the student can move to other special facilities areas. This focal building is the only one in which vertical change between the two campus elevations can be made. Outside traffic moves freely between the buildings by means of ramps or steps.

LIBRARY, LANGUAGES, SCIENCE FACILITIES

Immediately adjacent to the academic buildings is the library, languages and science building. This two-story structure consists of library and language laboratories on the first floor, and science rooms and branch college administration space on the second. The three major subjects taught in the academic buildings -- English, social studies and mathematics -- have assigned departmental centers in the library area. Staff members and students from the "little schools" can use the areas adjacent to the library for concentrated pursuit of their subjects. The language laboratories also have a center for staff work and individual conference space.

The second floor of the library-science building houses two science laboratories for use in chemistry and physics. Three others on this floor accommodate the life sciences. One of these rooms is provided with a projection dome for use in astronomy. A special projects area is centrally located for both physical and life science projects. On this floor, immediately accessible from the upper level of the campus, is a small area devoted to branch college administration. This space is physically detached from the high school. A separate staff and conference room in the science area carries through the detachment of a particular teacher from a particular teaching station.

ADMINISTRATION, COMMERCIAL, AND ARTS DEPARTMENTS

Overall administration of the school is concentrated in the principal's office, located in the administration, home arts, arts and commercial building. This simplified administrative area consists of general office, teachers' work room, and a principal's office. The commercial office contains rooms for typing, stenography, office practice, distributive education, and two classrooms separated by a movable partition to permit conversion to a single, large teaching station. The home arts suite consists of a room for classes in cooking, a living center with facilities for patio and outside teaching, and a sewing center. Across the corridor is the art department, with a ceramics center and outdoor sculpture court.

THEATRE, MUSIC, INDUSTRIAL ARTS

Across the campus from the library is the student activities center, consisting of facilities for a little theater, music, and industrial arts. The student center consists of a lounge area, visually open to the central campus, a student store, and a student bank. The latter two are administered by the student body. The lounge area is also the entry and main lobby for the little theater, which seats 300. It is expected that the little theater area will be a multipurpose facility. It is possible to separate the major portion of the platform area from the seating space, and utilize the seating area for lectures, while simultaneously performing activities such as TV production on the remainder of the platform. The TV control room is located at the rear of the platform area.

The seating area within the little theater is extremely flexible. Every two rows of seats are on the same platform level, one row being on standard height legs, and the other on extremely short legs, utilizing the edge of the platform for normal seat height. Each row of standard height seats can be removed and replaced by tables for testing purposes, or for cabaret purposes during student functions. The little theater separates the industrial arts area from the music area. One large, 2000 sq. ft. bandroom has permanent risers in a semi-circular seating arrangement, and ample instrument, robe, and uniform storage facilities. An office and library of more than 300 sq. ft. also has listening booths for auditing tapes and recordings. An ensemble room can be utilized by the little theater as a dressing room.

The industrial arts area consists of spaces for wood and metal arts. Both are provided with adequate material, storage space, finishing space, and project storage space. A separate room devoted to graphics is adjacent to the wood arts area, and a room devoted to mechanical drawing is accessible from both of the arts areas. Between the wood and metal arts areas is a staff planning and conference room, and a common classroom for group discussion purposes.

PHYSICAL EDUCATION

The gymnasium is in close proximity to all outdoor activity areas. It contains a standard court with a side-court seating 1,400 people. A folding partition parallel to the long dimension of the playing court divides the gymnasium into two standard basketball courts when the seating is retracted. One court will be utilized by the boys, and the other by the girls. The boys' locker rooms and two team rooms are adjacent to the boys' side of the gymnasium, and accessible from a platform at the end of the main playing court. The platform can be closed off from the gymnasium and used by the boys for individual and group exercises, thereby creating two teaching stations for the boys. The girls' locker room is adjacent to the enlarged lobby in this building, which is designed for use as the girls' exercise area, thereby creating two stations for the girls.

At the entrance to the gymnasium building is the nurse's station, with two rest areas, an examination office, and a testing room. Adjacent to the lobby of the building is a classroom for health education. The space over the toilet areas contains a classroom of about 1,200 sq. ft. for driver training. The remaining building on the campus contains the central kitchen, general storage facilities, and mechanical plant. All utilities are fed underground to the individual buildings within the campus.

TRAFFIC CONTROL

The site has access from two streets into a common parking area adjacent to the administration building. The parking area is located for quick service to the central kitchen and service building. A separate drive for buses terminates at the academic buildings. The entrance drives, parking areas, and bus drives are located on the periphery of two sides of the site. There is no penetration of the site by vehicular traffic, and the students move freely, without the hazards of moving traffic. The walks within the campus provide easy passage between buildings and between levels. Walks provide access for emergency vehicles to two buildings on the campus which are not available from drives or parking areas.

ENVIRONMENTAL CONSIDERATIONS

The school is located approximately one mile from the Weirton Steel Mills, and will be subject to much atmospheric abuse. The smoke from the mills is sulfuric, and this factor was a strong element in determination of the physical shape and materials used for roofing. The roofs are sloped so as to be self-washing and to rid themselves immediately of the dilute acid precipitated into the atmosphere. No objects penetrate the roofs except plumbing vents. Air intakes and exhausts are placed in gabled ends of buildings. A very dense, low-absorptive brick was selected for exterior walls.

The design, products and material dictated by the conditions at the South High School site were carried over to the physical plant at North High School and Chester Elementary School for reasons of economy in bidding and construction. The eight buildings at South High School, four at North High School, and two at Chester Elementary School were bid at the same time. Construction contracts on the three schools were awarded in June 1962, and occupancy of at least the academic buildings was scheduled for September 1963.

Eureka College
Eureka, Illinois

By John E. Severns and Ambrose M. Richardson, Richardson, Severns, Scheeler & Associates, Architects

THE PROBLEMS INVOLVED in planning the small college are best expressed in an observation by Sydney Harris, columnist and author: "There is never enough time. There is never enough space and there is never enough money." However, without problems there would be little progress.

The problems and principles of physical planning apply to large and small institutions alike. These principles recognize that any physical plan must be an outgrowth of an institution's academic program. The physical development to house its academic and supporting functions can be no better than the goals of the institution, and the changing policies and programs which implement these goals.

In addition, a physical plan must provide for continued orderly growth and circulation without the context of its relationship to the community at large, and a recognition of the problems of finance, existing facilities, and utilization of space.

We might outline the characteristics of the typical small college; not the one that is well endowed and academically excellent, but the one that needs help. This type of institution has from 300 to 1,000 students. In 1972 it may have an enrollment of from 900 to 3,000. Many such colleges originated as church-supported schools. Their student bodies are largely resident, and drawn from the church constituency and the immediate area.

The academic program is basically liberal arts, with a large percentage of the graduates going into teaching and other service

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SEVERNS, JOHN E. Partner, Richardson, Severns, Scheeler & Associates, Architects; member, American Institute of Architects. RICHARDSON, AMBROSE M. Partner, Richardson, Severns, Scheeler & Associates, Architects; member, American Institute of Architects.

professions, although interest in the natural sciences is increasing. The student-faculty ratio may range from 5-1 to 25-1. Twenty to 35% of the current graduates take graduate work at other institutions.

The campus is characterized by mixed styles of architecture, with buildings seldom disposed in accordance with any functional relationship. The structures are generally more obsolete than those of public institutions. They are low-rise, of two to four stories, and small in area. Land coverage is on the order of from 20% to 25%. Classroom space may be adequate for the need, and may even reflect poor utilization, but special facilities are limited, and faculty accommodations may be completely inadequate. There are no standards for space allowances for various functions, or for space utilization.

Fiscal policies may be rudimentary, and records incomplete. The primary sources of income are tuition and support from the church. Business and industry support is on the increase, as is aid from foundations. Federal support for capital improvement is almost entirely for student housing, food service, and student union facilities. Research is minimal.

The staff is engaged in full-time, continuing academic planning and no one is engaged, even on a part-time basis, in physical planning and related activities. Under these circumstances, the architect-planner functions as a catalyst, and may in time almost become one of the "college family."

BASIC PLANNING CONSIDERATIONS

Orderly campus growth dictates that each discipline be free to expand without limiting the expansion of other units, or disturbing overall relationships. It is, however, necessary to consider interim use of space by varied functions, since no discipline can justify an entire structure of economical size.

The unpredictable supply of funds for capital expenditure further complicates the problem. Efficient reuse and economical renovation of existing buildings on the small, private college campus may be less practical than on those of their public counterparts, due to age, size, and a generally lower level of maintenance. Similarly, the utilities distribution system suffers by comparison, and may not be readily improved. These problems may be more acute than in larger institutions, but relative size is a mitigating factor. For example, time and distance are not important considerations in site planning for the small campus.

Generally, land acquisition is not an acute problem. The demands on the large university for sites for research, extension programs, etc., seldom exist on a small campus. We are thus able to rule out two of the least predictable factors in the campus planning spectrum. Perhaps most important, the scale of the campus lends itself to the creation and maintenance of an appropriate environment. There is intimacy of contact between student and staff which does not exist in large schools. With these differences in mind, let us consider the case of Eureka College.

Eureka College is located in Eureka, Ill., a community of 2,500 about 140 miles southwest of Chicago. The college was organized in 1848 and chartered by the State of Illinois in 1855. It is situated on a wooded, sloping site. In 1960, when this study was made, there were 300 full-time equivalent students. It was predicted that enrollment would increase to 600 by 1970.

Although no comprehensive physical planning had been undertaken prior to our retention as architects, the college had been in the process of a major self-appraisal. The development plan, then, was in some respects a crystallization of this self-analysis. The planning process took the following course:

1. Establishment of clear definition of goals.
2. Analysis and inventory of existing facilities.
3. Analysis of enrollment and class registrations and schedules to determine present utilization of facilities.
4. Development of basic academic and physical planning assumptions.
5. Detailed analysis of space and functional requirements developed from these assumptions.
6. Development of land-use and circulation patterns.
7. Studies of development plan.
8. Study of long-range plan.
9. Recommendations.

DEFINITION OF GOALS

The definition of goals was achieved by consultation with the administration and staff. Every effort was made to take an objective view of various aspects of growth, possible means of financing, potential changes in academic policy, and changes in size and character of the student body. It was finally agreed that the basic academic and administrative organization would remain constant, and that except for housing, student union, and food service facilities, which may be financed through government programs, all funds would be derived from the church constituency and from private business and agencies.

Since the college is sponsored by the Disciples of Christ, expansion is subject to the approval of the church, as well as to the Board of Trustees of the College.

ANALYSIS OF EXISTING FACILITIES AND FUTURE NEEDS

The general goals were translated into definitive planning assumptions and space standards. Existing facilities were evaluated as to obsolescence and utilization. The projected enrollment was converted into an adjusted course registration from which an estimate of the number of classrooms and laboratories required could be made. Projections of academic and administrative staff established the requirements for office space. Supporting facilities, including food service, housing, student union and physical plant, were similarly projected. Adding the chapel provided a total building area for the campus. Land area projections were based on physical education and recreation needs, parking, and the general desirability of a 20% land coverage for buildings. The summary of these findings, together with the detailed estimates of the space needs of the various disciplines, permitted development of a physical plan.

DEVELOPMENT OF LAND-USE AND CIRCULATION PLAN

As important as the projection of space requirements in the development of a comprehensive plan is the relationship of the functional areas to each other and to the total environment. These relationships should express the objectives of the institution, and should allow for orderly growth of each segment within its respective zone. Also related to this land-use plan is the circulatory system for pedestrian and vehicular traffic.

The land-use and circulation plan includes seven zones: academic; chapel, union, and food service; parking; student housing; open land; physical education and recreation playing fields; and physical plant.

The circulation plan envisions separation of pedestrian and vehicular traffic so that the academic block is a pedestrian "island" with traffic and parking on the periphery. Service would be accomplished by use of sidewalks designed for limited vehicular access.

The land-use and circulation plan then became the foundation for a series of plans intended to test the validity of the zone relationships, and develop appropriate building-massing and disposition.

The academic plan evolved from the basic organization of four divisions -- humanities, social studies, natural sciences, and education-psychology -- grouped around a core including the chapel, general college, and administration. Such a distribution of elements would permit expansion in the various disciplines, yet would allow for orderly circulation among classes. Further analysis of the existing academic structures, together with the supporting areas and possible routes of expansion, resulted in several possible combinations of building size and groupings. After these alternatives had been weighed by our staff and the college administration, and an objective appraisal had been made, a preferred plan was developed and recommended to the Board of Trustees for approval. This plan is illustrated in Figure 1.

No plan, of course, is static, and it was therefore necessary to consider long-range plans to assure that continuing orderly growth could be possible within the framework of the proposed development plan for 1970. For this reason, allowance has been made for a long-range expansion of at least 50% beyond the 1970 projections in all areas.

Figure 1 -- Proposed development plan for Eureka College in 1970. Key: (1) Chapel; (2) Library; (3) Administration; (4) Burgess Hall, academic; (5) Vennum Hall, academic; (6) Old Chapel, academic; (7) Old Gymnasium, academic; (7a) New Gymnasium; (8) Future academic; (9) Student Union; (10) Food Service; (A) President's residence; (H) Student housing; (PP) Physical plant.

RECOMMENDATIONS

In substance, the recommendations included: adoption of the proposed plan as a base for further development; the establishment of certain building priorities; the establishment of a planning committee representing the faculty, administration, and Board; and the establishment of a landscape plan. Emphasis was placed on the need for careful architectural study to insure total campus cohesiveness and the general compatibility of new buildings in terms of form, general relationship, materials, and scale.

SUMMARY

Two years later, changes in some specifics of the plan have been made. Enrollment is now expected to be 800 rather than 600 in 1970, because of the accreditation of the college by the North Central Association in the summer of 1962.

A permanent residence hall has been deferred and a facility of less permanent character substituted because of financial considerations.

A new food service building, on the site proposed in the plan, was dedicated in October 1962.

A library has been designed, and the project is in the fund-raising stage at present. In each of these cases, the program for the facility was modified somewhat from the planning study. All these changes have been absorbed without loss of basic principle or direction.

It may be said, with some justification, that such a procedure for planning a college which only anticipates a growth of 500 students over the next seven years is overly complicated and laborious. An elementary school of similar magnitude would not be considered a major planning or architectural problem. However, it should be pointed out that the problems of planning for an institution of higher learning, no matter how small, warrant a great deal of consideration, since those institutions are the very heart of our educational future. It is fitting that we in the building industry recognize their needs and our obligations to provide them with creative professional and technical services.

Panel Discussion

Moderator: William S. Kinne, Jr.,* Univeristy of Wisconsin

Panel Members: Messrs. Obata, Buchen, Herrick, Kellam, and Severns, and:

Edmund J. Gleazer, Jr., Executive Director, American Association of Junior Colleges

George O. Weber,* Director, Physical Plant and Supervising Engineer, University of Maryland

Mr. Gleazer: I have a deep interest in planning educational facilities. Today, we have the opportunity of establishing about 20 new collegiate institutions each year. Planning these institutions from the beginning presents us with some remarkable opportunities. One thing that has concerned me a great deal, however, is the lack of direction from the educational community itself.

*BRI member

Our perceptions are limited. Architects and educators look at educational planning from necessarily different viewpoints. We should ask, What is the responsibility of a group such as this toward the stimulation of critical thought, as we approach problems of planning? What kinds of questions should planners ask? How can we test our assumptions?

We do know that universities are changing in character. There is a drive in Missouri to have the University of Missouri establish itself in Kansas City and St. Louis, as well as in its more rural setting in Columbia. The University of Michigan has already established additional campuses in Dearborn and Flint. In many of our major universities, there has been a reduction in lower division enrollment. One of the new public, state-supported universities being established in Florida will have no lower division at all. Its source of enrollment will be junior college graduates and transfer students.

We know that there will be changes, yet many people working in different disciplines are not acquainted with these changes. I think one of the basic things to be considered is what we can do about the assumptions upon which our planning is based. Another is how we can utilize, or stimulate the utilization, of experimental data. To what extent is research being done by psychologists, sociologists, anthropologists, and others interested in human behavior? To what extent is this type of research being made available to those who have responsibility for establishing requirements and for working with architects and builders?

Even on a university campus there is not always good communication between the people responsible for planning and those working in the behavioral sciences, yet the data produced by these investigators has much to do with the effectiveness of our planning. I am disturbed about our basic assumptions, how we can test them, and particularly, the role of the professional planner in asking the questions that will test these basic assumptions and lead toward the utilization of the basic research data coming out of the behavioral sciences.

Mr. Weber: To planners, I would say make a place for my colleagues, the physical plant administrators in the operation and maintenance field, on your planning team. Their experiences gained in living with the end result of the dreams of architects and planners would probably be worthwhile.

Another thought I would like to present has to do with the need for collective efforts in trying to come up with answers. Our world is made up of compromise, and this must be recognized when buildings and campus plans are being developed. However, one must not get into a position where, because of expedience and in an effort to make a project go, he gives in on what might appear to be a very trivial point but one which, in his opinion, is completely wrong. Keep the question open. Ask for a little more study, on paper, before the building becomes brick and mortar. For instance, would you think that six inches more width in a single bedroom was a serious problem? In one case it stretched a nine-story domitory from 286 to 316 feet, and ran the price beyond the budget.

I fail to understand how architects can design what educators cannot describe. Individual architects have accepted the challenge and fitted themselves into the picture. I know that the American Institute of Architects has no publication on how to properly program buildings for universities and colleges, because I have tried to obtain it. Here is a needed piece of work for architects, who have to take the brunt of all the blame and responsibility for the end result.

For lack of proper guidance, many of us have resorted to architectural programs developed out of sheer necessity, which probably fall far short of the ideal. But now, having been at our institution for 17 years, I have seen what excellent teamwork can result when everybody is consulted, and what dire results ensue when the people who are going to use a building don't have a chance to express themselves. Getting a widely variant group together seems to me to be the answer to obtaining a proper program, providing one person is then completely responsible for articulating the wishes of all.

Paul Achenbach, National Bureau of Standards: Are any school-planning groups making efforts to incorporate fallout shelter characteristics in new buildings on a dual-purpose basis? What are your attitudes about the Federal Government's program to provide shelter space for school children?

Mr. Severns: The library we have planned for Eureka College has provision in the program for a fallout shelter, but it will be built only if someone other than the college provides the money. It will not spend its money for a fallout shelter in lieu of expanded library facilities.

Mr. Kinne: What has been the attitude of the institutions with which you have had contact concerning provision of space for storage of civilian defense equipment, etc.?

Mr. Weber: We are close to Washington, D.C., which we think would be the primary target. You have probably seen reports on protection factors that your buildings offer. I think a program will be financed shortly to allow you to stock your fallout shelters, and the protective ratios and capacities will be posted. We are in the process of developing an organization for monitoring, for wardens, etc. The Cuban crisis hastened us into accelerating a normal trend of development. When we build a building having a large basement area, we use reinforced concrete in the ground, and we think in terms of dual use. We are not, however, converting existing structures that do not measure up to minimum protection ratios.

Mr. Severns: The University of Illinois Medical Center has been asked to provide storage space. Its facilities have been surveyed. The question, however, is one of available space. The University is about four years behind in its building program, and the space for any function is at a premium.

Mr. Kinne: Ohio State University is already a very large institution. For how much additional growth does its master plan provide? Is there a maximum size beyond which any one university should not grow?

Mr. Herrick: We are providing in our plan a framework into which the university can grow as required over the years. We have no specific total enrollment in mind. We used 44,000 for our calculations on teaching space, office space, etc., thinking in terms of 30,000 undergraduates, 10,000 graduates, and 4,000 professionals. Our plan could be adjusted to exceed this figure by 10,000 or more, but our goal was to have a plan that would work at any intermediate point between our present enrollment and 44,000. We thought it best not to fix plans and rigid limits in a way that might create intolerable conditions later, when the size might need to be adjusted. I see no objective way of determining the optimum size of an institution. If there is such a size, I suspect that the larger institutions exceeded it years ago. Bigness does have some advantages, such as making it possible to attract research grants and highly-qualified graduate students and faculty members. Bigness may not be nearly so detrimental to the advanced or graduate student as to the freshman or sophomore. Also, most college freshmen have traveled extensively and TV, radio, etc., have broadened their horizons with the result that they are less perturbed than their elders about the bigness of an institution.

Mr. Gleazer: The best study I know of dealing with optimum enrollment in a college was one made at Hamilton College in New York a few years ago. It dealt with social and academic values, as well as with economic ones. For that type of college, the optimum size was found to be about 800. The University of

California has come up with an estimated ceiling size of about 25,000, but this is a subject of great controversy, and will continue to be so.

Milo D. Folley, Sargent-Webster-Crenshaw & Folley: Are the buildings at Southern Illinois University air conditioned? What about sun control for the administration building, with its large glass areas? What about noise control in the open center well of the library?

Mr. Obata: All of the buildings will be air conditioned. As to sun control, we do have glass from 30 in. above the floor in the faculty offices; however, we feel that these small offices should have a view of the beautiful countryside. We do have a five foot overhang on the buildings to control the south exposure. There is no problem on the north, but we do have problems on the east and west. Here, we will depend on venetian blinds. In the matter of sound control in the library, it is felt that there is enough control exercised by the librarian. The whole building will be carpeted. Some tests on the background noise level for libraries have been run, and it is felt that a limit of 35 decibels will permit people to move about without disturbing others.

William Lukacs, Architect: At Grand Valley State College, what happens to students in each building in their second, third, and fourth years? Are different subjects handled in any one building?

Mr. Buchen: Different subjects are taught in the same building. That is the purpose of the learning center: to mix the faculty and to mix the subjects taught. We would hope to mix the students at different levels within the same building, rather than draw a sharp line between students in different years, for we think the intermingling of students at different levels is important to their education.

Mr. Kinne: In the planning for design of your complex in West Virginia, what did you find as regards the pattern of the high school? How many students were taking their terminal education, and how many were in a college preparatory program? Did this have any particular effect upon the way you planned the buildings in the complex?

Mr. Kellam: I think the percentage of college-bound students is probably low within that school district. However, I don't think the makeup of the high school itself was affected greatly by the number of students going on to college. The fact that this facility may be used as a branch college did affect, materially, the "little school" concept. This, we believe, will help the college situation, as well as the high school situation, in terms of what the school district is trying to do in its educational program.

Unsigned Question: The case study of Eureka College is representative of a rural or exurban density of land use. Is this appropriate for an urban situation, particularly one with an essentially commuting population?

Mr. Severns: We cannot hope to maintain a low density of land use in an urban situation. Our experience in working with the Medical Center of the University of Illinois, which is essentially a high-rise group with about a 60% land coverage, and buildings ranging from five to 14 stories, leads us to feel that although it may not be appropriate in an urban setting to maintain this low intensity of land use, it is quite important to maintain some open area. Thoughtful disposition of buildings and appropriate landscaping help create an environment which can contribute greatly to the interchange between students and faculty, a benefit so often lacking on the urban campus.

Mr. Obata: How high the building should be, and how spread out the campus, depends upon the human scale -- how far you want the students to go up, and how quickly, and how far you want them to move horizontally. We have 2,600 acres at Southern Illinois, but the compactness of the academic core was determined by how far we wanted the students to go up (three or four stories) and by the distance from the parking area to any academic building. This limited our essential academic area to 220 acres.

W. Wieting, Perkins & Will, Architects: Has the fire marshal approved the open wells and stairwells on the Southern Illinois campus?

Mr. Obata: We were concerned about this, and therefore we obtained a special consultant on fire safety. He has checked all of our fire stairs, our open wells, etc. In some areas, we have had to install sprinkler systems. However, our consultant worked closely with the State Fire Marshal, and we have received approval of these buildings.

Unsigned Question: What importance do you attach to wide dissemination of planning information within the institution, to the legislature, and to the community at large?

Mr. Herrick: We decided that we had to have wide dissemination of information among the faculty, partly in reaction to the "star chamber" approach that prevailed earlier in our institution as well as in many others. During the course of our study we distributed to the faculty what we called "campus planning bulletins," which began with an announcement of the purpose and nature of the study and the general procedures, and ended with a summary of the final report. We received a great deal of faculty support as a result of these. We also made numerous reports to community groups and to legislative groups. I think we have, for the first time in many years, a good relation with the city. For example, the City Planning Commission was a part of our team at certain stages, and there were no proposals for change in street pattern or expansion of the campus that it did not know about and concur with prior to publication of the report. We are now in the fortunate situation that any proposed variance or change in zoning in the university district is referred to us, before it ever goes to the City Planning Commission for a decision. This is a very favorable climate in which to work.

A. R. Hough, Hough Manufacturing Corp.: Would you comment on the practicality of the multi-building plan in West Virginia winter weather?

Mr. Kellam: The decision in this case was arrived at by everyone involved. It was not something that we pushed off onto the school board as a design feature. Its serious consideration was the result of the site we had to work with, and the educational program. However, this certainly is not to say that the educational program determines the shape a building must take. Any number of architects can take an educational program and come up with their own particular physical solutions.

Mr. Hough: Have you had any reaction on the part of teachers to the substitution of the "home office" for the "home room" concept?

Mr. Kellam: There has been none. Of course, the buildings are not yet completed. The teachers and some of the staff participated in the discussions which took place, and their comments seemed to be very favorable.

Unsigned Question: Has the ultimate retirement of proposed units been given any consideration in any current planning programs?

Mr. Kellam: Not in our case. We are planning the replacement of certain existing one- and two-story buildings which create a high degree of land coverage in order to make more efficient use of the land. This is the principal reason for replacement, but we are not planning any new buildings with a definite date of obsolescence.

Mr. Severns: At Eureka we are contemplating removal of some structures that are either presently obsolete or that will become obsolete. No definite time limit has been set at present. We anticipate, in the case of housing, retaining them for from two to five years.

William Lukacs, Architect: Please describe the "scramble" dining room in the student center as to operation, service, seating, clean-up, etc.

Mr. Obata: In contrast to the standard cafeteria, in which the slowest person in the line establishes the speed, in a "scramble" system there are a number of serving stations and several cashiers. The system works well, and we anticipate being able to serve some 5,000 students in a matter of two hours. Diners sit at tables of their choice, and there are two exit points where they leave their trays and soiled dishes.

Mr. Kinne: I should like to call attention to the fact that I am, as you will note in the program, a consultant for the University Facilities Research Center, a group which has largely been subsidized by Educational Facilities Laboratories, Inc., and sponsored by the Western Conference of Big Ten Universities and the University of Chicago. We have a number of publications which are available free. These deal with design criteria for college and university buildings. If anyone would like to avail himself of these publications, he can write to me at the University of Wisconsin. I will be very glad to add individuals or firms to our mailing list for publications now in print, or to be published. There are a number of new ones in the offing.

Evaluation of Climate Control and its Contribution to an Effective Educational Program

By Floyd T. Christian, Pinellas County, Florida
Board of Public Instruction

Abstract: This is a comparison of two schools, one equipped with air conditioning and one without, in terms of cost of maintenance and depreciation, educational outcomes, and the incidence of physical illnesses and psychological problems among pupils. Two junior high schools were employed in the study, each meeting similar standards of area, enrollment, and cost of construction. The schools are described physically, and the mechanics of the project are considered. Preliminary findings are reported.

EARLY IN 1959 OUR STAFF CONCEIVED THE IDEA of building two equal facilities for junior high school students, air conditioning one, so that their relative merits could be studied.

The idea was introduced as a climate control project, and received favorable support in the local news media. The state superintendent and school plant director were also enthusiastic about what we proposed to do, and they helped make minor changes in state regulations to facilitate the project.

DESIGN OF THE TWO SCHOOLS

Charles Colwell was commissioned to design the nonair-conditioned building, and he developed plans for a sound, traditional school, Pinellas Park Junior High School. In our area of the country "traditional" means a building constructed so as to take advantage of natural breeze.

James Bruce was commissioned to design Oak Grove Junior High School, the climate-controlled school. It was stipulated that the design must be similar to the building designed by Mr. Colwell in terms of the amount of space allocated for different school activities, and costing not more than $9.00 per square foot.

THE RESEARCH DESIGN

With the preliminary drawings of the physical facilities available, our research director began to construct a research design which would thoroughly investigate the two schools over an extended

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CHRISTIAN, FLOYD T. Superintendent, Board of Public Instruction, Pinellas County, Florida; member, American Association of School Administrators, Florida Education Association, National Education Association.

period of time. Since this type of project was novel, there was some minor modification of the original research design. As submitted to and approved by the U. S. Office of Education, it contains the null hypotheses that there is no significant difference between a climate-controlled school and a nonclimate-controlled school (a) in the cost of maintenance and depreciation, (b) in certain educational outcomes when certain other factors are controlled, and (c) in the incidence of certain physical illnesses and psychological problems.

Under Public Law 531, the U.S. Office of Education agreed to supply $57,000 to help us carry out the three-year study. Our research project is entitled "An Evaluation of Climate Control as a Contributing Factor to an Effective Educational Program." This is a three-year study in which we are examining compactness combined with climate control, versus the campus or wing-type school with natural and mechanical ventilation.

With the project begun, we received further assistance from the School Facilities Council and our County Board of Health. Also, while the results of the first year of research were being accumulated, the American Society of Heating, Refrigerating, and Air-Conditioning Engineers supported an extension of the actual field research for an additional year. The research project began in October 1960.

COMPARISON OF THE TWO SCHOOLS

The floor plans of the two schools compare well in terms of area. Figure 1 presents a comparison of the two schools. Areas allotted to functions within the schools are very similar. According to definitions of the American Institute of Architects, the gross area of Oak Grove is 70,481 sq. ft. and that of Pinellas Park is 74,678 sq. ft. Details on areas and costs of capital investment have been reported in the June 1962 issue of the ASHRAE Journal.

These research schools include the 7th, 8th, and 9th grades. This age group is flexible and highly adaptable, yet the students are in a highly difficult transition period, that between elementary and senior high school.

Pinellas Park School

Let us consider some construction points of Pinellas Park, the pod-type, nonair-conditioned school. This plant has a mall that serves as a central gathering and traffic area between each two pods of eight classrooms. The malls connect with walkways leading to the gymnasium, cafeteria, auditorium, and library sections. There is an abundant use of glass on all sides of each classroom pod. The bottom third of each window is opaque.

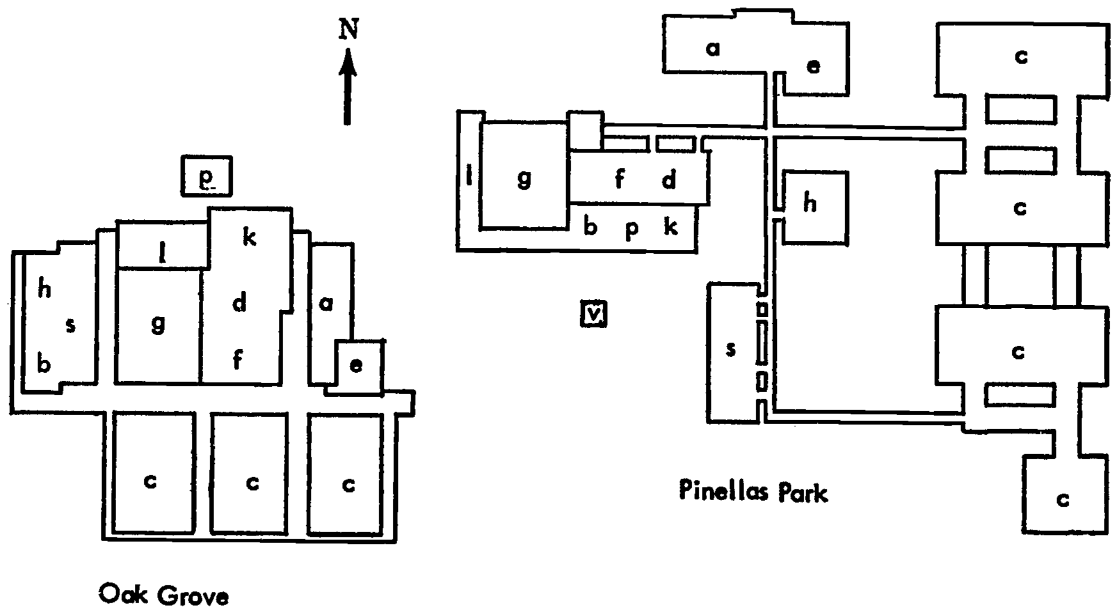

Figure 1 -- Plans for the Oak Grove and Pinellas Park schools show (a) administration area; (b) band area; (c) classrooms; (d) dining facilities; (e) library; (f) stage; (g) gymnasium; (h) home economics area; (k) kitchen; (1) lockers; (p) power plant; (s) shop; (v) electric vault.

There are eight duplex classrooms in this building. A duplex is two standard-size classrooms divided by a folding door providing excellent acoustical protection. Two teachers may work separately with their students, then push back the door and unite the groups for an experiment or an audio-visual presentation.

The standard classroom contains approximately 750 sq. ft. The ceiling is exposed, with prestressed concrete beams. In each classroom are 2 ft. x 6 ft. louvered skylights. In each corridor, serving two regular classrooms and one duplex room, are two plastic sky domes and a 4-ft. exhaust fan.

The Pinellas Park industrial arts building contains a typical junior high school shop in which are taught woodworking and a small amount of craft work. This building is amply skylighted, and has two-foot windows on the east and west, along the entire length of the building.

The gymnasium-auditorium building is unique. Starting at the west end, first are the shower rooms, then the gym bleachers and the gym floor. Next, there is a 60-ft. door opening into a teaching auditorium seating 200 students. Beyond the auditorium there is a stage 15 ft. deep, and another folding door which opens into a cafeteria seating 400. This is used for assemblies, testing, PTA meetings, and community events. This building can be opened for its entire length and accommodates 500 people.

Oak Grove School

Oak Grove Junior High School is the compact, climate-controlled school. From the east, a solar screen protects the classroom mall along the first set of four classrooms. As we move north along the east wall, we next find a student entrance and at its right is the library. Beyond the library is the administration section entrance and at its right is the library. Beyond the library is the administration section entrance and to the right of this are offices and teacher work areas. The main office of this school is an attractive center, well-designed for accessibility to other offices. As in Pinellas Park, the classrooms are approximately 750 sq. ft. and there are single and duplex arrangements. In each classroom is a unit ventilator opening into a chaseway running the length of the building. The chaseway supplies fresh air and carries all piping and wiring. Since this was our first air-conditioned building, we may have used more glass than necessary. We also left operators on the lower sections of the windows. The ceiling has glass fiber acoustical tile with 4-in. mineral wool batts above it, a 9-in. dead air space, and a built-up tar and gravel roof. Ceilings throughout this school are 9 ft. 4 in. high.

Students use a main east-to-west mall that is 32 ft. wide, as well as 12-ft. halls leading south into the classroom areas. Leading north from the main mall are two 22-ft. malls serving the administration, cafeteria, gymnasium, shops, and teaching auditorium. There are lockers along the walls of these passageways. Students can go to their lockers and change classes within three minutes. An evacuation of the school in emergencies takes only 42 seconds, since all malls lead directly to the outside. Students do not get wet on stormy days during class changes, as they do in the traditional building. In addition, at the end of each classroom hall is a covered bus-loading area.

All passageways have ample 4 ft. x 4 ft. plastic sky domes. There are 88 of these in the roof of this school, which has four different elevations. None of the passages is air conditioned, so there is little effect on cost of operations from allowing so much sunlight into these areas.

A separate building at the north of the plant houses the cooling and heating equipment. We have learned to allow ample room in the equipment centers, as a means of labor saving, both in construction and in service. The cooling equipment consists of two 60-ton condensers driven by gas-fired engines. Another 60-ton unit will be installed as enrollment expands to 1,200 students.

Hot water for the cafeteria, showers, and heating is supplied from a gas-fired boiler. For heating and cooling, water is circulated to the units by a two-pipe system.

MECHANICS OF THE RESEARCH PROJECT

The recording of temperature and humidity is basic to the entire project. We therefore installed three inside instruments and one outside instrument at each school to constantly record temperature and relative humidity. The charts in each of the instruments are changed every morning. These are collected periodically, interpreted, and a tabulation rendered. Eight recordings a day per instrument are retained, and these findings are converted into wet-bulb temperature-humidity index and effective temperature. An attempt will be made to arrive at a new index of temperature-humidity conditions to describe the junior high school physiological environment. This index will then be related to other phases of the study.

As well as keeping daily temperature and humidity records, we developed a record system to let us know how fully a school is utilized. There are many benefits to be derived from such a record, especially the provision of more accurate design figures for our architects and engineers.

The educational program required a firm base in order to ascertain the gains, if any, within the schools. In four academic areas, committees of teachers were selected to develop study guides. These guides encompass the junior high school curriculum in our school system of 106 schools. The 140 teachers concerned with the project use the guides to keep close together in their course content.

Several commercially-produced tests of achievement were analyzed to see how well they would measure achievement in the curriculum called for in our study guides. The Metropolitan Battery was selected, with the provision that a local supplement be constructed to fill in the untested areas of our curriculum. To cover the testing schedule, we have used alternate forms of the Metropolitan, and have developed five forms of the local supplement test. This battery of tests is given at the beginning and at the end of a school year at both regular and summer sessions.

This research project attracted much attention. We have had thousands of visitors tour the project. Some who have been contemplating air-conditioned schools in their own systems have spent three or four days with us. An instrument was designed by which we could obtain an estimate of the reactions of randomly selected visitors to both types of school environment, in order to allow us to arrive at an objective analysis of the impact of the schools on the visitors, as well as a definite analysis of the 11 items the visitors are asked to scale.

During the eight months prior to the beginning of actual research, trial data indicated that we needed another nonair-conditioned control school to give us a larger school population. The control school selected was Tyrone Junior High School, a recently constructed finger-type school. This school has about

1,500 students whose past achievement scores compare favorably with the students at Oak Grove. The addition of Tyrone to the study brings the total student population to 3,500. This allows for the inclusion of many more cases in various parts of the research, when we need to match groups of students with those in the experimental school, Oak Grove.

FACTORS OF STUDENT HEALTH AND COMFORT

Other parts of the study deal with student health, use of the clinic, absenteeism, and discipline. The responsibility for collecting this information has been assigned to professional personnel in each school. Health data are reported weekly, and graded into 44 different types of absenteeism. Provision is made for recording frequency of absenteeism by sex, grade, and duration. In addition, a card is made for each student who has three absences for the same illness. The nurse then visits the home of that student and obtains a history of the ailment. Reviews of this information will be checked for possible connection with the classroom environment.

It was theorized that during the hot months there would be fewer disciplinary problems at the climate-controlled school. Therefore, daily records are kept of infractions of discipline according to 18 classifications. These data are also recorded in terms of grade and sex, with additional data on whether the infraction occurred before, during, or after lunch. The division by time of day is to satisfy an often-expressed theory of educators that discipline infractions will be fewer in the afternoon in a climate-controlled environment.

Within the three schools a voting form is completed by students selected at random throughout the day, all during the school year. Students complete this form in about a minute by circling one letter on each scale to indicate their vote on temperature and humidity as it exists at the time of voting. Actual room conditions are obtained at the time of voting by the use of a sling psychrometer.

FINDINGS TO DATE

So far, we have issued one project report on capital costs, which was printed in the June 1962 issue of the ASHRAE Journal. The gist of that report is shown in Table 1.

By the standards of the American Institute of Architects, the area cost was a little higher at Oak Grove for a completely equipped, air-conditioned building, but on the basis of cubic feet the cost was less. Locally, we extend these definitions to include the double-loaded corridors at full value. According to this calculation, the climate-controlled school was considerably less expensive in terms of both area and volume. The per-student figure is only another way of presenting unit cost.

TABLE 1 -- COMPARISON OF CAPITAL COSTS[1]

Treatment of Data	Oak Grove		Pinellas Park	
	Sq. Ft.	Cu. Ft.	Sq. Ft.	Cu. Ft.
AIA gross area definitions divided into costs	$9.92	$0.582	$9.56	$0.618
AIA definitions plus all double-loaded corridors at full value	9.10	0.540	9.42	0.610
Same as (2) above, plus roof overhang at 1/3 value	9.08	-	8.99	-

[1] Based on the design capacity of 930 students in each school, the cost per student at Oak Grove was $751.77, and at Pinellas Park, $767.58.

In addition to the original research project, we are conducting many side studies. Our accumulation of data is great and, for some of these data, we are depending on consultants to devise methods of data-processing and analysis. One of our most important rewards is in the thousands of visitors who exchange ideas with us and compel us to be thoroughly versed in what we are doing, in order to be able to answer their many questions.

At this time, only vague findings on other sections of the final report are available. Analysis of the summer school and full year of school operation shows a surprisingly low operating cost for the climate-controlled building. We had to take into account an extremely mild winter in which there were only approximately 15 days when any heat was required at Oak Grove. On some of these days, only enough heat was used to take the chill and dampness out of the air. The total cost of 12 months' operation at Oak Grove was $37,075.26, and at Pinellas Park, $38,203.73.

There is much similarity in the costs, even though both of these schools were designed for 930 students. These figures include a six-weeks summer school held at Oak Grove, which Pinellas Park did not conduct. During the regular school year, Oak Grove had approximately 800 students, and Pinellas Park about 1,100.

Of the given total costs of operation, energy costs and Btu's consumed for 12 months are shown in Table 2.

TABLE 2 -- ENERGY COST AND ENERGY CONSUMPTION FOR 12 MONTHS OF OPERATION

Energy Source	Oak Grove		Pinellas Park	
		(Btu's)		(Btu's)
Natural and LP gas	$2,174.98	2,680,000	$2,399.83	1,237,209
Fuel Oil	-	-	1,072.77	1,349,426
Electricity	7,135.96	787,353	6,471.06	759,102
Total	$9,310.94	3,467,353	$9,943.66	3,345,737

And, finally, these data are expressed by factors, as shown in Table 3.

TABLE 3 -- FACTORS OF 12 MONTHS' TOTAL COST OF OPERATION

Dividing Factors	Oak Grove	Pinellas Park
Design enrollment	$39.87	$38.59
Average daily attendance	50.37	34.70
Square feet	6.00	5.56
Cubic feet	.034	.035
Man-hour-use	.037	.027
Cu. ft. per design student	32.02	34.86

Here we have broken down total costs, since architects, engineers and school administrators might want to see the costs presented in different units. The final report will carry all of these data much further, and include the third school, Tyrone.

The achievement data for the first six-week summer school show a trend, the degree of which is not yet firmly established, in favor of the climate-controlled building. However, until the data are fully processed, we may not make conclusive statements concerning their significance.

The Pinellas County Board of Public Instruction is overwhelmingly in favor of air conditioning for our schools. Our building program calls for more than 200 new classrooms a year, and these will be designed for air conditioning, with some equipped initially and others later. All of our major school plants now being built and in the future will be completely climate-controlled. Our research and observations have indicated that we can build and operate these schools at less expense than traditional schools. I am convinced that the educational values and other factors such as discipline, attendance, and teacher and student morale, are greatly enhanced in the schools which are now air conditioned.

School Facility
Design, Equipment, and Services

School Environments Research and Evaluation of Windowless Classrooms

By C. Theodore Larson, University of Michigan

Abstract: How various environmental relationships affect learning is a source of concern to educators. A yardstick to indicate the comparative effectiveness of different school environments is needed. This paper presents a preliminary report on a case-study of two schools: one with windows, the other without. The effects on learning, if any, of windowless classrooms are being studied in order to compare the relationship of school fenestration with other environmental relationships so that a relative scale of environmental values in education may be obtained.

THE UNIVERSITY OF MICHIGAN, on a part-time basis for the past two and one-half years, has been exploring the question of how the learning process is affected by different school environments. This is an interdisciplinary study which is known on the Michigan campus as the SER or "school environments research" project. It has been supported by grants from the Ford Foundation's Educational Facilities Laboratories, Inc.

SEARCH OF LITERATURE

The study began with a review of the literature. Some 700 publications dealing with different aspects of environment and human behavior were selected and put into summary form. Most of these references describe laboratory experiments rather than actual learning situations. Very few treat a "space" or environment as a totality which can be controlled or modified for the benefit of its occupants and their activities.

Considerable information is available as to the effect of light, temperature, sound, air composition, and air movement on human comfort. Meteorological research is giving us knowledge of weather-and climate-control. Indeed, if the prevailing environmental conditions are known, both indoors and outdoors, it is easy to predict whether teachers and children will feel comfortable or uncomfortable and then make the adjustments needed to achieve the desired level of comfort.

The significant question, however, is not how physical comfort is affected by environmental variations, but what effects variations in physical comfort may have on learning. This is still a matter

LARSON, C. THEODORE. Professor of Architecture, University of Michigan; member, American Documentation Institute, American Institute of Architects, International Society of Biometeorology, BRI.

of conjecture. When this question is asked, it usually provokes a suggestion that some discomfort may perhaps be essential for a "good" learning environment. If, as is often said, children are made too comfortable, then they may be put in a mood that is not conducive to serious classroom work, but no one really knows whether this is true.

There is little agreement among educators and psychologists as to what constitutes the learning process. Even specialists concerned with programmed learning treat the process as something which can only be interpreted in light of its consequences.

EVALUATION AND MEASUREMENT TECHNIQUES

We directed our attention to the need for developing a technique whereby the various environmental relationships that may affect learning in the classroom can be readily identified, and their relative importance measured and appraised.

The hope of the project staff is that we will be able to devise a yardstick to indicate the comparative effectiveness of different school environments. Implicit in this hope is the concept that any controlled environment is not an end in itself, but a means to an end--the facilitating of the activities or tasks being performed within that environment.

In trying to establish a measuring and evaluation technique, we think we have made some progress. It is generally agreed that "total environment" must be defined in the broadest sense. Not only is there the physical spectrum, embracing factors such as light, heat, and sound, but there are also environmental factors represented by people themselves; for example, contrast the environmental difference in a room that is sparsely occupied with one that is crowded.

How people are organized in their ways of living also makes a difference, for the structure of society varies throughout the world. Nor can the differences in the way people think be ignored as an environmental influence. Moreover, there is the factor of time to be considered, for every individual carries within himself, as an environmental influence, all of his own prior experience. Our perception of environment is conditioned by how well we have learned to perceive, and by what we already know about a particular environment.

There is little that cannot be included within the concept of "total environment." Development of a frame of reference to permit all possible factors in any pertinent environmental relationship to be singled out for critical study is one of our principal project aims.

The analysis does not stop with a definition of environment, however. Every environmental relationship involves an individual who is affected by the environment while performing a specific task or activity, and the range of possible tasks and activities is very wide. Consider how many types of students there are, and how many different learning tasks they perform. Presumably, for each learning task there is an "ideal" environment, with precise dimensions and conditions that we should be able to specify. What may be "ideal" for one activity or type of student may not be "ideal" for another.

From this point of view, with an infinite number of relationships demanding investigation, the problem of environmental evaluation would appear beyond any hope of solution, even with the aid of computers. Fortunately, however, what is being studied is the relative importance of various environmental relationships, and although there are many different relationships that could be investigated, they are obviously not all equally important. Some have little significant effect on the learning process, and can safely be dropped from consideration. Others appear important, and should be the subjects of comparative study.

THE CASE-STUDY APPROACH

We have concluded that there should be a series of case-studies to permit certain specific environmental relationships to be singled out, and their effects on learning contrasted and evaluated. From such a comparison, we should be able to determine which environmental conditions have the highest educational significance for different types of students engaged in different learning activities. In this manner, we ultimately obtain a scale of environmental values that will facilitate the design and planning of more desirable educational facilities.

The first case-study selected for analysis and evaluation involves windowless classrooms. Our literature search revealed no data as to what effects the lack of a view of the outdoors might have on classroom learning.

In the neighboring town of Wayne, there were several elementary schools that could readily be transformed into windowless buildings without becoming architecturally offensive. These units were erected experimentally as a demonstration of demountable space-frame schoolhouse construction. The Wayne School Board and the local superintendent of schools consented to let us use two of these schools for our case-study.

One, the Mann School, is the control unit, while the other, the Hoover School, is the test unit, the only one in which the windows are being changed. Both are "feeder" schools. They serve as adjuncts to larger elementary schools and provide instruction for kindergarten through grade three. Each has four classrooms, a multi-purpose room, a teachers' room, toilets, and utility spaces. Each is in a similar neighborhood and has the same architectural appearance, and the same type of occupancy.

In this case-study only a single experimental variable, the fenestration, is being manipulated. All other factors are kept as constant as possible. The objective is to find out, after the children in the Hoover School have been without an outside view for one entire school year, whether there has been any detectable difference in their learning achievements, so far as such achievements can be observed and measured in several different learning activities. The rate and level of learning in a windowless environment will be compared to those which prevailed when the classrooms had outside views. The main reason for using the Mann School as a control unit is to be sure, in case there are detectable differences in learning at the Hoover School, that these cannot be attributed to causes other than the elimination of windows.

The teachers in each school have been surveyed to find out what they like and do not like in their school environments. Various environmental factors are specifically covered in the questionnaires. Pupils in the Hoover School have also been queried as to their individual likes and dislikes. For both schools, there are complete records on each youngster's learning ability and achievement, so it should be easy to compare previous performance against what they may do during their windowless experience. The collection of data on personal likes and dislikes involving the school building constitutes an effort to find out whether there is a correlation between environmental attitudes and actual learning performance.

Windows in the Hoover School were eliminated this past summer. Figures 1 and 2 provide "before" and "after" views and show that what was previously the window wall in each classroom has now become a "working" wall. Opaque panels of asbestos-cement were substituted for the existing, transparent panels of dark-tinted, glare-reducing plastic. On the exterior, new surfacings have been applied to the wall studs to give a double-thickness wall similar to the other existing walls. Each teacher was asked to specify what she wanted for the new wall treatment in her classroom. The kindergarten and first grade teachers requested more tackboards, while the second and third grade teachers asked for more chalkboards and shelving for storage of books.

Except for the elimination of windows, the individual classrooms remain much as before. Each has a completely luminous ceiling. To compensate for the loss of daylight, fluorescent lamps were installed in the roof-ceiling plenum. Since the window walls had ventilating sashes which have now been eliminated, it was necessary to devise a ventilating system for each room. Separate exhaust fans were installed in the roof-ceiling plenum, and fresh air is pulled in from outdoors through the central air-intake of the school's warm-air heating system on hot days, when this system is not operating. An effort has been made to match the earlier environmental conditions, but it has not been possible to do so exactly. For example, the transmission of heat between indoors and outdoors is now quite different, but this is an inevitable consequence of substituting opaque walls for the transparent window walls.

Figure 1 -- Interior of Hoover School classroom before window removal.

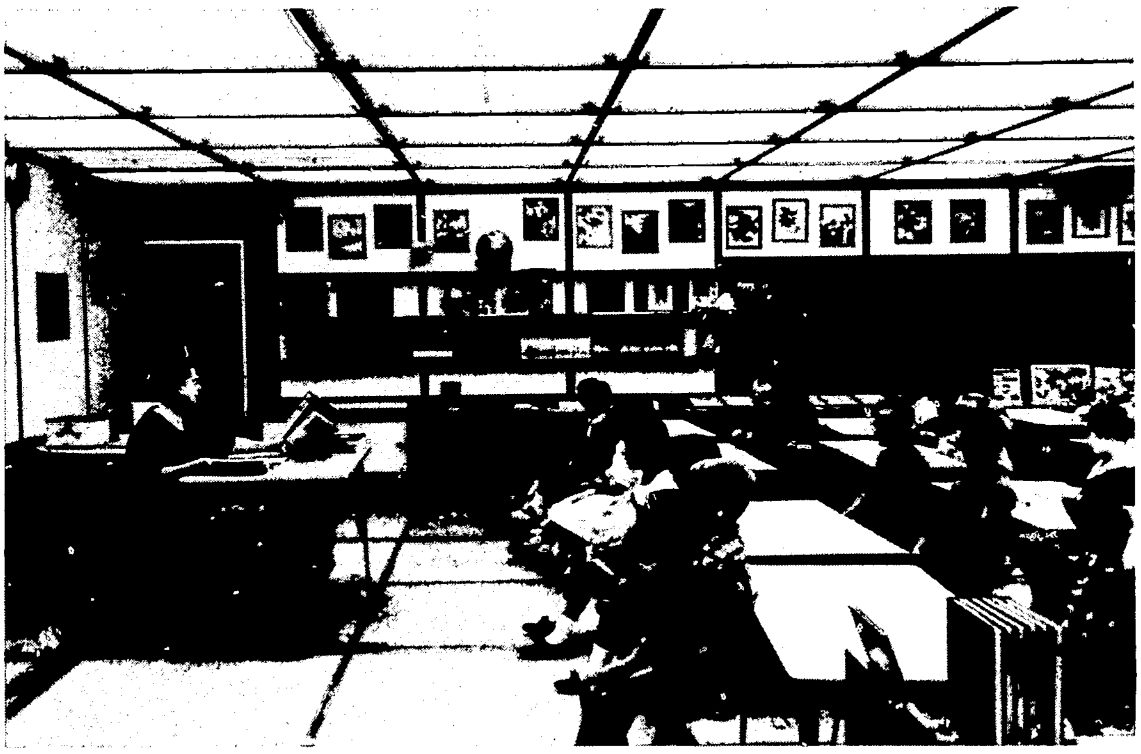

Figure 2 -- Interior of Hoover School classroom after window removal, showing additional wall space and illuminated ceiling.

POSSIBLE PSYCHOLOGICAL EFFECTS

The big problem troubling the project staff is what psychologists call the "Hawthorne effect"--the possibility that teachers and youngsters may become self-conscious, and react in a manner different from their behavior under normal circumstances. There is a curiously widespread local fear that the children may become psychopathic without windows through which to stare. All parents of children in the Hoover School have been reassured that if there is any sign that any youngster's health is being impaired the case-study will be immediately called off.

Every effort is being made to keep the educational routine the same as in earlier years. Three of the four teachers at the Hoover School are new this fall; however the kindergarten teacher continues as before. This turnover in teaching staff is not unusual, and it did not occur because the school windows were to be removed. At first we were disturbed by this change in teachers but, on second thought, we saw that the turnover might even be an advantage, insofar as it serves to minimize the possiblity of a Hawthorne effect. The children would normally get different teachers as they move to a higher grade. The teaching programs and the teaching methods have not been changed, so in all other respects, the classroom environments remain the same for each youngster.

Whether there will be a Hawthorne effect of serious proportions in this case-study is still being debated by the project staff. Some contend that the turnover in teachers has minimized the possibility on the teaching side, and it is the teachers who will be the primary observers of learning performance. On the learning side, it is believed that the children are too young to be concerned that they are being observed, and any Hawthorne effect would therefore be of short duration.

If any Hawthorne effect does occur, there should be no great difficulty in coping with it. By restoring the school fenestration, the learning achievements of pupils in classrooms with windows would be observed and compared with those recorded during the windowless stage. In theory, any Hawthorne effect occuring in one stage would be cancelled out by its equivalent effect in the next stage. Since the restored-window stage must also run for at least one full school year it will be in the latter half of 1964 before the case-study is completed and a report on findings can be ready for release.

Historically, windows have been needed in buildings to provide illumination, ventilation, and views of the outside. In the Hoover School they are not needed for the first two reasons. Whether they are still needed because a view of the outside is desirable for certain learning tasks or activities is what we are trying to determine. If windows are desirable, then we want to know whether they are highly important, or just a minor element in the scheme of the things affecting academic education. This implies making a comparison of the relationship of school fenestration with other environmental relationships, in order to establish a relative scale of environmental values in education, an undertaking that will take us far into the future.

At best, this study can give us only a preliminary and limited answer. We think our findings will be indicative, but they will not be conclusive or complete. We are dealing with just one small school in one small town. There are other schools in other communities with other levels and types of instruction that should be studied in the same fashion. The main significance of this study lies in its demonstration of an analytical procedure which we hope will be helpful in formulating a broader base of assumptions calling for still further research.

SUMMARY

At present, no one knows definitely how learning is affected by environment. Until we do, innovations in school architecture will continue to be an empirical application of unsupported suppositions and professional prejudices, an accumulation of architectural and educational folklore, tempered by only a few hard facts.

If school architecture is to have a scientific basis, then we must develop a method for evaluating the effectiveness of different school environments on a comparative basis, and in line with desired goals.

One fact is quite clear. In establishing an environmental yardstick, we must treat the environment as a totality, not as a series of fragmented and isolated factors. Just as specific terms have been coined to serve as units of measurement for the individual aspects of environment, e.g., foot-candles of light, Btu's of heat, decibels of sound, man-hours of work, there should be a term to indicate the effectiveness of the total environment. This would permit any particular school environment to be evaluated according to an established scale of desired quality. What this unit of measurement for the total environment might be called, we do not profess to know; the labelling problem is one that probably is best turned over to the experts in communication.

Speech Isolation Problems in Schools

By B. G. Watters and W. J. Cavanaugh
Bolt Beranek and Newman, Inc.

Abstract: In modern schools and other buildings, speech privacy has become more of a problem than ever becau. of lightweight construction and flexibility of space. Case histories of speech privacy show that the transmission loss rating is only one of the factors to be considered. Other factors are source room size, source room speech use, background noise level, noise reduction rating of sound-isolating construction, and privacy requirements. A design tool, the Speech Privacy Design Analyzer, has been developed to eliminate the gross errors that can result from conventional design techniques. A field study used to check the design tool is described in detail. Such a tool is needed, unless we can afford to over-design or to risk the lack of speech privacy.

SPEECH PRIVACY HAS ALWAYS BEEN A PROBLEM in buildings, but recent years have brought it to more epidemic proportions. This is basically due to the trend toward less expensive, lighter weight, structurally more efficient constructions. The increasing trend toward flexibility and expandability of spaces has made people more concerned than ever with speech privacy problems. Our firm has investigated a number of speech privacy problems in recent years, and we think we know fairly well how to diagnose and cure these problems. Many of the cases we have undertaken recently have been buildings on school campuses.

SOUND ISOLATION DESIGN

In choosing the partitions for a college administration building, it is necessary to find the least expensive construction which would satisfy acoustical and other requirements. Most designers would probably handle the sound isolation design in the following way. First, they would refer to a book on architectural acoustics and find a recommendation for the minimum average transmission loss between private offices. (Most books recommend values in the 35- to 45-decibel range for offices.) Next, they would refer to manufacturers' data on various products. Constructions whose ratings exceed the recommended value are acceptable; those whose ratings are less, are not.

WATTERS, B. G. Engineer, Bolt Beranek and Newman, Inc.; member, Acoustical Society of America, BRI; and CAVANAUGH, W. J., Architectural Acoustics Consulting Staff, Bolt Beranek and Newman, Inc.; member, Acoustical Society of America, BRI.

Does this procedure work? To answer this question, we have gathered data from a large number of case histories of speech privacy in buildings. The results, published in a paper in the Journal of the Acoustical Society[1] are shown in Figure 1. Each point represents at least one pair of rooms; the open points represent a group of similar rooms, such as a suite of similar offices or dormitory rooms. We estimate that the experience of 1,000 or more occupants is represented here. Their reactions are shown on the scale along the side of the chart. At the top of the scale are cases in which the building owner or occupant was seriously dissatisfied. At the bottom of the scale is that happy state where almost everyone is satisfied. Along the abscissa of the chart are listed the average transmission loss (TL) values such as you might get from Sweet's Catalog or from manufacturers' literature.

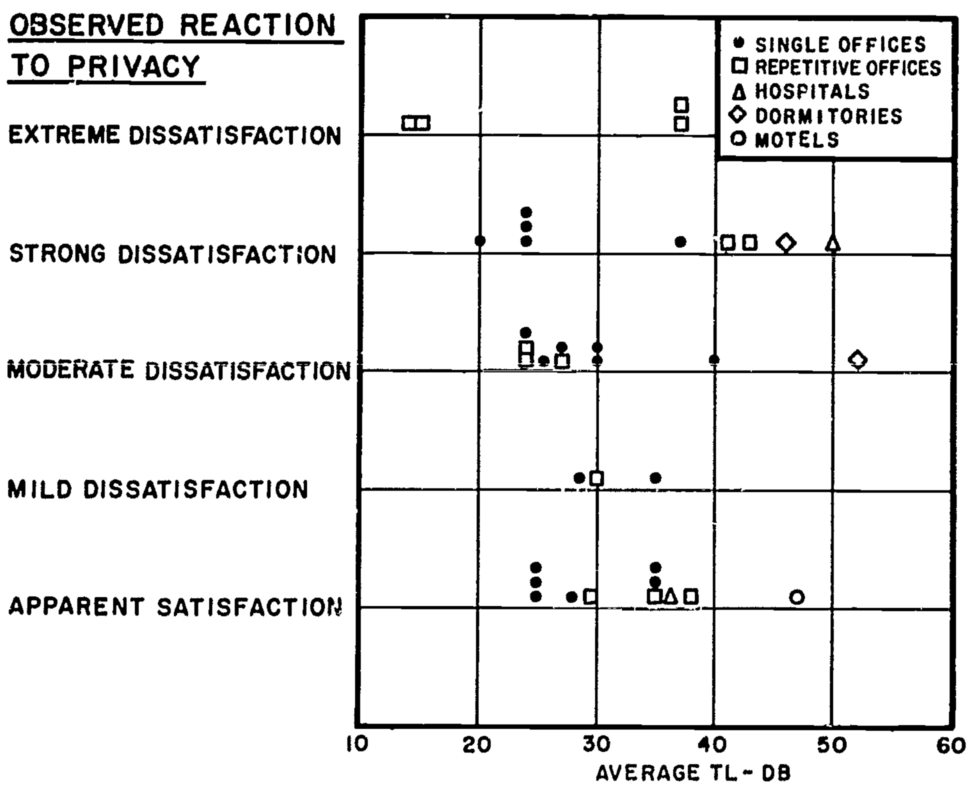

Figure 1 -- Case histories of speech privacy in which the observed subjective reaction is compared to average transmission loss of isolating structures.

How well might we have succeeded, using this design scheme? The answer is: not very well. We found that, of offices with partitions having ratings of 35 to 45 decibels, about as many were serious complaint cases as were satisfactory. What is even more perplexing is a group of offices with only 25-decibel partitions,

[1] Cavanaugh, W. J., Farrell, W. R., Hirtle, P. W., and Watters, B. G. "Speech Privacy in Buildings," Journal of the Acoustical Society of America, 34, April 1962, pp. 475-492.

but with happy occupants. Clearly, something is wrong with conventional design technique. We conclude that the transmission loss rating is only one of several factors which must be considered.

BASIC ELEMENTS OF SPEECH PRIVACY

In a typical speech privacy situation involving a pair of private offices, one of the occupants is talking in a conversational tone. The sound spreads through his office, and is partially absorbed by the carpet and the sound-absorbing ceiling. However, a small fraction is transmitted through the partition, where it spreads and is further absorbed by the carpet and ceiling in the adjacent room. In addition, the intruding speech has to compete with other noises in the room -- background noises coming in from traffic on the street and from an air-conditioning unit. However, the intruding speech may be strong enough to override the background noise and can be at least partially understood, causing annoyance in the adjoining office.

Obviously the transmission loss of the wall (or the ceiling, if the wall doesn't extend to the structural slab) is very important, but it is not the only critical factor. For example, if the talker's room is large, his voice will spread out and become weaker. If there is no carpet or sound-absorbing ceiling, the speech sound will persist longer and be louder.

If the talker is in a private office, we normally expect him to speak conversationally, since he will be speaking to people only a few feet away. If, however, he were in a conference room or classroom, we should expect him to raise his voice to be heard over a greater distance. The degree to which intruding speech sound spreads out and bounces around is to an extent determined by both the size of the room and the absorptive character of the room surfaces. Clearly, these factors must be taken into account in an accurate assessment of conditions necessary for speech privacy.

If two men in adjoining offices work for the same firm, there are probably few secrets involved in their office conversations. However, in another case, men in adjoining offices may be unaffiliated doctors or lawyers. Things are very different if confidential conversations are involved. In designing offices for college professors, no secrets are involved -- we simply want to prevent distraction. We call this design condition "normal privacy." On the other hand, in the case of the dean's office or the president's office, conversations should be strictly confidential. About 5 decibels more isolation should be provided for the dean than for the professors. A final consideration is the level of "city" noise coming in through windows, and air-conditioning unit noise. People rarely complain about noise of this sort; generally they are unaware of it. However, its existence is most important to the speech privacy problem.

SIGNIFICANCE OF OTHER FACTORS

Table 1 lists some of the factors already mentioned, as well as others important to speech privacy, and gives approximate effect (in decibels) they can have on the degree of privacy achieved. Fortunately, not all of these factors work against us in every speech privacy situation, but the magnitude of possible error that can be introduced if they are not taken into account clearly shows why there is such a scatter of reactions in Figure 1.

TABLE 1 -- VARIATIONS POSSIBLE IN USING "CONVENTIONAL" APPROACH TO SPEECH ISOLATION DESIGN

Factor	Variation
	(Decibels)
Neglect of background (masking) noise	30
Use of optimistic laboratory TL data (not representative of field installation)	15
Use of "average TL" rating	10
Neglect of Transmission Loss-Noise Reduction correction	5
Disregard of source room speech use	10
Disregard of privacy requirements (normal-confidential)	5

Returning to background noise, we see in Table 1 that the variations in background noise in different locations require a compensating variation of as much as 30 decibels in the sound isolation. To illustrate, we have recently studied the noise levels in restaurants, cafeterias and college dining rooms. Although most people never notice the noise in one of these eating places, the actual noise levels are quite high. Here, a degree of acoustical privacy without partitions may well exist.

At the other end of the scale, students in a college dormitory made strong complaints about poor sound isolation, claiming they could hear ordinary conversations through the walls. In this dormitory, the walls were constructed of 6 in. masonry block. The basic trouble was that the campus was in a quiet section of town, where there was little traffic noise. The rooms had no air-conditioning units to make background noise, so almost the only sounds heard in that building were the intermittent sounds made by the students themselves and they found them quite distracting.

For more usual spaces, the background noise in one situation may vary drastically from the level of another. This variation is one of the major reasons a particular type of partition construction may be very effective in one building and very ineffective elsewhere. Clearly, we need to be able to predict, and allow for, the background noise in the buildings we design.

FIELD STUDY TO CHECK DESIGN SCHEME

Having identified the factors important to speech privacy, one can put them together in a design scheme or tool. This has been done in a published design tool entitled the Speech Privacy Design Analyzer.[2] However, rather than describe the Analyzer, it may be helpful to describe a field study we did to double-check our design scheme. After all, we are dealing with the subjective response of human beings to a complex acoustical situation, and behavior observed in controlled laboratory studies may not be the same as in real life. We therefore obtained a complete set of data for each of the case histories mentioned in connection with Figure 1. In this way we determined the average long-term response of approximately 1,000 subjects to a wide range of acoustical environments.

Figure 2 shows the worksheet used to assemble the appropriate data. The left side is concerned with a physical description of the spaces and the subjective evaluation of both speech privacy and background noise. The right side is concerned with the objective acoustical description of the spaces involved, using rating techniques developed for each of the relevant parameters. The floor plan shown here, the acoustical description, and the subjective evaluations are for a different university dormitory than the one described earlier.

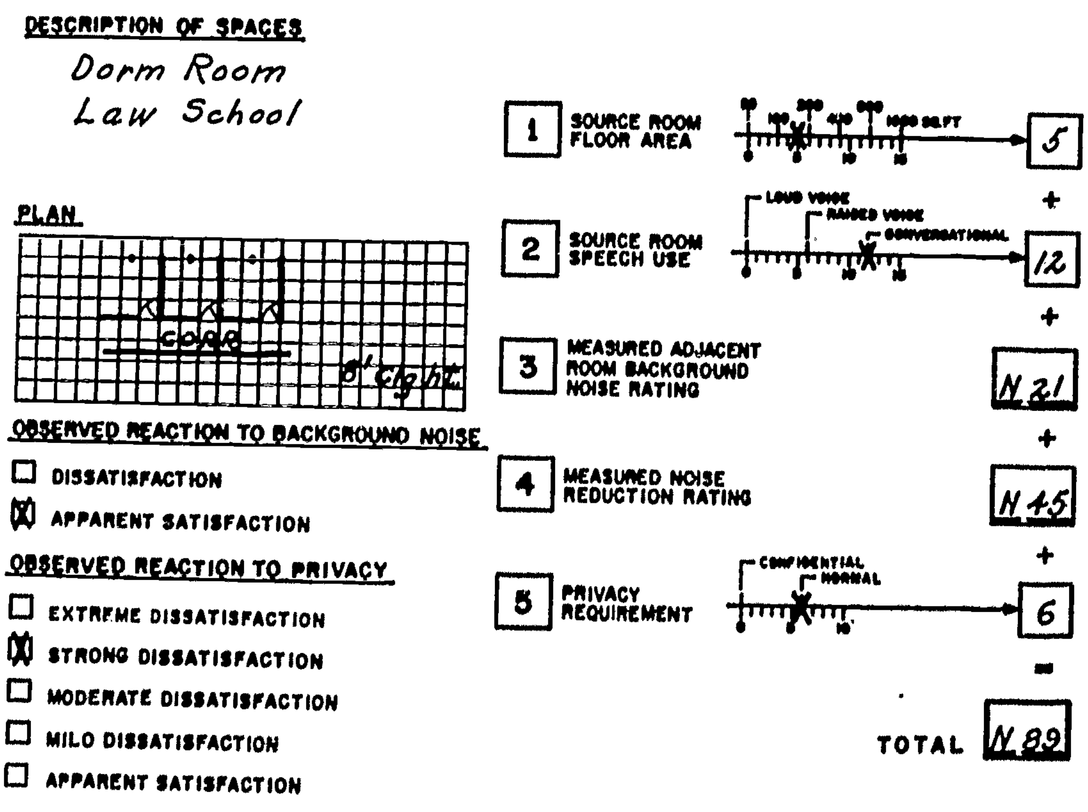

Figure 2 -- Worksheet for dormitory case history.

[2] Published in January 1962 by the Owens-Corning Fiberglas Corp.

In this case, the furnished rooms were approximately 180 sq. ft. in floor area and separated by 4 in. lightweight masonry block partitions. This same construction was repeated throughout several wings of the dormitory. This case history combines experience with about 200 rooms. The buildings were not mechanically ventilated and were located in a suburban area remote from traffic noise. The occupants had no complaint about background noise, but the speech privacy between rooms was far from acceptable. We rated the students' response as "strong dissatisfaction."

In the objective acoustical description on the right side of the worksheet, each important variable is taken into account, using single number ratings specifically geared to the privacy problem. The sum of these ratings provides a meaningful total assessment of the speech privacy situation. In Figure 6, we will show the degree of correlation between the totals for the case histories studied and their corresponding subjective ratings. For the present, we can simply say that the rating system is devised so that a higher total means greater assurance of satisfaction.

In Item 1 (Source Room Size) we account for the sound absorption of the source room, which is generally proportional to room size. The rating becomes larger as the source room size increases because, the bigger the room, the lower the reverberant speech levels. Therefore, a simple bar graph can be used to assign a single number rating. As can be seen, there is a 15-unit spread between small rooms and large ones. In this case, the room size makes a 5-unit contribution to the total.

Item 2 (Source Room Speech Use) is concerned with the level of speech in the source room. There is a spread of 12 units between conversational speech effort and a loud voice. Conversational speech effort was judged as typical of the dormitory usage and receives a rating of 12 units. Louder speech would contribute less to the total.

Items 3 and 4 (Background Noise Level and Noise Reduction Rating) are the two most significant factors affecting over-all privacy. Since background noise level and noise reduction vary significantly with frequency, more elaborate rating procedures are involved than simple bar graphs, in order to obtain a meaningful "single number" rating.

Here we are concerned with the role of background noise in providing masking, rather than causing annoyance. Therefore, the usual NC (noise criteria) curves[3] are not directly suitable for our purposes, since the actual background noise spectrum may not follow the NC curve near the entire frequency range of interest. An extension of the NC criterion concept, which does lead to a rating scheme useful in evaluating the masking effectiveness of

[3] As defined in the chapter on Sound Control in the ASHRAE Guide (American Society of Heating, Refrigerating and Air-Conditioning Engineers).

background noise, is shown in Figure 3. The NC-30 criterion is plotted in the five octave bands important to the speech privacy problem. Since this spectrum shape is so often found, we have called it a "normal" or "N" spectrum shape. Contrary to the NC criterion use, a data curve is rated N-30 only when it follows very closely the N-30 shape throughout this five-octave frequency range.

Often a noise spectrum will match an NC curve at low frequencies, but fall below it at high frequencies. Such a curve is also shown in Figure 3, and is called an "L" or low-frequency spectrum, since it matches the NC curve only at low frequencies. Similarly, the "H" or high-frequency spectrum matches the NC curve only at high frequencies. Finally, there is an "M" or mid-frequency characteristic which matches the NC curve only at mid-frequencies, i.e., in the 600-1200 cycles per second band.

It should be noted that N-30, L-30, M-30, and H-30 spectra all have NC values of 30. Thus, to the extent that the NC curves do not change their shape with level (a good approximation from about NC-20 to NC-50 in the five octave bands of interest), the proposed rating system consists of a number which is the NC rating for the noise, and a letter which identifies the tonal characteristic of the noise. Within a reasonable degree of accuracy, the number and the letter completely define the noise.

To use the characteristic noise curves to rate a particular data curve, one tries the characteristic curves, one after another, until the best fit to the data is obtained. The NC number and tonal characteristic letter are then assigned. The example for the dormitory case history is shown in Figure 4. For most situations, sufficient accuracy of fit can be determined visually. One adjusts for minimum absolute deviation in any frequency band. For a more precise fit, the characteristic and the data curves are adjusted until the decibel deviation multiplied by the weighting functions shown in Figure 4 are minimized for any band. The N-21 rating for the dormitory background noise spectrum represents a rather quiet situation and, in large measure, accounts for the severity of the speech privacy problem in this instance.

Item 4 (Noise Reduction Rating) rates the noise reduction of the sound-isolating construction, using a technique specifically tailored to fit the speech-isolation problem. Because of this restriction, the scheme can be made much more accurate than rating by a simple, average transmission loss. Figure 5 illustrates the rating method for the dormitory construction in the presence of an N background-noise spectrum. The dots superimposed on the noise-reduction plot symbolize the contribution to intelligibility of the intruding speech sounds in various frequency bands. If all of the dot-field lies about the noise reduction curve, perfect intelligibility may be expected. If none of the dots lie above the noise reduction curve, zero intelligibility should result. As shown, the dot field has been adjusted vertically so that about 10 dots,

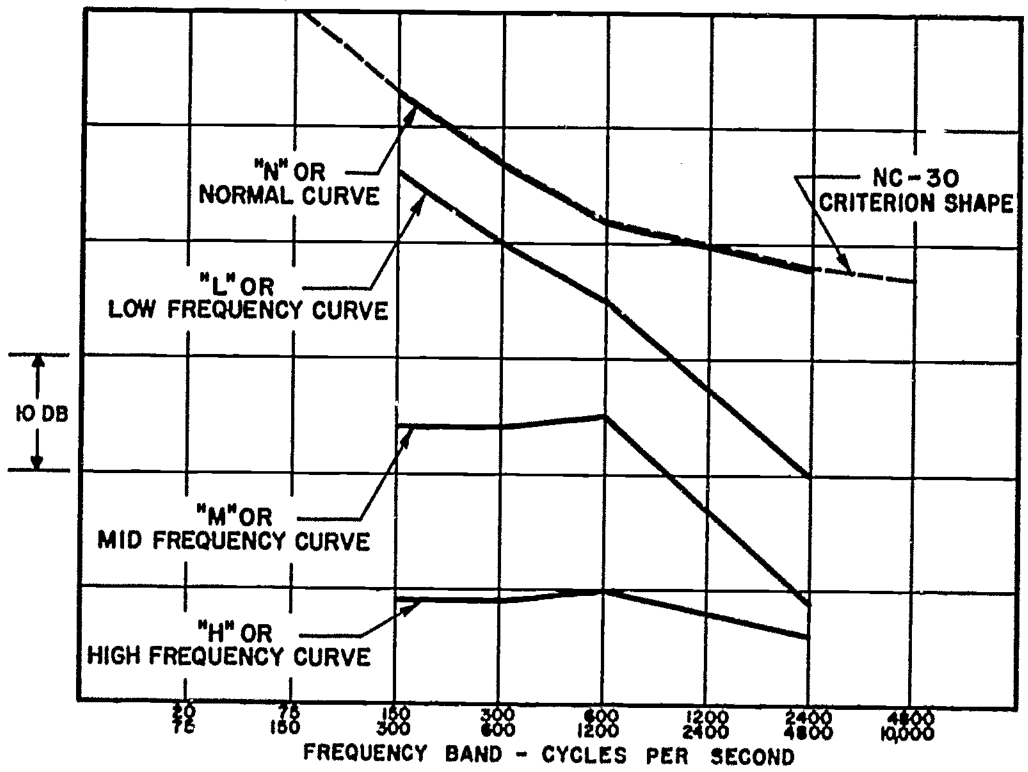

Figure 3 -- Characteristic background-noise spectra used in rating scheme.

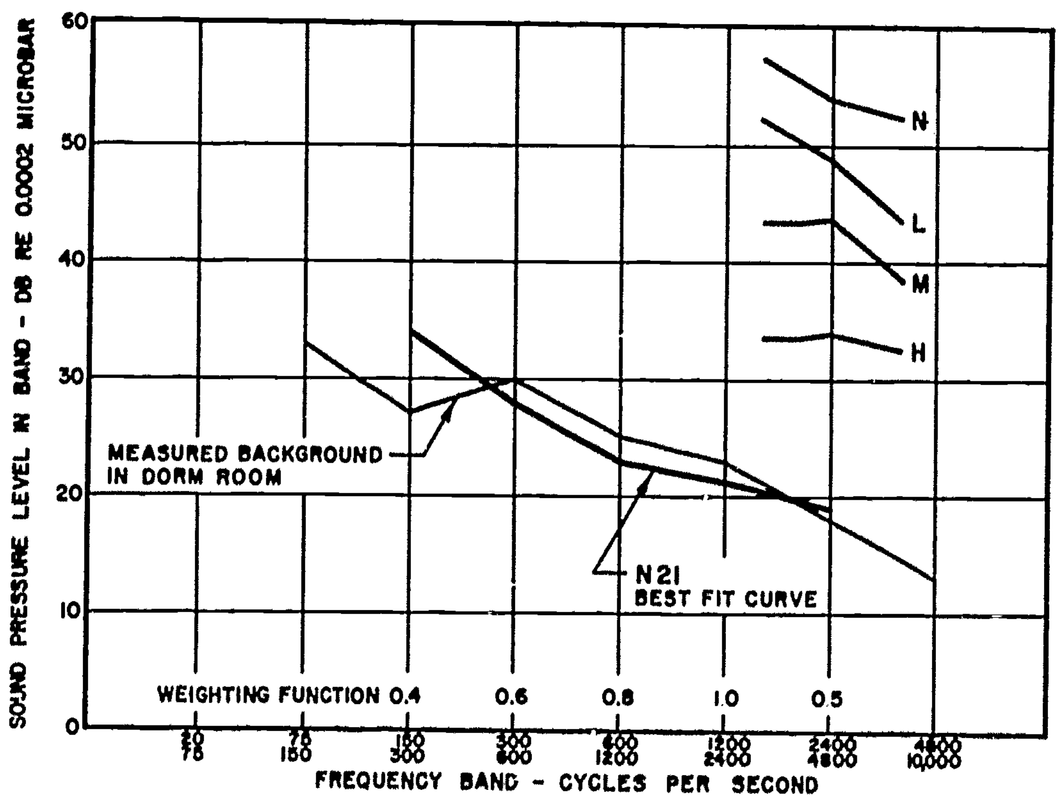

Figure 4 -- The "best fit" characteristic background-noise curve compared to actual measured data for dormitory room.

representing an articulation index (AI) of 0.05,[4] appear above the noise reduction curve.

The overall effectiveness of the sound isolation is seen to be proportional to the height of the dot field on the plot. The rating number applied to the particular noise reduction curve in Figure 5 is N-45. The letter N signifies that the articulation index has been calculated for a background noise with an N tonal characteristic; the number 45 is proportional to the height of the dot field, and thus, proportional to the structure's ability to provide speech isolation. It should be noted that 45 is not the average noise reduction at any particular frequency. Rather, 45 gives the relative "rank" of the structure in a scheme for rating both the problem and the construction required to solve the problem. Very effective structures will have a rating on the order of 60 or more; ineffective ones will be considerably less.

The frequencies which contribute to intelligibility in the dormitory example shown in Figure 5 extend from about 300 to 800 cps. At frequencies above 800 cps, the structure provides an excess of isolation. In fact, the noise reduction curve could have been considerably less in the higher frequencies without significantly affecting the rating number. The possibility of excess or unused noise reduction explains why the common "average TL" rating cannot accurately measure the effectiveness of a structure: a high "average TL" rating may be gained by high TL values in a frequency range that is not significant in decreasing intelligibility.

Item 5 (Privacy Requirements) rates the occupant's "degree" or need for privacy. That is, confidential privacy assumes that on AI of 0.05 is good enough. Normal privacy allows a little more intelligibility of intruding speech. In the case of the dormitory, normal privacy was judged to be sufficient; therefore, a value of 6 is given for this item.

The total of all of the numbers on the worksheet is 89. Figure 6 shows just what this means. Here, we have replotted all of the case history data. The dormitory is the diamond-shaped point about midway in the "strong dissatisfaction" category. The abscissa for this figure is the total of the five items on the worksheet. The ordinate is the observed subjective reaction. There is now a reasonably tight grouping of the data points about a line.

THE DORMITORY CASE HISTORY REVISITED

The dormitory situation, with a total of 89, needed to be improved by 10 to 15 units to provide greater assurance of satisfaction.

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[4] Intelligibility of about one phonetically-balanced word in 20, or one sentence in seven. Our laboratory studies revealed that most listeners felt this to be the dividing line between satisfaction and some dissatisfaction when carrying on confidential activities in the presence of intruding speech sounds.

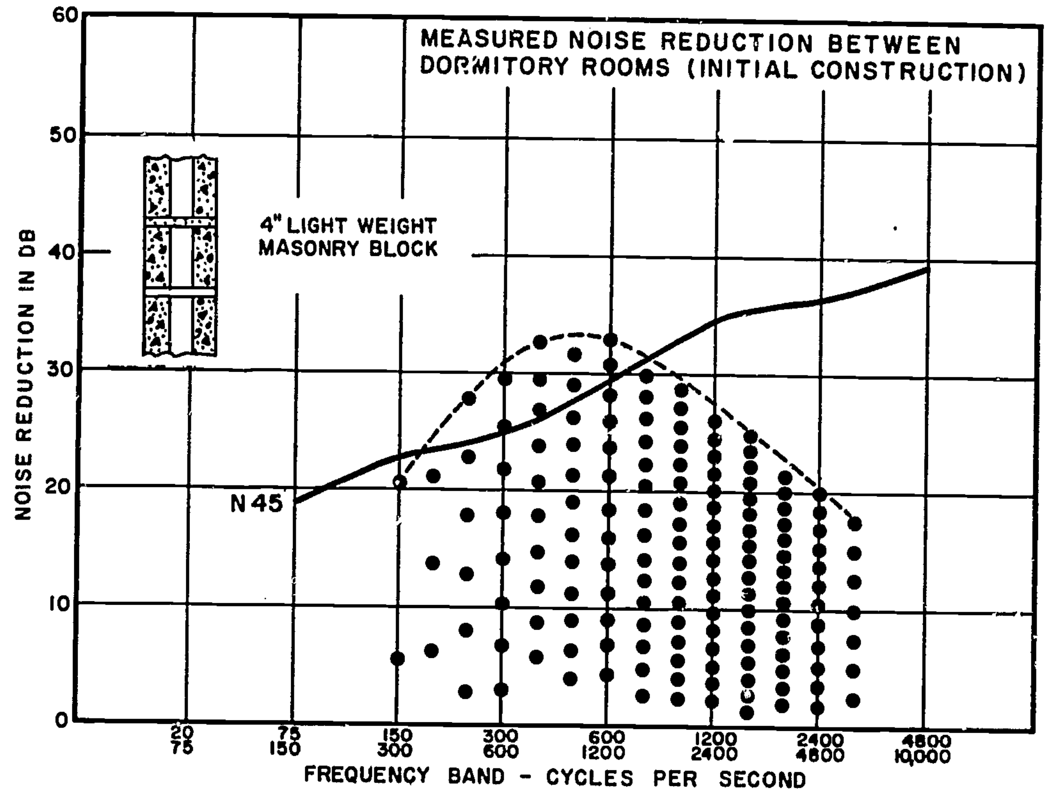

Figure 5 -- Room-to-room sound isolation (noise reduction) rated by superimposing dot field symbolizing speech intelligibility over the frequency range of interest.

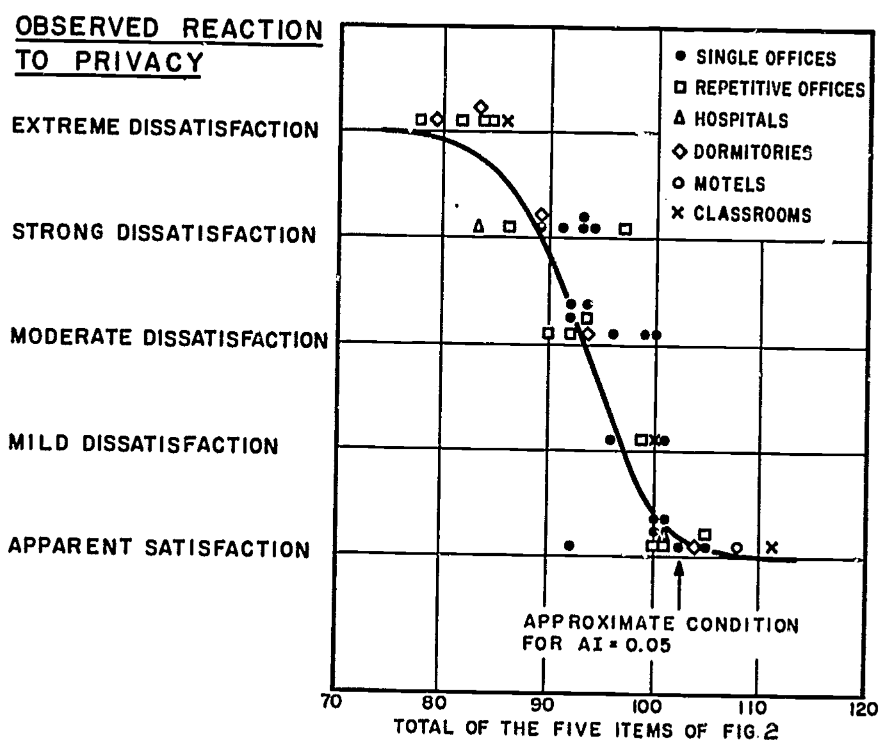

Figure 6 -- Case histories of speech privacy in which observed subjective reaction is compared to total speech privacy rating obtained from worksheet.

Only two of the five factors contributing to the total rating could be "improved:" the background-noise level (Item 3) and/or the sound-isolating performance of the partitions (Item 4). For example, the introduction of continuously operating ventilation units in the dormitory rooms could raise the background-noise level rating by the 10-15 units needed, or improvement of the wall structure would have an equivalent effect of raising the total speech-privacy rating.

Study of relative costs, and evaluation of other nonacoustic factors, resulted in the university electing the latter course. Figure 7 shows the measured noise reduction of the improved construction and the new rating. The addition of a dense plaster and gypsum lath "skin," supported on resilient clips from one side of the existing wall, increased the rating from N-45 to N-64. The increase in the total speech-privacy rating from N-89 to N-108 places the modified construction in what our studies have shown to be the "satisfactory" range.

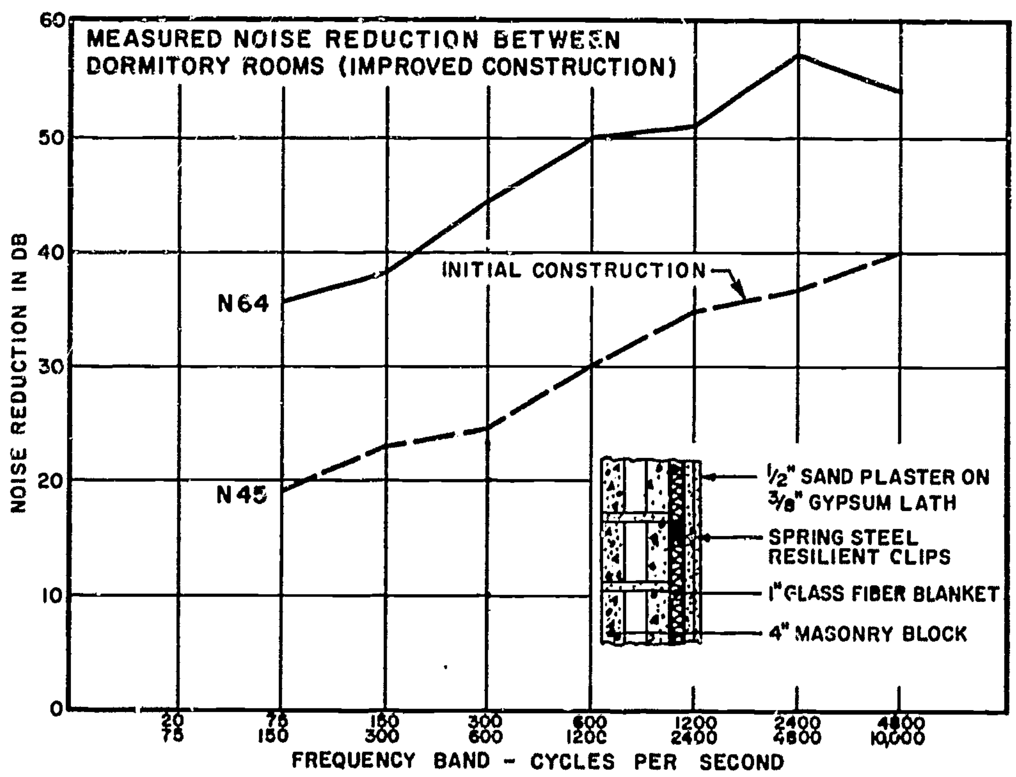

Figure 7 -- Comparison of measured noise reductions of initial and improved dormitory constructions.

DESIGNING FOR SPEECH PRIVACY IN ADVANCE

We have considered the analysis of existing speech-privacy situations. Hindsight is valuable but it is more important to be able to design in advance. The Speech Privacy Design Analyzer is a design tool intended to eliminate the kind of gross errors that can result from conventional design techniques. The Analyzer embodies the basic analysis and rating techniques described here. It allows the designer to assess his problem, taking into account all of the relevant parameters that affect speech privacy. It also permits him to select constructions from a large variety of manufacturers' products, all of which have been tested in the field or under simulated field conditions.

Unless we can afford to over-design, or prefer to risk taking chances, a comprehensive, relatively simple design scheme for speech privacy is clearly needed in this important aspect of noise control in schools and other buildings.

School Facility

Design, Equipment, and Services

Recent Experiences with Plastic Glazing for School Windows

By F. J. Rarig, Rohm & Haas Company

Abstract: The New York City public schools have experimented with plastics glazing in school windows in an attempt to reduce breakage. Most of the demand for plastics materials is for purposes of replacement of broken panes; however, a demand for such materials in new construction is developing. Plastics panels with the elements of endurance, glare reduction, and low heat transmission, as well as the ability to resist shattering in the event of an atomic detonation, have been experimentally installed. An evaluation is made of the performance of acrylic plastic panes, reinforced polyester panels, and butyrate sheets. As a result of the experimental installations, several plastics materials have been approved for glazing in New York City schools.

OUR EXPERIENCE WITH PLASTICS GLAZING in schools extends over a period of less than 20 years and involves but a small number and variety of installations. Such experience is inconclusive, but we assert with confidence that it indicates the future possibilities for plastics glazing in schools.

This paper will discuss the glazing of windows, and by glazing is meant the installation of a light-transmitting material in a frame, so that it will permit the transmission of light, but bar the transmission of weather. The materials employed in this process are "glazing materials."

Plastics glazing materials may be thin or thick. They may be clear and colorless, transparent and tinted, or translucent. They may be cast or extruded. They may be reinforced, insulated, or laminated, and there are double- and triple-glazed window assemblies available. Plastics glazing materials may be patterned, corrugated, or formed. Different forms and colors can be used to absorb or reflect solar heat, or to eliminate glare.

PROBLEMS OF INSTALLATION

There are two situations confronting us when we speak of glazing. One exists in new construction, and the other in old buildings. The problems involved in these situations are dramatically different. Traditionally, a builder installs glass at the earliest opportunity, in order to enclose his building. He does not protect the glass, except from breakage, because he can clean it later. One thing a builder must do, if he uses plastics for glazing, is recognize that

RARIG, F. J. Secretary, Rohm & Haas Company; member, American Bar Association, American Judicature Society, BRI, Federal Bar Association.

the surface must be protected as is the surface of any polished facing material. All plastics sold for this purpose should be accompanied by appropriate instructions for care and maintenance. Some are not easily cleaned, others are easily scratched, and the installer must be made aware of this.

Protecting surfaces is much easier in replacement glazing. The substantial demand for plastics glazing materials for schools is for replacement; however, a demand for such materials in new construction is developing. This is probably based, 99%, on three needs: to reduce breakage, to control glare, and to reduce heat transmission. The other 1% perhaps represents an awareness of schools as shelter areas for civil defense.

EARLY EXPERIMENTS

The earliest interest in plastics for glazing was exhibited by the New York City Board of Education in 1942 when it was thought that glass should be removed from areas in which people might be during an air raid. The small amount of plastics available for shelter area glazing in World War II was second-grade, clear material, and its performance was not outstanding. However, when interest in civil defense was rekindled by the Korean War, the Board of Education again turned to plastics as a means of eliminating hazards from flying glass.

Confronting the Board in the early 1950's was the problem of protection from atomic blast. School authorities were looking for a glazing material having the same blast resistance as the structure in which it was installed. Beyond this, they wanted a material which would not be hazardous when shattered. They asked for data showing the capacity of acrylic sheet to withstand a shock wave at various distances from ground zero of the detonation of an atomic bomb, and they also wanted data on the shattering characteristics of such a sheet under these circumstances.

Through the cooperation of the Atomic Energy Commission, a test was made of various glazing materials in the shock tube facilities of the Ballistics Research Laboratories at Aberdeen, Maryland. This investigation concluded that while, in the event of atomic attack, the hazard of flying glass may extend over an area of 200 sq. mi. the area of hazard could be reduced to approximately 7 sq. mi. by proper selection of glazing materials. It went on to state that acrylic sheet can withstand high pressure shock waves of long duration, and that it is feasible to protect against shattered windows at a distance from ground zero equal to that at which substantial structural damage will be done. It was also found that the shattering characteristics of acrylic sheet are such that damage from this source would be minimal.

The New York Board of Education was favorably impressed with this report, but by the time these data were available the atomic powers were equipped with the hydrogen bomb. This terror-weapon apparently convinced the Board that all of its shelter programming was now obsolete. In any event, it abandoned the civil defense measures which had been under consideration.

The Maintenance Division of the Board was still interested in using plastics to replace broken glass, in order to reduce the effects of vandalism. However, the legal status of plastics glazing was such that the Maintenance Division did not feel that it could use the material, and the interest of the Board was not sufficient to prompt it to seek approval for the use of such glazing in the schools.

In the meantime, the cost of replacing broken glass in New York City schools continued to mount until, by 1957, it was almost a third of a million dollars a year. There was also danger to pupils and teachers from broken glass, and discomfort experienced in the classrooms when broken panes were not repaired for two or three weeks. Ultimately, the teenage vandals did what the threat of war was unable to do, and the Division of Architecture of the Board of Education decided to reduce breakage. Representatives of the plastics industry were called in and asked to develop a program to demonstrate whether the use of plastics materials in place of glass could substantially reduce window breakage. This challenge was accepted, and the Division made available the ground floor on one side of Public School No. 279 in Brooklyn. Various manufacturers of reinforced polyester resins and acrylic sheet, and a manufacturer of butyrate sheet provided panels suitable for glazing.

The original idea was to put translucent plastics materials in the upper two panes of a four-pane sash, and glass in the two lower panes, but school officials decided to test the feasibility of eliminating protective grillwork from these first floor windows by the use of clear acrylic in the lower panes. Therefore, some of these panes were not adequately protected after installation, and many had to be polished in place to restore their appearance. Several were badly cut in an abortive attempt to remove paint and had to be replaced.

PERFORMANCE TO DATE

We had thought that clear panes of acrylic plastic located within easy reach of persons inside and outside of the school buildings would be damaged by contact with persons and objects. However, without the benefit of special maintenance, these panes are in good shape after more than four years of ordinary use and cleaning. The reinforced polyester sheets appear to be performing satisfactorily, although they are not quite as easy to clean as a perfectly flat sheet, because the surface is pebbled. The white translucent acrylic sheet looks as good as new and the smokey-gray transparent acrylic sheet is performing well. The butyrate sheet appears to have failed. It changed in color from blue to green, one pane was broken, and it has warped and does not present a pleasing appearance.

OFFICIAL APPROVAL FOR USE

The Board of Education was sufficiently well satisfied with the overall performance of this experimental installation to join with us and the New York City Building and Fire Departments in requesting the Board of Standards and Appeals to act favorably upon a petition to permit plastics materials to be used for the glazing of windows in school buildings. Because of jurisdictional requirements, the application had to name a specific material, and the material covered by the first application was an acrylic sheet. The Board ruled on October 17, 1961, that this particular acrylic sheet was approved, provided the height of the school building did not exceed 75 feet.

Subsequently, the Board approved several standard reinforced polyester materials for this use. The way has now been opened for general use of plastic building materials in schools in the City of New York.

Statistical Studies of Electric Heating in Schools

By Fred Nicholas and William L. Muschlitz
Pennsylvania State University

Abstract: There has been a rapid rise in the number of electrically heated schools during the last decade, but few large-scale studies of such schools. This paper reports a study of the annual owning and operating costs of 67 public schools built in Pennsylvania since 1955, both electrically heated and fossil-fuel heated. It is concluded that the owning cost per pupil per year is less for the electrically heated buildings.

FOR FIFTEEN YEARS, the Institutional Engineering Service at the Pennsylvania State University has been interested in fuel utilization in colleges, hospitals, and prisons owned and maintained by the Commonwealth of Pennsylvania. At the present time, 72 institutions comprise the group for which energy consumption experience and costs are evaluated each month by the Service.

Pennsylvania enjoys a fortunate position in terms of energy sources. Abundant supplies of coal, fuel oil, and natural gas are available in nearly every section of the Commonwealth.

In continually evaluating the competitive position of the fossil fuels, attention was inevitably directed toward the use of electrical energy for space heating because over 80% of the electricity generated in Pennsylvania is produced by coal operated, steam generating power plants. A second reason for investigating the use of electrical space heating was its increasing use in public schools.

In the United States, the number of electrically heated schools has risen from about 60 in 1954 to more than 1,000 in 1961. Because of this rapid rate of increase, many studies have been published comparing electrical systems with fossil fuel-fired systems. However, many of the published reports are based on estimates and formulas, or are limited to a few isolated examples. They are not comprehensive evaluations of actual construction and operating cost data for a large number of schools. Our study indicated that the space heating system efficiency was three to five

NICHOLAS, FRED Associate Professor of Engineering Research, Pennsylvania State University; member, ASHRAE, National Society of Professional Engineers. MUSCHLITZ, WILLIAM L. Associate Professor of Engineering Research and Supervisor, Institutional Engineering Service, Pennsylvania State University; member, ASHRAE, National Society of Professional Engineers.

times greater for electric heat systems than we had previously found for wet heat systems.

SCOPE OF STUDY

A decision was made to evaluate annual owning and operating costs for all public schools built in Pennsylvania since 1955. Final review construction costs were taken from the official files of the Department of Public Instruction, but bid costs were available in three cases only. Annual operating costs were obtained from the respective school districts. In addition, the electric utilities supplied data for electric cooking and domestic water heating.

A total of 67 buildings make up the group, with 32 heated with natural gas, 20 with fuel oil, 10 electrically, and five with coal. All of these schools comply with the Commonwealth's School Plant Guide for Planning School Plants of Pennsylvania. The same requirements have been met for ventilation, floor area, ceiling heights, fenestration area, and illumination levels, regardless of the type of heating system.

OWNING AND OPERATING COSTS

In determining the actual or true cost of owning, both the total cost of building construction and the combined cost of mechanical and electrical construction were considered. This approach to owning cost permits comparison of a building using an electric energy heating system and one employing another fuel, because the hidden costs of each system are included in the total cost of construction, or in the combined cost of mechanical and electrical construction. In general, electrically heated schools employ slightly better insulation values than the average fossil fuel-heated schools; however, the cost of the added insulation is included in the total construction cost.

The actual owning cost for each school was calculated by multiplying the total construction cost by the factor 0.070. This factor, representing $70 per $1,000 of construction cost, is the present rental paid by each school district in Pennsylvania to the School Authority for use of borrowed money and the administrative expense of the Authority.

In determining the actual annual operating cost for each school facility which might in any way be dependent upon the type of energy source for space heating the following items were included:

1. Total fuel or energy changes including space heating, domestic hot water, cooking, general electrical power and lighting.
2. Maintenance and repair costs of building and equipment.
3. Custodial labor.
4. Custodial materials (wax, cleaners, etc.)

RESULTS OF THE STUDY

The tables that follow present the results of this study. Table 1 shows the construction and owning costs for the 44 elementary and 23 secondary schools included in the study. The unit costs are reported per pupil, per square foot, and per cubic foot. The areas and volumes were determined by the standard AIA method. The annual owning cost per pupil was based on rated capacity (the total number of pupils on which the school design was based) and the total final review construction cost multiplied by the factor of .070.

Table 2 reports the annual operating costs per square foot and per pupil (rated capacity) for the school year 1960-61. These data were obtained from the respective school district and, where minor omissions were observed, averages for the specific school district were used.

Table 3 lists the average annual owning and operating costs on a per pupil basis for the 67 schools included in this study.

CONCLUSIONS

Examination of Table 1 shows that the owning cost per pupil per year is less for electrically heated elementary schools than for fossil fuel-heated elementary buildings. The total construction cost per cubic foot is greater for the electrically heated schools, but this may be because the ratio of building volume per pupil is less for the electrically heated buildings, owing to lack of certain utility spaces which are required in wet heat buildings.

The cost-per-pupil basis is of most interest to school districts since official records are kept on a per-pupil basis.

The comparison of one electrically heated secondary school and 22 conventionally heated secondary schools does not offer any sound basis for a positive conclusion. However, the smaller owning cost per pupil per year may indicate that electrically heated secondary schools could follow the pattern established by the elementary schools.

Table 2 shows the annual operating costs on a square foot and per pupil basis. The total annual operating cost per pupil per year for the elementary electrically heated schools is less than the cost for conventionally heated elementary buildings. For the secondary electrically heated school, a similar conclusion to that suggested for owning cost may be reasonable.

The total owning and operating costs on a per-pupil basis presented in Table 3 clearly show that the average owning and operating cost for electrically heated elementary schools is less than that of conventionally heated schools.

Finally, it should be noted that 10 electrically heated and 57 fossil fuel-heated schools cannot be considered a large sample in

TABLE 1 -- CONSTRUCTION AND OWNING COSTS

Type of School	Number of Schools	Total Construction Cost/Pupil	Total Construction Cost/Sq. Ft.	Total Construction Cost/Cu. Ft.	Mechanical and Electrical Cost/Pupil	Mechanical and Electrical Cost/Sq. Ft.	Mechanical and Electrical Cost/Cu. Ft.	Owning Cost/Pupil Year
Elementary: Wet Heat	35	$1105.00	$16.65	$1.17	$225.00	$3.31	$246.00	$ 78.00
Elementary: Electric Heat	9	955.00	16.62	1.49	201.00	3.56	285.00	67.00
Secondary: Wet Heat	22	1907.00	16.79	1.10	429.00	3.81	304.00	138.00
Secondary: Electric Heat	1	1701.00	13.32	1.30	324.00	2.54	247.00	119.00

TABLE 2 -- ANNUAL OPERATING COSTS 1960-61

Type of School	Number of Schools	Heating Cost/ Pupil/Yr.	Heating Cost/Sq. Ft./Yr.	Total Elect. Cost/ Pupil/Yr.	Total Elect. Cost/Sq. Ft./Yr.	Custodial & Maintenance Cost/ Pupil/Yr.	Custodial Wage Cost/ Pupil/Yr.	Maintenance & Repair Cost Pupil/Yr.	Boiler Insurance Cost/ Pupil/Yr.	Total Operating Cost/Pupil Yr.
Elementary: Wet Heat	35	$ 6.16	$0.0974	$ 5.48	$0.0879	$2.06	$13.97	$2.09	$0.23	$30.17
Elementary: Electric Heat	9	9.48	0.1680	14.22	0.2560	1.68	11.90	1.35	none	28.64
Secondary: Wet Heat	22	8.13	0.0766	7.46	0.0689	2.99	25.65	2.92	0.25	47.85
Secondary: Electric Heat	1	15.40	0.1210	21.60	0.1700	2.10	15.90	none	none	39.60

statistical terms; however, these schools represent all the schools for which official data were available at the time of this study. Additional studies with a larger number of schools should be conducted as more information becomes available, but the results given in this report indicate that electric heat today enjoys a favorable position as compared with fossil fuel-fired, wet heat systems in Pennsylvania.

TABLE 3 -- OWNING AND OPERATING COST PER PUPIL PER YEAR

Type of School	Number of Schools	Owning Cost	Operating Cost[1]	Total Owning and Operating Cost
Elementary: Wet Heat	35	$ 78.00	$30.17	$108.17
Elementary: Electric Heat	9	67.00	28.64	95.64
Secondary: Wet Heat	22	138.00	47.85	185.85
Secondary: Electric Heat	1	119.00	39.60	158.60

[1] National operating cost in 1961 was $31.90 and operating cost in 1961 for the three states of New Jersey, New York, and Pennsylvania was $42.75, as reported in the January 1962 issue of School Management.

The OCD-AIA Competition for School Shelter Design

By Robert Berne, Office of Civil Defense,
U. S. Department of Defense

Abstract: As one means of carrying out its aim to obtain 235 million fallout shelter spaces by 1967, the Office of Civil Defense conducted a National School Fallout Shelter Design Competition in 1962. The problem was to design an elementary school for from 300 to 500 students, incorporating shelter space for twice the school population. The mechanics of the competition and some of the basic concepts shown in the designs submitted are reported.

THE OFFICE OF CIVIL DEFENSE, convinced that fallout shelters can be incorporated in buildings as dual-use space without impairing functions or esthetics, and at little additional cost, conducted a National School Fallout Shelter Design Competition in 1962.

The competition was intended to stimulate solutions to the community shelter problem. The interest of industry leaders was evident, when about 700 applications to enter the competition, nearly 200 more than predicted, were received before the deadline.

NEED FOR QUALIFIED PROFESSIONALS

OCD is interested in establishing 235 million shelter spaces by 1967, so that everyone in the United States may have the opportunity to find shelter from radioactive fallout in the event of nuclear attack. To achieve this goal, those responsible for building designs must be made aware of fallout protection techniques. Architects, consulting engineers, and teachers of architecture and engineering are being qualified through intensive courses. It is the aim of the Division to have at least one qualified professional in each architect's office, consulting engineer's office, school of architecture and engineering, government agency with architectural and engineering staff members and in each industrial firm employing architects or engineers on its staff. Ultimately, it is hoped that state registration boards will include fallout shelter analysis in their regular examinations.

ORGANIZATION OF THE COMPETITION

Because of some of the inherent characteristics of the average school building, such as food preparation and sanitary facilities,

BERNE, ROBERT Chief Architect, Architectural and Engineering Development Division, Office of Civil Defense, U. S. Department of Defense; member, AIA.

and the existence of an organized administrative cadre in the faculty, this type of building was chosen as the most appropriate subject for the fallout shelter design competition.

The competition, administered by the American Institute of Architects, afforded regional first prizes of $4,000, regional second prizes of $1,000 and regional third prizes of $500. An added $11,000 went to the national grand-prize winner. In addition, five certificates of merit were awarded to entries exhibiting exceptional features. The awards were determined by a five-man jury with a professional and a technical advisor.

The competition was open to teams of registered architects and engineers, or faculty members or graduates of accredited architectural and engineering schools. Because of the scope of the competition, and because a commission of this magnitude in the average architect's office would not be attempted without the services of consulting engineers, collaborative participation by architects and engineers working as design teams was required.

THE PROBLEM

The problem was to design an elementary school for from 300-500 students incorporating fallout shelter space for twice the school population, with a protection factor of 100 or better. Shelter space was required to serve normal functions in the educational plant, while providing protection from gamma radiation during emergency periods. Economy of construction and maintenance and operating costs were essential considerations. Each team was required to describe its site in detail and particular attention was given by the jury to the suitability of the building to the climatic conditions.

Shelter areas were required to provide at least 10 sq. ft. of usable space per person. With mechanical ventilation, above-ground areas required 65 cu. ft. net per person for 50% of the occupants. These requirements were increased, when mechanical ventilation was not provided, to 65 cu. ft. per person above ground and 500 cu. ft. below ground. Where minimum space requirements were used, it was mandatory to provide a minimum of 3 cu. ft. of fresh air per person per minute by mechanical means.

Provision was to be made for the storage of basic shelter supplies by allotting 1-1/2 cu. ft. per person for the storage of 14 quarts of water and 10,000 calories of special bulgar wheat biscuits per person, medical care kits, sanitation kits, and radiation detection instruments.

These objectives were fully met by several hundred talented people throughout the country. The results of their efforts, particularly as expressed in the prize-winning designs which showed much original thought and many ingenious solutions, should have a positive impact upon attitudes toward shelter space and should give greater understanding of the concept of what a fallout shelter is.

BASIC CONCEPTS PRESENTED

In an overview of the entries, it is significant to note that at least 10 basic concepts for fallout shelter space were explored, some with variations. These are as follows:

1. The shelter as an interior core shielded by a buffer of peripheral rooms and walls.
2. The shelter as a completely underground unit, either covered with earth or in a basement.
3. The shelter as a windowless building above the ground, with a completely controlled environment.
4. The shelter built around a limited vista court, either as an underground or windowless building.
5. The shelter with a movable protective enclosure that closes glass areas.
6. The shelter with a combination of overhangs and shields to achieve openness, yet provide protection to glass areas.
7. The shelter as a multistory building with minimum roof, automatically reducing the roof contribution which is generally about 50% of the total contribution.
8. The shelter above grade of sufficient height to reduce automatically the approximately 50% "ground direct" contribution.
9. The shelter as a system of baffle walls achieving great openness, while shielding the protected area geometrically.
10. The shelter protected by mechanical devices which are closable when protection is required, such as hydraulically operated roof systems.

CONTRIBUTIONS TO KNOWLEDGE

The jury felt that some very important lessons are to be learned from this competition. Probably the most important is the fact that shelter capability can be incorporated in a school with absolutely no interference with the educational process. In many of these schools, it would be difficult, if not impossible, to know that the school was also a fallout shelter.

While addition of fallout-shelter capability to a school will increase its cost, the competition proved that there are many ways it can be done quite reasonably. It also demonstrated that a team of capable architects, engineers, and shelter analysts can devise dual-use fallout shelters which will not adversely affect the esthetics or the function of a school.

The principles learned relative to schools are equally applicable to other types of buildings. The prize-winning school fallout shelter designs are described and illustrated in Office of Civil Defense Technical Report, TR-19, entitled National School Fallout Shelter Design Competition Awards, published by the U.S. Government Printing Office in February 1963. Copies of this report may be obtained from the author.

School Facility
Design, Equipment, and Services

Open Forum Discussion

Moderator: Gustave R. Keane,* Eggers and Higgins, Architects

Panel Members: Messrs. Berne, Christian, Larson, Nicholas, Rarig, and Watters

W. S. Young, Jr., Owens-Corning Fiberglas Corporation: What effect on cooling capacity did solar heat gain from skydomes have versus insulated opaque deck? Were double insulating domes used or considered?

Mr. Christian: Such domes were considered but not used. The rooms were so well insulated that the skylight did not affect the heat load enough to significantly change the temperature.

A. J. Chlada, Baltimore Public Schools: In evaluating total environment, should space proportions be considered, and if so, should some evaluation be made of the elongated "flexible classrooms?"

Mr. Larson: The relationship of spaces should be one of the principal items to be investigated, although we have not explored this in our work at Michigan. We do hope, eventually, to go more deeply into the problem of space in general.

M. J. Wilson, Carrier Air Conditioning: We hear use of the term "acoustic perfume," or background noise. Cannot this be provided by an air conditioning system, if the noise contribution is of proper quality and sustained intensity?

Mr. Watters: There is always background noise around us. The thing we must do is plan for it, keep tabs on it, and see that it is not annoying. The noise contributed by air handling equipment is often an important part of speech privacy, and other kinds of acoustic privacy. When the noise gets too low, sometimes that very fact is annoying, for we begin to hear our own body sounds, the rustle of our clothing, etc. In addition, the cost of providing acoustic privacy rises greatly if some background noise is not present.

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*BRI member

Unidentified questioner: What about the surface deterioration of clear acrylic plastic? Is it objectionable in the end-use? Which is better from this standpoint, clear or translucent materials?

Mr. Rarig: The durability of clear acrylic plastic depends on location, thickness of the sheet, and area of the sheet. The material is relatively soft, and if it is located where it can be scratched by hard objects, or if it is subjected to abrasives in the cleaning process, it will acquire a patina of scratches, and may be seriously damaged. If the relationship of the thickness of the panel to its size is such that the installed panel is quite flexible, it may be difficult to restore the damaged surface with material in place, even though the damage consists of very light scratches. If the scratches are heavy, it may be almost impossible to restore the surface no matter how solid the installation. Colored and patterned acrylic sheet can withstand a great deal of abuse without acquiring an objectionable appearance. Clear acrylic, and the acrylic materials generally recommended for glazing, do not deteriorate but their appearance can be damaged by abuse.

Clarke T. Cooper, Cooper and Auerbach, Architects: Is the saving evidenced in the electrically heated schools due to reduced fuel costs, or to the combination of less maintenance, lower installation costs, etc?

Mr. Nicholas: The answer is involved, because the approach we took was to determine the total owning and operating cost per pupil for schools heated by conventional systems fired by oil, gas, or coal, and also electric energy for heating. The energy cost of the total operating and owning cost per pupil amounts to between 7% and 9% of the total cost, so the energy cost is not of such a significant amount that it would destroy the trend evidenced by our present sample. The total construction cost is, perhaps, more important than the energy cost applied to a particular school.

K. G. Fleming, City College: What danger is there of flooding from water mains in underground fallout shelters?

Mr. Berne: This is a fundamental consideration in designing a building. Some sort of shutoff valve should be provided so that, in case the piping does break within the building, and tends to flood the shelter, the water can be cut off easily and simply.

J. F. Weinhold, Cornell University: Have you any indication of the optimum temperature and humidity that should be maintained within the school?

Mr. Christian: No. This will come out in our final study.

Tony Tysenn, Products Research Company: Did you compare the classroom environments at Hillsdale High School, San Mateo, California? The interior classrooms there have top lights only, and perimeter classrooms have windows. After four years, I heard that most students and school administrators prefer the windowless rooms.

Mr. Larson: I have visited the Hillsdale School. Our project is a little different from that because there are windows at Hillsdale, or at least there is fenestration. The Hoover School, as it is now arranged, has no view whatsoever of the outside. The two schools are not comparable. There are different occupancies, and they are in different parts of the country. In our experiment, the comparison is not of Hoover School in contrast to other schools throughout the country, but of the performance of the same children in the same school under two different environmental situations.

George Rottman, Guilford County Schools, N.C.: In comparing wet heat and electric heat costs, what specific types of system are considered -- radiant pipe coils vs. heat cable; wet heat unit ventilators vs. electric unit ventilators; wet heat direct radiation vs. resistance type units; or what?

Mr. Nicholas: The Pennsylvania school-building code limits the type of system that can be employed, regardless of the type of fuel used. Most of the schools in our study were equipped with the conventional unit ventilator, whether they were electrically heated or wet heated, fired by gas, oil, or coal. We did have one or two examples of a multizone unit with a single duct into the classrooms under the floor, coming up the outside wall, but the conventional approach in Pennsylvania has been to employ the standard unit ventilator. The present heating and ventilating code requires that we use 10 cu. ft. per minute of outside air per pupil. Because of the large amount of ventilating air required, the unit ventilator is generally used by most architects.

W. O. Wieting, Perkins and Will: What is the cost range per kilowatt for electric power in the Pennsylvania area where the electrically heated schools are located?

Mr. Nicholas: The cost per kilowatt hour varies throughout the Commonwealth, depending upon the utility. Our lowest cost was 1.28¢ per kilowatt hour, and the highest was around 1.65¢. Since our study was undertaken, a number of the electric utilities have reduced their rates. Therefore, data obtained for future schools, recently constructed or now being built, will show slightly lower rates. We expect that they will probably average less than 1.5¢ per kilowatt hour.

Rhees Burkett, Architect: Do you consider interior views or openings from classrooms having no exterior windows to be essential or an advantage?

Mr. Christian: The first air-conditioned building had some windows, either for esthetic reasons, or because the school board wanted them. However after covering some windows, and building several schools, we have come to the conclusion that you can own and operate a windowless school more cheaply. We do think that there are some areas in the schools that should be attractive enough to break the routine of windowless classrooms. We are using glass in the cafeteria, the library, and some open spaces as you enter the administration area, and we are leaving the classrooms windowless. In the new designs we are building -- three new junior high schools -- we think this is going to be the answer. Actually, we do not feel that it will have any adverse effect upon the students, the teacher morale, or anything else. We think it is more economical, and the effects from teaching will be just as great.

Unidentified questioner: Would you comment on the fire hazard involved in the use of plastic materials for glazing?

Mr. Rarig: This question is being investigated by various groups concerned with fire safety. The problem is complex, involving such variables as ignition temperature, flame spread, rate of burning, relative smoke production, etc. Some plastics glazing materials have very low flame spread; others have quite high flame spread; still others, such as the thermoplastics, appear not to present much of a flame spread problem, because they do not ignite in place, but fall out at a temperature somewhere between their heat distortion temperature and their ignition temperature. Some plastics produce a great deal of smoke; others produce almost none. In general, the industry, in attempting to define good practice in the use of plastics glazing, makes the assumption that all plastics available for this purpose are combustible. Therefore, the area of installation should be limited, individual areas should be separated from one another, and the height of the installation should be limited. The problem appears to be that of balancing the hazard from shattering against the combustibility of plastics materials that are capable of eliminating the missile hazard inherent in conventional glazing materials.

Tom Grimm, Zonolite Company: In your judgment, is it meaningful to convert a decibel reduction in sound pressure level to phons and sones, and express the reduction as a percentage reduction in loudness? In other words, is it valid to say that a 5 db reduction in pressure level is a 30% reduction in loudness?

Mr. Watters: It depends on the problem upon which you are working. In the case of speech privacy, you can find a condition which constitutes the breaking point between what people will accept and what they will reject. A convenient way to measure the various parameters is to ascertain how many decibels you are away from this breaking point. Since most of the acoustic industry is geared to decibels, this is a convenient system.

P. R. Achenbach, National Bureau of Standards: What are the provisions for exhaust ventilation in Pinellas Park School and the chilled water units in Oak Park School? Is any study being made of comparative food and water intakes in the two schools? What has been done to compare the teaching staffs in the two schools?

Mr. Christian: First, Pinellas Park is not air conditioned. It is just a normal ventilated school with windows on one side, and high windows above the blackboard on the other side. In areas like the cafeteria, there are exhaust fans to take the air out. In the Oak Grove School, where we use the unit ventilators in the classrooms, this is done by cold water circulated by a gas-driven engine. We have made a study of the cost of other utilities, including water, in the schools. As to whether the teaching staffs of the two schools are comparable, in my judgment they are. We tried to put experienced, qualified teachers in both schools. Of course, there is some turnover and there are some new teachers, but in degree and experience the staffs of both schools are alike. When you begin to measure achievement, you want to be sure that this is the case. We also tried to assure that the learning capacities of the student bodies were equal and that parental education and living standards were similar. We have attempted to equalize these factors as much as humanly possible.

Mr. Keane: Are the researchers enlisting the active cooperation of the parents to report on possible damage to their children's personalities, such as symptoms of claustrophobia, an exaggerated desire to get out of the house, etc.?

Mr. Larson: No. Some parents are concerned that their children might become psychopathic. We have on our staff a member of the faculty of the School of Public Health who specializes in child health, and he is also very much concerned about this. We are keeping a close watch on the youngsters, and if there is any evidence of mental disturbance, which is very, very doubtful in the minds of all of us, it would be noted, I am sure, by the parents who have already complained about the possibility. The children seem to be unaware of the absence of windows. The fact that they are no longer talking about it indicates to us that the parents have stopped worrying about it. All four teachers seem to approve of the absence of windows. They seem to feel that the children are more attentive and less distracted by outside activities.

P. R. Achenbach, National Bureau of Standards: There are probably at least three factors that have a major effect on the learning process: the pupil, the teacher, and the environment. There are also lesser ones, such as the parents, the food, the sleep habits, etc. How much has been done to compare the teaching staffs of the two schools? Might not the furnishing of additional chalkboards and shelves, as requested by the teachers, be a morale-building element that might have a positive effect upon both teachers and students, essentially unrelated to the absence of windows? What evidence is there that the learning rate of a given group in successive years would be constant, even if the fenestration were unchanged? Could not comparisons now be made between Mann and Hoover schools for the year in which both had windows, as a basis for comparing the teacher-pupil relationship in the two schools? Are you not, in fact, testing teachers as well as pupils?

Mr. Larson: The teachers are part of the environment, so far as the children are concerned. There is no doubt that having new teachers does change the environmental relationship with respect to the individual youngsters. On the other hand, we must remember that each year the pupils are promoted and, automatically, they get a new set of teachers. We do not think, therefore that the teachers who are new this year make too much difference. We will have to double-check at the end of the year to see what has happened at Mann School.

Undoubtedly, there will be a comparison with the changes that have taken place at Mann School, just as there has been at the Hoover School this year. We have a new set of teachers, but the individual youngsters continue in each case. The main point of our inquiry is to discover whether there is any difference in the response of the pupils. It is quite true that this indirectly becomes a test of the teachers in the schools. It is very likely that a good, strong teacher will have a very powerful effect upon the youngsters, but I do not know how we can avoid this effect in our experiment. We are not trying to prove a thesis. We are merely trying to find out if there is any measurable effect on the youngsters when they are in classrooms for one whole year, with no view of the outside.

As regards the addition of chalkboards and things of that sort, I think we are creating a prejudice on the part of the teachers. We have encouraged the teachers to indicate to us any changes they would like to make on the new working wall. We are interested in the suggestions that the teachers have for making the wall more useful. Last year, before the change was made, we asked the teachers to indicate their desires; these were followed through in the summer. Now we find that the teachers in whose rooms shelves and chalkboards were introduced seem quite satisfied.

J. T. Burwell, American Radiator and Standard Sanitary Corporation: In view of the small samples of electrically heated schools, would you comment on the statistical significance of the differences in costs of the two types of heating?

Mr. Nicholas: We are aware that this is a limited sample. However, the averages are indicative that the annual owning and operating costs of electrically heated schools are slightly lower than those for conventional schools. Regardless of the number in the sample, our present evaluation does indicate that the electrically heated school is in the running when compared with other types of schools.

William Lukacs, Architect: In one junior high school in a good New York neighborhood, I have seen tempered glass transoms, with panes about 42 inches squre, repeatedly broken. Can clear plastics overcome such a problem?

Mr. Rarig: It depends upon the capacity of the missiles with which the transoms are struck, and it is also a matter of edge encasement. The plastic glazing will be as strong as the other components of the assembly. Tests have indicated that tempered glass is vulnerable to a dart, to a sharp point that breaks the surface tension. Such a dart would probably not break a comparably thick piece of acrylic.

P. R. Achenbach, National Bureau of Standards: Your paper represents a comparison as is. It does not establish that the quality of school or quality of heating were comparable. What type of wet heat was used in the fossil-fuel heated schools? How were controls operated between night and day? What are the specific comparisons between coal, oil, gas, and electricity? Were special incentive rates offered by the electric utilities?

Mr. Nicholas: The Commonwealth of Pennsylvania has a heating and ventilating code which restricts or eliminates many types of systems in the design for a particular school. As to the comparison between a school that is heated with a conventional hot water system and one that is heated with an electric system, they are quite similar in that they both employ unit ventilators. The only difference in the construction of the unit ventilator is that the one using an oil-fired system, for example, is equipped with a hot water coil; the one using electric energy is equipped with an electric heating coil.

The temperature control system applied to both units is identical, except that the mechanics of the system might be slightly different. However, the final result is very much the same, so that the occupied and unoccupied controls are quite similar. A very common method of controling the units on the night cycle, or in the unoccupied period is, of course, to turn the fans off and on to maintain the night set-back temperature. This can be done whether the unit is equipped with a hot water coil, steam coil, or electric coil.

In some instances the electric utilities offered an incentive to the school district, but of course the oil and gas interests have done the same. I wouldn't say that this has influenced the decision of the board to use any particular fuel. The fuel costs in Pennsylvania for bituminous coal, for example, might run from $5.50 to $10 a ton. No. 2 oil costs might be from 11¢ to 15¢ a gallon. Natural gas costs might be from 50¢ to $1 for a million Btu's, and perhaps in some areas even higher.

Unidentified questioner: Do you label all of your acrylic sheet which may possibly be used for glazing and, if not, how do you know what acrylic sheet to label with your special cautionary labelling for the guidance of glazers and contractors?

Mr. Rarig: We put cautionary labelling on the sheets of material which we believe will be used for glazing, and we supply our distributors with cautionary labels to place on sheets which they sell for this end-use. Their knowledge is often more definite than ours. We do not control the end-use of our material, and some of it undoubtedly moves into glazing installations without any cautionary labelling. We try to reach everyone with informative literature and instructions, but time and experience alone will ultimately solve the problem.

National Inventory of School Plants

By George J. Collins, U.S. Office of Education

Abstract: If America is to know the true status of its elementary and secondary school facilities, a national cooperative effort must be made by state, local and Federal authorities to pool all information available in a central location. The First National Inventory of School Facilities and Personnel is such an attempt. This paper describes the methodology used in the Inventory, indicates the type of data collected, and presents a representative tabulation of facilities in a single state.

AN UNPRECEDENTED UNIVERSE OF DATA on individual school plant facilities was provided by the First National Inventory of School Facilities and Personnel for Resource Evaluation and Damage Assessment. Beginning in April 1962, approximately 135,000 schools were sent inventory forms. By June, more than 90% of the schools had responded. Of 50 states, 41 and the District of Columbia chose to conduct the inventory themselves. The Bureau of the Census mailed forms to each school in the nine remaining states and to more than 16,000 nonpublic schools.

The principal objectives of this study were to locate schools; to inventory structural, classroom, and general-use facilities; to determine the functional use of school plants in an emergency; and to establish the number of pupils and adults usually on a given site on a school day. At the same time, the substantial data collected have provided certain basic information on school facilities.

INVENTORY FORM

A four-page inventory form was used to obtain the data. The unit reported on each form is a school plant. The Common Core of State Educational Information, Handbook I, which was developed cooperatively with state and local educational agencies, representatives from educational associations, and the U.S. Office of Education, defines a school plant as the site and all the buildings thereon. Hence, one inventory form may report on several schools, if they are using the same site. The first page of the form is concerned with locating and identifying the school.

COLLINS, GEORGE J. Director, National Inventory of School Facilities and Personnel, U.S. Office of Education, U.S. Department of Health, Education and Welfare; member, American Association of School Administrators, Association of School Business Officials, National Council on Schoolhouse Construction, National Education Association, and National School Public Relations Association.

The center spread of the form is used for reporting the structural characteristics of each building by age, basement, stories, outside wall material, framing, fire resistance, number of classrooms, and general-use facilities.

The final page of the form seeks information about the number of pupils and employees in the school plant, the capacity of facilities for heating, cooking, and obtaining water in emergency conditions, and the acreage of the site.

Procedures for obtaining data on costs and detailed information on school site, buildings, and instructional spaces are already under way in about a dozen states, as part of implementing Handbook III, Property Accounting for Local and State School Systems. This handbook was also developed cooperatively by state, local and Federal employees and representatives from important educational associations.

One result of the Inventory is the creation of a much-needed system for exchange of data with the Bureau of the Census, Office of Education, the states, and National Resources Evaluation Center. A conversion deck of codes developed for the Inventory should prove useful in future survey work, and particularly in the implementation of Handbook III.

DATA PROCESSING

Over 106,000 school plant forms were returned. Each form was punched on three basic data cards. Estimates indicate that 450,000 data cards will be required to enter all the data collected in the Inventory. Modern methods of data processing took less than four months to have the data processed and back to the states. A publication of some of the data by the Office of Education is planned for December 1963.

SORTING INVENTORY DATA

Data collected in the Inventory are being summarized by individual item responses for each state and the United States. Public and nonpublic school data are being totaled separately. The item summaries essentially follow the items on the inventory form. Fire-resistance classifications of school buildings and additions will be sorted by number of rooms, number of pupils, and acreage.

Tables 1, 2 and 3 show some actual item summaries from a representative state.

The total number of classrooms reported in Table 1 is 29,472, with 93% of the schools reporting. Therefore, it can be assumed that the total for this state is about 31,690 classrooms. While Table 1 does show several aspects of unsatisfactory teaching conditions; namely, the improvised, most of the temporary, and the off-site rooms, there is no attempt to estimate how many of the designed rooms are unsatisfactory.

TABLE 1 -- NUMBER OF INSTRUCTIONAL ROOMS IN PERMANENT BUILDINGS, NONPERMANENT AND AVAILABLE OFF-SITE FACILITIES BY ORGANIZATIONAL LEVEL OF SCHOOL PLANTS IN STATE "X," SPRING 1962[1]

Type of School	Designed	Improvised	Temporary	Off-Site	Total
Secondary	5,720	83	57	7	5,867
Combined	13,477	338	260	125	14,200
Elementary	9,034	150	184	37	9,405
Total (93%)	28,231	571	501	169	29,472
Projected Total (100%)					31,690

[1] Represents 93% of total mailout.

TABLE 2 -- NUMBER OF PERMANENT-USE FACILITIES AVAILABLE FOR USE BY ORGANIZATIONAL LEVEL OF SCHOOL PLANT IN STATE "X," SPRING 1962[1]

Facility	Elementary	Combined	Secondary	Total
Centralized school library	228	477	195	900
Auditorium	214	275	112	601
Cafeteria or lunch room	387	565	174	1126
Gymnasium	42	132	112	286
Combination gym-auditorium	53	275	73	401
Combination cafe-auditorium	192	90	9	291
Combination cafe-gymnasium	1	1	0	2
Combination cafe-gym-auditorium	4	14	2	20
Other multipurpose	93	129	80	302
Swimming pools	1	11	7	19

[1] Represents 93% of total mailout.

Manufacturers of special equipment for general-use facilities are constantly attempting to determine potential markets. Table 2 is a listing of large general-use facilities. In this regard, note that 228 elementary schools of the total 1,004 surveys reported (Table 3) have central school libraries. More than one-half of the combined elementary and secondary schools have libraries, as do about 9 of every 10 secondary schools. Adding the gym combinations indicates that about 1 in 10 elementary schools, 1 in 2 combined schools, and about 9 in 10 secondary schools have access to a gymnasium.

TABLE 3 -- ADDITIONAL DATA AND DERIVED AVERAGES BY ORGANIZATIONAL LEVEL OF SCHOOL PLANTS IN STATE "X,"[1] SPRING 1962

Data	Elementary	Combined	Secondary	Total
School plants	1,004	889	211	2,104
Schools				(2,167)
Acres	5,537	10,535	3,535	19,607
Average acres/plant	5.5	11.9	16.8	
Day-school membership, elementary	251,273	197,509	856	449,638
Day-school membership, secondary	1,552	148,439	143,357	293,348
Sub-total	252,825	345,948	144,213	742,986
Day-school membership-average	252	389	686	
Full-time instructional staff	8,569	13,020	6,104	27,693
Pupils per full-time instructional staff, average	29.3	26.6	23.6	
Full-time non-instructional staff	3,027	3,119	1,880	8,026
Full-time non-instructional staff per school plant	3	3.5	9	
Full-time instructional staff per school plant	8.5	14.6	28.9	

[1] Represents 93% of total mailout.

In Table 3 there are additional summaries of the data collected, and some averages can be computed. Probably the most significant caution concerning the use of averages relates to the final figures -- pupils per room, or the derived pupils per teacher ratio. The averages indicate rather acceptable ratios for better educational programming. However, the lower number of pupils in sparsely populated schools compensates for overcrowding in the more densely populated schools. With basic data for an individual school plant, a more realistic view of the range of extremes may be computed, and this may prove to be a very important statistic on the status of educational construction and staffing.

This collection of data for over 106,000 individual school plants by the National Inventory of School Facilities was made possible only by the assistance received from the personnel of the state educational agencies and the cooperation of district administrators and school principals. The cooperative spirit of all participants, and skillful knowhow of the personnel in the Office of Education, has established a major breakthrough in assessing school facilities. Missing schools must be added to the total. More detailed data refinements of Program Handbook IV (yet to be published), Property Handbook III, and Financing Capabilities Handbook II should follow if America is ever to know the true status of its elementary and secondary school facilities.

Mobile Classrooms for School Plant Flexibility

By Francis B. McKeag, Chicago Board of Education

Abstract: Population growth and mobility are of special significance to city schools, because redevelopment and the changing character of neighborhoods make their school-age populations highly unpredictable. Since it takes up to two years to acquire a site and build a school, classroom units that can be moved from place to place can be of great value. Chicago has experimented with such units, providing 600 sq. ft. of instructional area and costing under $10,000 installed, and found them satisfactory. This paper gives the details.

CITY SCHOOLS FACE SERIOUS PROBLEMS of population growth and mobility. From 1951 to 1961, enrollment in the Chicago Public Schools increased by 146,000 students. The projection for the five-year period through 1966 is expected to be an average annual gain in enrollment of approximately 15,000 students.

Each year, nearly 500 additional teachers and 500 additional classrooms are needed, as well as added personnel, facilities, and services. In the five years ahead, there will be a continuing need for almost 500 teachers and 500 classrooms, just to maintain the status quo.

THE MOBILITY PROBLEM

In Chicago, there is the problem of population shifting within the city. One or more of the 21 district attendance areas may grow 20%, or approximately 5,000 students, in one school year. Some schools have doubled their enrollment in only two school years. Many schools experience from 50 to 100% turnover of pupils in a single year. Such movement of the population brings about overcrowding in specific school attendance areas, resulting in temporary double shifts, an arrangement not readily acceptable to the citizens.

Under normal circumstances, about two years is required to acquire a site and to plan and construct a school building. This is acceptable in projects which are in the scope of long-range planning, but it is too long for communities which experience population explosions in only a few months. The answer to problems caused by sudden spurts in population is not to be found in a regular school-building program.

McKEAG, FRANCIS B. Assistant to the General Superintendent of Schools, Board of Education of the City of Chicago; member, American Association of School Administrators, National Education Association.

Various types of temporary, portable, and demountable buildings may be used to solve the problems occasioned by population growth. However, any building, to be acceptable, must meet all standards and code requirements imposed by the Board of Education and the city. Two types of school buildings are desirable: one completely mobile type, to serve a community for from six months to two years, and another type which would be a semipermanent structure built to serve for a period of five to 20 years in one location, after which time it could be demounted and moved to another site.

EXPERIMENTS WITH MOBILE UNITS

During the summer of 1961, several mobile home manufacturers were queried about manufacturing mobile classrooms which would meet Chicago's standards of floor area, lighting, sanitation, heating, ventilation, exits, fire rating, etc. Several manufacturers produced experimental mobile units. The first of these was 10 ft. wide by 68 ft. long. The front 60 ft. included a classroom. The 8 ft. at the rear provided for washrooms, wardrobes, and heating apparatus. However, the proportions of this classroom made it difficult for the teacher to communicate with the students in the back rows. This one-section mobile classroom could have been purchased for approximately $6,500, installed to utilities provided by the Board of Education.

Another experimental unit was built in two sections, each 10 ft. wide and 40 ft. long. One side of each section is open, and the two sections are joined at the site to make a unit 20 ft. wide and 40 ft. long. The 10 ft. sections, with their open sides covered with plywood, are comparatively easy to transport. From the outset this unit was completely acceptable to teachers, administrators, parents, and children. The initial use was for a first grade group, but later use for kindergarten and upper grades indicated that it is suitable for most any age or grade level. After a short period of experimentation, the Board of Education in January 1962 included in its budget an appropriation of $1,500,000 to purchase and install 150 of these mobile classrooms. Figure 1 shows the interior of a mobile unit in use.

CONSTRUCTION AND EQUIPMENT SPECIFICATIONS

The general specifications as outlined in the bid solicitation included the following:

Materials: A minimum fire rating of one hour.

Space: An overall class area of 620 sq. ft. for 30 pupils.

Lighting and Windows: A minimum of 50 foot-candles of light without glare on each desk, from fluorescent fixtures and natural sources. (Twenty percent of the wall area is in jalousie windows equipped with shades and screens.)

Figure 1 -- View of mobile classroom showing built-in chalkboards, shelving, etc.

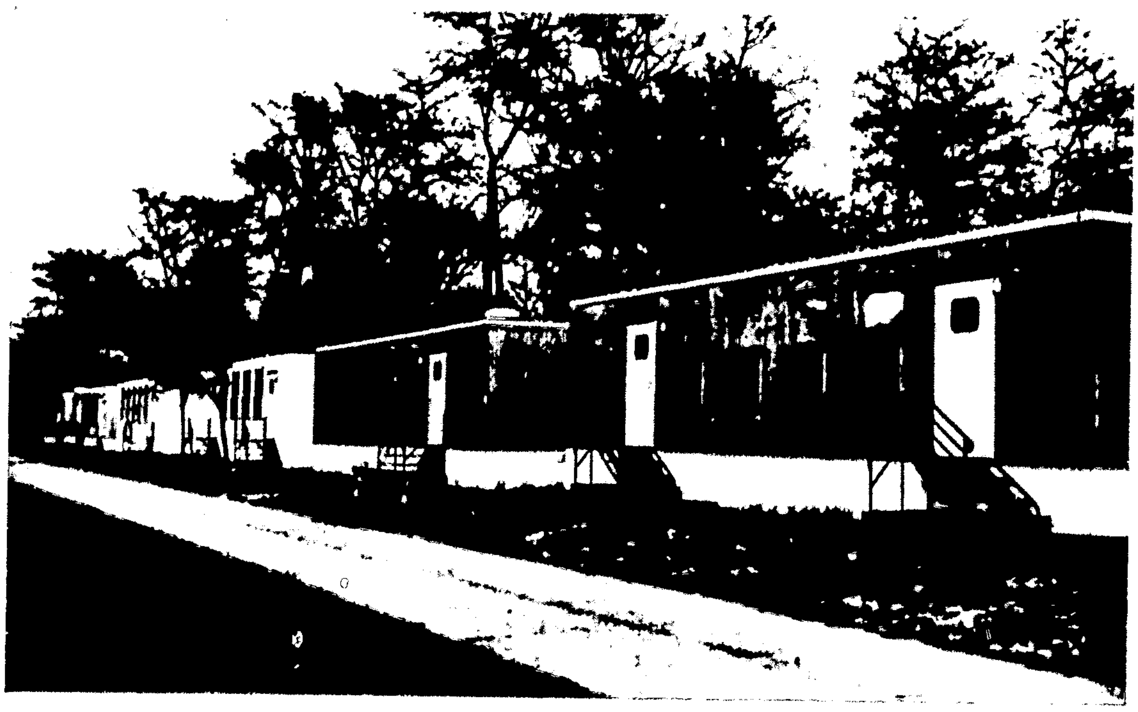

Figure 2 -- Mobile classrooms located in a Chicago park area.

Heating: Thermostatically controlled electric baseboard heating. Electric water heater.

Ventilation: Mechanically controlled forced air ventilation system to provide three complete changes of air each hour.

Air Conditioning: Three-ton air conditioner to provide classroom comfort regardless of the outside temperature.

Built-in Educational Facilities: Chalkboards, bulletin boards, and storage space for books and supplies.

Comfort Facilities: Drinking fountain and restrooms.

Floor Covering: The first five units were equipped with wall-to-wall carpeting for experimental purposes. The remaining units have linoleum floors.

Exits: Three exit doors, two at the rear of the classrooms and one at the front, each equipped with basic hardware.

Appearance: Interiors to be attractive, conducive to creativity, learning, and personality development, with soft gray or beige floors, walls and ceilings, and movable desks with seats of various colors. Exteriors to be finished in colored aluminum.

The cost of each unit, delivered and installed, is $8,460. The average cost of installation of utilities is $1,500, making the cost of the installed unit just under $10,000. The average pro-rated cost of a regular classroom in a complete school facility is $32,000.

ADVANTAGES OF MOBILE UNITS

The biggest advantage of the mobile classroom is that it can be moved literally overnight, assuming that the connections for electricity, water and sewer, and foundations have been made ready.

One hundred and fifty mobile units were purchased and installed in approximately two months on sites owned or leased by the Board of Education. In one location, in a park, there are 28 units esthetically located in a setting of trees and shrubs. Six of these units are shown in Figure 2.

The installation of these units in Chicago helped to reduce double shifts from 33,000 pupils in June 1961, to less than 4,000 in June 1962. As soon as double shifts have been eliminated from the Chicago Public Schools, these units will be used to reduce class size where population influx is suddenly increased. In no case will such units be used longer than two to two-and-one-half years, during which time the population will stabilize or new schools will be constructed.

Other uses for the mobile units in terms of adaptability to school and community needs are numerous. In connection with a regular school program, the unit can be used as a library, health or reading clinic, special education or supervised study room, or for many other comparable purposes. In summer schools and evening schools the unit can be used as a classroom, if an entire building is not required. Operational costs would thus be more economical. The unit may be used for after-school activities, as a library, a recreation center, a meeting place for students' extra-curricular activities or for adult groups such as the Parent-Teacher Association. The mobile classrooms provide an ideal place to help the kindergarten child adjust in that he is associated with only a few people, whereas, in regular school he may be associated with hundreds of students in a large building. Chicago is satisfied that the mobile classroom has provided a completely satisfactory and economical answer to its need for flexible school facilities.

Incorporating Educational Facilities in Buildings with Other Occupancy

By Michael L. Radoslovich, New York City Board of Education

Abstract: School facilities planning in metropolitan centers demands new thinking in school design on the part of educators and architects. It is no longer practical to place urban schools alone, on isolated lots, thereby violating the principles of economy, real estate, and city planning. This paper reports on two possible alternatives to traditional school construction: the combination of a kindergarten-elementary school with a housing project and a combination business education high school and office building.

THE URBAN SCHOOL OF TODAY STANDS ISOLATED, as if learning must be in a stronghold, because its facilities are housed in a building which violates the basic principles of economy, real estate, and city planning. The typical urban elementary school for 1,000 pupils has three or four stories and costs approximately $2-1/2 million. It is built on a 1-1/2 acre site, at times costing more than $1 million, and forcing the dislocation of numerous families and businesses.

The concept that school building facilities in urban areas must stand isolated on this type of location is a deplorable social and economic phenomenon. The school, under these conditions, becomes a paralyzed mass in the midst of our rapidly changing metropolitan centers.

If what we are told is true, we will double the number of our school facilities and we will rehabilitate or replace half the structures now in existence within 40 years.

It is imperative that we search for solutions now. The time is upon us when our conventional inhibitions become a hindrance, and a new order of vision is a necessity. The task ahead cannot be calculated solely on a quantitative basis. The solution demands quality as well as quantity. Our responsibility is to seek new means of housing educational facilities. Our interest must be to relieve the tension and congestion of our cities.

STEPS TOWARD A SOLUTION

To find an answer, we must analyze and understand the functioning of cities, as well as that of the educational facilities serving them.

RADOSLOVICH, MICHAEL L. Director of Architecture, New York City Board of Education; Fellow, AIA; member, Architectural League of New York, Fine Arts Federation of New York; holder of Gold Medal of Honor, Municipal Arts Society of New York.

For several years, the American Association of School Administrators has asked forcefully for new thinking in urban school design. It has conducted architectural exhibits and seminars and worked in collaboration with the American Institute of Architects. Movable, adaptable, convertible, air-conditioned, and windowless schools have been discussed. School facilities combined with housing and other types of buildings have been presented.

In June 1962, the U.S. Office of Education held a conference to "discuss and identify school facilities planning problems in metropolitan centers." The conference was attended by conferees from 10 major metropolitan areas. Among subjects discussed were the effect of urban renewal, zoning regulations, cooperative planning, population changes, and expressways on urban school planning as well as construction costs, sites and financing.

The conference saw an evident need for continuity of effort and for teamwork, and it was agreed to meet again to continue the discussion of urban school building problems and to form a permanent organization.

Since 1959, cognizant of the need to search for new types of school building facilities, the New York City Board of Education, with the assistance of the Educational Facilities Laboratories, Inc., has been conducting a study of building types, including a combination school and housing project with kindergarten through third grade school facilities and a combination business education high school and office building.

COMBINED SCHOOL AND HOUSING PROJECT

The first of these studies, the combination housing project and a kindergarten through third grade school for 800 pupils was prepared by the New York City Board of Education and the New York City Housing Authority. The plan is shown in Figure 1.

The floor plan of a typical high-rise dwelling unit, subdivided into comparatively small spaces, with irregular, short-span column spacing is not adaptable to conversion into classrooms. However, the abundance of plumbing facilities and other utilities makes this type of plan desirable from the standpoint of providing toilets, kitchens, special rooms, teachers' and remedial rooms, storerooms, etc., all of which are necessary parts of a school plant. This gives the planner an opportunity to use to advantage the space within the dwelling units, and freedom to arrange the classrooms, cafeteria, and assembly spaces on the periphery of these units.

In New York City the additional ground coverage, if less than 23 feet in height, is not added to that of the housing units for zoning purposes. The roof of the low unit may be landscaped, or used for various types of outdoor activities, by the school, the housing tenants, or both.

In this manner, schools can be integrated with housing economically and efficiently and can provide desirable educational

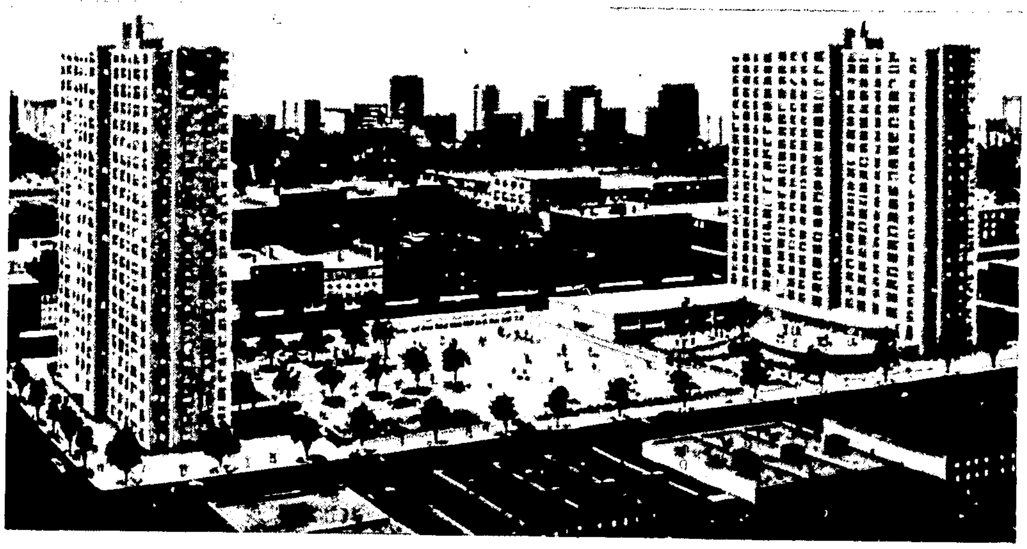

Figure 1 -- Artist's conception of a combination housing project and kindergarten-elementary school. Twenty-one-story housing units rise at each end of the block. A two-story school is connected to the building on the right. At the center of the block is a playground, with parking facilities adjacent to the building on the left.

facilities as well. The playground area should be located as far from the dwelling units as possible to minimize disturbances to the occupants.

The proposed design occupies 120,000 sq. ft. If the same facilities were designed on separate sites, the area would encompass 178,000 sq. ft. Thus, the integration of housing and school facilities saves 58,000 sq. ft. of tax-bearing land.

Educators state that 600 to 800 pupils in a kindergarten through second or third grade elementary school are more desirable than 1,200 pupils in a kindergarten through sixth grade school.

The educational program of a kindergarten through third grade school does not require separate auditorium, gymnasium, and lunch facilities. In their place, it calls for a multipurpose room of 5,000 to 6,000 sq. ft., with adjacent kitchen facilities, storage, toilets, etc. This modification represents a saving of 6,000-7,000 sq. ft. of new construction, as well as a saving of land. In addition, the multipurpose room, with its auxiliary facilities, can be planned so that it can be used as a community center, as well as serve school needs.

Additional savings are derived from the mutual design and construction operation including savings on overhead, administration, and buying power, as well as construction savings resulting from common utilities and mechanical services, common foundations, columns, walls, etc.

COMBINATION BUSINESS EDUCATION HIGH SCHOOL AND OFFICE BUILDING

The existing business education high school in New York is an obsolete four-story building located on valuable property on East 42nd Street. It has an enrollment of 2,100 pupils in its day school and 900 pupils in the night school. Its students are employed part-time or full-time in nearby offices.

The space analysis and the school plan for the school portion of the combined-function building are based on a program of requirements prepared by the school administration in cooperation with the High School Division. The design, prepared for a specific site in the heart of Manhattan, complies with the zoning ordinance of New York City. It is envisioned that the school will have facilities completely independent of the office building. These facilities will be contained within a portion of the sub-basement, basement, and ground floor and, except for the elevator core of the office building, in five or six floors above the first floor.

The school will have separate entrances, exits, service facilities, stairs, escalators, and elevator. It will occupy approximately 130,000 sq. ft. of typical floor space and will also have two facilities, an auditorium-cafeteria and a gymnasium, each approximately 7,000 sq. ft., with a clear span of approximately 65 ft. and ceiling heights of 16 to 18 ft. These two facilities will be located free of the office-building tower.

To house the school facilities adequately, the minimum column spacing of the office building should be not less than 24 feet.

The School Facilities

The school facilities proper should consist of a net area of 73,000 sq. ft., divided as follows: laboratories and special rooms, 55,000 sq. ft.; administration area, 11,000 sq. ft.; library, 1,000 sq. ft.; and student activities, 3,000 sq. ft. In addition, walls, columns, stairs, escalators, elevator, toilets, corridors, and service facilities would occupy 22,000 sq. ft., bringing the gross area to 95,000 sq. ft. The above facilities should be housed on a portion of the ground floor, and on not more than six floors above it, in typical office-building space. The office-building floor area at these levels should be at least 15,000 sq. ft. The gymnasium will be about 65 x 100 ft., and easily partitioned for simultaneous use by boys and girls. It can be housed in the basement.

The Office Building

The office building is to be an entity completely separated from the school. Entrances, exits, service facilities, lobby, and elevators are to be independent of comparable facilities for the school.

Portions of the sub-basement and basement are to be retained for office building use, and rentable store space may be provided at the ground floor level, because it is intended to locate a minimum of school facilities at this level, except for the necessary entrances and exits. The square footage of rentable floor space above the school is dependent on the size of the plot and the design suitable for this plot.

The builder will incorporate in the building the basic features necessary to convert the predetermined office spaces into the high school, i.e., gymnasium, and auditorium-cafeteria, entrances, exits, escalators, elevator, toilets, and other facilities necessary for the school. A second contract would be let by the Board to convert this space into the school.

The office building will supply the school with heat, ventilation, air conditioning and electricity, but the school will be responsible for the mechanical facilities within its own premises. It will also be responsible for the cleaning and maintenance of its own premises, including repairs and layout changes.

CONCLUSION

These are two examples which show how this problem can be met; both solutions are sound from educational and technical aspects. Insofar as these studies are concerned, there is also every indication that the solutions offered will be financially sound and practical for operation and maintenance. However, this should be determined by qualified persons in the fields of finance, real estate, operation, and maintenance.

Economic Evaluation of a Combined School, Apartment Building, and Medical Center

By Stephen Shilowitz, Charles Shilowitz &
Stephen Shilowitz, Architects

Abstract: The City and Country School in New York City is engaged in a building program which centers about the most complete development of its site possible, in order to obtain income. The site is an 18,000 sq. ft. lot in downtown New York City. After a thorough analysis of zoning laws and community needs, the decision was made to erect a combination school, apartment building, and medical center. Details of the planning are given, and the project's financial feasibility is assessed.

PRIVATELY ENDOWED NURSERY AND GRAMMAR SCHOOLS located in the midst of crowded cities are generally in financial trouble, even though they may occupy extremely valuable real estate. They must seek a source of independent means, which may be provided by a thorough development of land for income-producing purposes. A design which makes possible a relative high return of income provides a scheme for capitalization by which a new school structure may be obtained at no expense to the school, and a permanent income established for teachers' salaries, scholarships, equipment purchase, and maintenance.

An actual project is the City and Country School's proposed plan to combine its own functions with those of an apartment house, a medical center, and a parking garage on its site in downtown Manhattan. Construction is due to begin in 1963.

The enrollment of the school is to be 190 children, 3 to 13 years of age, in nursery school through eighth grade. It operates upon a site of about 18,000 sq. ft., transversing the block and bounded on the sides by brownstone residences. The building lot is roughly 90 ft. in length along each street front and 200 ft. deep.

Because of financial difficulties brought about by the need to maintain obsolete facilities, any unexpected emergency may spell sudden death to the school as it now exists. Compounding this difficulty are the low tuition which permits the admission of a wide cross-section of children, some on scholarship, and the failure of donations and proceeds from other activities to keep abreast with rising costs of teachers' salaries, school supplies, utilities, etc.

The school has two assets, however, which will enable it to solve the problem of revitalizing its economic condition. The first is the high value of the property. The second is inherent in the continued welcome of the school as a part of the life of the community. It was concluded that, if the school were to remain in the

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SHILOWITZ, STEPHEN. Partner, Charles Shilowitz & Stephen Shilowitz, Architects; member, AIA.

present location, consideration would have to be given to the possibility of combining income-producing elements upon the site. This would involve the construction of a new complex, incorporating the school with other elements in such manner as to avoid compromising their proper functioning. Such a concept represents a departure from the traditional picture schools have of themselves, as being outside the business world.

DEVELOPING THE PROGRAM

In developing a building program, the site was analyzed to determine its current market value, and any characteristics which would bear upon the nature of the income-producing element to be combined with the school. The zoning laws of New York City, recently revised to insure the provision of more open space than had previously been demanded, placed the school site within a residential district of medium density. A study was initiated of uses permitted in conjunction with an apartment house, the obvious major choice for investment purposes.

So-called community facilities not only were permitted under the zoning law but were assigned greater percentages of development allowance than were given to residences themselves. The definition of floor area, the calculation of which now represents one of the major limiting factors in determining the size of new projects, excludes cellar areas not devoted to living purposes. This aspect of the zoning law promises maximum generation of income, because sites may utilize their underground rights in lieu of air rights, which are limited in proportion to the congestion of their surroundings.

The importance of maintaining the proper functioning of the school in a large-scale project necessitated careful judgment in selecting the income-producing elements and provided more criteria to be applied in early planning stages. At the same time, it was vital to consider the needs of the tenants.

Compatability of types of occupants is an important factor. On the other hand, the temptation to accommodate a single-tenant occupancy might, in some instances, be dangerous. When a single occupancy vacates the premises, the gap between rentals may be damaging to income. Therefore, a scheme of multiple units, so rhythmed that vacancies will not occur simultaneously, should be developed.

In addition to the great demand for residential units in the neighborhood, medical office space, classified as a permitted community facility, was at a premium. One of the city's major hospitals was located immediately across one of the two streets bounding the site. It was supposed that doctors would find it more convenient to have their offices adjacent to the hospital. The desirability of incorporating such office space within the scheme may be seen by comparing the rent derived from different types of occupancy. Current standards indicate rents of $3.50 to $4.00 per sq. ft. for apartments, and $6.00 as a minimum for air-conditioned, modern office space.

The final element in the design was a parking garage, desirable as a commercial enterprise, and required by zoning.

Having determined the nature of the income-producing elements, it was necessary to consider their placement. The garage was placed at the level below grade, and the two levels of medical offices at cellar and basement level, thereby allowing the site to be fully developed for the school and apartment house, according to the law. The school is shown in Figure 1. It occupies three floors, standing on a plaza formed by the roof of the medical offices. The apartment tower rises above the school. Open space is available for the necessary play yard of the school, while meeting zoning requirements. The low income-return of the relatively small number of apartments permitted to be developed, after subtracting the floor area absorbed by the school, is offset by the large amount of office space in the underground area.

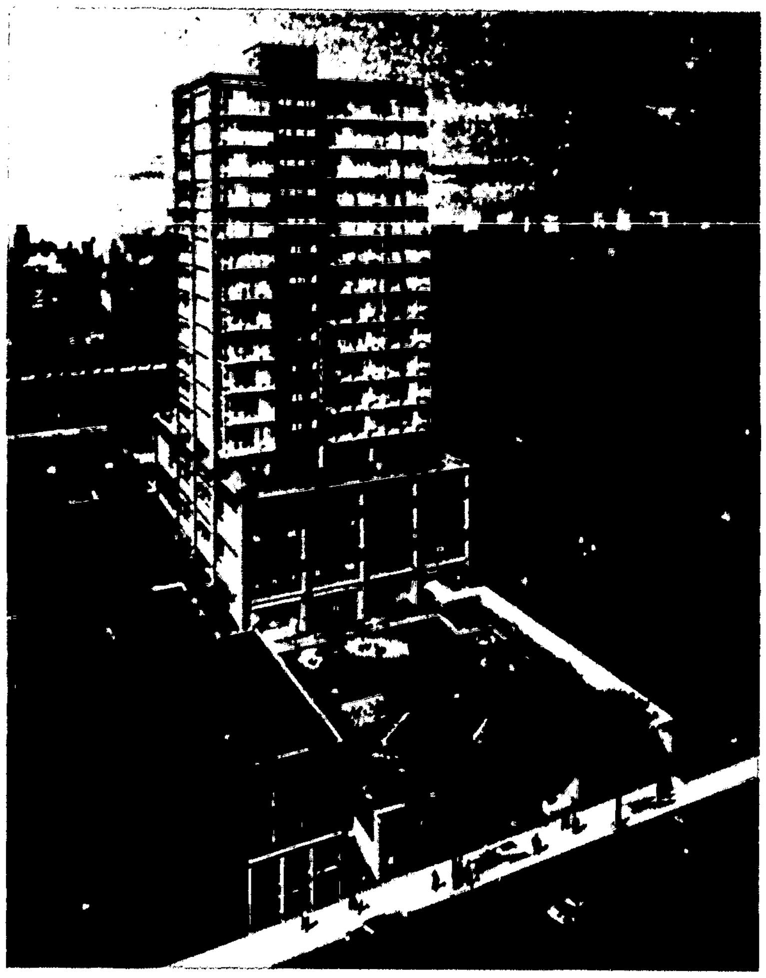

Figure 1 -- The City and Country School.

DETERMINING FINANCIAL FEASIBILITY

The initial estimate for judging the feasibility of the concept was made by determining the extent of the construction loan which could be expected. The estimated cost of construction was $1,800,000, with an additional $750,000 representing the value of the land. The index figure of 75% of the combined value of the buildings and land, as used by lending institutions for estimating the maximum extent of the mortgage loan, is then applied to the total value of $2,550,000. This yields a mortgage loan of $1,910,000. A more conservative figure of 70% will yield $1,800,000. Thus, the first test was passed successfully.

An analysis was made of the income that could be expected to accrue after all expenses had been deducted. The gross income of all the elements was established, excluding the school. The maximum rents to be derived from the apartments, offices, and garage spaces were determined by surveying the neighborhood's current standards. It was presumed that the presence of a school in the complex would add to the assurance that maximum rental would be forthcoming. Apartment dwellers would be pleased to send their children to school without their having to leave the property. More possibilities lay in store for the doctors whose hospital duties were performed across the street. Also, the "prestige" quality of the building complex should not be overlooked.

The net income was determined after all expenses had been established. Figures pertaining to taxes and the operation of buildings were obtained. After all these expenses had been deducted, and the gross income based between an estimated low and high range, the net income to be realized by the school appeared as shown in Table 1.

Management costs have not been included, as the school may assume this function in order to provide additional savings. The tax-exempt status of the school is another important factor. The intrinsic combined value of the land and buildings is eight times the gross income, and operating expenses are very roughly one-tenth of the gross income.

CONCLUSIONS

Some lessons may be derived from this study. As high a value as possible must be placed upon the site contemplated for such an endeavor. Characteristics of the neighborhood must be ascertained, as these will indicate the type of multiple occupancy to be introduced. The ratio of space allotment must be carefully studied in terms of income and operating expenses. Care must be exercised to avoid a top-heavy capital structure which may overwhelm the school effort. A reasonable balance of income to school operating costs is better than an overbalanced income.

As a factor in capital financing, the design itself should be conceived as a unit complex rather than a divided complex. Placing the school upon one portion of the site and the revenue structure upon another will not offer the advantages which are obtainable

TABLE 1 -- INCOME AND EXPENSE ANALYSIS OF THE CITY AND COUNTRY SCHOOL

Income		$75/rm.	$90/rm.	$100/rm.
Apartments - 35 units (139 rooms[1])		$125,100	$150,120	$166,800
Medical - 23,500 sq. ft. @ $6.00		141,000	141,000	141,000
Garage - 59 cars @ $50.00		35,400	35,400	35,400
59 cars turnover		35,400	35,400	35,400
Gross income		$336,900	$361,900	$378,600
Expense		**$75/rm.**	**$90/rm.**	**$100/rm.**
Taxes - 82,400 sq. ft. @ $20 x 75¢ x $4.19	$ 52,000			
Operating				
Heat, fuel	8,000			
Electric	4,000			
Elevator maintenance	2,500			
Water	1,500			
Wages, general help	18,000			
Wages, garage help	8,000			
Exterminator	125			
Painting	5,000			
Supplies	500			
Repairs	2,000			
Insurance	3,500			
	$105,125	$105,125	$105,125	$105.125
Net income		$231,775	$256,775	$273,475
Interest & Amortization - ($1,800,000) 6% + 1-1/2%		135,000	135,000	135,000
Net return		$ 96,775	$121,775	$138,475

[1] Balconies are counted as 1/2 room.

in a single structure. Lower costs will be derived by:

1. A single roof for the whole complex
2. A single excavation for the whole complex
3. Combining of footings and foundations
4. A single plumbing service, stack and water risers
5. Similar arrangements for electrical services
6. A single heating plant
7. Elevator combinations
8. Stair combinations

Long-term savings may be developed for maintenance such as help, single purchasing authority and a levelling off of peak loads. An evaluation of tax umbrellas should be made. In this area the planner must permit the design with the greatest financial yield.

It is, therefore, apparent that schools established on sound business principles and well-organized will be self-sufficient and may amass reserves for future contingencies. The steps described here are a general approach to an urban school-building program.

Management and Operation of School Facilities

Indoor Swimming Pools as Community-School Facilities

By R. Jackson Smith, Eggers and Higgins, Architects

Abstract: The great increase in swimming over the past 15 years has resulted in a corresponding increase in the number of swimmingpools built. This paper considers school pools and cites the principles of pool planning and the optimum dimensions of pools constructed for various types of use. Some attention is given to the materials frequently used in pool construction.

SINCE SWIMMING HAS BECOME A REQUIREMENT almost basic to the physical and social development of the average American, interest in school and community pools has advanced tremendously. A survey published in Swimming Pool Age magazine indicates that the number of pools in schools and institutions has increased from 2,400 in 1948 to 12,700 in 1962, while community and municipal pools increased from 4,000 to 24,700 during the same period. The number of residential pools in America is reported to have increased from 2,500 in 1948 to 248,400 in 1962.

Most residential, club, and community pools are located outdoors and used only in the summer months. More indoor pools are needed to meet the demand for facilities in which swimming skills may continue to be developed during the winter season.

LOCATION

In most communities, pools are located in or near the local schools. Such a location allows the pool to be used for educational purposes during the day and for other purposes in the evening and on week-ends. Such a location also allows for administration by the local Board of Education and the dual use of school parking areas.

POOL PLANNING

There are four basic uses to be considered in planning indoor pools, i.e., teaching, recreational and competitive swimming, (including water-safety, lifesaving, exhibitions, etc.), recreational and competitive diving, and spectator accommodations. In addition to these planning considerations, various service areas must be included, such as lobby, control rooms, lockers, toilets, showers, storage rooms, and filter plant.

SMITH, R. JACKSON. Partner, Eggers and Higgins, Architects; member, American Association of School Administrators, BRI.

INSTRUCTIONAL POOLS

The smallest and most simple indoor swimming pool is a shallow-water instruction pool, which may be considered in conjunction with elementary or secondary schools or community recreation buildings. This pool should have a minimum size of 20 x 30 ft. with a depth of 2-1/2 to 3-1/2 ft. A more desirable size would be 24 x 36 ft., but the pool need not be larger than 30 x 42 ft. with maximum depth of 4 ft.

The instructional pool should have a roll-out gutter for ease of entry and exit to the pool. The water should be from 74° to 76° F., with the room temperature at 78° to 82° F., and instructional classes should not exceed 24 persons. The dressing facilities need not be extensive.

Deck areas around the instructional pool should be sufficient to seat swimmers, but spectator space is not required. Minimum decks should be 5 to 6 ft. with at least one deck somewhat wider than the minimum. Thus, the minimum space required for an instructional pool would be 30 x 45 ft. A more desirable room size, however, would be 36 x 60 ft. Ceiling height for an instructional pool should be at least 9 ft. and need not exceed 11 ft. Dressing areas for the pool should be at least 160 sq. ft., with a more desirable area being 200 sq. ft. The instructors' control and storage room should contain from 100 to 120 sq. ft.

A practical consideration in designing an instructional pool is the "above-deck" principle, which allows the instructor to both observe and talk to the beginner-swimmer with greater ease than in a conventional pool.

TYPICAL INDOOR POOL

The most simple and economical multi-use indoor swimming pool would be 30 ft. x 75 ft. Minimum decks would be 5 ft. wide on one side, 10 to 15 ft. on the other, 10 ft. in the shallow end, and 15 ft. at the deep end. The minimum pool of 30 ft. width is limited to small classes of 16 to 20, and provides only four regulation racing lanes of 7 ft. More desirable would be a 36 to 45 ft. wide pool, 75 ft. in length. This provides for six regulation 7 ft. lanes, plus two outside or buffer lanes.

The standard indoor pool is 45 ft. x 75 ft. with a 5 to 10 ft. deck on one side, and a 10 to 15 ft. deck on the other, and with minimum end decks of 10 and 15 ft. Larger decks should be provided if spectator events are to be held in the pool. Water temperature should be 70° to 74° F., and room temperature 74° to 76° F., except for spectator events, when room temperature should be 68° to 70° F.

While fixed seats for spectators are desirable, it is not impractical to install folding-type bleachers, thus permitting alternate use of the deck-area for lifesaving instruction, body-building, and swimming exercises.

SPECIAL FACILITIES

Greater use may be made of the swimming facility if separate pools are built for swimming and diving. Although the size of the building housing the pools is increased by less than 50%, its capacity for classes and recreational swimming is increased by more than 100%.

A diving pool should be 35 or 45 ft. x 35 ft., with a 12 ft. maximum depth for springboard diving. If high diving is practiced, distances and depths should be increased in accordance with Amateur Athletic Union standard dimensions for diving facilities.

A number of combinations can be made using the pools described above, either to meet budget demands or to provide maximum facilities. A swimming center, with an instructional pool combined with a multi-use single pool, might be desirable as the first phase of development in a community. A more advanced swimming center might contain an indoor swimming pool and a diving pool, while a complete indoor aquatic center might well contain three separate pools, i.e., instructional, swimming, and diving. Combinations of indoor and outdoor pools are also possible.

High platform diving should be given consideration in communities where swimming and diving interest is keen. European countries provide many more indoor pools with high-diving platforms than does the United States. Since diving is an Olympic event, pool planners should include the necessary facilities if funds permit.

Diving facilities should include one, and preferably two, one-meter springboards. A three-meter regulation springboard is desirable and this may be on a hydraulic lift platform, if space is limited. Attractive single-pedestal "streamlined" diving stands are available, and new aluminum springboards have added greatly to diving accomplishments. Springboards should be 16 ft. long, and all fulcrums should be instantly adjustable.

POOL CONSTRUCTION

In addition to the conventional reinforced-concrete pool, we now have air-emplaced sprayed concrete pools; steel pools; aluminum pools; vinyl-liner pools with cement block walls; poured bottoms with steel or aluminum side walls; and poured bottoms with concrete-filled cement-block walls.

Wall and bottom finishes for pools vary from painted cement to tile. The most typical pool finish is a 3/8 in. unpainted or painted plaster coat, consisting of a mixture of white cement, fine sand, and white marble dust. While tile demands the least in long-range maintenance, it has a higher initial cost than other finishes. If tile is used, it should be white and nonslip to a depth of at least 3 ft. Epoxy-resin paints and vitreous wall surfacing may soon provide economical and practical pool wall-finishes.

Gutters are more expensive than flat tile walls, skimmers, and copings, but they serve the purpose of reducing water surface agitation. Types of gutters include roll-out, back-set, deep-set, and flush-deck.

Peripheral tunnels, while desirable, add considerable expense to pool construction, if they are to be leakproof and of sufficient size to permit easy access to the piping. Economical solutions to the pipe-access problem include: overflow trenches with return-line laid in the bottom; combination aluminum or steel return-line coping and over-flow box gutter; and return-line at bottom of pool, with overflow skimmers or flush-deck trench.

Filter systems include pressure or gravity sand and gravel, pressure sand, pressure anthrafilt (coal particles), and pressure or vacuum diatomite. Sand and gravel or sand filters require more space and have a higher initial cost, but are generally simple to operate and maintain. Diatomite filters require less space and have a lower initial cost.

Extensive use of glass on the side walls of indoor pool rooms should be avoided for several reasons, including heat loss, glare, and condensation. Top-lighting is the most practicable natural-light source. If sidewall openings are desired for indoor-outdoor design relationship, provision should be made for opaque blinds or curtains, to reduce heat loss and glare.

Heating, ventilation, and humidity control are extremely important in the indoor swimming pool. Radiant heat in the deck, walls, or low ceiling areas is desirable. Infrared electric heating units are a practical solution. Ventilation should be concentrated in the spectator area, and excessive air movement should be kept away from the swimmers. Humidity may be 50% during most periods of pool use, but should be reduced to 40% for spectator comfort during meets.

In 1962, the approximate construction cost of an indoor pool, including excavation, pool, piping, filters, and diving equipment, but excluding decks, enclosing room structure, lockers, showers, offices, etc., may be estimated at approximately \$12 to \$15 per top sq. ft. of pool area. The budget cost will vary according to locale, subsoil conditions, and design requirements, such as gutters, diving boards, and underwater lights.

School Plant Operation and Maintenance and the Cost of Education Index

By Paul Abramson, School Management magazine, and
Orlando F. Furno, Baltimore City Public Schools

Abstract: An instrument is needed for analyzing how school funds have been spent and for comparing the expenditures of one school with another. The Cost of Education Index is such a device. This paper describes the Index with particular attention to school spending in the areas of operation and maintenance. It is shown that the cost of maintenance is relatively very small, and it is suggested that educational specifications should be the controlling element in school budgeting.

ONE PROBLEM SCHOOL BOARDS AND ADMINISTRATORS must face is tied directly to cost: How can "educational productivity" be increased so that a given sum will provide more and better education? Schools have changed greatly in 60 years. In 1900, public schools enrolled 15-1/2 million pupils and spent almost $215 million. By 1960, enrollments had risen to about 36 million, but expenditures had increased to $15 billion. During 1961-62, expenditures were estimated to be over $18 billion. It is indicated that costs will increase in the future at an even greater rate. As these rise, so will the opposition of the taxpayer.

School leaders need an instrument by which to analyze how school funds have been spent. They need a means of comparing their expenditures with those of their neighbors. This may help to avoid budget cuts, because they will be able to realistically explain why costs are rising. To do this job, School Management magazine has developed a Cost of Education Index.

In the 1940's, the New York State Educational Conference Board supported a pilot study on a cost of education index. Later, in 1958, an index was developed for 18 cities with populations of over 500,000, yet a truly national cost of education index had still not been developed. In February 1959, Dr. Orlando F. Furno requested the editors of School Management to undertake a pilot study of a National Cost of Education Index. School Management agreed to underwrite the cost.

ORGANIZATION OF THE PROJECT

In the fall of 1959, Dr. Furno set up three matched panels of 600 school districts each. Each district was selected because it

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ABRAMSON, PAUL. Editor, School Management magazine; member, Educational Press Association of America, Educational Writers' Association and FURNO, ORLANDO F., Director of Research, Baltimore (Md.) City Public Schools.

represented, by reason of location, population, and expenditures, a random unit of measurement. Each of the 1,000 districts was asked if it would participate in the pilot study. After screening, a sample of some 800 districts was chosen to receive a four-page form requesting information on their spending patterns. In April 1960, the first part of the 1959-60 Cost of Education Index, based on returns from 583 districts, was published in School Management magazine. Actual expenditure figures for 1958-59 were also included. A start had been made toward obtaining a valid and usable National Cost of Education Index.

In developing the CEI we were faced with certain problems. One was the problem of expense. A more important consideration was the demand made upon the time of school administrators who completed our forms. Unlike previous surveys of national school costs, we wanted to go directly to school districts for expenditure data. We needed a form which would elicit a great deal of information from school districts in a manner that would not take a great amount of the respondent's time.

Using the budget classifications developed by the U.S. Office of Education, local school districts were asked to supply information on total budgeted expenditures for administration, instruction, health services, operation of plant, maintenance of plant, fixed charges, other services (food services, student activities), transportation, debt service payments, and current capital outlay payments. Within many of these classifications, details were requested in from one to five subcategories in order to gain additional insight into costs. From this information, a national summary of school expenditures was computed (see Table 1).

TABLE 1 -- NATIONAL SUMMARY OF SCHOOL EXPENDITURES

Category	Average Cost per Pupil		Percent of Net Current Expenditures	
	1957-59	1962-63	1957-59	1962-63
Administration	$ 10.70	$ 13.50	4.1	4.0
Instruction	201.20	261.60	78.0	78.1
Health services	1.50	2.00	.6	.6
Operation	26.00	33.80	10.1	10.1
Maintenance	9.30	11.80	3.6	3.5
Fixed charges	9.00	12.00	3.5	3.6
Other services	.30	.40	.1	.1
Net current expenditures	258.00	335.10	100.0	100.0
Transportation	11.40	14.70	4.4	4.4
Capital outlay	7.20	8.90	2.8	2.7
Debt service	29.50	35.90	11.4	10.7

The first part of the National Cost of Education Index was published in the April 1960 issue of School Management. By August 1960, after the publication of four more parts of the index, schoolmen could compare their budgeted 1959-60 expenditures with those of their neighbors; those of other districts in their region (the nation was divided into nine regions); other districts of their size; and, in a few cases, other districts of similar expenditure levels.

The CEI was developed, basically, to help school districts improve themselves by improving their financial status in relation to other districts of equal size and means, especially those in their own geographical areas.

ENLARGED STUDY PROGRAMMED

In the second year of the CEI study, an Index of Educational Inflation was developed so that school costs over the years could be measured in terms of constant dollars.

We were able to show that, although school expenditures had risen during a period of two years from $276 to $304 per pupil, an increase of $28, less than $4.50 could be attributed to higher expenditures in order to better the schools. The rest of the increase went simply to offset the effect of inflation. Thus, the Index of Educational Inflation shows precisely how much of the increase in school expenditures (i.e., teachers' salaries or costs for teaching materials) went for educational betterment and how much merely offset the effects of inflation. For example, maintenance expenditures rose 18.5% in the first two years of our study. However, the effects of inflation wiped out 10.5% of this rise in these expenditures.

Each January, School Management publishes the Cost of Education Index for the current school year.

OPERATION AND MAINTENANCE COSTS

In the first year of our study, 1958-59, the median school district in the United States spent $276 per EPU[1] for net current

[1] In this study we have used a unit of measurement called Expenditure Pupil Units (EPU). This is based on expenditure studies by Dr. Paul R. Mort which have shown that it costs about $1.30 to educate a secondary school pupil for every $1.00 needed to educate an elementary school pupil. In other words, high school education is about 30% more expensive than elementary education. To make it possible for all districts in the United States to compare their expenditures with all others, we have devised this Expenditure Pupil Unit to make costs at the elementary and secondary levels comparable.

expenditures.[2] In 1961-62 this figure had risen 14.1% to $315 per pupil. For 1962-63 the median district is spending $335 per pupil, an increase of 21.4% over the 1958-59 figure. To bring our study into line with those put out by various government agencies, we have computed a 1957-59 average expenditure figure of $258. We have learned that the cost of educating students is rising at a fairly rapid rate.

Together, expenditures for operation and maintenance rose from $35.30 per pupil in 1957-59 to $43 in 1961-62. For 1962-63 the cost per pupil rose to $45.60. Costs for maintenance and operation have risen steadily over the years. However, applying the index of Educational Inflation against these expenditures, we find that an apparent increase of $10.30 over the 1957-59 average turns out to be an increase of just $6.50.

To talk of maintenance and operation as a single entity reveals but part of the cost picture. Of the cost of the two, more than three-quarters is spent on operation, including heat, utilities, and custodial salaries. Over the five-year period of the CEI study, the median district in the United States has spent from 10.1 to 10.5% of its budget on plant operation.

COST AND EDUCATIONAL QUALITY

The CEI study, among others, has revealed that although there is a positive relationship between expenditures for plant operation and maintenance and quality education, the relationship is neither large nor constant. One of our studies was of the "quality quarter" school districts. These are the districts whose net current expenditures are in the upper 25% of all school districts. In each of the years that this study has been undertaken, the median "quality quarter" school spent a greater percentage of its budget on operation than did the median school for the nation as a whole. It also spent more dollars. In 1961, Cleveland Heights, Ohio, a "quality quarter" district, was spending about $363,000 per year more on maintenance and operation than the average district of the same size.

The question arose as to whether this budget could be pared by cutting out this large expenditure. The answer was that, so far as expenditures for operations were concerned, the cost of heat or utilities could not be cut without affecting the school program. But those were only a small part of the total operations budget. The greater amount went for custodial salaries, which had to be competitive with industrial wages.

[2] Net current expenditures include the amount expended for administration, instruction, attendance and health services, operation, maintenance, fixed charges, student body activities and food service. They do not include debt service, capital outlay, or transportation.

There is a direct relationship between the expenditures of a school district and the quality of the education that district is providing. Anyone can point out a district that is providing a superior education while spending less money, but it is the exception rather than the rule. In general, schools that spend more money on their educational programs are able to provide a better education for their students.

An analysis of expenditures for administration, instruction, capital outlay, debt service, and operation (excluding heat and utilities) reveals a great deal of information about the quality of a school district's ongoing educational program. However, studies made over a number of years have tended to show that the same is not true of expenditures for maintenance. These are a poor indicator of school quality, for they relate most directly to climate, terrain, and other items beyond the control of local school boards.

The Cost of Education Index was designed as an instrument to measure educational quality, but studying a district's maintenance budget yields unreliable clues and unsatisfactory guidelines in the quality of its educational program. Our studies show that most school districts expend relatively small fractions of their total school budgets for plant maintenance. This cost is not equal, in general, to the amount a school district spends each year for its retirement funds, insurance, and other fixed charges. It is less than the amount spent on transportation or on administration, and it is minor compared to what is spent for instruction.

MAINTENANCE COST SMALL

That is as it should be. School budgets should not be designed for the sole purpose of keeping buildings clean. Buildings should be kept clean and in good repair, but this objective should not be the major purpose of education. Yet, when the question of expenditures for education comes up, there is always the cry for holding the line on maintenance costs. A school building may be redesigned to make it easier to clean. In some cases, windows are eliminated because they get dirty and cost money to clean. There may be good reason to make these changes, but ease of maintenance should not necessarily be one of them.

There has been much talk lately about the use of carpeting and air conditioning in schools. The point is always made that these will cut down on maintenance costs. Such a case makes for a strong selling-point, but not necessarily a valid one. If carpeting schools is of value educationally, if air conditioning is of value educationally, then let's have them--but only if air conditioning in a school results in a better environment for pupil learning; or if carpeting can reduce distractive noises, which impede pupil learning. To bring these things into the school because they can cut down on our maintenance costs would be foolish, indeed.

The cost of maintaining our schools, as shown by the Cost of Education Index, is very small. Certainly, if we can save a few pennies here and there, let's do it, but let's beware of the school built for ease of maintenance, of the material used solely because it is easily cleaned. Let us build schools that meet all of our educational specifications, first. The cost of maintaining them may be important, but it must be a secondary consideration.

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Open Forum Discussion

Moderator: Henry J. Stetina,* American Institute of Steel Construction, Inc.

Panel Members: Messrs. Abramson, Collins, McKeag, Radoslovich, Shilowitz, and Smith

Mr. Stetina: Schools are noisy. Gyms, play areas, workshops, group singing, band practice, children coming and going are all sources of noise throughout the school day. Isn't this objectionable to medical offices which are in the lower levels of the building described by Mr. Shilowitz, and also to the apartment dwellers above the facilities, particularly those who sleep during school hours? How is this problem solved?

Mr. Shilowitz: Some of these questions have arisen and they are still unanswered. You must realize that schools in urban areas exist now with apartments surrounding them on all sides. People are conditioned to this. I know of no great number of vacancies in apartment buildings near schools. There might even be a reverse situation, because many families want to live in proximity to school, and they expect it to be noisy.

In our particular scheme, the medical portion is isolated, because there will be a concrete deck above it. The medical center is essentially below grade. The apartments overhead could receive a full share of noise, but again I point out that the school exists now on this site. It's surrounded by large new apartments, and they have very few vacancies.

Also, to alleviate this problem, we are including balconies. This is going to be a luxury-type apartment and we may design the balconies to be somewhat sound-absorbing. This would aid in noise reduction. We have also designed the apartment house tower so that all the bedrooms are on the north side, which happens to be away from the play yard. We have only living rooms on the south side.

*BRI member

Mr. Stetina: You described the case of a school built within the framework of an office building. In your example, the site obviously belonged to the city, because it contained an existing school. Who will be the owner of the office building? Second, you mentioned rentable floor area. Is the City of New York going to rent office space?

Mr. Radoslovich: I don't believe that this can be solved by educators or architects or engineers, or even builders, by themselves. Finance, American business, and private enterprise must work out these problems. As an architect, I will give you briefly two possible answers. One is the erection of the combined school-office building by private interests, with school space leased to the Board of Education by the builder. Another plan would be for the School Board to erect a building on the site, and rent air rights to private enterprise.

Mr. Stetina: My own reaction is that whenever a municipality, or any arm of the government, competes with private enterprise, nothing but confusion ensues.

William Lukacs, Architect: Were any studies made of the life expectancy of each mobile unit, number of moves, cost of maintenance, repair during the lifetime, etc.?

Mr. McKeag: These units have been in operation in Chicago since February 1962. We have moved 18 of the 150 units from their original locations without difficulty and without causing any deterioration of the structures. Each of these units comes with an undercarriage of four wheels at the rear. We maintain several sets of these wheels in our warehouse, and we put them on when we are ready to move. I would hope that we will get 10 years plus out of these units, and I believe that, if they provide 10 years of this type of flexibility in our system, we will be well repaid. The exterior is aluminum which can be washed. The interior is very simple to maintain and clean. The only difficulty we have had is that some of the air-conditioning units failed to function, and we have had to replace the motors. We have a one-year guaranty, so it has cost the school board nothing for this particular replacement.

William Lukacs, Architect: How and when will the data collected in the National Inventory be available in substantially final form to architects and school administrators?

Mr. Collins: The Office of Education is planning a publication that will be available to architects. It is impossible to publish all the material. Preliminary plans are to select about 40 tables to represent the national totals and some of the state figures.

It probably will be around December 1963 before this publication will be available. Since the states are getting all the material, each state could also publish the material it has for its particular state, and this would not be a duplication of the national effort.

Jonathan King, Educational Facilities Laboratories: Does the City and Country Project suggest anything about the nature of the architect's professional services, i.e., was design and structure your major problem or did other factors require major attention?

Mr. Shilowitz: The problem revealed itself as we went along. Just the other day, a school administrator asked me how I would recommend that a similar study be made for his school. Could it be made by a committee of parents, teachers, those with specialized backgrounds in real estate, particularly? I had to answer, at the risk of over-emphasizing the case for the architect's early participation, that the architect must enter into the picture very early in the planning stage. He must perform many functions which were not his in former days. He has to become a real estate expert. He has to develop much of the entire program for the clients who, in most cases, have had very little experience with this kind of planning. The architect, to cite one instance, must help in the matter of zoning. An economically feasible solution depends immediately upon where you are going to distribute the different income-producing elements. If you develop four different schemes, you will have four different economic pictures. Therefore, I think there is a very expanded role for the architect.

Edward Lowenstein, Loewenstein & Atkinson, Architects: What are your personal preferences for tank construction, tank surfaces, and tank gutter and profile? What's wrong with the aluminum pool?

Mr. Smith: My preferences are: for tank construction, concrete; for tank surfaces, tile; for tank gutter and profile, roll-out. The vertical wall of the gutter is set back about 12 in. This allows for ease in getting in and out of the pool, and prevents water from washing out on the deck. Its only disadvantage is that, in competitive swimming, the backstroke swimmers will have a tendency to swim out of the pool. To prevent this, turning boards and starting boxes are set at the ends of the pool racing lanes.

Aluminum is practical for small pools. One of the most interesting developments in the construction of pools is a combination of concrete bottom and steel or aluminum side walls. These pools have a roll-out gutter, with the return water carried in a tube at the back of the gutter.

Georgette Manla, Overview magazine: With so many school districts relying on state aid for funds to finance all phases of their operations (in some cases receiving about 50% of their funds from the state), how can the Cost of Education Index set a true measure of the amount of money a district could or should spend? Doesn't state aid influence the barometer of costs beyond what the Index shows?

Mr. Abramson: It really has no bearing on the question at all. What we have developed in the Cost of Education Index is a measure of how the district spends all of the money that comes to it. We have, in addition to this, asked the districts to tell us where they got their money, and from this, have been able to develop certain estimates of the local effort that a district is making. This particular index of local effort would be affected by the source of the money. If the district gets a lot of money from the state, obviously the local effort is going to look lower than, for example, some New England states where the state provides a much lower percentage. But in terms of expenditures, where the money comes from does not have any effect or any bearing at all.

William Lukacs, Architect: Have you not had maintenance problems with exposed iron and steel in bleachers and trusses, and with the wood trusses which are exposed?

Mr. Smith: We have not had problems with metal connections in folding bleachers, nor have we had problems with metal or glue-laminated arches in the structural framing of the room.

S. Silverstone, Carnegie Tech.: Pittsburgh landscape architect John Simonds has referred to a school playground as being a colorful, playful place that expresses "running, climbing, swinging, shouting, etc." By suggesting the use of mobile units, windowless classrooms and multi-use buildings, are we merely providing the most economical floor area necessary for education, and forgetting the spirit for which the entire educational concept is intended?

Mr. McKeag: An educational plant is a combination of all these fine services. The playground definitely renders a tremendous service to a school system. We have only established mobile units on the playground where we have had adequate space. We believe in fine playground facilities, and feel that all schools should have them. Incidentally, we started a program about five years ago in which every school playground in the city received a complete rehabilitation, with blacktop surfacing, stabilized soil, and the necessary equipment. We feel this is extremely important. I talked about mobile units merely as temporary classrooms, but there are many other possible uses of these classrooms. For instance, four units could be placed in a square with a floor in the center and a raised ceiling installed to provide light on all four sides, and create an all-purpose room of approximately 1600 sq. ft. Since we have baseboard heating in each of the four classrooms around the periphery, this could be used to heat the newly created room. This area could then be used as a playroom or a small gymnasium. So far, we have only placed these units where they are relatively near existing schools. We happen to have 16 of these units placed on one school site at the moment. This school building has been under erection during this period of time, and is now nearly complete. The top floor, some 10 rooms, will then be available to us. As these 10 rooms are made available, we will move some of these units from this site to another location where a school building is currently being erected.

Fred Osmon, Architect: Mr. McKeag suggested that the relationship between a school and a park is a good objective to strive for. Mr. Radoslovich, by placing a school in a commercial office building, has reversed the concept. Isn't a school something more than a certain amount of square footage of office building space? Why don't the New York public schools strive for more park-school sites?

Mr. Radoslovich: Unfortunately, we cannot work with our Park Department in the same manner as Mr. McKeag does in Chicago. It's not permitted to have schools in parks. It would be nice if we could. As for the first part of the question, cities live by taxes, and real estate taxes are very important. If we take 10, 15, or 20 acres of land out of the taxable land in the city, and continue to do that for the next 20, 30, or 40 years, there would be no land and no income left; there would be no schools left. I am not saying that my suggestions are the perfect solutions. I would suggest, though, that it is wrong to take half a block of land in the heart of Manhattan and build a three or four-story school on it, fence the property with a 16 foot fence, and cover every window with jail guards. That doesn't make a good environment for a school, in my opinion, We can, perhaps, create a far better environment if we let the school be a part of the city, particularly a business high school. The students work in the neighborhood, part-time or full-time; and they have day school and night school. If they have their own school-building facilities in the environment in which their careers will be, will that not help them?

Mr. McKeag: I don't know what the local problems are in New York in terms of school-park use, but I think probably the same kinds of problems existed in Chicago before people got down to basic facts and tried to do something about them. It took five years of conferences, of getting together, of give and take, to achieve this. Chicago has been noted for its fine park system. This is due to the foresightedness of the people of Chicago, who looked ahead and obtained the land for parks in the early period of its development. For this we are very grateful.

However, it seems to me that what has been accomplished in Chicago in terms of a school-park cooperative development has done much not only for the parks but for the schools and the public in general. The savings in terms of capital improvements in Chicago have now exceeded $20 million and this would seem to be worthwhile from the standpoint of the taxpayer. There is no reason to have duplicate facilities, such as a school building in one location, and just a half a block away an elaborate fieldhouse containing gymnasiums, libraries, meeting rooms, etc. These things should be used jointly. The park district moves into our school building at 3:30 p.m. and it conducts its park operations until 10 p.m. It uses these facilities all day Saturday, or holidays, etc.

Mr. Radoslovich: We do have jointly-operated playgrounds with the park departments in New York, but that does not mean that we use our parks in the same manner as Chicago does. It means that whatever is left of the site is devoted to a common playground, jointly operated by the Park Department and the Board of Education.

George Rottman, Guilford County North Carolina Schools: In the use of mobile classrooms, did Chicago find it necessary to waive or revise any existing zoning requirements pertaining to the control of mobile housing units?

Mr. McKeag: No. When we decided what the specifications should be, we consulted the Planning Department and received their approval of our plans. When the units are brought into the city, we obtain permits to move them over the city streets. The Chicago Police Department even cooperates to the extent of providing an escort service through the streets. Everyone has cooperated very well in this enterprise.

Charles A. Klesius, Housing and Home Finance Administration: Do you have the comparative cost of your mobile unit without air conditioning?

Mr. McKeag: No. All of our 150 units are air conditioned, and future units will be air conditioned. Our use of air conditioning in these units has now led to the incorporation of air conditioning in our newer school buildings, the first of which was opened in September 1962.

I would like to digress, to tell you of another flexibility core we have in our system. Some 4,000 units were established between 39th Street and State Street to 55th Street. From these particular housing units we received 13,000 school children. We were not ready for this kind of development when the Chicago Housing Authority created the project, but we got busy, got the sites, and got our buildings underway. Then, we found these high-rise buildings, 19 stories high, each of which supplies 375 to 425 children to our school system, were to be finished 9 to 12 months ahead of schedule. We were not ready for this, either.

We went to CHA and asked, "Is it possible for us to obtain for classroom use the two large apartments on the first floor at either end of your buildings?" We met with some resistance at the outset, and finally had to go to the Federal authorities, but we got approval there. We now are renting 83 apartments from the Chicago Housing Authority for classrooms that I think are very good. Without interference of posts, we have 800 sq. ft., with washrooms in each of them. The only thing which CHA did was to eliminate the partitions for bedrooms. We put in some additional lighting, the necessary blackboards, bulletin boards, and other facilities. This is another temporary measure, but if there is future development of this kind in Chicago, I see no reason why these buildings would not be ideally suited and located, for purposes of school structures. We now house kindergarten and first grade classes in these apartment units. This is one more phase of our flexibility in Chicago.

Milo D. Folley, Sargent-Webster-Crenshaw and Folley: Your program seems very effective, but is a classroom of 620 sq. ft. adequate for an up-to-date educational program? If it is, why do we need 700-800 sq. ft. in fixed units?

Mr. McKeag: The 620 sq. ft. meant that we could not accommodate a class of more than 30. I feel that we will eliminate many of the problems that trouble education throughout the country if we can reduce our class size to a reasonable figure. All around us in Chicago, throughout our schools, in places like New Trier, Winnetka, Evanston, Glencoe and Oak Park, the classes are very small. Some high school classes have only 15 and 16 students. In Chicago, we have nearly twice that number. In our elementary schools, for a long period of time, we have had classes of more than 40. The 620 sq. ft. limits the number which we can put in these classrooms, so I find it to be no disadvantage. The teachers are able to have their reading units in one corner and do other things in the other corners, and for this size group in the primary grades, there is no difficulty. It might become a problem for the high school unit. If you were going to use one of these for science, I have an idea you would want something considerably larger, but there's no difficulty in making these larger. You can't make them wider, but you can make them larger. These could be made 50 ft. long so the actual interiors would be 20 by 41 ft. or 820 sq. ft., which should be perfectly acceptable to a high school group.

S. E. Hubbard, Kawneer Company: Does the $10,000 to $30,000 spread account for the absence in the mobile unit of auxiliary spaces such as corridors, offices, gyms, cafeteria, boiler rooms, etc.?

Mr. McKeag: I would say probably $5,000 of the $30,000 for the average standard classroom would be so interpreted.

Definition of School Facilities Needs and Utilization

By Alonzo J. Harriman, Alonzo J. Harriman Associates, Inc.

IN THE PAST 40 YEARS OF SCHOOLHOUSE CONSTRUCTION, there has been a complete cycle in some of our design concepts. Consider the size of the classroom in the 1920's. We standardized quite generally throughout the country on a 22 x 32 ft. classroom for plus or minus 35 students, for all grades. The reason for this was to reduce the size of the teacher load by reducing the size of the room. The classroom was big enough to seat 50 students.

In the late 1930's, starting with the Crow Island school designed by Saarinen and Perkins & Will, elementary classrooms began to increase in size. By this time, the idea of smaller classes had been accepted. It was now safe to increase the size of classrooms to accommodate new methods of teaching. This complete cycle took place in about 20 years.

The window-glass cycle has taken somewhat longer. There have been regulations about the required glass area for approximately 50 years in some parts of the country. It was once stated as fact that any childhood ailment could be traced to a lack of natural light in the classroom.

With this so-called fact in mind, architects and educators worked to solve the light-deficiency problem, and many solutions were suggested: clerestories, north light, and glass blocks as well as many ingenious and frequently ridiculous schemes -- all for the purpose of developing uniform intensity of daylight. Yet, today, we are proposing classrooms with only artificial light.

Another example of our about-face reasoning of the past is that of the school-building plan. If you wanted to win a commission in the 1920's or 1930's you designed a school with the gym and auditorium in the center and the classrooms grouped around them. This was compact and economical. The initial cost and maintenance were low, but it later developed that school administrators did not like this plan due to the interference of noise from gym and auditorium with the classroom activities. Also, the gym and auditorium were not easily isolated from the classrooms for extra-curricular use.

HARRIMAN, ALONZO J. Architect-Engineer, Alonzo J. Harriman Associates, Inc.; Fellow, AIA: member, American Association of School Administrators, BRI, National Council of Architectural Registration Boards, Society of Professional Engineers; Chairman, Committee on School Buildings and Educational Facilities, AIA.

So we moved the gym and auditorium, separating them from the classrooms for easier use by the community and for better isolation, and the educators loved it. This began a trend which continued until we had the campus plan with separate units, sometimes connected by corridors. This plan was their second love.

In the end, however, this was just another case of "when you get what you want, you don't want it," and today, the trend is back to the compact school. This change in reasoning creates confusion in the mind of a person trying to design a building for a reasonable life expectancy.

EDUCATIONAL GUIDELINES NEEDED

It would be of great help to school building designers to have good educational specifications, including space requirements and interdepartmental relationships. From indications in the preceding papers, the future looks no brighter than the past. With teaching aids on the market which are still very much in the developmental stage, and with methods of teaching and size of learning groups both in a state of flux, it seems that for the present we should design our new buildings "to keep out of the way." To design such a building and still have one that has the extra something educators ask for is a real challenge. It will require real teamwork, and will take time and study, but it can be accomplished. However, from our look at the past, we cannot expect or even hope to design the ultimate educational structure. The current thinking seems to be quite to the contrary.

This means that a planning team made up of school board, superintendent, teachers, consultant, architect, and engineer, has to know what is current in school buildings and it must be able to improve and modify it to meet a community's particular needs.

This conference has also pointed out that research needs to be done on evaluating teaching methods, teaching environment, and teaching aids. One cannot expect a building, designed to fit an unknown eventuality, to fit by happenstance the detailed educational program that one finally puts in to it. A building that is designed to take care of any particular situation is bound to be somewhat insufficient.

This ability to house a multitude of functions is what some call "adaptability," and others "flexibility." Whatever term is used, the cost of the building will vary with the amount of its adaptability; the more adaptability, the more cost. This will naturally require modular design, with services and utilities available and controllable at single or double modular intervals. It can be done, and citizens can get what they want when they want it, but if the school building team wants these more costly ideas, they will have to sell them by keeping the community informed.

Many areas are indicated in which there is need for further definition, to give a clearer picture of the requirements to the consultant and the architect. This also applies to utilization, which I would say is normal, under present conditions.

NEED FOR ORGANIZED RESEARCH EFFORT

The large amount of research done by the Educational Facilities Laboratories has only scratched the surface of the work remaining to be done. The idea of developing better communication between educators and industry surely warrants further investigation. There is a real need for this kind of activity, but it is rather late in coming.

The CLASP system may well warrant further investigation as to method of school construction, and it may develop some potential savings in school costs. The greatest saving, however, in the British schools is due not to the structural system used but to the reduction in area of the school plant itself, as the result of a close study of space requests with an eye to multi-use, wherever possible.

The prize-winning designs for combined school and fallout shelter are very interesting. They indicate that schools can be designed with fallout protection and that the protected area can also be used for school functions without a material increase in cost. This proves that it does not pay to be dogmatic in this changing age. The American Institute of Architects and the State of California had both stated that fallout shelters and school buildings are not compatible; these designs show how wrong they were.

School Facilities Design, Equipment, and Services

By Milo D. Folley, Sargent-Webster-Crenshaw & Folley

IT WOULD APPEAR FROM THE SUBJECT MATTER covered at this conference that our schools are alive and energetic. The challenge for improved knowledge has heightened the quality and variety of our educational program and increased the need for the facilities necessary to accommodate such a program. The problems of school growth are of concern to all who are in the business of building. Architects, engineers, researchers, finance, and industry, as well as educators, all help to provide the physical facilities, equipment and services for education.

With educational programs taking such varied directions, industry finds itself at a loss to keep up with the random patterns of development. Where does industry look for its answers? When every school system follows its own dictates, to what oracle can we go to find out what next year's teaching patterns will be like? Do we follow the windowless, the core, the school-in-a-school, the flexible-space approach, the spiral-vertical tower program, or what?

STEPS TOWARD BETTER LIAISON

It is obvious that industry can contribute to the educational program. Papers included here show that, when science and industry join to solve functional problems of education, real advances can be made. However, guidelines should be drawn so that industry can better analyze problems of education. The following suggestions to educators might expedite the liaison between industry and education.

1. Define the educational program in a manner which can be universally understood. Avoid jargon having meaning only to educators. Educators are accustomed to dealing with broad concepts, while industry must supply definite and detailed space, equipment, and services. When discussing space, determine actual areas and periods of usage, characteristics of acoustics, problems of maintenance, etc. How much can be spent for a folding partition? Is that degree of flexibility needed?

FOLLEY, MILO D. Partner in Charge of Design and Research, Sargent-Webster-Crenshaw & Folley; member, American Institute of Architects, BRI; AIA representative on the Inter-Society Color Council.

2. Do not be misled by unusual architectural schemes which may warp a teaching program. Solve educational problems with a careful programming of your requirements. Don't leave it to the architect to suggest an educational program; give him the specifications, and make sure the building and its equipment will accomplish what you have in mind.
3. Be realistic in establishing requirements. Don't expect a cafeteria to be acoustically all-absorbent during the lunch hour and perform as an acoustically ideal auditorium the next moment. When you ask for 100 foot-candles of light, be aware that more ventilation and cooling are required because of the heat of the lamps and that these are costly. Ventilation, lighting, and acoustics must be carefully studied, and costs are bound to increase when such flexibility is provided.

AREAS FOR CONCENTRATED STUDY

In the realm of interior finishes, new products continually offer better solutions to age-old maintenance problems. It is not that industry has not provided the product, but that it has not been brought to the consumer's attention. In the same manner, the consumer has not transmitted his desires to the product manufacturer, so a gap exists between needs and solutions. In this relation, the architect must keep himself informed of industry's accomplishments, so he can offer his client the improvements and economies industry has developed.

Research in facilities for division of space, for the handling of multi-use areas, and for adequate heating-cooling, lighting, and ventilation of teaching space must be carried on by industry but under the guidance of educators who understand the limits of such construction. Preassembly of building components may limit usefulness in certain aspects, while offering savings in cost and construction time.

Educators are looking to industry to offer a "packaged" environment, capable of producing an ideal learning situation. They look for a system which will "purify" the environment, preventing the spread of germs, allergy, dust, and odors. They have heard of the reported advantages of negative ions, and how they improve the attitudes of both teachers and students. Lower maintenance costs may be a by-product of such an environment.

The success of any teaching facility is affected by the equipment used to transfer knowledge. In this field industry is working closely with the National Education Association and other groups to produce teaching machines and up-to-date visual-aid materials. The potential danger here is that of the impersonal relationship between the machine and the student. Industry is warned that it must work closely with education specialists so that the student will not reject these devices. Increased progress is possible only if educators and industry work together to prepare educational materials and equipment.

Research by educators is also necessary if the machines prepared by industry are to be used to maximum advantage. Teachers sometimes resent intrusion into their vocation. Educators can advance their science by using the resources and the efforts of industry. Old-time teaching methods can be upgraded with industry's assistance, but attitudes must be susceptible to change when new products or ideas are presented.

Because new products are constantly being created, the service of the architect must be improved, if the client is to receive full advantage of industry's progress. In this connection, many architects work closely with educational consultants. The educational consultant has a broad background in teaching, the philosophy of education, the concept of space, and the application of teaching methods. He must keep abreast of new products and services, and thus supplies an important link between the client and the building industry.

Recently, industry has become aware that schools are a great consumer of services. Innovations in communications, computers and data processing, food preparation and serving, maintenance, and teaching devices are only a few of these. This market will develop tremendously in the future. Many schools have installed data systems, and others take advantage of television broadcasts, and subscribe to audio-visual libraries. Food is now being frozen to be dispensed through automatic devices as needed, all without a moment's concern by the school staff.

Research is also needed in building codes affecting schools. The code that applied to the little wooden schoolhouse cannot be applied to a concrete "bunker" school. Previous codes are often inadequate to deal with flexible partitions, large lecture spaces, etc.

Research in the philosophy of the relation of the school to the community is also an appropriate subject. I am distressed at the attitudes of those school boards which feel that schools should meet the "minimum" standards of the community, rather than be functional tools for teaching. If a carpeted school is a better school, why worry about public opinion? Why should not a district build a school to be proud of, rather than be concerned only with whether the school looks too "costly." We have often avoided using products, such as marble, which would be less expensive and more functional than those finally selected, because of public opinion against their luxurious appearance. If air conditioning can produce better learning, or if better illumination or more floor space or better equipment can increase learning and safety, why do we avoid their use?

New products, new spatial relationships and new methods will necessitate a re-evaluation of our concept of beauty in a school.

We have left the classical facade, passed by the factory effect, and survived the "chicken coop" criticism. Now we are pioneering the new science of building. If we are to arrive at successful school solutions we must demand the best efforts of educators, the design professions, and the building industry.

Management and Operation of School Facilities

By Marvin R. A. Johnson
North Carolina Department of Public Instruction

THE DEFINITIONS DISCUSSED HERE are presented to help improve communication among those who are interested in school facilities research. Dr. Collins has mentioned the Handbook I, The Common Core of State Education Information, which was developed by school people from all parts of the country, and published by the U. S. Office of Education. Its purpose is stated as follows: "This handbook is designed to serve the same purpose for certain basic items of educational information as the dictionary serves for words in the English language."

This book includes a glossary of terms in which the word operation is defined as: "Those activities which are concerned with keeping the physical plant open and ready for use. It includes cleaning, disinfecting, heating, moving furniture, caring for grounds, operating telephone switchboards, and other such housekeeping activities which are repeated somewhat regularly; daily, weekly, monthly, or annually. It does not include repairing."

Maintenance of plant (plant repairs and repairs and replacement of equipment) is defined as "Those activities which are concerned with keeping the grounds, buildings, and equipment at their original condition of completeness or efficiency, either through repairs or by replacements with property of equal value and efficiency. If additional values and increased efficiency result through replacements, these additional values should be charged to capital outlay."

The term school management does not appear in the book. A suggested definition is "that part of school administration which deals with problems relating to the operation and maintenance of school facilities -- buildings, grounds, and equipment. Operation and maintenance both have rather precise definitions, but they appear to have been expanded to include such functions as insurance, safety, cost analyses, facility utilization, and security; building renovation, rehabilitation, and remodeling; selection and training of custodial and maintenance employees; purchase, storage and

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JOHNSON, MARVIN R. A. Design Consultant, Division of School Planning, North Carolina Department of Public Instruction; member, AIA, American Association of School Administrators, BRI, National Council on Schoolhouse Construction, North Carolina Education Association.

utilization of custodial and maintenance supplies, materials, and equipment."

In quoting these definitions I would like to emphasize that it is well for us to agree to some extent on the meaning of these words, as all of us together continue our research and studies of these matters.

COMMENTS ON CONCEPTS PRESENTED

First I would like to discuss the report of Dr. Collins on the National Inventory of School Plants. For such an inventory, we need more objective reporting methods. North Carolina did a good job on this. However, the information our people gave is not as consistent as it should be, even though the questionnaire forms were well designed to minimize subjective responses. Too many different people had to fill out various parts of the report forms -- people of wide variation in experience, competency, standards, and understanding.

The inventory indicated the willingness of school people to cooperate in furnishing information. The emergency and defense aspects of the request helped. It also will demonstrate to educators the effectiveness of the use of data-processing methods in recording and retrieving information. It provided an incentive for local administrators to gather information they needed and wanted. In other words, this inventory started something; it did not finish it.

Second, on the subject of mobile classrooms, it appears that in the Chicago area they are proving quite successful. If that is so, it is urgent that we get the best designers available to plan them. However, mere adaptation of existing types of mobile residential units won't do, nor will purely "practical" transportable units. A school is more than a collection of functional units for sheltering people or "academic trailer camps," as Harold Gores called them. We should determine whether decisions in regard to these portable units are made more in the interest of simplified school management than in terms of long-range educational merit. There is a place for mobile, demountable, transportable, and temporary facilities, but much study is still in order.

Third, let us consider the two presentations concerned with schools and other functions combined in the same building. The possible combination of schools with facilities of other occupancy makes good sense in urban areas. This approach means that school people must reconsider the management of school properties. It will also put the schools in a more realistic position relative to the communities they serve, and will provide convenient facilities for continuing education for all residents. However, more studies and research endeavors are needed in this area.

As to the report on swimming pools, swimming is admittedly an excellent activity in a physical fitness program. It is something for which you never get too old. There is great need for more emphasis on water safety in this day of increasing boating, beach trips, and number of local ponds and pools. Preserving human lives is involved in an expanded swimming program in schools.

Problems of safety and sanitation in pools are attracting the attention and concern of safety and health organizations. The school pool, designed for maximum year-round use, is such a good idea that it will never be accepted. We need more studies on the advantages of pools and on the costs of construction and operation.

In the field of education costs, there remains a great need for extension and expansion of valid methods of measurement, especially in the matters of facilities, initial costs, and management costs. It is encouraging that someone is working to do something about this, as Mr. Abramson and Dr. Furno are. I strongly agree that good schools should be built to meet educational, not maintenance, specifications. A school may be clean, but not a very good place in which to learn.

Schools are for people; for children and young people; for pupils and students. Teachers are for students. Administration and management are for pupils and for teachers. Schools and the people who serve them are for the education of people; that is their reason for being.

It is necessary always to keep in mind that which is important, when we talk of administration, management, operation, and maintenance. Mr. Abramson was right when he said that air conditioning and carpeting must be defensible educationally, not merely administratively; and so with all matters of management. Reduction in costs of school operation and maintenance should make more money available for instructional services, materials, and space.

SELECTED AREAS FOR FURTHER RESEARCH

Further research may help us in making decisions regarding other problems in school plant management, such as:

1. How to measure and compare the costs of school plant construction and management, and to understand the relationship of these costs to the total cost of education.
2. How to compare objectively the cost of various methods of providing the appropriate thermal environment in schools.
3. How to simplify controls of increasingly complex mechanical and electrical systems and equipment installations.
4. How to obtain the necessary technical services to operate and maintain the complex equipment of the newer educational media.
5. How to achieve optimum safety of occupants within the limits of reasonable cost, agreeable environment, and individual responsibility.
6. How to determine the attitudes which result in vandalism and in other willful misuse and destruction of school facilities.

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7. How to determine if and when existing facilities should be remodeled, renovated, abandoned, and how to reduce early obsolescence in new facilities, to achieve flexibility and adaptability to change.
8. How to appraise the merits of materials and finishes, considering original cost, maintenance and operation, durability, sanitation, and their effect on people.
9. How to achieve the most suitable surfaces for outdoor areas.
10. How to make decisions achieving a balance between cost for site acquisition and site development, and how to plan for intensive use without high maintenance costs, yet with attention to human needs.
11. How to handle management matters related to a more extensive use of school facilities for such programs as adult education, recreation, and avocational use.
12. How to utilize effectively the improved mechanical methods in operation activities, such as cleaning and other custodial services.
13. How to add status and dignity to positions in custodial service.
14. How to select furnishings and equipment which are comfortable and also easy to maintain.
15. How to encourage proper responsibility on the part of students for the care of school facilities.
16. How to compare preventive maintenance with the "breakdown" approach.

OUR CHALLENGE

I repeat that schools are for people and for their education, and I ask the question: How do we judge whether what we are doing in our buildings improves education and is good for people? No one knows all the answers to that. Part of our research efforts in the field of school facilities must be directed toward finding out.

Many of us do not know what has already been proved in regard to man's response to his environment, how environment teaches, how environment affects learning. In his brief statement. Mr. Edward Gleazer asked for more emphasis on the use of knowledge in the behavioral sciences, of psychology, sociology, and anthropology. We might also add physiology, health, and medicine.

I leave with you a challenge. In producing, manufacturing, promoting, selling, designing, furnishing, installing materials and equipment, and providing buildings which are especially intended for schools, is what you are doing primarily in the best interest of improving education? Ultimately, everything we are doing must be evaluated in these terms. How are we going to know?

Open Forum Discussion

Moderator: Howard E. Phillips,* Western Electric Company, Inc.

Panel Members: Messrs. Folley, Harriman, and Johnson

Mr. Phillips: It has been said during this conference that the most important shortcoming in the academic field is the lack of academic objectives; that we as architects need to adjust more quickly to new teaching techniques. It has also been stated that architects have a hard time finding out needs for school design, yet it has been suggested that we not design a school around today's needs, but look into the future. This seems to put the architect on the spot, by asking him to design something that the educators haven't actually specified. Has anyone on the panel a comment on the need for a more specific statement of objectives?

Mr. Harriman: If you design a school building for multi-use, you lose the intimateness of that building. The more flexibility you put into it, the more sterile and institutional it becomes. The little things that you design into a school building give it the "homey" feeling you want to create. We like to design school buildings for the size of the student, but if it is to be an all-purpose structure, you can't reduce the height of it. The height must be the maximum required for some future use, not for its use at present.

Mr. Folley: I think there's a problem here that is broader than just education. The problem is that architectural service is becoming a broader and broader subject. It may even be necessary for an architect to have real estate personnel on his staff, so that he can make decisions for the benefit of clients involved in real estate, and perhaps in finance. We have found it necessary already to be well versed in both engineering and city planning, and now we are finding it necessary to act as educational consultant. An architect, with all his diverse duties, cannot be the educational consultant himself. He must rely on people who have the proper training. We should all try to use the best talents available in analyzing the subject.

William Lukacs, Architect: You did not say anything about the "unit" building idea. Doesn't this seem to go back to the old one-room schoolhouse? Is this good?

*BRI member

Mr. Harriman: The reason I didn't was because Mr. McKeag indicated these were only temporary, and I hope that is true. I hope we are not going to put a lot of these small units all over the country and deprive the children of what they would gain by the larger school we know to be necessary if we are to give them a well-rounded program. This does not, of course, apply to the kindergarten and first grade, but when we come to the third grade, we need adequate buildings in order to supply a rounded educational program. Some great Americans have come out of one-room schools, but there might have been more of them if we had had bigger schools.

Mr. Phillips: Mrs. Flanigan, in her discussion of obsolescence, indicated that a 2% replacement each year would be necessary over the 50-year life of a building, but that surveys by the U. S. Office of Education have indicated that there is actually a little over 5% replacement. Do these facts indicate that we should be designing buildings for a longer life, or a shorter life?

Mr. Harriman: I hear quite often that the buildings we design have too long a life and that the older buildings are too well built. I think the buildings we are designing today will have a life equal to the older buildings. One of the heads of our State Department of Education said that he wished we would build school buildings like the one-horse shay. He wanted them to live 20 years to the day, instead of 100 years because then he would be able to get new buildings that would conform to the educational requirements developed over the 20-year interval. The difference in these two figures, 2% and 5%, is that we have not been able to get rid of some of the old buildings constructed during the war years, and we have had to keep using them. Maybe in a few years from now this will level out, and 2% will be the right factor.

Mr. Phillips: This is in keeping with Mr. Kinne's comment yesterday that, on a college campus, there's nothing so permanent as a temporary building.

Mr. Folley: Until the public is aware of the educational value of structures as such, we will be forced to use buildings as long as they can be used. I don't see anything in the economic picture that can change that, unless human nature changes or unless people's attitude towards education changes.

Mr. Johnson: Since some of our schools are being built with money that we are borrowing over a long period of time, I suspect it will be hard to convince people to tear the buildings down before they are fully paid for. At least a building will have to outlast the term of the bonds. Philip Handler, in a book written some time ago, presented the results of a study which indicated that schools, after about 40 years in a particular section of the country, became so functionally obsolete they had to be replaced. We have had experiences in which it has been very difficult to get agreement to tear down a school building, and yet in one instance not long ago it proved to be quite easy. You can't predict what the public's attitude will be.

Mr. Phillips: It has been said that we should consider high-rise buildings on college campuses because of the saving of time in travel between buildings. In my own business, we made a survey of tall buildings versus spread-out buildings on a group of several hundred structures. We found that multi-story buildings, from 4 to 12 stories high, cost 40% more per usable square foot of floor area than lower, spread-out buildings. A great deal of space is taken up by elevator cores, stairways, and other services, and you do not get as much productive area.

Mr. Johnson: I sometimes wonder whether our horizontal transportation should not be mechanized too, as well as our vertical transportation. I am not talking merely about running buses about the campus. Another thing I might suggest is putting in classrooms where you have the teacher move, instead of having all the students move. This might also solve some transportation problems.

Unsigned question: Have educators given up the idea of the traditional old buildings?

Mr. Harriman: Harvard, to cite an example, still has the Yard, and I can't conceive of anybody ever taking the Yard away from them. The Yard is composed of buildings of almost every period of design. Personally, I like this arrangement better than I do that of Duke University where the buildings are all of one style of architecture. Even the "General Grant" style of architecture in the Yard to me is very interesting, if you understand the period of architecture and what they were trying to do. I think it would be terrible to tear these buildings down, and I'm certain Harvard feels that way too. However, the new buildings at Harvard are nothing like the old. I am thinking in particular of the one Corbusier is building there now.

Unsigned question: Mr. McKeag made the statement that his mobile units cost one-third of the cost per unit of permanent space. Is this correct?

Mr. Harriman: This is true. There are two reasons for this. One is the difference in cost between a masonry structure and a frame structure. Second, in the analysis of the cost of classroom space, no attempt is ever made to relatively apportion the costs of the auditorium, gymnasium, etc. With portable units, large auxiliary areas are eliminated, and their costs are not added to the cost of classrooms.

G. J. Collins, U. S. Office of Education: I hope that when we make comparisons of things like unit costs, etc., we also consider the life of the building. This may make a considerable difference. I have nothing against the mobile classrooms; but they have not yet been in use long enough to prove whether there really is a one-third difference in cost. The life of some permanent structures has been too long, perhaps, and of course it has been considerably longer than some of these temporaries.

Don Hamill, State of Virginia: We have found in some instances that the cost of mobile classrooms on a per square foot basis is just as high as that of permanent construction, which is quite a bit different from one-third. And, obviously, they have a very short life. It is a very expensive way to house pupils; and it is a very limited field of need in my opinion.

Mr. Folley: In certain neighborhoods, we have found an expanding primary population. In such cases we have used residences as temporary school housing. The purchase price of these was around $10,000 per unit, but they were sold later as residences and returned almost the full cost.

Mr. Phillips: I recently read a report from the Engineers' Joint Council that ties in with our thinking here. It was published in an engineering magazine in July 1962. This report said that computer technology promises to have a revolutionary impact on the nation's routine mental task, as the Industrial Revolution had on man's physical labor. Other exciting new developments that promise to greatly expand technology can be expected to emerge from the interaction of engineers with biologists and biophysicists. Here, a whole new technology called "bionics" has been created.

While emphasizing the bright promise of new technology, this engineering research committee drew attention to some potential obstacles to rapid progress. For one thing, the overwhelming concentration of current research and development on defense and outer space areas needs a searching re-examination at the highest national and professional level. A primary need is for closer integration of engineering research and development with national purposes, objectives, and needs. The problems of our congested urban areas, traffic, smog, housing, water pollution, and noise, need bold new action programs.

This Engineers' Joint Council committee also recommended closer collaboration between engineering and educational theorists. This Conference has stressed the great need for establishing more specific academic objectives to help the architects and engineers who are designing school buildings. In addition, these sessions have brought out the need for better evaluation of research and development expenditures. They have pointed up the need for an established national policy on schools that will contribute to the welfare of the nation and its citizenry.

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Adhesives in Building, No. 979, Selection and Field Application, Pressure Sensitive Tapes, 1962, 95 p., $5.00
New Joint Sealants: Criteria, Design, and Materials, No. 1006, 1963, 248 p., $12.00
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