DOCUMENT RESUME

ED 034 382 EF 003 693

TITLE New Trends in the Design, Cost, Construction of the Modern School Building.
INSTITUTION Allied Masonry Council, McLean, Va.
PUB DATE [68]
NOTE 28p.
AVAILABLE FROM Allied Masonry Council, 1750 Old Meadow Road, McLean, Virginia 22101

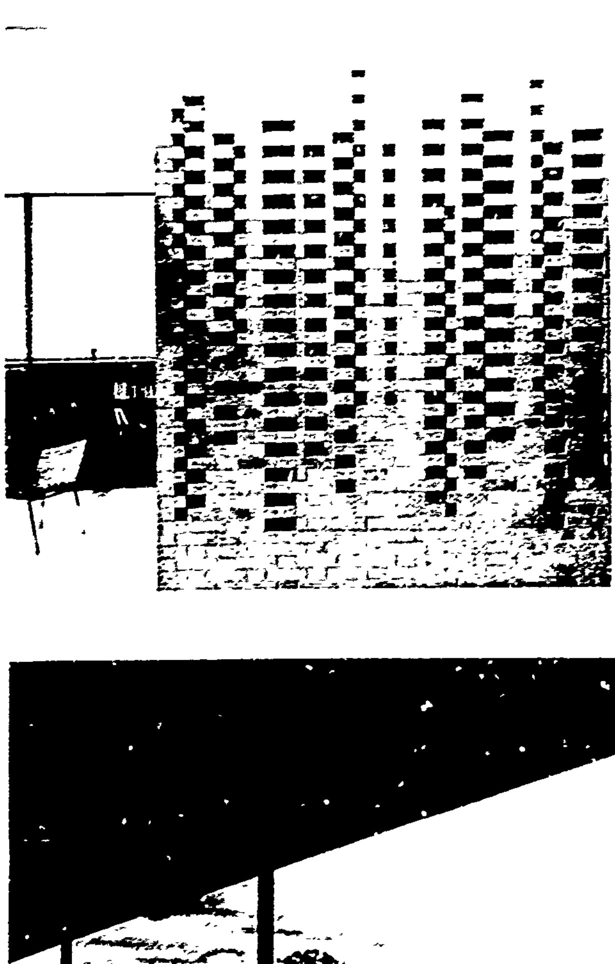
EDRS PRICE EDRS Price MF-$0.25 HC-$1.50
DESCRIPTORS *Building Materials, Building Plans, Construction Costs, Educational Needs, *Masonry, Physical Design Needs, *Physical Environment, *School Design, Spatial Relationship, *Structural Building Systems

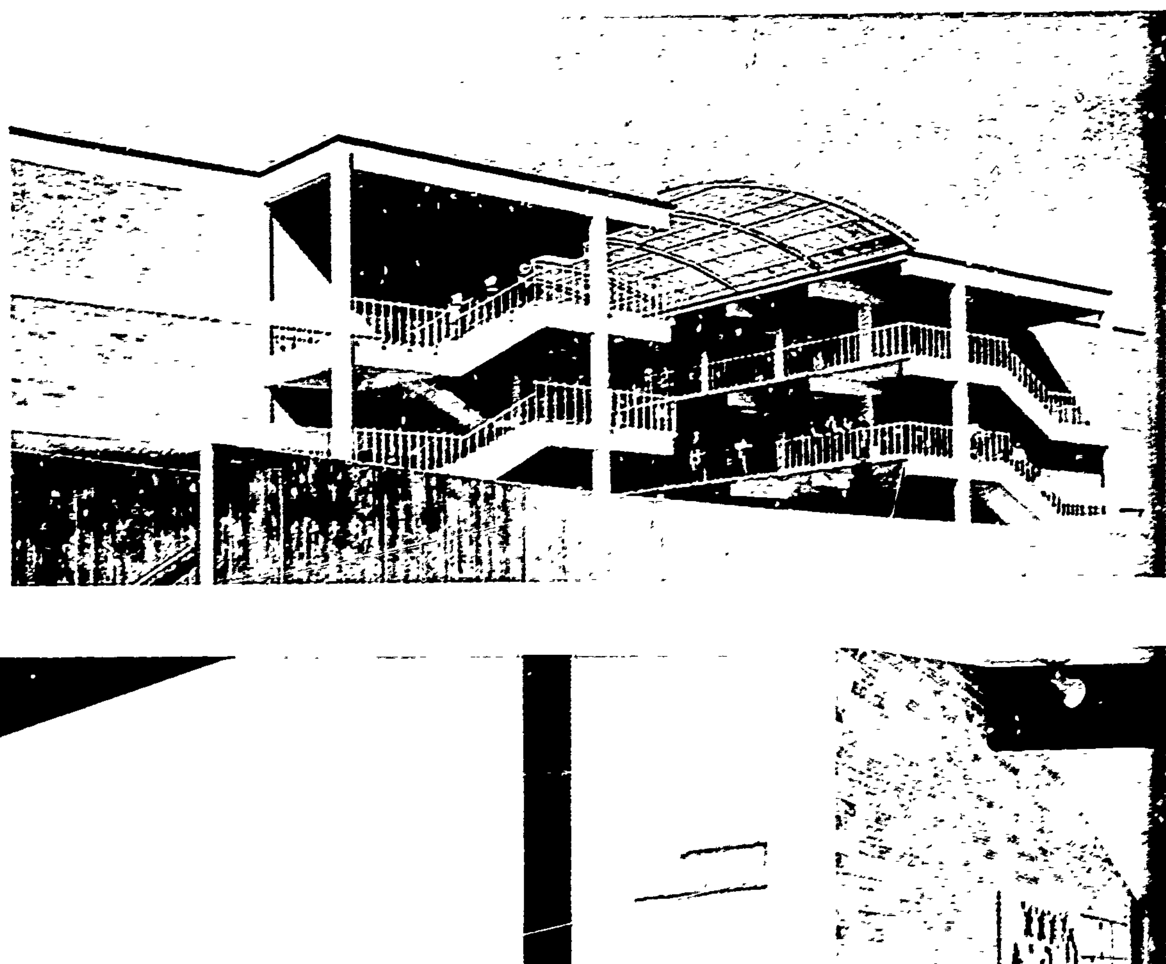
ABSTRACT

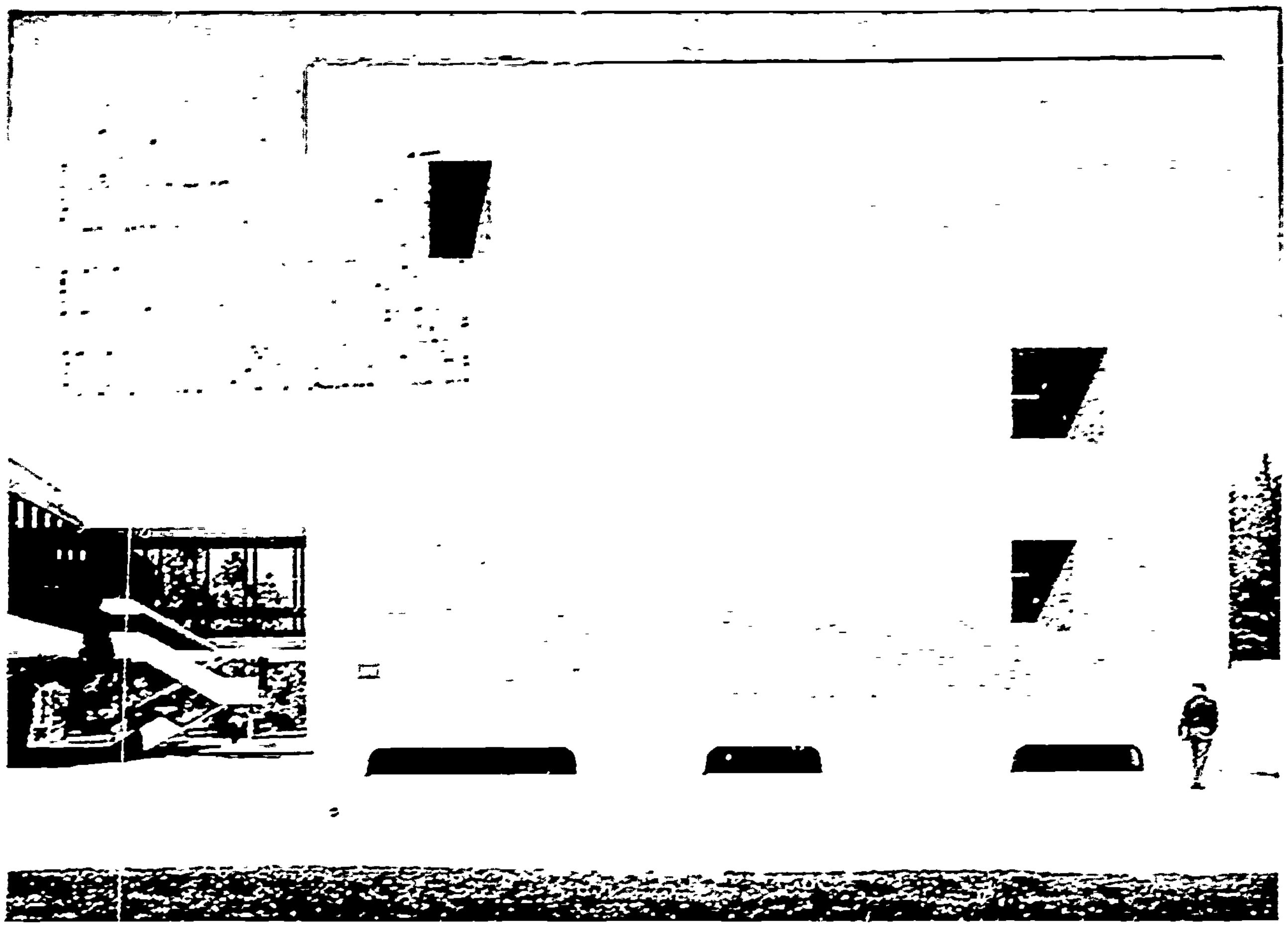
The compact school, generally defined as a brick structure with a flexible interior and natural light admission of skylights, domes, clearstories and interior courtyards, emerged from the new educational programs. Evaluation of the compact school design includes--(1) appraisals and reactions to the physical environment, (2) explanations of the structural and economic effects on school design, and (3) examples of brick and tile as building materials for the compact school. (TG)

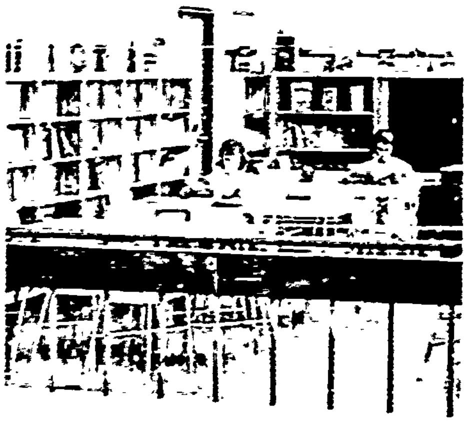
NEW TRENDS

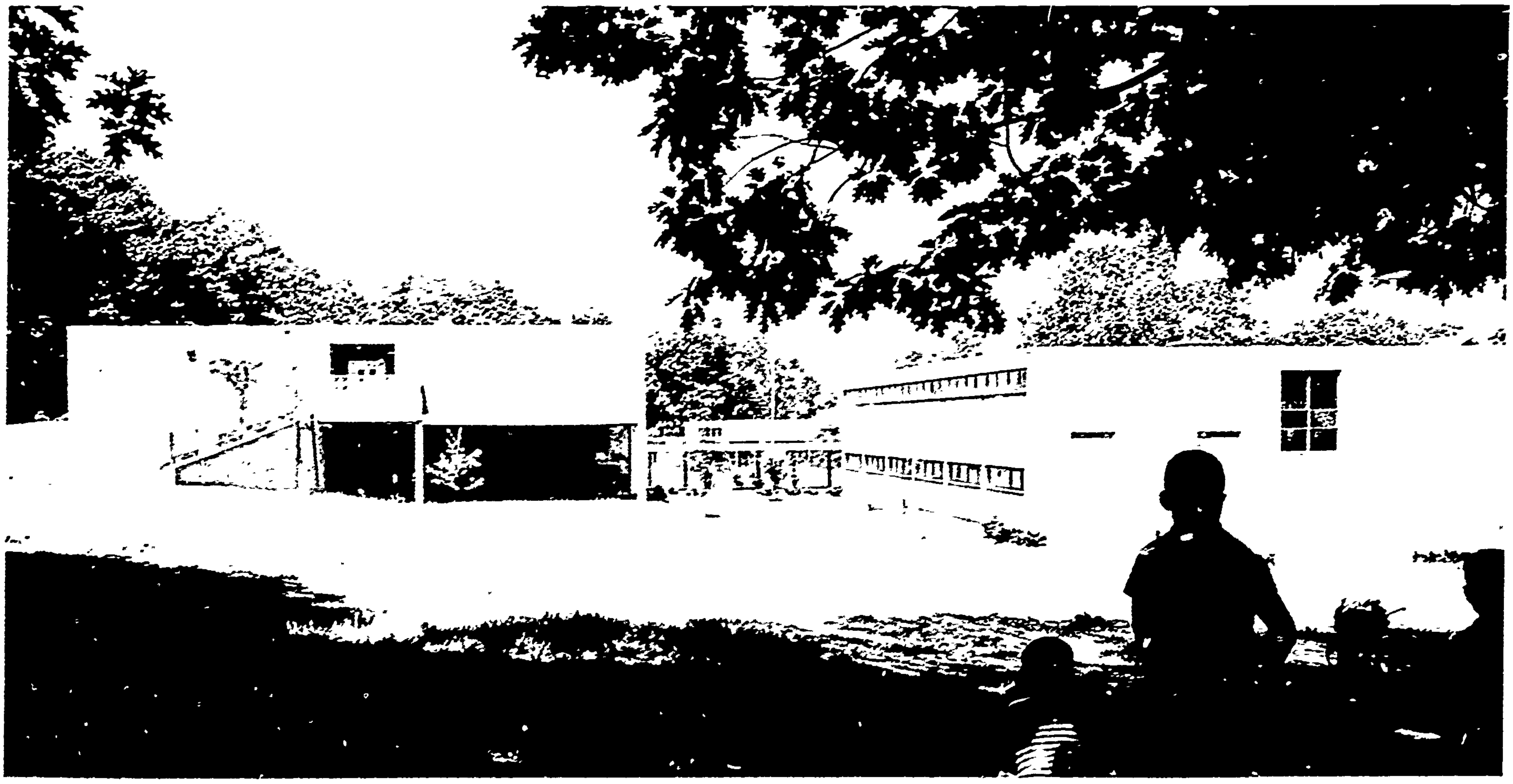
in the design/cost/construction of the modern school building











FRONT COVER: TOP LEFT—*Brick mural, Harvard Univ. Architects. The Architects Collaborative.* • TOP RIGHT—*Carlsbad Sr. High School, Carlsbad, N.M. Architects. Caudill, Rowlett & Scott. Associated Architect, Kern Smith.* • BOTTOM LEFT—*Douglas MacArthur High School, Saginaw, Mich. Architects. Caudill, Rowlett & Scott. Associated Architect, Glenn M. Beach.* • BOTTOM RIGHT—*Broad Street School, Nashua, N.H. Architects. Carter and Woodruff.* / INSIDE FRONT COVER. TOP LEFT—*Deep-set windows of the Olin Hall of Science, Colorado College, Colorado Springs, Colo., are an exterior manifestation of the unusual, 4-ft.-wide, walk-in perimeter utilities' chase of the building. Architects. Caudill, Rowlett & Scott.* • TOP RIGHT—*Broad Street School, Nashua, N.H. Architects. Carter and Woodruff.* • BOTTOM—*Heath School, Brookline, Mass. Architects: Hugh Stubbins & Associates.*

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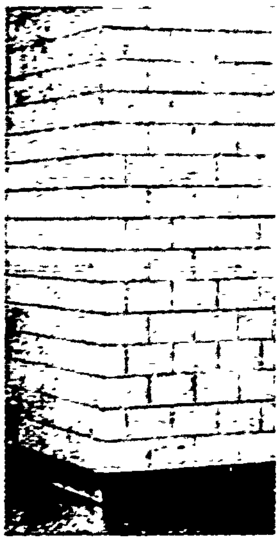


SPONSOR'S COMMENT

Any building industry organization that publishes a booklet on schools can be accused of self-interest. It should be. It's the business of the materials producer or installer to gain favor for his products. He also has a responsibility to the community, of course. But the educator, confronting the sponsor's literature, has the problem of determining whether the latter pays lip service to that responsibility or genuinely honors it.

This booklet has been published by the Allied Masonry Council. Its supporters are the Structural Clay Products Institute, the Mason Contractors Association of America, and the Bricklayers, Masons & Plasterers International Union of America.

Several years ago, the masonry alliance published a booklet on schools called "A Few Hard Facts About the Design/Cost/Construction of the Modern School Building." Educators and architects were generous in their praise of "Hard Facts" and one State made it the official publication for new building committees. Ultimately, the work was given three printings. We hope this new booklet will prove as useful.

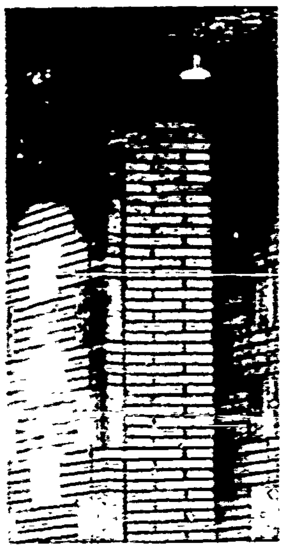
One point needs particular mention: Certain emphasis is placed in this booklet on the compact school, which is generally defined as an essentially opaque brick structure with flexible interior, admission of natural light by means of clerestory strips, skylights, domes, and/or interior courtyards, and—with growing frequency—central air conditioning.

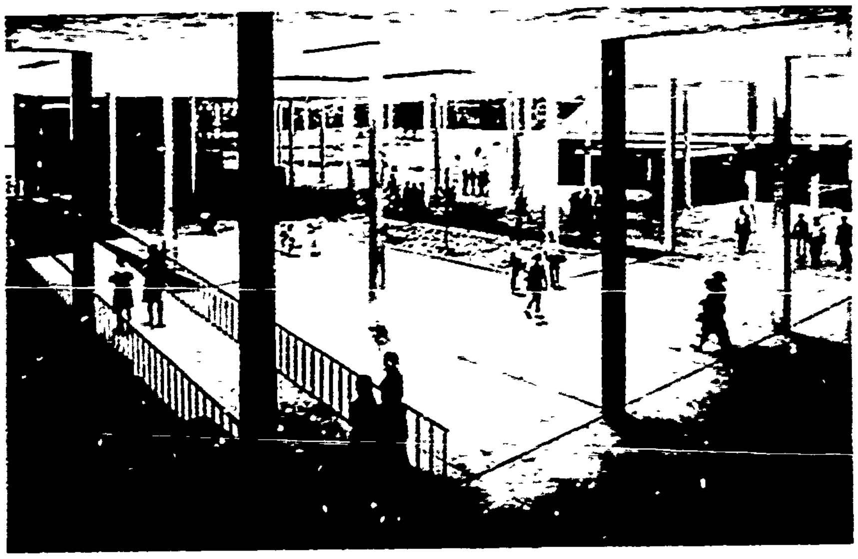
(Left) High School, Southgate, Mich. Architects: Eberle M. Smith Associates.

The compact school emerged from new educational programs and from the realization that even newer ones have to be planned for now, even though their precise demands cannot be forecast with accuracy. This phenomenon has pleased some material makers and alarmed others. The people who make, sell, and install brick and tile are pleased that these timeless materials are meeting so well the needs of contemporary education. It should be noted, however, that the compact school is not necessarily a bonanza for the masonry industry. True, when you reduce glass area, you add brick. But when you replace the spread-out finger system with a compact plan, you also shorten the wall perimeter. In some designs, the compact school may use more brick than the conventional plan; in others, it may use less.

Nevertheless, while the compact school may not be a magic elixir for either educators or building manufacturers, the trend is an interesting one. New designs are making it clear that a great deal of variation and flexibility are possible within the compact philosophy. Compacts can be round or square; they can be subdivided to combine the best features of compact and campus plans. They can even be high-rise structures.

This booklet, then, attempts a fair appraisal of the compact school, presents some reactions to the environment it creates, explains how this and other building forms may be affected by new structural and economic studies, and offers a few opinions on related matters. It does attempt to place brick and tile in a favorable light. But it tries to do so within the context of established educational needs and worthy community goals.





Spring Woods Sr. High, Houston, Texas. Architects: Caudill, Rowlett & Scott.

THE PERSISTENT ILLUSION

Despite all of the hard-earned experience our citizens have gained in business and personal affairs, many still apply a different standard to education and try to get something for nothing. Billions of dollars of public money are spent on highways and bridges. Billions of private dollars are spent on cosmetics and clothing and liquor and horse racing. Amid this conspicuous consumption, efforts are made persistently in many communities to "get the cost of schools down where they belong." Johnny, it seems, diminishes in importance when he walks into the schoolhouse door.

Most frequently, the principal target of these cost-cutting campaigns is the schoolhouse itself. It doesn't matter, seemingly, that it would save the average taxpayer very little money if he got his schools for nothing. Since the buildings themselves cost perhaps 20 cents of the school tax dollar, the average taxpayer, if he wanted to, could lay away the cost of next year's school building program by abstaining from the purchase of one new suit or, perhaps, a family dinner in a good restaurant.

Cost-cutting attacks usually center upon "frills" associated with buildings. Carpeting, the preoccupation of many cost studies today, is so astonishing a "frill" that many potential critics haven't yet found voice to object to it. (By the time they do, they may find the evidence—and the carpets—imposingly stacked against them.) Air conditioning is moving rapidly from the "frill" to the standard-equipment category. There are a few communities which still look suspiciously on the architect as a "frill." And there are many more which still hope to get something for nothing by drawing up stock plans for the construction of future schools over an indefinite period of time.

The latter two problems deserve some comment. The case for the architect can be made relatively easily. He is trained to design buildings. Nobody else has that training. The contractor assembles components and co-ordinates the work of craftsmen and laborers. It's his job to see to it that the architect's drawings and specifications are translated into structure. Even the best architect, however, may botch a school if his client botches the job of giving him a program from which to design.

It is the job of school authorities to state clearly and in detail the school program, its philosophy and policies, teaching methods, curriculum, present and anticipated enrollment, budget limitations, and obvious physical data. And even then the brightest talent can be frustrated if the community, for lack of long-range planning, presents the architect with a cramped and inadequate site for the new building.

Detailed information is vital to the design process and it should be articulated just short of the point where it begins to dictate the design itself. Some communities have deprived themselves of effective architectural service by enmeshing themselves in arbitrary regulations which decree how large a classroom should be, how many cubic feet it should contain, how much window space it should have, and how many pupils it should house.

The architect's normal services fall into four phases. In the *schematic* phase, he establishes the requirements of the building and prepares rough design studies. In the *design development* phase the architect designs spaces in

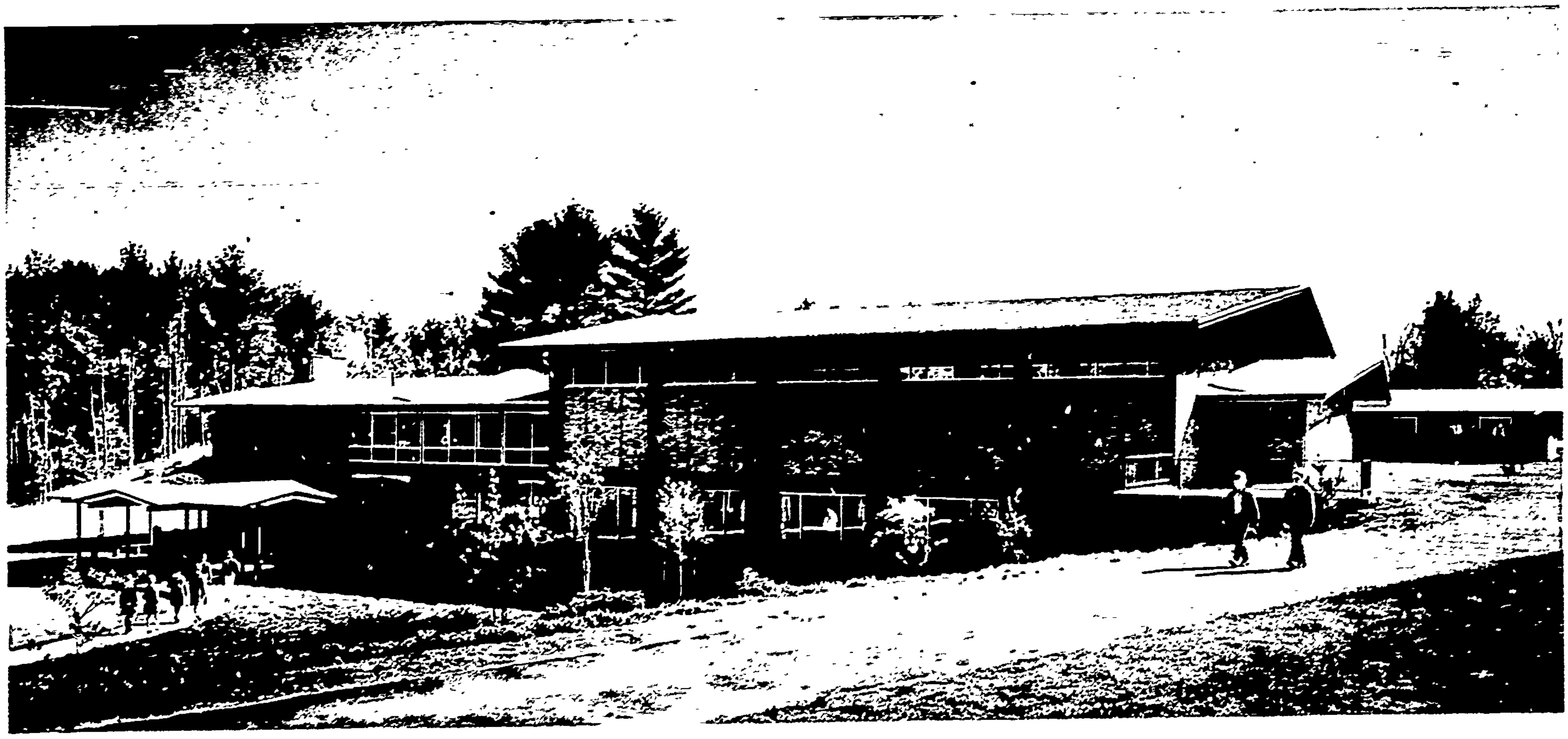
detail, plans circulation patterns, and defines major systems, materials, and equipment. In the *contract documents* phase, the architect prepares detailed working drawings and a book of specifications on which contractors can bid and on which their work will be based. The specifications identify parts and products to be used, state how they must be assembled, and prescribe the finishes and craftsmanship required.

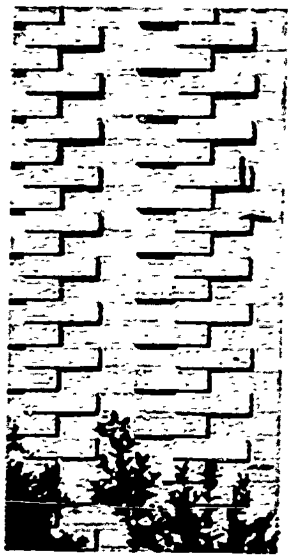
In the *construction* phase, the architect helps the owner take and evaluate bids, watches the work as it progresses, and issues certificates of payment to the contractors. While the architect makes periodic checks on the contractor's work, he cannot guarantee the contractor's performance. Consequently, some school boards pay a full-time construction superintendent to see to it that every board and brick go exactly where they are supposed to go.

Under the ethical standards of The American Institute of Architects, the architect may not profit from the use or sale of building products or services. He is a professional whose only compensation is his professional fee. He may not function as designer *and* contractor. These prohibitions have a practical base, as some school boards can testify. A few have had unfortunate experiences with "package" merchants who purport to supply construction, design, and materials under one roof at a "guaranteed" price. This guarantee has been adhered to on some occasions by skimping on the specifications and violated on others by the unexpected presentation of "extras."

The stock plan is the most persistent of illusions, however. Nearly every State in the Union at one time or another in the past 30 years has experimented with stock plans. Nearly every State, after spending considerable time and money on them, has abandoned them. The experience can be summed up by the comment of one State educator: "Nobody has ever recovered his initial investment in the preparation of these things—*nobody*." The reasons are simple, once explained: You can't stock-plan a site. Terrain differs and so do foundation plans. Utility connections differ. Site orientations differ. Electrical needs differ. Building codes differ. By the time all of these individual characteristics are taken care of by individual plans, the only thing that can be stock-planned is a section of wall. And varying educational needs wipe out the feasibility of doing *that*. Even if all of this weren't hard reality, it would *still* be foolish to draw up stock plans. Why? Because conditions change. You wipe out all of the advances and improvements which lie in the future if you freeze your thinking into the present. Any business that followed such a philosophy would go bankrupt in short order.

Broad Street School, Nashau, N.H. Architects: Carter and Woodruff.





THE COMPACT TREND

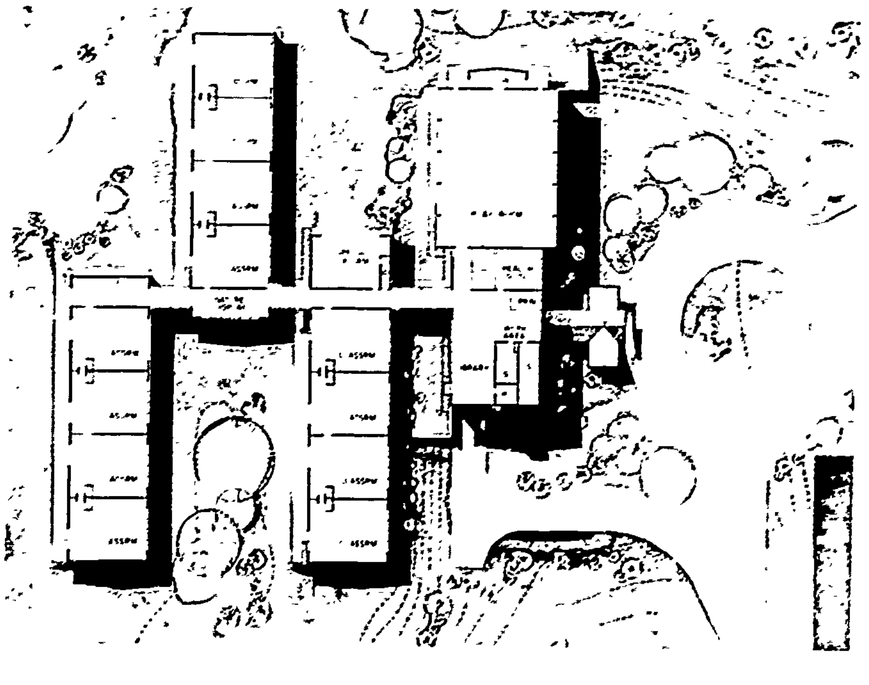
Since World War II, three essentially different types of school structures have evolved from educational policies and design concept. The oldest of the three is the "finger plan", often designed with double-loaded corridors.

The "finger plan" evolved from educational programs which called for classrooms of fixed size. The students went from room to room after each period (which accounted for the "cells and bells" nickname often given such schools). The state of building technology at that time demanded the maximum amount of natural daylight and cross-ventilation through window openings. Problems with glare and heat gain were sometimes severe. The "finger plan", while still being built in some areas, seems to be on the wane.

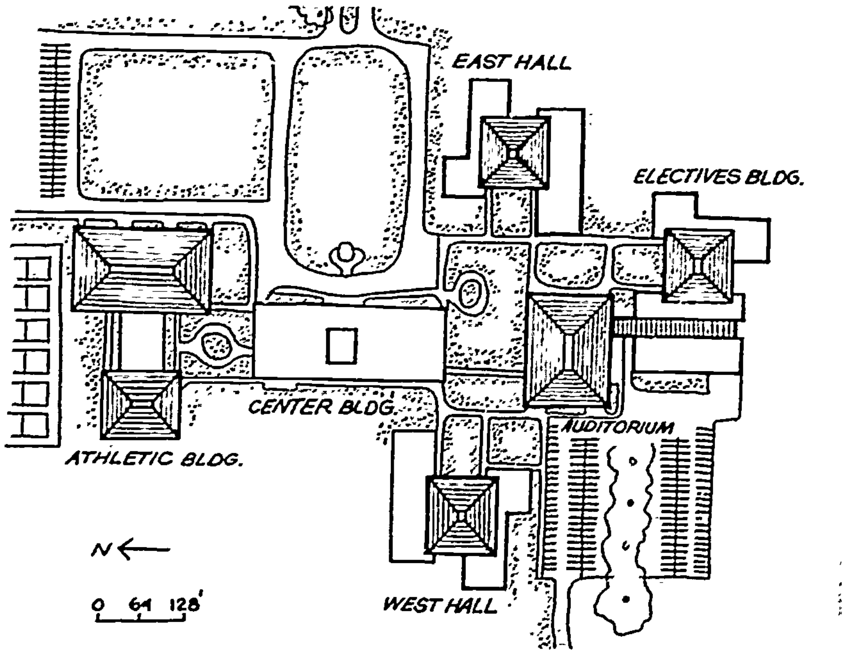
Of newer vintage is the "campus" plan, an interesting design solution to the problem of anticipating long-range educational needs and an expanding enrollment. It requires a large site so that units can be built as needed according to a master plan. Individual buildings, often "compact" in design and use, can be connected by exposed walkways (as some are in very cold areas of the nation), or by covered passageways. The campus plan has an additional rationale. It reduces the scale of buildings to a comfortable size for children. There are ways to do this in larger buildings, of course, but the campus plan is an obvious way of handling the problem.

The "compact" school is generally thought of as a rectangular structure with a minimum of conventional window area and maximum flexibility of interior space. It usually is built of brick for reasons of economy, to create a pleasing scale through pattern and texture, and for certain reasons of performance which are discussed in a later portion of this booklet. Natural light is usually admitted by vertical strip windows in the exterior walls, by horizontal clerestory windows tucked under the roof overhang, by glass or plastic skylights and domes, and/or by glass

"Finger" plan schools may have single- or double-loaded corridors. This is the Broad Street School, Nashua, N.H., which has single-loaded corridors. Classrooms are in the left three fingers. Finger at right has a play room, library and administrative offices.



"Campus" plan schools consist of separate, relatively small buildings. This is Douglas MacArthur High, Saginaw, Mich. Campus schools are usually built according to a master plan, and the number of units can be increased to meet future needs.



panels facing into an interior courtyard. (It is important to note that natural light is admitted for visual relief, not to see by. Experience shows that electric lights stay on virtually all of the time in all kinds of school buildings.) In competent hands, the design of the compact school can be managed so that walls create a maximum of educational wall surface, greatly reduce building cost (often paying the entire cost of an air-conditioning system), allow maximum use of interior space, and completely dispel the impression that there is anything really very different about the fenestration of the building.

While many compact schools are being centrally air conditioned, it is important to recognize that this is an educational decision; it is not a necessary concomitant of the compact design. Reduction of window area reduces both heat loss and heat gain and allows better year-round control of the environment.

One example of a non-air-conditioned compact is Meadow Lake school in Birmingham, Michigan. Meadow Lake was built with 50 per cent less glass than its predecessors in the community.

Albert Schumm, principal of Meadow Lake, said recently: "We have been in this school for two years. It is working out to all expectations. Teachers like it because children are not easily distracted. Students seem to like it as well. This school is not air conditioned. We have a ventilating system that gives us fresh air whether the heating system is on or not. We find this school is about five degrees cooler (in summer) than comparable size schools with traditional window areas. We have had no days when the school was unbearable."

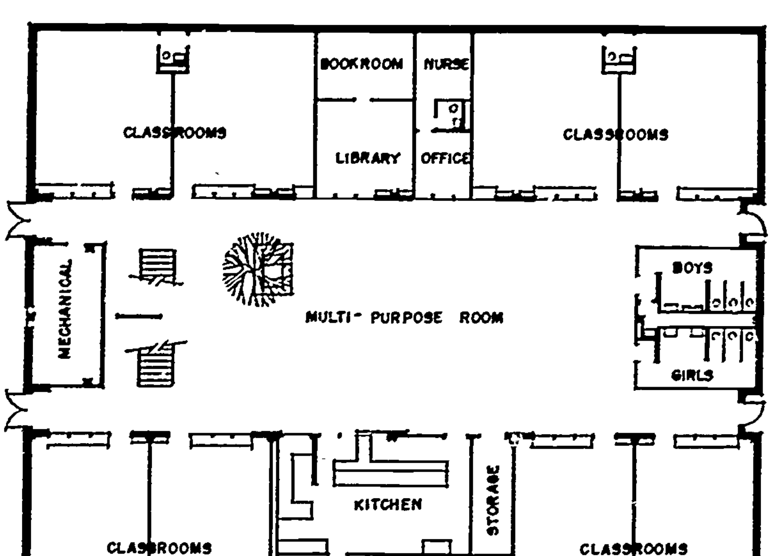
Advantages of the compact design, Schumm said, include easier adaptability to audio-visual use, more wall area for chalk boards and bulletin boards, and less space devoted to hallways. Children may be grouped and regrouped in different manners in the flexible interior.

Scientific and sociological studies have played a role in the acceptance of compact schools. Dr. Ervin Rose, clinical psychologist with the District of Columbia Public Schools, issued in January, 1964, a report* on the influence of windowless classrooms on learning and learners.

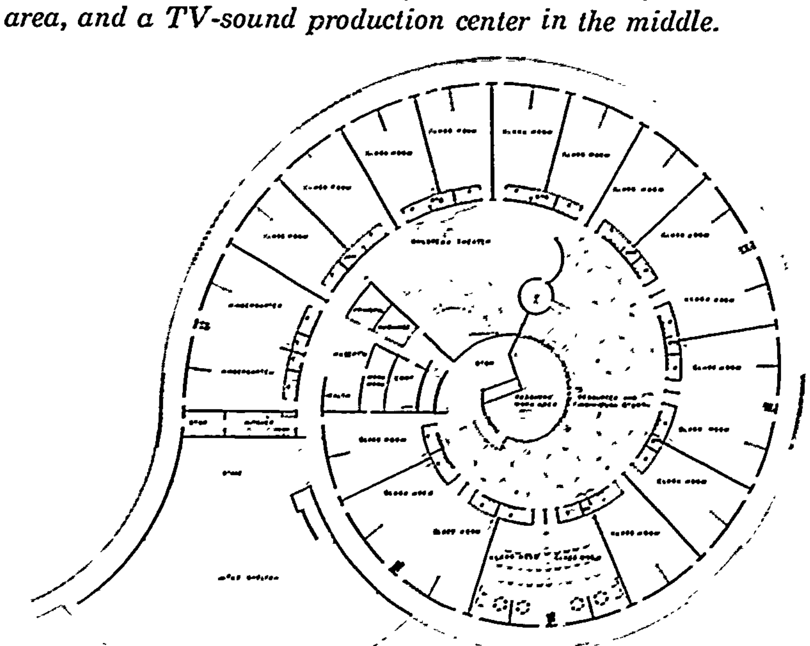
Rose concluded that "the literature in psychology related to sensory deprivation and the learning situation indicates: (1) An artificially controlled luminous environment is more conducive to visual learning; (2) an artificially controlled auditory environment is more conducive to auditory learning; (3) an artificially controlled physical environment leads to less fatigue; (4) an artificially controlled task-performance environment leads to greater

*"*The Influence of Deprivation of Sensory Activities in Windowless Classrooms as Related to Psychological Studies of Sensory Deprivation Upon Learners in Learning Situations and the Performance of Such Learners.*"

Compact schools can be designed with or without a central court. This is the first-floor plan of the two-story Granbury School, Granbury, Texas, designed by Architects Clutts and Parker. This school has a center court.



Compact schools also can be circular. This is Valley Winds School near St. Louis, designed by Architect John Shaver. It has classrooms on the perimeter with group study areas, teacher's work area, and a TV-sound production center in the middle.



productivity; (5) in general, an artificially controlled environment is more conducive to learning than a natural environment, provided that such an artificially controlled environment is not sustained over a prolonged, continuous period of time." He added that changes in classes, lunch periods, play periods, etc., would "provide multiple environments without prolonged, continuous, sustained sensory deprivation for the learner."

Accompanying fears of the effects of compact schools on their occupants were misunderstandings of the educational and technological reasons for an artificial environment. Architects began considering elimination of large windows only after they were convinced that such glass areas were a waste—that windows in schools were covered up when possible, and that they created far more problems than they solved.

Architect Walter T. Rolfe, FAIA, once said:* "Can anyone tell me what is a good school window? How do you control its illumination, its glare factor? I haven't seen one yet and I think I've used every kind that's been built."

As the compact trend gains strength, it is important to recognize that it need not exist in a single, rigid form. It can be round as easily as square. It can be one very large loft-type structure or a cluster of smaller compact buildings. It can, conceivably, be one, two or 15 stories in height. Most school boards committed themselves to the one-story suburban school many years ago. But structural advances in the use of masonry may soon lead some educators to reconsider the advantages of the multi-story school.

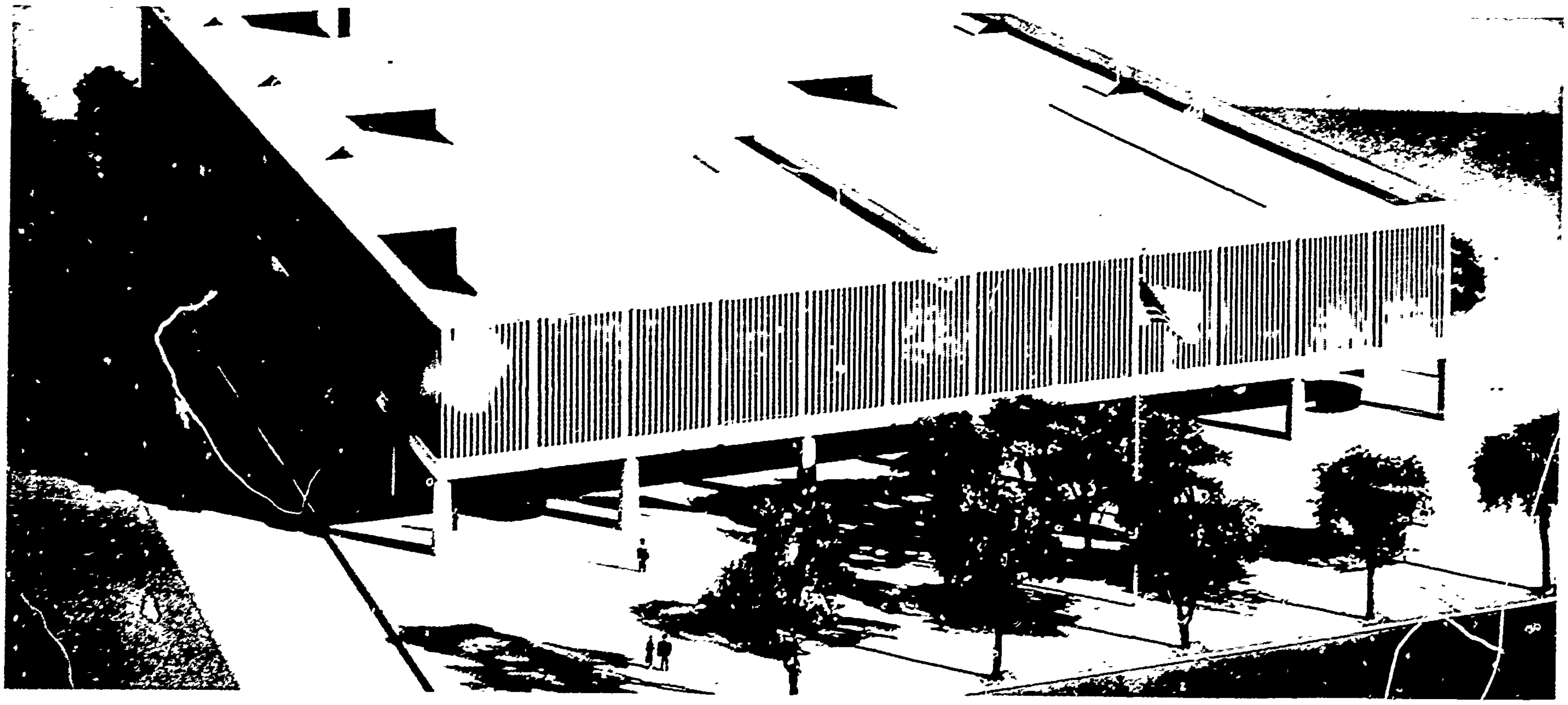
This impetus comes from a different direction in densely-built up urban areas. As new housing forms emerge in the city, and multi-family housing units continue to represent one-third or more of all units built in the United States each year, the demand will increase for new city schools. Because of high land prices, these will inevitably be built on small plots of land. There, the compact masonry school will have even more validity. Fire protection will have to be superior in high-rise structures; control of sound transmission from outside will be imperative.

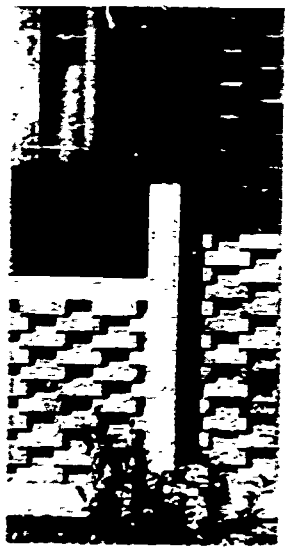
By virtue of new structural techniques for designing high-rise masonry buildings, we may within a few years see the city school built as a vertical series of compacts, one atop the other.

It is entirely possible that the compact plan, like the architectural orders of past civilizations, may become a continuing philosophy within which many changes, variations, and refinements will take place.

*Carrier Corp. seminar, "Improving the Learning Environment," New York City, June 28, 1960.

Model of Junior High School 201 in New York City, shows how the architects, Curtis & Davis, met the requirements of an urban site. The compact building covers practically all of the site. The first floor is set back to create open space at ground level, and to give some protection from vandalism to glass areas. Above, the exterior facade is windowless and all brick.





REACTIONS TO THE NEW ENVIRONMENT

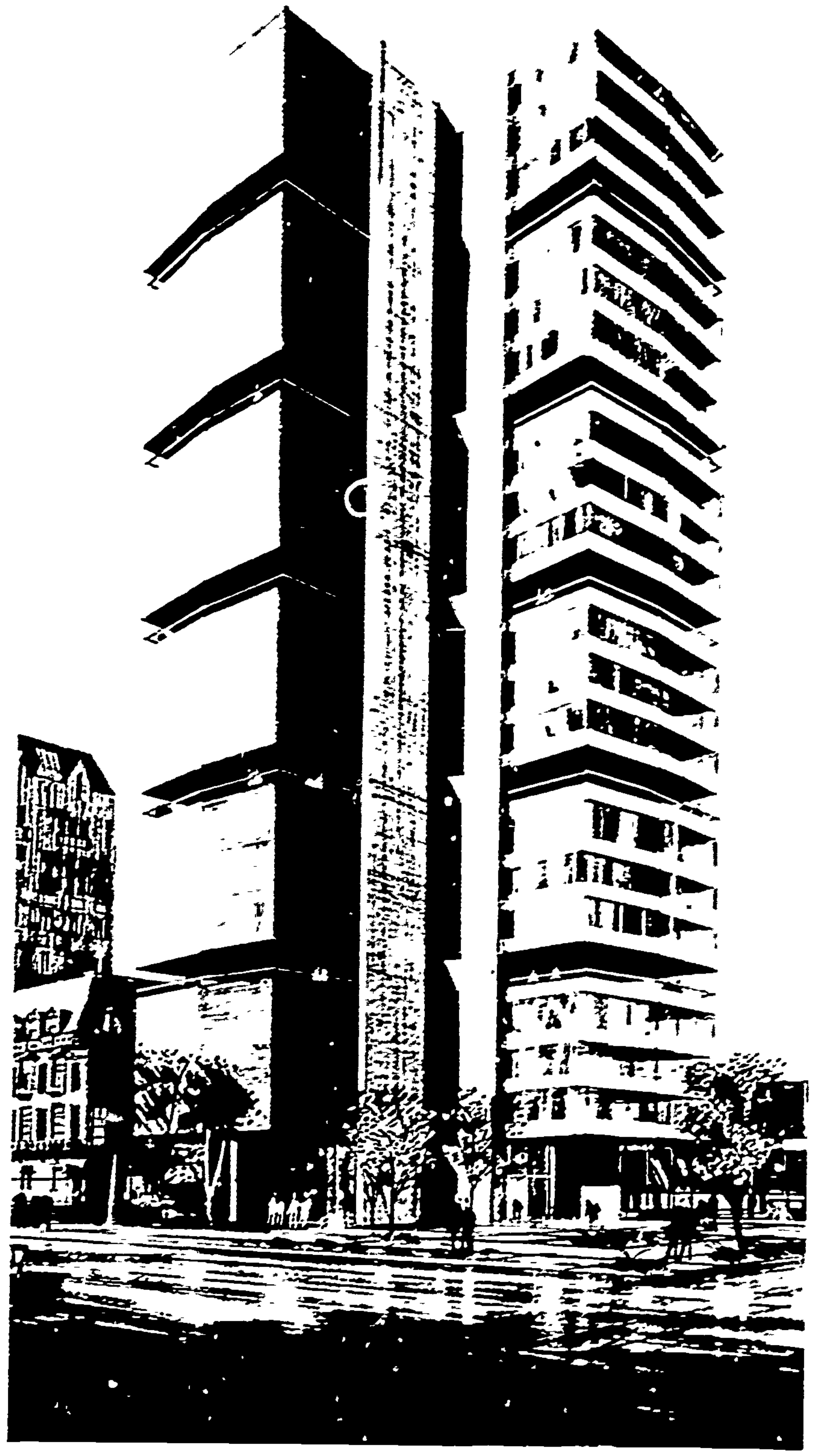
When compact schools first appeared, they were met with opposition from some quarters. Much of it rested on assumed effects of a controlled environment on children.

Actual experiences of students, teachers and administrators in such schools have dispelled these fears. They have done more: They have given persuasive evidence that such schools make a definite contribution to the learning process with no significant negative results.

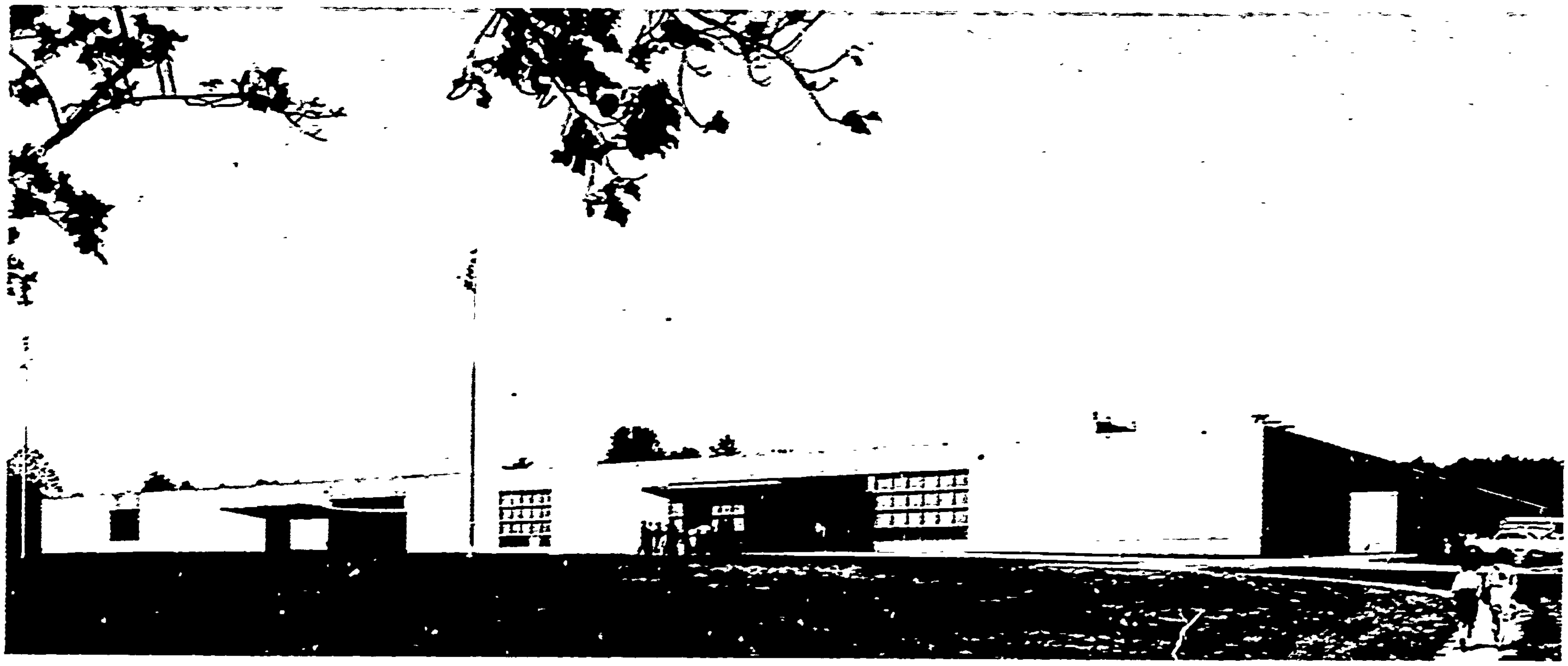
MONTGOMERY COUNTY, MD.

The Parkland and Randolph Junior High Schools in Montgomery County, Md., are a case in point. These compact schools were designed in 1961 by the architectural firm of Burket, Tilghman, Nelson Associates. These two identical brick structures are built around small courts which furnish some natural lighting and give children an opportunity to relax outdoors.

Dr. Alexander M. Gottesman, principal of Randolph, said that after less than a half year of operation, 38 of his 40 teachers expressed a desire to come back to the school. "These schools are based on a great idea," Gottesman said. "Independence from natural lighting and ventilation in the classrooms, has permitted the use of movable walls for large group instruction. There is less distraction, window maintenance and breakage costs are low, and there have



New urban schools can go high-rise. This is an architect's conception of how such a school might look. The Perkins & Will Partnership designed the 24 story building as a special project for The Philip Carey Manufacturing Co. This rendering shows that the projected school would consist of six four-story compact school units, one atop the other.



(*Above and below*) *Randolph Junior High, Montgomery County, Md. Architects: Burket, Tilghman, Nelson Associates.*

been very few complaints about the building from teachers or pupils."

Yet the design of Parkland and Randolph schools was considered controversial when it was proposed four years ago, even though the reasons why they were to be compact were set forth by the late Rhees Burket, AIA, a nationally-recognized school architect.

Burket said* that when his office designed a school in 1948 in Hagerstown, Md., it included vision-strip windows below glass block panels, and, on the outside, jalousies to control sunlight and glare. In visits to the school over a period of years, he noted, "we were surprised to find that the sun-control jalousies were often left in a closed position for several days or more . . . that neither the teacher nor the students were conscious of being unable to see out."

Burket investigated further, studying the work of educators on new teaching methods and programs, and the work of other architects. In a 1959 report he said that "better visual conditions can be achieved today with proper artificial lighting than ever resulted from window lighting," and "If the planner is freed from the tradition of day lighted rooms, greater flexibility in arrangement is

*"*Background Material Leading to a Compact School Design for Parkland and Randolph Junior High Schools, Montgomery County, Md.,*" *by Rhees Burket.*

immediately possible." He felt that certain features of such a school would cost more than in a conventional school, but that there would be offsetting economies through the shortening of corridors and exterior walls, and the reduction of window space.

Faced with the task of designing Parkland and Randolph schools, Burket resolved the cost question by making preliminary estimates of building costs for three different types of schools—a one-story compact school, a two-story compact school, and a two-story conventional school. The studies showed that the one-story compact school, *including air conditioning*, would cost $40,000 less than the two-story *non*-air-conditioned conventional school. (The one-story compact design had a small cost advantage over the two-story compact plan.) Actual construction figures supported his estimated cost advantage. In addition, it was estimated that heating-cooling operating costs in the compact school would be only four per cent higher on an annual basis than the cost of merely heating the conventional school—an increase more than justified by the capability of using the compact school for summer programs.

HOBBS, N.M., EXPERIMENTS

Hobbs, N.M., was the site of two of the earliest compact, windowless schools, designed by Frank M. Standhardt, AIA. School Superintendent Charles L. Mills said Hobbs decided on this design after observing that businesses achieved salutary results with similar buildings. "Teaching and learning are work," he said, "so it became obvious to us . . . that the same physical work conditions essential to higher performance in office and industry were applicable to education . . . The windowless school, through its capacity for more complete environmental control, offers a practical means of improving the quality of education. Obviously, pupils and teachers who see, hear and feel better at their work without mental or physical distractions will achieve more of what is demanded of today's graduates."

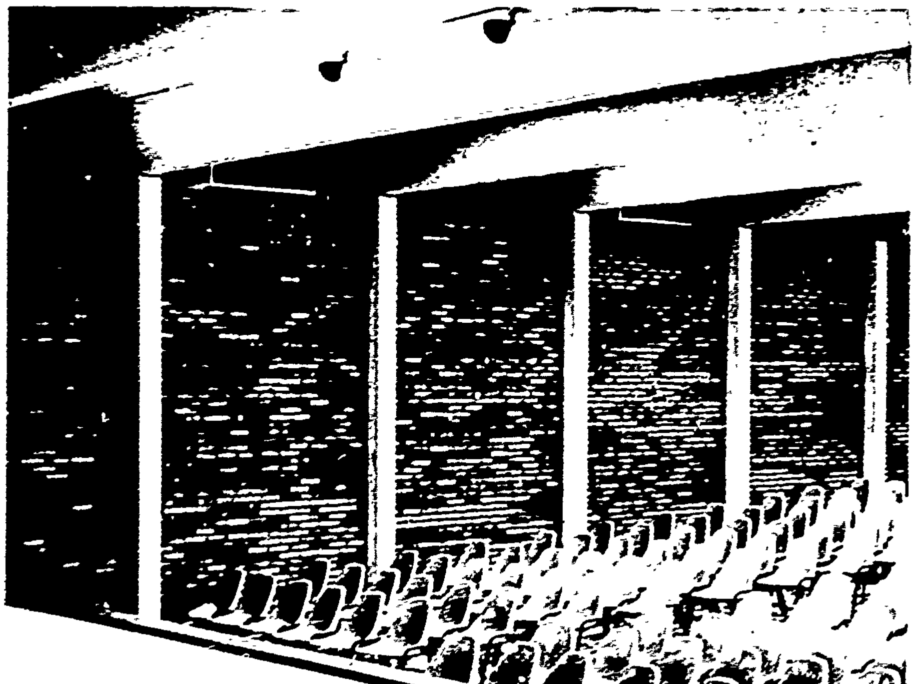
PEORIA, ILLINOIS

The St. Louis, Mo., architectural firm of Drake-O'Meara Associates has designed a number of compact schools, including Catholic Boys High in Pueblo, Colo., St. Paul High in Chicago, O'Hara High in Kansas City, Mo., Brady High in St. Paul, Minn., and Bergan High in Peoria, Ill.

The Bergan school, which has insulated masonry cavity walls, also has an auditorium with exposed brick walls.

Brother Hilary Mark, principal of the Bergan school, said that "Nearly the first question of every visitor to our school is to ask if the students get claustrophobia, and I

(Below, left and right) Bergan High School, Peoria, Ill. Architects: Drake-O'Meara Associates.



can answer that I don't recall a single such complaint." "About 10 years ago," he remarked, "I was at a school of almost completely opposite construction with great emphasis on glass, and while I believe there to be advantages and disadvantages in both types, my feeling is that the advantages of the windowless construction far outweigh the disadvantages."

SAGINAW TOWNSHIP, MICHIGAN

The Douglas MacArthur high school in Saginaw Township, Michigan, is a series of compact "houses" designed as a village-like campus plan. The buildings are brick, heavily-insulated, and with minimum window area. Roofs are peaked to provide design character. There are no enclosed passageways between buildings.

Douglas MacArthur High, Saginaw, Mich.

Principal Sam Moore has this to say about the effect of the new environment on education:

"Opaque walls in our school have presented no problem. Conversely, since the interior walls are not load bearing, we feel that a far greater degree of flexibility will result. At the present time we have formulated plans to re-arrange some of the interior teaching space by removing walls. Also, the material which was used on our interior walls has lent itself to bulletining and display space without having to add special equipment.

"Concerning the campus layout of the total plant . . . I am unequivocably in favor of it. We have set up a workable 'house plan' type of administrative and instructional arrangement which has allowed for decentralization of administration and grade level home base teaching clusters. The ancillary facilities have been used for multiple teaching stations, and I might add that community use of our buildings is at a high pitch. The flow of student traffic is easy, although inclement weather presents some minor problems.

"While we have not seen fit to add air conditioning at this time, the need for it being somewhat questionable in terms of the present comfort level of our buildings, the system will accommodate chillers if we should desire to add them."

KIMBERLY, WISCONSIN

The new high school in Kimberly, Wisc., is of compact brick design. School superintendent Ray Hamann describes its advantages:

"The biology teacher attempting to explain osmosis does not have to compete for the students' attention with the track team, or the maintenance man mowing the lawn, or dog fights, or jets, or anything else that might occur outside the school more interesting than osmosis."

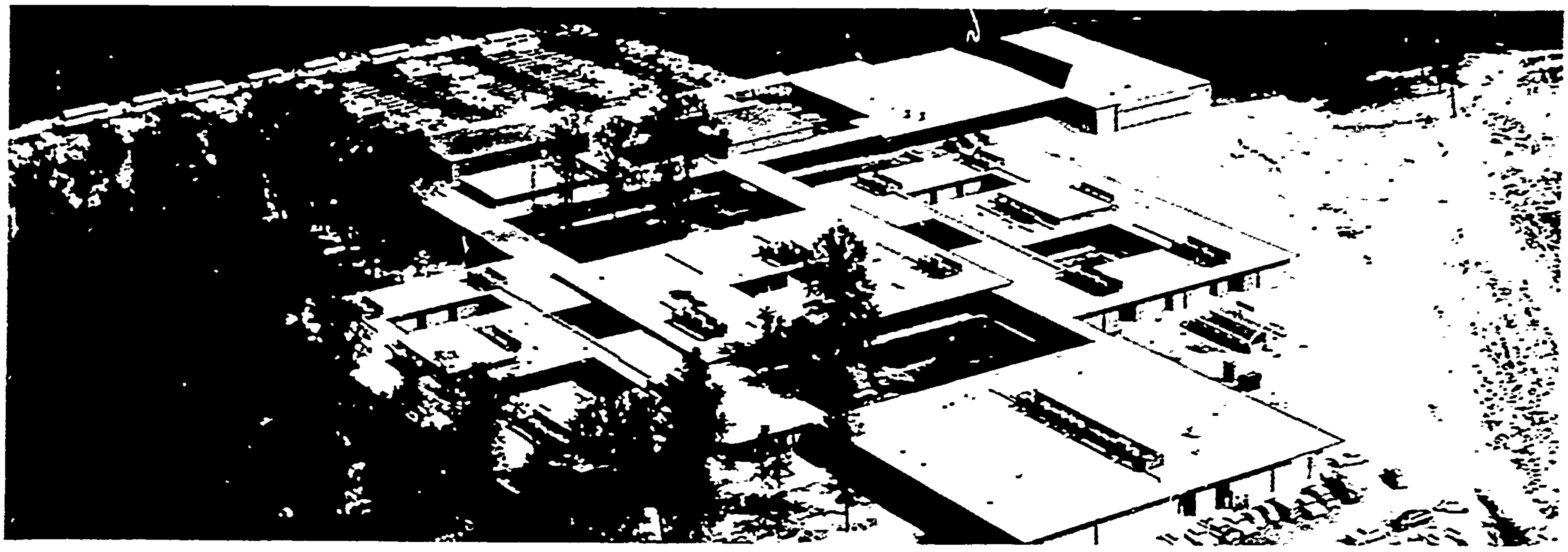
As for the scarcity of glass in the building, he points out that "repair of a broken window pane costs as much as a good textbook."

A unique feature of the Kimberly school is that its heating and cooling are provided by a combination of heat pump and the heat given off by the artificial lighting. The heat pump is a simple device which extracts heat from air. In the summer, it takes heat out of the interior. In the winter, it extracts heat from cold outdoor air and brings it inside through a reversal of the cycle. The heat pump is

less effective in very cold climates than in temperate areas. This inadequacy during wintertime at Kimberly is made up by capturing the heat normally given off by the electric lights and recirculating it to the building perimeter. This heat-by-light principle is now being used in very large buildings as far north as Canada.

EL DORADO, ARKANSAS

The El Dorado, Ark., high school is of compact brick load-bearing design. Heat pumps located on the roof provide 84 independent zones that can be heated or cooled as desired. The school board of El Dorado said this elaborate system became feasible "when cost analysis showed that by reducing the number of windows the cost of the air conditioning would add only $15,000 - one per cent of the total cost. It was further found that the cost of additional utility bills would be less than the expected cost of maintaining large window areas."



El Dorado High School, El Dorado, Ark. Architects: Ginocchio, Cromwell, Carter & Neyland, Inc.

COLUMBIA, S.C.

The W. J. Keenan Junior High School in Columbia, S.C., designed by Lafaye, Lafaye and Associates, is a compact brick school. It has classrooms for 900 students, with contemplated future expansion to 1,350 or even 1,800.

Edgar Waites, business manager for the Richland County public schools, the district in which the Keenan school is located, reported that "the school board, faculty, and all would not make a change in the building." The school was "nearly perfect," he said, and lower than normal operating and maintenance costs are expected.

SAVANNAH, GA., SCHOOLS

Four compact schools were opened in Savannah, Ga., in 1962 and 1963—George A. Mercer, Edward J. Bartlett, Leiston T. Shuman, and Tompkins Junior High Schools. These brick structures with only a few strip windows represented a departure from traditional school design in Savannah. The board of education and the architectural-engineering firm of Thomas-Driscoll-Hutton, Inc., which designed the four buildings, published a booklet to tell citizens what it was all about.

"Totally enclosed classrooms and other space have been possible since the advent of adequate lighting, ventilating and air conditioning systems," the booklet noted. "All of these systems have been in existence for some years now, but only recently has their use in schools been economically feasible. This feasibility has not come about through the appropriation of larger budgets for construction, but through the savings made possible by artificial lighting and climate control. The great reduction of exterior wall areas, the abandonment of the open window as a means of ventilating and natural lighting have brought great economies . . . so great in fact that schools built in this concept cost no more, and often less, than the 'finger-plan' with extensive glass areas."

The four Savannah schools attempt to blend the virtues of the "finger-plan" school with those of the completely compact school through use of glass in interior partitions and along corridors.

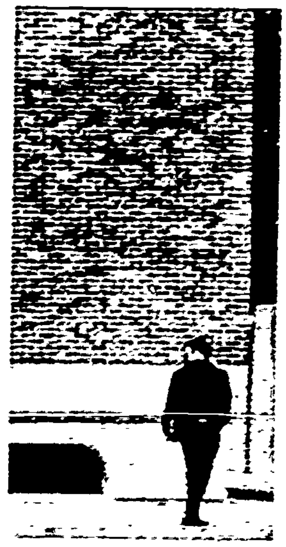
The report states that: "The more compact plan, the reduced walking distances, the enclosed space for recess on inclement days, the reduced amount of dust and

dirt tracked into classrooms, the quiet of the school in full operation, the elimination of outside distractions, the excellent lighting, and the freedom from the influence of unpleasant heat or cold . . . all these, we feel, add up to a better environment for education."

This impressive report is backed up by comments of the users of these schools. Principal Thomas H. Edwards, Jr., of the Leiston T. Shuman school, said:

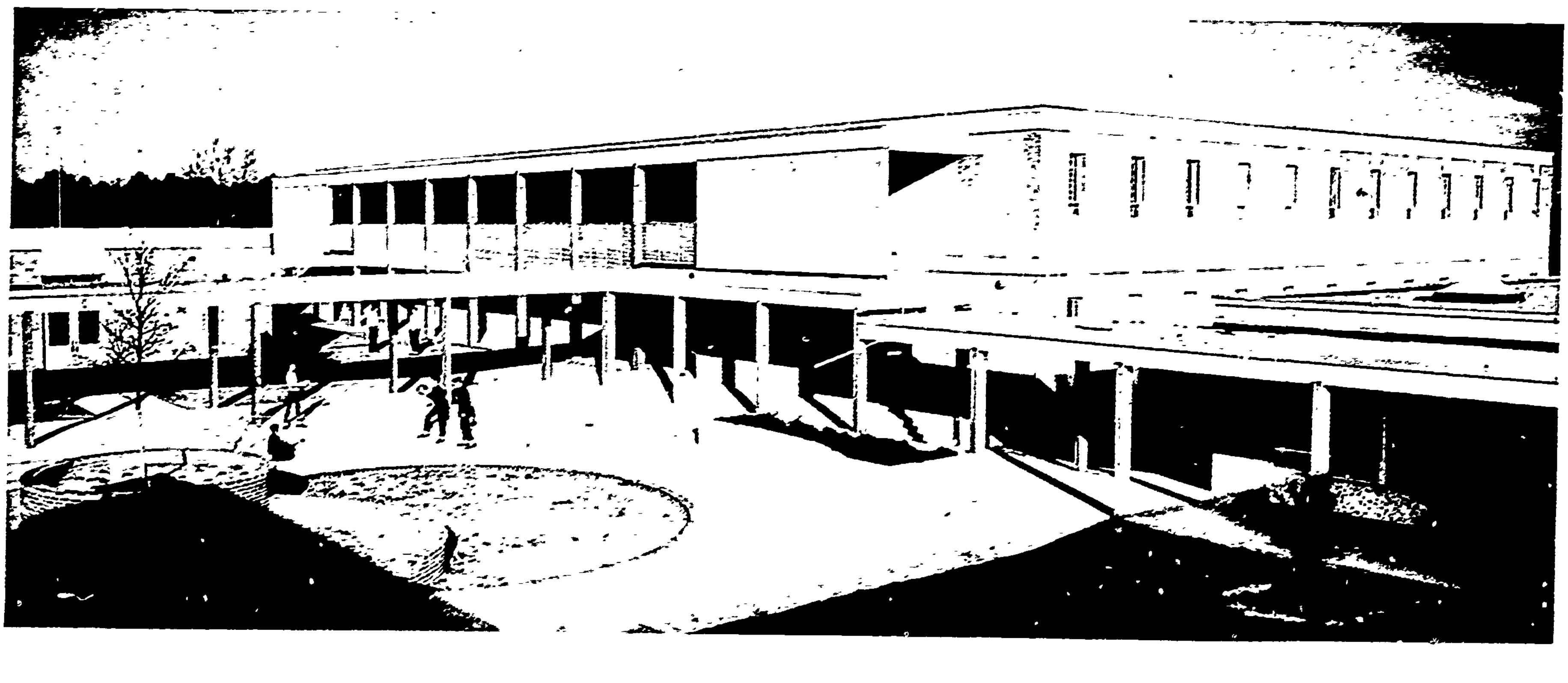
"We have been in this building since Sept. 13, 1963. We are completely sold on it. We think it is the best type building to carry on a good school program. The maintenance is much simpler than in a conventional type building. The general atmosphere is conducive to good learning. The noise in the building is at a minimum . . . Of course, we have no windows in the building. In the classrooms, it is not a temptation for the students to look outside . . . someone might say that you would have a feeling of being fenced in or hemmed in all the time, but this is not true. I have discussed it with our teachers from time to time and they assure me that they do not have this feeling. I have talked with students . . . and they do not have a feeling of being fenced in or hemmed in. This is my twenty-fourth year in the school teaching profession . . . In all those years, I have never seen a building that is as fine as this type building. It is just designed for learning . . ."

A parochial school in Savannah, the Benedictine Academy, is also a compact, windowless brick structure. It, too, was designed by Thomas-Driscoll-Hutton, Inc. The principal, Father Christopher, gives the building top marks as a learning environment.



"As an aid to teaching, certainly the controlled environment school is unequaled," he said. "The temperature is perfect; you are not bothered with stuffiness; you are not bothered with heat; you are not bothered with cold. Therefore, the teacher concentrates simply on imparting subject matter . . . We were all afraid of the controlled environment, for fear the school would have a submarine effect. It has not had that at all because of the lavish use of skylights . . . I have taught in the ordinary types of buildings, but never in anything like this, never in an atmosphere that was so thoroughly conducive to learning . . ."

W. J. Keenan Jr. High, Columbia, S.C. Architects: Lafaye, Lafaye and Associates.



Amory Middle School, Amory, Miss. Architects: Biggs, Weir, Chandler, Neal & Chastain.

AMORY, MISS.

Amory, Miss., is a town of about 6,500 population. It decided to build a "middle school" when increasing enrollment forced changes in its traditional six-year school organization. It wanted to avoid the usual junior high school plan, and thus the "middle school" has a lower school (grades 5 and 6) and an upper school (grades 7 and 8) flanking a resources center. It has no cafeteria as such —each "school" has a multi-purpose room which serves for dining. The building is air conditioned for year-round use, and it has only small strip windows. The central area of the school is a skylighted court which serves as a student lounge and display center. Plants, pools, and furnishings in the area make it an attractive center for the inward-oriented plan. It is a brick building which was constructed at a cost far below the national average.

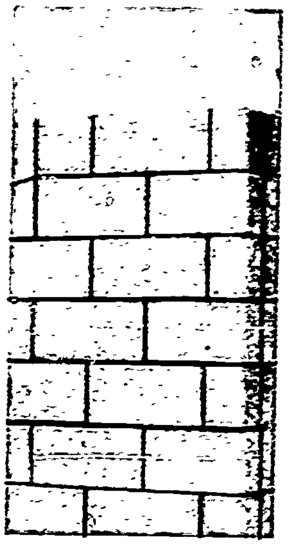
Principal Holace Morris said the small strip windows in the school are not really needed, and are merely a concession to tradition. He adds that in the summer with the air conditioning system off, the "middle school" is more comfortable than a conventional school would be.

The Amory school has proved to be exceptionally quiet, though in some modern schools control of interior sound is a problem. Most frequently the problem is related to the use of partial partitions, movable partitions, or folding walls. Students have complained of being distracted by noise from corridors. Teachers have noted that metal partitions transmit vibrations from one room to another, and that sounds "leak" through.

But even where this problem exists, administrators, teachers, and students are strongly in favor of the compact school and the educational advances it makes possible.

This kind of school is no longer an innovation in the real sense of the word. Its appearance in many school districts may still surprise some people, if only because it is different from the schools they attended in their childhood.

But compact schools are well beyond the experimental stage. The educational benefits of these schools appear to be real and substantial. They create an environment which is more conducive to learning than the conventional school. Students appear to be able to work longer, and are healthier in a controllable environment. Distractions are minimized. Interior spaces can be fully utilized. Further, such schools give the community a year-round, multiple-purpose facility for both the regular program and adult education.



MAKING THE MOST OF MASONRY

Brick and tile are uniquely versatile materials with many applications in school design and construction. The properties of structural clay products are generally considered to be well-known and appreciated. In many cases, however, those who use these materials in schoolhouses fail to take advantage of their full range of other capabilities. In doing so, they sometimes sacrifice important economies.

It is generally understood, for example, that brick's small unit size offers enormous flexibility in application. Long-term durability and low-maintenance characteristics are recognized. The superior fire resistance and acoustical properties of dense clay units are undoubtedly responsible for much of their popularity in school buildings. It may also be true that the relatively low initial cost of masonry is well-known to educators and school administrators.

However, two areas of information are less well-known. One concerns the heavily-documented studies which have been made of comparative in-the-wall costs of materials over the useful life of schoolhouses. This information is extremely useful for evaluating wall materials on a true "ultimate-cost" basis. It is not only important to the educator that he exercise maximum fiscal responsibility. It is often equally important, in this age of community consent, that he be able to demonstrate that he is doing so.

The second matter concerns the structural capability of masonry walls.

THE CONTEMPORARY BEARING WALL

Brick has tremendous compressive strength; that is, it is capable of supporting very heavy loads. Virtually any properly-designed brick or structural tile wall will support a one or two-story school building. Many new schoolhouses are designed with load-bearing masonry walls. Some designs, however, ignore the structural capability of brick and tile. Instead, they utilize steel or concrete columns for structural support and use masonry as a "curtain wall" material.

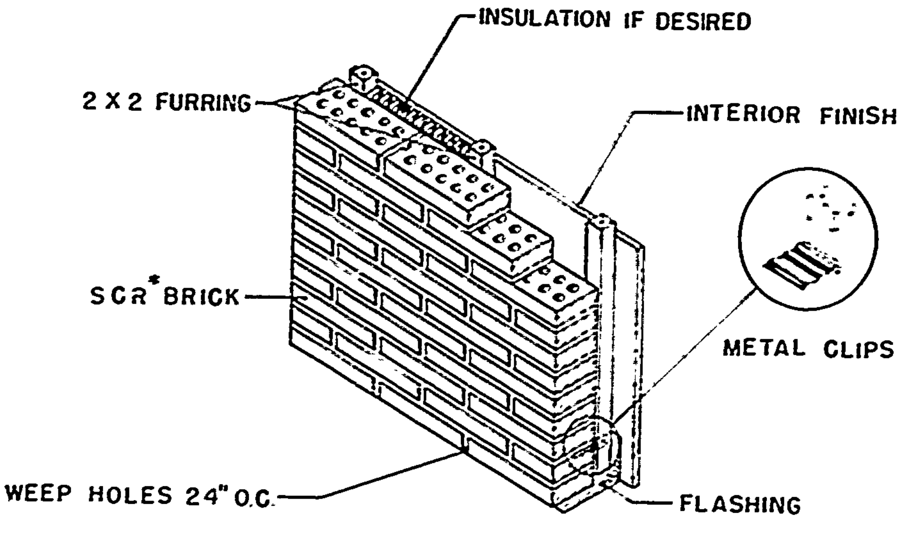
Very often this is a waste of an important masonry property, and it will measurably and unnecessarily increase the initial cost of a school building. Brick or structural clay tile walls can provide structure, enclosure, and interior finish in one; it is often an extravagance not to take full advantage of these inherent capabilities.

New high-rise schools which are being planned for some of our urban centers may also be supported by brick walls. The new brick bearing wall concept, developed by architectural engineers of the Structural Clay Products Institute, permits relatively thin masonry walls to bear the weight of buildings as high as 16 stories. In this design concept, walls and floor are designed to act as stiff diaphragms and provide a rigid structural system of great strength.

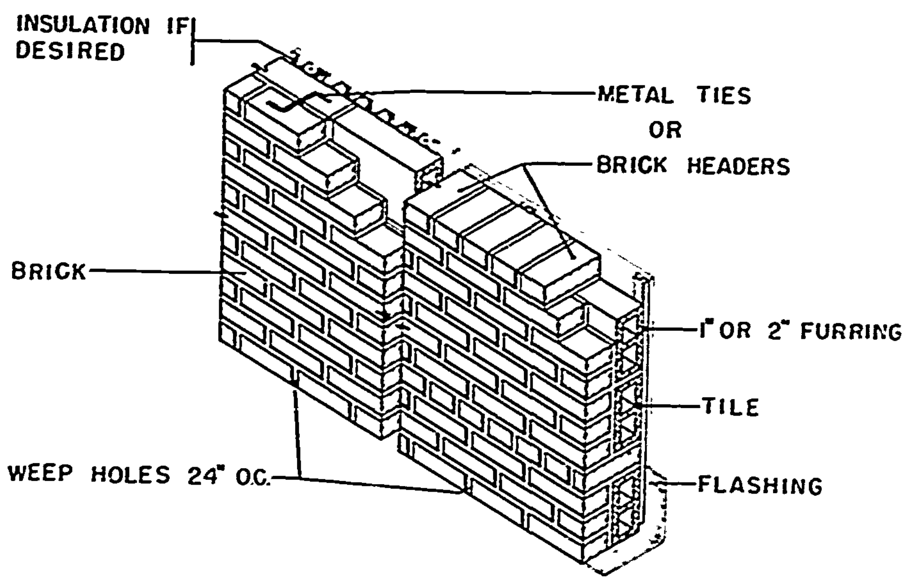
In one recent project, 15 residential buildings ranging in height from four to 10 stories were designed as load-bearing brick structures. Studies requested by a Federal agency disclosed that the masonry load-bearing system cost 20 per cent less than a conventional steel frame and bar-joist structure. Particularly wide use of the brick bearing wall concept is being made today in university dormitory design.

PRIMARY WALL TYPES

It is the architect's task to select the best wall for a given purpose. Different masonry walls have been designed and tested over periods of many years to fit every conceivable need, including resistance to lateral forces as great as those created by nuclear explosions. Some general



SIX-INCH BRICK WALL



EIGHT-INCH BRICK AND TILE WALL

information about frequently used masonry walls may be of help to the educator.

SIX-INCH BRICK WALL

Like other masonry walls, the six-inch brick wall may be used as a load-bearing wall enclosure within a structural frame. It has special use in single-story, low-silhouette school design. As an exterior wall, the six-inch through-the-wall unit lends itself well to furring, insulating, and plastering. As an interior partition, it may be left exposed. It may also cut costs if it is used to bear the roof load. Substantial savings may accrue in dispensing with a structural frame. Without plaster, the wall is approved for a 2½-hour fire rating.

EIGHT-INCH BRICK AND TILE WALL

This is a conventional eight-inch masonry wall; it may be built of brick and tile as shown, all brick, or of brick and structural facing tile. It is adaptable to masonry bonding or the use of metal ties in the mortar joints. The wall is usually furred and finished on the inside. It may be load-bearing or used with a structural frame. This wall is listed in the National Building Code of the National Board of Fire Underwriters as having a four-hour fire rating when plastered.

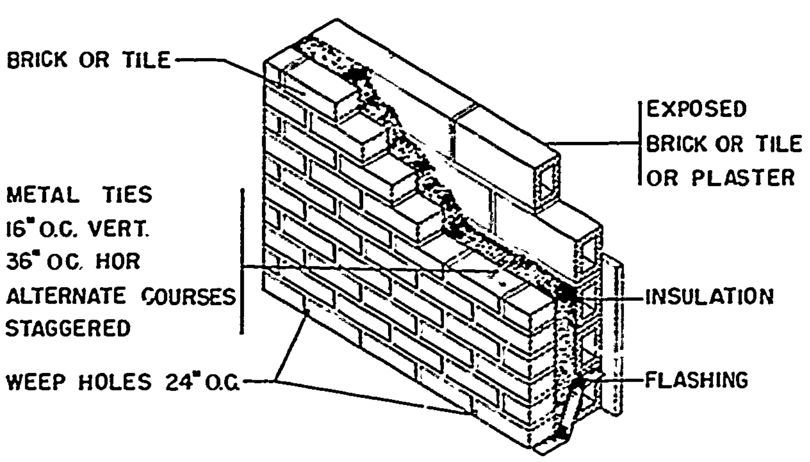
BRICK AND TILE CAVITY WALL

The wall shown on page 18 is a brick and tile cavity wall made of two four-inch nominal wythes of masonry units, one of brick and one of tile. They are bonded by corrosion-resistant metal ties embedded in the mortar joints. Between the wythes is a two-inch air space or cavity. The cavity, left as dead air space or filled with insulation material, provides an excellent barrier to the penetration of moisture, heat, and cold. The design is such that even wind-driven rain cannot penetrate to the interior wall face. This makes it possible to leave the interior face exposed. It may also be plastered, if desired, without furring, lathing, or special treatment. When plastered, it has a fire rating of four hours. It should be noted that this is the highest rating generally required in buildings; the true fire resistance may be much greater. The cavity wall is used in the taxpayer cost study and is highly recommended for school construction. It may be used as a load-bearing wall and it is especially recommended when air conditioning is considered.

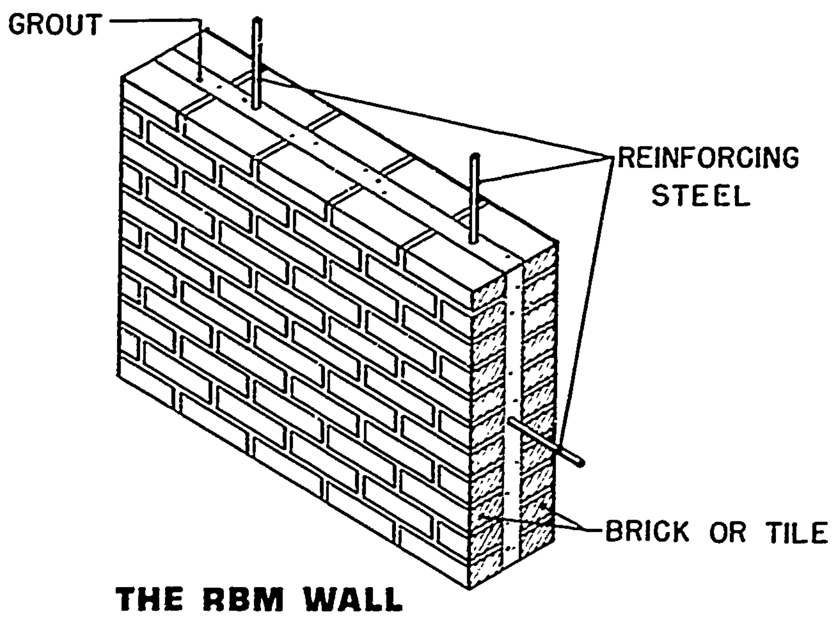
THE RBM WALL

This is known as a reinforced grouted brick masonry (RBM) wall. It is similar to a cavity wall in that it comprises two wythes of masonry with an interior space between the tiers of units. In this case, however, reinforcing bars are placed in the cavity, which is then filled with grout. The steel bars are placed as they are in reinforced concrete work, except that RBM dispenses with the labor and material costs of building and removing concrete forms.

The RBM wall is most effectively used in areas in which severe lateral forces resulting from high winds, tornadoes, earthquakes, hurricanes, or blast can or may



BRICK AND TILE CAVITY WALL



THE RBM WALL

be expected. Because of its tremendous strength, it also may be employed by architects where high-load design is needed but where thicker walls are undesirable. The RBM wall is also a primary design factor in the "safety core" concept of human safety. Such a "safety core" may be incorporated within any private or public structure as protection against blast, fallout, and natural disaster.

A classroom unit built with RBM walls successfully withstood the nuclear blast of the "Operation Plumb Bob" test in Nevada during 1957 while neighboring test structures, built with other materials and methods, failed. In the test, the walls were designed to withstand a lateral force of five pounds per square inch of wall surface. This pressure figure was chosen because (1) it is in the upper range of force anticipated from tornado and other natural disasters, and (2) it is believed to represent the point beyond which no owner can be expected economically to build a pressure-resistant wall. The RBM wall passed both tests; it withstood the shock, and it proved extremely economical and simple to design and build.

BRICK PARTITIONS

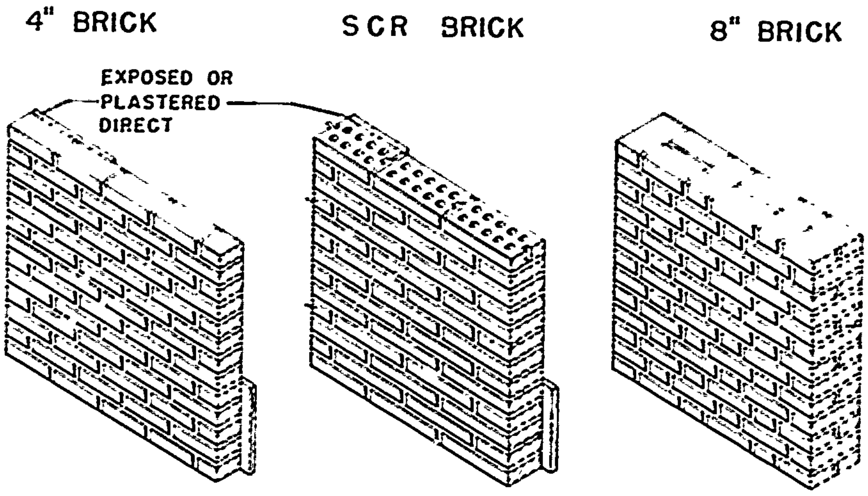
Brick partitions are usually four, six, or eight inches thick. All are free-standing and the six and eight-inch walls may be load-bearing. Exposed clay masonry walls, as is well known, are virtually maintenance-free over the life of the building. They do not rot, warp, bend, rust, pit, dent, spring, or bow. Their low sound transmission characteristics make it possible to place high-noise level spaces, such as gyms, music rooms, and cafeterias not only near but adjacent to quiet areas. In itself, this advantage can create economies through compactness of design. Fire resistance, depending upon thickness, ranges from one to seven hours.

An exposed, unplastered four-inch partition has a sound transmission loss of approximately 48 decibels and a fire resistance of 1¼ hours. If plastered on both sides, the fire rating rises to 2½ hours. Most building codes allow a maximum height of 12 feet. The six-inch brick partition, when used as a load-bearing wall, usually is limited by most model codes to a height of 10 feet. It is permitted by building codes to carry approximately 28,000 pounds per linear foot. Sound loss, unplastered, is 56 decibels. It has a fire resistance of 2½ hours. The eight-inch brick partition will carry up to 38,400 pounds per linear foot. Sound loss, unplastered, is 61 decibels. It has a fire resistance of five hours.

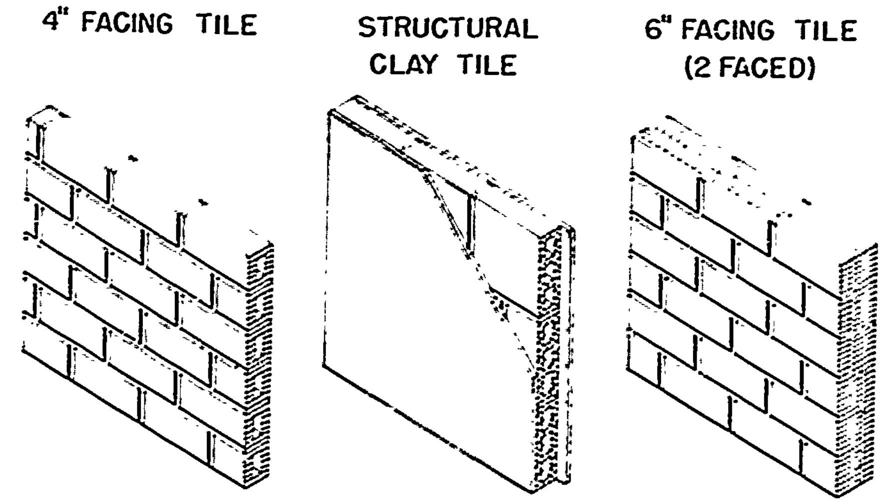
TILE PARTITIONS

Shown in drawings at right above are examples of structural clay tile walls. One wall is glazed on one side, and one has glazed units on both sides. The wall shown in the middle employs structural clay tile units which are especially appropriate as a backup material for brick exterior walls, for the fireproofing of columns or structural members, or for use, when plastered directly without furring or lathing, above a wainscot height of glazed facing tile. Structural tile of either type is designed to provide superior fire protection (thus reducing insurance costs), very low sound transmission, and an absolute minimum of maintenance and housekeeping.

Facing tile partitions for schools are usually four, six, or eight inches thick, the latter two having load-bearing capability. The research division of the Structural



BRICK PARTITIONS



TILE PARTITIONS

Clay Products Institute has developed a four-inch unit specially designed for sound absorption and noise reduction—"SCR Acoustile."* It is particularly useful in music rooms, cafeterias, gyms, and other essentially noisy spaces.

Facing tile for four, six, and eight-inch facing tile partitions is available in 22 standard field colors and nine additional strong "accent" colors for aesthetic emphasis. In these thicknesses, the average sound transmission losses are between 44 and 50 decibels. Fire ratings for brick and tile partitions are generally superior to those of other materials and range up to four hours for eight-inch walls.

THE ULTIMATE COST OF WALLS

Walls, and the materials in them, affect not only the initial cost of a school, but maintenance costs, repair costs, heating and cooling costs, and even insurance costs. A cost analysis of walls is, therefore, valuable in demonstrating how the use of masonry in walls can appreciably alter the total ultimate cost of a school.

A few years ago, a highly-praised study entitled "Ultimate Cost of Building Walls"** was adapted by one of its co-authors to school design. In this adaptation, a hypothetical classroom enclosed with three alternate materials serves as the point of study. Applying nine identical financial considerations to each of the three wall materials, the study projects their relative costs over a school building's useful life, assumed to be 50 years, and arrives at a relative total cost for each. This final result is the "ultimate cost" of a wall—the total amount that a community will have to pay for it over its useful life span.

The method of procedure used in the study is to isolate all of the factors which create true taxpayer cost. It shows clearly that the initial cost is only the down payment so far as the taxpayer is concerned, and that higher initial cost does not always pay for itself in reduced annual expenditures.

The cost factors used in the analysis are: (1) Initial wall cost; (2) support of the wall cost; (3) salvage credit; (4) illumination credit; (5) heat loss charge; (6) maintenance charge; (7) insurance charge; (8) value of money; and (9) anticipated price increases.

Six tables tell the story. Table I compares a brick cavity wall, composed of a four-inch wythe of brick and four inches of plastered structural tile separated by a two-inch air space, with a typical metal panel wall and a typical glass window wall. It sums up the costs of each factor and gives a relative ultimate cost for each. Table II describes the hypothetical classroom used in the study. Table III gives the wall design assumptions; Table IV shows the cost assumptions; Table V relates design and cost assumptions, and Table VI describes the financial assumptions.

Present Value of Ultimate Wall Costs. An understanding of this fiscal concept is necessary before each of the cost factors is considered. Initial cost can be amortized

"SCR Acoustile" Reg. U.S. Pat. Off., Pat. No. 3001602. SCPI
***By Clayford T. Grimm and James G. Gross, professional engineers.*

over a period of time and the annual amortization payment added to the average annual cost of operation to produce a total annual cost. But these annual costs fluctuate, are unequal, and lie in the future. They wind up being expressed in a series of payments, rather than as a lump sum. Thus they produce a vague picture which is far less understandable than a demand for an immediate cash outlay. But future costs may be converted to a "present value," and this sum can be added to the initial building cost. Then you have an equivalent initial cost which includes in one figure the initial cost of construction and the present value of all future costs.

Anyone who has ever borrowed money has used the "present value" or "present worth" concept. The present worth of a future expenditure is the sum which may be secured today in exchange for the promise to make a specified future payment. The present worth to a borrower of making a $100.70 payment a year from now is $95 when money is valued at six per cent annually.

Wall Cost Estimates. Specific material and labor prices vary from area to area. For this study, national average costs were used. On this basis, they are estimated as $2.30 per square foot of wall area for a 10-inch brick and tile wall whose two-inch air space is filled with a suitable insulating material and whose interior face is plastered and painted; at $6.00 for a typical metal panel wall which has four-inch structural mullions and a two-inch-thick wall panel with painted and plastered inside face; and at $4.60 for a clear plate glass window wall set in an aluminum frame.

Cost of Wall Support. Heavy walls cost more to support than light ones, though the cost difference has frequently been exaggerated. For a 20-story building, this cost would hardly exceed 50 cents per square foot of wall area. In low school buildings where load-bearing walls may be used, wall types which carry a structural frame should be charged with the entire cost of the frame. The cost difference in framing and foundations between light and heavier walls for low buildings may be negligible. However, to be as conservative as possible in making this study, a charge based on weight was made against the heavier walls.

Wall Thickness Considerations. When space is severely limited and the entire site will be used by the building, wall thickness may be an important economic matter because of the usable floor space it occupies. Even here, of course, this cost figure must be measured against possible cost savings accruing from less expensive, thicker walls. However, wall thicknesses mean nothing in a school building since it would be hard to imagine a situation in which the building covered every foot of the site.

TABLE I
PRESENT VALUE OF ULTIMATE WALL COSTS
(Per Square Foot of Wall Area)

COST ITEM	MASONRY CAVITY WALL	METAL PANEL WALL	ALUMINUM WINDOW WALL
1. INITIAL WALL COST	$2.30	$6.00	$ 4.60
2. SUPPORT OF THE WALL CHARGE	.16	.04	.02
3. TOTAL INITIAL WALL COST	2.46	6.04	4.62
4. LESS SALVAGE CREDIT	.07	.33	.20
5. LESS ILLUMINATION CREDIT	None	None	3.96
6. TOTAL INITIAL COSTS LESS RECOVERED COSTS	2.39	5.71	.46
7. HEAT LOSS CHARGE	1.15	1.16	11.79
8. MAINTENANCE CHARGE	.59	.59	6.62
9. INSURANCE CHARGE	None	1.70	1.61
10. PRESENT VALUE OF TOTAL COST	4.13	9.20	20.48
11. RELATIVE ULTIMATE COST	100%	223%	496%

TABLE II
DESCRIPTION OF CLASSROOM

1. NUMBER OF STORIES	1
2. LENGTH (inside)	31'-8"
3. WIDTH (inside)	23'-0"
4. WALL HEIGHT	10'-0"
5. FLOOR TO CEILING HEIGHT	8'-8"
6. CONTAINED CLASSROOM AREA	728 Sq. Ft.
7. CONTAINED CLASSROOM VOLUME	6312 Cu. Ft.
8. CLASSROOM EXTERIOR WALL AREA	320 Sq. Ft.
9. ROOF CONSTRUCTION	Built-up Roof Steel Deck Steel Joist Acoustical Tile Ceiling
10. STRUCTURAL FRAME	Unprotected Steel
11. FLOOR	Concrete Slab
12. BUILDING AREA	10,000 Sq. Ft. plus

TABLE III

WALL DESIGN ASSUMPTIONS

	MASONRY CAVITY WALL	METAL PANEL WALL	ALUMINUM WINDOW WALL
1. WINDOW AREA, PERCENT	0	0	100
2. WALL THICKNESS, IN.	10	6*	3**
3. WALL HEIGHT, FLOOR TO FLOOR, FT.	10	10	10
4. WALL WEIGHT, LBS. PER SQ. FT.	65	16	7
5. FIRE RESISTANCE, HRS.	4	1	0
6. U VALUE, BTUs/HR./SQ. FT./°F.	.12	.12	1.24
7. COLOR	Medium	Medium	Clear
8. INTERIOR ELECTRICAL ILLUMINATION, HRS. PER YR.	1600	1600	800

*Two-inch panel and four-inch structural mullions

**Includes structural mullions

TABLE IV

COST ASSUMPTIONS

	MASONRY CAVITY WALL	METAL PANEL WALL	ALUMINUM WINDOW WALL
1. INITIAL COST			
(a) of wall per sq. ft.	$ 2.30	$ 6.00	$ 4.60
(b) of classroom per cu. ft.	1.50	1.65	1.60
(c) of classroom per sq. ft.	15.00	16.50	16.00
(d) of classroom	11,520	12,704	12,256
(e) of classroom contents			
2. SALVAGE VALUE PER SQ. FT. OF WALL	.16	.80	.57
3. MAINTENANCE COST PER SQ. FT. OF WALL AND FREQUENCY			
(a) cleaning exterior	.07 every 35 years	.02 every 8 years	.02 three times a year
(b) cleaning interior			.02 three times a year
(c) cleaning blinds			.02 three times a year
(d) pointing	.50 every 35 years		
(e) caulking		.06 every 8 years	.06 every 16 years
(f) painting interior	.03 every 4 years	.03 every 4 years	
4. INSURANCE RATE PER $100.00 VALUE			
(a) fire insurance on building (85% Co-Ins)	.09/100	.23/100	.23/100
(b) fire insurance on contents ($576 per classroom)	.14/100	.28/100	.28/100

TABLE V

RELATED DESIGN AND COST ASSUMPTIONS

1. CONCRETE COSTS:	
(a) superstructure	$80.00 per cu. yd.
(b) foundations	$35.00 per cu. yd.
2. AIR CONDITIONING:	
(a) initial plant cost	$.10 per BTU of hourly capacity
(b) power costs	$.02 per kw-hr.
(c) power input per ton	2 kw
(d) wall orientation	Average of N,E,S & W
(e) design temperature on August 1st at 4 p.m. on 40° N. latitude	
exterior	95°F
interior	74°F
daily range	20°F
(f) summer degree-days, per year	500
3. HEATING:	
(a) initial plant cost	$.02 per BTU of hourly capacity
(b) fuel cost	$.10 per therm (100,000 BTU)
(c) design temperature	
exterior	0°F
interior	70°F
(d) heating degree days per year	5000
4. ILLUMINATION:	
(a) power cost	$.02 per kw-hr.
(b) lamp replacement cost	$.04 per watt
(c) design level	40 foot-candles
(d) illumination, foot-candles per watt	15 foot-candles
(e) normal lamp life	8000 hrs.

TABLE VI

FINANCIAL ASSUMPTIONS

1. VALUE OF MONEY	4% Per Year
2. ANTICIPATED USEFUL LIFE OF BUILDING	50 Years
3. DEPRECIATION RATE OF BUILDING	2% Per Year
4. ANTICIPATED USEFUL LIFE OF MECHANICAL EQUIPMENT	20 Years
5. DEPRECIATION RATE ON MECHANICAL EQUIPMENT	5% Per Year
6. ANTICIPATED AVERAGE ANNUAL RATE OF PRICE CHANGES:	
(A) INSURANCE	+.01
(B) MECHANICAL EQUIPMENT	+.0377
(C) HEATING PLANT MAINTENANCE AND FUEL	+.0333
(D) MAINTENANCE ON WALLS	+.0377
(E) ELECTRICITY	+.01

What Will Salvage Value Be? All materials have a salvage value, though it is difficult to anticipate what the market for such materials will be 50 years hence. The present worth of this anticipated income will be small. However, it is included in the interest of fairness.

Illumination Credit: In most buildings, regardless of use, the lights are kept on during the working day regardless of the amount of natural light coming from the windows. Usually, no reduction in illumination cost can be traced to window area; the need for windows, if it exists, is psychological rather than physiological. However, this study assumes a possible savings in power and lamp consumption through the natural light provided by glass. A special credit for this purpose is given to the glass wall.

Cost of Heat Loss. The amount of heat loss through one square foot of wall may be computed from data published in the ASHRAE (American Society of Heating, Refrigeration and Air Conditioning Engineers) Guide. The initial cost of the heating equipment, the space it occupies, and its operation and maintenance are considered in this study.

Cost of Heat Gain. The cost of air conditioning is the cost of removing heat from school buildings. This cost is not included in the analysis but some relevant figures are of interest.

The Houston, Texas, architectural firm of Golemon & Rolfe was commissioned to design an air-conditioned school for direct comparison with a school they had designed several years earlier. This was one of the pioneer studies of air conditioning costs. They used the original Bellaire Senior High School, its site, enrollment, educational program, etc., as the basis for their hypothetical research structure. Carrier Corp. published a booklet on the study showing that the air-conditioned school design occupies a third less acreage than Bellaire, is a compact, all-masonry structure that eliminates $46,350 in metal window costs, reduces glass and glazing costs from $26,680 to $1,748, and saves $547,997 in adjusted construction costs from the original $2,588,710 price of the Bellaire school. (It is significant that the city of Houston decreed in 1964 that all of its schools must be air conditioned.) This explains why the ultimate taxpayer cost of air conditioning per square foot of wall area shows such a definite advantage for masonry. These ultimate costs for air conditioning, based on unshaded walls of average orientation, are: Masonry cavity wall, $0.43; Metal panel wall, $0.91; Glass window wall, $28.23.

The Insurance Factor. Building insurance rates are based on structure, occupancy, the degree of exposure to danger, and the protection provided. An investigation of rates shows that walls not backed with masonry cost the owner considerably more in insurance premiums. A survey of rating bureaus writing insurance in 33 States showed that rates on buildings and their contents were appreciably higher for non-masonry walls. In 87 per cent of the States involved, fire rates on buildings and their contents were affected by the amount of window area in the building.

Broad Street School, Nashua, N.H.

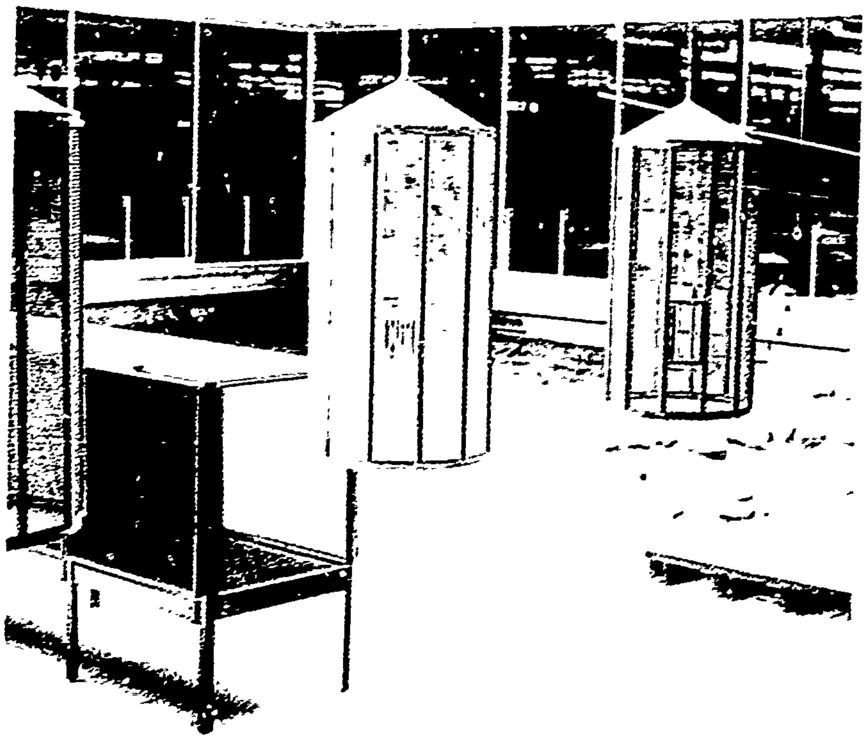
Maintenance Costs. The cost analysis does not include wall repairs. It is assumed that metal walls will last the life of a school building. The study also assumes that glass walls will not be broken by schoolboys with rocks. (In 1963, the City of New York spent nearly $1,000,000 to replace broken glass in its schools. Philadelphia spent $211,614 to replace broken window panes. Chicago spends about $650,000 each year to maintain windows and replace broken glass. Broken windows cost Baltimore $105,590 in 1963.) Sticking to maintenance, then, the study includes expenses of cleaning, pointing, painting, and caulking. To be conservative, the study assumes that metal walls will be cleaned only once every eight years, and that glass will be washed three times a year.

An additional factor in maintenance savings, while not part of the study, is brought out by G. B. Wadzeck,

superintendent of schools in San Angelo, Texas. Wadzeck has had long experience with compact, air-conditioned schools. Based on studies he has made, Wadzeck says: "When a building is sealed, the air filtered, dust particles removed, etc., janitorial labor is cut by between 40 and 50 per cent. On our present schedule, we shall save $27,000 a year on janitorial labor alone . . . We have found that when you seal a building, filter the air and tunnel your circulation and ventilation artificially, that the dust and dirt, manufacturing particles, etc., which are removed from the air will allow your janitors to carry 50% more square footage than in your traditional buildings, and this will easily offset your increased utility cost and amortization of your equipment. We have also found that, even with a paid summer school, we have 10 times as many children interested in summer programs as we did in our traditional buildings."

Further long-term economies can be made through provision of superior insulation. The masonry cavity wall is of particular value in such cases.

Life Science Court, High School, Kearney, Neb. Architects: Caudill, Rowlett & Scott; Associated Architects, Helleberg & Helleberg.



HOW MANY BRICK A DAY?

The architect decides what should be built, and how. To carry out the architect's orders, the general contractor assembles a variety of subcontractors and craftsmen and coordinates their work. Of particular importance in the school building process is the mason contractor. He brings to the job both men and machinery—skilled bricklayers and masons, stone setters, tile setters, and terrazzo mechanics, and such exotic modern devices as high-speed masonry saws and guillotines, brick buggies, portable scaffolding, and fork-lift tractors that can lift packages of brick high in the air.

The mechanical equipment brought to today's construction site is far different from that used a few decades ago. Similarly, today's bricklayer differs markedly from the bricklayers of a few decades ago. For one thing, he is younger. A U.S. Senate Subcommittee studying the role of apprenticeship in manpower development noted that the estimated median age of mason craftsmen is now 37.9 years. Fifteen years ago the median age was 43, and 25 years ago it was even higher.

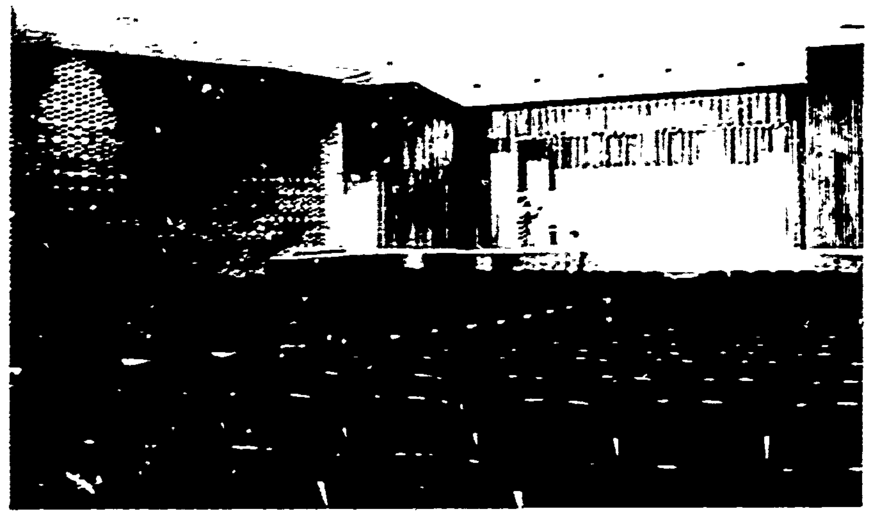
Today's bricklayer is more highly trained than his predecessors. Bricklayers become craftsmen by going through a three-year apprenticeship program. This includes more than 400 hours of classroom training.

The productivity of the bricklayer has been subject to much misunderstanding. The magazine *Architectural Forum* has said:

"Mason groups have wearied of the perpetual need to explain to the uninitiated that scarcely any jobs today are comparable to work done in the era of 2,000 brick per day. That rate was possible in old-style walls that were often three and four feet thick. The unexposed central section was literally slapped together. Building is one of the most productive enterprises in terms of output of any on the industrial scene. The annual output of a construction worker is double that of the average U. S. worker."

According to a survey conducted by mason contractors in 17 cities, the average daily production of a bricklayer for all types of structures was 638 brick. Production rates shown in the survey ranged all the way from 400 to 1,000 brick a day, depending on the type of design, thickness of the wall, number and type of window openings, and intricacy of pattern and bond. The higher production rates were noted, as might be expected, on buildings whose wall surfaces were relatively unbroken. Thus, it may logically be concluded that to the many economies of the compact school can be added those accruing from efficient building methods and a high rate of production.

THE AESTHETICS OF MASONRY



High School, Southgate, Mich.

Olin Hall of Science, Colorado College, Colorado Springs, Colo.

The renowned British architect Sir Basil Spence has called brick the "best prefabricated building product ever devised by man." A great part of its ability to earn such high praise derives from its aesthetic properties.

Drawn from the earth, shaped, and baked in kilns, brick acquires a unique adaptability to any aesthetic situation or purpose. At the same time, it retains the fundamental affinity to nature and man which is the property of any natural material.

Brick's small size and great range of surface textures enables the architect to form an infinite variety of wall patterns and textures, capturing the interplay of light and shadow in delightful ways. A conservative estimate of the number of different colors, shades, and textures available in brick approaches 10,000.

Because brick can be used in many applications, it serves as an aesthetic unifier. Exposed interior brick walls create a scale with which children are comfortable and relate visually to the exterior of the building. In corridor walls, floors, and entranceways, brick links inside with outside. In attendant uses for planters, walkways, terraces and windbreak or solar screens, brick creates a desirable unity of design. Used in combination, brick softens the cold surfaces of industrial materials. In the compact school, brick's pattern, texture, and color relieve the masses of large wall areas.

A FEW LAST WORDS

It has been the purpose of this booklet to give educators and school administrators useful information about clay masonry products within the larger context of worthy educational goals.

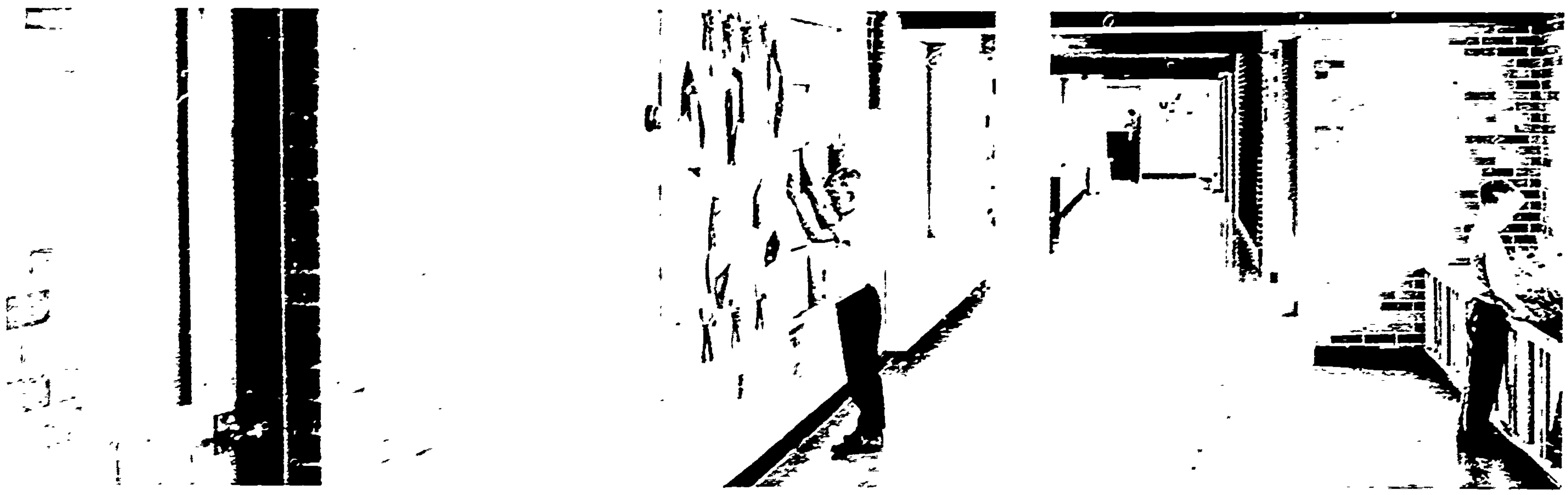
However, we would not presume to try and tell any community just how "good" a school it should have, or what kind of school would be best for it.

The responsibility for the first decision—that is, how good a school should be—rests with the community. The responsibility for deciding which kind of school the community should have—compact, finger-plan, campus—rests with educators and architects.

The masonry industry does have its own idea of what the ideal school should provide. Schools are architecture, and they should fit the definition for architecture given 1,900 years ago by the Roman architect, Vitruvius. "Architecture," he said, should encompass "commodity, firmness, and delight."

Expressed in contemporary terms, this definition means that a good school should fulfill its educational and social purposes. That is its "commodity." It should be soundly built, safe, and economical. That is its "firmness." Finally, a good school should furnish young children with a valid frame of reference in which to begin to form concepts of beauty. That is its "delight."

"We shape our buildings and afterward they shape us," said Sir Winston Churchill. This booklet has attempted to consider some of the possibilities now open to us in the shaping of our school buildings, in full recognition of the fact that these structures, more than any other buildings we use, will, indeed, afterwards shape us.



Broad Street School, Nashua, N.H.

BACK COVER: *Lilibridge Elementary School Addition, Detroit, Mich. Architects: Birkerts & Straub.*

Published by The Allied Masonry Council. 1750 Old Meadow Road. McLean. Virginia 22101 PRINTED IN USA