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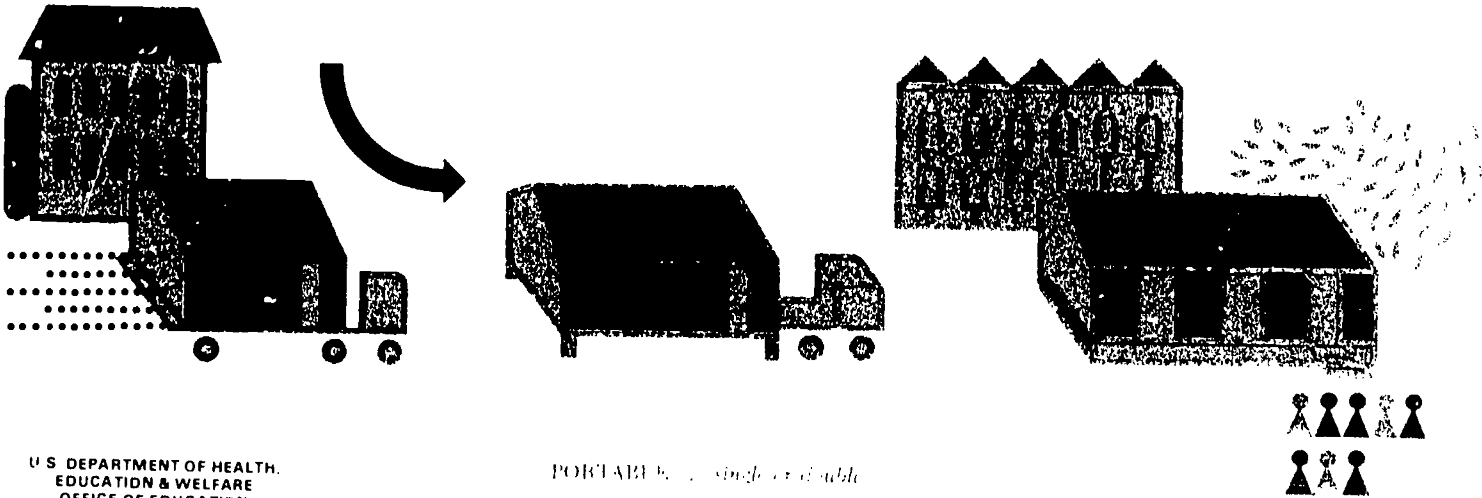
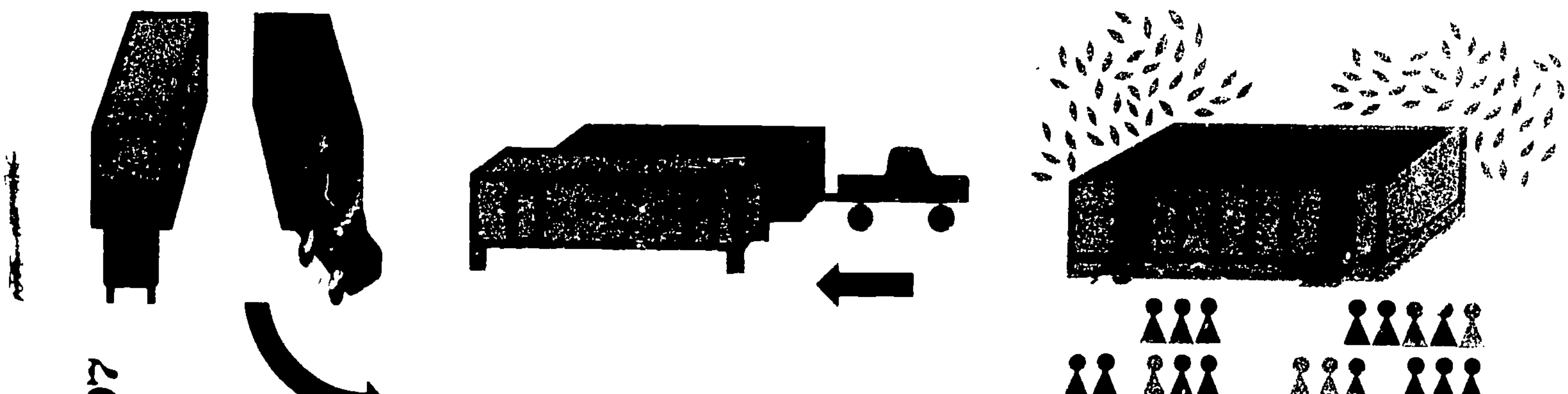
ABSTRACT

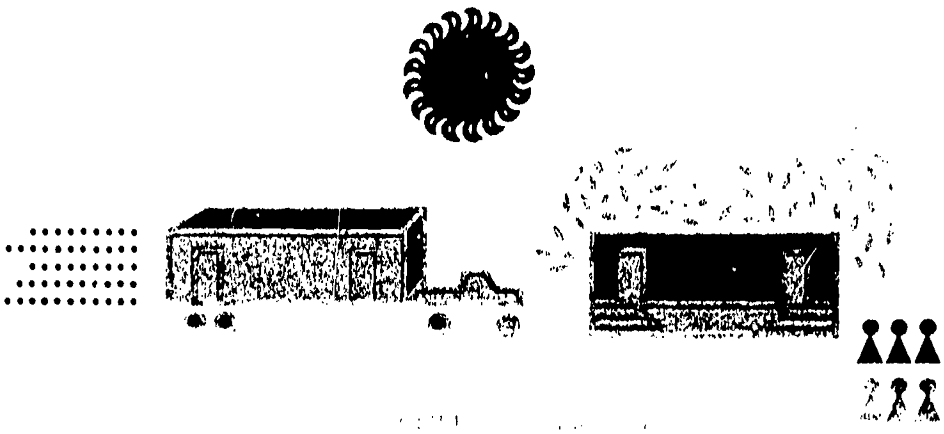
This document provides baseline information about temporary facilities as alternatives to school construction. More than 40 individual school districts in 18 States cooperated in a review of their units. The study scans the problem of temporary facilities historically, analyzes prevailing conditions at the beginning of the 1960's, makes projections concerning future use of relocatables, discusses new developments and transportation problems, and includes guides for calculating costs. The publication includes a detailed chart that displays specifications for and costs of the temporary structures in 23 selected districts. The chart is keyed to photographs and descriptions of some of the district units surveyed in the study. The document concludes with sketches and plans for a "convertible classroom/commons core" -- a permanent structure designed to serve multiple purposes in conjunction with linkage provisions for a variable number of relocatable units. (Photographs may reproduce poorly.) (MLF)



PORTABLE . . . *single or double classroom building designed to be moved as a unit . . . dimensions and weight limit relocatability to comparatively short distance within community . . . can be useful and amenable self-contained classrooms or supplementary facility (See detailed notes, page 16)*



DIVISIBLE-MOBILE . . . *structure easily moved in halves, each section similar to mobile house trailer, open on one side . . . total width (two halves) generally limited to 20 ft. . . . broad variations in structural quality, design amenities, equipment, and costs. (See detailed notes, page 18)*



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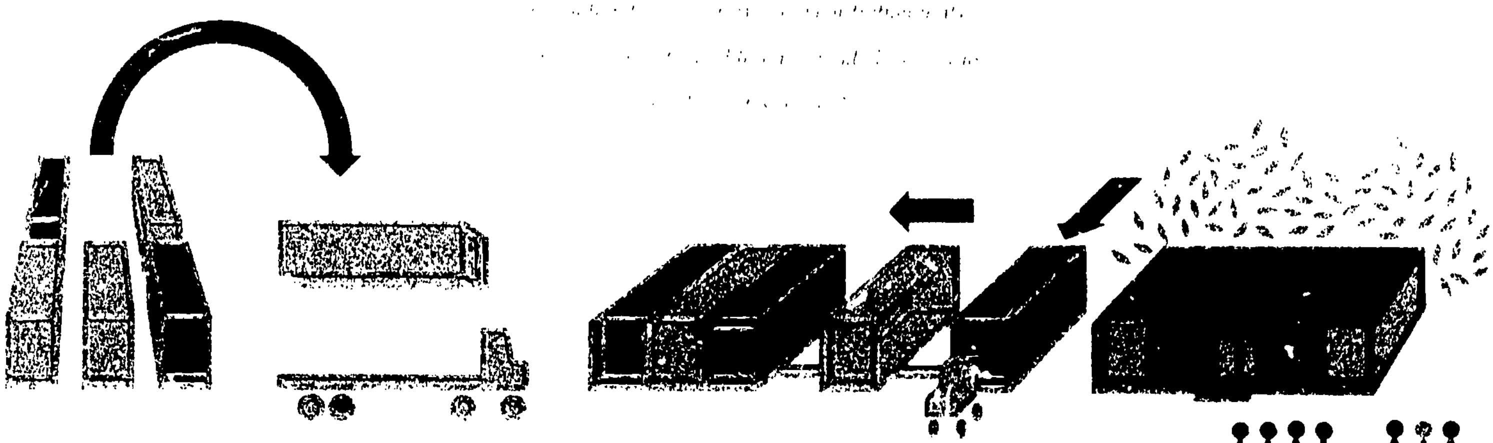
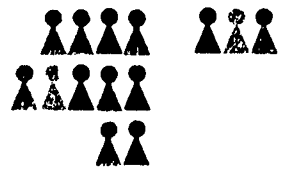
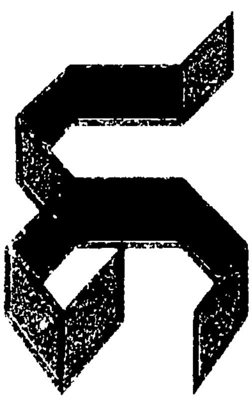
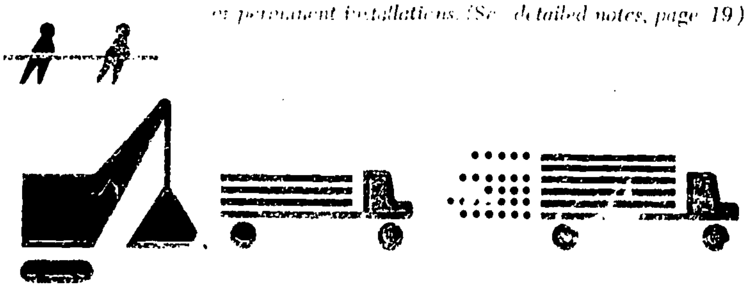


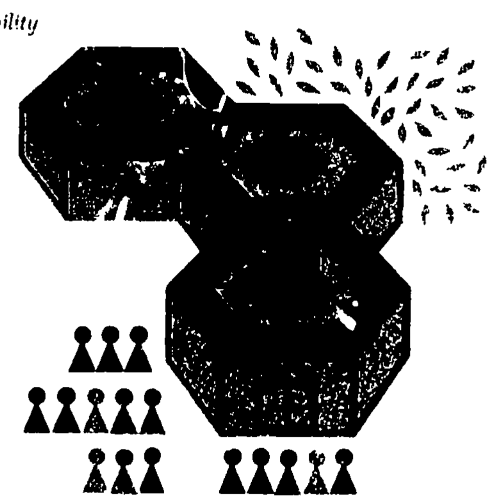


DIVISIBLE . . . structure easily moved in segments, [illegible] not exceeding 10 ft x 50ft, 24-[illegible] ft clear span . . . wood, steel or concrete space frame system and wide [illegible] . . . high degree of planning [illegible] for small to moderately large spaces. (See detailed notes, page 18)

DEMOUNTABLE . . . basic structure based on panel system, dismantled into smaller segments for moving . . . floor may or may not be relocatable . . . highest degree of flexibility in space planning potential of all relocatable structures . . . high cost of relocating suggests use for longer-term or permanent installations. (See detailed notes, page 19)







PAST EXPERIENCE CLARIFIES THE QUESTIONS

SPRING, 1964. It is important to date the first release of this report—perhaps more so than with most reports.

The subject is a national review of relocatable school facilities. Field research by Educational Facilities Laboratories began in the spring of 1962. More than 40 individual school districts in 18 states cooperated in the review of their units. Twice that number supported the study by supplying facts, figures, and opinions, pertinent to the questions asked.

Portable . . . demountable . . . mobile . . . divisible . . . this report deals with experience in many school districts, all seeking to answer similar problems of overcrowding, double-sessions, fluctuating enrollments. While their problems are similar, the answers in terms of building types, materials, designs, and quality have been as varied as the locations and climates.

Relocatable classrooms have indeed helped to bail out many a school district caught in the flood of enrollments and short of time, money, or available sites to deal with the immediate housing problems.

But the majority of districts quite candidly report that their relocatable units to date do not approach the functional, cost, or aesthetic qualities to meet their goals. The practice of designing-building-moving the movable units is obviously in a stumbling stage of infancy. Costs are generally higher than were anticipated by the districts. Appearance and space have often been sacrificed in meeting a low-cost target.

However, by reviewing the successes and failures of programs in the past, it is clear that within a year or two there *could* be significant new developments to improve the over-all picture. The design skills of the architect and school planner already exist. The technological know-how of industrial suppliers, engineers, and fabricators also exists. Practice in the building field here and abroad is also providing the experience for testing the skills and materials that will be used.

The X-factor in the equation, then, becomes the school community and administration. In order effectively and creatively to plan the use and specific design of relocatable units, administrators need to clarify their aims and standards. The first question quite logically relates to the need for relocatability. Why should the units be relocatable? Shifting enrollments? . . . rapidly growing district? . . . or an apparently cheap solution to a financial squeeze?

Other questions at the head of the list include--Will standards of building quality and educational utility be maintained? What will it cost to gain the feature of relocatability? If standards are lowered to achieve lower initial cost, at what point do we slip from acceptable facilities to scholastic chickencoops? How do relocatable units stack up against one another (and against permanent facilities) in *total* evaluation of cost, mobility, educational utility, appearance, maintenance, etc.?

What is past and recorded here has helped clarify some of the questions. The potential for better answers is clear. It is hoped that this EFL report in spring, 1964, will serve as prologue to improved designs for relocatable facilities in the future.

EDUCATIONAL FACILITIES LABORATORIES

The following fold-out chart collates the statistics based on the experience of 23 selected school districts across the nation which have used relocatable structures. Some were built as recently as the spring of 1964. Some date back to the 1920's. This sampling of over 10,000 unit classrooms represents almost one-third of all "non-permanent facilities" in use in United States public school systems in 1964.

These are the impersonal statistical facts about the districts, types of structures in use, space, facilities, foundations, initial installed costs, and costs to relocate. This is only part of the story. The information in this chart is cross-indexed to pages later in the report which include photographs, sketches, and further information regarding the various buildings.

LOCATION	SCHOOL DISTRICT	CASE STUDY PAGE	ENROLL-MENT	NO. SCHOOL PLANTS	TEACHING STATIONS TOTAL	TEACHING STATIONS RELOCAT-ABLE STRUCTURES	TYPE STRUCTURE Generally in Use	SIZE
Atlanta, Ga.	Atlanta Public Schools	40	115,154	138	3,535	46	Divisible-Mobile (A)	20 x 42 single
							Divisible-Mobile (special) (B)	20 x 56 single
Chicago, Ill.	Chicago Public Schools	24	536,025	533	20,781*	215	Divisible-Mobile	20 x 40 single
Dallas, Texas	Dallas Ind. School District	···	141,700	166	5,509	283	Portable	22 x 32 single
Detroit, Mich.	Detroit Public Schools	44	294,619	300	8,922	179	Portable (A)	26½ x 71½ double
							Portable (revised) (B)	26½ x 66 double
Downers Grove, Ill.	Downers Grove Comm. H/Sch. Dist.	33	2,824	1	81	2	Demountable (experimental)	35 x 40 double
Grossmont, Cal.	Grossmont Union H/School Dist.	49	13,953	9	466	10	Portable	25 x 37 single
Houston, Texas	Houston Indep. School District	···	210,573	199	7,385	1,280	Portable	20 x 60 double
Los Angeles, Cal.	Los Angeles Unified School District	50	589,529	569	19,950	5,366	Portable	28 x 64 double
Miami, Fla.	Dade County School District	38	193,674	203	7,500	418	Portable (all 1941-43)	20 x 30 single
Minneapolis, Minn.	Minneapolis Public Schools	32	71,877	99	2,636	26	Portable (1916-21) (A)	23 x 30 single
							Demountable (since 1956) (B)	26 x 35 single
							Demountable (experimental) (C)	35 x 40 single
New York, N.Y.	City of New York Public Schools	56	1,047,800	853	42,393	358	Demountable (A)	29 x [illegible]2 double
							Divisible-Mobile (B)	20 x 35 single
Newark, Ohio	Newark Public Schools	28	9,500	19	371	4	Divisible	30 x 72 double
Norfolk, Va.	Norfolk City Schools	···	55,965	66	1,766	121	Demountable (1953-60)	24 x 30 single
							Divisible-Mobile (1962)	20 x 35 single
Oakland, Cal.	Oakland Unified School District	50	79,672	90	2,800	700	Portable (revised)	24 x 36 single
Oklahoma City, Okla.	Oklahoma City Public Schools	54	72,575	106	2,307	135	Portable	24 x 36 single
Pasadena, Cal.	Pasadena Unified School District	49	30,876	37	1,361	31	Portable (1955) (A)	27 x 36 single
							Portable (B)	28 x 32 single
Pittsburgh, Pa.	Pittsburgh Public Schools	36	82,362	123	2,571	25	Demountable* (experimental) (A)	28 x 72 double
							Divisible** (experimental) (B)	28 x 72 double
Richmond, Va.	Richmond City Schools	57	44,124	59	1,806	20	Mobile (A)	12 x 48 single
							Divisible-Mobile (B)	20 x 42 single
San Diego, Cal.	San Diego Unified School District	48	128,008	145	3,995	798	Portable	24 x 40 single
St. Louis, Mo.	St. Louis School District	46	111,763	146	3,108	99	Demountable (A)	28 x 32 single
							Demountable (B)	28 x 32 single
							Portable (C)	28 x 32 single
Tulsa, Okla.	Tulsa Public Schools	55	73,544	95	20	415	Portable	24 x 68 double
Tucson, Ariz.	Tucson Public School Dist. No. 1	42	48,120	73	2,016	46	Portable	24 x 32+ single
Upper Marlboro, Md.	Prince George's Co. School Dist.	52	90,500	159	4,000	128	Mobile (A)	11 x 40 single
							Demountable (B)	22½ x 33½ single
							Divisible-Mobile (C)	20 x 35 single

FLOOR SPACE Per Unit	INSTRUCT. SPACE Per Unit	NO. STUDENTS Capacity or Assigned	TOTAL INSTRUCTIONAL SPACE/STUDENT	HEATING	VENTILATION	PLUMBING R/R – Rest Room	UTILITY HOOK-UPS NEEDED	FOUNDATION
840 ft²	816 ft²	32-35		Electric Furnace (2 units)	Natural and Mechanical	None*	Electric	Perimeter Concrete and Block Piers
1,120 ft²	1,094 ft²	32-35		Electric Furnace (2 units)	Natural and Mechanical	Sink*	Electric, Water, Sewer	Perimeter Concrete and Block Piers
800 ft²	656 ft²	30		Electric Furnace	Air Conditioning	Drinking Fountain, R/R	Electric, Water, Sewer	Cedar Posts or Block Piers
704 ft²	700 ft²	30-35		Gas Space Heater	Natural	None (some R/R adjacent)	Electric, Gas, (some water, sewer)	Recoverable Concrete Pads and Wood Blocks
947 ft²*	696 ft²	32		Gas or Oil Furnace (2 rooms)	Natural and Mechanical	Sink, Double R/R (shared)	Electric, Gas, Water, Sewer	Perimeter Concrete and Block Piers
875 ft²*	754 ft²	32		Gas Furnace (2 rooms)	Natural and Mechanical	Sink, Double R/R (shared)	Electric, Gas, Water, Sewer	Perimeter Concrete and Block Piers
700 ft²	675 ft²	30		Electric Heat Pump	Air Conditioning	None	Electric	Full Concrete Slab
925 ft²	925 ft²	35-40		Electric Space Heater (floor unit)	Natural	None	Electric	Mud Sill or Concrete Piers
600 ft²	596 ft²	30-35		Gas/Steam Space Heater (floor unit)	Natural	None (water in specials)	Electric, Gas	Concrete Block Piers
896 ft²	880 ft²	35-40		Gas Heater Unit (built-in)	Natural and Mechanical	Sink	Electric, Gas, Water, Sewer	Black Top or Mud Sill or Concrete Perimeter
600 ft²	596 ft²	30-40		Oil Space Heater (floor unit)	Natural	None	Electric (fuel oil storage outside)	Concrete Block Piers
690 ft²	690 ft²	30		Steam Heat (main bldg.)	Natural	R/R and Bubbler (in corridor)	Electric, Water, Sewer, Steam	Perimeter Concrete and Block Piers
910 ft²	910 ft²	30		Steam Heat (main bldg.)	Natural	Sink, Bubbler, R/R (elementary)	Electric, Water, Sewer, Steam	Full Concrete Slab
1,400 ft²	1,250 ft²	30-35		Electric Heat Pump	Air Conditioning	2 Sinks, Bubbler, R/R	Electric, Water, Sewer	Full Concrete Slab
750 ft²	635 ft²	35		Gas Furnace	Natural	Sink, R/R	Electric, Gas, Water, Sewer	Full Concrete Slab
700 ft²	675 ft²	36		Gas Furnace*	Natural	None	Electric, Gas*	Concrete Piers
1,080 ft²	970 ft²	30-35	[illegible] ft²/student	Electric Heat Pump	Air Conditioning	Sink, Bubbler, R/R (shared)	Electric, Water, Sewer	H-Beams on Concrete Piers
720 ft²	720 ft²	30-35	[illegible] ft²/student	Steam Heat (main bldg.)	Natural	None	Electric, Steam	Full Concrete Slab
700 ft²	680 ft²	30-35	[illegible] ft²/student	Electric Furnace	Air Conditioning	None	Electric	Full Rough Slab
864 ft²	860 ft²	30	28 ft²/student	Gas Forced Air Heater	Natural	Sink, Bubbler (K, some primary)	Electric, Gas, (water, sewer, some primary)	Concrete Piers or Perimeter Concrete
864 ft²	864 ft²	29-35	25-30 ft²/student	Gas Furnace	Natural and Mechanical	Sink, Bubbler (elementary)	Electric, Gas, (sewer elementary)	6 Poured Concrete Footings
972 ft²	968 ft²	35	27 ft²/student	Gas Space Heater (wall unit)	Natural	Sink	Electric, Gas, Water, Sewer	Concrete Piers and Wood Beams
896 ft²	892 ft²	30-35	25-29 ft²/student	Gas Space Heater (wall unit)	Natural	Sink	Electric, Gas, Water, Sewer	Perimeter Concrete
1,008 ft²	896 ft²	35	26 ft²/student	Gas Furnace	Natural and Mechanical	Double R/R (shared)	Electric, Gas, Water, Sewer	Perimeter Concrete
1,008 ft²	896 ft²	35	26 ft²/student	Electric Furnace	Natural and Mechanical	Double R/R (shared)	Electric, Water, Sewer	Concrete Piers
576 ft²	566 ft²	25	23 ft²/student	Oil Furnace	Natural and Mechanical	None	Electric	Full Rough Slab*
840 ft²	830 ft²	40-45	18-21 ft²/student	Electric Furnace	Natural and Mechanical	None	Electric	Full Rough Slab*
960 ft²	960 ft²	30-40	24-32 ft²/student	Gas Space Heater (ceiling hung)	Natural	Sink, Bubbler (primary)	Electric, Gas, (water, sewer primary)	Mud Sill
895 ft²	876 ft²	30-35	25-29 ft²/student	Gas Furnace	Natural and Mechanical	None	Electric, Gas	Full Concrete Slab
896 ft²	876 ft²	30-35	25-29 ft²/student	Gas Furnace	Natural and Mechanical	None	Electric, Gas	Full Concrete Slab
896 ft²	876 ft²	30-35	25-29 ft²/student	Gas Furnace	Natural and Mechanical	None	Electric, Gas	Block Pier on Blacktop
816 ft²	816 ft²	30-35	23-27 ft²/student	Gas Furnace (new) Space Heater (old)	Natural and Mechanical	Sink K-only, R/R adjacent	Electric, Gas (water, sewer, some primary)	Perimeter Concrete, Block Skirt and Piers
883 ft²	883 ft²	30	29 ft²/student	Electric Heat Pump	Air Conditioning	None	Electric	Concrete Pads
440 ft²	440 ft²	30	14 ft²/student	Electric Furnace or Gas Space Heater	Natural and Mechanical	None	Electric (some gas)	Concrete Piers
787 ft²	762 ft²	25-30	25-30 ft²/student	Forced Air Oil Furnace	Natural	None	Electric	Full Concrete Slab
700 ft²	675 ft²	25-30	22-27 ft²/student	Forced Air Oil Furnace	Natural	None	Electric	Concrete Piers and Blocks

[redacted]

Atlanta	*Total mobile school w/separate toilet buildings of permanent construction; costs based on mass purchase and installation; electric power station on special lease arrangement; electric lines overhead.
Chicago	*Incl. 92 rented class spaces. **Cost based on purchase 50—150 units. ***Never relocate less than 2; incl. $75 disconnect utilities.
Dallas	*Frame, all staff construction.
Detroit	*Incl. furnace room and janitor service space. **Incl. supervisory costs, plans, specs, etc., $2.500[2]. ***Incl. painting interior and exterior, $975[2]; supervising, $405[2].
Downers Grove	*Cost for ½ of inseparable double unit.
Grossmont	*Approx. cost, stripped and unpainted frame shell as reported.
Houston	*Add $500[2] if repairs and painting are needed.
Los Angeles	
Miami	*Foundation costs incl. in moving contract. **Incl. $20 to re-site former location.
Minneapolis	*Incl. improvements on old structure. **Incl. regrade old site, new corridor, increase supplementary space, general improvements.
New York	*All utilities trenched. Same structure w/electric heat and overhead leads, $16,600 on-site cost; w/self-contained oil furnace and storage, $15,000 on-site.
Newark	*Incl. chalkboard lighting; ceiling speaker system; all adjustable teaching/display surfaces; ETV cable; steps; sidewalks; landscaping; utilities. ** Incl. $475 erection costs. ***Incl. walks.
Norfolk	*Add $600 for storage cabinets; add $75 to mobile units for steps. **Incl. sidewalk for mobile units.
Oakland	*Incl. 10% for architectural fees, inspection, etc. **Cost reduced to $9,000/unit with order for 100 units.
Oklahoma City	*All staff labor for erection; costs based on mass purchase of 28 units. **All staff labor.
Pasadena	*Add $500 for variable costs, site restoration, etc.
Pittsburgh	*Experimental concrete demountable structure, 1963. **Experimental steel demountable structure, 1963. ***All relocation costs est.—no experience to date; est. covers dismantling and re-erecting — $11,500[6].
Richmond	*Orig. used perim. concrete and block skirt; found full rough slab less expensive.
San Diego	*Add $600-$700 for cabinets; all construction costs based on purchase of 20+ units.
St. Louis	*Utility co. supplies trenched gas leads to building; electric lines are overhead, tap off main building.
Tulsa	*Incl. $625[2] for sidewalks, grading, drainage; all costs include staff labor.
Tucson	*Incl. footings for porch.
Upper Marlboro	*All staff labor (pre-fab components) to erect, dismantle, etc. **Incl. additional $610 to dismantle and erect; $275 for tile floor, steps, walks; $270 to remove old foundation, cleanup, etc. ***Incl. additional $224 to dismantle and erect; $262 to replace skirting, restore old site; $115 for floors, walks, steps.

Educational Facilities Laboratories, Inc. is a nonprofit corporation established by the Ford Foundation in 1958 to help American schools and colleges with their physical problems by the encouragement of research and experimentation and the dissemination of knowledge regarding educational facilities.

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Which is the most pressing of problems facing U.S. education today? The unprecedented rise in enrollments? Shortages of qualified teachers? Teaching methods and materials? The subject matter of education? Cost of building, operating, staffing the schools? Classroom shortages?

All of these—with endless variations—are inseparable in the mix that is our total program of education from nursery school through the university. Our concern in this report stems from enrollment pressures which have mounted constantly and dramatically over the past two decades:

Release Aug. 25

Washington, D.C.-- Fall enrollment for 1963 in the nation's public and private schools and colleges is expected to increase for the 19th consecutive year to an all-time high of 51.5 million, the U.S. Office of Education announced today. This will be an increase of 3.4 percent over the 49.8 million enrollment figure estimated in the fall of 1962.

The most immediate problem is clear. Millions of additional students—where do we put them?

In sequence, the most urgent problem is the school facility—the schoolhouse—the classrooms and teaching spaces—the *place* for assembling students, teachers, and equipment for instruction.

At the most primitive levels of planning, the school is simply a shelter; a shed or large box to protect the student, his books, his papers, and his teacher from rain, snow, and the glare of the sun. Simple arithmetic would have it that the bigger the enrollment, the more boxes we need.

Obviously school planning as a process has advanced beyond the simple arithmetic means to an end. Following more advanced concepts of planning, today's school is a complex of spaces and facilities of varied sizes. It is fitted with whatever tools may complement a creative hunt for knowledge, and staffed with teachers and aides to help the student find his way. *Space* for the student to work by himself. *Space* to meet with a teacher and/or small group in a seminar. *Space* to receive instruction in a larger group. *Space* to meet in large assemblies. *Space* for the principal, the counsellor, the nurse . . . the cafeteria, the gymnasium, the heating plant.

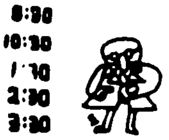
While the *classroom* is still the most recognizable unit of school space, it is clearer today than ever before that the isolated classroom, a 30'x30' cell for 30 students and one teacher, is not sufficient for the total education of the students who occupy it. Planning for an effective interrelationship of spaces and equipment has superseded older concepts of joining a series of cells by a corridor and calling it a school.

The preceding notes are more than casually pertinent to an understanding of the full impact of the report which follows on the use of relocatable school facilities across the nation.

By the very nature of the structure and the attitude of the public and administration to it, *the relocatable facility used as a supplementary teaching station is usually an isolated classroom unit, physically separated from the main school plant to which it has been assigned.* Building code requirements generally go even further in demanding that the units (single or double) must even be separated one from another.

This isolation from the mainstream of a school's functional plan—the limited access to the educational experiences designed into a well-planned school complex—is undoubtedly the major educational disadvantage of relocatable facilities now in use. And thus we may slip back to the cliché of a school being a series of isolated cells, this time not even joined by a corridor.

On the other hand, where no other solution is immediately feasible, a series of unit classrooms is



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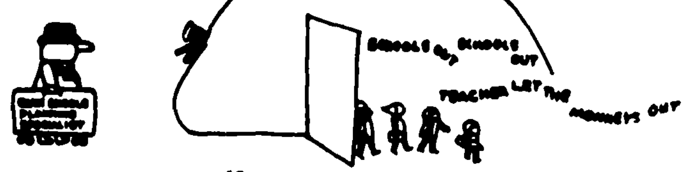

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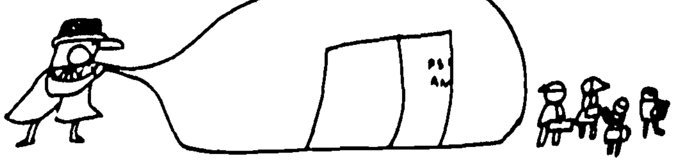

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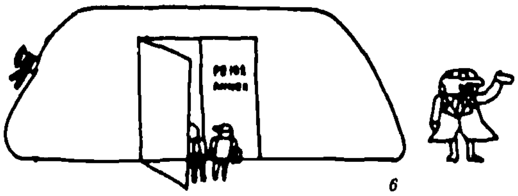

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undeniably better than double sessions, or excessive travel, or overcrowded schools and overcrowded classes. *As a stop-gap solution to school housing on a short-term basis, these units can be invaluable.*

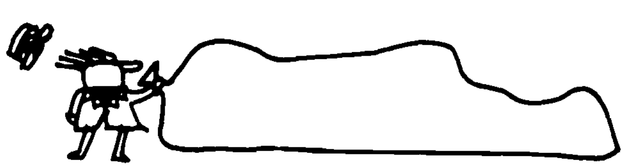
To define more clearly the problems that have led to the need for relocatable housing, to present some guides for planning such buildings, and to review experience in the field, this report has been set out as follows:

The Record - - Spring, 1964

The Problem - - Past, Present, Future

Guides for Planning Relocatable Structures

Case Studies - - Experience and Experiment



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The Problem—Past, Present, Future

Classroom shortage—it's real

No matter how you juggle the statistics, classroom shortages across the nation are a very real problem.

Over the past five years, an estimated 348,500 classrooms have been added to the U.S. public school system. A building program of this scale would have staggered school planners a generation ago. And yet, the U.S. Office of Education reports in February, 1964, that public school classroom shortages at the opening of the 1963-64 school year totaled 124,300.

Each year, old classrooms grow older and enrollments continue the upward spiral. The 40,200,000 students in public schools for the 1963-64 session represent almost 1.5 million more than were there in 1962-63.

The report goes on to explain that despite completion of an average of 69,700 classrooms annually during the past five years, ". . . little headway is being made in reducing overcrowding and replacing old and unsatisfactory facilities. Most newly-completed classrooms . . . are used to provide for higher enrollments and to replace abandoned rooms."

THE SHORTAGE — A CONSTANT PROBLEM

School term beginning Fall of —	Public school enrollment
1956	31,719,000
1957	32,951,000
1958	34,081,000
1959	35,182,000
1960	36,281,000
1961	37,464,000
1962	38,748,000
1963	40,217,000

*Number of classrooms needed to replace overcrowded or unsatisfactory facilities

Source: U.S. Dept. of Health, Education, and Welfare

According to the same survey, an estimated 1.75 million children were attending school in the fall of 1963 in 64,900 classrooms rated as obsolete and unsatisfactory. Another 1,659,000 pupils "were in excess of normal classroom capacity" — attending school in overcrowded classrooms, makeshift quarters and rented facilities, or under similar emergency arrangements.

NEED FOR MORE AND BETTER FACILITIES The rapid and widespread obsolescence of many existing facilities is due both to age of the buildings and changes in the need for more and improved facilities to cover an expanding, more complex educational program. There is more to learn and more to teach; outdated facilities won't do the job.

More students are staying in school for a longer period of time. The number of years of public education offered to the average citizen is rapidly extending from 13 years to 15 years. Parochial schools are wincing under the pressures of overloaded enrollments . . . and their overflow is already spilling into the public systems. Waiting lines for private schools grow longer. College enrollments are skyrocketing.

These are but a few of the factors effecting a need for more facilities. Even with this partial picture in mind, it is not difficult to understand why school planners have been eying developments in new school building techniques with intense interest. It is the law of the land for the public schools—the burgeoning crop of school-age citizens must be accommodated, right now!

NEED FOR "INSTANT SCHOOLS" Advances in building technology, and *acceptance* of these advances can be utilized to a positive advantage today as never before. A shortened building timetable—*a faster building pace is a critical need.* To answer the need for "instant schools" we must encourage improvements in building techniques that will help us to *provide more educational facilities for more students at a faster schedule.* The urgency of the need demands more efficient patterns for revising and updating local and national building codes to test and accept new materials and building techniques.

It is also suggested that we concurrently consider revisions in the pattern and pace of school planning and financing. The lag between the time a community first recognizes the future need for a school and the date when the school is ready for occupancy is often two or three years behind the time of actual need.

Naturally we hope to meet our school housing needs at as low a cost as is practical or possible. Since schools are in general a long-term investment, however, the seeming expedient solution of constructing cheap schools, reducing quality of materials, reducing space-per-student, and stripping away any vestige of amenity has proven shortsighted and expensive in the long haul.

A NATION ON THE MOVE But even if the money is forthcoming, increased budgets must be allocated effectively to get the new classrooms in the right place at the right time.

The *right place* is where the students may be at any given moment—which is as easy to determine as asking the exact location of every car on the Los Angeles freeways.

The U.S. citizen is a highly mobile individual. The periodic move of a family from one home to another, from one neighborhood or city to another, or even from East to West Coast is not only considered normal, but indigenous to the spirit of the nation. An analysis of census figures shows that 20 per cent of our population moves each year, locally, out of their county, or out of the state. Where children are involved, each move means a change of enrollment from one school to another. Thus, 12 per cent of the school age population in the U.S. moves from one school to another during each school year.

FOLD YOUR TENT . . . AND MOVE Back in the twenties engineer-architect R. Buckminster Fuller recognized the mobile spirit of the populace as suggesting changes in the types of homes we might build. He visualized a "home" as being a lightweight, movable, sheltering structure which could be picked up (perhaps by helicopter) and moved with the family.

Was the thinking extreme? Hardly. To this day, nomadic families in the benign climate of the Middle East fold their tent-homes and slip from watering hole to market with their families and possessions. Scientific and military expeditions in Arctic regions are sheltered by Fuller's geodesic domes air-lifted to remote frozen sites before the men arrive.

TO SOLVE SCHOOL PROBLEMS It was inevitable that school planners would look seriously at the possibility of using relocatable structures to meet the problems of growing and shifting school enrollments. The concept of planning and constructing parts or the whole of a school complex for potential mobility from one site to another is reasonable and practicable.

"Instant schools" or parts of schools might be stockpiled and moved from site to site for temporary relief of rising enrollments until permanent facilities could be built. If the school housing need is temporary, or may stabilize eventually at a level below the peak of any given year, it might be wise to plan a school capable of *growing down* as easily as it grew up.

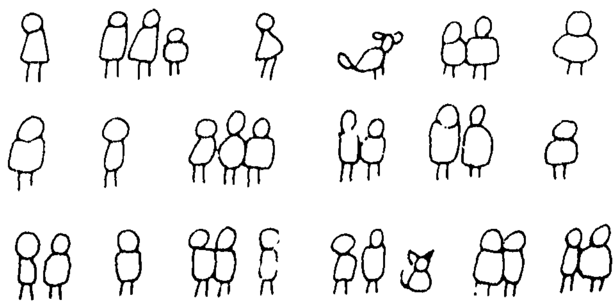
Once we have progressed this far, we might ask, "is mobility itself the most important factor—or does the concept of 'instant space' overshadow it in importance?" *How often does a school community actually grow down in the long range? Will it grow up again?*

To clarify this question, it would be well to attempt a brief review of demographic patterns as they generally reflect population growth and movement. Experience is seldom identical in any two communities. But the *patterns* of demographic change can be calculated.

Fluctuation of school enrollments

The problem of growing and shifting enrollments has become acute. It is possible to pinpoint some of the reasons for a rise (by far the major problem) and the occasional fall of enrollments in certain school districts. Where records are kept in constant survey, fluctuations can be fairly accurately anticipated even in specific schools.

NATURAL POPULATION GROWTH As new homes and clusters are built in a traditional urban neighborhood, there naturally follows a steady upward curve in population growth and school enrollments. Eventually a saturation point for new residential building is



reached in accord with zoning allowances. Within a number of years, school enrollments level off at a peak.

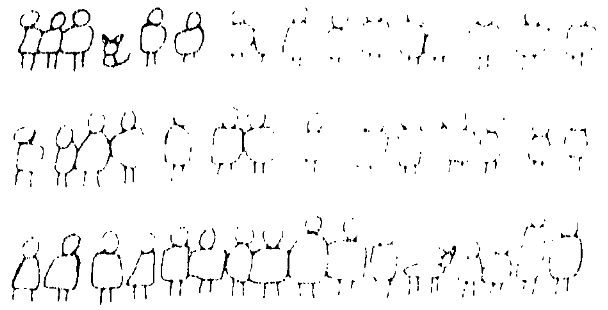
Several decades ago it was fairly common in fringe-urban and suburban areas for school enrollments to decline from this peak as youngsters left the community for jobs or college. Parents without children of school age would often hold on to their homesteads until retirement. Schools might remain below capacity for a decade or more.

But today, if this enrollment dip does come at all, the dip is more normally limited to three to five years. Parents of the first crop of children are inclined to leave their oversize homes in favor of travel and/or smaller quarters. Younger, more prolific families move into the community . . . and they, too, may move on again in short order as their families increase or decrease in size.* Enrollment figures once more rise to their original peak—or higher.

CHANGING SOCIOLOGICAL PATTERNS The *natural* change in the population of any neighborhood generally reflects a downward scaling of the economic and social levels of the residents, whereupon there usually begins a dramatic *upward surge* in the density of the area population. As homes go through the hands of second and third buyers, the original taut zoning

**Current experience of home loan authorities indicates that the "holding span" of a home mortgage is now down to an average of seven years. Trading-up from one home to another is common practice.*

requirements begin to sag. The number of residents, tenants and/or families in a given area—or even a given building—generally increases. The child output



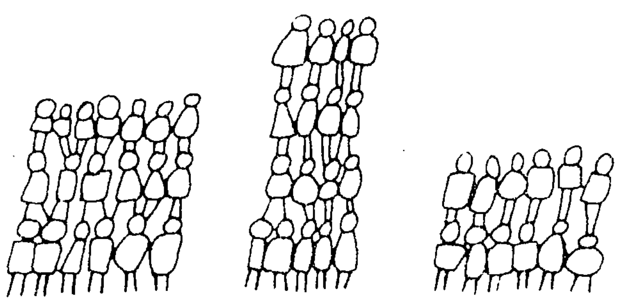
of the neighborhood also increases. A neighborhood which has gone through a second and third stage process of change may increase the density of the original family units three or four times.

Important to the educational planner is the fact that the student density in the neighborhood may start careening toward factors 8 or 10 times as high as the first-stage peak enrollment of the neighborhood.

HIGH DENSITY HOUSING Overloading the planned population of any community is the first step toward the blight of slums. Blighted neighborhoods have long been a problem for school and civic planners. All schools and public facilities become overloaded. Population density and accompanying economic hardship cause major problems of relocation as a clearance project is planned. Home and schools must be found for displaced residents.

The age of most such communities in our major cities suggests that the schools in the area have already been used beyond their intended life span. The school is often among the last buildings to go in a slum clearance project.

Such areas normally sit near the core of the central city. There have been evident signs in the sixties of a rebirth in the demand for housing in the central city areas across the nation. For this reason, the ma-



jority of clearance projects make way for privately or publicly financed housing projects, rather than allow the area to revert to industrial development.

Revitalization of central city cores across the nation defies a theory of a decade past. The migration to the suburbs during the fifties led some city planners to believe that school enrollments in the central city area would steadily decline, or at least level off at a point below original peak enrollment figures. *Quite to the contrary, it now appears that high-rise apartment buildings or closely mated town-house apartments increase the density of both the general and school population in the central city beyond any level of past experience.*

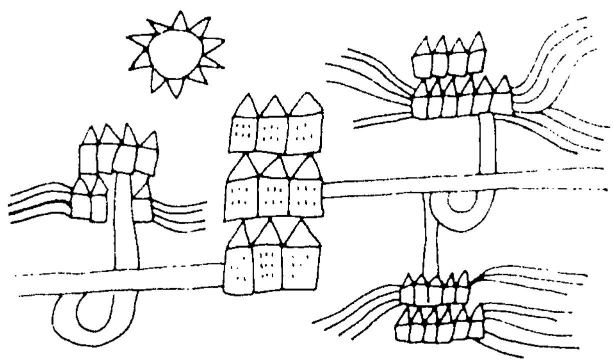
Improved efficiencies in building techniques over the past decade mean that enormous housing developments of thousands of units are being completed from the ground up in a period of 18 months to 2 years.

The long-range plans for renewal housing within the central city area must stake out reservation of adequate school sites early in the planning stage.

Even given a running start of a few years, school planners will do well if they can overcome the hurdles of planning-designing-approvals-bidding-contracting-building to open a school before the kids get there.

It can be done. But it takes vigorous action to bring it off.

NEW SUBURBS—NEW CITIES Totally new communities can and do spring up in the prairies and suburbs in literally a matter of months. For example, in the spring of 1963, entry roads were begun for a com-



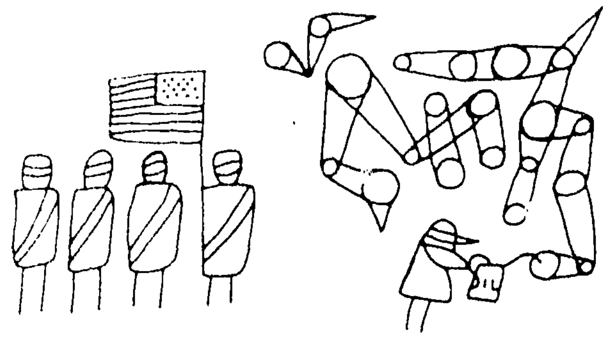
munity called Reston, Virginia—within commuting distance of Washington. By the winter of 1964 the first village of 370 units is scheduled for tenancy. By 1980 it is estimated that 75,000 persons will inhabit what was in spring of 1963 only 6,750 acres of woods and farmland.

In terms of educational planning, this illustrates a projected need for at least 15 elementary schools, 6 intermediate schools, 2 high schools, and possibly a third technical high school and junior college.

This is only one section of the total Fairfax County educational system. The Greater Washington plan for the year 2000 envisions many such planned-growth satellite communities ringing the capital, to accommodate an estimated population growth of three million for the region. Here, as elsewhere, school plans, finances, and schedules must all be flexible enough to grow up with the community—not too fast, but fast enough to be there when the students are ready to be taught.

A unique situation? The scope is unique neither to the outlying community, nor the suburb, nor the big city. Major urban areas, such as Los Angeles, New York, Chicago, Detroit, and others, face building programs in a single year which are comparable to the needs of this 17-year Reston community prognosis. Chicago alone recently completed a 10-year building program which involved $275,000,000 in new school construction, and New York City has budgeted an estimated $170,000,000 for public school construction for fiscal 1964-65.

NEW INDUSTRIES AND THE MILITARY School boards in smaller communities can be shaken when a new industrial plant or military installation comes to town.



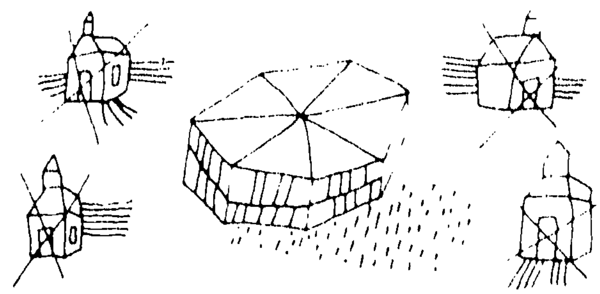
How big will they get? How many students will they bring into the system? Near which school will the newcomers live?

The flexibility factor of school enrollments *really* begins to bend under the question, "how long will they stay?" This question is especially pertinent in the case of military installations where personnel may be recalled on short notice.

The problem is comparatively individual — but nonetheless important to the community when it does crop up. A variety of solutions with variable merits and financial feasibility are suggested: (1) Rental of available spaces in churches, public buildings, commercial and residential property for short-term use; (2) Use of temporary, relocatable facilities with resale or re-use potential; (3) Joint occupancy of a school with professional or other offices; (4) Design of a school facility in such a way that it will have future sale value for commercial or industrial use; (5) Construction of permanent school facilities on the chance that the normal growth of the community will fill the school even if the temporary tenants leave the area.

One consideration must override all others. If we are to fulfill the public educational responsibility, *the school facility must enhance, not impair, the educational progress of the students.*

CONSOLIDATION OF SCHOOL DISTRICTS There have been obvious reasons for a strong movement toward consolidation of school districts over the past 30 years.



In 1932 there were 127,000 school districts in the nation; by 1963 that number had been reduced to 31,700.

It would normally be assumed that with such rapid consolidation, many schools and classrooms have been left vacant. While there is no record of what has actually happened, a general review indicates that acts of consolidation in themselves were often sparked by the common needs of adjacent communities for improved facilities to replace obsolete schools—especially one-, two-, and three-room schools too old and too small to keep up with educational requirements.

The process of consolidation has seldom been a crash program. The timetable normally allows for adequate planning and construction of permanent facilities to meet the needs of the new, combined school community. Money, naturally, is always a major problem, especially since the aspirations of the joint community are generally more than twice the aspirations of each community before it decided on a joint venture with its neighbors.

Consolidation of school districts has usually meant improved school facilities for the combined student groups. In spite of the human problems of give and take among new partners, the transitions are usually beneficial to all—especially the students.

"Non-permanent" structures

More than 36,000 "non-permanent facilities" are currently being used in U.S. schools, as reported in a spring, 1962, *National Inventory of School Facilities and Personnel* (study by the U.S. Office of Education, released February, 1964). Of these, 31,230 units are in public schools, 4,782 in non-public schools.*

Examples of more than 10,000 of these units were reviewed in detail for this EFL report. A blunt evalua-

**An additional 9,100 "non-permanent instructional rooms not on a school site (such as rooms in churches, residences, etc.)" are reported—6,000 in public schools; 3,100 in non-public schools. In spring, 1962, there were in the public schools 1,478,649 permanent instructional spaces, including shops and laboratories. Of all instructional spaces in public schools, then, the 37,230 non-permanent facilities constitute approximately 2.5% of the total.*

tion would suggest that less than a fraction of 1 per cent of the total reflect any real infusion of creative design or advanced educational planning.

One major factor accounts in large part for such harsh criticism. In the majority of cases it is clear that the pressure of a lack of adequate building funds induced the use of these units much more than the announced need for relocatability. Building codes are generally more lenient with "temporary and/or movable structures" than with permanent construction. With the approval of reduced code requirements, building standards and costs can be reduced, and erection or delivery time shortened.

As a short-term investment, such low-cost buildings *can* provide more immediate shelter and a higher *quantity* of housing for a lower initial capital outlay than permanent structures might run (though this is not always the case). The *quality* of educational utility and structure, however, is generally lower than that of permanent facilities. The comparatively short life of structures built to lower standards and the higher costs of maintenance all add up to higher costs over a long period of time than is normally the case with quality, permanent construction.

SOME EXPERIMENTATION UNDER WAY There is a more positive side to the picture. Several school communities, architects, and suppliers have undertaken truly experimental approaches to developing relocatable school facilities. In such cases, the need for actual relocatability to meet emergency housing needs and fluctuating enrollments has been given first consideration. While cost has not been overlooked, it has been subordinated (by varying degrees) to the need for mobility.

Some of these experiments have dealt with variations of traditional building designs and techniques; others have taken off on entirely new approaches, following new concepts of design, framing, materials, etc. In every case, however, the planners have quite logically realized from the onset that they might have to pay a premium for the feature of relocatability in any structure which would meet high quality standards.

Other communities are seeking and testing still other approaches to meeting their short-range and emergency housing needs. They are considering such solutions as shared-occupancy with residential or commercial complexes; the use of several floors in a high-rise building; and the conversion of existing commercial or residential buildings for school use.

By any other name—relocatable

There are as many variations on the theme of relocatability as could be devised through the ingenuity of local officials and, at times, the paralleled efforts of architects and industry. The variety of approaches and purposes is only partially expressed in a review of the descriptive names attached to the buildings or housing programs:

Transportable	Instant Schools
Portable	Add-a-Class
Mobile	Temporary
Movable	Emergency
Relocatable	Classrooms-on-Wheels
Unit Classrooms	Studio Classrooms
Semi-Permanent	Cottage Classrooms
Prefabricated	Bungalow Classrooms
Factory Planned	Shared Tenancy Structures
Factory Built	Convertible Schools
Redeployable	Primary Unit Schools
Demountable	

The majority of these structures are physically relocatable by one method or another. Several, such as the primary unit schools, convertible schools, and shared tenancy structures, suggest that the body of students be moved from one building to another, rather than relocating the structure itself.

Thus, at this sitting, 20 names are applied to structures that share perhaps only one detail in common—all were built with the intention that they would be moved. Hundreds of the 31,700 independent, self-governing school districts in the nation have taken a fling at building or buying relocatable classrooms. In the course of this study no two communities were found to use identical or even closely similar units, except for the most recent few purchasing prefabricated split-units from the same manufacturer. Even these took models that varied in details.

Only the *problems* seem to be common to all these school communities—skyrocketing enrollments and inadequate financing. While the problems today may be more severe in matters of pace and degree, they are not new. On a lesser scale and at a slower pace, perhaps, many school districts have faced the dilemma of classroom shortages since the turn of the century. How did they handle the problem in the twenties, thirties, and forties? Not much differently; certainly in no better style.

POST-WORLD WAR I "TEMPORARIES" In the days following World World I there often appeared, adjacent to a Greek or Gothic Revival schoolhouse, an incongruous Early American frame building, complete with potbellied stove and gabled portico—supplementary housing. The building was labeled a "temporary," and the fact that the structure *could* be moved soothed the fears of the community that their children might be housed in substandard structures for a major portion of their young lives.

The "temporaries" built in the twenties are still in use in some communities, housing a fifth or sixth generation of students. The potbellied stove was probably replaced by a more efficient gas heater during the thirties. The incandescent ceiling bulbs were sometimes replaced by cheap fluorescent fixtures in the forties. And for each 10th anniversary the exterior was given a fresh new coat of paint, the braces on the eaves were checked, and the rain spouts were patched again or replaced.

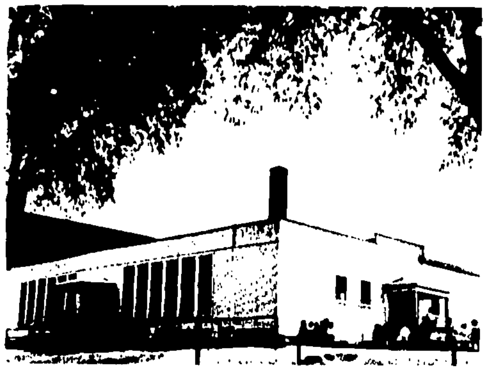
But the buildings *were*, in truth, relocatable. Sometimes they were moved as a unit; in other cases they were split into smaller sections and trucked to a new site. No matter what our attitudes may be toward the appearance, human comforts, or educational validity involved, these buildings served a very useful purpose. Without them, many students would have been on double session.

DEPRESSION "BUNGALOW" CLASSROOMS Another major shortage of school facilities which occurred in the early thirties once more focused attention on the use of temporary, relocatable facilities. This time, another factor was brought sharply into focus—a national depression made school finances a nightmare.

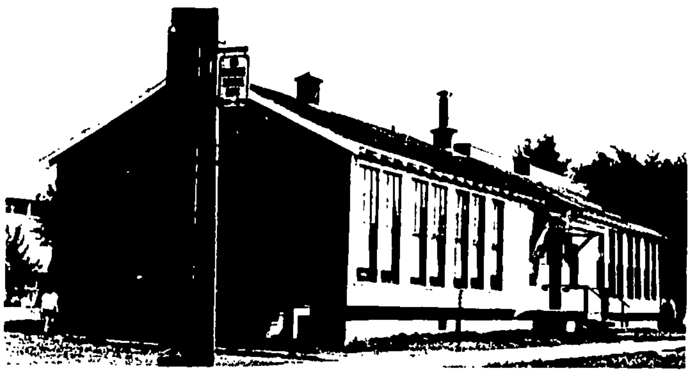
Enrollments continued on a slow but steady upward curve. This was not a time to get popular approval of bonds for long-range programs for permanent school structures. The appeal of comparatively short-term financing for "emergency" housing was enticing.

Thus the rash of "bungalow schools" that sprouted like weeds adjacent to the Modified Tudor and

1918

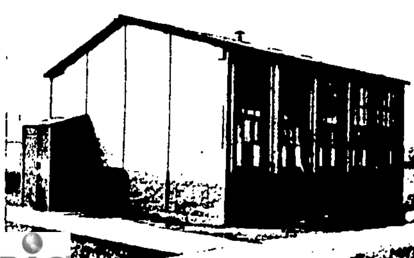


1920



1930's

1937



1934-1938

Stripped-Classic schools of the thirties. Anticipating the day when these temporary classrooms might be used for another purpose, they were also planned to be relocatable.

Many of these units are, today, celebrating three decades of faithful service. Some are still classrooms. Others are serving out the end of their terms as supply shacks, repair sheds, and dead storage centers.

ARMY BARRACKS REVISITED In the early forties, alerted to the imminent pressures of war, the nation faced rapid shifts of population to industrial and military centers. Again, school facilities had to be supplied on short notice. Both materials and financing for permanent school construction were in short supply.

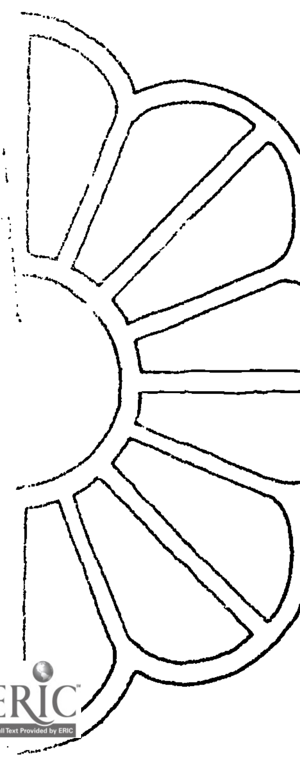
Taking a lead from military construction techniques, dozens of school districts cobbled up a Rube Goldberg collection of quonset huts and variations of barracks-like structures. An overhead sign sometimes identified the conglomeration of isolated boxes as a school.

Although the solution was less than ideal, the intent was clear. These temporary wood and metal shack schools would be removed or relocated once the emergency had passed.

The best-laid plans were quickly scuttled in the period immediately following the war. This time the need for school housing extended all the way to college levels. Returning G.I.'s doffed their khaki . . . and marched right back into the barracks which had been donated by the military to provide emergency dormitories and classrooms on campuses across the country. The relocatable military structures had been relocated on the American campus . . . where they still, in many cases, remain after almost two decades.

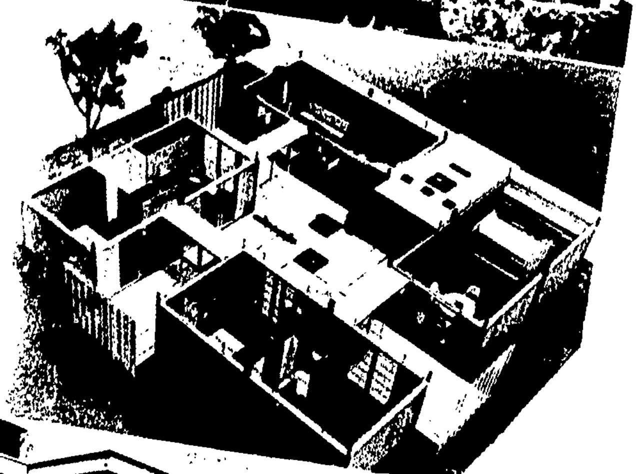
LEARN FROM PAST EXPERIENCE? It is reasonable that school administrators today should expect more of advanced building technology than was available in the obviously minimal structures of record. How *much* more can be expected, without disproportionately increasing the cost, is an immediate question.

New building materials; improvements and efficiencies in standard construction procedures; entirely new approaches to prefabrication of components and entire structures—advanced building technology induces planners to expect more building, at a quicker pace, at a lower cost.



Meanwhile in Europe . . .

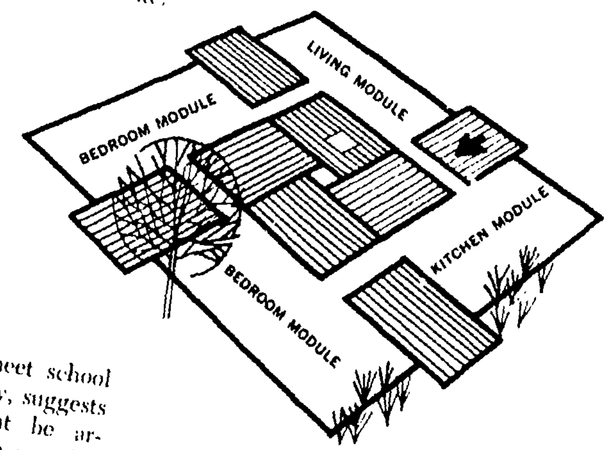
Swiss architect Fritz Stucky has developed a divisible structure which can be moved in 9'x27' sections. Using a crane lift at the sites (with new foundation pre-prepared), a four-classroom unit with two separate toilet-blocks and heating rooms can reportedly be disassembled, transported 30 miles, and reassembled in 10-12 working hours, with no replacement of materials, roofing, flooring, or any painting needed. Sectional space frames can be prefabricated in wood, steel, or concrete. Interior space arrangements are limited only by the span of the segments; building length is determined by the number of segments employed. The architect hopes to begin producing his units in the U.S. in 1964.



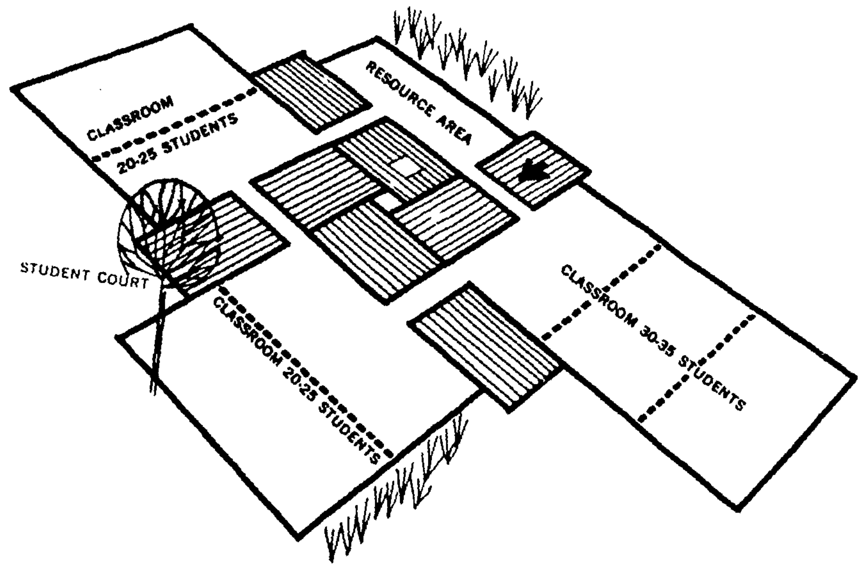
Prototype built by U.S. Plywood Corp.

Modular homes—modular schools

In his design for amenable but compact living quarters on a limited site, architect Robert Martin Engelbrecht created an arrangement of four 12'x24' factory-built space modules surrounding a central courtyard. Each segment contains built-in heating, air-conditioning, plumbing, and lighting requirements, all ready to be plugged in at the site.



Projecting the concept to meet school needs, the second plan, below, suggests how similar segments might be arranged to create a relocatable complex of school spaces, retaining the amenity of the courtyard commons area.



". . . The style of the exterior should exhibit good, architectural proportion, and be calculated to inspire children and the community, generally, with respect for the object to which it is devoted. It should bear a favorable comparison, in respect to the attractiveness, convenience and durability, with other public edifices instead of standing in repulsive and disgraceful contrast with them."

Henry Barnard, *School Architecture*, 1842

Guides for Planning Relocatable Structures

Four basic types

Whatever the specific name applied, relocatable structures normally fall under one of four categories, reflecting the method by which the structure is moved and, in part, certain physical characteristics of the building:

(1) Portable	**(2) Mobile**
(3) Divisible-Mobile and Divisible	**(4) Demountable**

Basic planning considerations that relate to standard school facilities are even more important to the planning of relocatable spaces—especially since these units are most often physically separated from the main plant. These basic planning notes apply to all relocatable structures, regardless of type.

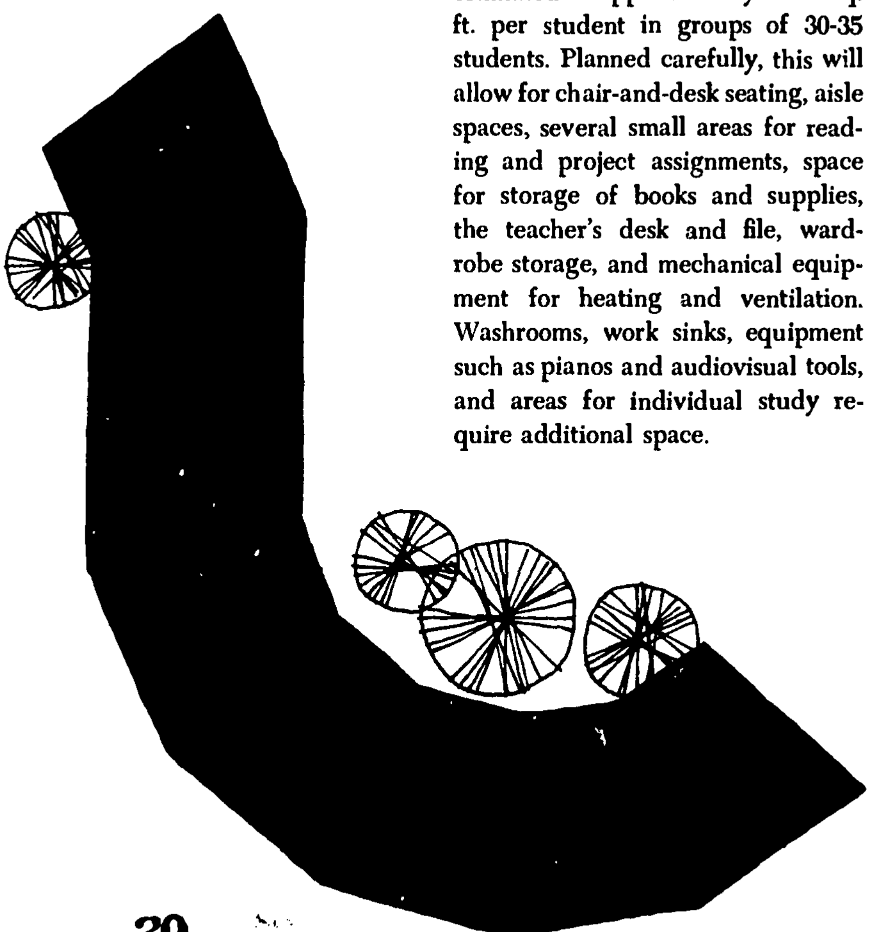
ALLOW ADEQUATE SPACE Relocatable facilities are generally assigned to a school only when the main plant is already filled beyond its planned capacity. It becomes imperative, then, that the supplementary, temporary unit provide more than just seating capacity for the students it must house—especially if the classroom is for the primary or intermediate grades.

If the relocatable space is to be used for a lecture room and only that (high school or university level), the space need can be roughly calculated at 18-20 sq. ft. per student in groups of 30-35 students. Such space allocation is not overly generous, but will allow for necessary tablet-arm chair and elbow room, aisle space, lecture space for the teacher, and some wall space for coat racks if necessary. Careful planning may also allow for the inclusion of mechanical equipment (furnace and ventilation or air-conditioning equipment) in this total space allocation.

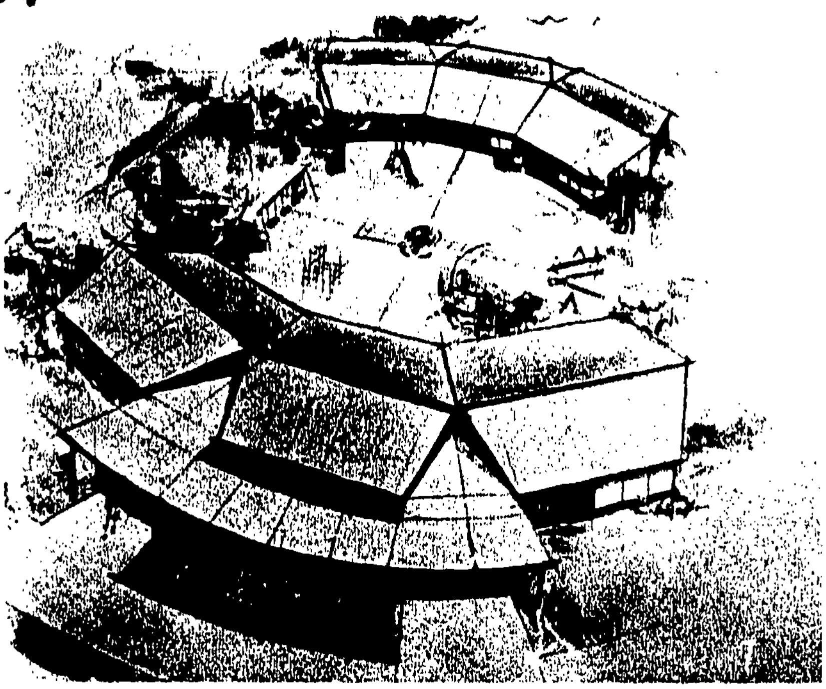
As the grade level drops, the space need per student within a classroom rises rapidly. The space need is even more critical if the classroom is isolated from the school, without easy access to rest rooms, library facilities, and other ancillary spaces. By virtue of their isolation, relocatable classrooms are, in reality, self-contained, one-room schoolhouses—especially in climates where cold, rain, or snow may make access from the satellite to the main plant uncomfortable, or impractical. At primary levels, the space need can be estimated at approximately 30-35 sq. ft. per student in groups of 30-35 students. Planned carefully, this will allow for chair-and-desk seating, aisle spaces, several small areas for reading and project assignments, space for storage of books and supplies, the teacher's desk and file, wardrobe storage, and mechanical equipment for heating and ventilation. Washrooms, work sinks, equipment such as pianos and audiovisual tools, and areas for individual study require additional space.

Cluster Plan

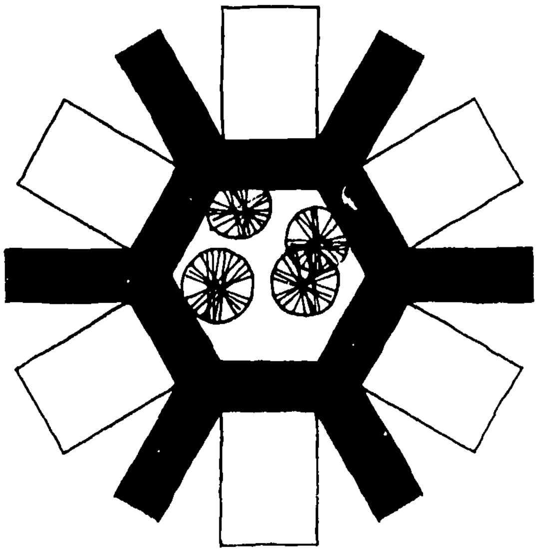
Row Plan



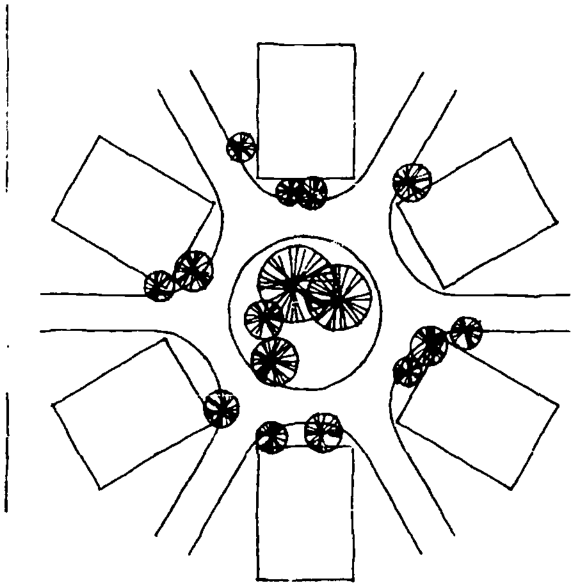
Irregular modular shape classrooms and plan proposed by Zeldlik & Harmala, Architects.



Six-classroom court plan proposed by Dave Chapman, Goldsmith & Yamasaki, Industrial Design, for Panelfab Corp.



Connected court plan

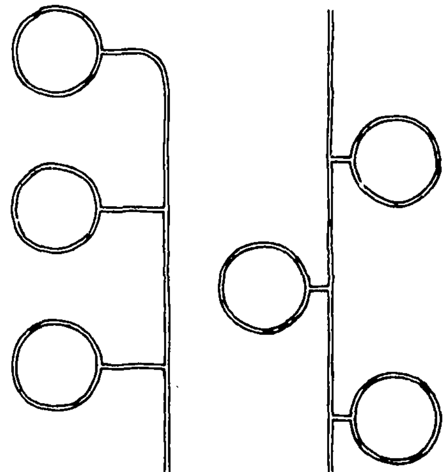


Open court plan

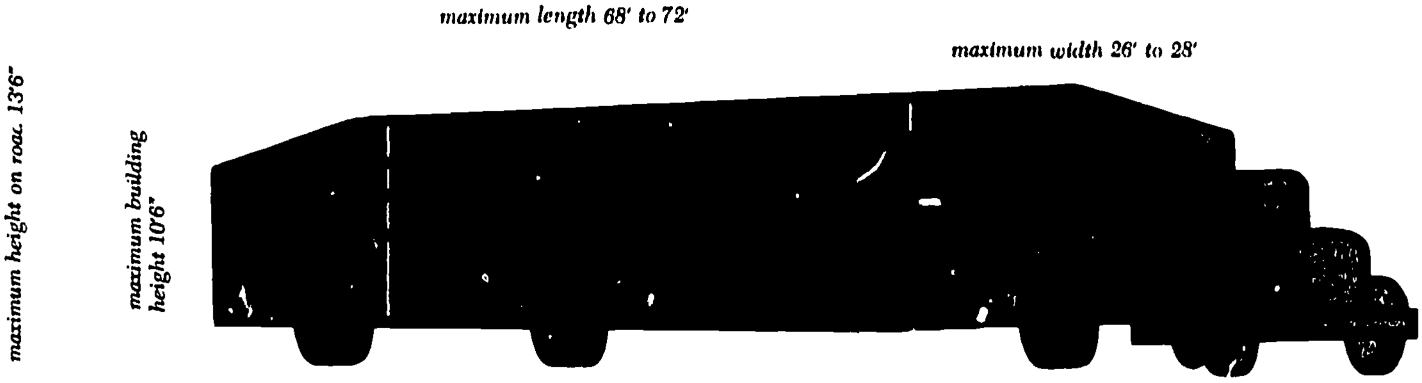
APPEARANCE OF THE UNITS AFFECTS STUDENT AND COMMUNITY REACTION Most relocatable structures currently in use have been stripped of amenities, ostensibly for the sake of economy. In many communities bad taste or no taste at all has been actively chosen over good taste in the belief that "the public won't stand for our putting a lot of money into fancy frills." It is understandable, then, that community reaction to the first appearance of those gray sheds sitting out in the school yard is usually negative. The inspirational effect on the student entering the unit day after day, or year after year, can hardly be much different. Several communities have demonstrated that good design and/or good taste are not necessarily equated with inordinately high costs. Color, textures, selection of proper building materials and finishes, and insistence on quality workmanship can produce buildings that will be a pride to the student and the neighborhood in which they are used. Landscaping around even a minimal structure can cover a multitude of visual sins of low-cost building—and the landscaping can also be planned as relocatable.

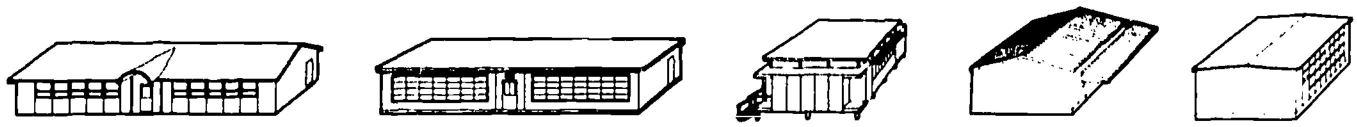
PLAN THE RELATIONSHIP OF RELOCATABLE UNITS TO EACH OTHER AND TO THE MAIN SCHOOL PLANT Careful planning for the use and placement of relocatable structures can help overcome some of the problems of isolation of the classrooms from the total school complex. Building and fire codes are generally adamant in demands for physical separation (usually a 10-foot minimum) of any one non-masonry structure from another or from the main building, especially in the larger cities. But even within such rulings, single and double classroom units can often be related by covered walkways and enclosed passageways which may also be designed to be relocated with the buildings. A campus plan for the structures even on a limited site can add pleasantry to a complex of relocatable units—arrangement of units around a central play or commons area, or fanning the buildings around a circle court, as opposed to lining the boxes up in rows like barracks in a military camp. It is true that such arrangements may require more site or a small premium in laying utility connections. But the gain in creating a more positive school atmosphere when the site is available may be worth the effort and small cost.

Connected row plans

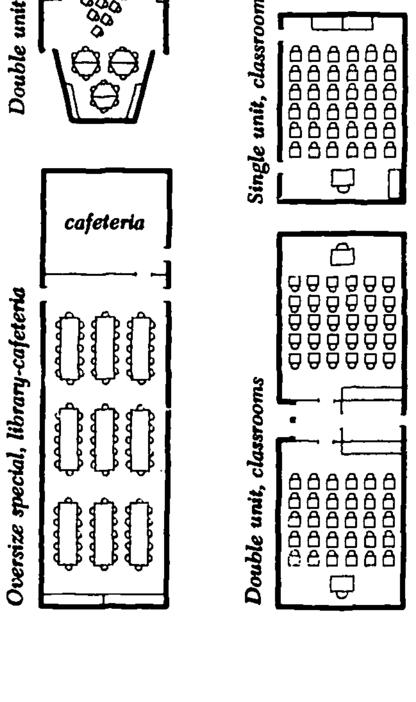


Portable Facilities





This descriptive name generally relates to a structure which is moved as a whole from one site to another. The techniques of transport are similar to those used for house moving, i.e., the total structure (including floor) is jacked up above the footing, lifted and dollied onto a flatbed, and hauled through the streets from one location to a new site.



SIZE LIMITATIONS Width, length, and height dimensions are restricted by the logistics of access to and from the site.

Before planning a portable building, check out clearances of viaducts, overhead power and telephone lines, trees and other obstacles on all routes through the school community. Cornering a building at a tight intersection is critical, especially for extra length, double classroom units.

Experience to date suggests 26'-28' as maximum feasible width for a portable building and 68'-72' as maximum length. A 13'-13'6" road-to-roof-peak clearance is generally considered maximum, with building riding on a flatbed 30"-36" above the road.

To achieve interior floor-to-ceiling heights of 8'-9'6", most portables are either flat-roofed or designed with low peaks.

STRUCTURAL SYSTEM The stress and strain of future moves must be calculated in the basic engineering of the portable building.

Traditional wood framing is most commonly used, sometimes over a rugged steel chassis. Exterior finishes of lap siding, plywood sheathing with battens and even stucco are all common, with choice related primarily to climate. For example, Oklahoma City has chosen to use a steel frame, shell and roof structure which authorities feel best suits the demands of their variable climate.

LIMITS TO MOVING DISTANCE Many state highway regulations impose limits on the distance a building of any given width and weight may be moved—the wider the building, the shorter the transport distance allowed. For example, from the State of Illinois, Bureau of Traffic code*, the following:

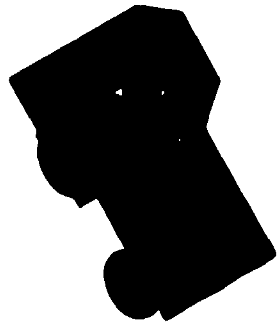
Width Range	Maximum Distance
8'-1" to 10'-0"	Unlimited
10'-1" to 12'-0"	25 miles
12'-1" to 14'-0"	15 miles
14'-1" to 18'-0"	10 miles
18'-1" to 20'-0"	8 miles
20'-1" to 24'-0"	5 miles
24'-1" to 30'-0"	3 miles
30'-1" to 34'-0"	2 miles
over 34'-0"	½ mile

*Article III Sec. 7-303 Permit Regulations for Oversize and Overweight Movements

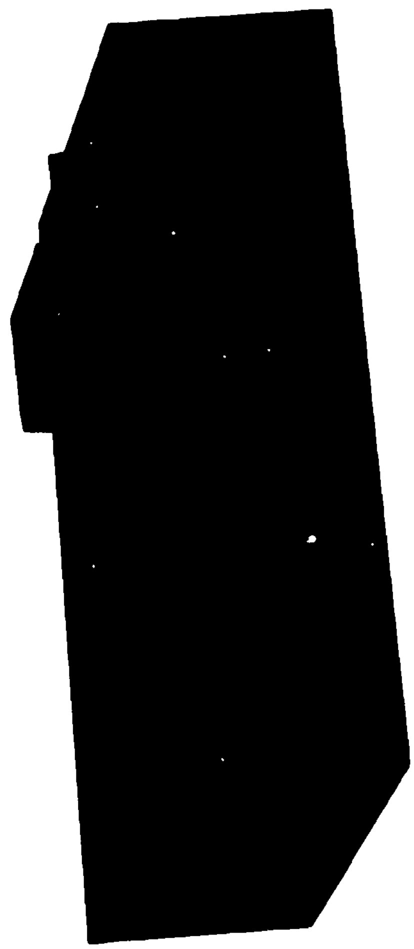
This ruling suggests that the initial erection of a portable building take place near or on the first site. Long hauls of prefabricated and preassembled portable structures is neither feasible nor allowable without special permits.

FOUNDATION Foundation requirements vary primarily with weight of the building, climate, and site condition. Portables are found on mud sills or blacktop in some warm climates; they are usually set on cement block or wood piers, a perimeter block foundation, or on a poured concrete perimeter foundation. The necessity of footings below grade varies with each site.

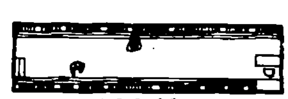
Mobile Facilities



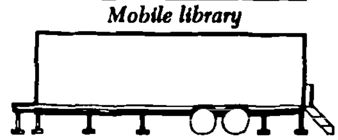
Within the last two or three years, a great deal of attention has been focused on supplementary classroom facilities designed along structural patterns used for mobile (trailer) homes, applying mass-production technology to a space enclosure with a high degree of mobility and roadability. The first "mobile classroom" was a 12'x40' unit equipped with student chairs and desks, chalkboard and tackboard facilities, and a teacher's desk. (The 12' width was later reduced to 10' as a standard to meet state codes for movement without special permits.) With 20-25 students crowded cheek-to-jowl in this space of bowling alley shape, it was immediately clear that the space was not satisfactory for classroom use. Industry and a few schools, however, have ingeniously adapted the long trailers (and sometimes modified buses or truck-trailers) to effective use as mobile demonstration centers, rolling laboratories, visiting libraries, and special training facilities.

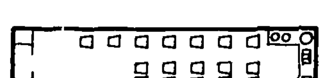


SIZE LIMITATIONS Since the mobile unit is planned for greatest ease of transport to most communities without special permits (often inter-state delivery from plant to school), the width dimension does not normally exceed 10'. Maximum feasible unit length does not normally exceed 65'-70'. Most manufacturers recommend 60' maximum length for greatest ease in handling and cornering. Maximum height dimension limited to 13'-13'6" is similar to logistical restrictions imposed on a portable unit.

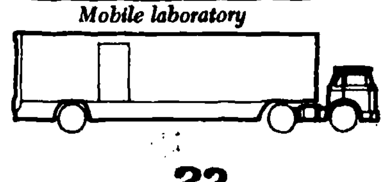


Mobile library



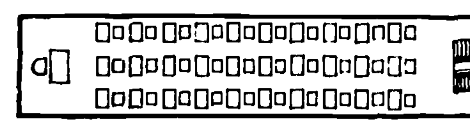


Mobile laboratory



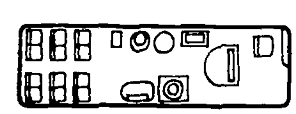
STRUCTURAL SYSTEM A steel carriage is standard to the mobile structure. Pulling hitch, axle, and wheels can be permanent or removable. Wood framing with sheet aluminum skin exterior is most common. Placement, size, quantity of doors and windows are determined primarily by code requirements, with some consideration to engineering requirements to insure adequate strength of the shell in transit.

Several mobile unit manufacturers have recently announced models utilizing all metal components, generally in standard modules and/or a curtain wall system. These developments seem more pertinent to divisible units than to the single-width mobile unit discussed here.

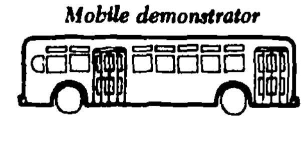


Mobile classroom

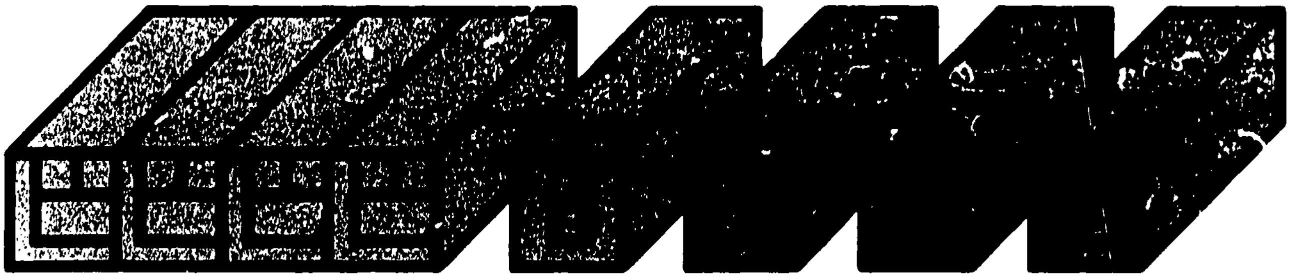
FOUNDATION Traveling laboratory and demonstration units are often left on wheels with ends supported by leveling jacks for comparatively short visits of a few days or weeks. If a unit is to remain on a site for a longer period, concrete block piers or a block perimeter foundation may be used. One community reports their preference for a full rough slab as a foundation. Engineers report that the flexibility inherent in the framing system of the mobile unit obviates the need for heavy foundations.



Mobile demonstrator

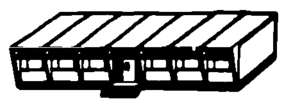


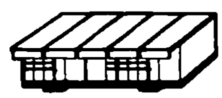
Divisible Facilities

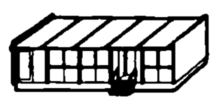


It is in the area of divisible structures that the greatest potential is currently seen for both relocatable and permanent school facilities. The term is self-descriptive, referring to buildings planned to fit together and come apart as large, modular building components. Bricks are small building modules; divisible structures take the concept of modularity several steps further until the components include windows, doors and entire side walls, roof, flooring, and utilities—all combined and pre-finished for greatest ease of shipping and rapid assembly at a given site. Impressive breakthroughs in this new technology have already been made in the United States, Europe, England, and Russia. Within the framework of established modules, there is great variability in design and space delineation. Factory construction proffers additional advantages of short-term delivery, quality and cost controls more difficult to achieve by traditional building methods. DIVISIBLE-MOBILE units fall into this category since they use a standard mobile-home unit as a segment of a larger building. The total width limitation of 20′ (two halves) is less than the 24′ minimum that should be set for a space for 30-35 students—but does not obviate the usefulness of such a unit. Three 56′ long sections (center unit open both sides) have also been combined to provide double classrooms, each 26′ x 30′.

FOUNDATION Any traditional foundation system can be utilized, from block piers and poured perimeter to full slab. A unique system used in Newark, Ohio, involves the "threading" of divisible building segments onto two H-beams set on concrete piers (see case study).



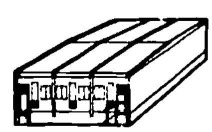


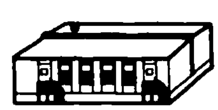


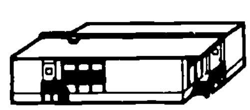
SIZE LIMITATIONS For greatest ease of transport, divisible unit sections are normally restricted to 8′-10′ wide modules. The length span of such units depends on the engineering capability of the designers—normally ranges from 24′-36′ by current capabilities. The 13′-13′6″ road-to-roof-peak height limit in transport, common to all units to be moved, limits building height to 10′-11′. Building length and interior space layouts are unlimited.

STRUCTURAL SYSTEM A steel space frame is currently the most common skeleton used for divisible building components, although wood frame and reinforced concrete systems have also been successfully employed. Confirmation of tight dimensional tolerances and a proven system for sealing joints and seams are both critical engineering and production demands.

Exterior and interior finishes and materials are a matter of choice, design, and cost rather than an engineering consideration.

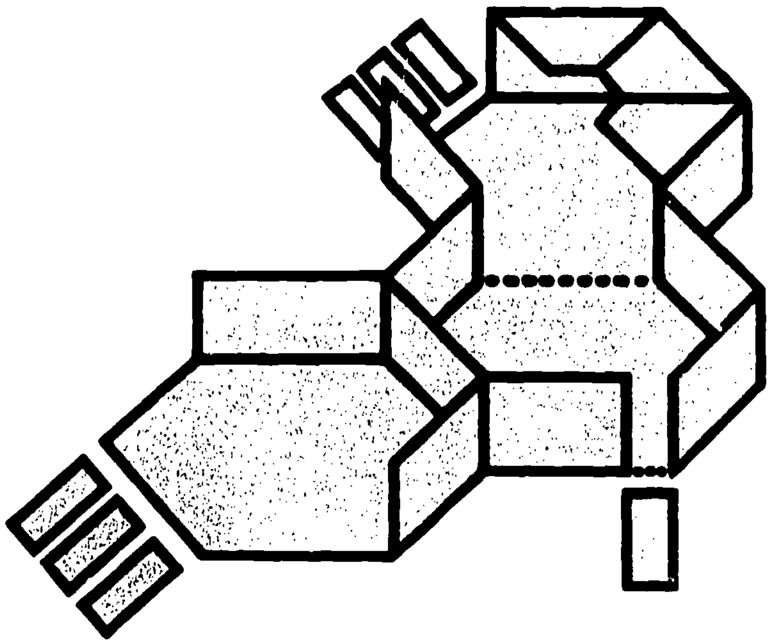


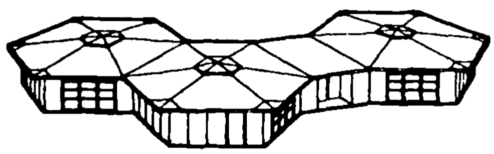


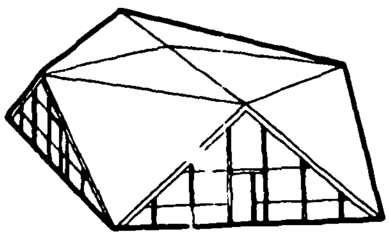


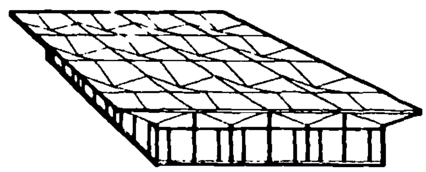
Demountable Facilities

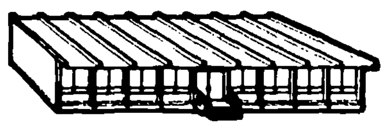
There are many demountable building types. For the sake of this study, the demountable structure is defined as a building which can be disassembled and moved to a new site with a comparatively high recovery of building components. Components are usually factory made (such as curtain wall modules) and assembled at the site—later moved in still larger sections. The floor may be planned as recoverable and moved with the structure or (as in a poured slab) it may be considered expendable. Of the four types of relocatable facilities, the demountable is the slowest and most costly to move. Its great advantage lies in the complete freedom of design and space accommodations possible—with no limits to height, length, or width except those imposed by the engineering scheme.



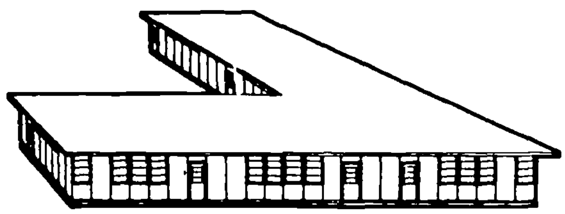






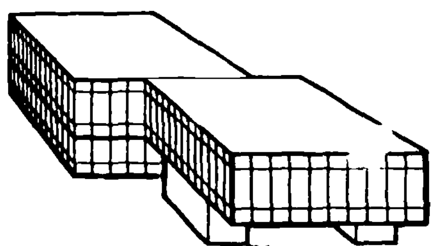


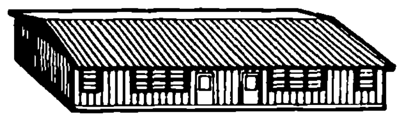
SIZE LIMITATIONS Buildings of almost any size, shape, or complexity can be planned following one or more systems of demountable component structures.



STRUCTURAL SYSTEM A broad range of structural systems is employed in demountable buildings, the curtain wall system being the most common.

FOUNDATION Demountable structures may be placed on various types of foundations, ranging from block piers to poured concrete perimeter foundations (where the flooring is a recoverable part of the building) or full poured slab which serves as the floor.





Calculating Costs

The summary chart of costs at the opening of this study shows initial in-place-costs of units reported to range from $4.50 per square foot up to $30.00 per square foot. Costs of site preparation (including utility hookups) vary from $75 to $8,000 per unit. Transport costs for unit classrooms also range widely from $45 to $1,500 per unit, and the total cost to relocate a classroom ranges as reported from $430 to $11,450 per unit. All cost reports were in response to the same set of questions. Obviously the quality of structures and facilities provided vary almost as greatly as the systems of cost-and-space accounting and value judgments applied to them.

As a basis for cost comparison, the relation between relocatable and permanent school facilities can be misleading. Public statements have been common, suggesting that the average cost of a relocatable classroom is $10,000 while the cost of a single permanent classroom is estimated at $30,000. The comparison further suggests that a school district might purchase three relocatables for the cost of one permanent—an enticing prospect for the overcrowded and financially pressed community.

However, the cost of a classroom in a permanent structure is ordinarily arrived at by dividing the total cost of the school plant (less site) by the number of regularly assigned teaching stations within the school. This calculation takes into account a pro-rated cost of structure for all school facilities and services that include* *(a) teaching stations; (b) auxiliary areas*—music, library, administration, cafeteria, gymnasium, auditorium spaces, outside physical education facilities, and site work; and *(c) service and structure areas*—corridors, walkways, toilet rooms, custodial storage, etc. Thus the $30,000 per classroom figure may include not only the "30 square feet" the student occupies in the classroom, but also the costs of an additional 40-80 square feet of auxiliary and service area space in which is housed his total educational program.

*See *EFL's* The Cost of a Schoolhouse, *1960, pp 64-68.*

By contrast, the $10,000 relocatable unit seldom provides more than classroom space, generally ranging from 22 to 28 square feet per student. Furthermore, this figure often represents the delivered cost of a structure, not including additional expenses for foundation, utility lead lines, entry steps, sidewalks, architectural fees, special permits, and other factors.

UTILITIES AND EQUIPMENT AFFECT INSTALLATION AND RELOCATION COSTS The costs of bringing water, power, gas, sewers, etc., to a site often account for more than half the total cost of relocating a unit structure—and sometimes run to 30-50 per cent of the cost of the building itself. Where a high degree of mobility is anticipated for any school space, planners would best attempt to reduce the number of utility leads needed for the operation of the building. For example, hookup and disconnect costs may influence a district's choice of oil, gas, or electric power for a heating and/or air-conditioning system. The choice of a system for a 1-2 year installation might be different if the building were scheduled for one location for an 8-10 year span. Another factor to consider is the number of relocatable units operating at one site over any given period. Bringing utilities to a site for a single unit might be prohibitively expensive, whereas the same basic costs (plus a small premium) could provide comparable utilities service to 3-4-6 relocatable units. This is one of the reasons that most school districts move relocatable classrooms most frequently in groups rather than individually.

COSTS PER SQUARE FOOT If costs per square foot are to have any real meaning as a measure of building costs, life expectancy must obviously be a factor in the equation. On paper, two buildings may be calculated to cost $13.00 per square foot. If one has a life expectancy of 10 years and the other a life expectancy of 40 years, it is clear that one is substantially more costly than the other.

New structural systems and the introduction of new materials hold promise of divisible-movable buildings rated for a 20, 30, or 40 year life span. However, it is current practice in a majority of cases reviewed to follow structural forms and use materials in relocatable classrooms that either require unusually high maintenance costs over the years or result in (or should result in) retirement of the building after a 10-15 year life. Sometimes such buildings live on beyond their useful life as academic slums.

TAKE ADVANTAGE OF COST SAVINGS IN PURCHASING PRE-PLANNED AND PRE-BUILT STRUCTURES Various fabricators and suppliers across the country have been developing pre-planned and pre-built structures to serve as relocatable or "instant" school facilities. Of course these vary in structural and design quality according to the experience and skills of the manufacturer and the market for which they were designed. These units or components can often be factory built and factory-or-site-assembled at considerable savings as compared to custom built, one-of-a-kind units. However, the buyer must be willing to purchase within the limits of the production system in order to enjoy these savings. Even a small change in specifications (i.e., asking for an 8'6" ceiling if a 9' height is standard) may throw the building into a custom built category of cost, require special handling, and wipe out the potential saving. If the standard building meets educational and code requirements in major areas, the school buyer would do well to re-evaluate his original specifications to work within standards so as to enjoy whatever cost advantage he might grasp. Shopping the building market with an ill-conceived set of specifications and/or dealing with inexperienced or speculative building entrepreneurs can be a touchy business. A district anticipating a relocatable-classroom program should—(1) consult with architects and planners to clearly define the variety of uses to which the spaces will be assigned; (2) evolve a building system standardizing heights, sectional components, finishes and materials, framing, utilities, installation procedures, etc.; and (3) wherever possible, place quantity orders for buildings (perhaps in cooperation with a neighboring community) to realize dollar savings and achieve consistent quality control that will be difficult or impossible to achieve in purchases of one unit at a time.

PAYING FOR THE UNIT CLASSROOM The system of purchasing and/or financing relocatable school facilities varies widely across the nation. Most communities lump these units with their general construction budget, financing from capital funds. Several districts report that they have squeezed two or three units per year out of operating budgets in order to have the time advantage of getting the units quickly without the long delay of a public referendum for building funds. Still other communities have taken the question to the voters, asking specific funds to finance relocatable housing.

Where the need is obviously short term (such as providing housing during construction of a new school or an addition to an existing school), and where such action is allowable by statute, some districts prefer to rent or lease relocatable structures. Contract payment, lease or rental programs are offered by many manufacturers.

Lease/rental costs for relocatable structures vary with the quality of unit provided, size, facilities provided, distance from the producer's plant, and length of contract. A realistic figure for the lease/rental of 800 square feet of space with heating, lighting, wardrobe facilities, chalkboard and tackboard, is roughly $300 per month on a three-year contract. The inclusion of rest rooms may run approximately $10 per month additional; air conditioning may add approximately $20 per month. Most suppliers will also arrange further options for special lighting, acoustical flooring materials (carpeting), work sinks and even complete furnishings.

TOTAL INSTALLED COST Prices normally quoted for purchase or lease/rental of prebuilt units include costs for the specified unit delivered and erected at a *site prepared by the purchaser.* Costs of grading, site, preparation, foundation, and bringing utilities to the site are generally paid by the purchaser over and above the cost of the unit. Entry steps are often additional, since the need for them is not always determined until the specific site is chosen. The same is true for skirting that may be needed or desirable between the base of the building and ground level. Landscaping, sidewalks and covered walkways are generally the financial responsibility of the purchaser, not the manufacturer.

The following check-list will serve as a guide to six major areas of cost consideration to be calculated into the *initial in-place cost* of relocatable school facilities (less movable furniture):

SITE PREPARATION...costs vary with factors such as grading; type foundation; utility hookup leads to site (trenched or exposed—major differential in cost); clearing access to site	$
PURCHASE/LEASE/RENTAL...cost delivered to site, erected on foundation; exterior finish trim, including skirt if needed	$
ARCHITECTURAL PRODUCTS...(if not included in contract price) heating-ventilation-air-conditioning equipment; oil storage tanks for oil heat; special lighting; storage facilities, wardrobe, and supply cabinets; chalkboard/tackboard surfaces; drinking fountain; sink; rest rooms; water heater; steps; entry shelter	$
SIDEWALKS AND COVERED WALKWAYS	$
LANDSCAPING...if on blacktop, consider relocatable architectural planters	$
SPECIAL FEES AND COSTS...architectural fees where pertinent; special permits and inspections; time and costs of staff and outside specialists needed	$
TOTAL INITIAL IN-PLACE COST PER UNIT	$

Moving the Movable

William Randolph Hearst brought an entire monastery, stone by stone, from Italy to the California hills for his baronial castle. The cost was beside the point.

Other monuments and landmarks have been split into sections or disassembled and moved to islands of historical safety when they got in the path of building progress.

But when we speak of moving the relocatable classroom, we must deal with the economics involved. What are the complete costs of the move? Has the building been designed to take the move with a minimum of damage in transit?

CHECK-LIST FOR THE MOVE Following is a resume of the basic steps involved in the move of portable, mobile and divisible structures (reference to demountable units follows the check-list). These are emphasized on a step-by-step basis because they include factors that otherwise may be overlooked in calculating costs and manpower needs between the time the building is jacked off its original foundation and is set onto a new foundation.

PREPARING FOR TRANSPORT

- ☐ Check proposed new site for grading necessary, preparation of foundation, access for utility hookups, site positioning of building for light and ventilation as well as relationship to main plant to provide best access
- ☐ Plan route of move, calculating (a) corner angles and clearance of streets and intersections; (b) overhead clearance of trees, wires, underpasses; and (c) clearances of bridges, hills, and legal restrictions on weight enroute
- ☐ Procure license; plan police escort for move where necessary; clear time schedule of move with local authorities where necessary
- ☐ Prepare new site to receive unit—foundation in place; utility leads in position for hookup; etc.
- ☐ Disconnect utilities at building; disconnect and separate fuel oil tanks where appropriate
- ☐ Disconnect and/or remove steps and entry shelter, deep roof overhang and supports, building skirt, covered walkways, etc.
- ☐ Separate building from foundation and adjoining structures (as a whole or in segments)
- ☐ Secure movable equipment and supplies in building, including suspended light fixtures
- ☐ Clear passage from school property and to new site—remove fences and/or gates obstructing passage, if any
- ☐ (For mobile units) Replace wheels on frame undercarriage of building
- ☐ Attach to hauling unit or position on moving platform and move

TO RESTORE OLD SITE

- ☐ Disconnect utility leads from source—recover or bury equipment
- ☐ Remove foundation above grade; regrade site
- ☐ Restore fence or other equipment cleared for building passage
- ☐ Restore landscaping or ground cover on original site

AT THE NEW SITE

- ☐ Position structure on foundation; remove wheels or moving platform
- ☐ Connect to pre-installed utility leads
- ☐ Check (and repair where necessary) structural damage in transit
- ☐ Install steps, entry shelter, overhang and supports, covered walkways, skirts to foundation
- ☐ Clean, restore and/or paint exterior and interior where necessary
- ☐ Loose any interior equipment secured for move; reset floor tiles at seams (where necessary)
- ☐ Final check on building equipment for health, safety, and functional performance

COST SUMMARY

To summarize total costs of the move, including both staff time and contracted services:

Foundation Costs (new site and restore old site)....................$.............
Utility Hookups (disconnect and connect)..........................$.............
Transport..$.............
Dismantle and Erect...$.............
Walks, Steps, Floor Tiles, Skirt, Overhang, etc.....................$.............
Special Permits, Inspections, Escorts, etc...........................$.............

TOTAL COST

TOTAL COST OF THE MOVE...$.............

Demounting Costs May Be High

Various manufacturers and building entrepreneurs have developed systems and structures which have been tagged demountable. Their sophistication in preplanning for speed and efficiency in *erection* of the building at the site has been most impressive. On the other hand, there has been little experience to give a true time-and-cost picture of the facts on demounting and re-erecting the structure at another site. The few cases of record indicate that since the expensive ingredient of man-hours is a factor in disassembly and assembly of demountable structures, the total cost of relocating these buildings is comparatively high.

One of the examples of a total record of erecting a structure, demounting a structure, and erecting the same structure at a second site with the same components has been the experience of the Prince George's County school district in Maryland. School plant supervisors here report complete recovery of all the major components of the structure. Since the concrete slab foundation-floor of the structure was not originally designed as an integral part of the building and was not recoverable, the costs of that portion of the structure were lost at the original site and had to be repeated at the new site. Adding this cost factor to the labor factor involved, and comparing all costs with costs of other building types, school officials have turned to the divisible-mobile type unit as the most logical choice to satisfy their relocatable classrooms needs.

	Mobile [A]** (11 x 40)	Divis-Mobile [B]** (20 x 35)	Demountable [C]** (22½ x 33½)
Foundation Costs (new site and restore old site)	\$ 185.	\$ 382.	\$ 935.
Utility Hookups (disconnect and connect electricity only)***	445.	122.	226.
Transport	240.	416.	105.
Dismantle and Erect	(none)	224.	610.
Walks, Steps, Floor Tiles, etc.	100.	115.	275.
TOTAL COST TO RELOCATE	\$ 970.	\$ 1,259.	\$2,151.
Initial In-Place Cost	\$7,080. (\$16.00 ft^{2})	\$10,200. (\$14.50 ft^{2})	\$8,302. (\$10.50 ft^{2})

**Figures taken from the budget for "relocation of demountable classrooms and trailers", 1963-64 school year, Board of Education of Prince George's County, Upper Marlboro, Md.*

***See chart at beginning of report for details of dimension and equipment.*

****Costs for utility hookups always vary widely according to difficulty or ease of access to site, existing utilities, and what facilities inside the unit may require in the way of electricity, gas, water, oil, etc.*

Case Studies: Experience and Experiment

Chicago: When enrollment shifts, classrooms follow

Chicago, Illinois

Divisible-Mobile

20x40

800 ft²

656 ft²

30

22 ft²/student

Electric Furnace

Air Conditioning

Drinking Fountain, Rest Rooms

Electric, Water, Sewer

Cedar Posts or Block Piers

$10,000-10,500

$12.50

$2,150-2,625

$45-60

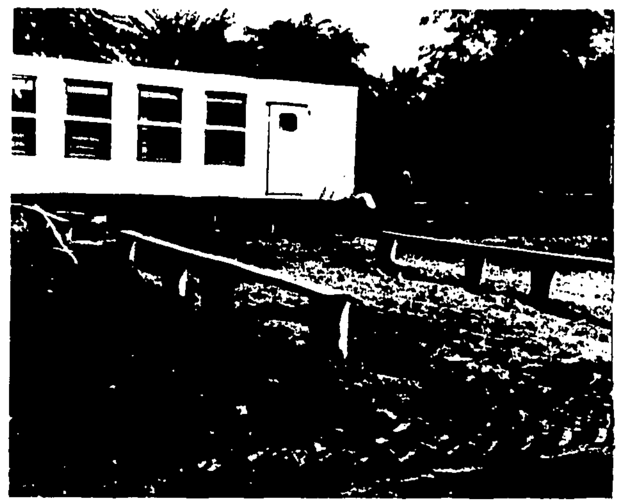
$2,200-2,685

The mobility of the Chicago student population poses a housing dilemma in its own right. In his 1961 Annual Report, Superintendent Benjamin Willis notes: "In five districts that had the highest record of pupil mobility, almost 40,000 pupils transferred out during just two school months. . . . One school alone accounted for almost 2,000 transfers—an average of 50 children leaving or enrolling in that school every day during the period in question."

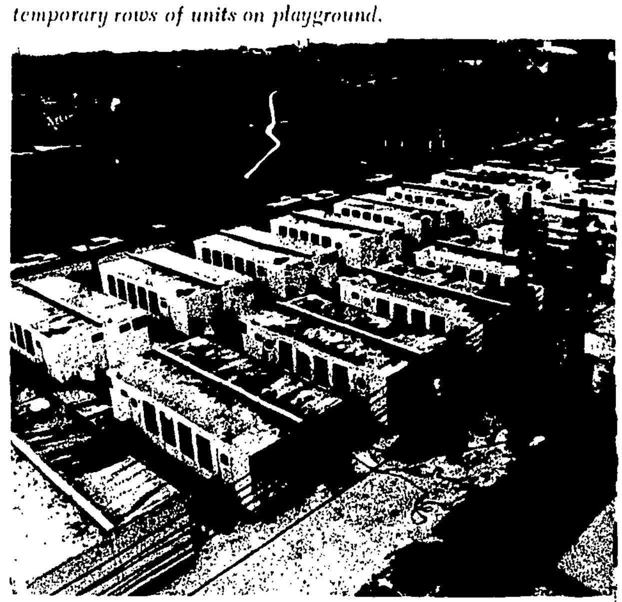
While building planners attempt to anticipate enrollment needs in advance to accommodate a two-year building schedule, the students often overload existing schools in a matter of weeks. For several years the Chicago staff studied various types of relocatable facilities which would support their program seeking to (1) eliminate and/or prevent double shift; (2) reduce class size or prevent increases in class size where a rapid population shift might overload an existing school; and (3) provide relief to overcrowding for a six-month to two-year period until permanent facilities might be planned and built.

During the summer of 1961 several manufacturers built experimental relocatable classrooms to meet standards set by the Board (standards specifically aimed high to avoid criticisms leveled at the temporary "bungalow" portables Chicagoans remembered from the 1930's). The first unit was 10′ x 68′—and was quickly ruled out as being too long and narrow for effective classroom instruction. The second unit was built in two sections, each 10′ x 40′, easily transportable and joined at the site to provide a total enclosure 20′ x 40′. This divisible-mobile building served as a prototype for the 215 unit classrooms purchased and installed between January, 1962, and the release of this report. To date these units have been used in all areas of the city, serving more than 40 different school sites. Within the first year, 82 of 200 units in use had been relocated at least once.

(EFL's variation on the standard Chicago unit is detailed on the following pages.)



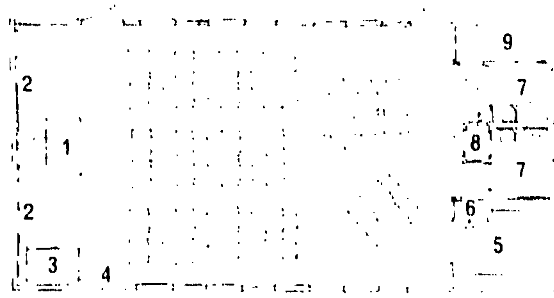
Limited site at overcrowded school forces temporary rows of units on playground.

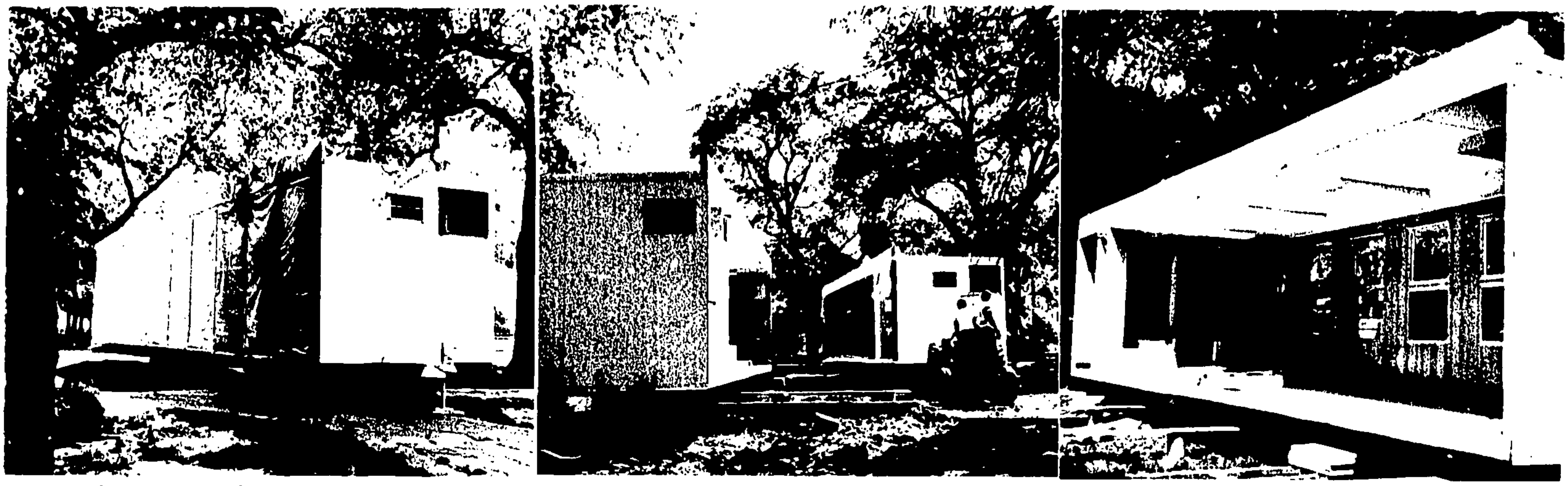


Divisible-mobile classrooms produced by Divco-Wayne Corp., Bourbon, Indiana plant.

Short-term lease of a Park District site provides pleasant setting for unit classrooms.

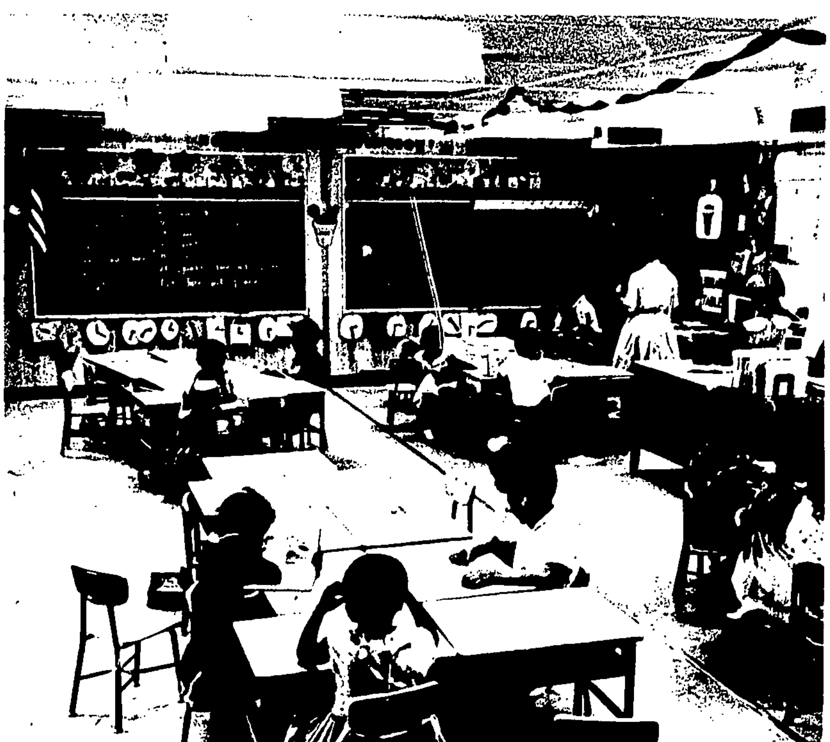
1 Teacher's desk
2 Chalkboard and cork strip tackboard
3 Project table
4 Tackboard
5 Wardrobe
6 [illegible]
7 Rest rooms
8 Water heater storage
9 Furnace space



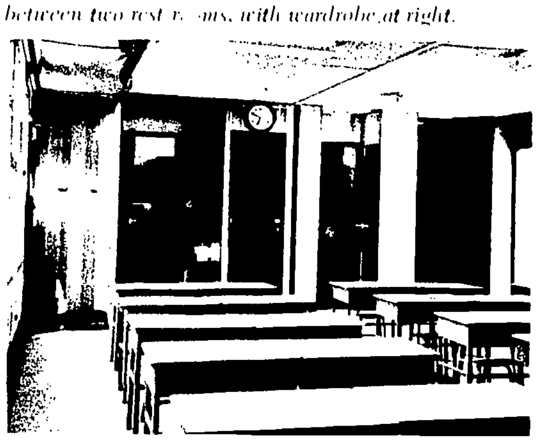


Cedar posts topped by two-inch plank provide adequate foundation for two 10x40 sections, joined to produce a 20x40 classroom.

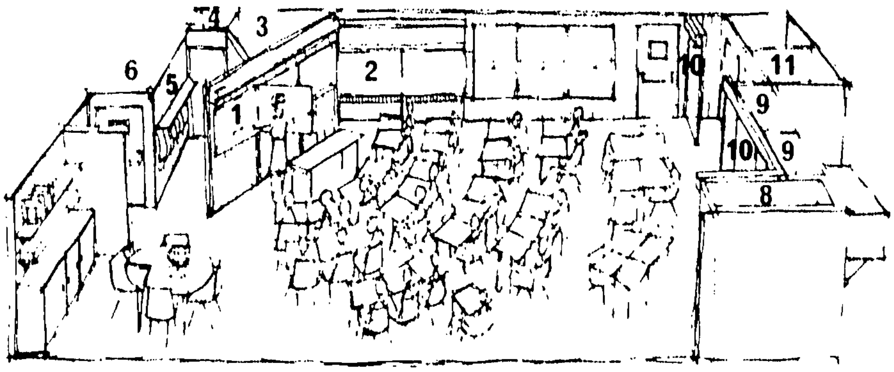
Front view of classroom interior.



Rear view of classroom shows storage closet between two rest rooms, with wardrobe at right.



Four prototype units test new color combinations of aluminum-skin exterior—tan and blue or brown and tan, both with white accents.

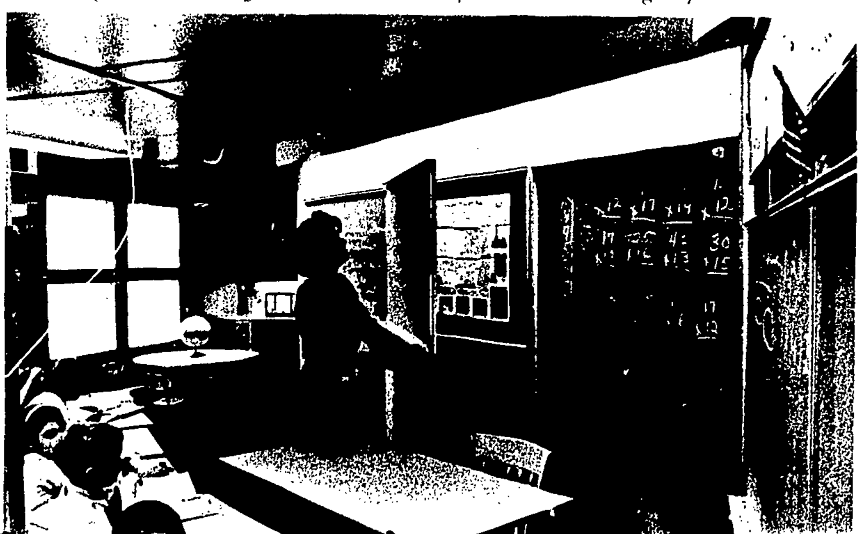


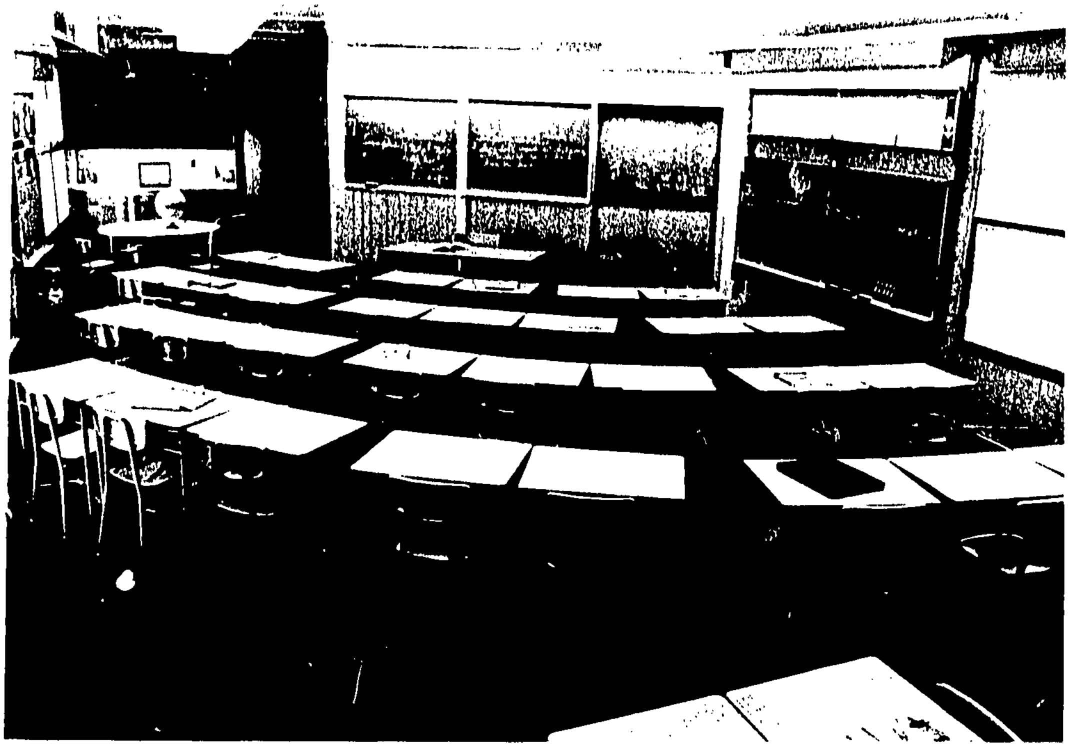
6 *Staggered alignment of building sections allows for recessed steps and covered entry.*

Without changing the structural system (divisible-mobile), the materials, or the cost per square foot, the standard Chicago unit classroom was considerably changed by adding 100 ft² to the total space, re-orienting utilities, and staggering (rather than matching) each of two, 10'x45' sections. Some additional costs were also added for built-in furnishings and special lighting to improve the functions of the spaces available. The results are illustrated in the photographs and sketches above: **1** lighted teaching wall; **2** lighted, adjustable student chalkboard; **3** teacher's center; **4** teacher's wardrobe; **5** student wardrobe; **6** recessed, sheltered entry; **7** resource project center; **8** furnace space; **9** storage; **10** lighted tackboard-display walls; **11** rest rooms. Windows were re-grouped to improve utilization of interior wall space and improve exterior appearance. Special lighting was installed to improve illumination in critical visual areas (such as chalkboards and tackboards) and to enhance the emotional environment for youngsters. The carpeted floor treatment in one of the four prototypes improved the acoustics.

2-3 *Open sliding wall exposes teacher's center behind student.*

1 *Teaching wall features swinging chalkboard panel, controlled chalkboard lighting, and sliding wall to close off teacher's center and provide extra writing surface.*



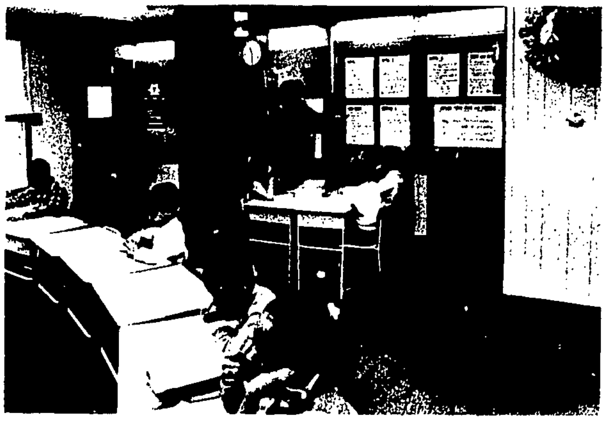


1

7 *Chalkboard, tackboard, and bookshelf are all adjustable to student's needs.*

7 *Adjustable overhead lighting and valanced lighting for cabinet work surface create special atmosphere in resource/project area.*

11 *Double washrooms and drinking fountain are set in recess at rear of classroom.*



9·10 *Lighted tackboard-display walls are overlaid on doors to supply closets and furnace space.*

Newark: New building technology applied to school needs

[illegible]	*Newark, Ohio*
[illegible]	*Divisible*
[illegible]	*30x72 (double)*
[illegible]	*1,080 ft²*
[illegible]	*970 ft²*
[illegible]	*30-35*
[illegible]	*26-31 ft²/student*
[illegible]	*Electric Heat Pump*
[illegible]	*Air Conditioning*
[illegible]	*Sink, Bubbler, Rest Room (shared)*
[illegible]	*Electric, Water, Sewer*
[illegible]	*H-Beams on Concrete Piers*
[illegible]	*$13,213*
[illegible]	*$12.23*
[illegible]	*$1,297*

The official news was released in 1962—the Inertial Guidance System Calibration Center of the U. S. Air Force would begin its move from the Wright Patterson Air Force Base in Dayton to a new site in Newark, Ohio. By the spring of 1964, more than 3,000 families had been shifted to the Newark area, with more to come. A new residential area is growing on former farm lands. Meanwhile, the flood of new students is being absorbed into the Newark schools and those of neighboring communities.

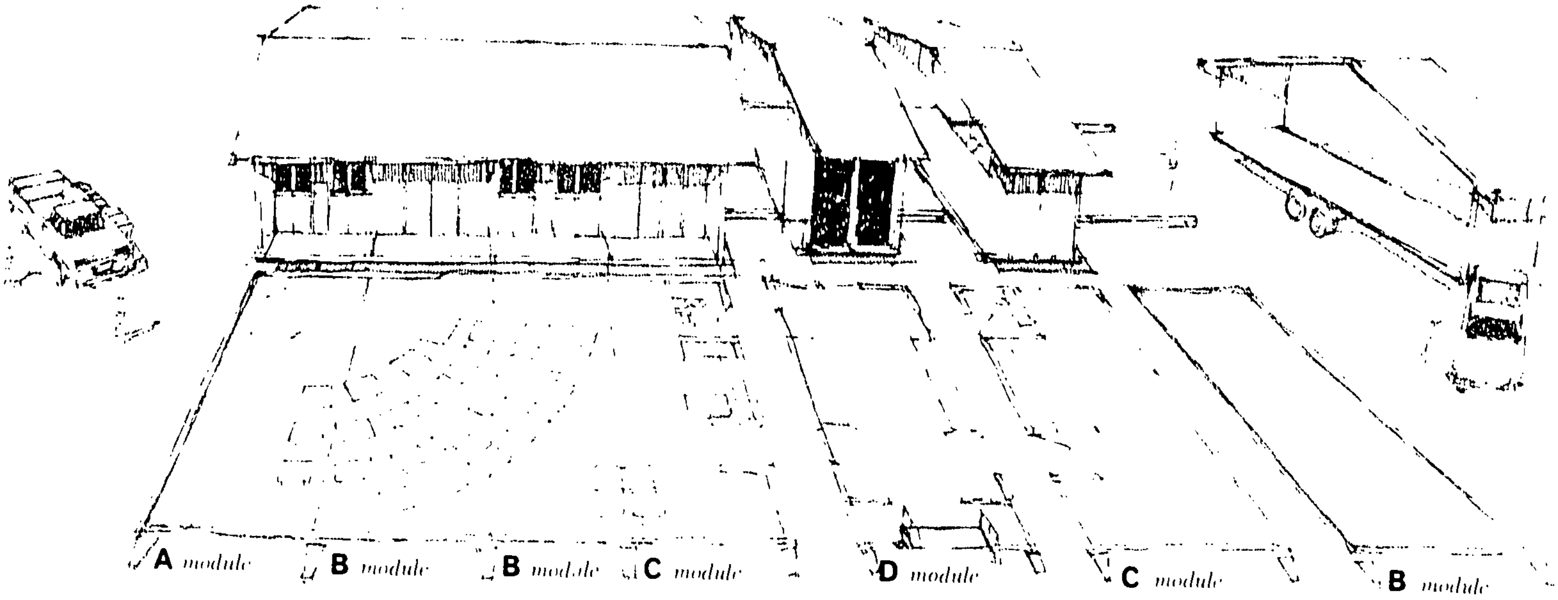
To alleviate the pressure until funds could be raised and plans drawn for the new schools needed, Newark Public Schools authorities sought a solution in supplemental housing. Superintendent (at that time) Tom Southard met with a Newark building research firm which had developed a structural system to produce factory-built, divisible building modules which could be site-assembled on a pre-set foundation in one day to produce a complete house or vacation cottage. They decided jointly to seek a way to apply this new building technology to the needs of the school community.

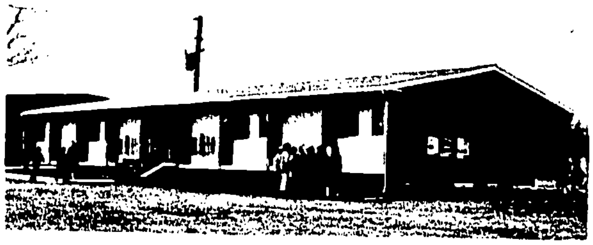
The recent rejection of school tax issues by the voters made economical costs imperative. EFL guidance was sought in planning relocatable spaces that would provide: (1) maximum possible ease in installation and relocation; (2) a minimum of 900 square feet per classroom for 30 students; (3) independent rest room facilities; (4) self-contained and individually controlled heating, ventilating, air conditioning (if feasible), and lighting controls for each classroom; (5) structures of such quality of design and materials as to be a pride to the students and community.

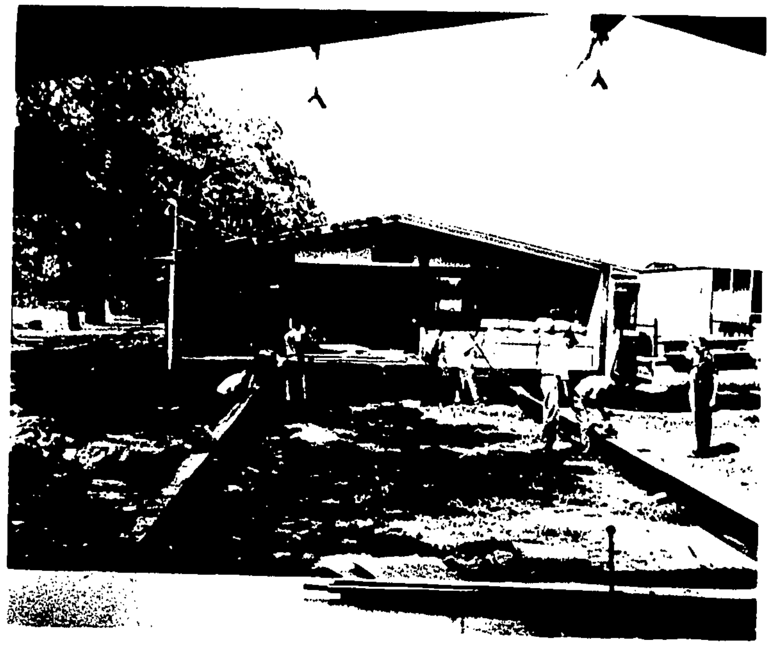
Two prototype double-classroom units were constructed and installed, one at each of two elementary school sites. The time lapse between beginning of the foundation and placement of the last of the furnishings in each double unit was four days. Two of the four classrooms were equipped as special units, including all furnishings and lighting controls considered desirable to get maximum utility out of the space available. (One of these special units was carpeted to compare acoustic quality of the carpeted room with the acoustics in the adjoining room finished with a hard-surface flooring.) The second double unit was furnished as a "standard" classroom, with the normal complement of student desks and chairs, teacher's desk and wardrobe. All four have special chalkboard lighting, wiring for ETV reception, and a built-in sound system with four-speaker ceiling installation.

"Studio" classrooms are individually identified by name and number on bright, multicolored panels next to the entrance.

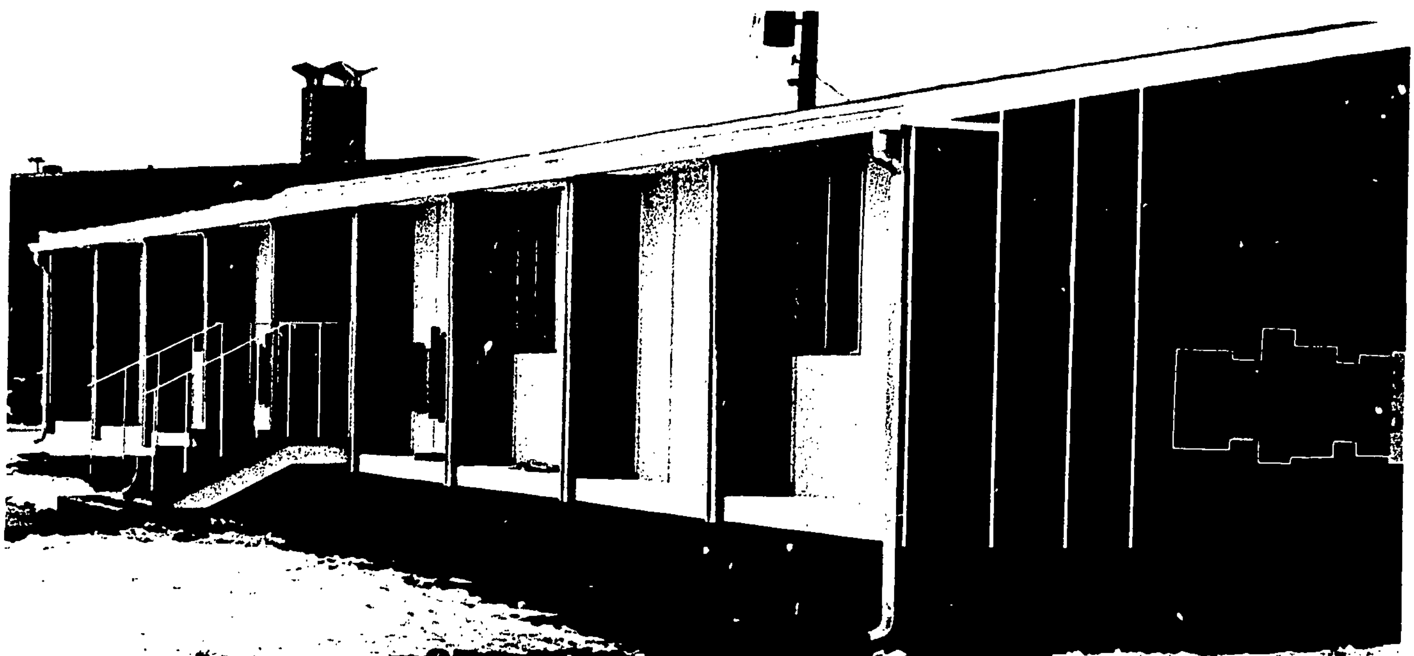
Divisible "studio classrooms" developed by Building Services Research, Newark, Ohio.

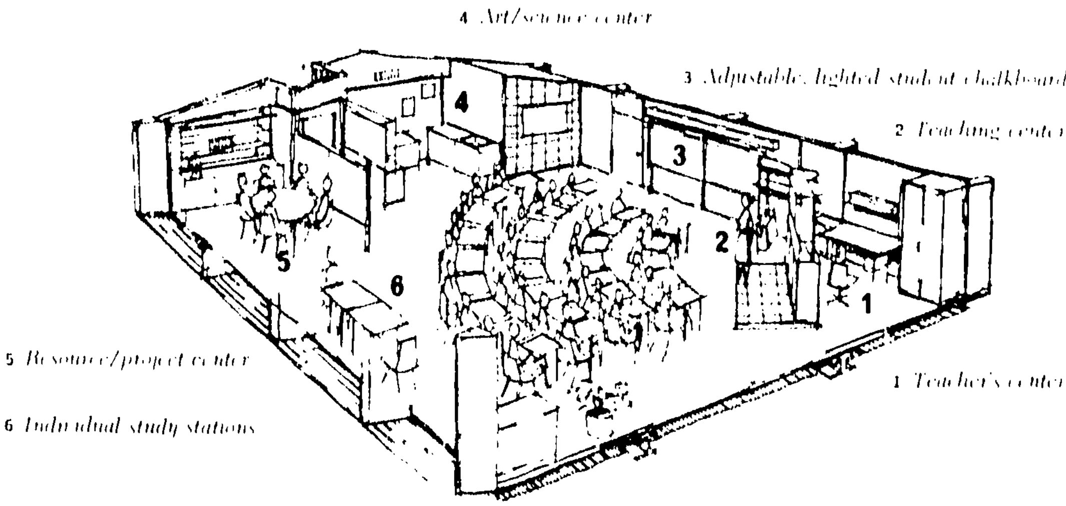


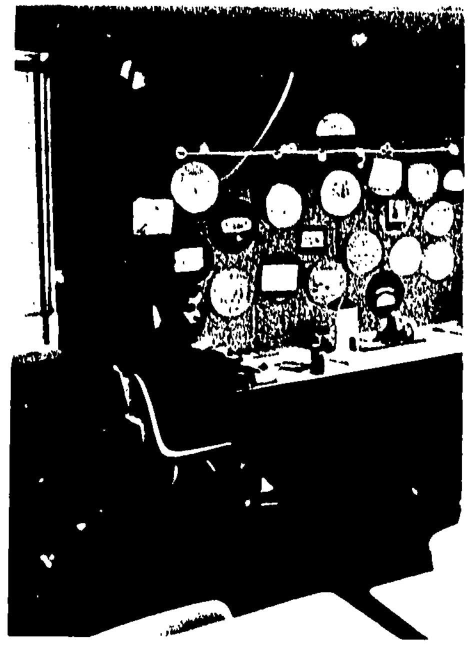




Double classroom unit consists of nine modules "threaded" onto double H-beam foundation. Special attention was given to visual details of the exterior. The roof is gray shingle, the building finished in brown and white. Black channel strips and colorful "studio" identification dress up the end view of the structure. Center doors are bright red.

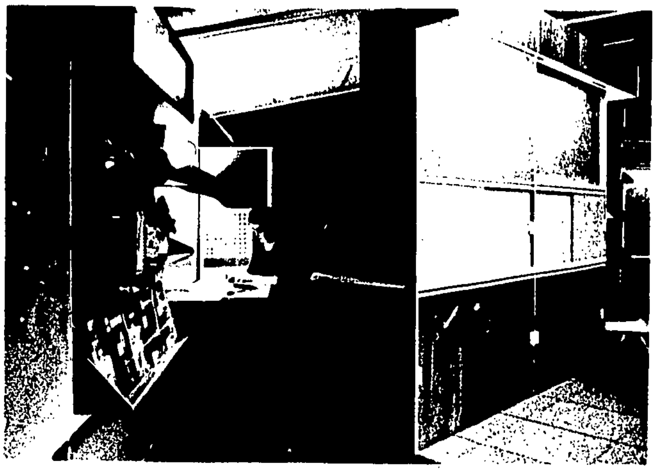




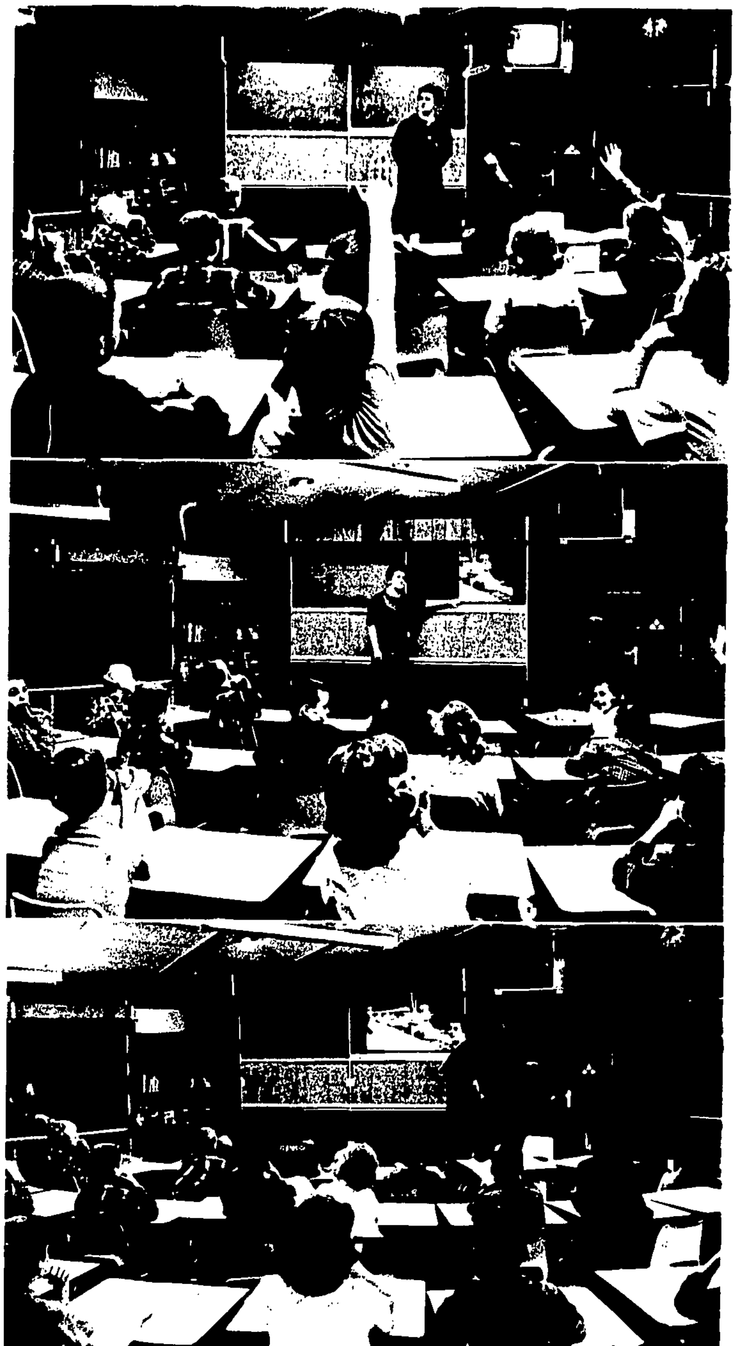


6 *Individual study stations*

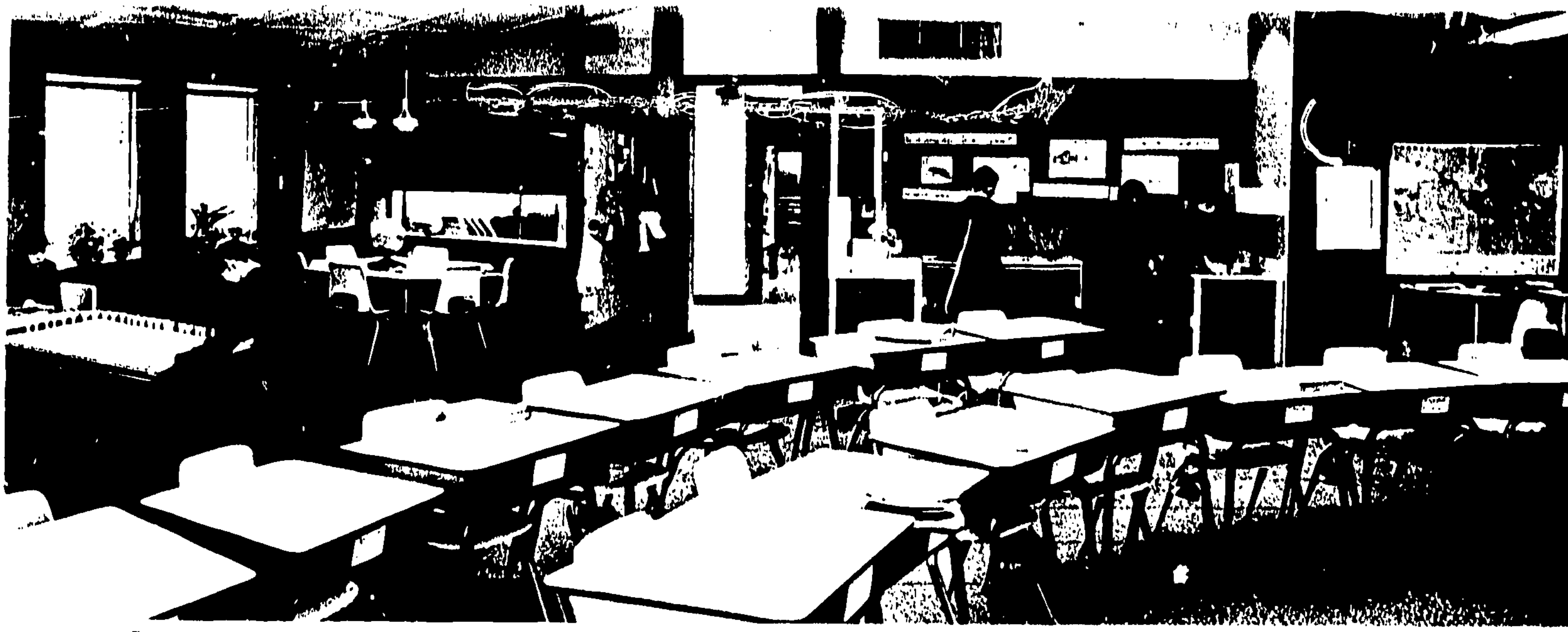
1 *Teacher's center*



2 *Teaching center is also . . .*



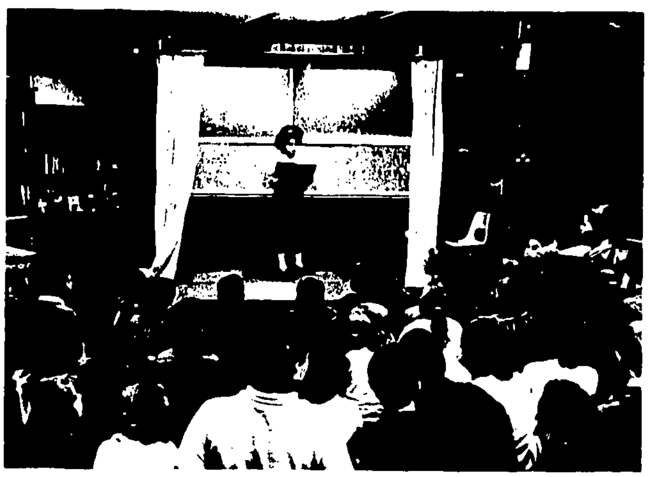
Special layout of furnishings and arrangement of standard cabinet units cater to skills of the teacher in demonstration and use of audio-visual aids. Ceiling mounted TV assures proper viewing angle for all students. Six-inch raised platform for teacher and raised, lighted chalkboard panels also improve sight lines and legibility. Chalkboard panel slides to utilize rear-screen projection facility.



5 *Resource/project center*

4 *Art/science center*

2 *. . . a learning center.*



3

4

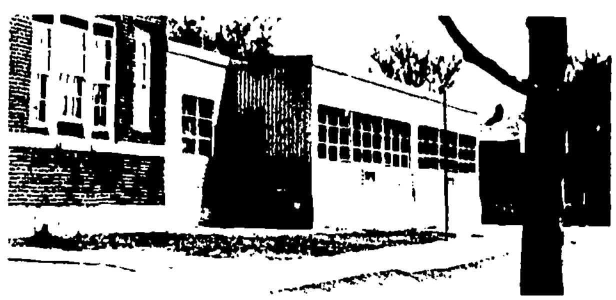
5

Most importantly, the furnishings and space layout of the room cater to the needs of the student, with spaces to work in groups; adjustable, lighted chalkboards; sink and cabinet storage in specially lighted areas; resource and project areas for work in small groups; and spaces for individual study.

Minneapolis: Experiment in building shape, materials, furnishings

[illegible] Minneapolis, Minnesota	[illegible] (C) Electric Heat Pump
[illegible] (C) Demountable (experimental)	[illegible] (C) Air Conditioning
[illegible] (C) 35 x 40	[illegible] (C) 2 Sinks, Bubbler, Rest Rooms
[illegible] (C) 1,400 ft²	[illegible] (C) Electric, Water, Sewer
[illegible] (C) 1,250 ft²	[illegible] (C) Full Concrete Slab
[illegible] (C) 30-35	[illegible] (C) $23,500
[illegible] (C) 36-41 ft² student	[illegible] (C) $16.80
	[illegible] (C) $2,500

(A) *Portable (built 1916-1921).*



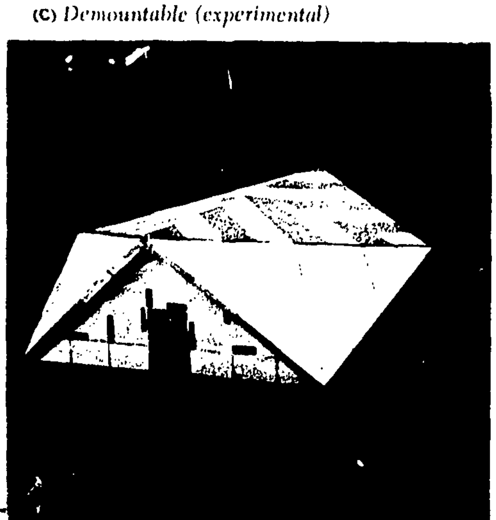
(B) *Demountable (since 1956).*

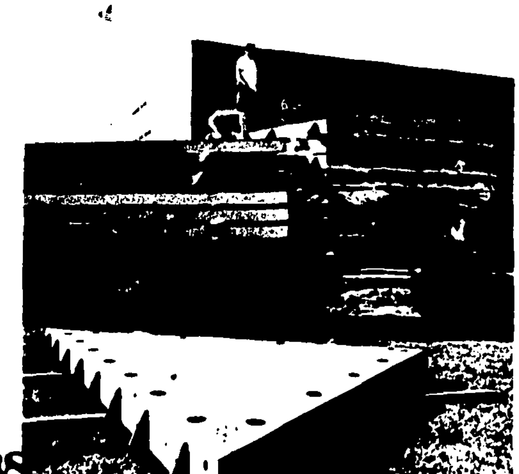
Records dating back to 1918 report the use of "temporary," relocatable, frame structures in the Minneapolis Public Schools. Since that date several other types of demountable and portable units have been installed, but none to the complete satisfaction of school administrators. In 1960 a building research study was initiated, assigning industrial designer Harold Darr of Minneapolis to evolve a structural system that would allow maximum ease of relocation of a building that would meet standards of permanent school facilities. Frederick Hill, then Assistant Superintendent in charge of Business Affairs, visualized [illegible] lassroom "with the mobility of a sheik's tent," quickly erected, dismantled, and moved.

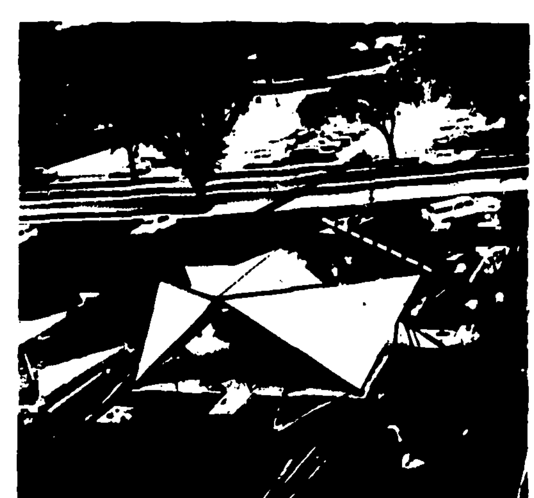
Darr developed a unique structure comprised of sixteen common-sized, triangular panels which would be mass produced and pre-finished, shipped flat to the site. When bolted together in 8-12 hours, the panels would enclose 1400 square feet of floor space under a vaulting, tentlike shell. The first two prototypes were erected at the Kenwood Elementary school in 1962. The cramped, blacktopped site at the street corner of the playground does not show the unique shape to advantage; but interest has also focused on innovation in the use of high-impact structural plastic sheathing on interior and exterior side walls, and tinted plastic (glare-reducing), fixed sash. A unit heat pump provides heating and air conditioning for each classroom. After allocating one corner for rest rooms, a generous 1,250 square feet of instructional space is provided. Hill sought EFL assistance to counsel on "the ultimate classroom furnishing plan which will serve to test new concepts of equipment and space utilization." Results of the furnishing plan study are shown in photographs and drawings on the following three pages.

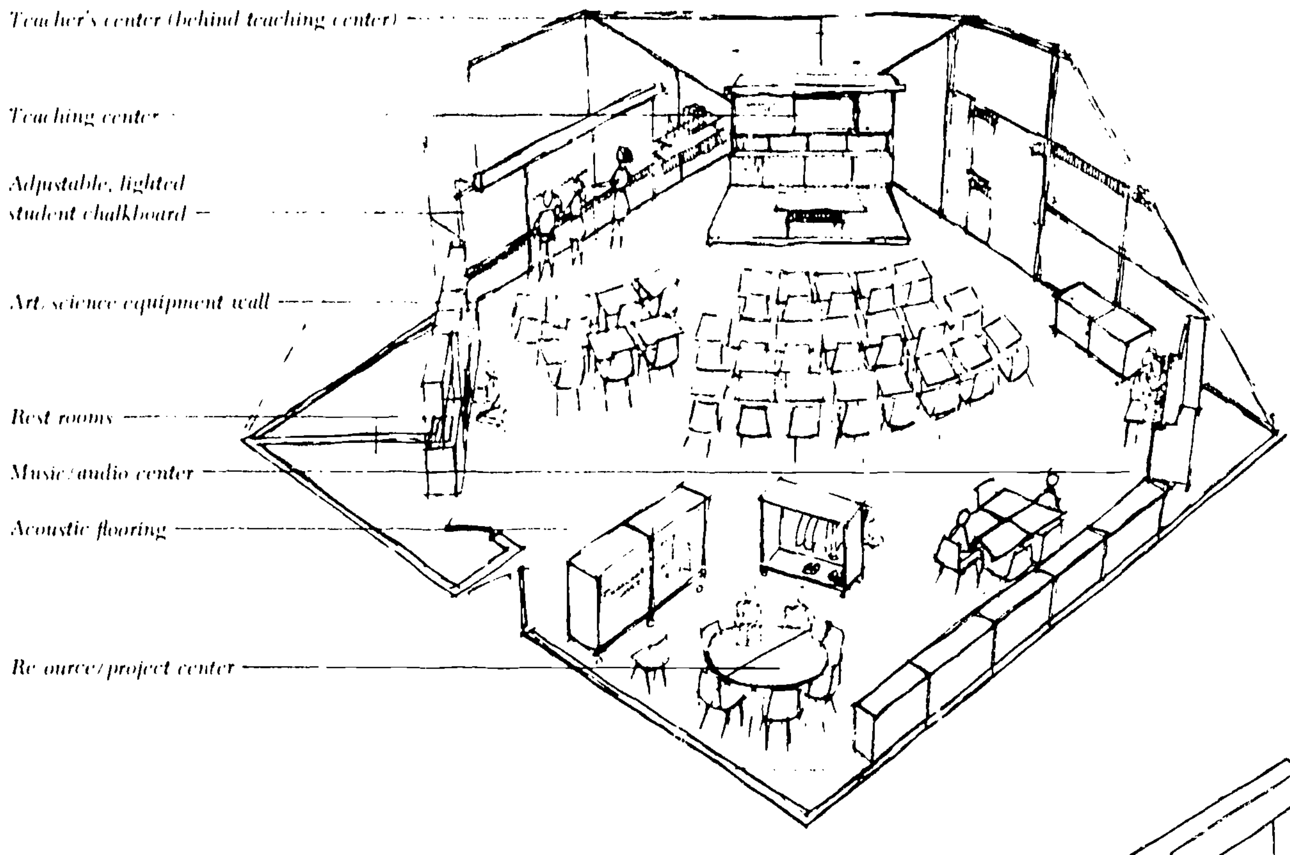
Demountable structure produced by Neoplastic Structures, Inc., Osseo, Minnesota.

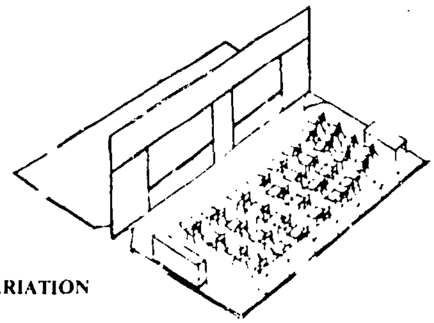
(C) *Demountable (experimental)*



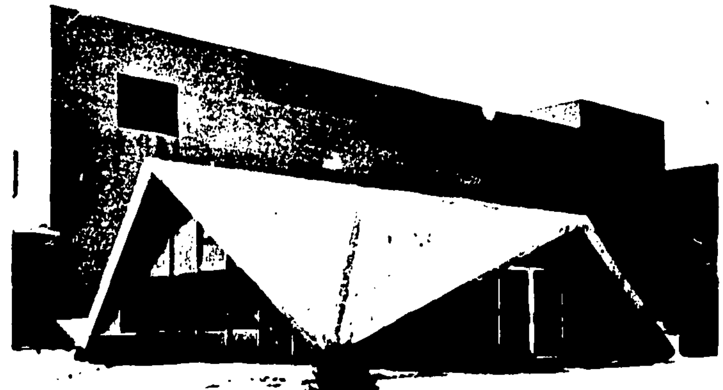




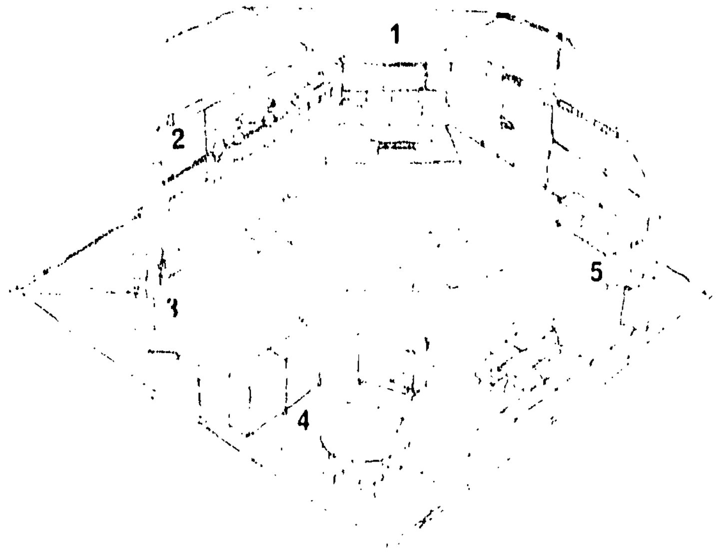




DOWNERS GROVE: VARIATION

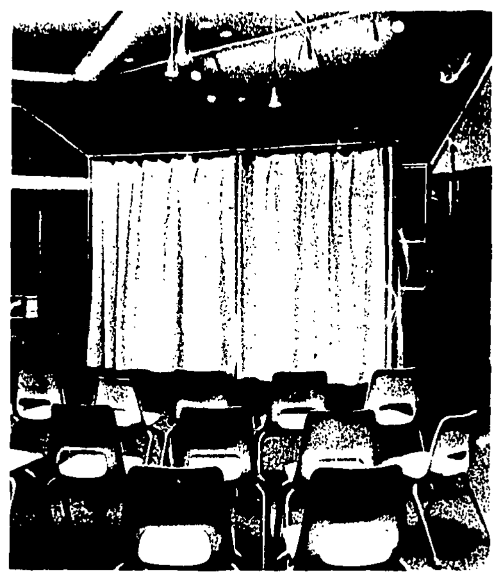


In Downers Grove, Illinois, Superintendent Glen Pickerell placed one of the same structures on the lawn adjacent to the high school. He divided the 1,400 square feet of space by a center wall and thus provided two lecture rooms, each 700 square feet. When and if the building is dismantled and moved at some future date, Dr. Pickerell visualizes use of the non-recoverable concrete slab as a tennis court. (See chart for details of Downers Grove unit.)



1 *Free-standing cabinets serve as room divider between classroom and teacher's work and counselling space.*

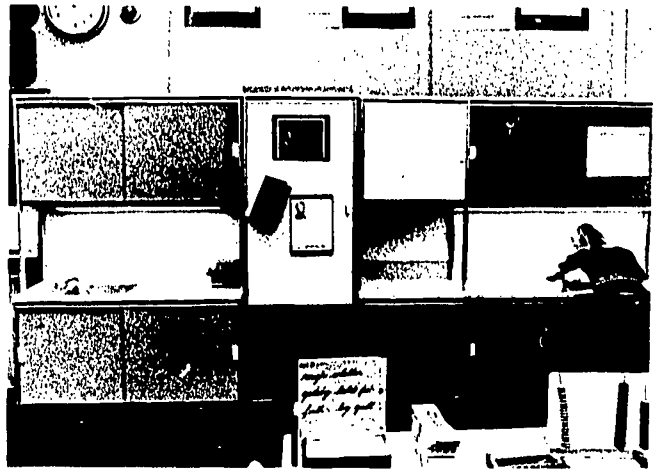
1 *Teaching center, focal point of the classroom: lighted chalkboard/display surface; special lighting for raised presentation platform.*



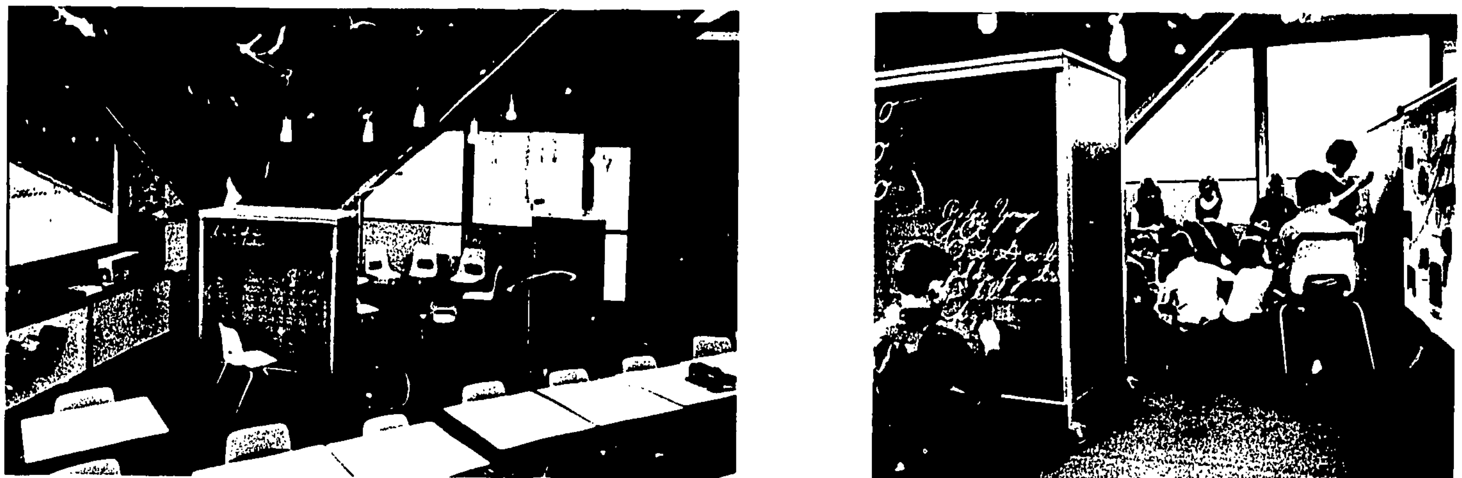
1 *Removable tubing and improvised curtain (above) transform teaching platform into student stage (below).*

1 *Stacked, sliding panels offer the teacher a quick choice of movable chalkboard, display panels, or rigid, translucent material for rear-screen projection.*

2 *Adjustable, lighted student chalkboard.*



3 *Art/science equipment wall includes double sink, bubbler, storage spaces.*



4 *Resource/project center: movable wardrobe cabinets are backed with tackboard or pressure adhesive chalkboard surfacing material; special lighting highlights the en ire area.*

5 *Music/audio center: movable cart at left, foreground, holds instruments, phonograph, and earphones for private listening.*

Pittsburgh: Building prototypes test two solutions

Location *Pittsburgh, Pennsylvania*

Type Structure (A) *Demountable (concrete)* (B) *Divisible (steel)*

Size (A)(B) *28x72 (double)*

Floor Space (A)(B) *1,008 ft²*

Instructional Space (A)(B) *896 ft²*

Heating (A) *Gas Furnace* (B) *Electric Furnace*

Ventilation (A)(B) *Natural and Mechanical*

Plumbing (A)(B) *Double Rest Rooms (shared)*

Utility Hook-Ups Needed (A) *Electric, Gas, Water, Sewer*

(B) *Electric, Water, Sewer*

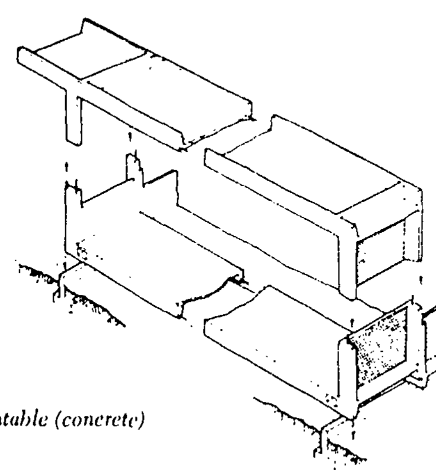
Foundation (A) *Perimeter Concrete* (B) *Concrete Piers*

Initial In Place Cost (A) *$26,900* (B) *$23,227*

Cost Per Square Foot (A) *$26.68* (B) *$23.00*

Site Preparation Cost (A) *Not Calculated* (B) *$2,250*

Unit Relocation Cost (A) *Not Calculated* (B) *$4,166 (est.)*



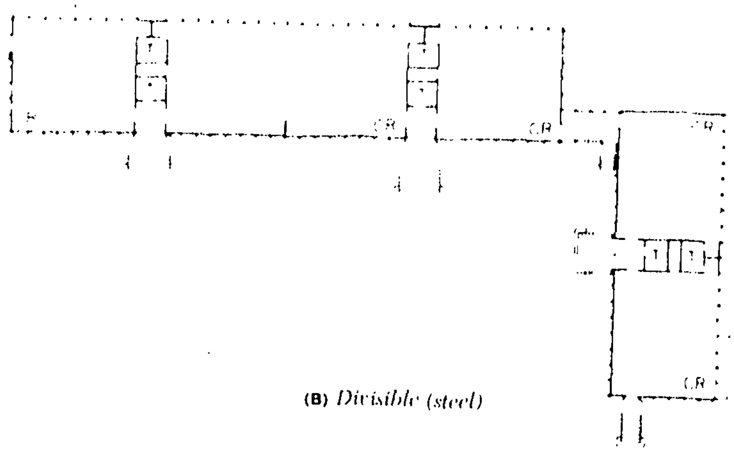
(A) *Demountable (concrete)*

For several years the Pittsburgh Public Schools dealt with shifting school enrollments by transporting students from overpopulated schools in their own neighborhoods to less populated schools in other areas. This approach was considered only stopgap. In 1961, with the support of an EFL grant, a committee of the Board of Education and their Consulting Committee of Architects undertook an investigation of solutions to the problem from two other approaches: (1) convertibility to school use of structures planned for some other purpose; and (2) relocatability of structures designed to be moved from one place to another with a minimum of cost and difficulty.

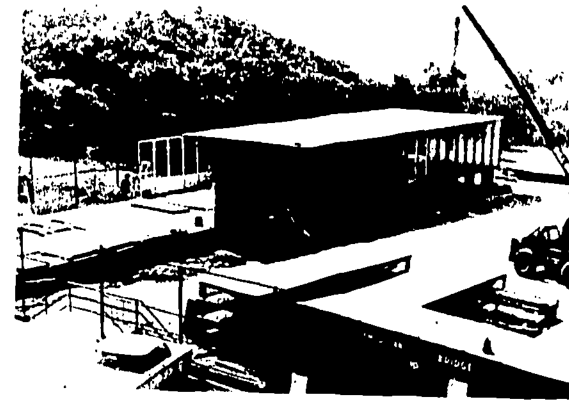
Results of the study of relocatability are illustrated here. The use of *portable* structures was ruled out because of the difficulty of moving total units over the steep, twisting, often narrow streets of the city. The committee felt the dimensional limits (20 feet maximum) of standard *divisible-mobile* units provided cramped and limited educational space. After months of planning, design, and production studies, the Board decided to construct prototypes of two building types—a divisible steel structure (site-erected) based on a plan for transverse sections 8'x28'; and a demountable concrete structure in split top-and-bottom, transverse sections of the same dimensions (see illustration).

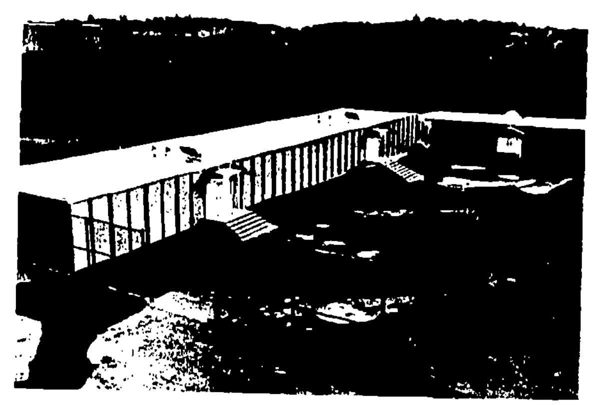
All of the prototypes are carpeted, to study acoustic and thermal properties of the soft floor covering. Each pair of classrooms is separated by a center utility core, including double rest rooms and independent heating unit. The L-shaped layout of the divisible units, in four-and-two-classroom groupings, gave the opportunity to create a large classroom divided by an operable partition. The enclosed passageway linking the two buildings enables all classes to assemble in the central double classroom without going out of doors. Since none of the units has been relocated to date, only estimates of these costs are available.

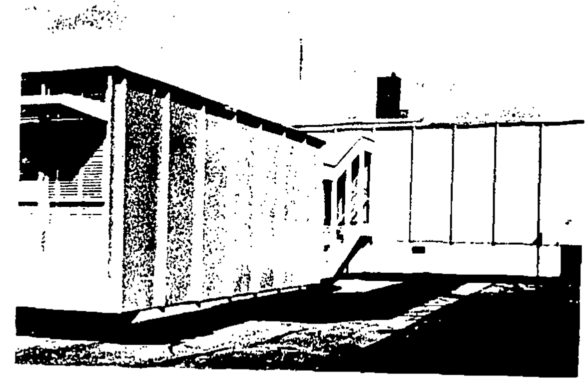
Divisible steel units built by American Bridge Division of United States Steel; demountable concrete units built by United Precast Structures.

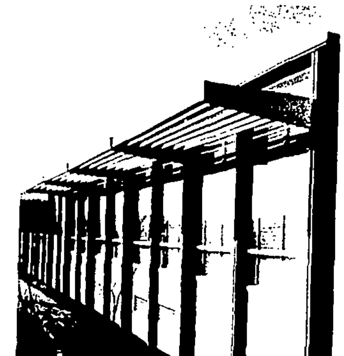


(B) *Divisible (steel)*









Miami: It began with the military influx in the 1940's

[illegible]	*Miami, Florida*	Ventilation	***Natural***
[illegible]	*Portable (all 1941-43)*	Fire Exits	***None***
Size	*20x30*	[illegible]	***Electric***
Floor Size	*600 ft²*	Foundation	***Concrete Block Piers***
Instructional Space	*596 ft²*	Initial In Place Cost	*$5,100*
Number of Students	*30-40*	Cost Per Square Foot	*$8.50*
Instructional Space Per Student	*15-20 ft²/student*	Site Preparation Cost	*$75*
Heating	*Oil Space Heater (floor unit)*	Unit Transport Cost	*$400-650*
		Unit Relocation Cost	*$475-725*

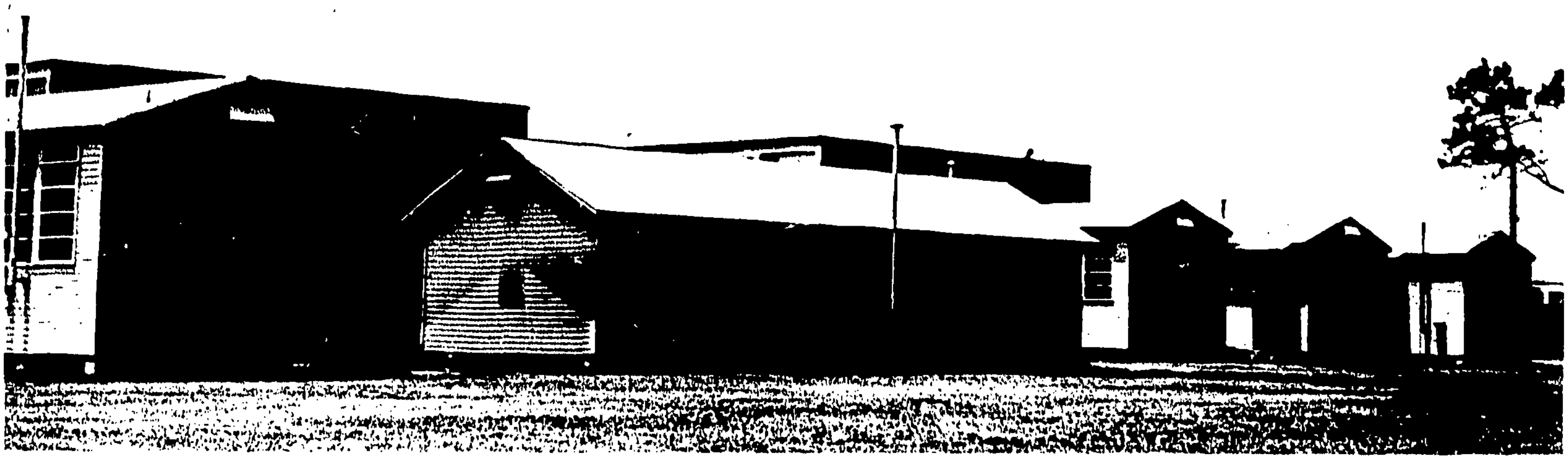
The beginning of World War II in 1941 marked an end to any normal pattern of growth for the Florida area. Population figures skyrocketed with the influx of the military and industry—and the trend is still up. Dade County School District (including Miami) had approximately 70 schools in 1941; by 1963 there were 203 school plants. County population growth following the war continued at 12 per cent each year, adding 12-15,000 students per year to school enrollment.

Shortages plagued the school administration in those first war years—shortage of classrooms; shortage of materials for building; shortage of planning time; and, of course, shortage of money to handle such heavy demands on existing building funds. An expedient solution to supplementary housing between 1941-43 was to build several hundred portable wood frame, barracks-like structures which could be shifted from one temporary site to another until permanent schools could be planned, financed, and built. Occasionally complete schools accommodating up to 200 students were comprised of these frame units.

Although no new portables were purchased after 1943, some former army buildings of the same type were given to the district in 1947-48. In spite of a building program which has almost tripled the number of school plants in the past 20 years, it was not until 1961 that the schools were off double session. More than 400 of the frame buildings are still on duty in Miami schools, shifting from site to site as the planners try to catch up with permanent housing needs.

To relieve overcrowding of the main building . . .

. . . wartime portables are still on duty.



Double unit serves for choir room.

Movable wall, once used to separate two single units, removed for large group meetings.

Floor space heater serves needs of climate.

Atlanta: Annex for 720 pupils in 90 days

Location *Atlanta, Ga.*

Type Structure **(A)** *Divisible-Mobile* **(B)** *Divisible-Mobile (special)*

Size **(A)** *20x42* **(B)** *20x56*

Floor Space **(A)** *840 ft.²* **(B)** *1,120 ft.²*

Instructional Space **(A)** *816 ft.²* **(B)** *1,094 ft.²*

Number Students **(A) (B)** *32-35*

Instructional Space Per Student **(A)** *23-26 ft.²/student* **(B)** *31-34 ft.²/student*

Heating **(A)(B)** *Electric Furnace (2 units)*

Ventilation **(A)(B)** *Natural and Mechanical*

Plumbing **(A)** *None* **(B)** *Sink*

Utility Hook Ups Needed **(A)** *Electric* **(B)** *Electric, Water, Sewer*

Foundation **(A) (B)** *Perimeter Concrete and Block Piers*

Initial In Place Cost **(A)** *$9,828* **(B)** *$13,104*

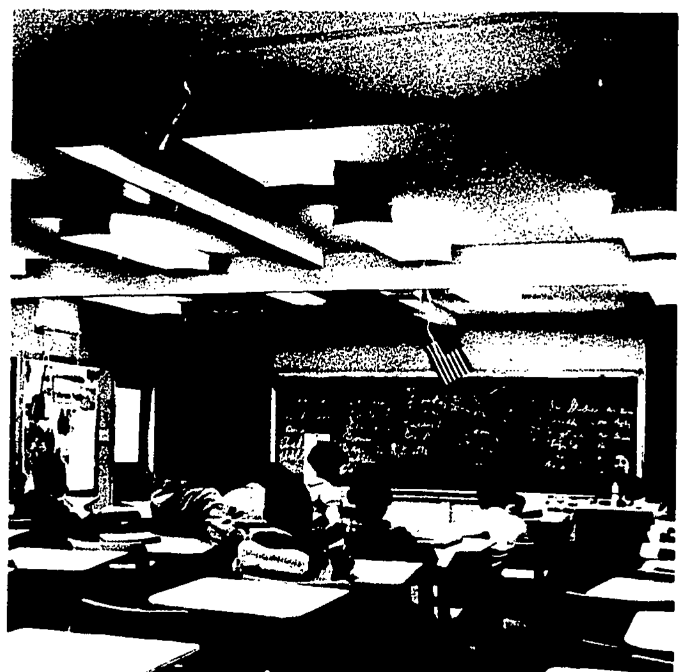
Cost Per Square Foot **(A) (B)** *$11.70*

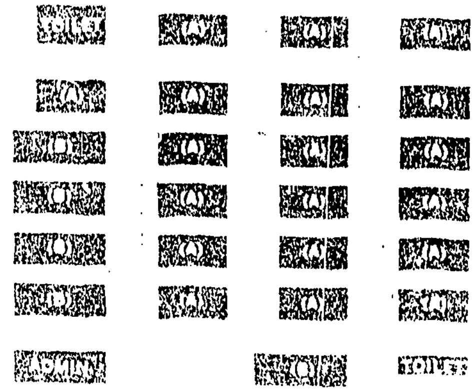
Site Preparation Cost **(A) (B)** *$1,300*

On June 11, 1962, the Atlanta Board of Education called for a school to house the entire eighth grade of a local high school, relieving the bulging enrollment of that school by reducing its grade span from four to three years. The new annex was to be self-sufficient, accommodating 720 pupils on a site remote from the parent school. Opening date required—September 5, 1962, less than 90 days from the date of the request. The Atlanta Schools building department reviewed the Chicago experience with divisible-mobile unit classrooms. Specifications for the same type of structure (trailer-home framing, etc.) were let for bid and a *contract awarded on July 9, 1962.* Strip concrete foundations were poured below grade and concrete block piers prepared while the fabricator was constructing the buildings. By the *middle of August* the split-classroom units were arriving at the site. By *September 5, 1962,* 795 students were attending classes at the new Howard Annex while finishing touches were put on covered walkways, landscaping, and plumbing hookups. By spring, 1963, there were 844 students enrolled. Shifting of school enrollments reduced the Howard Annex to approximately 600 for the opening of the 1963-64 session.

As an emergency solution to a school housing need, the program illustrated here does demonstrate an expedient approach to instant schools. Reviewing their experience to date, local authorities feel that relocating the units at some future date will be more costly than originally anticipated. While housing standards are somewhat better than exist at the older parent school, they are well below standards of new permanent structures in Atlanta. Educational utility suffers from lack of supplementary spaces such as library, eating facilities, and special purpose facilities (for art, music, etc). Additional space is also needed for administration, counselling, health facilities, and service and maintenance utilities. There are no enclosed physical education facilities.

Unit **(A)***; standard classroom, 20x42.*



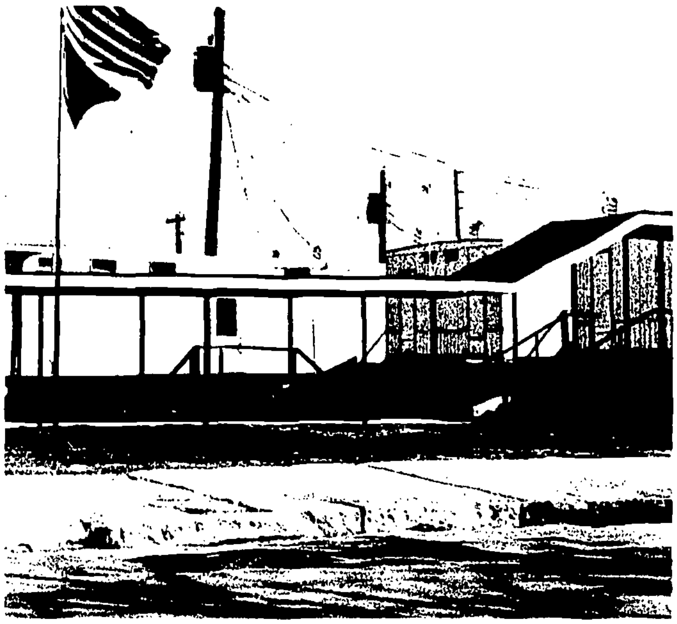


TOTAL SCHOOL ANNEX (Relocatable)

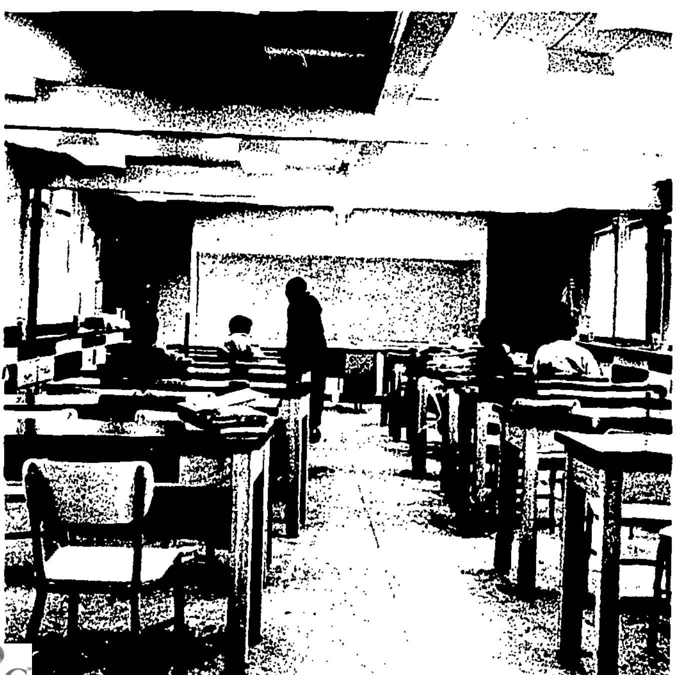
Relationship of Space Available, Enrollment, Costs:

		As planned for 720 students	For peak enroll. 844 students
Classroom space	21,560 ft.²	30.0 ft.² student	25.5 ft.² student
Administration	1,120 ft.²	1.5 ft.² student	1.3 ft.² student
Toilets shower	1,584 ft.²	2.2 ft.² student	1.9 ft.² student
½ Walkways	4,861 ft.²	6.7 ft.² student	5.8 ft.² student
Totals	29,125 ft.²	40.4 ft.² student	34.5 ft.²/student
Total construction cost		$284,127°	($9.80/ft.²)

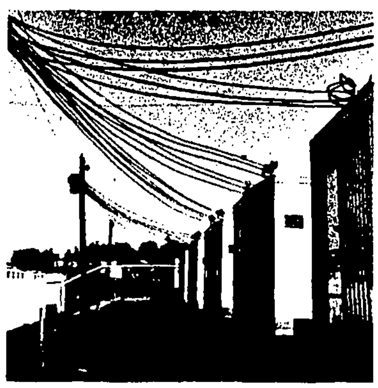
°*Not incl. architects' costs, out-of-pocket expenses, and time of staff administrative personnel—total est. at $4,500-6,500.*



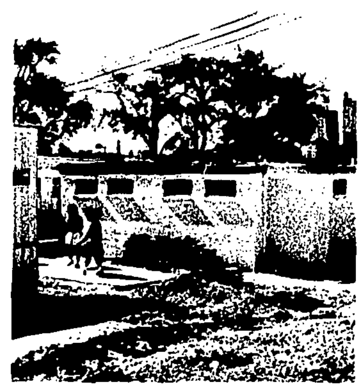
Unit (B); science, home economics units, 20x56.



Graded field provides physical education space.

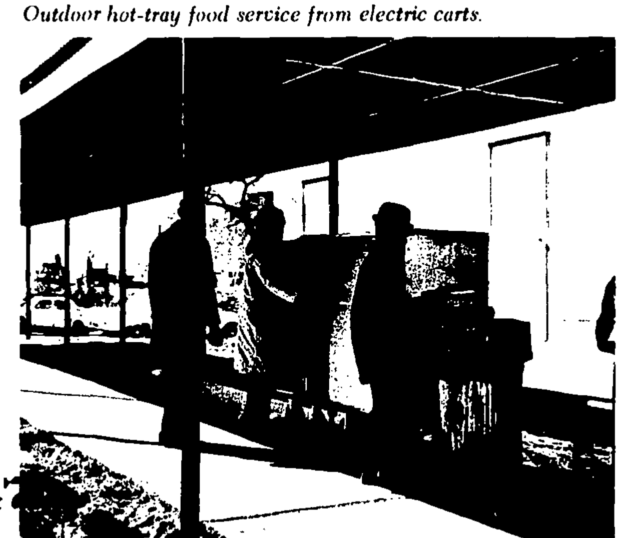


Codes allow overhead power lines—less expensive than trenched leads.

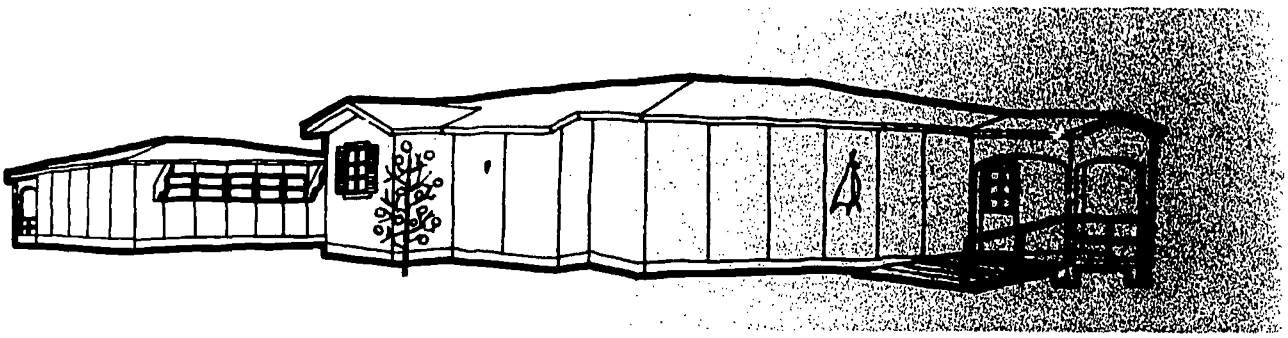


Toilet facilities in two separate buildings, permanent construction.

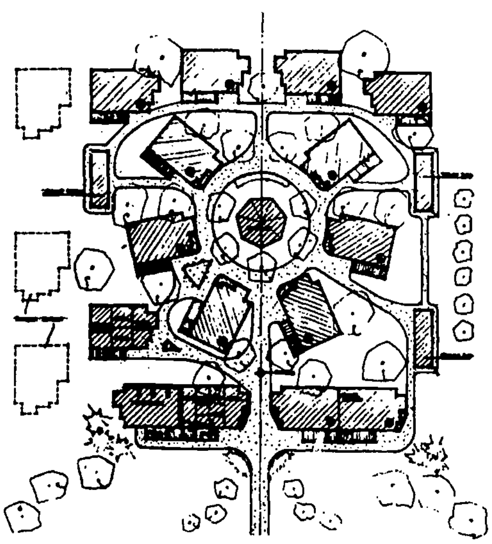
Outdoor hot-tray food service from electric carts.

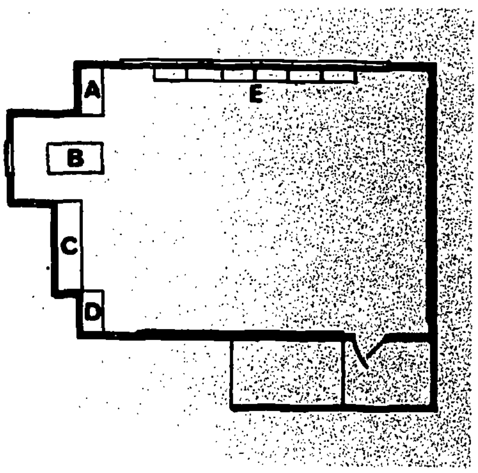


Tucson, Arizona	*Air Conditioning*
Portable	*None*
24x32 + (irregular)	*Electric*
883 ft²	*Concrete Pads*
883 ft²	*$8,710*
30	*$10.00*
29 ft²/student	*$500*
Electric Heat Pump	*$300-400*
	$800-900



Campus layout of portables.





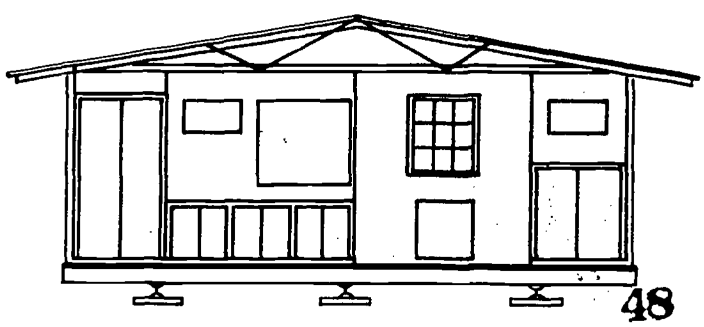
A *Coat cabinet*

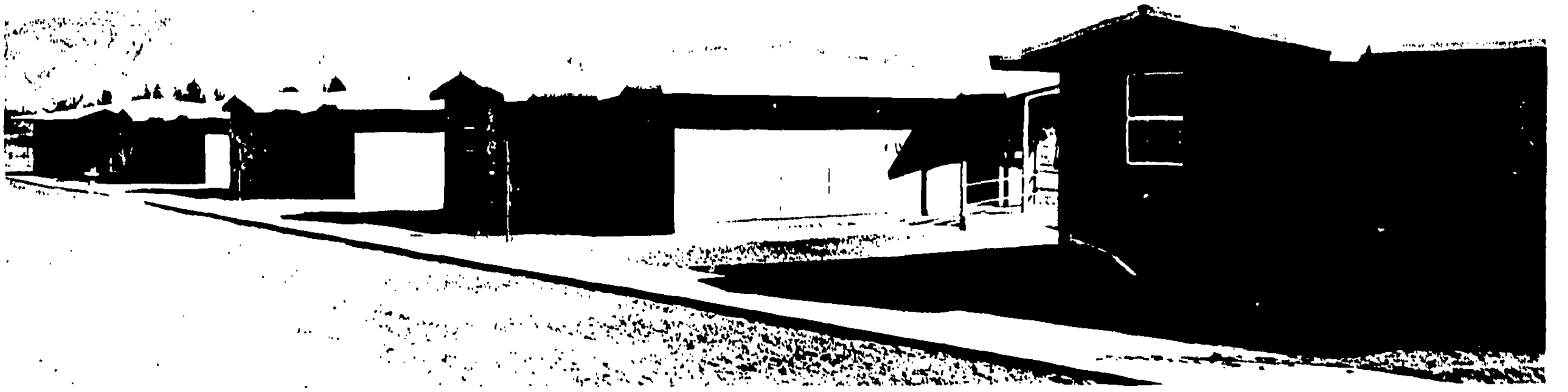
B *Island cabinet*

C *Students' cabinet*

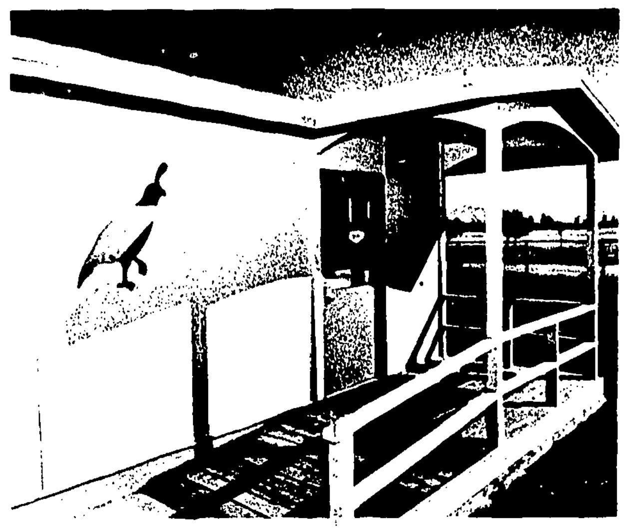
D *Teacher's cabinet*

E *Mobile bookcases*

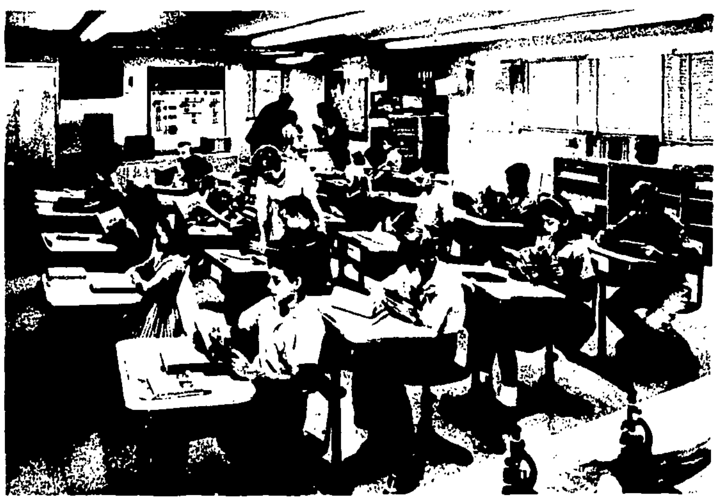




Ten years ago, the Engineering Department of the Tucson Public Schools, District No. 1, began a study of portable classrooms by visiting buildings in other school districts. Superintendent Robert D. Morrow reports: "We were never satisfied with the plan, exterior or interior design. Our first experiment was made by using a stock rectangular-type plan. The buildings were very pleasant inside, but the exteriors were as usual—typically nondescript. We wanted to produce a building that would provide (1) all necessary functions for good teaching and learning, plus (2) an attractive exterior architectural design that would conform to the average neighborhood surroundings. We decided to develop a plan other than the rectangle."



The first of the new buildings developed by staff architects and engineers was built in 1962. At one end of the building, a recess in the floor plan allows placement of most of the cabinets out of the main room floor area. This alcove accommodates an island cabinet and work surface (with sink, where desired), with access from all four sides. A hip roof with low pitch keeps the buildings compatible to most residential areas. A gabled and ramped entry porch (removable for transport) provides both protection and an added design element. Each entrance is defined by a different colorful plywood cutout depicting animals typical of the Southeast. Furnishings of the interior, including mobile bookcase-room dividers, generous chalkboard and tackboard surfaces, and ample storage facilities, cater to educational function.



Mobile bookcases.

Detroit: Forty years of experience with portables

Detroit, Michigan

(A)(B) *Portable*

(A) *26½x71½* **(B)** *26½x66 (both doubles)*

(A) *947 ft²* **(B)** *875 ft²*

(A) *696 ft²* **(B)** *754 ft²*

(A)(B) *32*

(A) *22 ft²/student* **(B)** *24 ft²/student*

(A) *Gas or Oil Furnace* **(B)** *Gas Furnace*

(A)(B) *Natural and Mechanical*

(A)(B) *Sink, Double Rest Rooms (shared)*

(A)(B) *Electric, Gas, Water, Sewer*

(A)(B) *Perimeter Concrete and Block Piers*

(A)(B) *$14,800*

(A) *$15.60* **(B)** *$16.90*

(A)(B) *$1,750*

(A)(B) *$1,350-1,500*

(A)(B) *$4,000-5,200*

With more than 40 years of experience in the use of relocatable facilities to draw from, the Detroit Public Schools have followed a policy of steadily revising and updating building plans, periodically changing to gain from experience and incorporate technological advances. As far back as 1920, school architects produced the "Circle A" structures, divided and moved in three-foot modules. Then they went to an eight-foot module, and next to a 24'x84' double-classroom building moved in three sections. Relocation of these buildings, however, ran to approximately $12,000 per double unit. The architects determined it would be easier and less expensive to design and move a total unit, especially if the building could be made more compact.

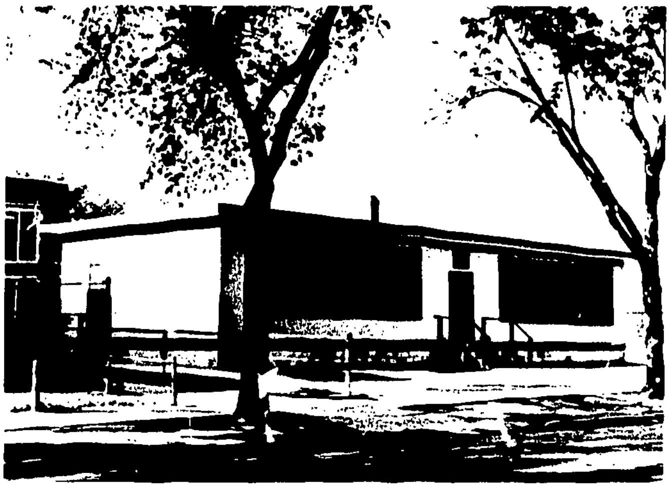
In the 1950's, the flat-roofed, double classroom portable became a standard. A reduced building height overcame problems of clearing overhead utility lines and tree branches during transport through city streets (with the older unit, costs of cutting and restoring power lines sometimes ran $2-3,000 per move). Strength and flexibility were achieved by erecting the wood-frame structure on a steel platform.

In 1963, a still further revised double unit was introduced, cutting five feet from the length of the previous model, but increasing instructional space by more compact and efficient planning of the core for rest rooms and mechanical equipment. The amenities of the "studio effect" of the low-peaked roof and the addition of the rolled entry portico were further revisions. Costs remained about the same.

Experience suggests that these portable classrooms may remain on one assigned site for five to ten years. A building can normally be relocated and ready for service at a new site in five working days. Estimated life of the buildings is 30 years (although some of the 1920 structures are still in service).

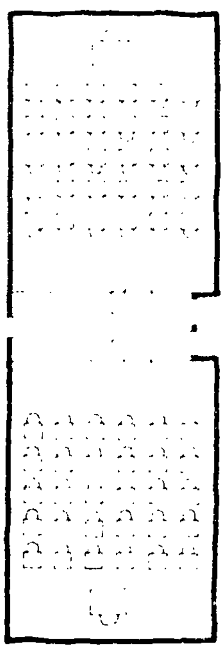
Walk-in wardrobe.

Revised wardrobe treatment.



(A) *Portable, 26½x71½ (double).*

(B) *Portable (revised), 26½x66 (double).*



St. Louis: Three variations on a 28'x32' theme

St. Louis, Missouri

(A)(B) *Demountable* (C) *Portable*

(A)(B)(C) *28x32 (per classroom)*

(A)(B)(C) *896 ft²*

(A)(B)(C) *876 ft²*

(A)(B)(C) *30-35*

(A)(B)(C) *25-29 ft²/student*

Heating (A)(B)(C) *Gas Furnace*

Ventilation (A)(B)(C) *Natural and Mechanical*

Plumbing (A)(B)(C) *None*

Utility Hook Ups Needed (A)(B)(C) *Electric, Gas*

Foundation (A)(B) *Full Concrete Slab* (C) *Block Piers on Blacktop*

Installed In Place Cost (A) *$11,000* (B) *$10,000* (C) *$12,000*

Cost Per Square Foot (A) *$12.25 ft²* (B) *$11.20 ft²* (C) *$13.30 ft²*

Site Preparation Cost (A) *$1,211* (B) *$1,502* (C) *$675*

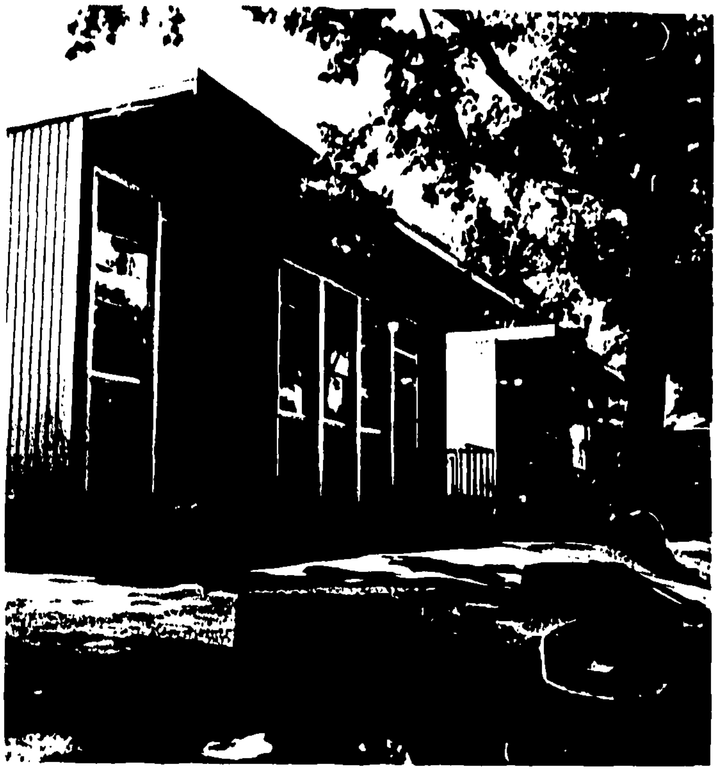
In the past five years, St. Louis School District administrators have been testing a variety of solutions to problems of growing and shifting enrollment. All agree that more permanent schools and school additions are needed in the long run. But what to do immediately? Should students from overcrowded schools be transported to classrooms (if available) outside their neighborhood districts; or should buildings be moved to the students?

Experience in transporting students has shown the process is costly. For several years. more than $250,000 of operating funds has been needed for bussing approximately 4,000 students from their homes to remote school neighborhoods (approximately $62.50 per student per school year). Furthermore, critics point out, the bus program removes the child from his familiar environment, is tiring to the student, and shortens his school day.

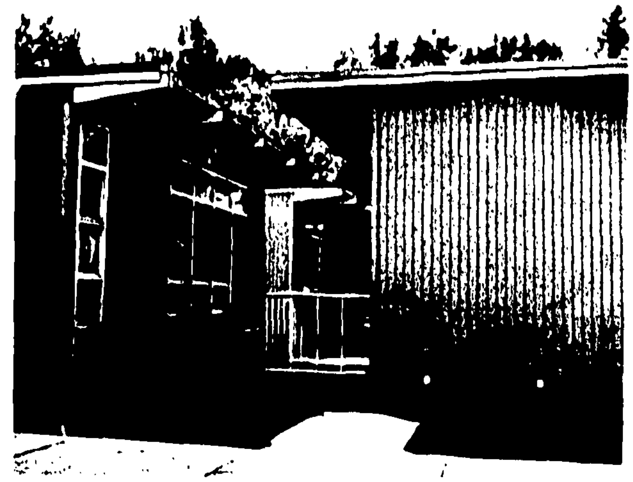
Three variations on relocatable building studies have also been undertaken. Beginning with a basic classroom size set at 28'x32', one portable building and two types of demountable structures have been installed. The portables are individual classroom stations; the demountables are either a double classroom unit assembled of pre-fabricated components. or a larger number of classrooms-in-tandem, utilizing a curtain wall building system. These variations are shown in the accompanying photographs. Complete details of facilities, costs. etc., appear on the chart.

Basic classroom interior, 28x32.

(A) *Demountable*

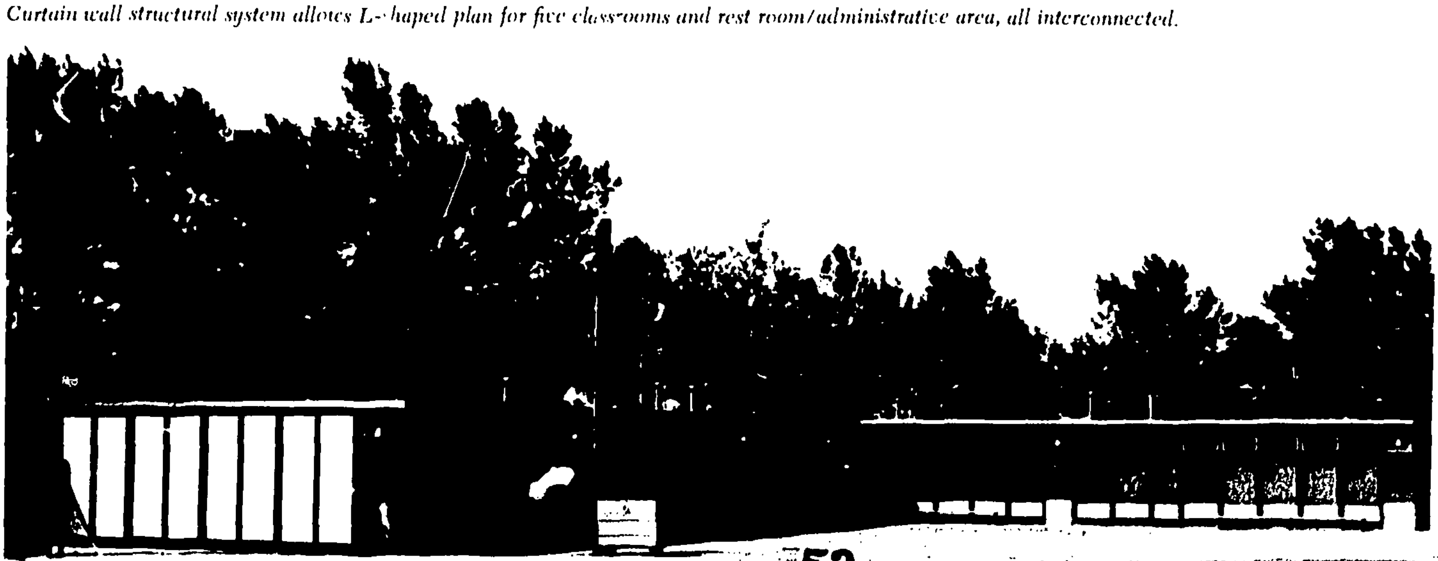


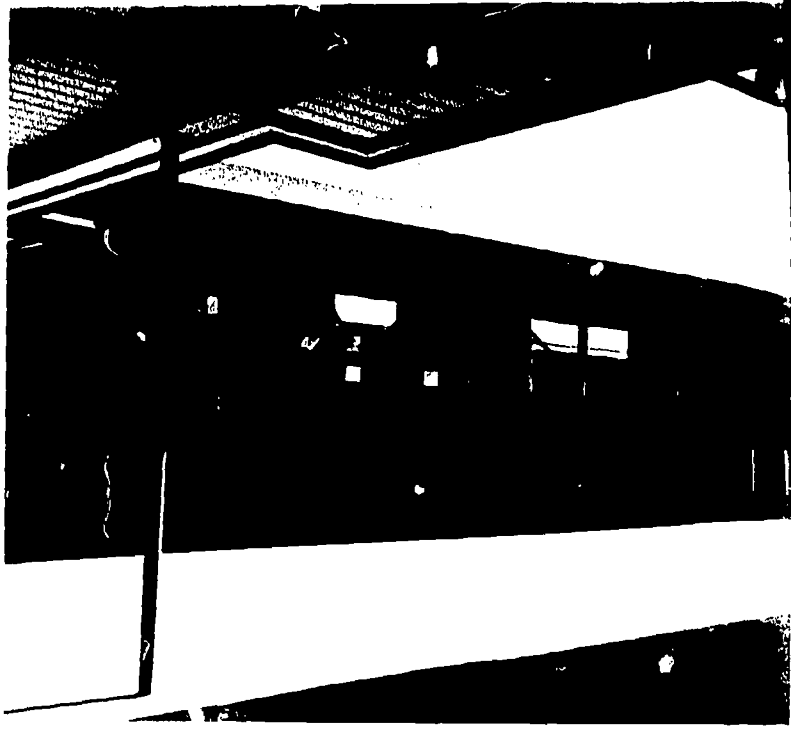
(C) *Portable*



(B) *Demountable*

Curtain wall structural system allows L-shaped plan for five classrooms and rest room/administrative area, all interconnected.





Approval or cancellation of military contracts for the many industries in the San Diego area can play hob with school enrollments as well as with tax-payer approval or rejection of the school building referendum. Portables, moved in single classroom sections, help fill the gaps in housing needs in the rapidly growing district

San Diego

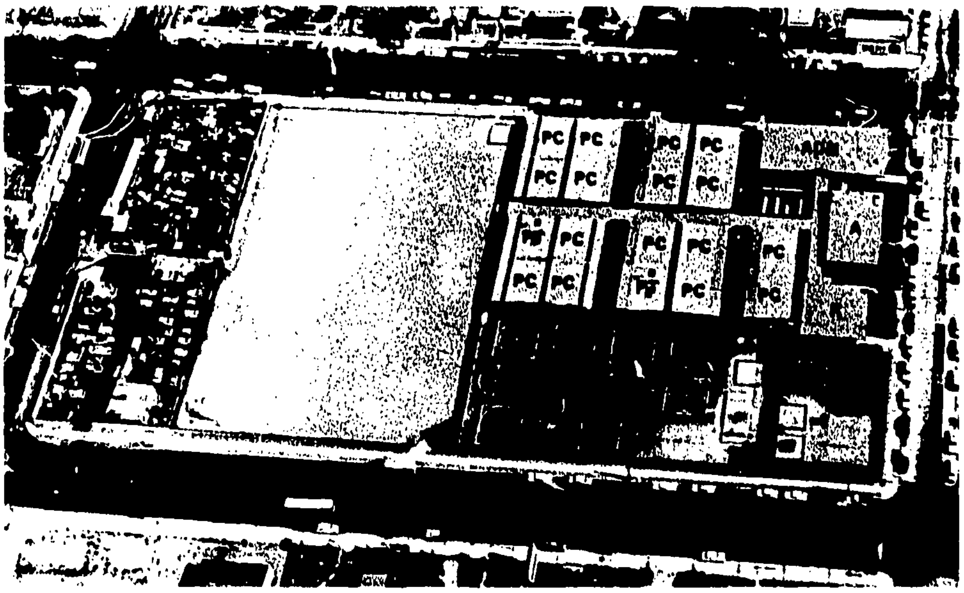
California: Portables are standard to school housing

The term "portable" has been in the vocabulary of California school planners since 1910. Today districts from one end of the state to the other consider relocatable housing as a standard part of their inventory of classroom space.

The greatest concentration of portables is in the warmer, drier, densely populated southern coastal region, rather than in the more thinly populated and damper regions in the northern portion of the state. Reports for the 1963-64 year show that approximately 27 per cent of all teaching stations in Los Angeles are portable; in San Diego, almost 20 per cent. In San Francisco the proportion is 6 per cent; in nearby Oakland, 25 per cent. In smaller communities such as Pasadena and the Grossmont Union High School District, less than 5 per cent of classrooms are portable.

The pattern of utilization of portables is obviously not rigid. As suggested, the temperate climate of the south caters to both the use and structure of portable buildings generic to the region—frame structures with stucco, lap siding, or wood panel exteriors; painted or stained plywood interiors; minimal foundation, or buildings set on mud sill or blacktop; minimal required heating units (often floor mounted or overhead space heaters); outdoor access from classroom to classroom, with need for only a rain or sun shelter.

When such large proportions of teaching stations in any one district are built to pre-determined specifications, it follows that that district enjoys the advantages of rapid approval of building plans and a shortened building timetable due to the familiarity of planners with building and contracting procedures. Advantages of mass purchase and mass production of 25, 50, or 100 identical units at a time also brings cost benefits. If the resultant "stock-plan-look" in the district is open to criticism, it is at least true that the needs for "instant schools" and reduced costs have been dealt with directly.



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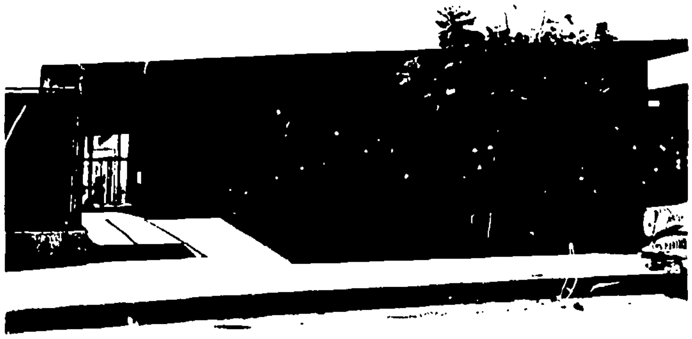
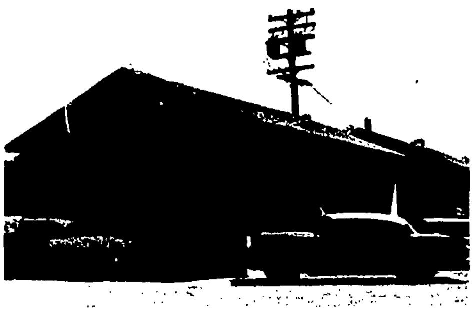
All classrooms (PC) *and the toilet building* (PT) *at Lowell Elementary in San Diego are portables; administration building* (ADM) *is permanent; assembly space* (A) *and kindergarten* (K) *are "semi-permanent"—relocated by dividing each into two or three sections. All construction is new except for the toilet buildings and 5 of the 17 portable classrooms, which were relocated from other schools.*

Special kindergarten space.



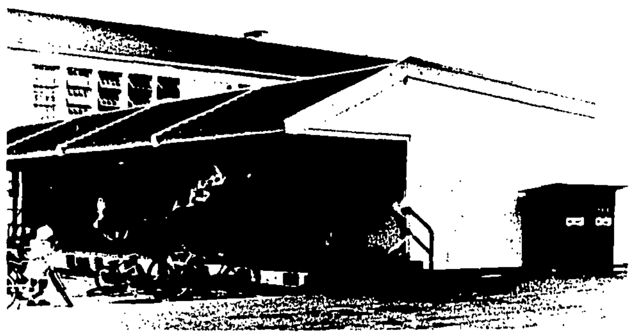
Deep overhang for shade and shelter.

Grossmont



Single-unit portables serve the nine schools in the Grossmont Union High School District near San Diego.

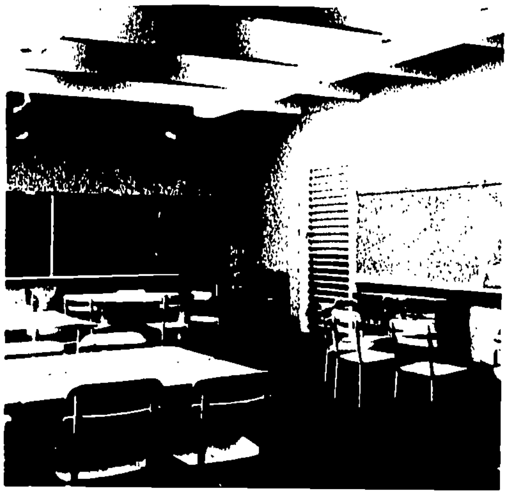
Pasadena



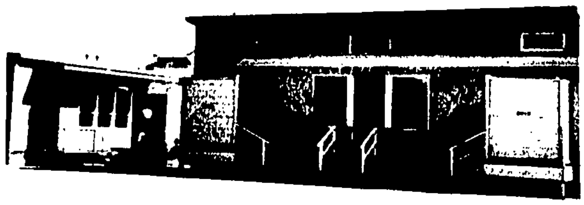
1955 model, portable classroom, double.

1961 model, portable classrooms-in-tandem.

Los Angeles

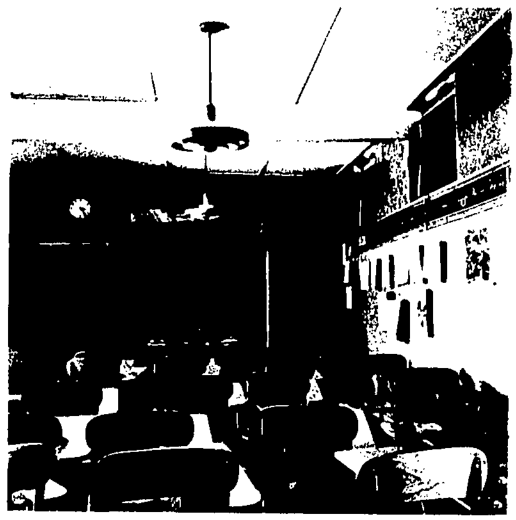


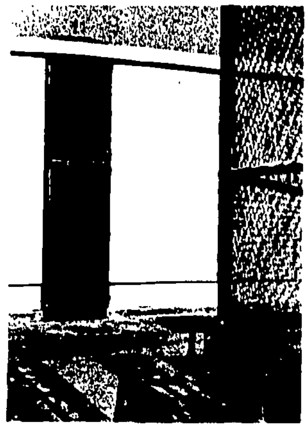
Basic Los Angeles portable classrooms (doubles) are stud frame with plaster stucco on wire mesh (no sidewall insulation) and plywood interior, $869 ft^2$ per classroom. Insulation is in roof structure. Portable toilet buildings (right) may include storage and janitorial space.



Oakland

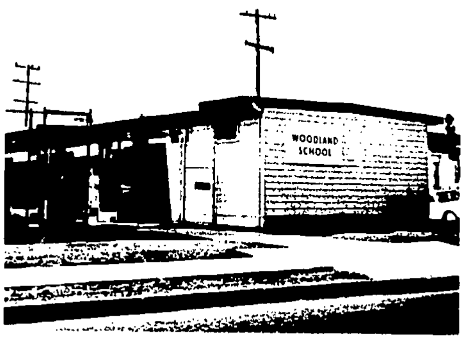
Latest models of Oakland's frame portables are a revision of models which have been used in this industrial district since 1910.





Space between buildings improves ventilation.

A total elementary school of portables includes covered walkways, double-unit for assembly.



Variation of the standard unit, adding stucco finish exterior and full landscaping, improves appearance considerably.

Upper Marlboro: Tests on three building types

Upper Marlboro, Maryland

(B) *Demountable* **(C)** *Divisible-Mobile*

(B) *22½x33½* **(C)** *20x35*

(B) *787 ft²* **(C)** *700 ft²*

(B) *762 ft²* **(C)** *675 ft²*

(B)(C) *25-30*

(B) *25-30 ft²/student* **(C)** *22-27 ft²/student*

(B)(C) *Forced Air Oil Furnace*

(B)(C) *Natural*

(B)(C) *None*

(B)(C) *Electric*

(B) *Full Concrete Slab* **(C)** *Concrete Piers and Blocks*

(B) *$8,302* **(C)** *$10,200*

(B) *$10.50 ft²* **(C)** *$14.50 ft²*

(B) *$800* **(C)** *$195-220*

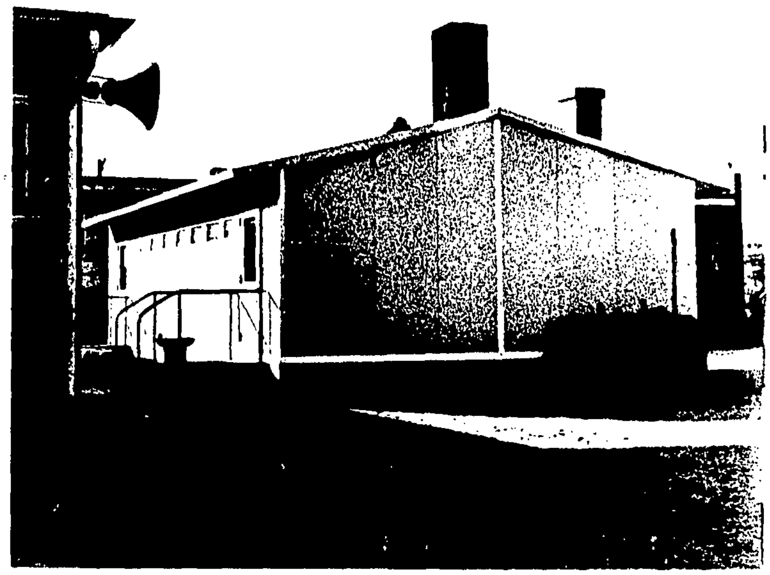
(B) *$105* **(C)** *$416*

(B) *$2,151* **(C)** *$1,259*

As the Washington, D.C., metropolitan area spreads farther each year in all directions, tangent county school districts are absorbing a steady increase of students. New housing developments are sometimes the equivalent of total new cities (see "New Suburbs —New Cities," page 8). The *expanse* of some of these once-rural counties compounds the problem of coping with enrollment growth itself.

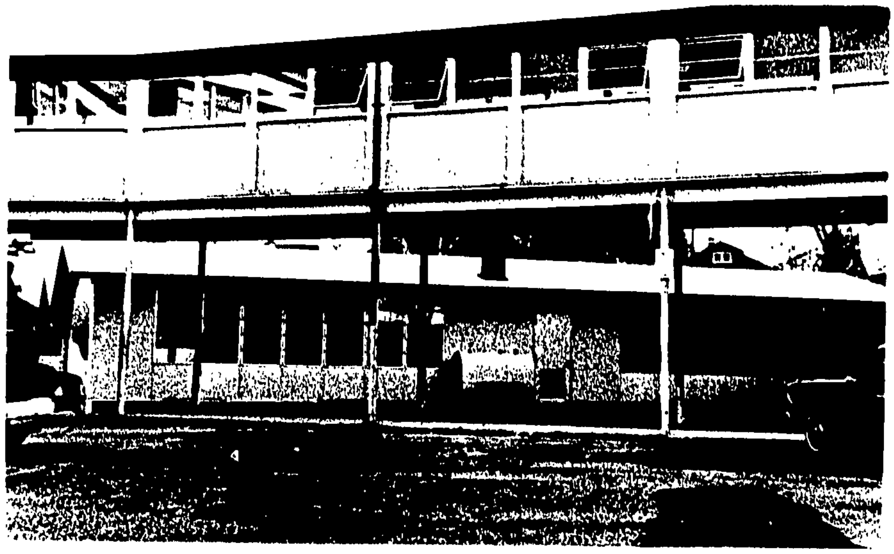
Prince George's County, Maryland, encompasses an area of more than 500 square miles of countryside, with 90,500 students scattered in 159 school plants. In such a loosely populated area, it has proven expedient since 1960 for the Board of Education, seated in Upper Marlboro, to use relocatable facilities to absorb overflow enrollments in some schools until a new school might be properly located and built. In the past four years, they have tested mobile units **(A)**, 11'x40'; demountable units **(B)**, 22½'x33½'; and divisible-mobile units **(C)**, 20'x35'. Mobiles were ruled out in the first year as being too long and narrow for effective classroom use. Demountable structures were adequate in this respect, but proved too costly to move (see "Relocating Three Different Building Types," page 23). Thus, at this point, it seems the divisible-mobile structure has proven most effective of the three types in this district.

Demountable and divisible-mobile structures produced by Panelfab Products, Inc.



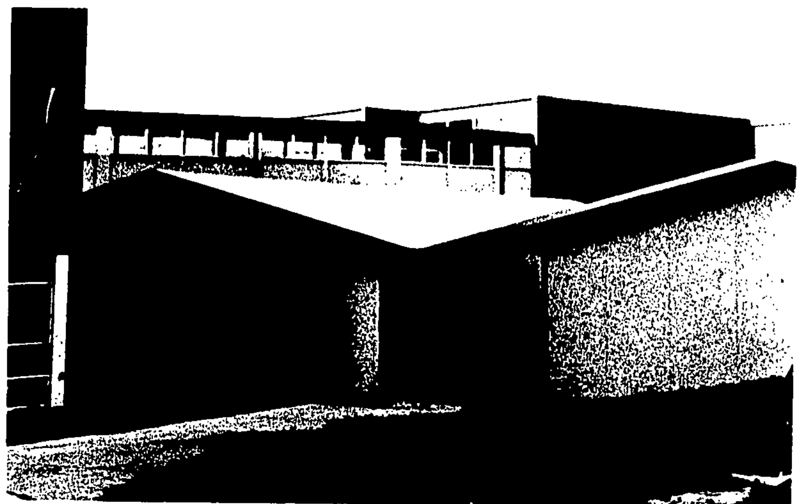
(C) *Divisible-mobile 20x35.*

Divisible-mobile interior.



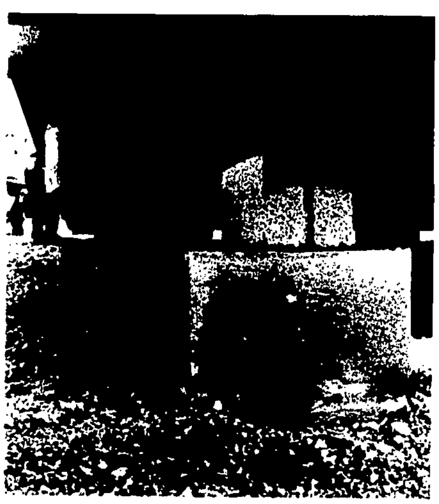
(B) *Demountable (double), 22½x33½ per classroom.*

"Free" corridor is gained by . . .



. . . butting overhangs of two buildings.

Storage or furnace area divides classrooms.



Foundation (C) *concrete piers and blocks.*

Oklahoma City: They design and build their own portables

Location *Oklahoma City, Oklahoma*

Type of Structure *Portable*

Size *24x36*

Floor Space *864 ft²*

Initial In-Place *$10,229*

Cost Per Square Foot *$12.00*

Site Preparation Cost *$1,531*

Unit Transport Cost *$220*

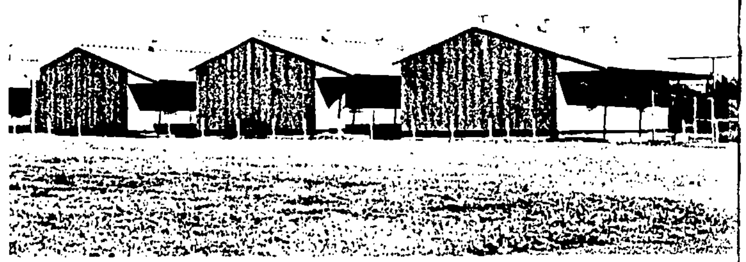
Unit Relocation Cost *$1,750*

(See chart for complete details)

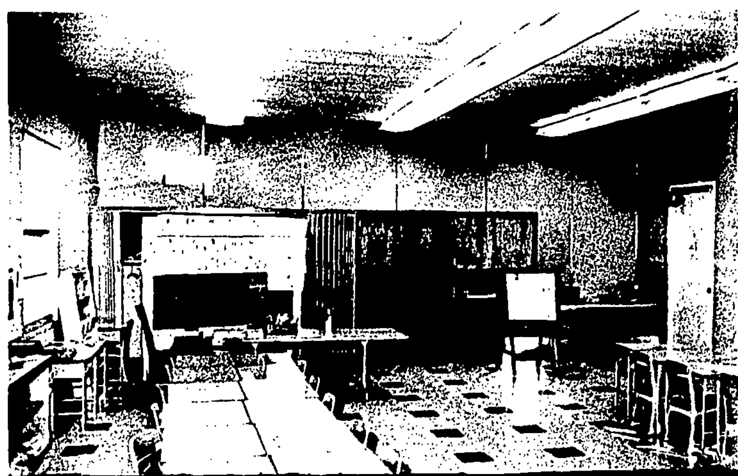
Oklahoma City's school administration had its first experience with relocatable facilities in the late 1940's, using surplus army buildings. They became convinced that the concept of relocatability was valid, but felt the frame structures were hard to heat and ventilate (windows too small), and involved high maintenance costs. In 1950 the school planners designed their first all-steel building, using their own staff (often including teachers) for construction during summer recess. Groups of units are first assembled in "production line" setup at one school site (perhaps on a large parking lot), and then moved to the assigned schools for final hook-up and installation. A shelter-overhang is added at the final site. Components are formed and pre-cut by the fabricator according to specifications. The only wood in the structure is the sub-floor and wall studding.

In 1962, a group of 28 units was built to a revised set of specifications, incorporating changes in some mechanical and lighting equipment to keep abreast of advancement in these fields. Another change was the shift to a baked enamel finish on exterior sidewalls to reduce maintenance costs which were considered too high with the galvanized or bonderized finishes previously used.

Units grouped in tandem on athletic field.



Units in rows on former parking lot.



Building system and components to specs by Armco Steel Corp.

Tulsa: Portables provide hedge against fluctuating enrollments

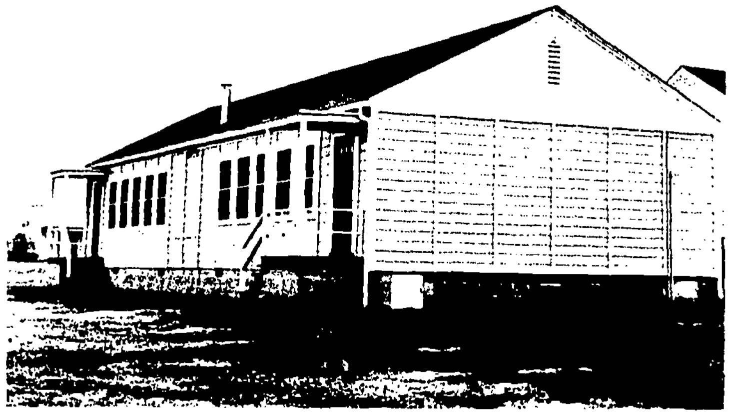
Location Tulsa, Oklahoma
Type of Structure Portable
Size 24x68 double)
Floor Space 816 ft^2 (per classroom)
Initial In Place Cost $6,000

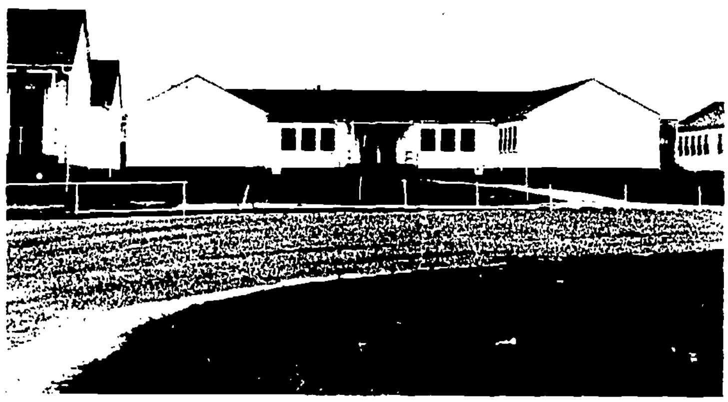
Cost Per Square Foot $7.35
Site Preparation Cost $1,187
Unit Transport Cost $125
Unit Relocation Cost $1,692
(See chart for complete details)

In the decade from 1946 to 1956, enrollment in the Tulsa Public Schools almost doubled, jumping from 29,732 to 57,241. To meet the increased needs for housing in both existing schools and in areas of new development, the supply of portable buildings was increased from 33 units to 415 units. School enrollments continued to climb to 73,544 for the 1963-64 session. But school authorities have found their 1956 stock of movable classrooms (approximately 16 per cent of their 2,620 teaching stations) adequate to hedge against problems of population shift and rapid growth.

The wood structures are staff-designed. Materials are delivered to the site in pre-fabricated, four-foot modular sections. Preparations of the site, utility hook-ups, and erection are all by the school's maintenance department. The buildings are not disassembled for transport, but moved in double-classroom units. Portables may remain on one site 8-10 years—are seldom moved in less than two years.

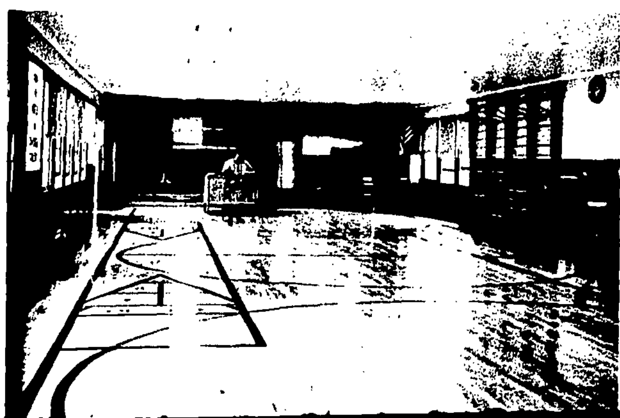
The exterior of most of the units has been treated in two colors, with white trim on sash and entry. Where a total school is composed of portables, several "links" in 24'x28' or 24'x48' sections may be used to provide rest rooms and administrative space. Two-classroom units are also often converted for library, gymnasium, and/or cafeteria space by removal of the center wall.



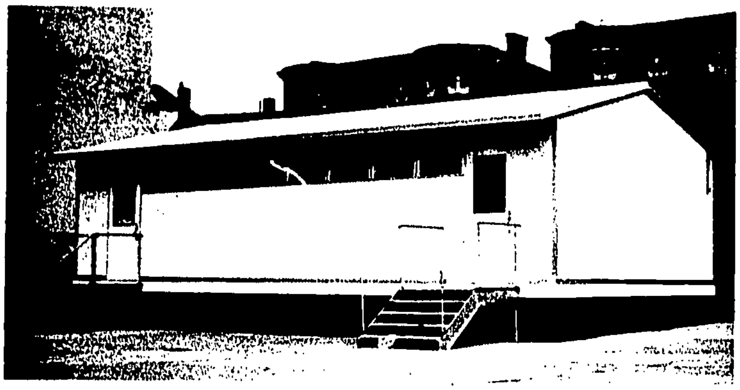


Double units "linked" for wing of total portable school.

Double unit converted for gymnasium use.

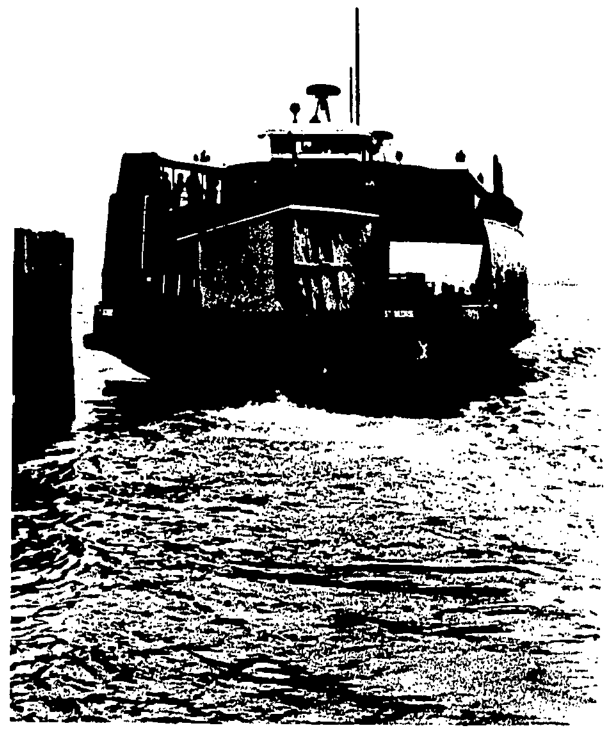


New York City: Classroom takes a ride on the ferry



In October, 1962, the City of New York Public Schools erected the model of a single-classroom, divisible-mobile unit in the play yard of Public School 1 in Queens. The prototype was designed to be moved in two halves, each 10'x35', and joined at the site to produce a 20'x35' classroom (700 ft^2) for 36 students. After studying time-for-installation and costs on a two-classroom, demountable unit with rest room facilities (see chart, (A)), officials determined that the single-classroom, divisible-mobile units would be built without plumbing (see chart, (B)). The single units are intended to be located close to the entrance of the school they serve so that students may have access to water and sanitary services inside the building.

A photographic report on the first move of the unit features a ride on the stern of the "St. George" en route from the Brooklyn side of the Brooklyn-Staten Island ferry. The move involved a ferry trip for each half, and ended at the site of PS 42 in Eltingville.

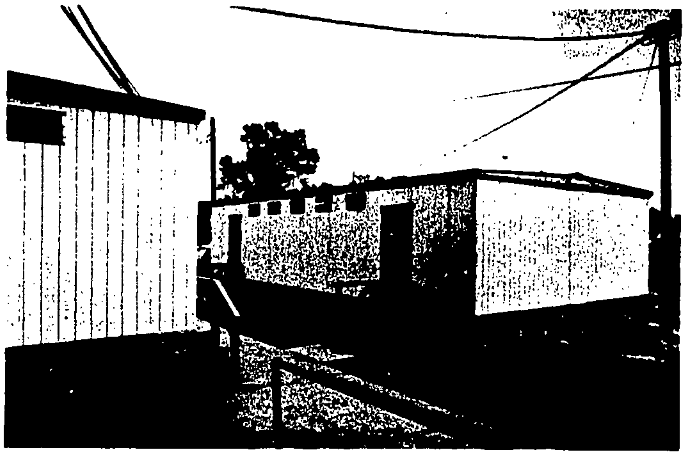


Model building produced by Panelfab Products, Inc.

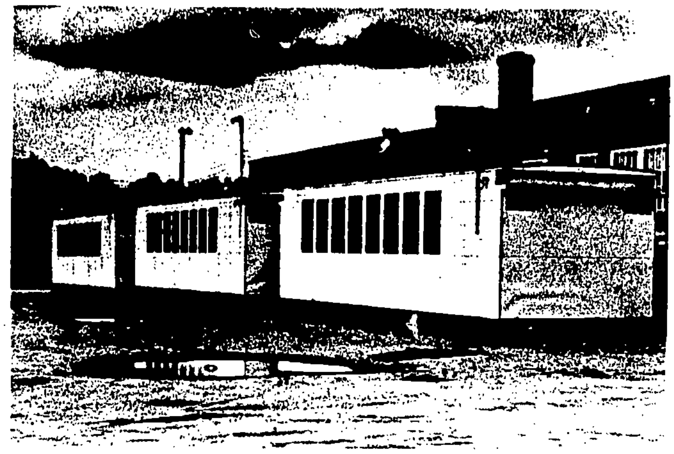
Richmond: Mobile classrooms "discourage permanence"

In 1959, the Richmond, Virginia, City Schools purchased a "fleet" of mobile classrooms—10 aluminum-skin trailers, each 12'x48' with steel undercarriage and custom interior. Superintendent Thomas C. Little reported: "Space, although at a minimum, will comfortably accommodate 30 elementary children. It is recognized by all concerned as a temporary facility, and with its high salvage value it should encourage rather than discourage permanent construction where such is needed." In 1962, to improve on the long, narrow dimensions of the original interiors, the Richmond schools supplemented their stock of mobiles with divisible-mobile units 20'x35' and 20'x42', with 40-45 students assigned to each. (See chart for details.)

Units constructed by Magnolia Trailer Co.



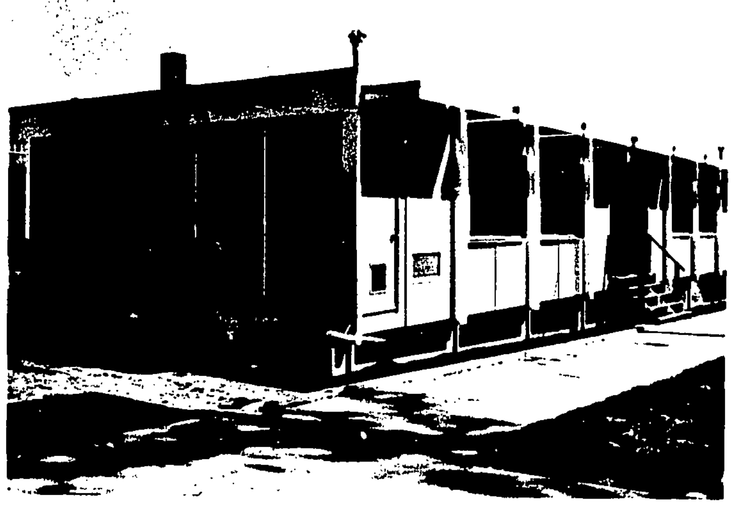
(B) *Divisible-mobile, 20x35 or 20x42.*

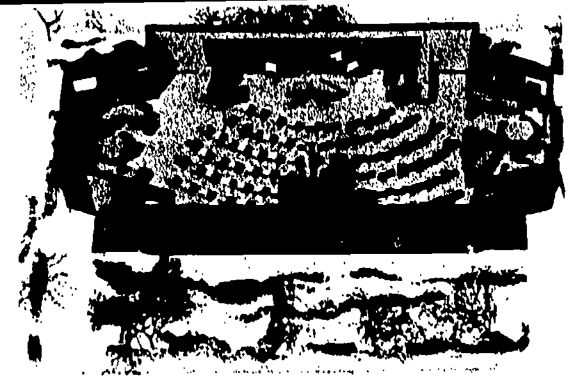


(A) *Mobile, 12x48.*

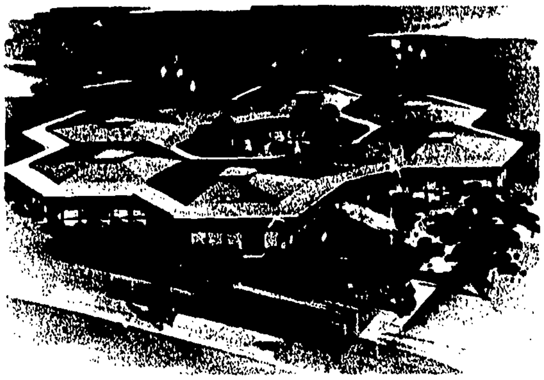
Cincinnati: New designs emphasize color

Faced with rising costs of maintaining and moving the barracks-like portables in use for many years, Cincinnati Public Schools officials designed a new, divisible structure introduced for the 1963-64 school year. Classrooms 24'x32' provide 720 ft^2 of instructional space for 30-35 students. The colorful, all-wood buildings can be moved in 8'x24' modules at an estimated relocation cost of $2,500 per classroom (compared to $5,600-8,100 to move the older-type portables).

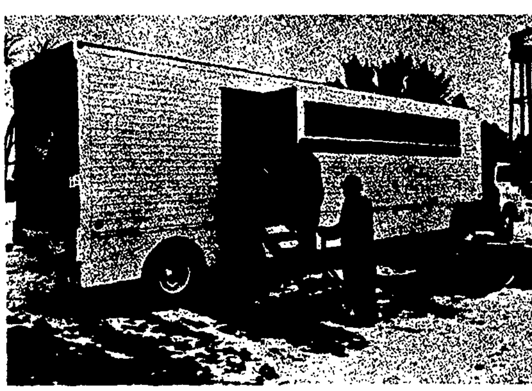


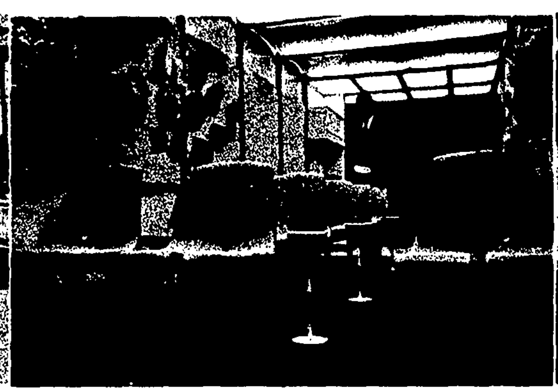


A double-classroom, portable unit laid out to accommodate large groups of 60-80 students or traditional groups of 30-40 students, has been taken from research studies by Los Angeles architects Fiel & Low and Associates and is being planned for production by FenCal, Inc., Los Angeles. The total structure is based on a steel modular component system; estimated cost target, $15 per square foot; 60-90 day erection schedule.



Hexagonal, demountable classrooms, each approximately 1,000 square feet (interior) are illustrated here as arranged for a court complex at the Gardena Elementary School in the Los Angeles district. The component system is produced by Pacific Curtainwall, Inc., of Long Beach, California.

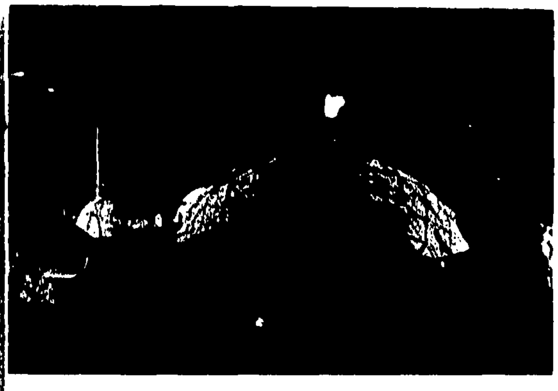




Industrial uses of travelling, mobile demonstration units suggest adaptations for more widespread application in public schools. The Ekco-Alcoa "Packaging Center" is a mobile display facility designed with unusual attention to taste and detail. The trailer is 8'x40' and 12'6" high; seats 15 in comfortable, stackable chairs; air conditioned; side and rear access; total luminous ceiling; built-in projection equipment; walnut-paneled interior; display walls and shelves.

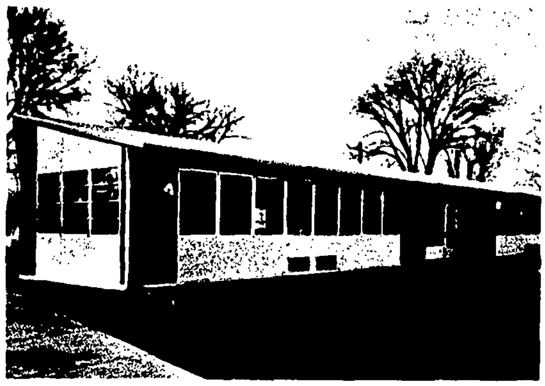
Michigan Bell Telephone uses a modified trailer home as a mobile trainer unit for plant construction forces. Accommodating 20 students at a sitting, the "one-room schoolhouse on wheels" carries equipment valued at $10-15,000 to student audiences throughout the state.

A divisible system of classroom transport and construction is being pushed one step farther —or one floor higher—by American Modulux Division of American Standard Cargo Container, Hayward, California. A 1964 experiment saw the 10'x32' modules stacked atop each other to produce a two-story, relocatable structure.

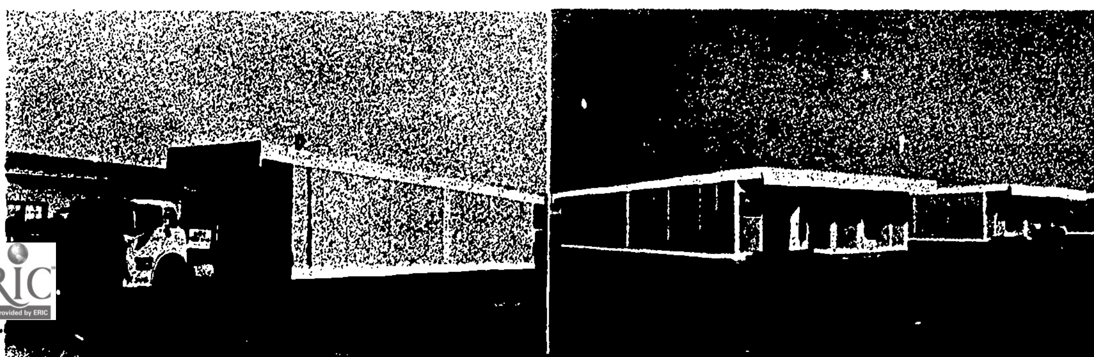


A proposal by Synergetics, Inc. of Raleigh, North Carolina, suggests helicopter transport of geodesic domes from school to school as classroom needs fluctuate. Also incorporated is the use of a large dome, open at the base, to serve as a sheltered commons area for satellite dome classrooms linked in pairs.

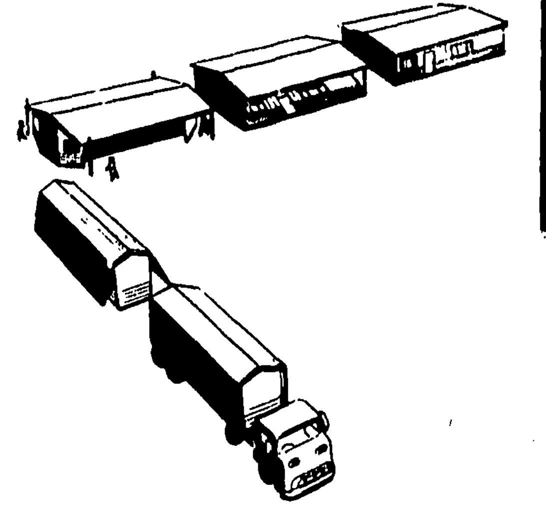
A break from the traditional "box", this demountable, double-classroom unit in Wayne, Michigan, features recessed center entry to both classrooms and unusual prow-shaped ends. Set on a full concrete slab, the duplex encloses 1,683 square feet, including toilet facilities. Exterior features yellow, white and red panels. Produced by Panelfab Products, Inc., Miami.

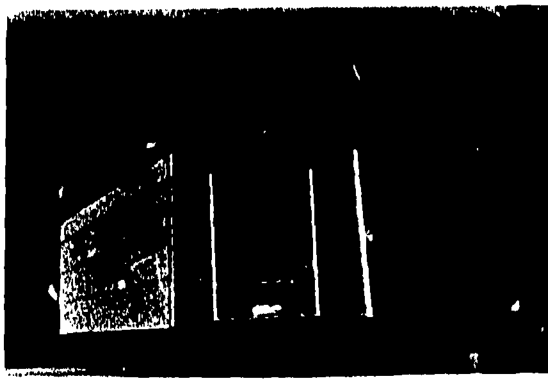


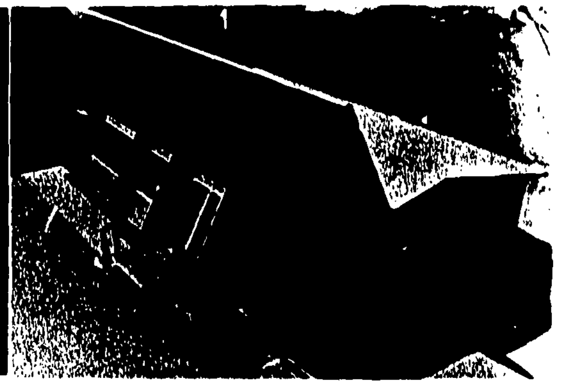
The Mobile Book Fair is a recent innovation by paperback distributors to bring a total library of 20,000 books right up to the entrance of a school. The trailer remains on its own wheels, is held firmly in place by stabilizing jacks for a period from a few hours to several days, according to the needs of the students and the desires of the teachers and administration.



A variation on the divisible-mobile structure is the double unit illustrated here. Each of three steel-frame sections is 10'x60'. When joined at the site, they produce two classrooms, one behind the other, each approximately 30'x30'. Developed by Mobile Rentals Corporation, Los Angeles.

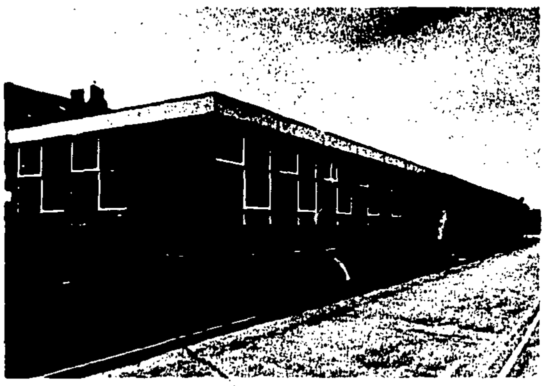


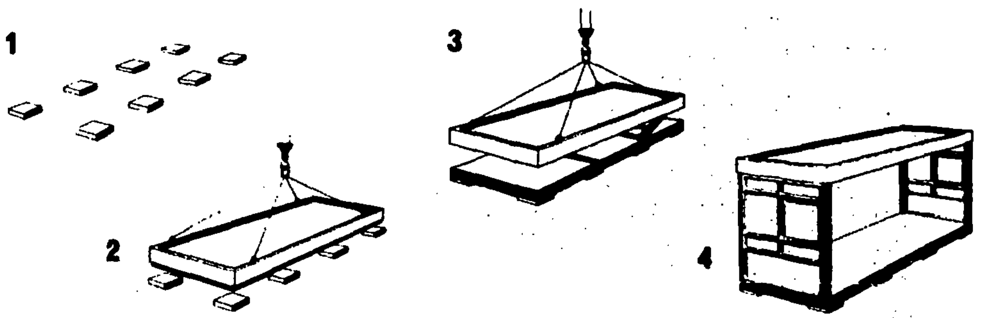




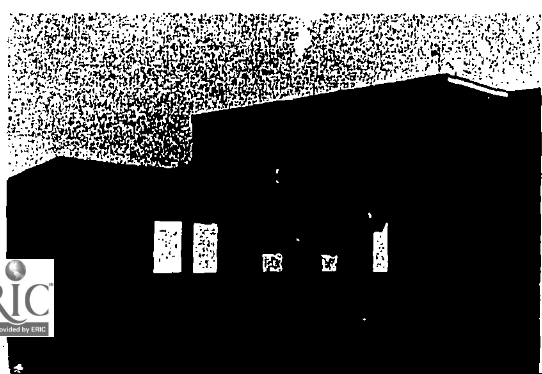
The concept of a completely contained, folding building was translated as a classroom by Transa Structures, Inc., Fullerton, California, several years ago (sketches, left). Further adaptation of the concept to produce a relocatable house for the Defense Department and use of the U.S. Air Force was under the direction of architect Leon Lipshutz of Carl Koch & Associates, Cambridge, Massachusetts. The model of the Air Force unit (above) illustrates how the factory-finished, factory-equipped building is hauled to the site as a 10'x44' package, then is unfolded to a 26'x44' structure.

The Terrapin Pack Unit Building System, developed in England, offers still another approach to building relocatability. When erected, the structure is composed of modules of approximately 25' span and 8' or 10' width. The unique system of folding each module allows shipment of the building in flat packs, nested one atop the other for transport. At the site each pack is set on pre-prepared footings, floor component is released, and wall panels hinge down as the roof is raised. A wide variety of wall panels is available and, if desired, the floor may be omitted. Produced by Terrapin, Limited, Denbigh Road, Buckinghamshire, England.

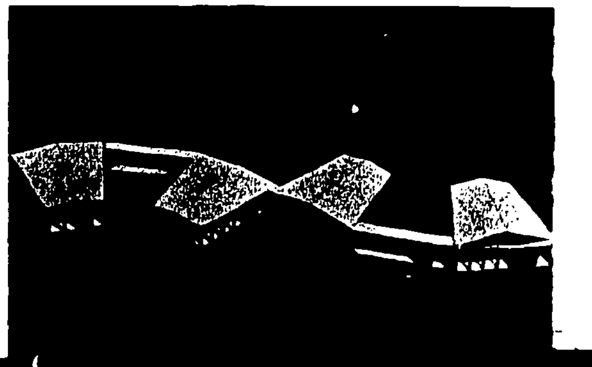


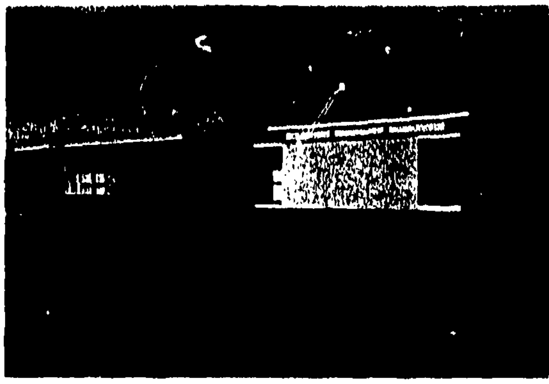


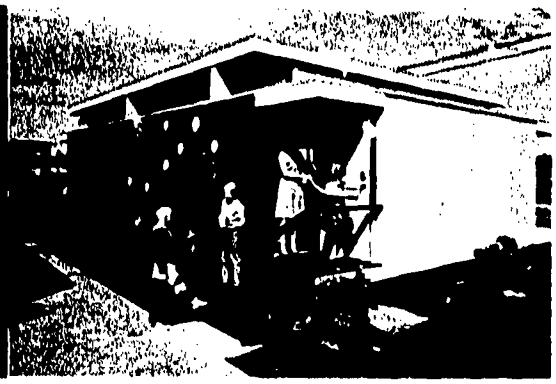
The first prototype of a new divisible building designed by Chicago architects Buderis and Sunshine for Modern Space Facilities, Inc., Northbrook, Illinois, was erected in March, 1964, at San Remo School, Kings Park, Long Island. The 8'x25' or 8'x31' segments can be combined for a wide variety of space layouts, placing utility cores, entries, etc., where desired.



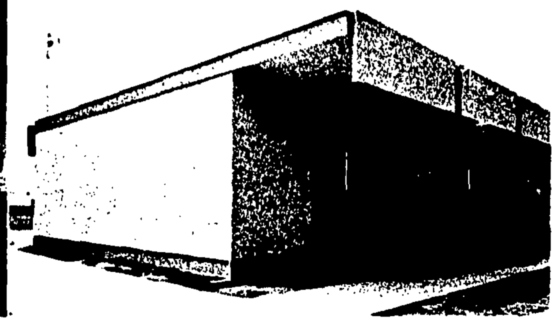
The unusual wedge shape of the all-wood portable classroom plan prepared by architects Zejdlik and Harmala of Minneapolis not only enhances the function of the educational space, but allows for interesting arrangements of buildings on school sites, even with sloping land contours. The units can be placed to form straight lines, curves, circles and serpentines with single or double loaded corridors.



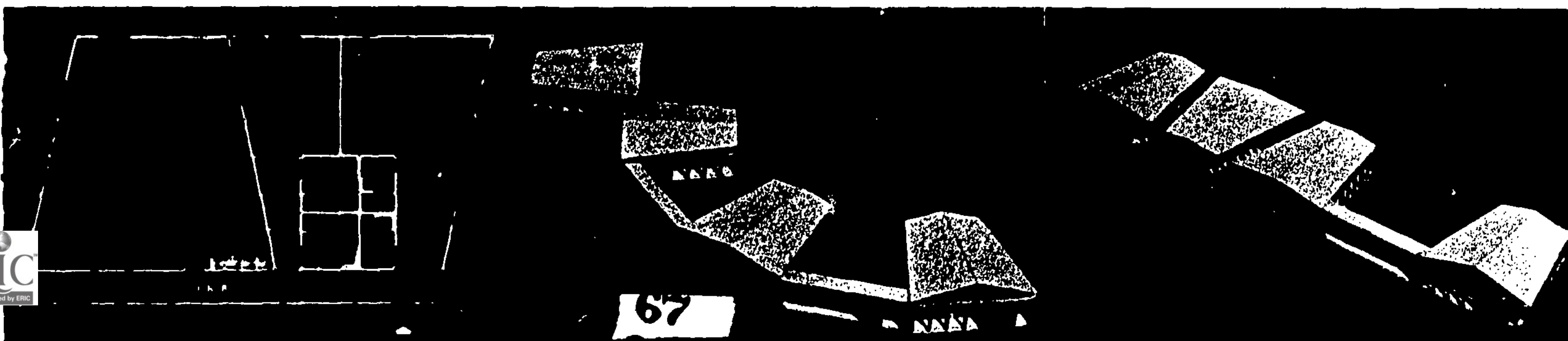




Complete plans for a 24'x40' supplementary classroom are available from the American Plywood Association, 1119 "A" Street, Tacoma 2, Washington. The portable building illustrated can be built by conventional construction techniques or by a system of combining pre-fabricated components.



A divisible system of steel components in 10'x31' modules, with extended 8' and 2'6" overhangs, has been developed by Los Angeles architects and engineers, Wexler & Perlin-Boggio. The prototype installation, produced by Caine/Perlin Company, is shown at the Alamitos School District in Orange County, California. A standard classroom is comprised of three modules, totals 910 square feet. Smaller or larger spaces can be assembled by adding or subtracting modules.



A Plan For the Future

Many communities have used relocatable classrooms as an answer to the need for growth and for rapid adjustments in school housing to meet population changes. The most serious criticism of these units (aside from the fact that often they lack design quality and appropriateness) has been their physical isolation from the main stream of activity in the parent school and their isolation from each other. Often this isolation limits the amount of space and facilities provided for students and teachers in these self-contained schoolhouses to the single classroom.

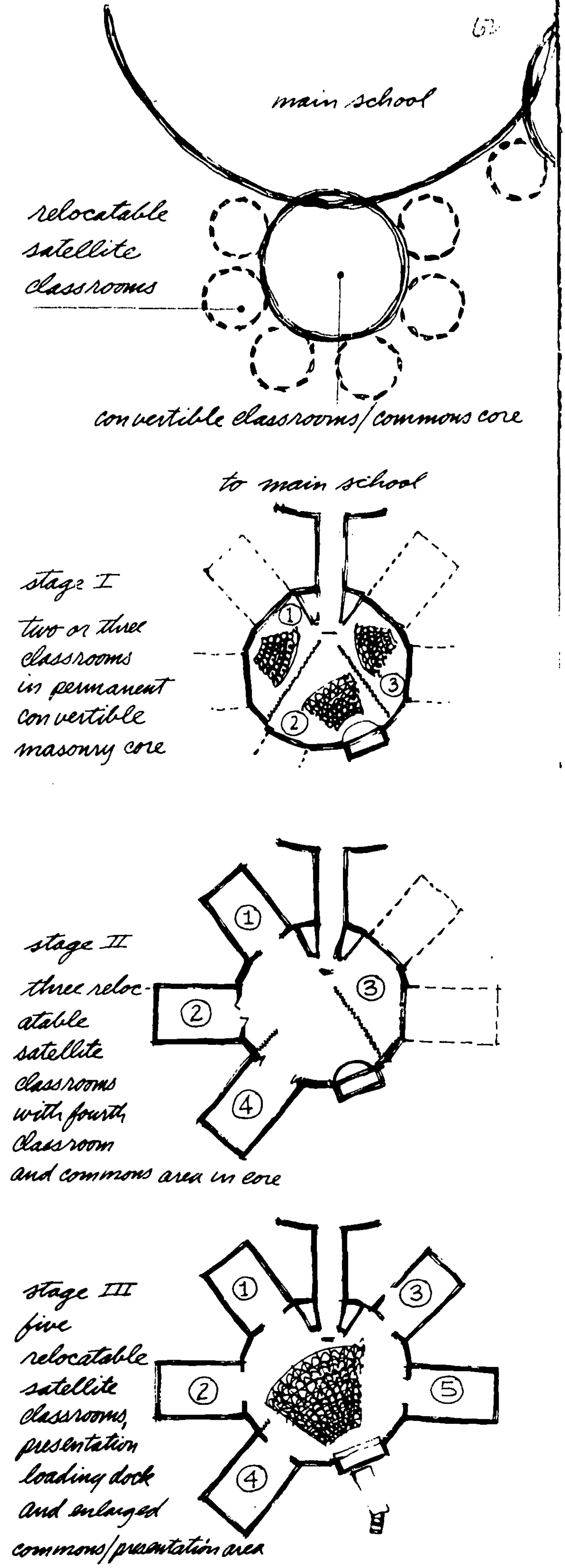
There are ways that these problems can be overcome. One approach is illustrated in the sketches that follow. They suggest relocatable facilities that are more than a substitute for the real thing, that offer a flexibility in school planning and utilization difficult to achieve through traditional planning and building methods.

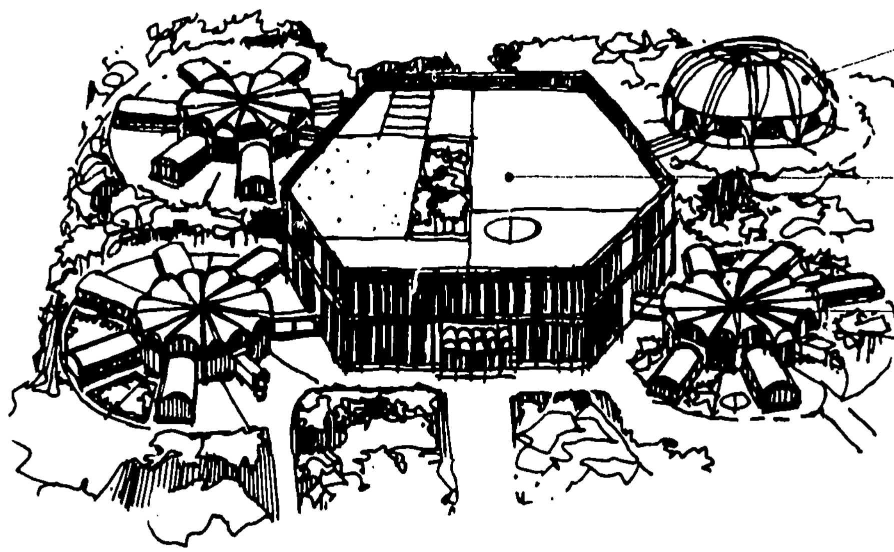
Key to the plan is the convertible classroom/commons core—a permanent part of the main plant, containing all utility leads and ready to accept growth through addition of plug-in, relocatable spaces as required. Until additional space is needed, the core itself houses several classrooms and shared demonstration facilities. As space units are added to the perimeter, the core fills the need for supplementary space adjacent to the new teaching stations. The relocatable spaces as defined here need be little more than easily moved, handsome, structural-shell segments. Plumbing, utility leads, even the heating plant could be permanently located in the main core.

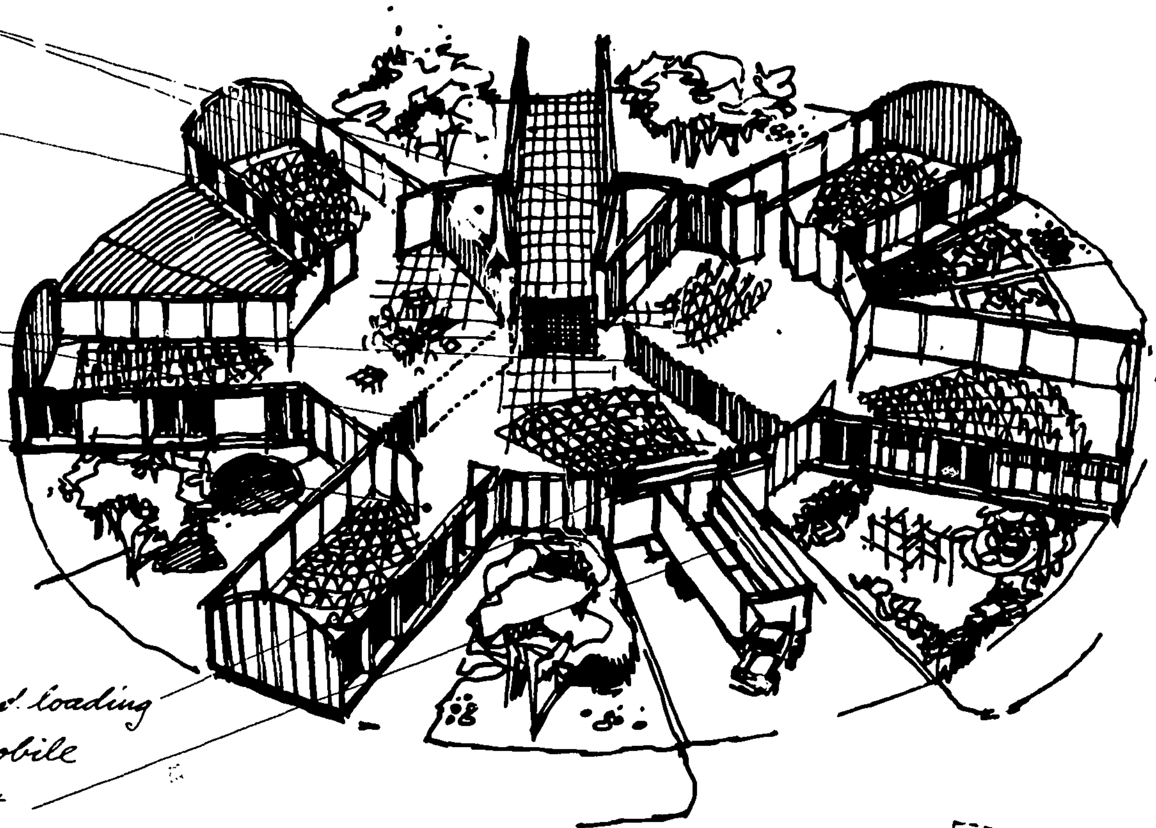
Spaces of varying sizes might ring the core, being changed as the teaching program changes. Truly mobile facilities (remaining on wheels) could bring laboratory equipment, visiting libraries, planetariums, or special demonstrations to the loading dock of the presentation area for an hour, a day, or a week. If enrollment at the school drops off, the relocatable spaces might be withdrawn to another school within the district or in a neighboring community with a similar receiving core and with similar growth needs.

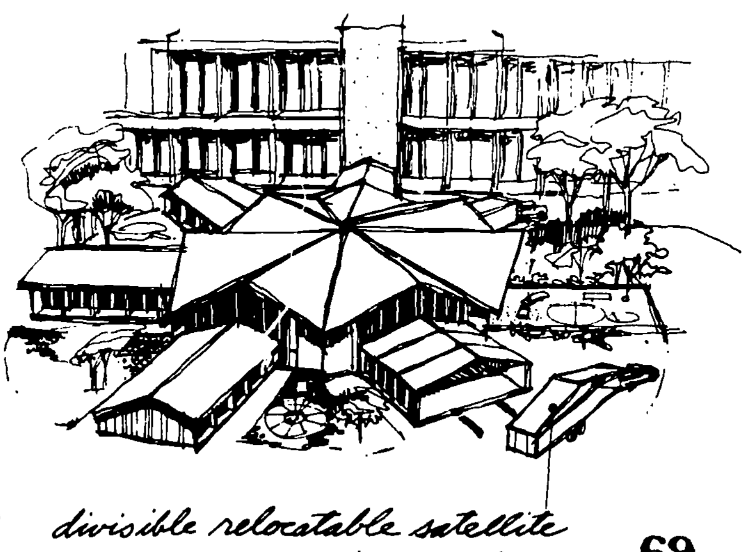
Conclusion

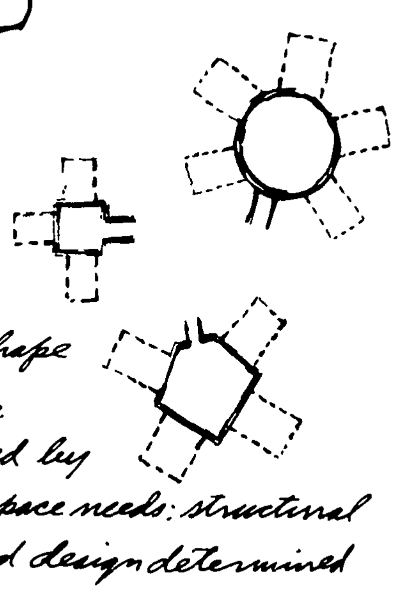
Relocatability has a place in school planning for the years ahead. It fills a need now and will continue to do so. This report has covered the subject of relocatable structures today. Some of them are quite good; others, unhappily, are less satisfactory. All have been built to try and deal with the pressing educational problems of communities across the United States. If this report clarifies the subject and stimulates superior relocatable buildings for education in the future, it will have served its purpose. —Frank Carioti




permanent auxiliary space; auditorium, field house, etc.
main school
convertible masonry core with relocatable teaching areas spaced 10' apart or to meet fire codes.


counseling, resource areas, or...
relocatable teaching spaces
operable walls to sub-divide commons core
acoustical flooring; operable walls or fire walls to meet needs and code requirements
presentation area and loading dock to receive mobile demonstration unit


divisible relocatable satellite spaces


size and shape of core are determined by projected space needs: structural system and design determined by the architect.

Publication and Photo Credits

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Pages 24-35 Illustrations, Emerson Fortaple [illegible]

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Page 3 Ted Williams.

Page 11 1930's, Courtesy Los Angeles Unified [illegible]

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Pages 28-29 Ted Williams; installation [illegible]

Pages 30-31 Ted Williams.

Pages 32-33 Two installation photos (bottom) [illegible]
building photo (bottom, right) [illegible]

Pages 34-35 Ted Williams.

Page 36 A. Church.

Page 37 Two installation photos (top, right) [illegible]

Pages 42-43 Munley Commercial Photography [illegible]

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Page 48 The move and classroom [illegible]

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