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SCSD: An Interim Report.
Educational Facilities Labs., Inc., New York, N.Y.
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Descriptors-Air Conditioning, Ceilings, *Component Building Systems, *Facility Guidelines, Lighting, Roofing, *School Construction, School Design, *Specifications, *Structural Building Systems

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# SCSD
# An Interim Report

School Construction Systems Development

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# SCSD
# An Interim Report

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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EFL

The SCHOOL CONSTRUCTION SYSTEMS DEVELOPMENT Project was set up by EFL to develop a group of standard building components in order to satisfy three objectives: to build better schools; to build them more economically; and to build them more rapidly.

The SCSD Project involves 13 California school districts, 10 architectural firms, 22 separate building projects, and some 2 million square feet of school space costing an estimated $30 million. The project is administered by the Stanford University School Planning Laboratory, EFL's Western Regional Center, under a national Advisory Committee of architects and educators.

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# THE PROJECT

On December 10, 1964, EFL's Board of Directors met in a small, quietly elegant building on the Stanford University campus. The next morning the Board Members entered the building to find themselves in a large, glass-walled room distinguished primarily by the fact that it hadn't been there the evening before. The changes which occurred in the building the night of December 10 (see photo above and drawings on page 4) constituted the first real test of whether the SCSD component system really provided the flexibility for which it was designed. That night:

1. 120 lineal feet of double-wall partition was removed, 25 lineal feet was installed, and 80 feet of partition face was removed and replaced.

2. 300 square feet of the ceiling-lighting system was moved, and one coffer rewired.

3. Seven air-conditioning zones were reduced to five, two thermostats were removed from the building and one moved; and the building was cleaned up.

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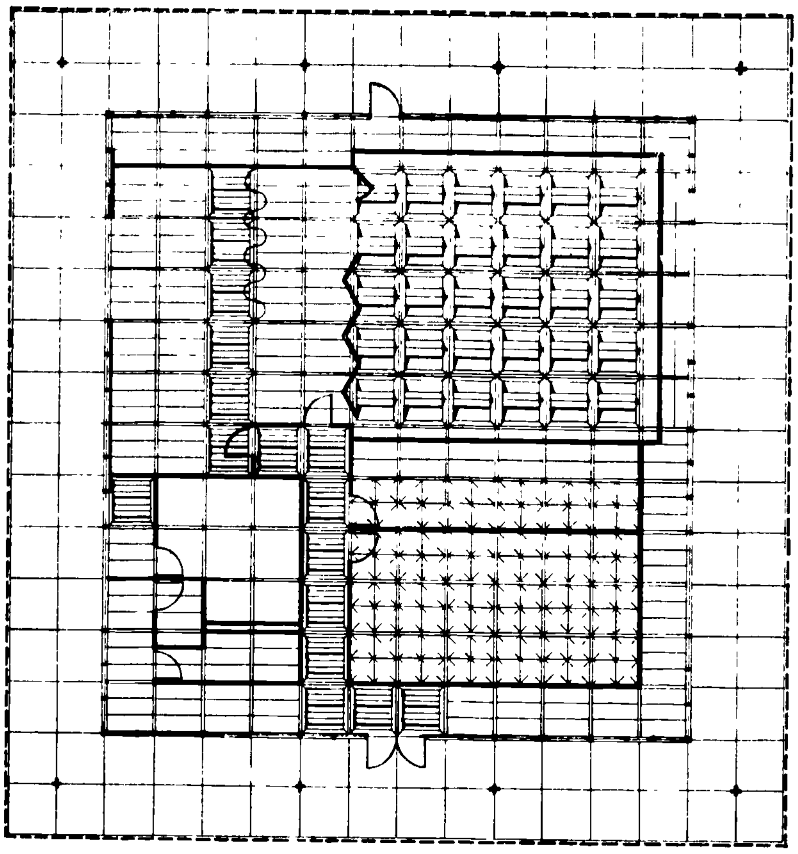
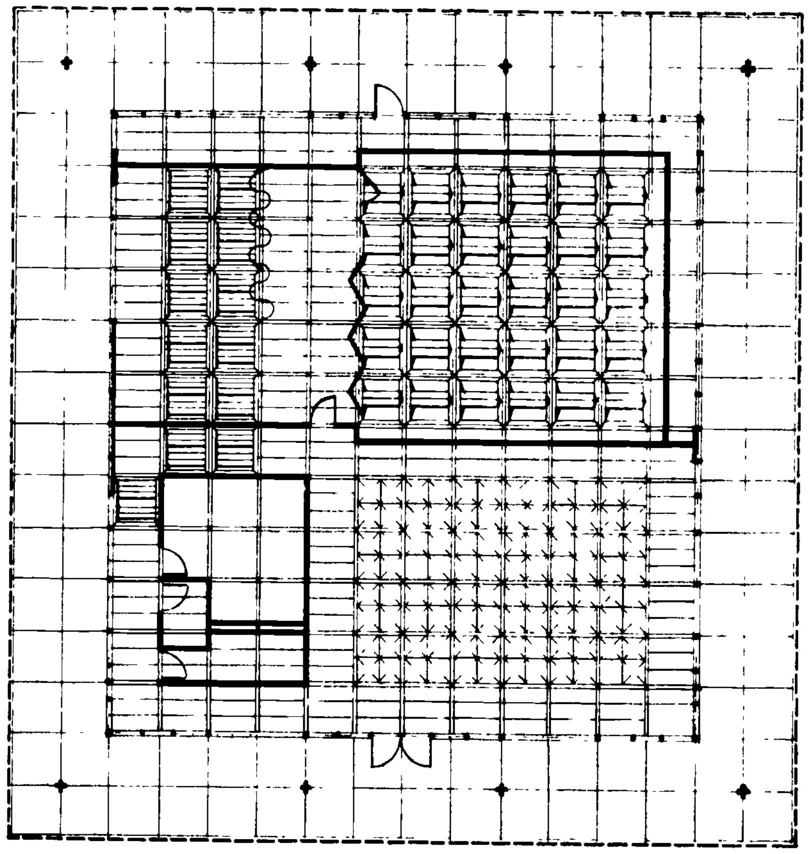
**All photos except p.7 by Rondal Partridge**



**BEFORE**



**AFTER**

All in all a substantial renovation, but it required only 59 man-hours: 48 on moving partitions, 6 on ceiling-lighting work, 2 on the air-conditioning adjustments, and 3 for clean-up. It was the first test of SCSD's ability to meet the number one criterion for today's schoolhouse: flexibility. As Project Architect Ezra Ehrenkrantz commented after early talks with educators, "All schools want to change space in some way in every year ... if nothing else were contributed by the project, a system of demountable partitions (designed specifically for schools) would be a significant step." In fact, the project has contributed a system in which all components, structure and services as well as partitions, are designed on the premise that walls can and will move - over a summer or a weekend, between terms or between classes, even overnight. The result is near-total flexibility in arranging and rearranging interior space, without compromising the quality of the physical environment.

There are, of course, other criteria the SCSD building system must meet within the budgets of the schools committed to using it, and no final verdict on the system can be given until they are up and operating. The quick-change artistry displayed in the mock-up is a valuable addition to the growing collection of evidence that SCSD will live up to its promise of providing better value for the school building dollar. But for the moment, the project's significance lies not only in what it has accomplished, but also in how and why.

## The Industry the Industrial Revolution Passed By

The why of SCSD is apparent in the gap between the increasingly complex, constantly changing demands being made on our schools, and the ability of traditional building practices and products to meet them. New teaching methods and equipment call for new ways of arranging new types of instructional space. Changes in curricula, teaching techniques, organization, and grouping of students and staff, require corresponding changes in buildings. And change is beginning to be recognized by educators as a continuing part of the educational scene. Upgraded educational standards point to an upgraded environment - good lighting, effective sound control, air conditioning, even carpeting. At the same time, the student population grows and shifts; budgets remain tight. In short, we are asking for more variety, greater flexibility, higher quality, and lower costs - a combination the schoolhouse can seldom provide.

Collectively, schools form a building market second only to housing; but because they are built one at a time, schoolhouses do not offer the manufacturer enough volume to spur product development to meet new educational requirements. As a result, school architects must select from products which were developed independently, often for other building types, and therefore do not fit perfectly either the school's physical needs, its budget, or one another. Too much of the architect's time is spent fitting together bits and pieces of material, instead of grappling with vital problems of program and design. And often no amount of time or effort can make standard catalog items conform to special educational needs. The choice is reduced to makeshift performance with make-do products, or cutting over-all plant quality in order to pay for a few costly specials.

By 1961, when SCSD was established, it was abundantly clear that such procedures - inefficient educationally as well as economically - were not the best answer to the demands of a decade in which taxpayers would buy $27.3 billion dollars worth of primary and secondary public schools, and in which change would be the only constant. And it was becoming evident that current attempts at reform - stock plans, pre-fabs, portables, and the like - offered only limited solutions and were winning only limited acceptance. Certainly, no latter-day Henry Ford was in the offing, ready to start rolling identical schoolhouses off an assembly line, nor were there any large numbers of school boards ready to order stock schools by mail.

But the lessons Ford taught auto manufacturers about the relationship between volume and standardization and profits had not been wholly lost on the building industry. In buildings, as in cars, the item picked from a standard catalog is cheaper than a similar item made to order; 1,000 identical items cost less per unit than the same item ordered singly. This knowledge is even applied where volume of construction, in units or dollars or both, warrants. Thus, a Levittown or the New York headquarters for the Chase Manhattan Bank might return the cost of developing a new type of door hardware; a single school project would not.

The British, however, have successfully applied mass production techniques to school construction since the end of World War II. When critical shortages of building materials and site labor - as well as a critical shortage of schools - suggested the industrialization of school construction, they came up with several versatile "erector sets" of prefabricated components. Groups of school customers (consortiums) were organized which could guarantee markets big enough to support the development work and tooling costs required by a factory-made system. The component approach has since been used for some 20 per cent of Britain's school building. Building costs were held down during the post-war inflation, construction time was cut, and a higher proportion of teaching area per school has resulted. The systems provided planning freedom and some design freedom for architects.

It seemed sensible to suppose that the same principles - standardized but versatile components and a large, guaranteed market for them - would work here, and that the English systems might even be improved on. So when the Board of the East Side Union High School District (San Jose, California) agreed to build three proposed high schools with a component system developed to meet its needs, EFL set up SCSD to give the building system approach a full-scale trial.

The first discovery of SCSD's professional staff, led by Dr. James Laurits, the Project Coordinator, and Ezra Ehrenkrantz, Project Architect, was that the how of a systems approach to secondary school construction was by no means as clear-cut as the why and the what. While sounding out manufacturers, Mr. Ehrenkrantz quickly learned that the available market - East Side's three high schools at $4½ million - was not big enough either to produce the desired savings or to stimulate any real research and development work by prospective components fabricators. Enlarging the market meant opening the project to other school districts, which in turn meant that the components-to-be would have to satisfy the needs of not one district and one or two archi-

An example of England's pioneering work with building systems, this two-story school used the CLASP (Consortium of Local Authorities Special Program) system developed by the Nottingham County Council and its architects.

tects, but many. This required devising procedures to enable the several districts to act as a single customer.

The SCSD project was no longer a simple test of the feasibility of using standard components to cut construction time and costs for a single enterprising school district. It had evolved into a four-pronged attack on the status quo of school construction:

1. Developing new products designed specifically for schools.

2. Encouraging manufacturers to work together so that their products would constitute a system.

3. Guaranteeing a sufficiently large market for the products.

4. Finding a satisfactory way to bring products, producers, and purchasers together.

Preliminary discussions with manufacturers of building components had indicated that the construction volume needed to interest them in developing new products to meet specific SCSD requirements would be about $25 million or more, and that their interest would depend on the number of typical projects represented as well as on total dollar value.

So the first order of business for SCSD was stimulating the interest of enough forward-looking school districts with enough building scheduled within the project calendar (all schools will be completed by 1967) to provide the required construction volume. Dr. Laurits and Mr. Ehrenkrantz traveled widely in California, explaining the project to a number of school boards throughout the State who had shown interest in it. Within six months, 5 school districts joined the project. By the end of SCSD's first year, the roll had expanded to 13 districts with 22 schools comprising an estimated building volume of $30 million - well over the required minimum (see page 31 for a list of participating districts and their architects). These 13 districts could,



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and did, under California law, join together to do what they are authorized to do separately. The formal legal agency through which the group acts is the First California Commission on School Construction Systems (see inside front cover) which asked for and received bids on the components.

Meanwhile work on the project continued with manufacturers, architects, educators, state and county officials - everyone, that is, professionally concerned with the construction of new schoolhouses in these 13 districts. By mid-1962 the feasibility of the project was officially recognized and the staff expanded from two to seven. With assistance from an active and interested Advisory Committee, procedures that might best accomplish SCSD's aims were outlined, and the <u>how</u> of the project began to take shape.

Aside from treating a group of schools as one customer SCSD's principal procedural innovations are in the methods of competitive bidding. First, bids were taken on the components before the schools in which they would be used were designed. Second, and more important, the components were bid on the basis of performance specifications which prescribed what the products must do, instead of the usual specifications and drawings, which describe what the products should be. In the case of the structural system, for example, the bidding document clearly stated the spans the roof must bridge and the loads it must carry - but not what the roof should be made of, how it should be constructed, or how it should look. Reinforced concrete structural systems could bid against steel (and did), so long as each demonstrated it could do the job set forth in the performance specifications. The toughest of these jobs, and the most vital to the functioning of the system, was the requirement for coordinating separate components at the design stage, particularly the "service sandwich," - the space between ceiling and roof in which the environmental services for a building are concentrated. The performance specifications spelled out criteria for this "service sandwich" as well as for the individual components, pressing for a level of coordination at which components would begin to assume functions other than their own.

A New Role for the School-Client

By making the function rather than the nature of the components the key to the bidding, SCSD's use of performance specifications led to an even more significant innovation: making the client an active participant in the design not only of the building itself but of its parts. The 13 school boards, through the First California Commission, became full partners in the project, not just customers to whom the schoolhouse happens.

Development work on the system began with the individual schools and their specific educational requirements. These became known during intensive discussions between the SCSD staff and the school officials and architects of each member district. This district-by-district analysis of educational needs was then translated into general educational specifications from which the criteria for the system components were derived.

It is not surprising that with so many and such varied schools involved the overwhelming demand on the project was for flexibility. Any acceptable component system would have to permit:

1. Freedom in over-all planning, from the single, large loft building to the multi-unit, campus-style school.

2. The simple and economical arrangement of a variety of spaces in a variety of ways for a variety of purposes. For many of the districts the self-contained classroom for 30 students was no longer the basic teaching space.

3. Altering and rearranging these spaces as the need arises. In fact, one of the assumptions underlying the design criteria was that an average of 10 per cent of the interior partitions would be changed yearly.

These three requirements established the parameters for the development of more detailed criteria for the proposed building system. The need for freedom in arranging rooms of various sizes suggests a structure capable of spanning two regular classrooms and providing a column-free space of at least 7,200 square feet as well as sundry smaller spaces in academic areas. Demountable and operable partitions were key elements in the project in order to maintain the desired degree of flexibility within the fixed structural umbrella. The physical environment of the instructional spaces should remain close to ideal whether or not the size of the room is changed. Consequently, it was requisite that flexibility of space depended on the adaptability of air conditioning, lighting, and acoustics to the rearrangement of partitions.

The educational program, therefore, pointed directly to the four components - the structural system, the ceiling-lighting system, the air-conditioning system, and the movable and operable partitions - that completed the first bidding round. Lockers, casework, and fixed lab equipment were bid later. Together, these components account for just over half (58 per cent) of the cost of a typical California secondary school.

The other half, the components not included in the SCSD system, are also an important aspect of the project. The most visible example of the non-system component is the exterior wall, which was deliberately left out on the advice of the Advisory Committee. There was no educational reason for including it, and there were a number of architectural reasons for omitting it. First, the schools would be built in different environments and should look it: fenestration - windows or no windows - would have to be locally determined. Second, enthusiastic acceptance of the systems concept was much more likely if exterior detailing were left out. Above all, the aim of the project was to increase design flexibility, not to inhibit it. A school building system does not mean a lot of look-alike educational filling stations.

## Money and Quality

The two principal objectives of the SCSD project are to build better schools and to build them more economically. Since none of the schools which will use the system components have been built, it is too early to say with certainty that the project has been a complete success in either respect. But the results of the bidding on the components strongly indicate that the project has brought to schools, at or below the prices they ordinarily pay, products which are superior to those they ordinarily buy.

Item: Long span structures are usually too expensive for schools built within California State aid formulas. SCSD schools will get long spans, and the interior flexibility accompanying large, column-free spaces, for $1.81 per square foot. Structure for the typical school with a roof span of only 30 feet costs an average of $3.24 per square foot.

Item: SCSD will provide air conditioning for all academic areas (but not such spaces as gymnasiums, kitchens, and storerooms), with local temperature control for all spaces of 450 square feet or more, plus a five-year maintenance contract, for only 34 cents more per square foot than California schools now pay for heating and ventilating alone.

Item: The lighting-ceiling system, which not only meets stringent lighting requirements but also provides for air distribution, fireproofing, and sound absorption, will cost $1.31 per square foot, as against $1.67 ordinarily spent for ceiling plus lighting.

Item: Although the specifications called for fixed as well as demountable and operable partitions, the demountable partitions turned out to be no more expensive than the fixed if educational work surfaces are included. The operable partitions, panel and accordion type, include built-in supporting frames that make them movable too - a feature previously unavailable at any price. Yet this near-total partition flexibility will be provided for slightly less than the cost of conventional partitions.

Item: The four system components add up to $6.85 per square foot installed, compared to about $8.39 for the same elements in a group of conventional California secondary schools recently bid. This leaves $1.50 a square foot to buy non-system features that otherwise could not be provided within the State aid budget.

But the most important contribution to the quality of the schools which will use the new components is the fact that SCSD is a system. The flexibility built into movable partitions will not be undercut by the air conditioning or sabotaged by the structure. Manufacturers were forced by the nature of the project to work together in teams to integrate their products for the benefit of the client. For example, the air-conditioning system included in the low composite bid. It came in at $3,410,000 with a structural system that made easy provision for it; at $6,110,000 with one that did not.

Except for the biggest projects, buildings are normally made of a collection of catalog products. But if the schoolhouse is to offer high performance and real flexibility, the products that make it up must be designed to meet its specific needs and engineered to work together. This is precisely what SCSD required of the manufacturers who were interested in bidding on the project.

Successful bidders were required to take a step common only for projects considerably larger than schools. They had to pay their share of the cost of a full-scale mock-up of the total system. This prototype, built on the Stanford campus, provides for testing the products as a system and also individually, to determine if they do indeed meet the specifications, and if not, to see that they are improved until they do.

## The End of the First Phase

SCSD is the first attempt in this country to develop a series of compatible components for a group of buildings. The word will not be in until all 22 project schools are up and can be evaluated, but a number of conclusions can be drawn from the development work to date:

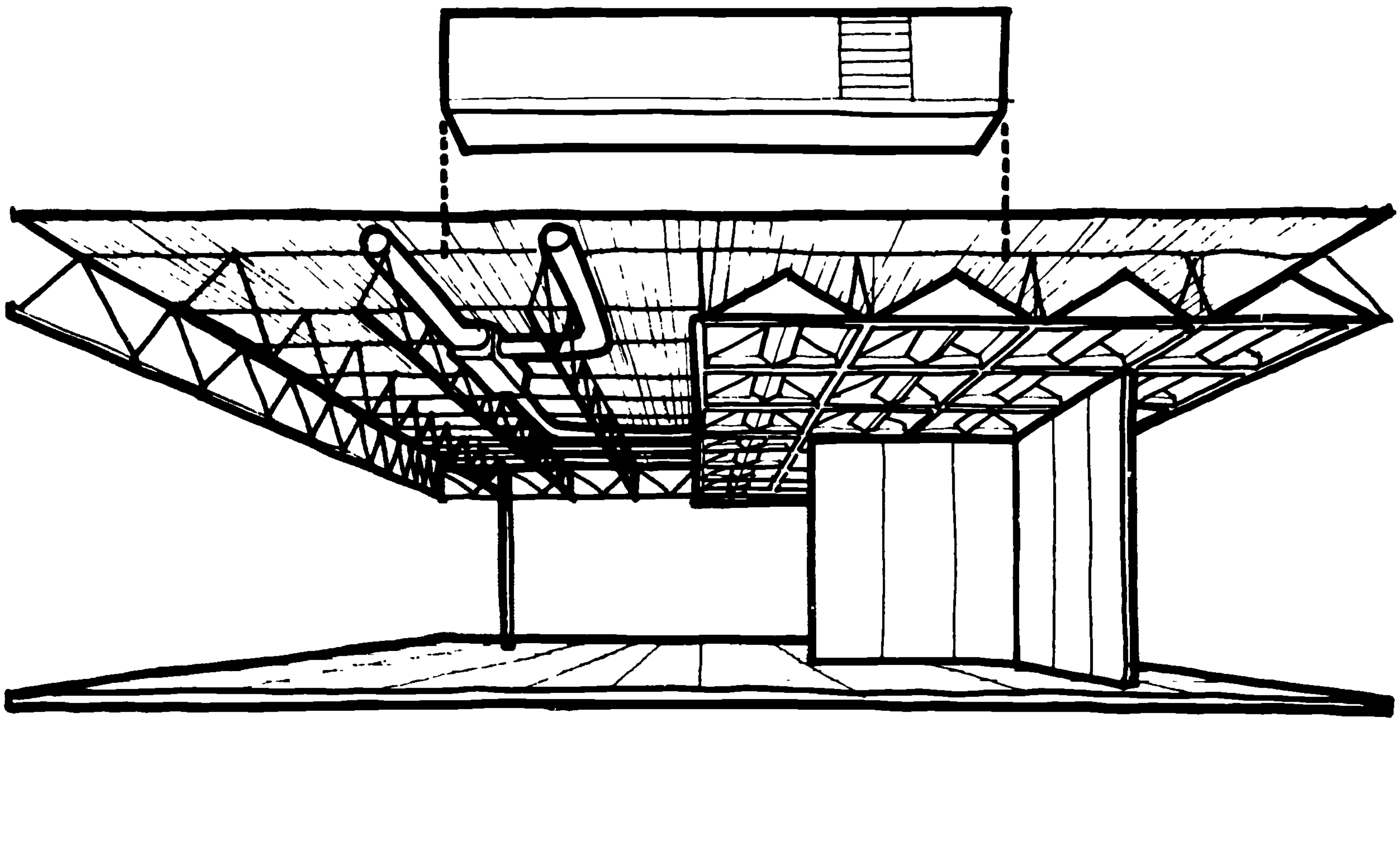
Industrialization of the building process can result in better quality as well as lower costs, provided the client can present industry with a clear-cut definition of needs and a market.

It is possible to analyze a behavioral process - in this case, secondary education - and use this analysis to help determine the design of major and minor building components which will facilitate that process.

The use of building systems limits architectural expression in some ways, but systems can also give the architect design tools otherwise unavailable, and consequently greater design freedom in some respects than the present anarchy of unrelated components.

Margaret Farmer

# THE SYSTEM COMPONENTS





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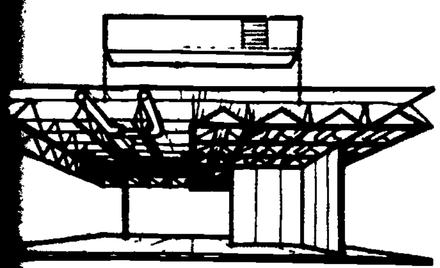


# STRUCTURAL/ROOF

SCSD's performance specifications called for a structural system that would permit a variety of campus plans and individual building configurations, using a 5 by 5 foot horizontal module and a 2 foot vertical module. They also asked for a structure that could be exposed without dire esthetic consequences and would provide the one-hour fire rating and compatibility required of all components.

The most stringent requirement, however, was the demand for maximum interior flexibility at minimum cost. Ready rearrangement of interior spaces without interference from permanent supports meant column-free roof spans considerably longer - and therefore normally more expensive - than the 30 foot spans in the typical school. The column-free area requirements made necessary horizontal spans of 30 to 110 feet, the most frequent clear-spans being 60 feet.

The accepted bid of $2,390,000 from Inland Steel Products Company meets the long span, low-cost requirements with a structural system that uses one member to do the work of two.

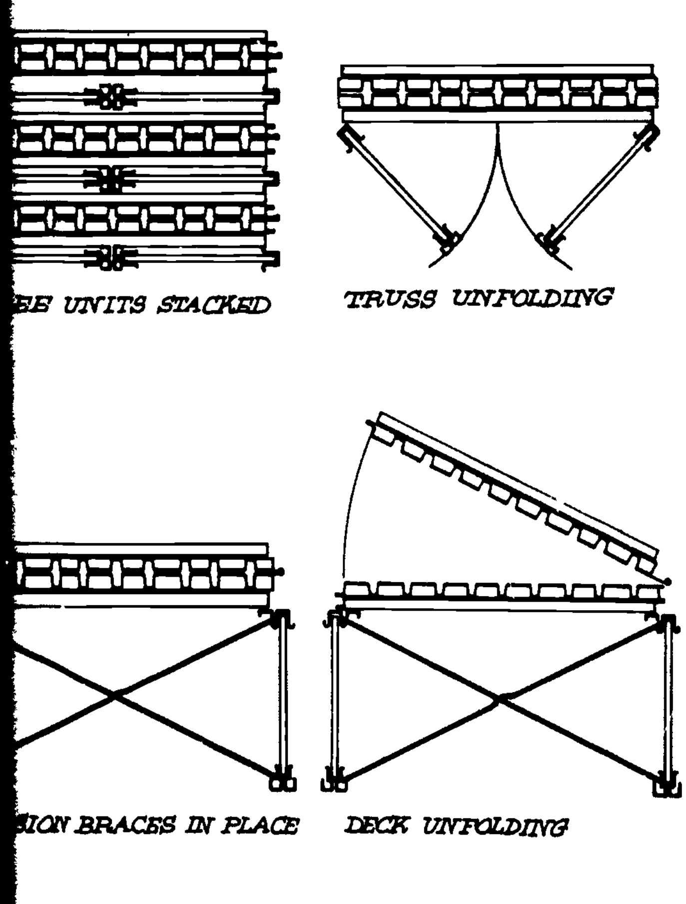
For ease in handling and shipping, truss-decks are hinged so that each 10 foot wide, 33 inch deep structural section folds flat. All roof members for the 80 by 80 foot mock-up building were shipped on one railroad flatcar.

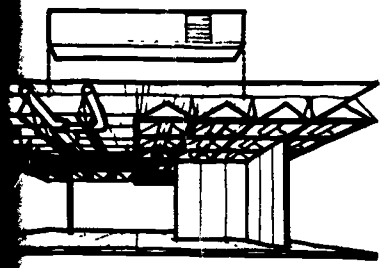
Truss-decks arrive at the site in units 1 by 5 feet by their length. As each truss-deck is lifted, the hinged trusses drop down (photo far right) and are braced. Top decks are unfolded after all units are in place

# SYSTEM

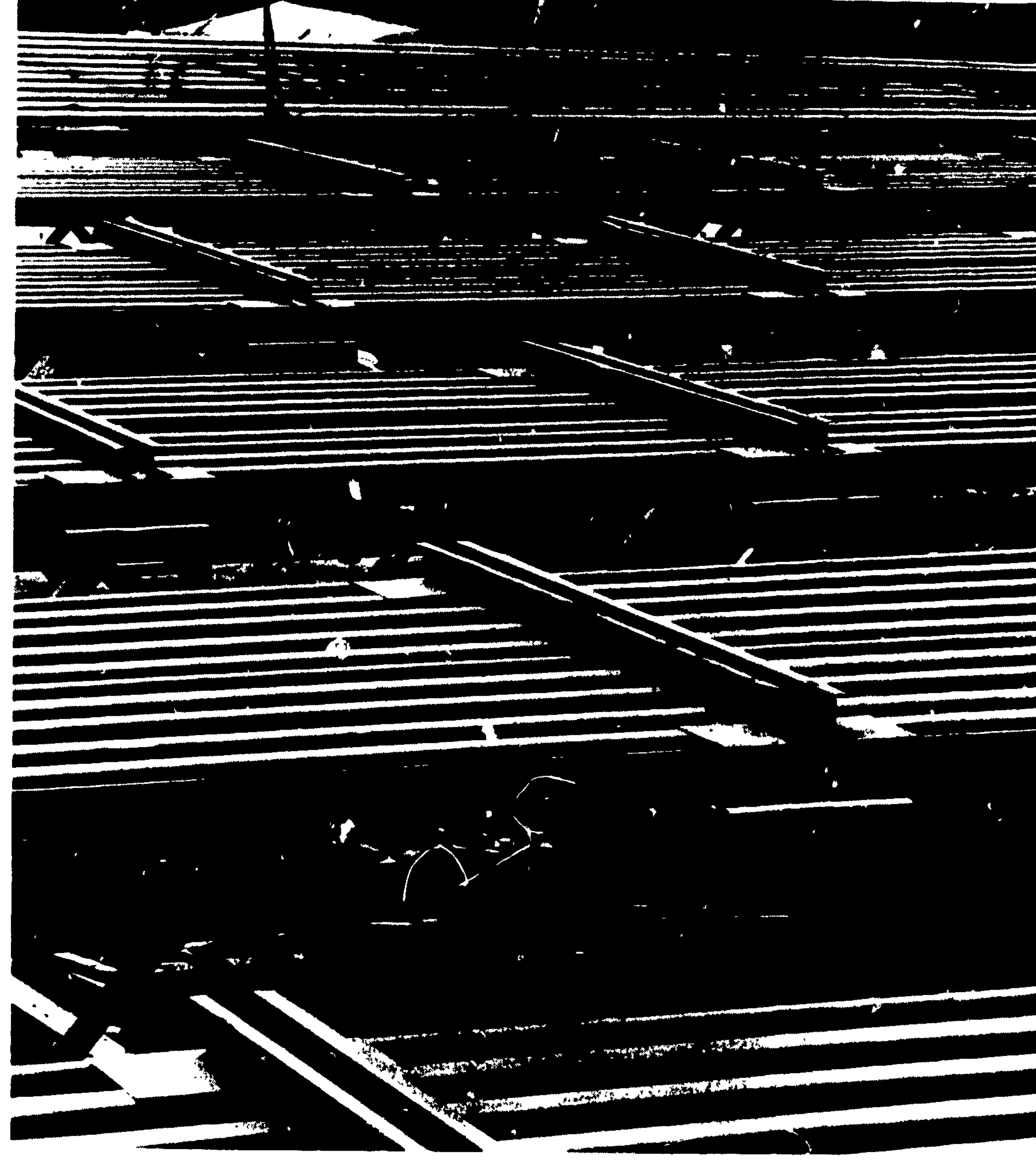
Devised for Inland by architect Robertson Ward and The Engineers Collaborative, the design is extremely efficient. The roof deck is not merely supported by the trusses but put to work carrying the compressive loads ordinarily taken by their top members. This is the first use of orthotropic structural design for conventional building. Such techniques, in which all parts contribute directly to structure, have previously been used for bridge building. This structural system enabled Inland to cut the amount of steel required and thus to cut costs as well. Supporting members for the truss-decks are conventional trusses, which serve as primary beams, and hollow metal cruciform columns. Insulation, flashing, and roofing complete the system.

Designed to integrate compatibly with other components, the structure permits the use of roof-mounted mechanical equipment, with space available for air-distribution devices between the roof and the ceiling. Interior partitions can be anchored to support points at 5 foot centers.



STRUCTURAL/ROOF SYSTEM (cont.)



ith truss sections unfolded,
eck units are hoisted into
osition, and lowered into seat
onnections on primary beams.
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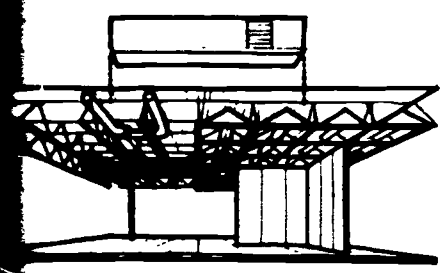
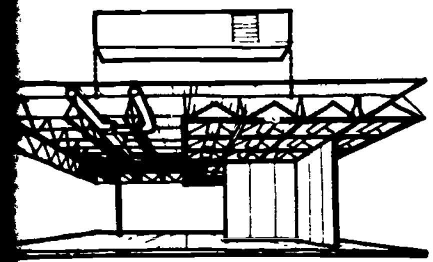
russes to columns.

When all units have been set in place (above), the hinged top decks are unfolded and flopped over onto adjoining members to complete the roof. Hinged joints and truss connections are then welded.



STRUCTURAL/ROOF SYSTEM (cont.)

Exterior wall frame is attached to completed structure, which provides support points for anchoring partitions at 5 foot centers in both directions. Space between deck and bottom of trusses allows passage of air-conditioning ducts, electrical conduit, and various piped services, programed so they do not interfere with each other.



# AIR CONDITIONING

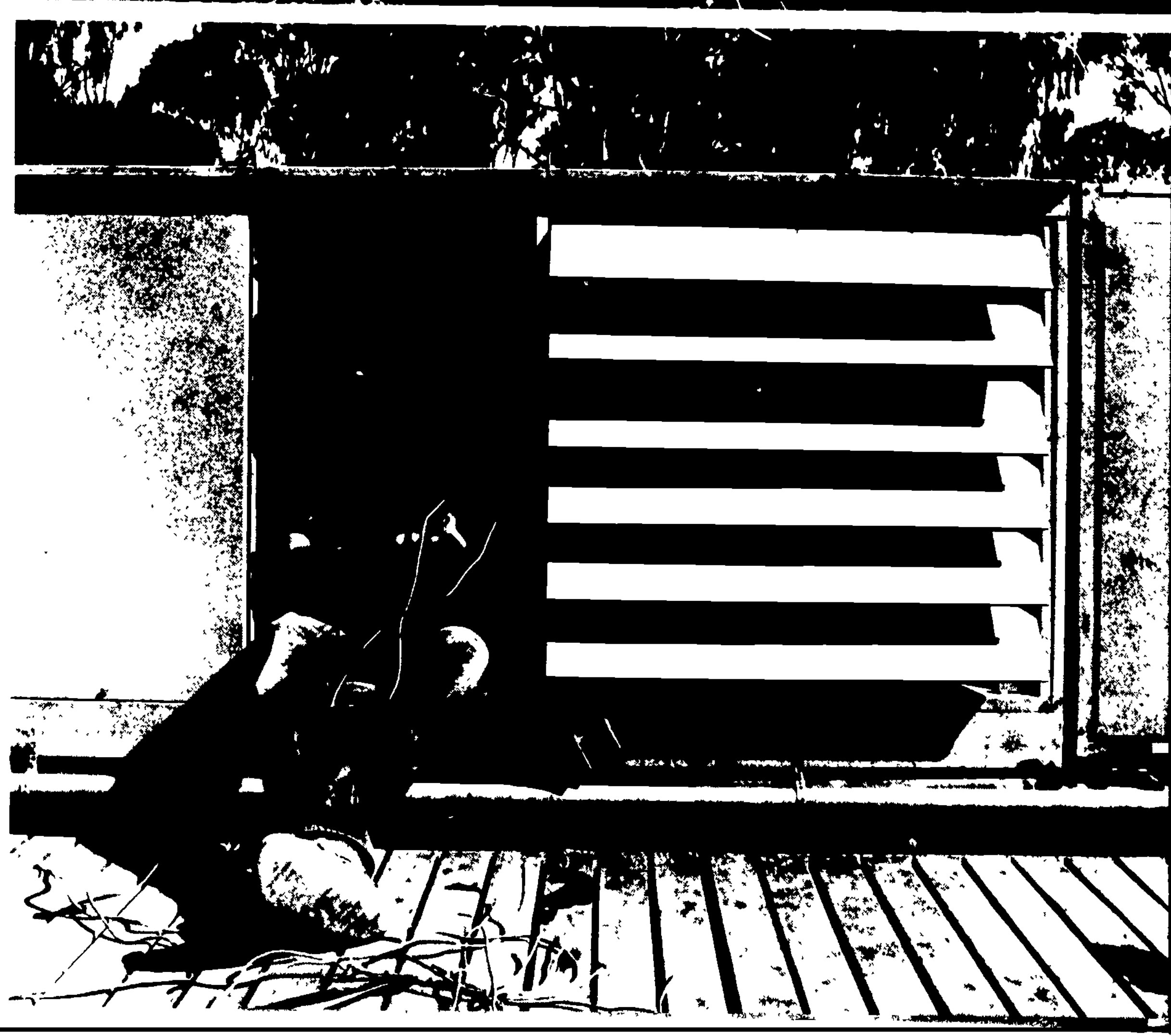
Because the ability to rearrange interior space is of little use if the resulting rooms are over- or underheated, or inadequately ventilated, SCSD's criteria for mechanical systems included an unprecedented degree of local environmental control. Air-handling equipment had to serve each space of 450 square feet or more regardless of the shape or arrangement. The control system must adjust easily to room rearrangement.

The winning system by Lennox Industries not only supplies this flexibility and the required compatibility with Inland's structural system, it also provides a hoped-for bonus. Because air conditioning is expensive, bidders were asked to give prices with and without mechanical cooling. The successful Lennox bid affords SCSD schools complete air conditioning for 56 per cent of their space for only 34 cents per square foot more than California schools usually pay for heating and ventilating alone. And the bid figure of $3,410,000 includes an optional five-year maintenance contract.

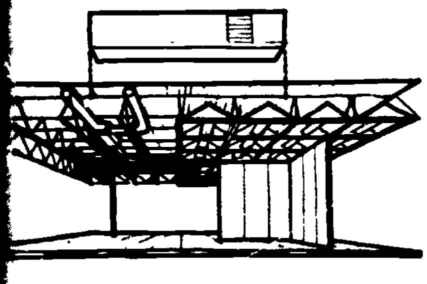
Air-handling and -treating equipment for each 3,600 square foot service module is housed in a self-contained rooftop unit. To get the required degree of flexibility, a multi-zone system is used, with warm air supplied by a gas-fired heater, and cool air supplied by direct expansion refrigeration.

Air distribution is through a multi-zone area incorporating eight mixing boxes, one for each 450-square foot zone. Conditioned air is carried from the mixing boxes to individual control zones via fixed fiberglass ducts. Flexible ducts then carry the air to strip diffusers, which are part of the ceiling system and can be moved as needed. Additional diffusers return air to the plenum space formed by roof and ceiling, from which it goes back to the unit.

# SYSTEM

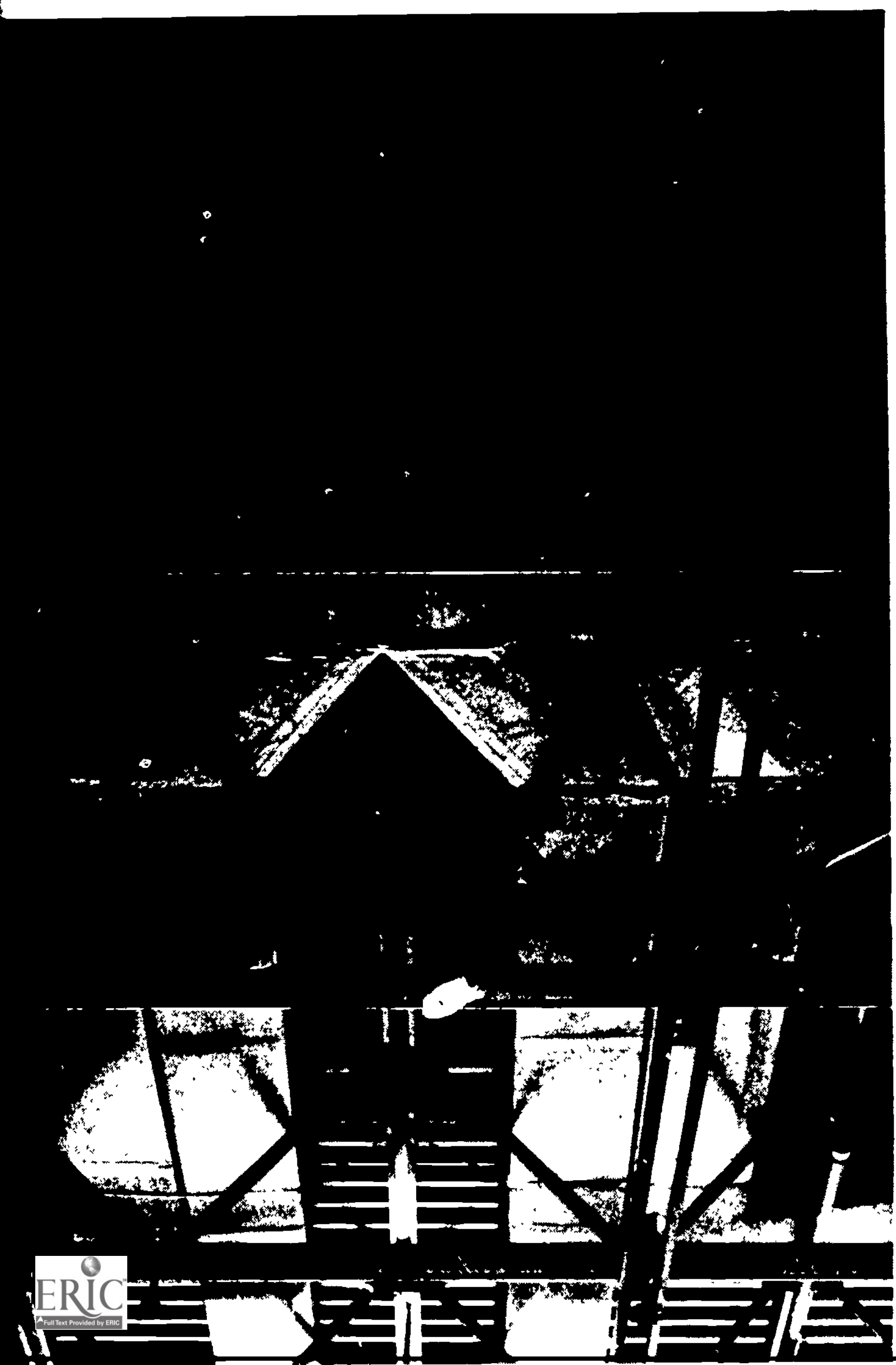


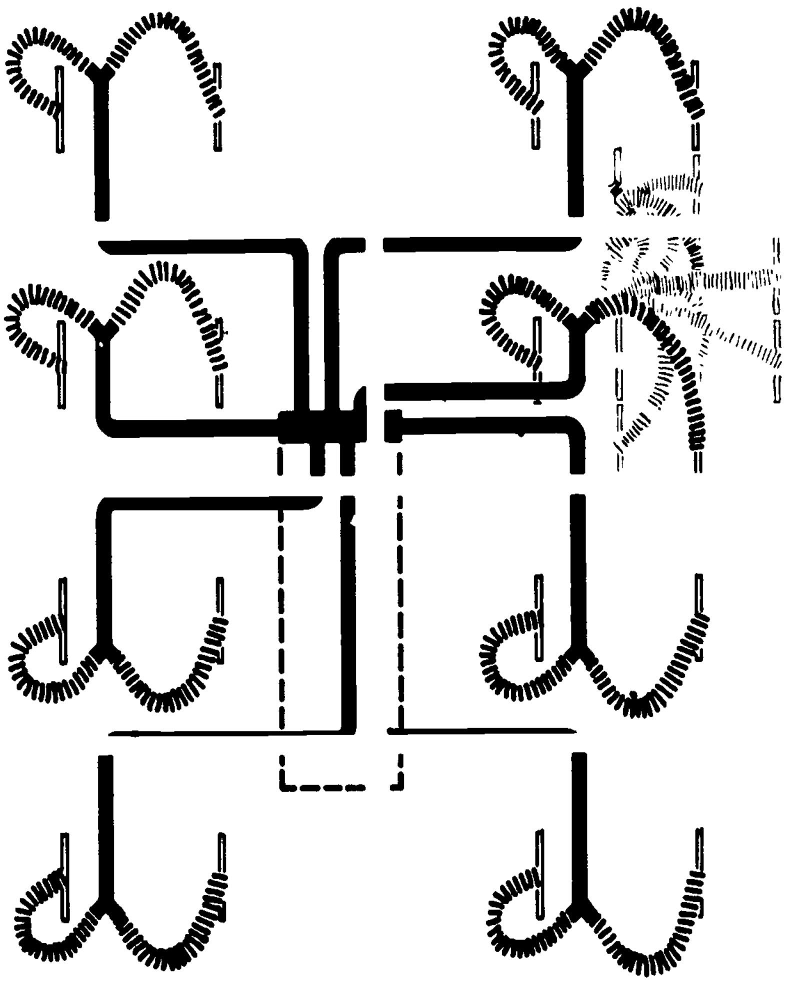
Above: In SCSD's most dramatic departure from traditional building techniques, a helicopter replaces crane in placing air-conditioning unit on the roof of mock-up. Right: The clean-lined unit, 8 by 21 by 4 feet high, houses all heating, cooling, and ventilating equipment for the mock-up's 3,600 square feet of enclosed space.



AIR-CONDITIONING SYSTEM (cont.)

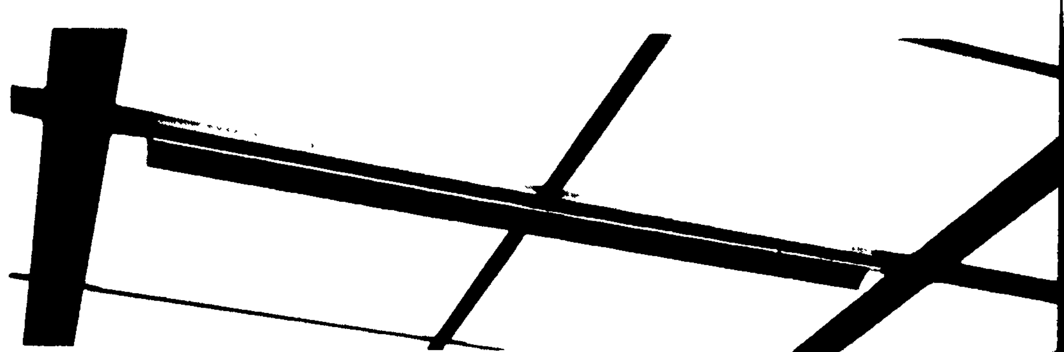
The multi-zone rooftop unit supplies hot and cold air to eight mixing boxes (see photo), one for each 450 square feet of floor space. Fixed ducts carry conditioned air to each control zone, where it is picked up by flexible fiberglass ducts leading to strip ceiling diffusers.

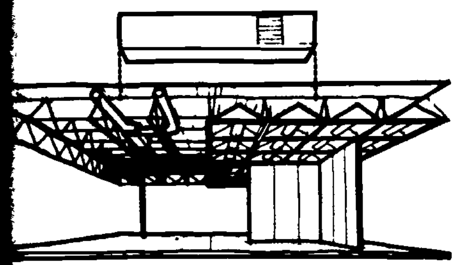




Flexible 9 inch fiberglass ducts carry air from the fixed ducts to the diffusers which supply each control zone. Since diffusers are movable and ducts flexible, the combination can service any configuration from 450 square feet up.

Flexible ducts snap into strip diffusers (bottom photo) which are part of the ceiling assembly. A similar type of diffuser is used to return air to the unit, via a plenum space between roof and ceiling.





# LIGHTING/CEILING

The performance specifications for the wall-to-wall component which includes all lighting, ceiling, and acoustical members were based on three considerations:

1. Stringent lighting requirements - a high (70 candles) illumination level combined with extremely low fixture brightness to minimize glare - indicated that at least half the ceiling had to be a light source.

2. The lighting had to retain its effectiveness as room sizes changed, requiring the ability to rearrange lighting-ceiling components within the structural module.

3. As the third component in the integrated "service sandwich," this system had to pick up all the required functions not performed by the structural or mechanical systems.

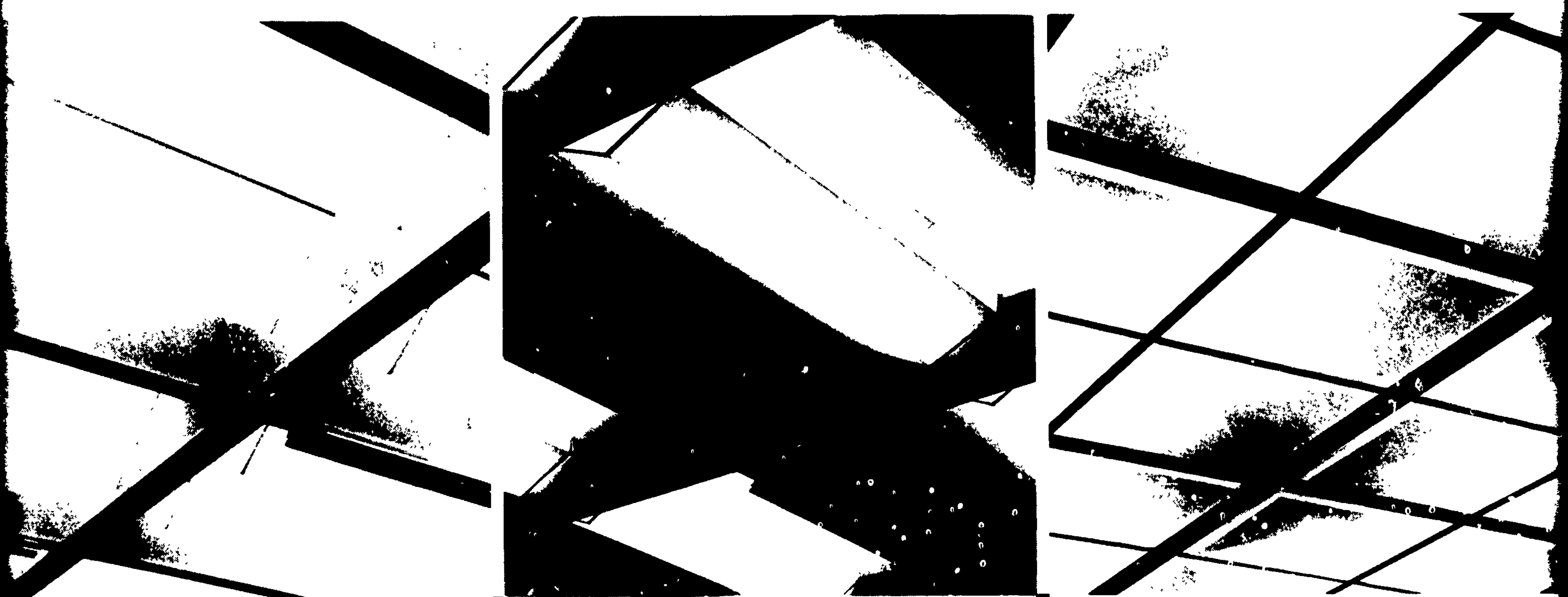
As a result, the lighting-ceiling component, which was also designed by Robertson Ward and The Engineer's Collaborative for Inland and bid at $2,256,000, is the most versatile part of the system. In addition to light, finished ceiling, sound absorption, and sound attenuation between rooms it provides fire protection for the structure, air-distribution devices for the mechanical system, and lateral support for demountable partitions.

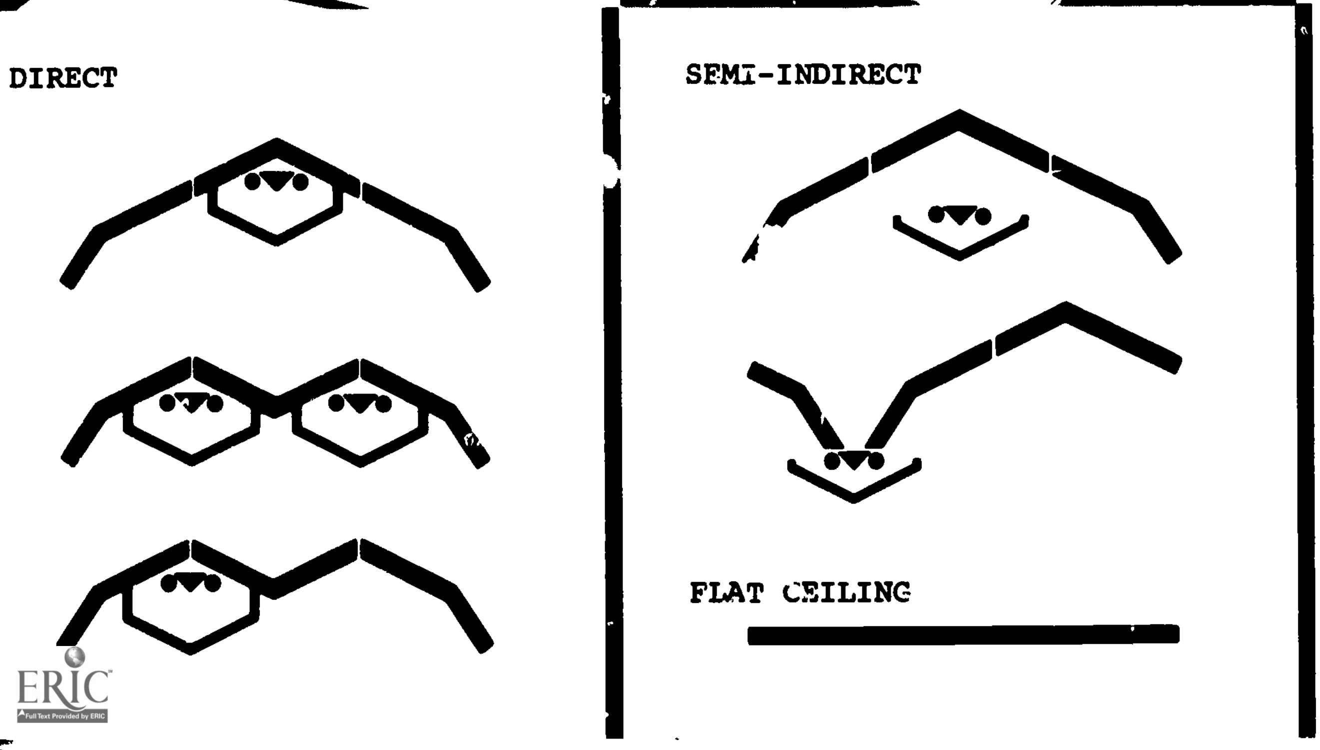
The system is based on a 5 by 5 foot metal grid suspended from the structure. Within this square grid goes a flat ceiling panel or a lighting coffer. Both are of prefinished sheet steel; both can be had with perforated surfaces for increased sound absorption; both can be backed with mineral wool batts to provide the necessary fireproofing and sound absorption.

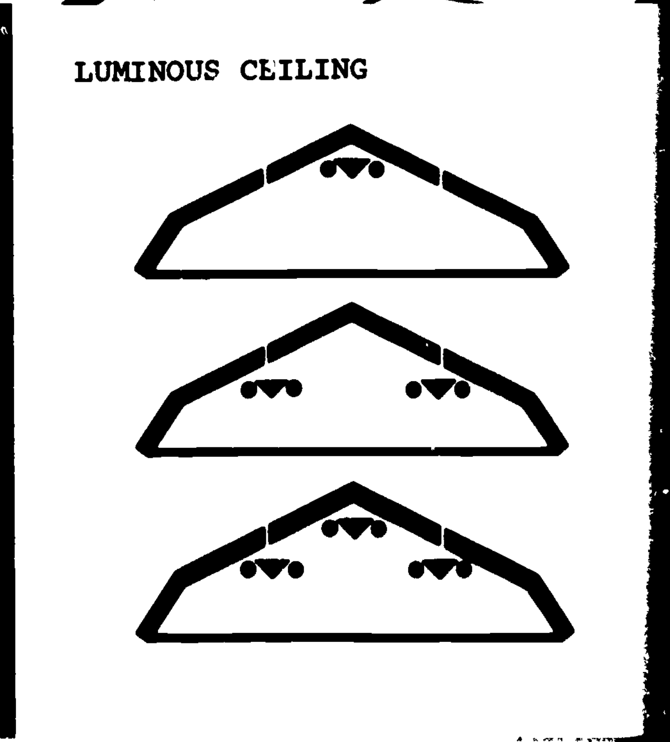
The three types of lighting required - semi-indirect, direct, and luminous ceiling - are all provided by varying the number of two-lamp strip fixtures used and their placement in the coffer. (Fixtures can also be surface mounted on flat ceiling panels or the grid between coffers.) The system includes lenses for direct lighting and appropriate diffusers for semi-indirect and luminous ceiling arrangements.

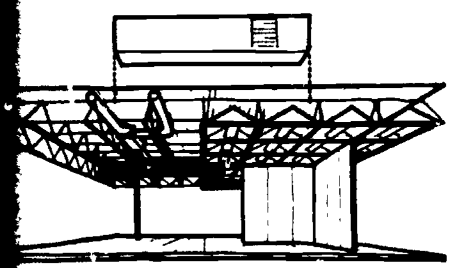
# SYSTEM

Above: Sheet metal lighting coffers backed with mineral wool fireproofing drop into 5 foot square ceiling grid hung from the structure. Slotted grid members at right are alternates designed to receive air-conditioning diffusers.
Below: All lighting requirements can be met with one simple fixture and three types of diffuser. Varying the number, type, and location of these elements gives a variety of direct, semi-direct, and luminous ceiling systems, three of which are shown from left to right.







# INTERIOR PARTITIONS

For freedom in original design, the interior partitions had to fit anywhere on a 4 inch planning module; provide for all the joint conditions that might arise; and come in 35 different colors. For freedom in future rearrangement, SCSD asked that more than 60 per cent of the partitions be movable, and that all panel faces be independently changeable. Bids were taken on fixed partitions, demountable partitions, and panel and accordion type operable partitions.

The E.F. Hauserman Company's low bid of $2,330,000 for fixed and demountable partitions broke the long-standing rule that movable walls cost more. Partitions had to be designed so that panels on one side of the wall could be changed independently of those on the other side. The fixed partitions provided in Hauserman's proposal are simply demountable partitions that will not be moved - for example, those that conceal plumbing.

The 3 inch thick partitions consist of steel studs faced on both sides with gypsum panels sandwiched between prefinished steel sheets. Snap joints make the panels easily removable.

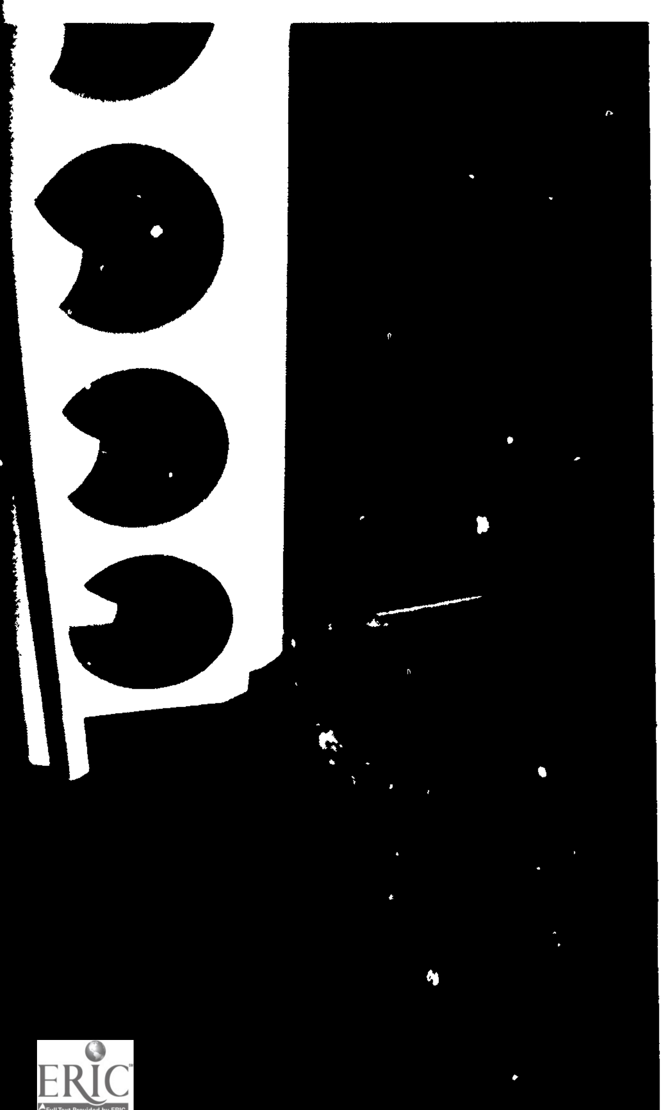
All partition systems provide a minimum of 28 decibels of noise reduction between adjacent rooms as measured in full field tests.

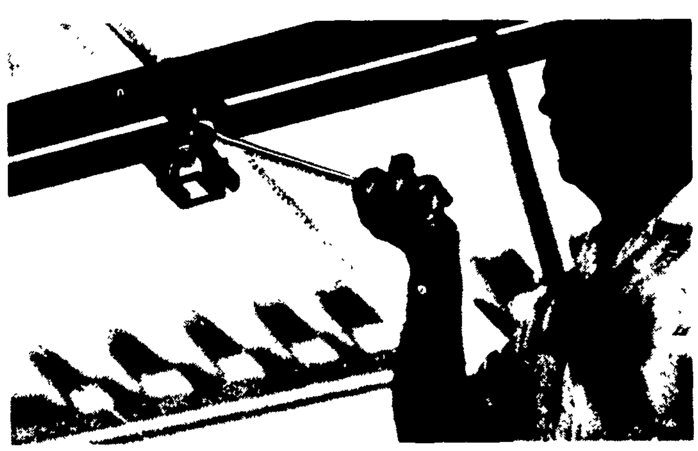
To make them movable as well as operable and avoid added loads on the structure, SCSD required that both types of operable partitions be supported by their own demountable structural frames.

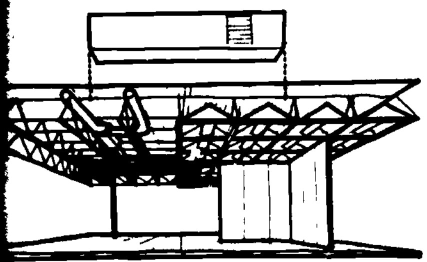
The panel type operable wall submitted by Western Sky Industries consists of 2½ foot wide panels that move in groups of two or three, and can be folded to any point without opening the whole partition, permitting the wall to be used as a partial room divider or to add wall work surface. The accordion wall provided by Hough Manufacturing Company is a catalog product modified to meet SCSD's acoustical, finish, and structural subsystem requirements, as well as the specified ease of movement.

# SYSTEM

Independently movable, interchangeable panels used for demountable partitions clip to both sides of steel studs which fit into a metal track at floor (below) and ceiling. The metal "spider" (below, right) isolates ceiling from structure for fire purposes, levels and supports ceiling as well as supporting partitions, and permits passage of conduit from ceiling down.

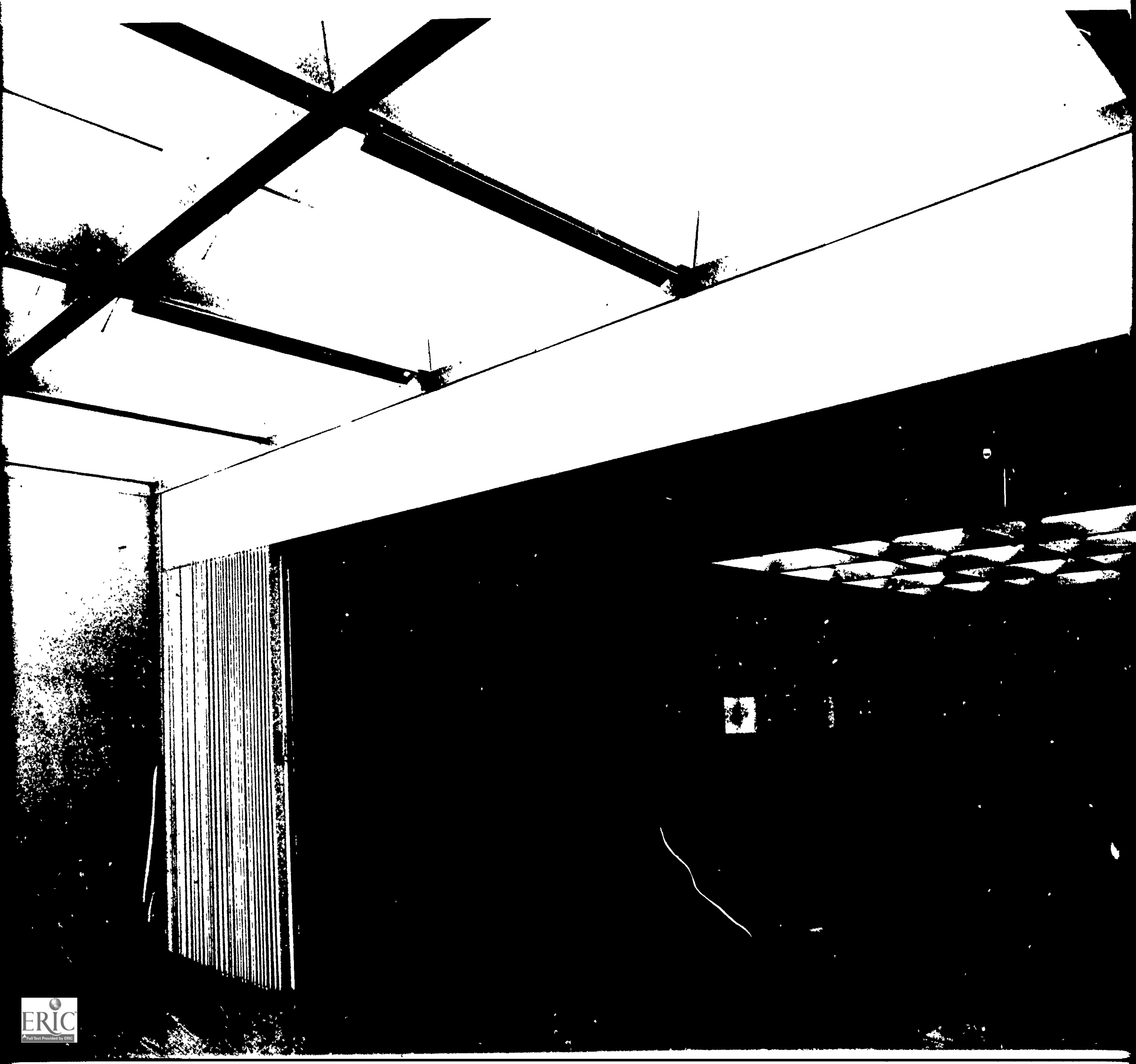






INTERIOR PARTITIONS SYSTEM (cont.)

To conform to SCSD's unique performance standards, operable walls are also demountable. As shown below, accordion and panel type operable partitions are both supported by their own column-and-truss frames and can be moved readily to new locations.



## TECHNICAL CONSULTANTS TO PROJECT

| | |
|---|---|
| ACOUSTICAL<br>Dariel Fitzroy | Dariel Fitzroy<br>Consulting Acoustical Engineer<br>San Rafael, California |
| AIR CONDITIONING<br>G. L. Gendler | G. L. Gendler & Associates<br>Mechanical and Electrical Engineers<br>Berkeley, California |
| COLOR<br>Miriam Leefe | Color Consultant<br>Sausalito, California |
| ELECTRICAL<br>Dan Finch | Professor of Electrical Engineering<br>Berkeley, California |
| Foster K. Sampson | Sampson, Randall & Press<br>Consulting Electrical Engineers<br>Los Angeles, California |
| CASE WORK<br>Burgess P. Stanley | Laboratory Planning Consultants<br>Chestnut Hill, Massachusetts |
| STRUCTURAL<br>L. W. Graham | Graham & Hayes<br>Consulting Structural Engineers<br>San Francisco, California |
| Clarence Rinne | Structural Engineer<br>Palo Alto, California |
| Alexander G. Tarics | Reid and Tarics<br>Architects and Engineers<br>San Francisco, California |

## MEMBER SCHOOL DISTRICTS AND ARCHITECTS

EAST SIDE UNION HIGH SCHOOL DISTRICT
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Frank Fiscalini, Superintendent
Allan M. Walter & Associates, Architects

EXCELSIOR UNION HIGH SCHOOL DISTRICT
Artesia, California
Murrell M. Miller, Superintendent
Kistner, Wright & Wright, Architects

FULLERTON JOINT UNION HIGH SCHOOL DISTRICT
Fullerton, California
Ernest G. Lake, Superintendent
William E. Blurock & Associates, Architects

GLENDORA UNIFIED SCHOOL DISTRICT
Glendora, California
W. Del Walker, Superintendent
Porter, Gogerty, Meston & Associates, Architects

HUNTINGTON BEACH UNION HIGH SCHOOL DISTRICT
Huntington Beach, California
Max L. Forney, Superintendent
Neptune & Thomas, Architects

LA PUENTE UNION HIGH SCHOOL DISTRICT
La Puente, California
Glen A. Wilson, Superintendent
Kistner, Wright & Wright, Architects

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Clifford G. Riddlebarger, Superintendent
William E. Blurock & Associates, Architects

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Sacramento, California
Melvyn F. Lawson, Superintendent
Gordon Stafford & Associates, Architects

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Arthur J. Gumbrell, Superintendent
Jung & Cloyes, Architects

SAN JUAN UNIFIED SCHOOL DISTRICT
Carmichael, California
Ferd J. Kiesel, Superintendent
Satterlee & Tomich, Architects

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Denny Morrissey, Superintendent
Porter, Gogerty, Meston & Associates, Architects

SANTA CRUZ ELEMENTARY SCHOOL DISTRICT
Santa Cruz, California
Denny Morrissey, Superintendent
Leefe & Ehrenkrantz, Architects

SIMI VALLEY UNIFIED SCHOOL DISTRICT
Simi, California
David H. Paynter, Superintendent
Daniel, Mann, Johnson & Mendenhall, Architects

# EFL PUBLICATIONS

*The following publications are available from the offices of EFL: 477 Madison Avenue, New York, New York 10022.*

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COLLEGE STUDENTS LIVE HERE A report on the what, why, and how of college housing; reviews the factors involved in planning, building, and financing student residences.

THE COST OF A SCHOOLHOUSE A review of the factors contributing to the cost and effectiveness of schoolhousing, including planning, building, and financing.

DESIGN FOR ETV—PLANNING FOR SCHOOLS WITH TELEVISION A report on facilities, present and future, needed to accommodate instructional television and other new educational programs. Prepared for EFL by Dave Chapman, Inc., Industrial Design.

RELOCATABLE SCHOOL FACILITIES A survey of portable, demountable, mobile, and divisible schoolhousing in use in the United States and a plan for the future.

SCHOOL SCHEDULING BY COMPUTER: THE STORY OF GASP A report on simulation programs employing a senior computer for programing schools and colleges.

THE SCHOOL LIBRARY A report on facilities for independent study, with standards for the size of collections, seating capacity, and the nature of materials to be incorporated.

TO BUILD OR NOT TO BUILD A study of the utilization of instructional space in small liberal arts colleges, with a do-it-yourself workbook for the individual use of the institutions that wish to survey their own utilization levels.

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2. SPACE AND DOLLARS: AN URBAN UNIVERSITY EXPANDS A report on the economical physical expansion of urban universities based on a case study of Drexel Institute of Technology.

3. LABORATORIES AND CLASSROOMS FOR HIGH SCHOOL PHYSICS Chapter reprinted from MODERN PHYSICS BUILDINGS: DESIGN AND FUNCTION.

4. A DIVISIBLE AUDITORIUM/BOULDER CITY, NEVADA Case study of an auditorium that can be converted to instructional spaces by the use of soundproof, operable walls.

5. NEW CAMPUSES FOR OLD: A CASE STUDY OF FOUR COLLEGES THAT MOVED What the decision to move means from an economic, academic, social, and physical point of view.

6. A COLLEGE HEALTH CENTER Case study of a model center for small private colleges; architectural design by Caudill, Rowlett & Scott.

7. NEW BUILDING ON CAMPUS: SIX DESIGNS FOR A COLLEGE COMMUNICATIONS CENTER Graphic representations of the results of an architectural competition for a new space to house the accoutrements of instructional aids and media.

8. THE SCHOOLS AND URBAN RENEWAL A case study of the Wooster Square renewal project in New Haven, Connecticut.

9. AIR STRUCTURES FOR SCHOOL SPORTS A study of air-supported shelters as housing for playfields, swimming pools, and other physical education activities.

## TECHNICAL REPORTS

1. ACOUSTICAL ENVIRONMENT OF SCHOOL BUILDINGS by John Lyon Reid and Dariel Fitzroy—Acoustics of academic space in schools. An analysis of the statistical data gathered from measurement and study.

## COLLEGE NEWSLETTER

A periodical on design questions for colleges and universities.

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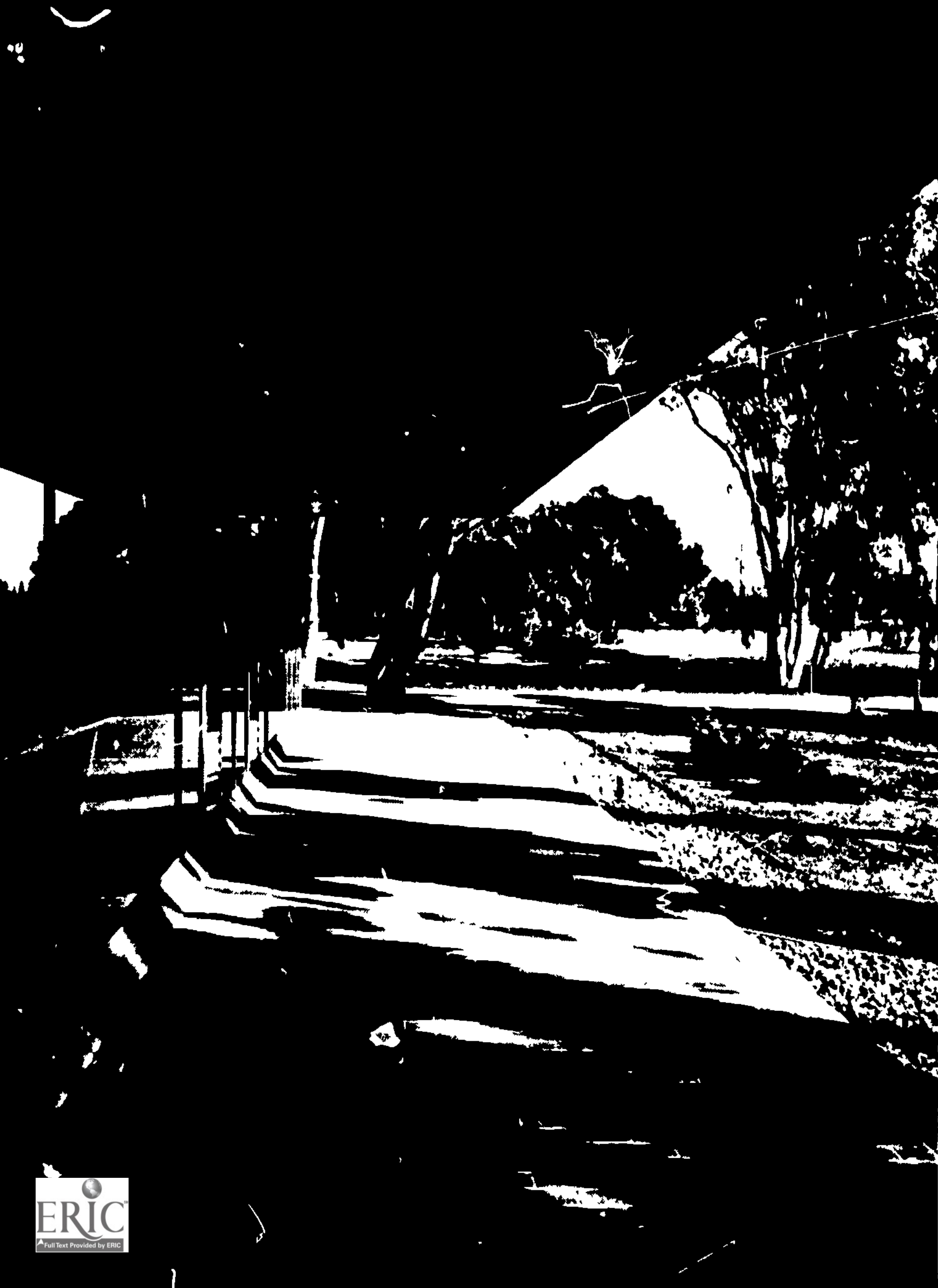

# A Report from Educational Facilities Laboratories