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SCHOOL CONSTRUCTION SYSTEMS DEVELOPMENT PROJECT.

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PUB DATE 65

EDRS PRICE MF-$0.25 HC-$0.36 7P.

DESCRIPTORS- *EDUCATIONAL SPECIFICATIONS, *PREFABRICATION, *SCHOOL CONSTRUCTION, *SCHOOL PLANNING, *SPACE UTILIZATION, ACOUSTICAL ENVIRONMENT, BUILDING DESIGN, BUILDING INNOVATION, CURRICULUM PLANNING, FIRE PROTECTION, FLEXIBLE CLASSROOMS, HEATING, LIGHTING, INTERIOR SPACE, MOVABLE PARTITIONS, VENTILATION, EDUCATIONAL FACILITIES LABORATORIES

ONE-HUNDRED MANUFACTURERS EXPRESSED INTEREST IN BIDDING FOR A SYSTEM ON SCHOOL CONSTRUCTION CALLED SCSD OR SCHOOL CONSTRUCTION SYSTEMS DEVELOPMENT TO THE FIRST CALIFORNIA COMMISSION ON SCHOOL CONSTRUCTION SYSTEMS. TWENTY-TWO BUILDINGS COMPRISED THE PROJECT. THE OBJECTIVE WAS TO DEVELOP AN INTEGRATED SYSTEM OF STANDARD SCHOOL BUILDING COMPONENTS THAT WAS ADAPTABLE, ECONOMICALLY FEASIBLE, AND TIME-SAVING. THE USE OF STANDARD COMPONENTS TO BUILD NONSTANDARD BUILDINGS WAS A NEW CONCEPT. INDUSTRY DEVELOPED THE SYSTEM ON PERFORMANCE SPECIFICATIONS DEVELOPED BY EFL. HOWEVER, THE COMPONENTS WERE NOT ALWAYS COMPATIBLE. THE PURPOSE WAS TO IMPLEMENT EDUCATIONAL DEVELOPMENTS BY GIVING THE EDUCATOR FLEXIBILITY IN THE PLANNING AND UTILIZATION OF SCHOOL BUILDINGS. THIS REQUIRED (1) LONG SPANS TO GENERATE LARGE AREAS OF SPACE, AND (2) ECONOMICALLY MOVABLE PARTITIONS. LIGHTING AND VENTILATING SYSTEMS HAD TO BE DESIGNED SO AS TO FULFILL VARIATION DUE TO FLEXIBLE SPACE ARRANGEMENTS NECESSITATED BY CHANGING CURRICULA. EXAMPLES OF PERFORMANCE SPECIFICATIONS EXPRESSED IN NUMERICAL QUANTITIES ARE GIVEN. THE TOTAL CONCEPT PROVIDES FOR AN INFINITE VARIETY OF BUILDINGS. THE STRUCTURAL-LIGHTING-CEILING SYSTEM PROVIDES (1) SOURCE OF ILLUMINATION, (2) FINISHED CEILING OR SOFFIT, (3) CEILING SOUND ABSORPTION, (4) SOUND ATTENUATION BETWEEN ROOMS, (5) FIRE PROTECTION FOR THE STEEL STRUCTURE, (6) SUPPORT FOR DEMOUNTABLE PARTITIONS, AND (7) SUPPLY AND RETURN AIR DEVICES. THE UNIT FOLDS FLAT FOR SHIPPING. THIS SYSTEM IS A STRUCTURAL TECHNIQUE FOR SCHOOL BUILDINGS THAT UTILIZES THE INHERENT STRUCTURAL PROPERTIES OF A STEEL ROOF DECK. IT DOES NOT INCLUDE THE EXTERIOR WALLS. CEILING SYSTEM DIAGRAMS ARE PROVIDED. (RK)

SCHOOL CONSTRUCTION SYSTEMS DEVELOPMENT PROJECT

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In July of 1963, more than 100 manufacturers of building materials expressed to the First California Commission on School Construction Systems, a joint venture of thirteen school districts in Northern and Southern California, their interest in submitting bids for a new system of school construction called "School Construction Systems Development"—abbreviated as SCSD.* The project comprised 22 school buildings.

A lengthy document, "Contract Documents and Performance Specifications," set forth a new approach to the construction of schools, with the following stated objective:
". . . an integrated system of standard school building components which will:
(1) offer architects desired design flexibility in meeting the changing program needs of individual schools,
(2) reduce the cost of school construction and give better value for the school building dollar in terms of function, environment, first cost and maintenance, and
(3) reduce the time needed to build a school."

This was indeed a challenge. It called for a new concept: the use of standard components to build nonstandard buildings. The specific products to satisfy these requirements were not presumed to be in existence; their creation was a fresh assignment to the research and development departments of industry. Bids were taken on performance specifications, not on descriptions of products in being.

The specifications had been developed from intensive study of educational requirements in the thirteen participating districts under a foundation grant from Educational Facilities Laboratories, without regard for traditional limitations. Fundamentally, the purpose was to implement educational developments of the present and the future by giving the educator flexibility in the planning and utilization of school buildings. This required long spans to generate large areas of space with no columns or shear walls to interfere with the use of space at any future time. It also required partitions with capacity to be moved at the will of the educator, at little

*Property rights in the building system as such and in the name "SCSD System" are vested in the Trustees of Leland Stanford Junior University.

cost and without reference to the business manager's capital-improvements budget. Some of the educators concerned with the project indicated that, on a basis of experience, they would have liked to move an average of 10 percent of their walls every year.

Efficient use of space requires a compact type of building. In such a design, you generate interior spaces without access directly to outside air. Ventilation in the form of an air conditioning system is required. This cannot be in the form of a single control zone; when you rearrange space with complete flexibility, the variation in heating and lighting loads is tremendous. This means that lighting, too, must be designed to facilitate moving partitions without changing major circuits; there must be flexibility in switching. For adequate illumination of academic spaces, the environmental need is for a ceiling 50 percent of which is a light-emitting source, with no localized brightness.

Changing curricula do not necessarily dictate equal-size spaces. Different group-size requirements manifest themselves even during a seven-period day. Therefore the program does not call for spaces of equal size. Layout changes must be possible between periods by means of operable partitions. Changes of classroom layouts must also be possible to accommodate changes in teaching techniques on a year-to-year basis.

To establish performance specifications, these requirements had to be expressed as numerical quantities. The following are examples:

A possible 7200 square foot unit of floor area without structural interference and with 60 feet spans.

A "mechanical service module" of 3600 square feet, divisible into eight control zones of 450 square feet.

70 foot candles of illumination, low maximum brightness required for good lighting.

Demountable partitions with fully demountable face panels which may be interchanged to provide different work surfaces.

Operable partitions for immediate flexibility, to be set in remountable frames.

Confronting industry with these performance specifications was a reversal of the process by which its customs and practices had grown up over the centuries. Working in their separate compartments, manufacturers in the various product categories up to now have developed their products independently. Unfortunately, these components do not fit together into a single building. Even if the architect specifies "standard" products, the building is a special. The products were not designed to go together compatibly.

To release the professional talents and creativity of the educator and the architect, it was necessary to take a completely new look at *functional* dimensions. This dimensional coordination, then, was one of the problems that had to be solved. The response was terrific, in the light of the quality built into the performance specifications. A tremendous amount of work was done in development laboratories around the country. The challenge was met in terms of acceptable systems below target cost.

Although the system permits developing a school building out of standard components, it is important to note some of the things it is not. Most important is the fact that nowhere in this project can be found any such thing as a standard *building*. The total concept permits not just 9 or 99 variations in building design, but an almost infinite variety. Fundamental to this is the fact that the total system represents only about half of the cost of a building. For example, the treatment of exterior walls is not involved. The design permits many changes in configuration. The building is conceived and developed by its own architect in terms of the educational program, the community environment, and the site.

In music, order and design create an opportunity for flexibility; the notes provide a vocabulary for infinite expression. It is my feeling as an architect that the analogy is valid; the SCSD System provides a neutral keyboard allowing varied architectural possibilities without esthetic bias.

COMPLETE FLEXIBILITY IN MANAGING SPACE . . .

The original specifications for the SCSD System proposed three bold accomplishments for an integrated system of school-building components: adaptability, economic feasibility, and time-saving. Other attempts have been made with one or two of these factors as a prime consideration; this one sought to combine all three factors in a total solution.

What are the results? The time lapse between need and completion appears to have been reduced by approximately one-half. A portion of this saving is attained in each of the three phases of a project: planning and design, factory fabrication, and erection on the site.

The architect can devote more time to planning, programming, preliminary design, and other work that calls for his best professional talents. Components of the several compatible systems are designed in themselves for rapid erection. Equally important is the fact that, as compatible systems, they are designed to fit together in forming the finished structure on the job site. This, of course, leads to more rapid completion of the actual construction phase. In the matter of cost, the objectives of the system have been accomplished within target costs, within the range of normal school-building budgets, and with the probability of actual savings in comparison with conventional construction costs. Another objective was complete adaptability in the use of space. This the system has accomplished on a practical schedule of time and cost which makes it a major innovation in schoolhouse construction.

STRUCTURAL-LIGHTING-CEILING SYSTEM

It provides economically for long spans — 50 to 75 feet — over large column-free areas.

It embodies raceways for wiring of all kinds.

It saves weight, saves money — requires 1/3 less steel.

It simplifies and speeds up erection — assures earlier completion.

It provides a low maintenance steel ceiling and lighting system.

It provides 70 foot candle intensity with low glare factor.

It provides for rearrangement of lighting-ceiling system to conform with educational requirements.

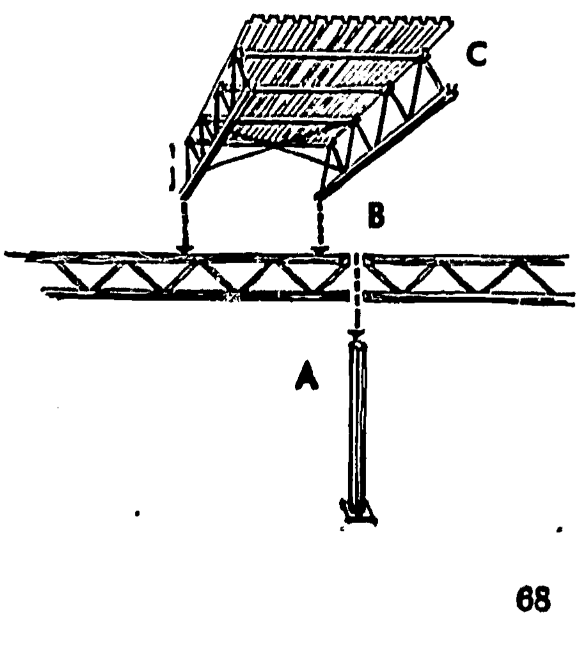
It provides air diffusers in ceiling-lighting system.

It permits the movement of air in two directions through the structure and delivers the air through the ceiling diffuser outlets.

It is designed to accommodate several mechanical systems without the necessity for field fitting and fabrication.

It accommodates movable partitions on a 4-inch module.

An infinite variety of plans can be developed around this type of Structural-Lighting-Ceiling System to satisfy the site, the program, and the creative bent of the architect. There is wide latitude for creative expression on exteriors, which are not an integral part of the system. There can be different spans — there can be a variety of configurations.



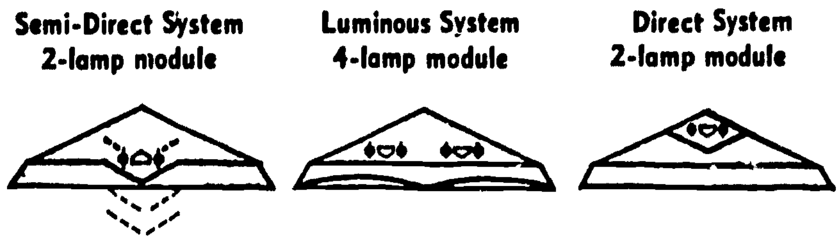
The three basic components of the Structural-Lighting-Ceiling System fit together in a simple sequence: The cruciform column (A) supports the primary beams (B), and the deck-truss units (C) are placed across the space between primary beams. The roof deck section of each deck-truss unit unfolds to bridge the gap between it and the adjacent unit.

This system is a new structural technique for school buildings that utilizes the inherent structural properties of steel roof deck. The system includes all columns and primary beams, all roof-spanning members for academic areas and gymnasia, and floor-spanning members. Also included is all insulation, flashing, and a 20-year bonded-type roof. The components are architecturally neutral, neither dictating nor inhibiting design.

Since a basic goal in the School Construction Systems Development program has been to avoid the building of identical schools, the Structural-Lighting-Ceiling System does not include the exterior walls of a school.

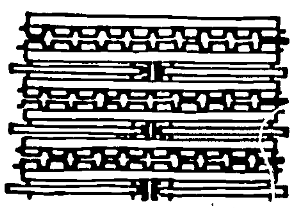
In keeping with the program's performance specifications, the lighting-ceiling components perform multiple functions by providing (1) Source of illumination; (2) Finished ceiling or soffit; (3) Ceiling sound absorption; (4) Sound attenuation between rooms; (5) Fire protection for the steel structure; (6) Support for demountable partitions; (7) Supply and return air devices.

Three kinds of lighting (direct, semi-direct, and luminous) and a flat ceiling panel fit with equal ease into basic 5 by 5-foot planning modules. By varying the number, type, and location of the lighting elements within the coffer, lighting systems with different visual and photometric characteristics can be achieved. Thus, different requirements for brightness and illumination level are satisfied (70 foot candles maintained in classrooms of average size and reflectances with low glare factor).

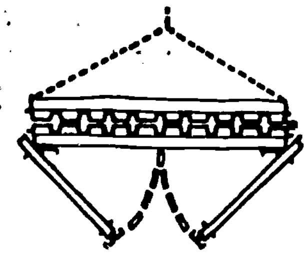


The three types of lighting are achieved by varying the placement of one simple fixture. Except in luminous ceilings, each two-lamp module is shielded by a triangular snap-on diffuser.

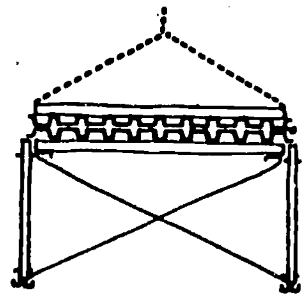
Although this structure bears some resemblance to a conventional bar joist and steel deck system, there is an important difference: Trusses spaced five feet on centers have no top chords. Instead, compressive stresses usually carried by the top chord are transferred directly into the basic roof-spanning member, a 20-gauge corrugated steel roof deck panel. As a result, the structure uses less than four pounds of steel per square foot compared to about six pounds for a conventional system.



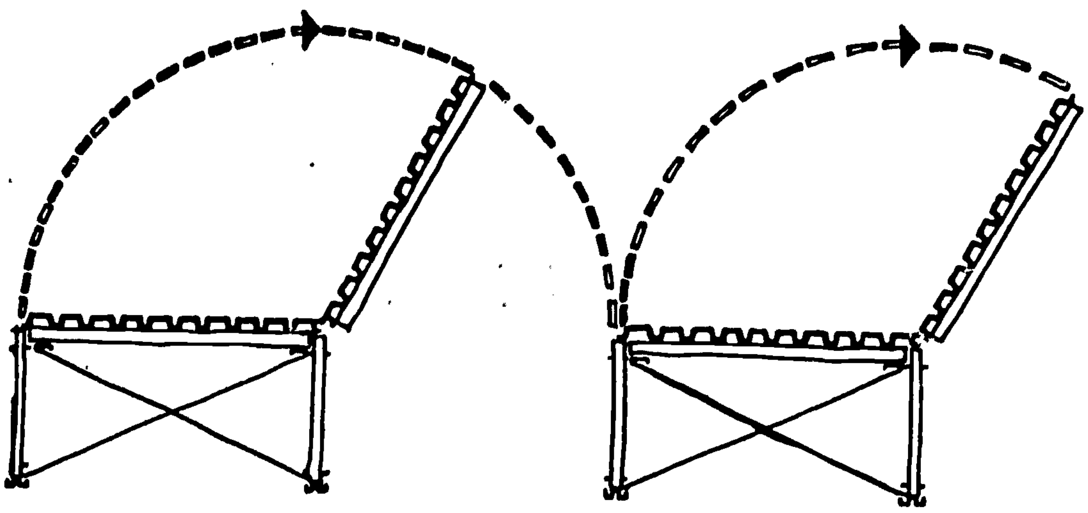
For ease of handling, and shipping, basic deck unit folds flat. Units stack for transport.



When unfolded, the deck unit is made rigid by light tension braces.



As deck unit is lifted, web sections unfold to their normal vertical position.



In-fill deck panel is unfolded to join, and be supported by, adjacent deck unit.

In order to ship units to a site economically, pivot joints were devised that allow each structural section to fold flat, for compact stacking with other sections. Erection involves lifting a deck unit from its package, allowing the webs to unfold. Then the unit is hoisted into position and attached to primary beams or columns.

The panel presented slides and movies to illustrate their discussion. At end of SCSD report:

Following the SCSD report, Charles D. Gibson presented "Performance Specifications for the Visual Environment in Schools and Colleges." For a complete report, see Nations Schools, *October, 1964, pp. 53-57.*