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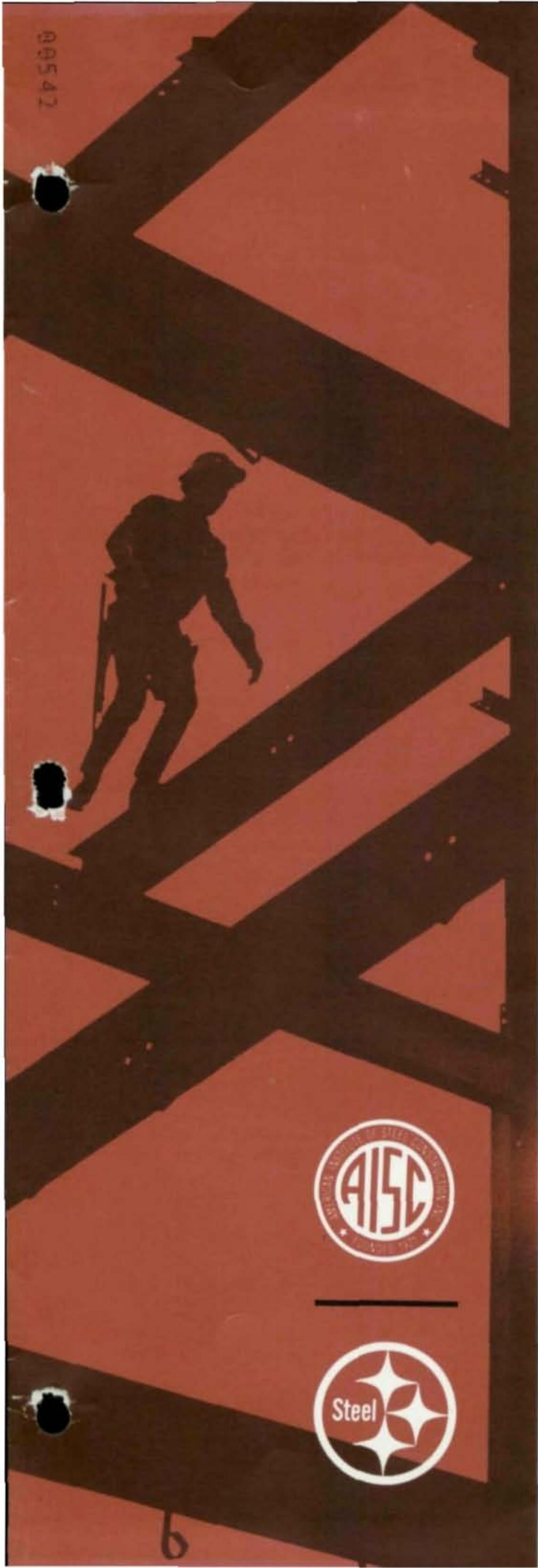

MODERN STEEL CONSTRUCTION

Steel Builds a New Image
On-site Development Adds Top Efficiency
Steel Preserves Historic Campus Landmark
A Space Frame Rises in Dallas

MODERN STEEL CONSTRUCTION

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ANNOUNCING: THE 8th EDITION OF AISC'S MANUAL OF STEEL CONSTRUCTION

Just off the press, the new AISC Manual reflects the technological progress and improvements that have been achieved in steel manufacture, design and fabrication during the 10 years since publication of the 7th Edition in 1970. Completely revised and updated, this 832-page, 6 x 9 inch, thumb-indexed volume is an essential reference and working tool for engineers, architects, detailers, draftsmen, contractors and building officials.

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- *Improved, easier-to-read allowable moment charts*
- *36 ksi and 50 ksi steels in each column load table, for easy comparison*
- *New load tables for WT columns*
- *Approximate method for preliminary beam-column design*
- *New column base plate design procedure*
- *New tables of allowable bolt and threaded fastener values*
- *New bearing tables for checking edge distance, fastener spacing, web tear-out at copes*
- *Revised tables of eccentric loads on connections, based on instantaneous center solutions*
- *New end plate shear connection tables*
- *New method for designing tension-loaded fastener connections without complex prying action formula*
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Steel Builds A New Image

Scovill, Inc., Waterbury, Conn., acquired a fresh, contemporary image with completion of its new world headquarters. Established in Waterbury in 1802, the firm was involved in the brass business. Over the years, the company outgrew the basic industry and became a leading producer of products for consumer and industrial markets.

The new, four-story steel-framed building of 66,000 sq ft is on a five-acre site just west of downtown Waterbury. Location of the new facility within city limits was a decisive move by Scovill officials to broaden the city tax base.

Scovill's new world headquarters projects contemporary image of company. Sloped facade of steel-framed building (east side) "Identifies us as an imaginative company," according to firm's CEO, Malcolm Baldridge. West facade of open-planned structure stands in sharp contrast.

Spacious four-story arboretum highlights steel structural system.

A New Image

A parallelogram-shaped structure was selected to project Scovill's new and progressive industry role. The building facade, a solar bronze-tinted insulating glass that covers about 30 percent of the exterior, creates an unusual contrast with the beige precast concrete panels.

While the east face of the building slopes 20 degrees and uses glass effectively, the west face expresses a different architectural feature with its recessed windows and cantilevered bays.

The building has an open-plan concept which minimizes hallway requirements. Typical bays are 36 ft x 42 ft. The new facility is 90 ft x 190 ft, with a roofline nearly 60 ft above ground level.

Steel members, and even high-strength bolts, remain exposed for strong visual effect.

Steel, Economy and Aesthetics

Built on a 26.5-degree skew, the steel-framed building has interior design amenities which complement the exterior architectural treatment, most visible of which is a four-story arboretum. Natural light enters the arboretum's glass walls on the northeast corner of the building.

The structural steel frame is rigid, with a composite beam and floor deck system. All the steel is A36. The composite floor system consists of 2-in. steel deck, 3¼ in. lightweight concrete.

Allen P. Tracy, in charge of structural engineering for Russell, Gibson, Von Dohlen, said a steel frame was selected because of its design flexibility and economy through speed and erection. In addition, he said a light framing system was required by the soil conditions.

To highlight the steel structural system, designers left exposed the 21-in. wide-flange columns and 18-in. wide-flange beams which frame the exposed arboretum. Even the high-strength bolts used to fasten steel members remain visible.

The ground level of Scovill's corporate center contains a reception area, an arboretum replete with trees, plants and shrubs, a mechanical area for building services, health and exercise room, two elevators—one glass-enclosed.

Employee support facilities—library, dining room and lounge—are on the second floor. The third level houses several administrative support departments. The top floor is reserved for executive offices. □

Architect/Engineer
Russell, Gibson, Von Dohlen
Farmington, Connecticut

General Contractor
Standard Builders
Hartford, Connecticut

Steel Fabricator/Erector
Berlin Steel Construction Co.
Berlin, Connecticut

Precast panel with integrated shading device swings into place on steel frame.

On-Site Development Optimizes Hospital Efficiency

by Jack DeBartolo, Jr., AIA and Frank B. Moson

St. Mary's Hospital and Health Care Center was the first such facility in Arizona. The original buildings were constructed at the eastern edge of the 32-acre site in Tucson more than 100 years ago. Over the years the facilities have been extended to the northwest, a growth which culminated in 1971 when an addition left no further space for expansion in that direction.

A new growth diagram was then developed for future expansion and replacement of facilities on the existing site. This new diagram turns the direction of growth back toward the site's center and allows orderly expansion and change over an extended period. The design involved adding new facilities, as well as replacement or remodeling of existing ones—and the expansion of existing services. All these tasks had to be accomplished without a major disruption of day-to-day health care activities.

Facilities Required

Expansion of St. Mary's called for four stories of new construction, with a partial basement for future services. The first floor contains a central plant, surgery, laboratory, G.I. labs, EEG, nuclear medicine and a new 40-bed critical-care facility.

The second floor is an interstitial level which contains air handling and other mechanical equipment for the entire building. The third floor contains 142 medical/surgical beds organized with all nursing support at the patients' rooms. The fourth floor encompasses a burn center, the only such facility in southern Arizona, as well as a pulmonary medicine rehabilitation center, respiratory therapy and orthopedic and rehab beds.

To complete this facility in the shortest time possible and with the greatest dollar savings—and still satisfy demands for efficiency — owners selected the fast-track process.

Expansion and Design

Since the existing hospital was to be retained to shelter administrative functions, and would house additional beds for some time, an efficient connection had to be established between the old and new wings. The task was complicated by the 10-ft floor-to-floor height in the old hospital.

Maintaining this 10-ft height in the new structure made distribution of medical equipment a difficult task. In the interest of economy, the second floor of the structure was designated as an interstitial level to house all mechanicals.

Mechanical distribution from the second floor feeds directly to the first floor in a conventional way. Ductwork, to carry air from the second floor interstitial space to the third and fourth floors, was installed in a distribution space between the structural steel and the precast skin of the building. Lateral air

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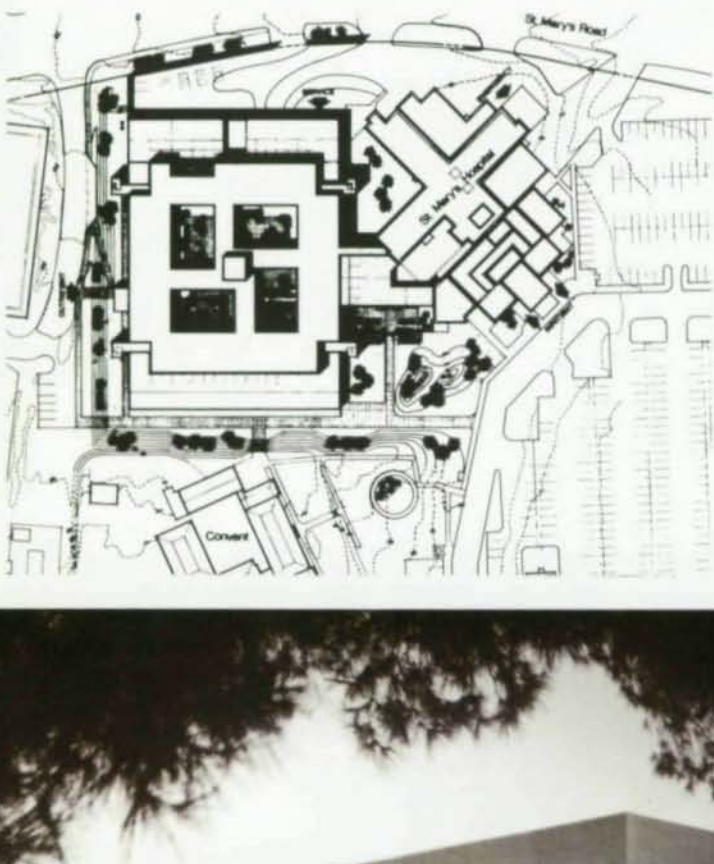
Jack DeBartolo is principal and partner-in-charge of project design, Anderson DeBartolo Pan Architects, Tucson, Arizona.
Frank B. Moson is director of marketing, Anderson DeBartolo Pan Architects, Tucson, Arizona.

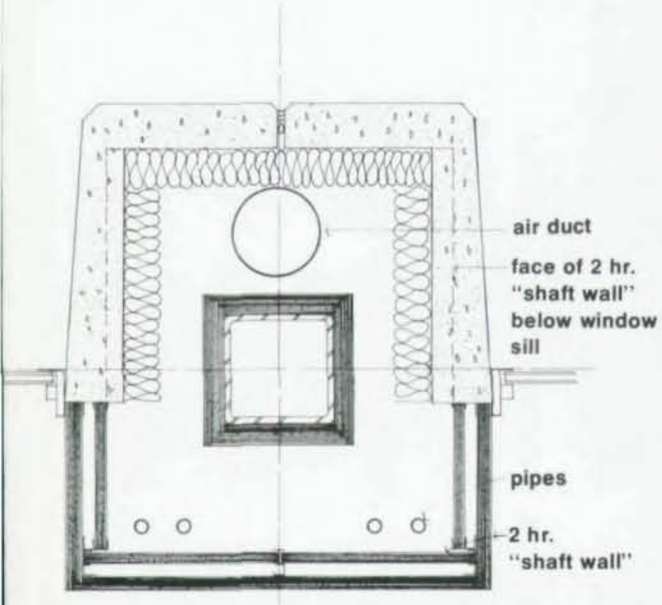
Erectors check trusses on second-floor interstitial level planned to facilitate mechanicals.



Newest St. Mary's addition on Arizona's oldest hospital turned growth to site center (see plan, l.). Tucson hospital was first one designed to meet 1976 seismic codes.

Patients' visual contact with outdoors boosts morale. All private rooms open to courtyards.

Detail at columns



ducts feed air into patients' rooms.

To meet air distribution code requirements, and to permit air supply from exterior walls, no interior space could be more than 50 ft wide. The air distribution problem was one of the major factors in arriving at the hospital configuration.

Four courtyards were established within the structure's core, thus regulating the depth of building spaces. This permitted ductwork to be fed up from the interior courtyard between the structural steel and the precast skin, as well as from the perimeter walls of the hospital. As a result of this approach to air distribution, shorter runs of the mechanical system were established, thus reducing overall energy costs for heating/cooling.

All semi-private patient rooms have an exterior window, and all private rooms have windows that look out upon one of four courtyards. The concept of patients' direct visual contact with the outside environment resulted in a reduction of artificial lighting — and a boost in patient morale.

Steel Framing Details

The four-story, 235,000-sq-ft facility required 1,300 tons of structural steel framing. And it was the first major hospital in Arizona designed under the revised seismic provisions of the 1976 Uniform Building Code. Lateral load resistance is provided by steel moment frame action in both directions. The interstitial space is contained between the top and bottom chords of second-level trusses.

The column grid at grade is 50'-0" x 50'-0"; column grid at upper levels is 16'-8" x 33'-4", with interstitial trusses acting as column load transfer elements for upper columns.

Top and bottom chords of the interstitial trusses are high-strength, A572 wide-flange sections. Web members of these trusses are A500 structural tubing. First-level columns are A36, 14-in. wide-flange sections, but columns from the third level to the roof are A500 grade B, 8" x 8" structural tubing. The horizontal framing, excluding top and bottom chords of interstitial trusses, is A36 steel.

All bolting was done with A325 high-strength bolts. Use of tension-set ("TS") fasteners proved especially advantageous, since they could be installed with an electric non-impacting tool. This technique greatly reduced the noise levels of the bolting operation for the benefit of occupied hospital areas.

Composite floor construction is 3¼-in. structural lightweight concrete over 1½-in. steel decking. Roof structure is insulating concrete over 1¼-in. form decking.

The exterior walls are precast masonry panel cladding. The panels, designed to incorporate integrated precast shading devices, protect exterior windows from direct rays of a hot Arizona sun. □

Architect
Anderson DeBartolo Pan Architects
Tucson, Arizona

Structural Engineer
RGA Consulting Engineers
Tucson, Arizona

Construction Managers (joint venture)
CM,Inc. Construction Managers
Houston, Texas
and
M.M. Sundt Construction Company
Tucson, Arizona

Steel Fabricator
Utah American Steel Company
Salt Lake City, Utah

Historic Syracuse University Hall of Languages was totally remodeled inside – from top to bottom – without disturbing exterior. Photos courtesy Syracuse University Photo Center.

From the Top Down— Steel Preserves Historic Landmark

by Arnold A. Bitterman, P.E.

Built of steel, and in a most unusual way, a campus landmark has a whole new interior. "Functional beauty" is how Melvin A. Eggers, chancellor of Syracuse University, describes results of a $4-million interior renovation of the university's Hall of Languages. Structural steel played a key role in achieving that functional beauty in a complex project which involved erecting an entire new building inside an old one.

"HL" was the first building on the Syracuse, New York campus, and it is now the home of the university's College of Arts and Sciences. The 1873 exterior — the part of the building that gained it a listing in the National Register of Historic Places—remains virtually unchanged after the renovation. But inside, the original four floors — and almost the entire interior—have been gutted and replaced by five new levels. Structural engineers had determined that steel erection had to commence with interior demolition to properly brace the structure.

Distinctive New Feature

Focal point of the new design is the dramatic octagon-shaped atrium that replaced the original quaint, but narrow and twisting, central stairway. The atrium houses a wide, open staircase that

New steel columns (Task 3) given intermediate bracing by installation of new fourth floor (Task 6).

Arnold A. Bitterman is a partner and chief structural engineer with Sargent-Webster-Crenshaw & Folley, Architects, Engineers, Syracuse, New York.

Drawing defines areas in unusual project.

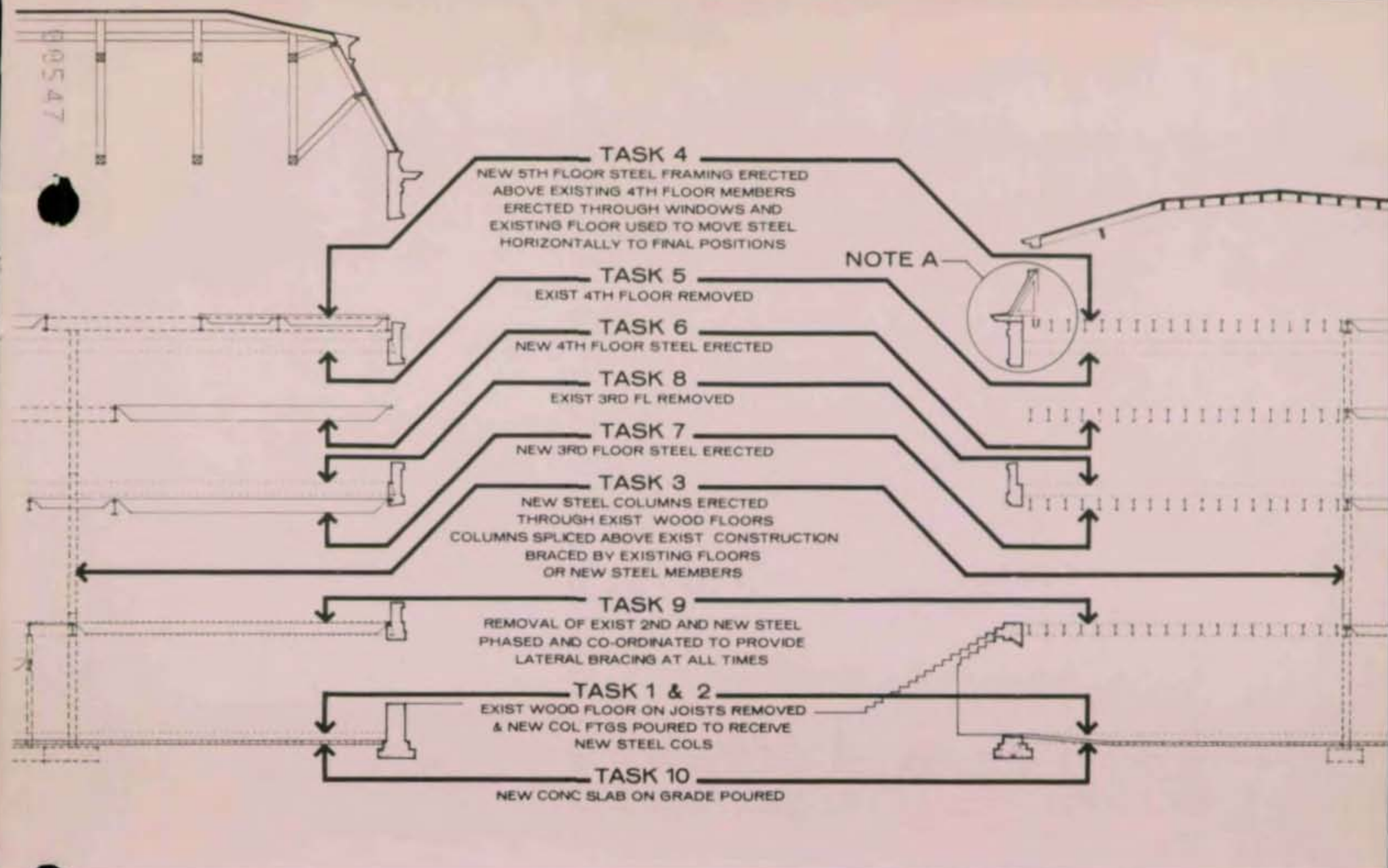
In the window–
150 tons of structural steel!

slopes diagonally through the building.

Throughout the interior, glass partitions and modern lighting now convey openness and brightness. Western hemlock ceilings in the atrium, and natural oak woodwork, set off the fresh, white walls. Gray tweed carpeting and Delaware County bluestone steps carry out the earth-tone motif.

In addition to erasing the scars of a century of wear, the renovation has improved the building's energy efficiency, safety and comfort, and made it fully accessible to the handicapped.

Construction from the Top Down
The key to the demolition-steel erection



Carefully phased demolition-steel erection involved ten tasks defined in drawing. "Note A" refers to aspect of Task 4.

process was that after erection of new steel columns, work proceeded not in the usual order—but from the top *down*, beginning with a new fifth floor.

Early erection of the fifth floor was necessary to provide support for existing exterior perimeter bearing walls, which in turn supported the old wood trusses for the massive roof. Over 75 percent of these perimeter walls were bearing on the original fourth floor. These wood stud walls are now supported by two 12-in. steel channels erected on either side of the studs. Lag bolts and steel clips transferred the load to the steel channels.

Another factor prevented normal bottom-to-top construction. That was the existing construction of interior bearing walls, some of which were to be removed, and some retained. Ultimately, about 70 percent of existing interior bearing walls were removed.

Central to the erection of the new fifth floor was use of the existing fourth floor as a working platform to receive the new steel, which was hoisted and unloaded into the building through the windows. Once inside, typical W21 x 82 and W21 x 112 steel girders were moved over the floor into final position by small, rubber tire-mounted adjustable hoists.

At the second level, erection of steel was complicated by an existing floor elevation which was the same as that of the new floor. Removal of existing floor construction had to be phased and coordinated with new construction to provide lateral bracing for the new steel columns and for exterior bearing walls.

This feat was accomplished by removing the existing framing in one small section at a time and following immediately with erection of new steel framing. The flexibility and versatility inherent in steel permitted the few necessary field corrections to be made quickly during the demolition and steel erection processes.

Completion on Schedule

The university had fixed the demolition start date as May 15, 1978, and required "HL" be out of use for no more than one academic year. Interior finishes were completed in August, 1979 so that the Hall of Languages could open for the Fall semester.

The office section of the building

Created 200-seat fifth floor colloquium
features panoramic view of campus, opens into clock tower.

Looking up through atrium to added fifth floor ceiling from new second level.

houses the Honors Program, departments of Fine Arts, Religion and Philosophy and part of the English department. About 70 faculty offices, plus departmental suites and the dean's office, occupy floors three through five.

On the fifth floor, the 200-seat colloquium space features a 28-ft high opening into the clock tower, and a panoramic view of the campus from three 12-ft-high arched windows. More than 2,300 students can be accommodated in the building classrooms, mostly on the first two floors.

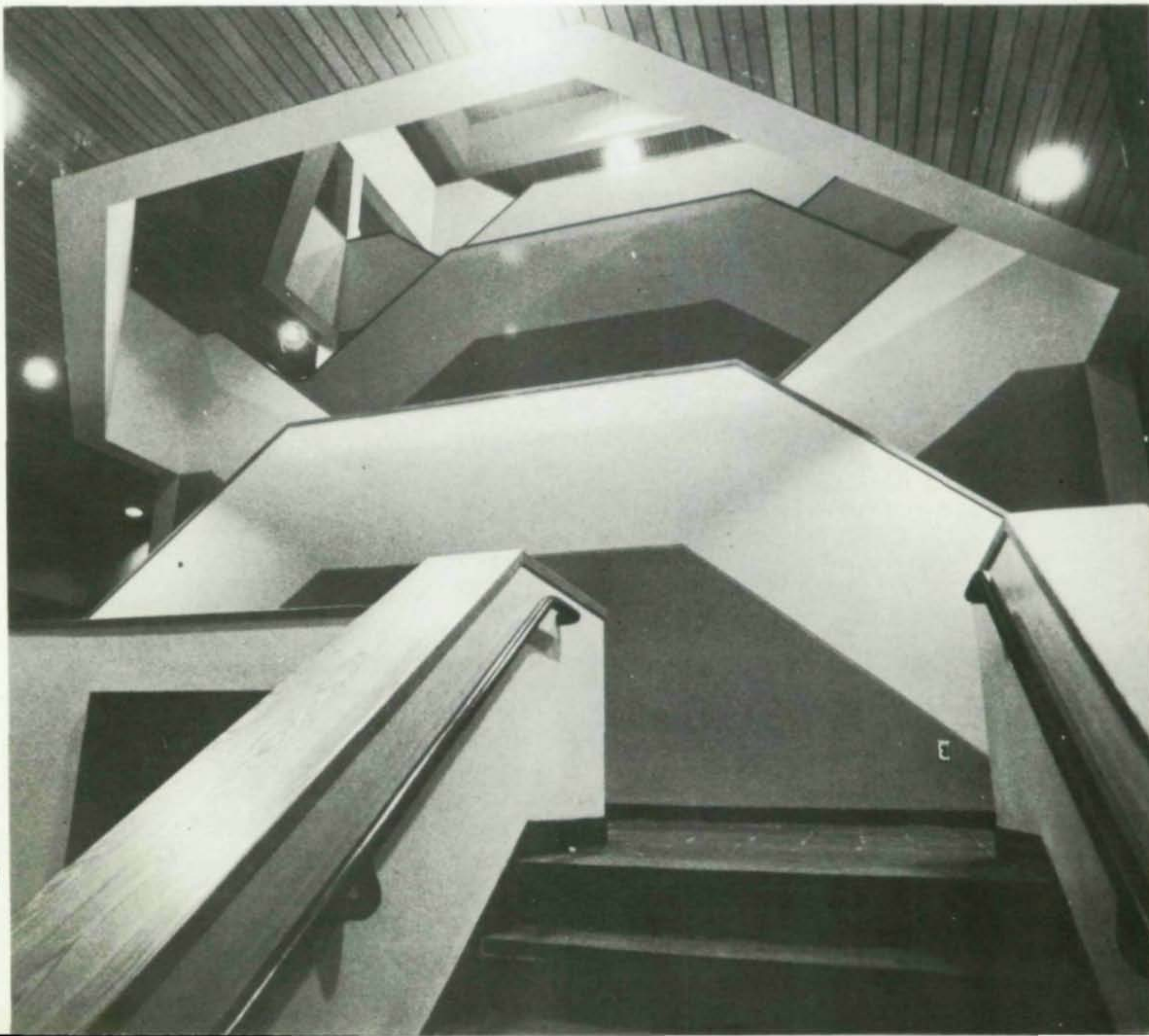
The student, faculty and administration reception of the renovated building has been very enthusiastic. And Syracuse University looks forward to another 100 years of service from their newest, *and oldest*, structure. □

Architect/Engineer
Sargent-Webster-Crenshaw & Folley
Syracuse, New York

Design Consultant
Architectural Resources Cambridge
Cambridge, Massachusetts

Construction Manager
J.D. Taylor Construction Corp.
Syracuse, New York

Focal point of new interior, finished atrium replaced original narrow, twisting central stairway.



Dallas' Reunion Arena with its unusual space frame roof is open for special events throngs.

Four-Acre Space Frame Rises in Dallas

Dallas' civic center convention complex has a new addition: the Reunion Arena, a special events coliseum, which opened in April, 1980. An assortment of entertainment, from rodeos and boxing competitions to concerts and ice shows will be hosted in the $26-million hall. Seating for 17,200 spectators in flexible configurations is provided by the oval-shaped arena.

The most unusual feature of the new hall is a four-acre space frame, one of the largest ever built. Using a shoring procedure similar to bridge construction, the 420-ft square roof, composed of 1,875 pieces, was erected section by section. The steel frame rests at an oblique angle on eight heavily reinforced, but slender, concrete support columns located near the corners of the building.

According to the builders, this construction permitted a more economical use of steel, saved 20 percent of the cost of a conventional roof and used about 30 percent less steel than would have been needed for a trussed roof.

Space Frame Optimizes Efficiency

The skewed space truss was finally adopted because it was the most efficient structure, in both weight and cost, to span the 412 ft between the eight supporting columns. The skewed truss is more efficient than the orthogonal two-way truss system originally considered, for two reasons: the array of staggered top and bottom chords, connected by skewed diagonals between the nodes, allows all space truss members to participate in carrying all loadings, with relatively balanced forces in the members. The two-way system tends to concentrate loads in the nearest trusses, without efficient participation of adjacent trusses.

Skewing the truss grid 45 degrees in plan stiffens the corners and causes reversals across them, effectively reducing the mid-span moments and deflections. This action is similar to that in continuous beams with cantilever and spans that reduce the mid-span moments. Member forces are reduced correspondingly.

The space truss system acts three-dimensionally much like a flat plate, so that members are more evenly, and thus more efficently, stressed.

The amount of steel saved in going from the two-way truss system to the skewed truss was about 800 tons — which represented a net savings of about $850,000.

The space truss has a 36'-5" module, and an 18'-10" center-line depth. Top and bottom chords are parallel, and staggered from each other in plan one half module in each direction. The nodes are connected by the skewed diagonals. Top and bottom chord members are A572 grade 60 steel wide-flange sections that vary from W14x34

Topped out, gigantic steel space frame is ready for roof deck.

to W14x233. Diagonals are mostly A36 steel wide-flange sections that vary from W10x33 to W12x79, with some A572 grade 60 steel W14 sections.

Connection plates are of A572 grade 50 and grade 60 material. All connections are shop-welded and field-bolted with 1¼-in. A490 bolts. Some connections are patent-pending by Dr. Paul Gugliotta, consulting engineer on the project.

Supports at the column tops are based on neoprene pads that permit rotation with various loadings. Temperature expansions and contractions are resisted by the columns, whose tops move under these forces.

The economy of a space truss system is primarily the result of weight savings inherent in the efficient space truss action and in reduction of numbers of members and joints.

It is important to the economics of a space truss, according to Dr. Gugliotta, that the module and depth be chosen properly, with due consideration to the geometry of the structure, kinds of loadings and support conditions.

And, it is necessary that connections be simple, universal and easily fabricated; and that the space truss can be assembled on the site economically, without field-welding, with standard bolting procedures. Connections for this project were designed to be field-bolted with a minimum number of bolts per connection.

Because of the stability at each corner such a frame has less tendency to sag at the corner when deflecting.

Rising 73 ft above grade, the roof is a pyramid-like network of high-strength wide-flange members up to 14 in. deep covered with an insulated roof deck. The roof, with the clear span of 412 ft, overhangs 4 ft on each side. The space frame's 22-psf weight is increased some 1,790 tons by rigging, mechanical loads and catwalks. Together, live and dead loads on each column are about 1,670 kips. And the design moment at the base of each column is 24,405 kip-ft.

Connections between the frame and tops of the concrete columns are steel box sections embedded in 5-ft high column caps and bolted to the frame with four 3-in. diameter bolts.

Craftsmanship and Aesthetics

Construction and erection of the arena roof was a mammoth undertaking. On top of the building, up in the air, the space frame was actually erected a piece at a time. The pieces, all single members, ranged in length from 25- to 100-ft. Lifted into position, each piece was bolted into place. And, once all pieces were in place, the roof was lowered by hydraulic jacks, one-quarter inch at a time, into final position.

Completed, the arena, even with its imposing roof, exhibits a rather fragile, airy aspect. A back-lit glass enclosure around the edges of the space frame roof makes it appear, at night, to glide—almost to drift—above the arena floor and seating area. □

Designer
Harwood K. Smith & Partners
Dallas, Texas

Engineers
Paul Gugliotta Consulting Engineers
New York, New York

Contractor
Henry C. Beck Co.
Dallas, Texas

Space Frame Designer/Builder
P.G. Structures, Inc.
New York, New York

Steel Fabricator
Mosher Steel Co.
Houston, Texas

Aerial shows perspective of steel roof trusses to 17,200-seat arena.

Massive four-acre interior adapts to many different types of entertainment.

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