VOLUME XX NUMBER 4 / FOURTH QUARTER 1980

MODERN STEEL CONSTRUCTION

An Education in Speed
Harvard Athletic: A Break with Tradition
1980 Prize Bridge Winners
Space Up, Costs Down—with Steel
Crystal Cathedral: Just Call It Unique!

MODERN STEEL CONSTRUCTION

Published by

American Institute of Steel Construction
The Wrigley Building
400 North Michigan Avenue
Chicago, Illinois 60611

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1981 AISC NATIONAL ENGINEERING CONFERENCE

Leading authorities in the fields of steel design, research and construction will meet in Dallas, Texas on April 30-May 2 to exchange ideas and information. The engineer, architect or educator who wishes to keep informed about the continuing developments in these fields will find this conference a valuable and stimulating experience.

Program highlights include:

STRUCTURAL STEEL RESEARCH

Status Report/*W. A. Milek, AISC*

Connection Panel Zones/*R. G. Slutter, Lehigh University*

Eccentric Load Tables in the 8th Edition Manual
R. H. R. Tide, Paxton & Vierling Steel Co.

Structural Tees in X-Bracing/*A. D. M. Lewis, Purdue University*

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R. Tomasetti, Lev Zetlin Associates

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Aesthetics of Truss Bridges
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Load Factor Design for Bridges
L. A. Garrido, Louisiana Department of Transportation

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North Sea Drilling Platforms/*Clar P. Ulstad, Tokola Offshore (UK) Ltd.*

Controlled Demolition/*J. D. Loiseauz, Controlled Demolition, Inc.*

Non-Principal Axis Buckling of Compression Members
M. Ojalvo, Ohio State University

T. R. Higgins Lecture

Contact AISC, 400 North Michigan Ave., Chicago, IL 60611 for information about registration.

Ridgewood Junior High—a compact, open-planned structure for 1,500 students, New Port Richey, Florida.

Ridgewood Junior High: An Education in Speed

Provide a compact, air-conditioned facility for 1,500 students, one that permits natural light and ventilation into every teaching area — and do it in ten months.

That was the challenge that fell initially on the designers of Ridgewood Junior High School, New Port Richey, Florida. Rowe Holmes Associates Architects took up the challenge in designing the new junior high campus.

The school's educational program strongly established a "media center" as the academic hub for the entire school complex. Yet, a need for security and a controlled access to that special area precluded an open, barrier-free solution.

Skylights pour daylight into a bright mall and interior spaces that would otherwise be buried. At the same time, the mall serves as both a major space for student circulation and as a common, multi-disciplinary meeting place for students.

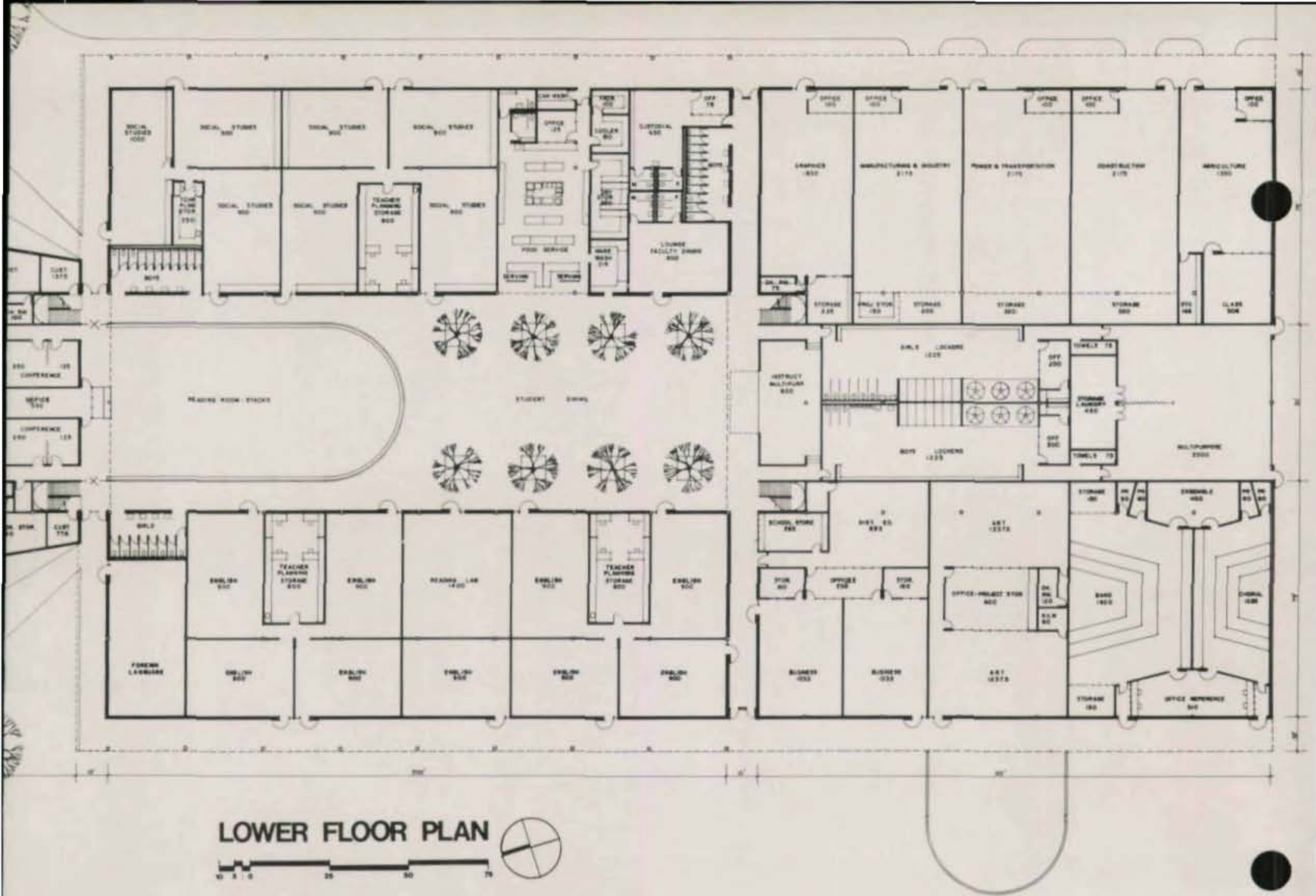
Media Center "Hub"

By surrounding this mall area with a 9-ft high free-standing screen wall, the designers provided a highly visible space that is both informal and relaxing, yet with needed controls.

The remainder of the mall was developed as a cafeteria/multi-purpose area, replete with large trees, to create a casual, sidewalk cafe atmosphere. The entry level, midway between the first and second floors, provides public access to either from the major parking areas.

Both the media center and cafeteria/multi-purpose areas on the first floor can be used for community activities without disturbing others in the rest of the building.

The time frame for construction allowed only ten months to get the building operational. That dictated a fast-track approach, and also influenced the choice of major building materials. A systems-type steel frame —a specific depth structural framing with standard connections — was specified for its speed of both fabrication and erection and the clean, aesthetic appearance of the finished assembly. And, a construction time plus — this modular framing permitted the architects to proceed with structural designs even before the



Sidewalk cafe-like atmosphere provides cafeteria/social center for students. Open steel joists and contemporary ducting cut costs. Floor plan (above) relates media center and cafeteria/multi-purpose area.

final interior configurations were completely determined.

On the upper level, the building exterior is clad with foam-filled metal wall panels, with the lower level done in concrete block. Construction on both floors could thus proceed simultaneously.

Because of the pleasing geometry of the open-web joists and truss-girders in the central mall, no suspended ceiling was needed there, or in the gym. Classroom areas have integrated *lighting-ceiling assemblies that interface* with the steel framing — with the resultant savings in both cost and time in erection.

Steel a Major Factor

According to the architects, "Steel, coupled with a systems design approach, was a major factor in maintaining a stringent cost budget and an early project delivery schedule."

The light-framed systems steel construction provided an in-place structure frame early on in what proved to be an intensively paced project. This light steel framing also permitted long, clear-span and column-free bays without a premium on foundation costs.

And, the steel frame, elected as most compatible with the exterior steel wall panel system, came out in final cost columns at 12% below the budgeted figures. □

Designer
Rowe Holmes Associates Architects, Inc.
Tampa, Florida

Structural Engineer
Rast Associates, Inc.
Tampa, Florida

General Contractor
CM Associates, Constructors/Managers
Houston, Texas

Typical classroom, this one a chemistry laboratory, demonstrates clear-span classroom areas attainable through use of lightweight modular steel framing.

Academic hub of school is airy media center, a highly visible, yet controlled-access area surrounded by a 9-ft wall.

New home of Garden Grove Community Church, Crystal Cathedral reflects surroundings in sea of mirrors. Steel framework (below) details masterpiece of steel structure before it was sheathed in glass.

The Crystal Cathedral: Just Call It "Unique"

Exciting! Spectacular! Colossal! Unbelievable! You soon run the gamut of superlatives to describe what has been billed "the most talked-about religious building of the 20th century." We refer to the Crystal Cathedral, the new steel-and-glass home of Garden Grove Community Church, 40 miles south of Los Angeles, Cal. The star-shaped cathedral, a lacy lattice of steel work covered with reflective silver glass, shimmers in the California sun—and reflects "a sense of freedom for the human spirit," according to the church's founder and pastor, Dr. Robert H. Schuller.

Designed by famed architects Philip Johnson and John Burgee, New York City, the $18-million structure leaves no doubt whatsoever about its being impressive. The white-painted space-frame canopy of steel pipe reaches out 420 ft in length and 210 ft across to form a four-pointed star. Soaring 127 ft to the church's roof, itself three sloping glass planes, the finished structure encloses 3.5-million cu ft of space to achieve the open-air effect envisioned by the pastor. Johnson/Burgee Architects took on the tremendous challenge of converting the pastor's 25-year dream of what a church building should be into reality.

Design Posed Challenges

Erecting a never-done-it-this-way-before structure such as the Crystal Cathedral provided some interesting challenges. Getting the 950 tons of steel in 625 chord members, 64 wall trusses, 50 roof trusses, 27,000 steel gusset plates and 29,000 pipe diagonals to fit perfectly sounds incredible enough. Add to that a tight working area, a fabricating operation that had to be coordinated 250 miles away and some complicated erection requirements, and the whole thing becomes even more incredible.

The reporter who likened the building to a giant Tinkertoy set couldn't be far from right. Special scaffolding had to be used to create a structurally independent shoring system to provide support for the long, thin roof trusses. The scaffolding contractor, Patent Scaffolding Co., designed and built special shoring systems to withstand heavy seismic loads and winds up to 100 mph.

One of Pittsburgh-Des Moines Steel Company's two field engineers on the project, Nancy Bendel, said, "You wouldn't believe the checklist for getting a correct fit."

Erection of the cathedral was virtually an assembly line. During the four months of erection time allotted, wall trusses came from Pittsburgh-Des Moines' Fresno plant two at a time. Then they were sub-assembled on working tables into a fully welded unit —a 15-ton unit to be tipped into place from the working tables. As many as 12 work tables were in operation at one time to keep the job moving. Coupled with a very small working space, kept so to accommodate the congregation in their existing church, a massive pre-planning operation fell to the fabricator.

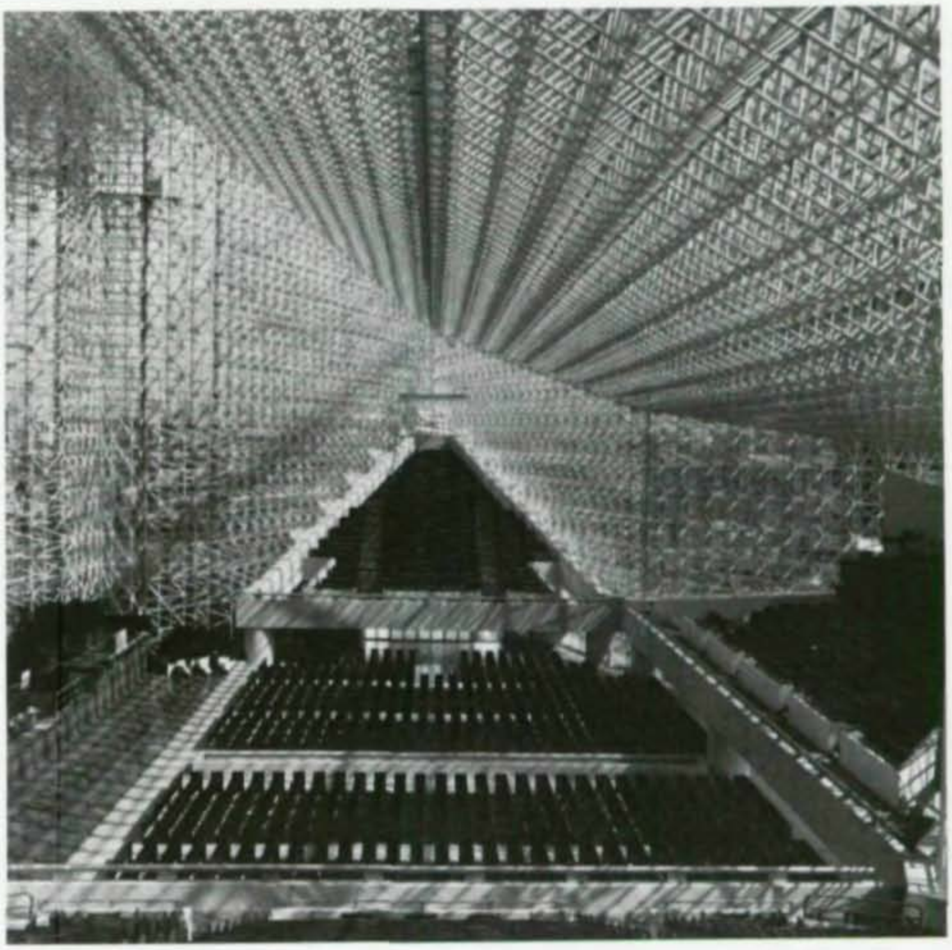
Massive 90-ft high doors (panels outlined by black gaskets) pivot outward to open service to outdoor congregation. Movable glass panels on left provide ventilation.

The building was built from the center out, and literally from the top down. The field engineers planned what their first needs were, then coordinated them with the Fresno shop. When the shop sent a unit, along with it would come all the plates, bolts, etc. needed for its erection. Plans were numbered so that pieces could be numbered. Meanwhile the erectors would "shoot" an elevation so they were ready to set up a truss. The trusses had to be worked without double handling, or so the crews would not work themselves into a box. Once a truss was off the table, a new truss came from the Fresno plant.

Then, too, the field engineers had to coordinate with the crews in the air. As many as 60 ironworkers were on the job at one time. Six FM units were employed to communicate and coordinate assembly, surveying and erection. The crane operator was tied in with head phones so he could make the necessary critical adjustments. Engineers even monitored how parts would fit at a given temperature.

The unusual roof angles were a critical part of this structure, since it was built from the top down. Levels were constantly checked so that adjustments could be made at top or bottom. As many as four transits were in operation at one time, checking levels to tolerances of 1/16 in. Crews had to preset the finished elements of the legs to support the trusses against wind load. For this, high-tension anchor bolts were used.

Lacy lattice of steel trusses frames 3,000-seat sanctuary, lends open-space air to worshippers. Closeup (above) shows interrelation of structural members.



Lots of miles "climbing the iron" went into fitting assemblies of gigantic filigree of steel and glass.

So many elements had to be coordinated, checked, re-checked, and so many problems solved, that, "We had to climb a lot of iron," in Nancy's words.

Three crews were used to erect the structure. A raising gang set the trusses into position. A second crew of scaffolders would set a platform for welders, the third crew. While welders worked, the first and second crews continued the erection cycle. To set the roof and center trusses required a double pick by two cranes, while the third and fourth cranes set the north and south roof trusses. Four cranes, ranging from 50 to 150-ton capacity and with booms up to 200 ft, were needed to pick up, reach over and set the sub-assemblies.

One of Pittsburgh-Des Moines Steel Company's field engineers, Nancy Bendel (l.) confers with ironworkers V.L. Cosgro and V.G. Kripal on critical details of erection. Eye on detail, Nancy checks close tolerances required to get sub-assemblies to fit precisely. Often four transits were working simultaneously.

Fabrication Complicated

Pittsburgh-Des Moines Steel Company, 250 miles from the church site, fabricated the 950 tons of steel pipe (160,000 ft of it) and solid bar into the 114 trusses needed. Before their long trip to the site, the assembled trusses were sprayed with two primers and a finish coat, a vinyl high-build system, for a total of six mils thickness. The inside of the pipe was also painted.

The project was a sophisticated fabrication job, not only because it required fabrication of a three-dimensional truss, but also because the members were pipes and solid rounds, with dimensioning for all pieces measured from the center lines of members. The shop did an enormous amount of quality control on each truss—the three-dimensional accuracy and squareness of the trusses, and the position of the glass clips. Three assembly jigs were required on this project to achieve the high degree of accuracy demanded.

A monumental task was to get the steel to the job site. A major problem was the long and wide trusses, plus the tremendous quantity and variety of loose pieces that were shipped with each. The trusses, up to 118 ft long, were shipped on trucks, some with stretch beds and a dolly rig behind. Coordination of shipping with the work of erection crews was vital due to the traffic problems on the road and equipment on the site.

Whatever your personal evaluation of the Crystal Cathedral, its concept or its architecture, you have to call it "unique." □

Architect
Johnson/Burgee Architects
New York, New York

Structural Engineer
Severud-Perrone-Szegezdy-Sturm
New York, New York

General-Contractors (joint venture)
C. L. Peck, Los Angeles, California
Morse/Diesel, Inc., New York, New York
Koll Co., Newport Beach, California

Steel Fabricator/Erector
Pittsburgh-Des Moines Steel Company
Pittsburgh, Pennsylvania

Owner
Garden Grove Community Church
Garden Grove, California

Traditional gate to Harvard University Athletics Complex swings open to new, contemporary Natatorium building. Photos by Nick Wheeler.

Harvard Athletic Facilities: A Break with Tradition

by Greg Downes

Swimming, track, tennis, hockey. The new Harvard University athletic facilities have it all. In response to the growing interest in exercise and athletics within the University community, both new and renovated facilities have been built to accommodate the fast-growing numbers of women, graduate students and faculty who want to be involved.

Greg Downes is a vice president of TAC. He, and Chip Harkness, TAC's president, were in charge of the project.

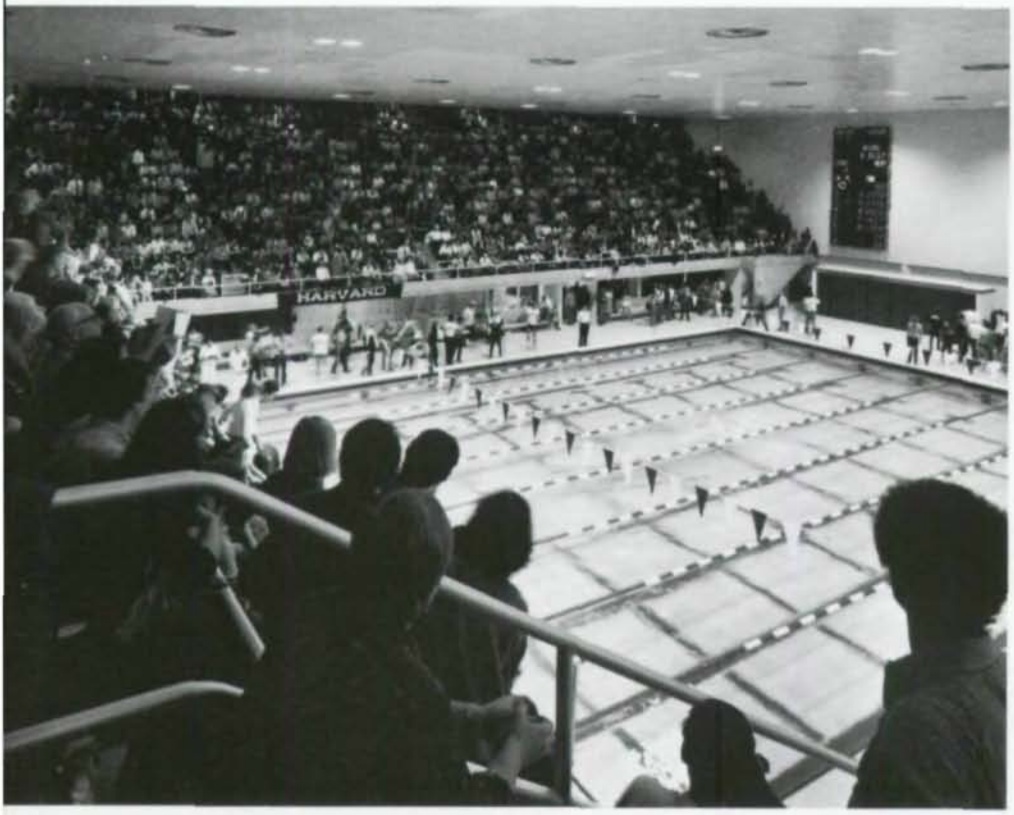
In building the facilities, Harvard departed from its traditional approach to design and construction. Officials wanted to save time in project scheduling, and explore innovative ideas that would provide them with both design and cost alternatives. To achieve these goals, the University decided to investigate the advantages offered by experienced design/build firms. As a result, they invited qualified architects and contractors to form such teams.

Ten Teams Compete

Prequalification criteria were established and published by the University. They defined the specific basic requirements for architects, contractors and their consultants who wished to be considered participants. Ten teams who best met the qualification criteria were selected to participate in the design/build competition.

The winners? The TAC/Turner team, a joint-venture of The Architects Collaborative Inc., Cambridge, Mass., and Turner Construction Co., Inc., Boston.

The new facilities were constructed next to the football stadium on Soldiers Field along the historic Charles



Natatorium provides facility for competition, water sports and recreational swimming, plus seating for 1,200. Long-span steel joists are covered for moisture protection, sound dampening.

Largest clear-span trusses (12 ft × 192 ft) in New England bridge running tracks, infield tennis and weight-throwing areas and bleachers for 1,500 in new Track & Tennis Hall.

River in Cambridge. The new buildings establish a backdrop for the older buildings, as viewed from the Charles River, and recall some of the forms of existing buildings.

New and Renovated Structures

The total project, when completed, included diverse facilities:

1. Natatorium (new), with a pool 25 yds. by 50 m. long, with three sections of various depths for competition, diving, water sports and recreational swimming — along with supporting facilities and spectator seating for 1,200.
2. Track and Tennis Hall (new) incorporates a six-lane, 220-yd. oval running track, with five tennis courts in the infield, a screened weight-throwing area and bleacher seating for 1,500 spectators.
3. Hockey Area (remodelled building) includes new ice surface and boards, permanent seating for 2,800 and supporting locker and shower facilities, a press gallery and a lounge.
4. Women's Locker Facility (new)
5. Dillon Field House (remodelled), with medical and training rooms, coaches' offices, and recreational lockers and showers.

The fundamental element of TAC's original design was to provide continuous indoor participant circulation to all facilities at ground level. On the second level, a platform provides sheltered outdoor circulation for spectators at all facilities. This concept creates a clear separation between players and spectators. And each of the major sport facilities (track, swimming, hockey), although a part of the whole, maintains its own identity and can be used separately without the need to open the entire complex. Both the scale and location of new buildings were considered to develop a proper relationship to existing buildings and the stadium. Their exteriors include walls, ramps and berms up to the platform level, with traditional Harvard red brick predominating.

Largest Clear-Span Steel Truss

The interiors of the major sport facilities are steel roof construction with field-bolted truss sections and open-web joists. Mechanical equipment, such as ductwork, is exposed, and painted, to express a well-integrated structural/mechanical system.

The track building features 12-ft deep, red-painted trusses that clear-span 192 ft, largest erected in New England up to that point in time. In contrast, the hockey building is clear-spanned with steel bents. These steel frames that span the width of the building were uncovered when existing walls were removed and new walls built. This permitted spectator circulation along the concourse at the perimeter of the new structure.

Existing steel bents were fireproofed, and strengthened with steel plates to meet current seismic requirements. In both the hockey and track buildings the steel structure is exposed and painted. The trusses and other roof members became an appropriate structural expression in the large, open space for the players and spectators.

In the swimming pool area, the long-span steel joists are covered with a perforated aluminum hung-ceiling, with insulation and vapor barrier to protect the steel structure from chlorinate in the air, and provide sound dampening.

Harvard's new facilities create an environment compatible with the existing structures. Differing steel structures permitted simple repetitive economies in construction — and at the same time allowed an individual shaping of each major space to meet the needs of each sport. □

Designer
The Architects Collaborative Inc.
Cambridge, Massachusetts

Engineers
Structural: Souza & True, Cambridge
Mechanical: Van Zelm, Heywood & Shadford
West Hartford, Connecticut

Contractor
Turner Construction Co., Inc.
Boston, Massachusetts

Remodelled Alexander H. Bright Hockey Center, clear-spanned with steel bents, was updated to include new ice arena, boards and seating for 2,800. Photos by Sam Sweezy (above) and Nick Wheeler (below).

1980 Prize Bridges

PRIZE BRIDGE 1980 — LONG SPAN

Mississippi Highway No. 25 over Tennessee-Tombigbee Waterway

Near Iuka, Mississippi

Designer/Owner: Mississippi State Highway Department, Bridge Division
General Contractor: Bowyer-Johnson-Kimes, Inc.
Fabricator: Main Span: Allied Structural Steel Co. Approach Spans: Gamble's Inc., Subsidiary of Trinity Industries, Inc.
Erector: Bristol Steel & Iron Works, Inc.

PRIZE BRIDGE 1980 — MEDIUM SPAN, HIGH CLEARANCE

Judge John Loughran Bridge

Kingston, New York

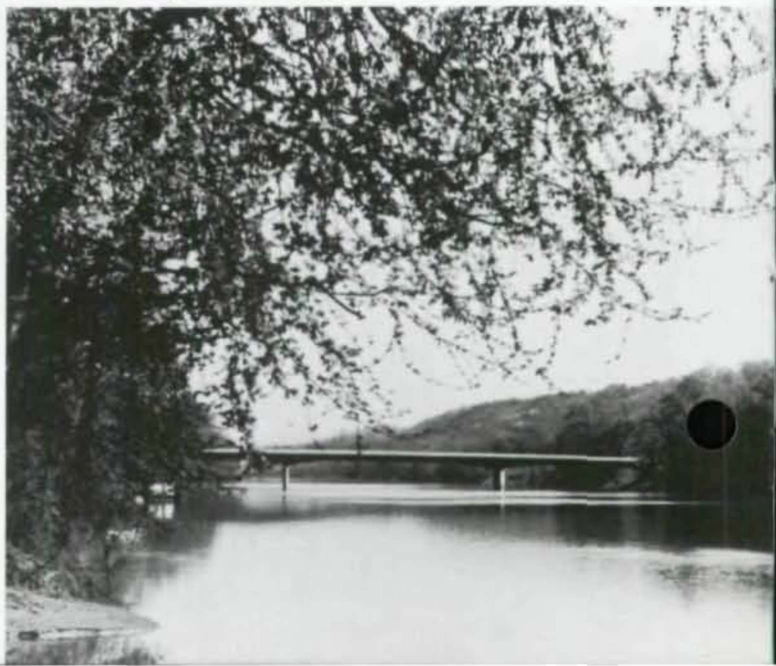
Designer: McFarland-Johnson Engineers, Inc.
Owner: State of New York, Department of Transportation
General Contractor: Slattery Associates, Inc.
Fabricator: Standard Erecting Co., Inc.
Erector: Cornell & Company, Inc.

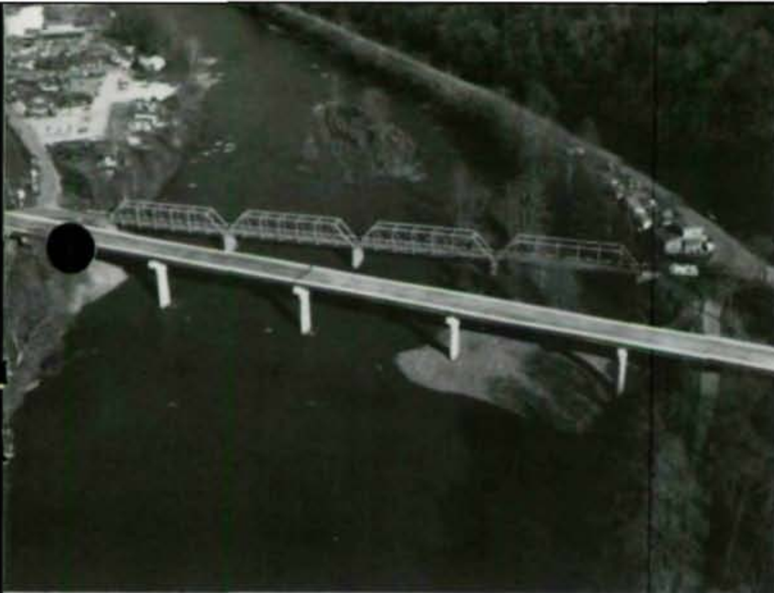
PRIZE BRIDGE 1980 — MEDIUM SPAN, LOW CLEARANCE

Muskingum River Bridge

Zanesville, Ohio

Designer/Owner: Ohio Department of Transportation
General Contractor: Shelly & Sands, Inc.
Erector: The Vogt & Conant Company





PRIZE BRIDGE 1980 — ELEVATED HIGHWAYS OR VIADUCTS

Caddell Bridge over Cheat River

Kingwood, West Virginia

Designer: Yule, Jordan & Associates
Owner: West Virginia Department of Highways
General Contractor: W. P. Dickerson & Son, Inc.
Erector: Middle States Steel Construction Co.

PRIZE BRIDGE 1980 — SPECIAL PURPOSE

Snake River Trails Bridge

Pine County, Minnesota

Designer: Bakke Kopp Ballou & McFarlin, Inc.
Owner: Minnesota Department of Natural Resources, Trails and Waterways Unit
General Contractor: M. G. Astleford Co., Inc.
Fabricator: St. Paul Structural Steel Company
Erector: Waverly Steel Inc.

PRIZE BRIDGE 1980 — MOVABLE SPAN

STH 42 and 57 (B-15-4)

Sturgeon Bay, Wisconsin

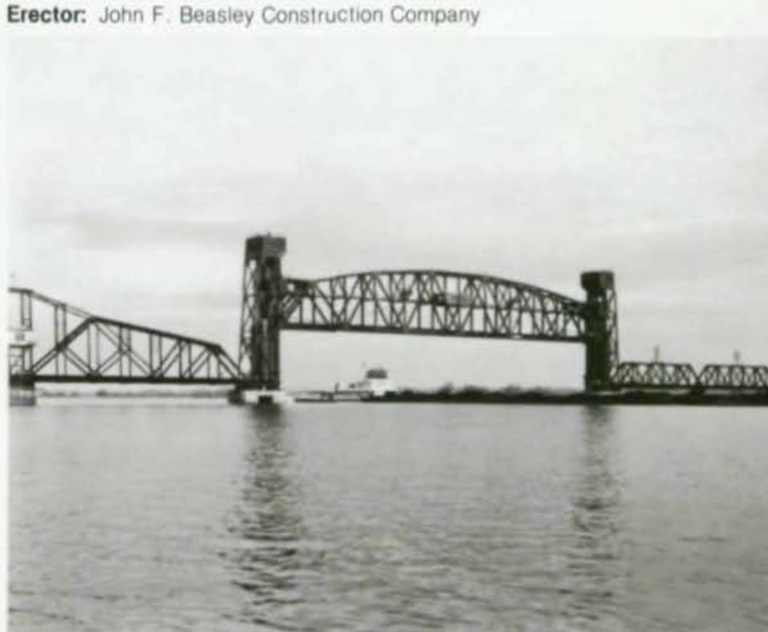
Designer: Hazelet & Erdal
Owner: State of Wisconsin, Department of Transportation
General Contractor/Erector: Lunda Construction Company

PRIZE BRIDGE 1980 — RECONSTRUCTED

Southern Railway Bridge across Tennessee River

Decatur, Alabama

Designer: Tennessee Valley Authority
Owner: Southern Railway Company
Consultant: Howard Needles Tammen & Bergendoff
General Contractor/Fabricator: Vincennes Steel Division of Halle Industries
Erector: John F. Beasley Construction Company



1980 Prize Bridges
continued

AWARD OF MERIT 1980 — SHORT SPAN
East River Road Bridge over Red Creek
Rochester, New York

Designer/Owner: City of Rochester, Department of Engineering and Maintenance
General Contractor: Penn-Crete Construction Corp.
Fabricator/Erector: Ernst Steel Corporation

AWARD OF MERIT 1980 — ELEVATED HIGHWAYS OR VIADUCTS
I-480 over Cuyahoga River Valley
Cuyahoga County, Ohio

Designer: Howard Needles Tammen & Bergendoff
Owner: Ohio Department of Transportation
General Contractor: The Horvitz Co.
Erector: The Vogt and Conant Company

AWARD OF MERIT 1980 — MOVABLE SPAN
Bridge over the New River
Ft. Lauderdale, Florida

Designer: Greiner Engineering Sciences, Inc.
Owner: Florida East Coast Railway Company
General Contractor/Erector: Powell Brothers Contracting Co.
Fabricator: Sheffield Steel Products, Inc.

AWARD OF MERIT 1980 — GRADE SEPARATION

High Street Bridge

Rhinelander, Wisconsin

Designer: Howard Needles Tammen & Bergendoff
Owner: City of Rhinelander
General Contractor/Erector: Edward Kraemer and Sons, Inc.
Fabricator: Theo. Kupfer Iron Works, Inc.

AWARD OF MERIT 1980 — RAILROAD

Big Blue River Bridge A-8

Kansas City, Missouri

Designer: Gibbs & Hill, Inc.
General Contractor/Owner: The Kansas City Southern Railway Company
Fabricator/Erector: Havens Steel Company

AWARD OF MERIT 1980 — RAILROAD

Route 72 under Conrail

New Britain, Connecticut

Designer: Edwards and Kelcey
Owner: Connecticut Department of Transportation
General Contractor/Erector: White Oak Corporation
Fabricator: The Standard Structural Steel Co.

AWARD OF MERIT 1980 — SPECIAL PURPOSE

Hall of Justice Pedestrian Walkway

Columbus, Ohio

Designer: Prindle & Patrick/Planners
Owner: Franklin County Commissioners
Engineer: Paul J. Ford & Company
Construction Manager: Morse/Diesel, Inc.
Fabricator: The J. T. Edwards Company
Erector: Industrial First, Inc.

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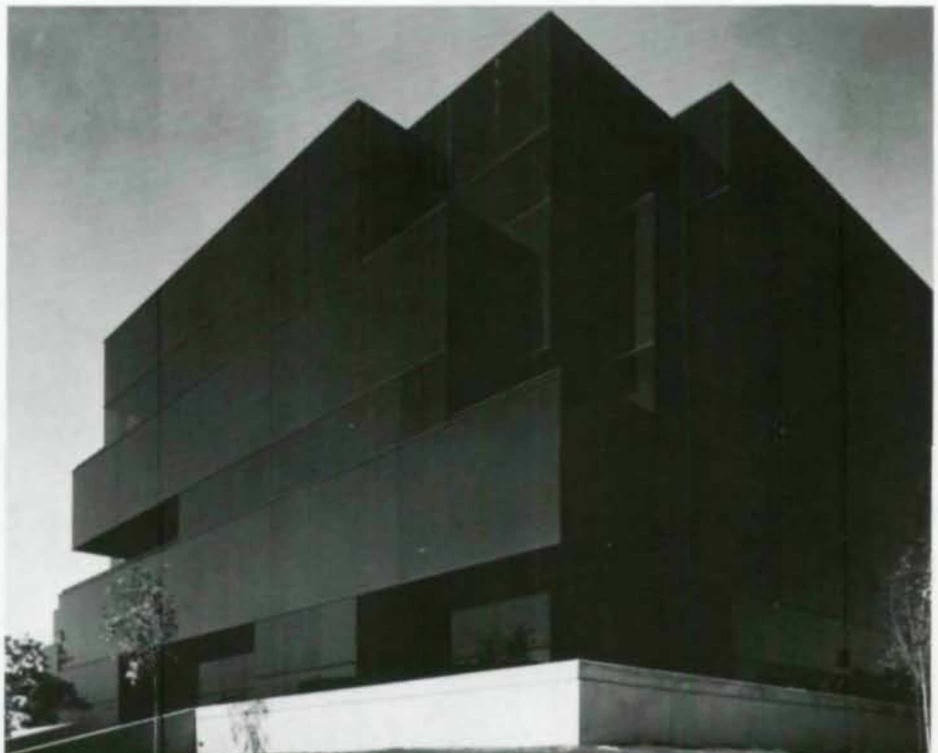
Santa Monica Business Park: Space Up, Costs Down—with Steel

Within over 1.4 million sq ft of office space, Santa Monica Park encompasses 15 steel-framed buildings. Each portrays a distinct personality. Vision glass around the perimeter of the buildings has been maximized, increasing tenant appeal, so that the majority of the park has been leased.

Tenants also enjoy the flexibility created by both the increased span between columns, and the smaller column size attributed to the use of steel. Open space planning, so prevalent now, is thereby facilitated. Tapered girders increase this flexibility, allowing more space for mechanical plenums by reducing the required distance between floors.

The use of steel was also an important factor in meeting cost for the Park—by reducing construction costs 11.5%, and cutting construction time by 10%. Most of the buildings are of aluminum and glass, though one building uses painted steel panels.



The varied tenants illustrate the individuality of the buildings. Transaction Technology, a high-tech computer manufacturer, occupies a black glass and alucobond building. In contrast, Matlow-Kennedy, Inc., a residential/commercial developer required a different image. The result is a sophisticated example of urban architecture with grey-lite glass and articulated corners with planters and balconies.

Santa Monica Park exhibits creativity achieved within cost constraints. Subtle differences in form, a variety of materials and the colors and types of glass foster distinctions between the buildings—while similar landscaping with berms around the perimeter, and courtyards with a view, integrate and unify the diverse elements. Dispersed equally, parking areas provide easy access to all buildings. □

Architect
Herbert Nadel AIA & Partners
Encino, California