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MODERN STEEL CONSTRUCTION

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30th Annual AISC National Engineering Conference

Leading authorities in the fields of steel design, research and construction will meet in Los Angeles, California on May 3, 4, and 5 to exchange ideas and information. The engineer or architect who wishes to keep informed about the continuing developments in these fields will find this conference a valuable and exciting experience.

Program highlights include:

Eighth Edition — AISC Steel Construction Manual
Frederick J. Palmer, AISC

Eccentrically Connected Bracing for Seismic Resistance
Professor Egor Popov, University of California at Berkeley

Bonaventure Hotel
Joseph P. Nicoletti, John A. Blume & Associates
David Doar, Portman & Associates

Rebuilding the Olive View Hospital
Lew Naidorf, Welton, Becket Associates

New River Gorge Bridge
A. P. Arndt, American Bridge Division, U.S.S. Corp.

Box Girder Bridges

Design — State of the Art
C. P. Heins, University of Maryland

Fabrication and Erection
Werner Quasebarth, Atlas Machine and Iron Works, Inc.

The Interstate at Vail, Colorado
Ernest D. Hunter, United States Steel Corporation

Prefabricated Modules for the Alaskan Project
Henrik Ring, Ralph M. Parsons Company

Lexington, Kentucky Arena
Alfred G. Ericksen, III, Ellerbe Architects/Engineers/Planners

Recycling Buildings
Daniel Shapiro, Shapiro, Okino, Hom & Associates

Engineering Fire Resistance of Bare Structural Steel
Roger H. Wildt, Bethlehem Steel Corporation

Discussion — Electroslag Welding for Buildings
Warren G. Alexander, New York State Department of Transportation
Walter P. Benter, United States Steel Corporation

End Plate Connection Design

Plate Thickness and Prying Action
N. Krishnamurthy, Vanderbilt University

Column Stiffener Requirements
Thomas S. Tarpy, Stanley D. Lindsey & Associates

Seismic Design Practice for Steel Buildings (T.R. Higgins Lecture)
Edward J. Teal, Structural Engineering Consultant

ENTER

l city park. Bougainvilleas
50-ft-long planter over the
facing the plaza.

framework of the project
sist the most severe pro-
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computations, since its
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support is a structural
on a continuous rein-
at, 30 in. thick. This
ghs over 3,600 tons,
f high strength steel. It
and eight longitudinal
column lines, 10 of which are composed of

Architect-Engineer
Gruen Associates
Los Angeles, California

General Contractor:
Henry C. Beck Company
Los Angeles, California

Steel Fabricator:
Bethlehem Steel Corporation
Bethlehem, Pennsylvania

rigid frames which were computer designed to resist earthquakes in conjunction with other imposed loads. The frames were designed to optimize the number of rigid connections, effecting substantial cost savings with no loss of structural integrity. The columns of the eight transverse and the two longitudinal rigid frames are composed of A572 Gr. 50 high strength steel and the girders are A36 steel.

A dynamic analysis of the building was run computing various mode shapes and story deflections. Stresses were computed by member distortion. Also, by utilizing a computed response spectra (a mathematical prediction of the response of soil to any seismic wave motion), mathematical models of the building were made and distortion shapes determined using six hypothetical earthquakes. Based on this information, properties were established and sizes of beams and columns were determined.

Steel Construction Details

Frame column dimensions are 24 in. x 24 in. and were built-up using welded web and flange plates. Girder design encompassed splitting a beam of one-third length into tees and welding them as haunches to the bottom flange of the frame girder at each end. This achieved an extremely stiff member and left maximum clearance space below the center third of the girder for ductwork and plumbing.

Minimum weight of steel (approximately 10 psf) was achieved using composite construction and A572 Gr. 50 steel. Shear connector studs were welded to the top flange of all non-frame floor beams to cause the concrete floor slab to stiffen the beams and make the composite section very strong (up to three times as stiff as the bare beams.)

The floor is 3¼-in. lightweight concrete placed on 3-in. deep metal decking with a span of 10 ft.

Typical column spacing is 30 ft by 30 ft with filler beams spaced 10 ft o.c. Cantilevers up to 20 ft were accomplished using composite construction whereby the reinforcing steel in the slab over the beams was utilized effectively to deepen the girders and reduce deflection.

Tubular steel mullions were integrated into the facade, where up to 36 ft vertical spans occured. These shapes harmonized with the typical facade members extruded from aluminum.

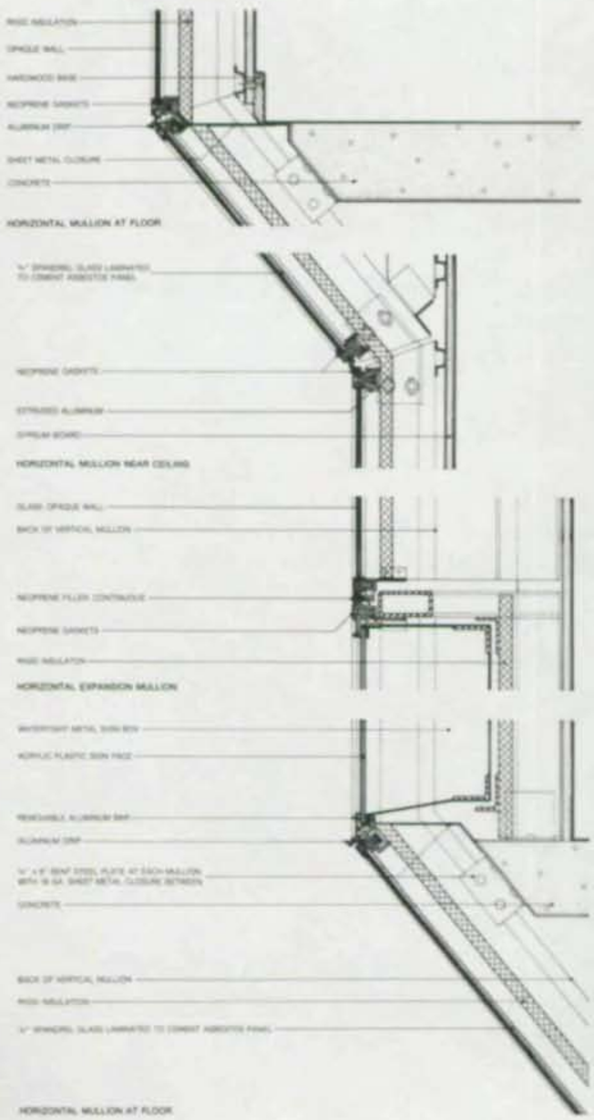
A curtain wall of blue glass set in neoprene mounting houses a sophisticated system of sliding expansion joints at each floor level, corners and intersections, allowing the frame to deflect both horizontally and vertically without damage to the glass.

The 3,600-ton building frame was erected in three connected segments, with each portion rising in six-story increments of approximately 1,200 tons. Because the building dimensions are so large, it would have been very difficult for the 100-ft cranes to erect steel for the entire building on a floor-by-floor basis. Frame erection took less than 10 weeks.

Tubular steel ribs, composed of radially bent members, comprise the structural framework for the longitudinal barrel vaulted skylight. These ribs are laterally stiffened by smaller tubular steel mullions that are welded and alternately bolted to relieve thermal movements. Special attention to details was mandatory because of the large portions of the structural segments of the structure. Welding details were designed to minimize distortion from heat and reduce field work.

A temporary expansion joint midway through the longitudinal dimension of the structure was accomplished by using slotted holes in the girder connections. When the ambient temperature of the steel frame and concrete floors had stabilized, the high-strength bolts were tightened and the floor slab closure strips were placed. The roof joints remain separated as permanent expansion joints that subdivide the main roof in four equal quadrants. Horizontal thermal expansion perpendicular to the barrel vaulted skylight is accommodated by springlike action of the tubular steel curved ribs that are designed to change shape slightly as the temperatures vary.

Horizontally curved wide-flange floor beams were employed to support the round, semicircular south escalator tower. Torsional stresses were resisted by a carefully detailed combination of composite action and bracing sub-members. Skillful shaping of these members was accomplished by the fabricator to conform to the available space and accommodate the necessary mechanical air conditioning ductwork, in conjunction with the clean architectural lines.



MEDICAL COLLEGE PLANS FOR FUTURE GROWTH

By John Matthew King, AIA

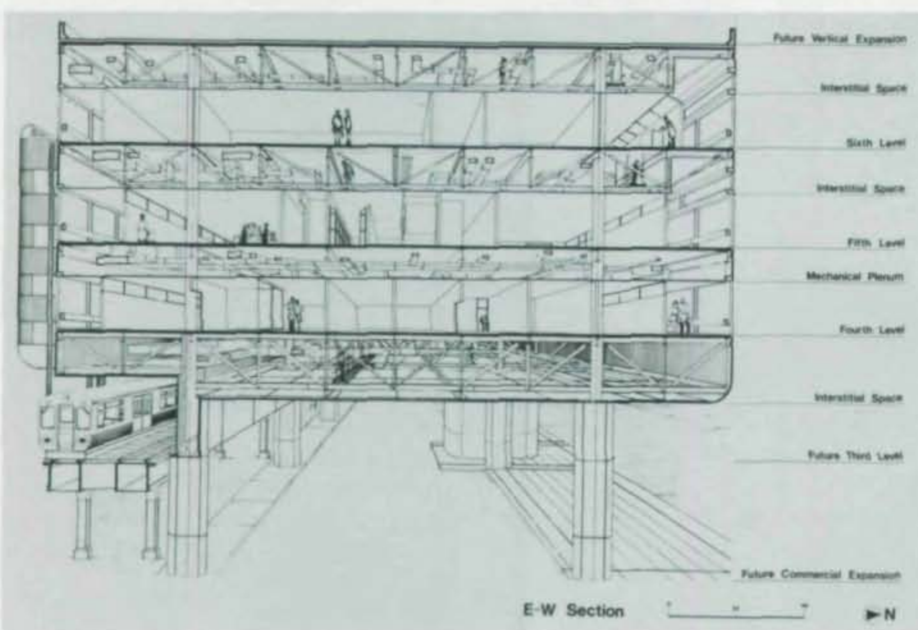
In 1971, commited to a care concept which stresses health maintenance in addition to the curative and restorative aspects of health-care delivery, our client, the Rush-Presbyterian-St. Luke's Medical Center, inaugurated a comprehensive health care system to develop the health manpower and care facilities for an integrated, continuing, and single standard of care to 1.5 million people in Chicago, Illinois. First, to achieve this goal, an affiliated network of colleges and community hospitals was organized with the medical center as the inner-city fulcrum in a unique effort that can become a prototype for meeting the health needs of the nation. This academic facility is the first of many components on a long narrow site, in a congested urban setting.

Program requirements of the 197,000 sq ft building included minimum column interruption and a structural system which allowed for maximum spatial and mechanical change, interconnection to several floors of two existing structures (each with varying and different floor heights), and provisions for vertical expansion which would triple the present building size. The major teaching functions included two multi-level lecture centers, a two story television studio, gross anatomy and 10 multi-disciplinary laboratories, student support and administrative spaces, and a two-level library.

Design Solution

In addition to satisfying the typical design concerns of program and function within a limited budget during an escalated economy, as well as responding to the unique problems of the site (the accommodation of the existing elevated mass transit and the capability of interconnection to the adjacent buildings by "beginning" the structure four floors above

Mr. King of Metz Train Olson & Youngren, Inc., Chicago, Ill., served as Design Principal on this project.



E-W Section

the ground), this design also represents a different theory for urban institutional construction. This medical center—like all others—had built new or recycled its spaces in the traditional and costly manner—additively and specifically.

Fortunately, when programming and design work started on the medical college, we also knew that another four or five building programs might be constructed within a relatively short time and possibly on the same site. We also learned, after carefully analyzing one of the older existing buildings, that there was an ongoing average investment of $6.60 per square foot per year (in 1969 dollars) for interior modifications to satisfy new needs, technologies, and users. Further, 85% of this amount was for mechanical changes. In short, constant change was a certainty and new construction a sure eventuality. This was our real design issue and challenge.

Conceptually, it required that the traditional building attitude for hospitals be superceded by one nearer to office building construction—one where the tenants are "unknown" specifically, but provided for in terms of common denominators. Our site had an actual potential "when ultimately filled" of 2-million sq ft—similar to Chicago's John Hancock Center, but laid over on its side and not built all at once. To implement this concept, four basic design principles were employed. The first relates to the commonalities of space, span, and services that not only satisfy the initial "component" but also the "near future" five building programs. The second relates to the concrete stilts and structural system that permit only one 3-story section of this "horizontal tower" to be built initially, from the fourth to the sixth level above grade, while allowing for growth vertically above and below as well as horizontally to the north and south. The third is the interstitial concept permitting easy and economical space and mechanical service adaptations with the minimum of user disruption. The fourth and last major design principle was to enclose this first portion of an expandable "horizontal tower for medical tenants" in a lightweight skin that not only maintained the integrity of the 72-ft free span/two 24-ft cantilever structures, but could also be counted on for its durability, cleanability, and future availability, so that once the ultimate 2-million sq ft was complete, the final facility would be uniform, in proper scale, and have an appearance as new and bright as the day when this—the first component—was built.

Outstanding Features

The architectural solution was required to respond to a number of physical factors and challenges: utilization of a narrow long site constrained by elevated mass transit; provision and proper positioning of future "health system tenants" in an "expandable building" concept; solving existing people and material flow patterns with a new "spine-site traffic plan," as well as the ability to move ahead on construction without disrupting current teaching, care, and research functions.

Locating the first functional level some four floors above grade increased the available building width from 90 ft to 120 ft. It also permitted interconnection with existing medical center buildings having varying floor-to-floor heights, and established a common vertical module for the development of a long span structure with maximum flexibility and "interstitial" mechanical spaces between occupied floors to contain life cycle costs. The structure can accept eight floors of vertical expansion and three levels of low-rise commercial facilities underneath for the needed services and amenities to all medical center personnel at the pedestrian level. The side-mounted mechanical service towers are also capable of vertical growth.

Use of Structural Steel

The structural consultant was confronted with imposing constraints and challenges. After deliberate cost analysis and careful examination of the material options, he concluded that "only steel construction could resolve the many design problems of this project."

The structural aspect of the overall design solution evolved as follows: analysis comparing varying structural material costs, spans, and column placement indicated that 24-ft x 72-ft bays were optimum in satisfying the interior space requirements. By locating the first functional level four floors (43 ft) above grade and cantilevering 24 ft east and west over the elevated transit facility increased the building site width from 90 to 120 ft. To accomplish such a long span in steel would normally require beams 3½-ft deep in a 5½-ft service plenum, but for a cost of only a few cents more per square foot, a 7 ft-4 in. steel truss—thereby establishing a new vertical construction module of 17 ft-6 in.—would offer level interconnections to the existing buildings at two out of every three floors and permit interstitial mechanical spaces between the occupied floors. This discovery cinched the "truss decision" since the architect had the owner's 10-year cost data on space readaptions.

The 24-in. x 24-in. built-up steel columns, which form the 72-ft x 24-ft bay can support six to eight additional levels above, a third floor below, and provide the potential for construction of two levels of masonry load bearing structures at grade within the "stilts" for commercial and other amenities to serve personnel and the public.

The 7-ft high, 120-ft long span steel trusses are A36 steel and act with the columns to form a rigid frame. The truss ends are connected to the columns by 1-1/8-in. A490 bolts. Floors of 3¼-in. lightweight concrete topping on a 3-in. deck are supported by steel beams 12 ft o.c. between trusses. Bar joists located on the bottom flange of the trusses support interstitial catwalks and ceiling systems.

The consultants for this project included structural engineers, C. A. Metz Engineers, Inc., Chicago, Ill., and LeMessurier Associates, Inc., Cambridge, Mass.; mechanical and electrical, Environmental Systems Design, Inc., Chicago, Ill.; acoustical, Bolt, Beranek & Newman, Inc., Cambridge, Mass.; lighting, David A. Mintz, Inc., New York, N.Y.; construction manager, Morse/Diesel, Inc., Chicago, Ill.

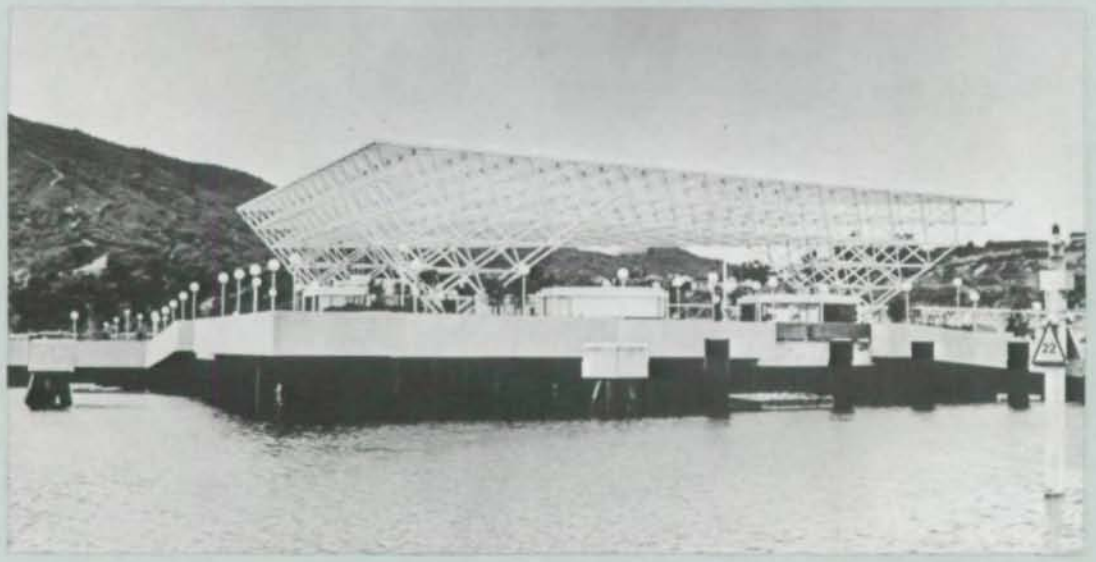
Others involved from Metz Train Olson & Youngren, the Project Architect, were: Kenneth R. Mullin, Managing Principal; Robert J. Schill, Project Manager; Gene Montgomery, Chief Architect; Gorge Sirgo, Job Captain; Jesse Horvath, Carl Hunter, Michael Molinaro, Senior Designers; and William Pontious, Interiors Chief.

1977 ARCHITECTURAL AWARDS OF EXCELLENCE

PRINCE OF PEACE LUTHERAN CHURCH ▲
Burnsville, Minnesota
Architect: Frederick Bentz/Milo Thompson & Associates, Inc.

◀ COAL STREET PARK ICE SKATING FACILITY
Wilkes-Barre, Pennsylvania
Architect: Bohlin and Powell

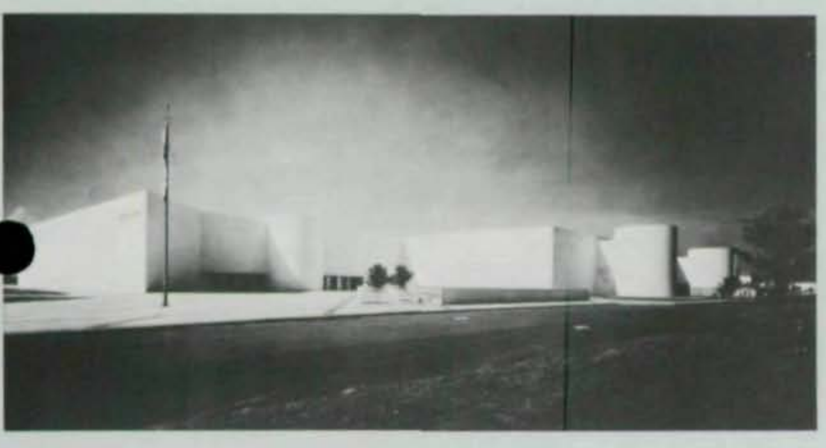
FREIGHTLINER CORPORATE HEADQUARTERS ▶
Portland, Oregon
Architect: Boutwell, Gordon, Beard and Grimes



◀ LARKSPUR FERRY TERMINAL
Larkspur, California
Architects: Braccia/DeBrer/Heglund

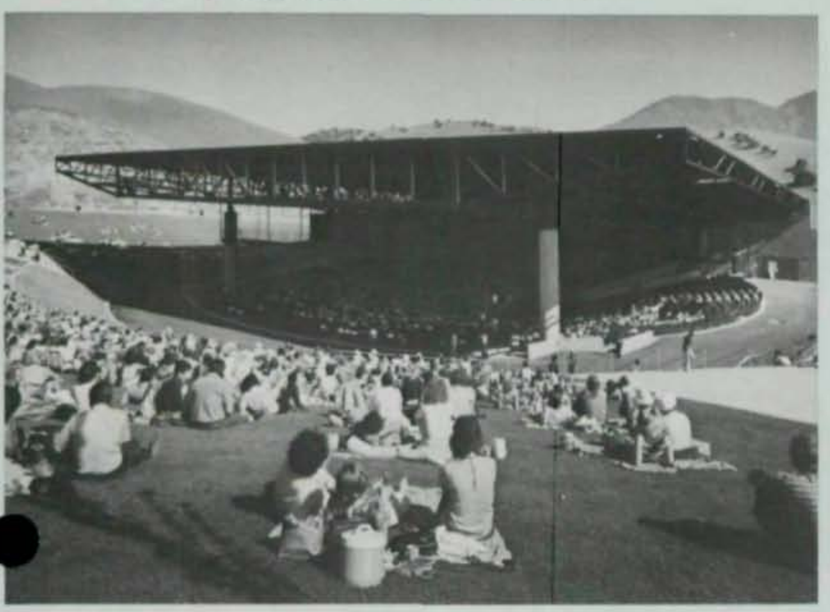
◀ CHICAGO POLICE TRAINING CENTER
Chicago, Illinois
Architect: Jerome R. Butler, Jr.

AMERICAN HIGH SCHOOL
Miami, Florida
Architects: (A Joint Venture)
Caudill Rowlett Scott
The Smith, Korach, Hayet, Haynie Partnership ▼



▲ NATIONAL AIR AND SPACE MUSEUM
Washington, D.C.
Architect: Hellmuth, Obata & Kassabaum

CONCORD PAVILION
Concord, California
▼ Architect: Frank O. Gehry and Associates, Inc.



PENNZOIL PLACE
Houston, Texas
▼ Associated Architects: Johnson/Burgee
S.I. Morris Associates

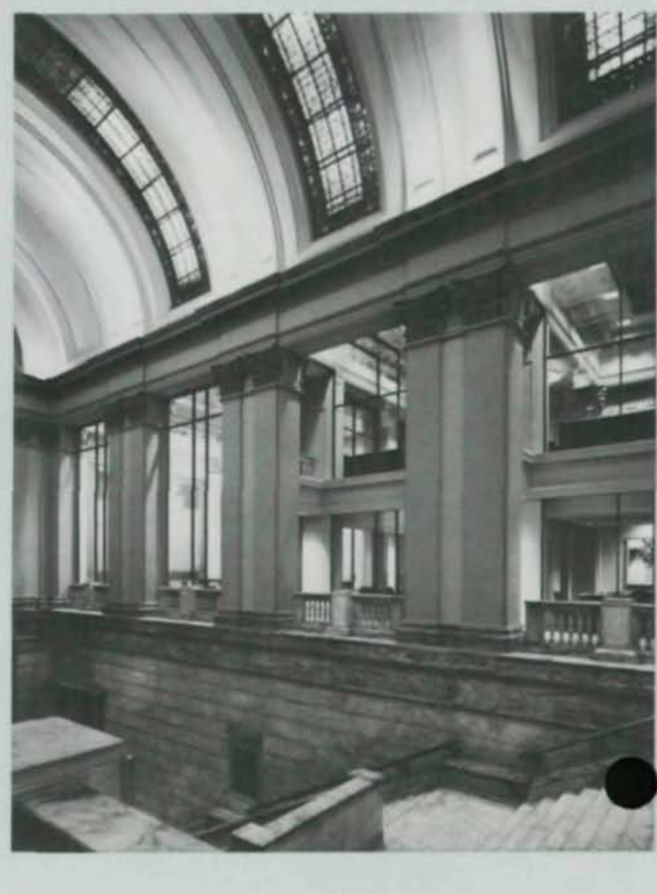
▲ SATELLITE BALL CASTING PLANT
Chandler, Arizona
Architect: Lester B. Knight & Associates, Inc.

RAMAPO COLLEGE PHYSICAL EDUCATION BUILDING ▲
Mahwah, New Jersey
Architects: (A Joint Venture)
Mahony & Zvosec
Kenneth DeMay (of Sasaki Associates, Inc.)

◄ JOHN A. VOLPE INTERNATIONAL TERMINAL
LOGAN INTERNATIONAL AIRPORT
Boston, Massachusetts
Associated Architects: Kubitz & Pepi, Inc.
Desmond & Lord, Inc.

ROBIN HOOD DELL WEST
Fairmount Park, Philadelphia, Pennsylvania
▼ Architects: John H. MacFadyen and Alfredo De Vido

STATE OF OKLAHOMA
HOUSE OF REPRESENTATIVES AND
SENATE CONFERENCE FACILITIES
Oklahoma City, Oklahoma
Architect: Architectural Associates of Meyer/Brown ▼



▲ PHYSICAL EDUCATION FACILITY
UNIVERSITY OF MINNESOTA
Duluth, Minnesota
Architect: The Leonard Parker Associates

▲ JOHN HANCOCK TOWER
Boston, Massachusetts
Architect: I.M. Pei & Partners
(Henry N. Cobb, Design Partner)

▲ GEO. L. SMITH II GEORGIA WORLD CONGRESS CENTER
Atlanta, Georgia
Architect: Thompson, Ventulett, Stainback & Associates

OMNI INTERNATIONAL
Atlanta, Georgia
Architect: Thompson, Ventulett, Stainback & Associates

HENNEPIN COUNTY GOVERNMENT CENTER
Minneapolis, Minnesota
Architect: John Carl Warnecke & Associates ▼

A MUNICIPAL STEEL PARKING DECK

A thorough and careful comparison of various structural systems for a new municipal parking deck in Burlington, Vt., proved structural steel to be very attractive from a cost and construction scheduling point of view.

The Burlington Square multi-level open deck parking facility was financed by a municipal bond issue and designed as an integral part of a multi-use downtown urban renewal complex. It is sited over and has direct access to an enclosed retail shopping mall which will ultimately connect with the various office and commercial buildings, residential towers, a 200-room hotel and convention center in the 15-acre development. A serious civic concern was that a large church existed across the street from the site designated for the parking structure.

Design Solution

Architecturally, the selection of structural steel, particularly in the exterior cladding which was painted a dark brown color, visually unified this structure with the other buildings in this project which are also of exposed painted steel or dark brown aluminum and glass curtain walls.

The above grade portion of the 525-car capacity parking structure was confined to the westerly two-thirds of the 400-ft long site in order to leave a generous landscaped plaza in front of the church at the east end of the parcel. In floor plan, a central core of one-way ramps, stairs and elevators surrounded by a continuous double-loaded parking aisle was adopted to fully utilize the 140-ft width of the site.

The entire structure is based on a 9 ft-6 in. parking module. The building is 3 bays @ 38 ft-0 in. wide by 9 bays @ 28 ft-6 in. long with a one module cantilever on all sides (133 ft-0 in. x 275 ft-6 in. overall).

There are six levels of parking including one below street level. Floor heights are 9 ft-3 in., except the lowest level, which is 11 ft-4 in. high.

The entrance floor is of poured-in-place concrete slab construction as is the single half parking level below grade. The construction of the three typical open parking decks and the roof deck is a welded structural steel frame with a 5½-in. poured concrete composite slab over 2-in. galvanized steel deck spanning the 9 ft-6 in. beam spacing.

A heating and cooling equipment enclosure for the entire complex is mounted on stilts over the roof parking level.

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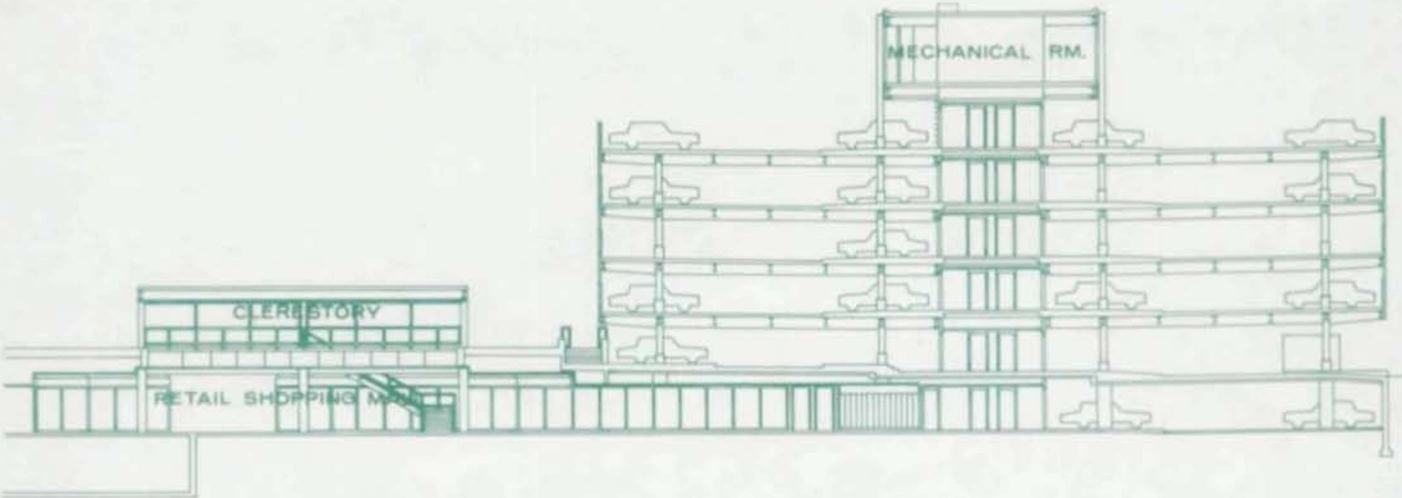


The exterior enclosing walls of the structure are composed of structural steel shapes and plates which complement and reinforce the character of the supporting exposed structural steel frame.

The 9 ft-6 in. parking module is repeated in the spacing and use of W8X20 mullions, which are anchored to the structural frame at each floor.

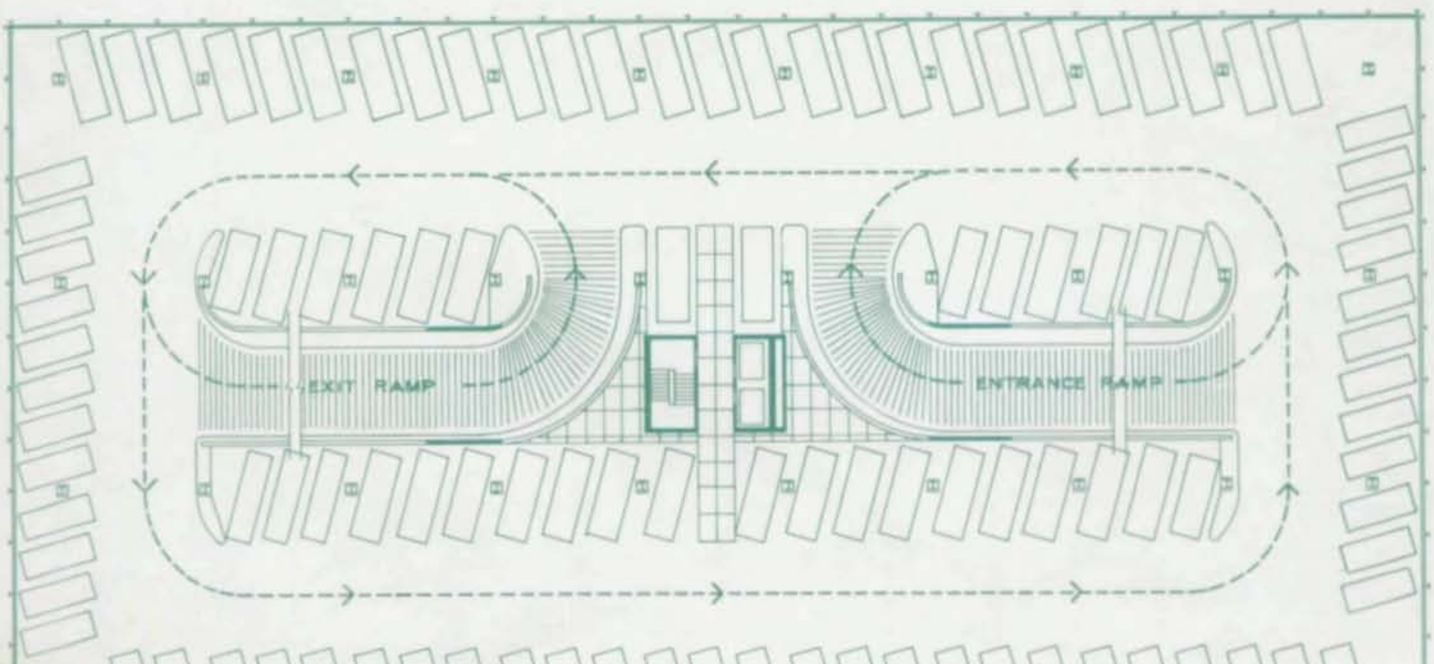
These mullions perform several functions:

1. On the exterior, 4-ft high steel plate spandrel panels are clamped to the mullions to visually screen the view of parked cars.

2. On the interior, continuous bumper height guard rails are bolted to brackets mounted on the back of these same mullions for protection around the perimeter of each parking floor.

3. The projecting verticality of the mullions relieves the otherwise horizontal character of the wall and creates a sculptural play of light and shadow.

Steel erection took only one month.



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Chicago, Illinois

Associate Architect:
Freeman French & Freeman
Burlington, Vermont

Structural Engineer:
Murray Backler & Associates
Montreal, Canada

General Contractor:
Dimeo Construction Company
Providence, Rhode Island

Steel Fabricator:
Vermont Structural Steel Corporation
Burlington, Vermont