VOLUME XVI / NUMBERS 1 & 2 / FIRST & SECOND QUARTER 1976 A9.16-1&2

MODERN STEEL CONSTRUCTION

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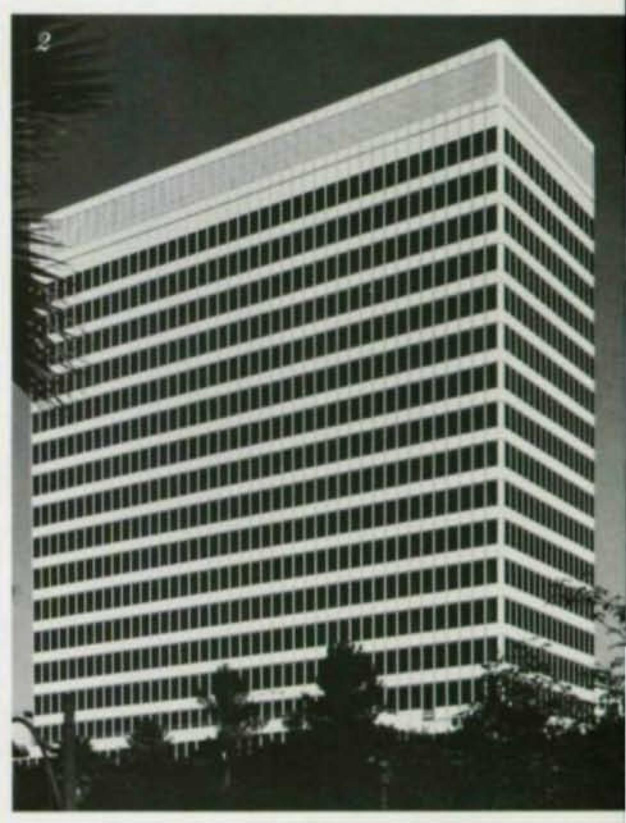

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MODERN STEEL CONSTRUCTION

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VOLUME XVI / NUMBERS 1 & 2 / FIRST & SECOND QUARTER 1976

CONTENTS

1976 PRIZE BRIDGE COMPETITION

Entries are invited for the 48th Annual Prize Bridges Competition to select the most beautiful steel bridges opened to traffic during the calendar year 1975.

The members of the 1976 Prize Bridge Jury are:

William A. Bugge, Jr., Hon.ASCE *Engineering Consultant, Olympia, Washington*

D. Allan Firmage, F.ASCE *Chairman, Civil Engineering Department, Brigham Young University, Provo, Utah*

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Satoshi Oishi, F.ASCE *Partner & Vice President, Edwards and Kelcey, Newark, New Jersey*

Leland J. Walker, F.ASCE *President-elect, American Society of Civil Engineers; President, Northern Testing Laboratories, Great Falls, Montana*

Prize Winners and Awards of Merit will be chosen from eight categories: Long Span; Medium Span; High Clearance; Medium Span, Low Clearance; Short Span; Grade Separation; Elevated Highways or Viaducts; Movable Span; and Special Purpose.

Entries must be postmarked prior to May 31, 1976 and addressed to the Awards Committee, American Institute of Steel Construction, 1221 Avenue of the Americas, New York, New York 10020.

ERRATA

On page 9 of the 4th Q., 1975 issue of MSC, under the listing of "Steel Fabricators;" the International Steel Company's location was incorrectly identified. The company is headquartered in Evansville, Indiana.

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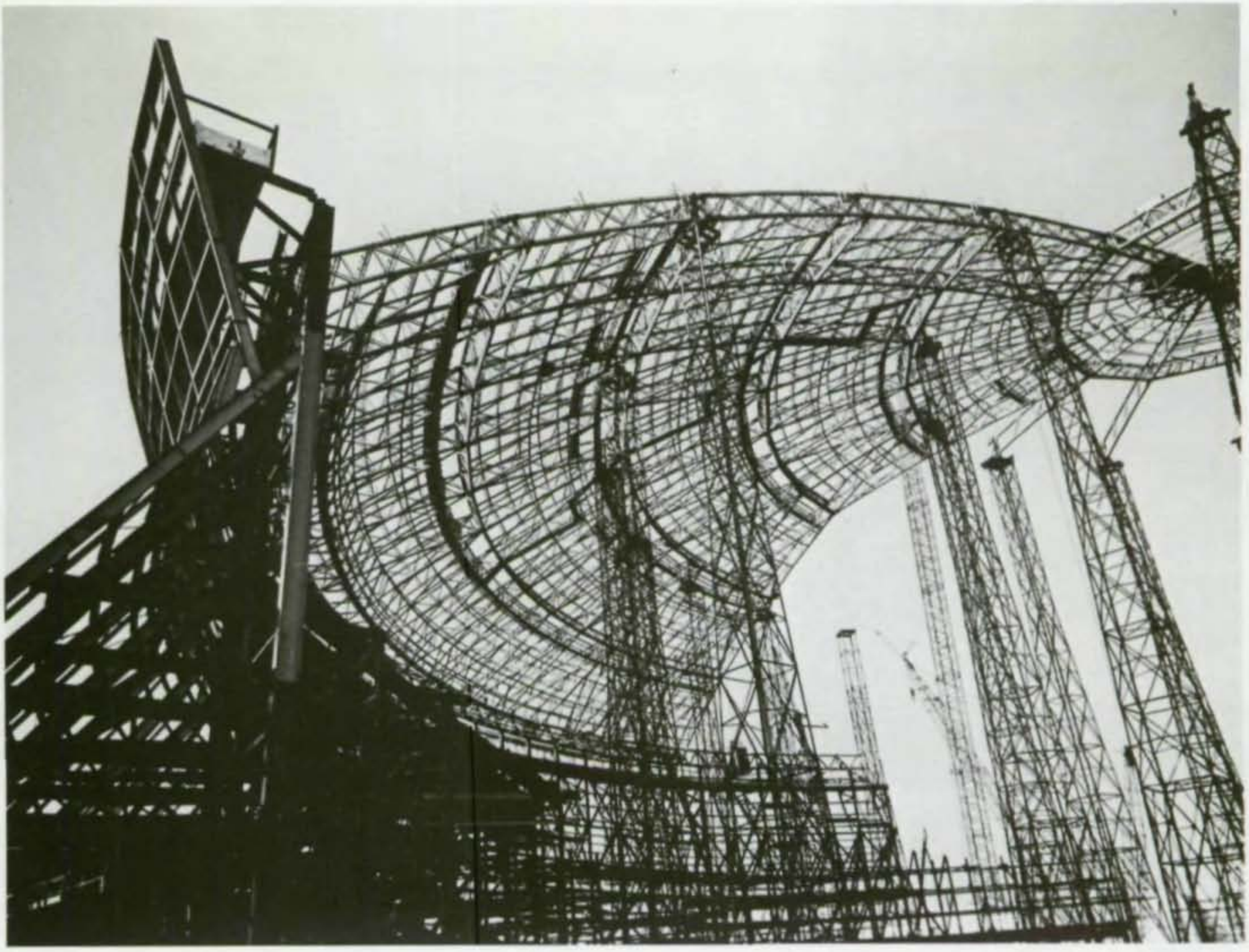


Louisiana Superdome

by M. C. Williams and W. R. Gibson

Architects: (A Joint Venture)
Curtis and Davis and Associated Architects, Inc.
Edward B. Silverstein and Associates
Nolan, Norman and Nolan
New Orleans, La.

Structural Engineers:
Sverdrup & Parcel and Associates, Inc.
Binkley Engineering Co. (roof framing)
St. Louis, Mo.

General Contractor: (A Joint Venture)
Huber, Hunt & Nichols, Inc.
Blount Brothers
New Orleans, La.

Steel Fabricator:
American Bridge Division,
United States Steel
Pittsburgh, Pa.

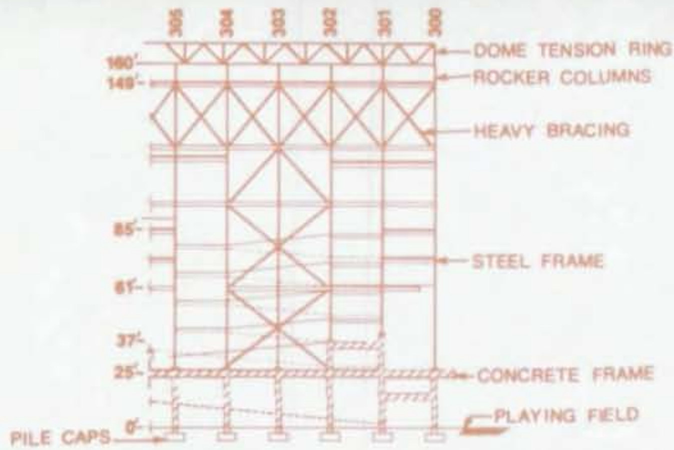
A dominant feature on the New Orleans skyline, the recently completed Louisiana Superdome can best be described as a "people place." This multifunctional building located in New Orleans' central business district will be served by existing traffic arteries and public transportation during off-peak hours for major events. Within walking distance of the French Quarter, facilities in the Superdome such as restaurants, cocktail lounges, shops, offices, and banks will be easily accessible to visitors and residents.

The Superdome covers 13 acres with 8.3 acres of ground space in the arena. Facilities will be provided in the arena for sports events, concerts, stage productions, trade shows, exhibitions, conventions, and other mass audience events. Capacity for sports events varies from 19,678 for basketball to 81,187 for football, with auditorium seating at 95,427. Other space includes 52 convention/meeting rooms and rental space. Air conditioning to keep the Superdome at a comfortable 72 degrees required 9,000 tons.

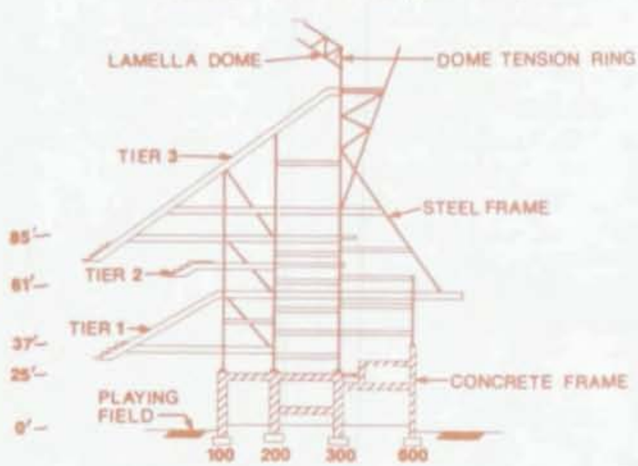
M. C. Williams is Asst. Vice President for Sverdrup & Parcel and Associates, Inc., and W. R. Gibson is Project Engineer for American Bridge Division, United States Steel.

Design

Many structural concepts were considered, such as twin arches with cable suspended roof, sheet arch, and several dome patterns of different materials. Budget estimates for these various concepts resulted in the conclusion that the high cost of resisting lateral loads



CIRCUMFERENTIAL (300 LINE)



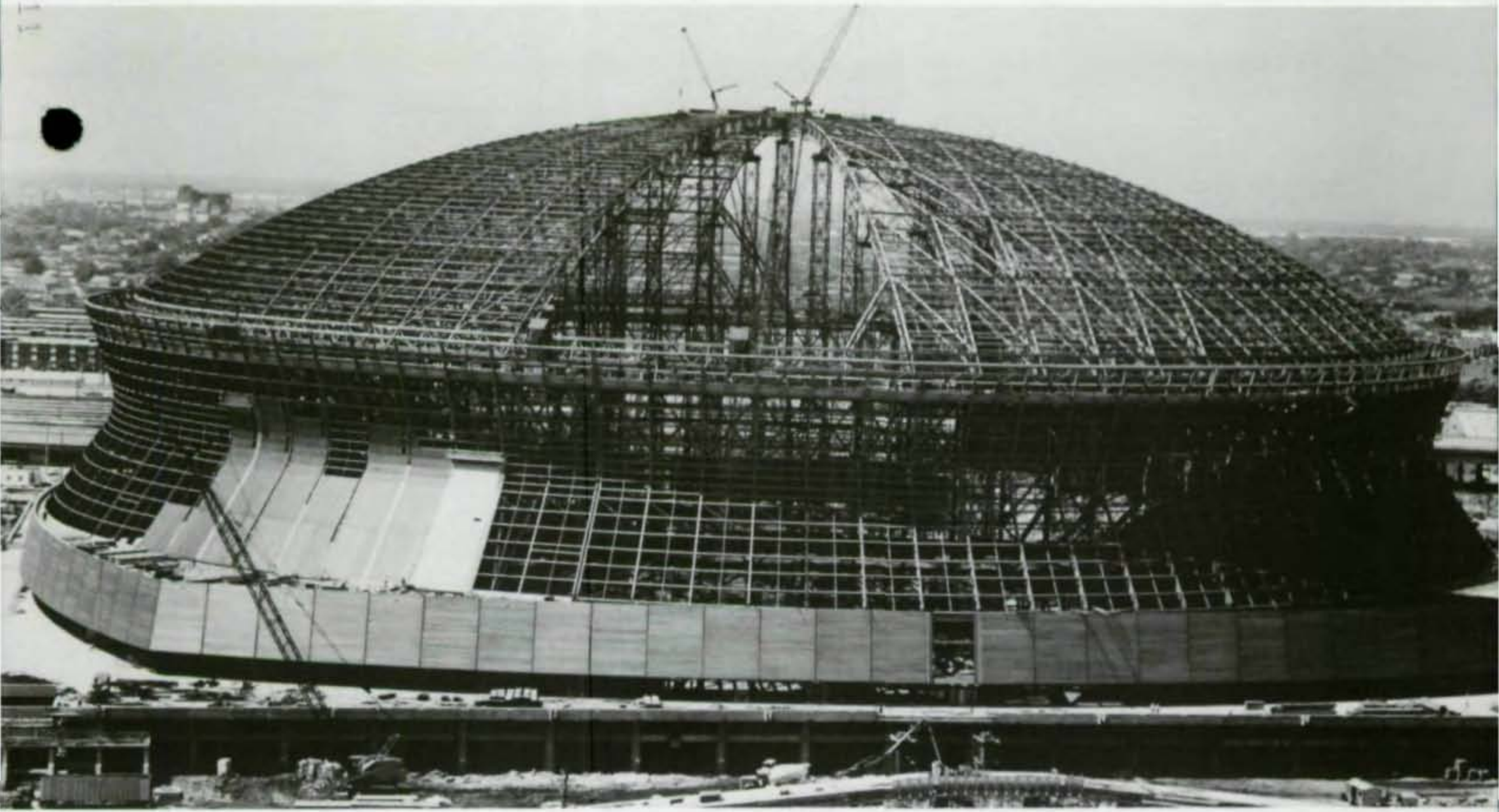
RADIAL BENT 5

at the ground level would be an important factor. Weak, water-deposited soils dictated the use of a dome configuration where outward thrusts from the large roof span were resisted by a circular tension ring.

The weight of the tension ring was approximately 1,000 lbs per ft. Poor foundation conditions also required that the total deadweight of the structure be minimized.

The final design selection for the Superdome was a 680-ft diameter steel lamella roof supported on steel radial bents which resist wind forces. The foundation is composed of 2,266 14-in. square segmented precast prestressed concrete piles.

Various combinations of loads were used in the analysis of the structure, including wind loads and differential settlement. Differential settlement along the column line supporting the dome was critical to buckling stability of the roof members. The required rigidity was provided by heavily bracing this column line circumferentially, as well as design-



ing each radial bent as a braced, rigid frame. The New Orleans Building Code specifies 60 psf above 100 ft which is comparable to a 153 mph wind. Wind analysis was based on a wind study using a scale model (1 in.: 24 ft). The shape of the Superdome resulted in nearly all roof and wall pressures being negative or uplift. The ICES STRUDL computer system was employed for the structural analysis. The final roof system required 26 psf of structural steel.

On a circle 680 ft in dia., 104 main columns rise 150 ft to the top level of the stands and support the dome roof framing at its perimeter. These columns function as the backbones of the radial bents, which consist of radial K-frames outside of the main columns and several bays of beam and column framing to the inside. The lower inclined legs of the K-frames suspend the low roof framing at the 60-ft level which extends to a squared circular perimeter about 750 ft on a side.

The three tiers of precast concrete seat units are supported by sloping steel beams trussed out from or resting on top of the interior bent columns. Longitudinal and filler beams and bracing complete the steel framing up to the 150-ft level. Concrete framing up to the 25-ft level toward the inside and up to 37 ft toward the outside provides the foundation for the steel columns.

With a surface area of 9.7 acres, the clear span dome rises to a height of 273 ft. Its framing is of the lamella-type. The chords of all of the intersecting 7 ft-4 in. deep wide flange welded trusses and all of the beam and trussed purlins are on great circles, whose centers are 604 ft below the center of the dome. All of this framing is contained at its perimeter by an 8 ft-10 in. deep wide flange tension ring truss.

The dome framing supports six television screens on a gondola at the center. This gondola added 150,000 lbs of load to the roof. Height of the screens can be varied for different events. The spectators will have "up close" view as well as "instant replay" from their seats in the Superdome.

As live loads or wind loads are carried by the dome framing, the tension ring is extended or contracted and the diameter changes. Temperature variations also cause the diameter of the dome to be altered. To allow for these variations, the tension ring is mounted on 96 rocker columns, 8 ft high. A 4-in. pin at the top and bottom of each rocker column permits the top to move toward the arena or away from it while the lower end remains stationery atop the 150-ft high main columns. Wind load on the dome is resisted by the rocker columns at the sides whose pins are parallel to the wind direction, while those with pins transverse to the wind offer no resistance.

Fabrication and Erection

Most of the structural steel for the Superdome was fabricated in Ambridge, Pennsylvania (superstructure), and Orange, Texas (roof), and transported to New Orleans by water. A storage yard was established at the Harvey Canal on the West Bank of the Mississippi River.

Movement to the site was by truck across the Greater New Orleans Bridge. Special arrangements were required for transport by truck of larger members, such as the 92-ft, 46-ton sections of the tension ring truss.

The weight of structural steel in the final structure is 18,000 tons. Most of the steel is A36 with A572 Grade 50 being used for columns and some roof framing. Shop connections were welded and high strength bolts were used for field connections except for the tension ring and roof truss field splices which were welded. Chords for the tension ring were heavy wide flange sections.

The structural steel framing of the Superdome was all erected from the inside. This allowed freedom for concurrent construction of the two attached 3-story concrete garages and approach structures. It did, however, present handling problems involving long and high reaches, heavy loads, and obstructions.

The continuous tension ring truss is four-tenths of a mile long and of welded construction. The 24 curved sections of this truss, weighing 46 tons each, were fabricated with precision in jigs in the shop. The chords were butt welded at the shop and field spliced, using electro-slag welding for the heavy flanges and a gas shielded process for the webs.

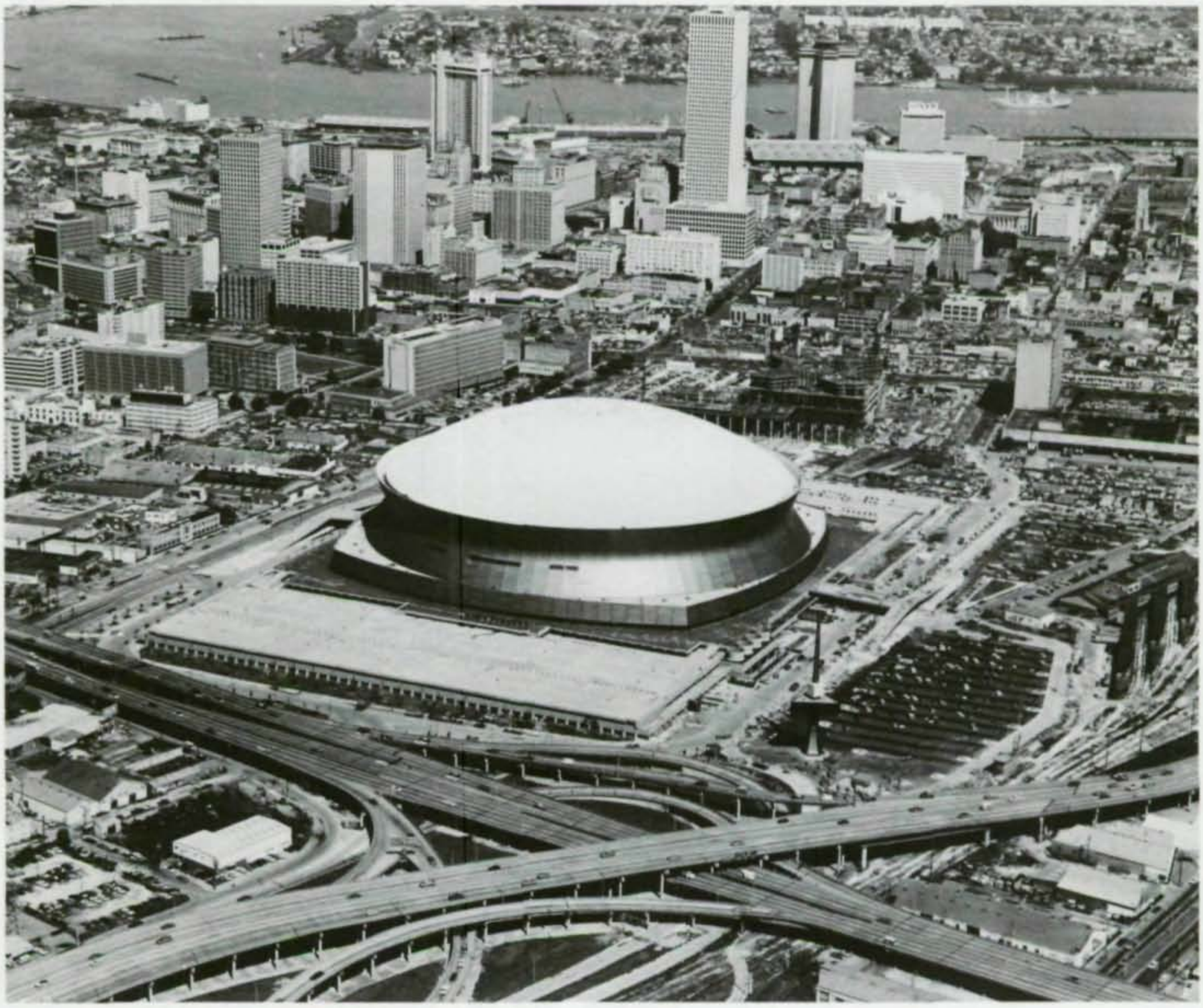
Because of the lack of radial stability, temporary strongbacks had to be used to keep the rocker columns upright while erecting the tension ring segments before the dome framing was complete.

The dome framing was erected by two crawler cranes each having 300 ft of boom. Thirty-seven temporary towers with provision for jacking were used to support the main trusses as they were erected. The towers ranged in height from 210 ft to 260 ft and were founded on steel H piles located to clear the permanent piles of the arena floor. Framing erection was started on opposite lines in the northeast and southwest quadrants and progressed clockwise by 30-degree segments until the two halves met at the starting point. Each segment was built out 120 ft from the center of the arena, then 110 ft in from the tension ring, and finally, connected by the intermediate section. Possible high wind pressures on the umbrella-like structure dictated elaborate bracing of the temporary towers and appropriate consideration in the design of the towers themselves and the supporting piles. A carefully conceived sequence was employed in the erection of the various pieces to maintain stability and to assure adequate clearance for entering the last members in each segment of the dome.

Before erecting the dome steel, the stand and outer framing had been erected. The two gigantic ringer cranes, starting at expansion joints in the northeast and southwest quadrants, had negotiated the limited arena space not occupied by temporary towers, piles, or stored material. The concrete structure also precluded close-up approaches to handling of the heavy tension ring sections and the 96 concrete gutter tubs placed outside of the tension ring above the 150-ft level. To make it possible to reach these and other pieces, the erection was divided into two passes. All of the outer framing up to the tension ring and some interior framing was erected first by the ringer progressing clockwise. The crawlers teamed up with the ringers to handle some of the heaviest and longest lifts. After the first pass was well along, the crawlers followed from the same starting points and erected all other interior steel and the precast concrete seat units. Due to a scarcity of permanent bracing in the first pass framing, distortions of the main columns (that would have been caused by unbalanced loads) had to be controlled by temporary wire rope bracing and shoring until the second pass steel was in place.

The last major operation in the steel erection was the swinging of the dome. When all of the jacks atop the 37 towers were lowered and cleared in a daylong carefully-planned procedure, the crown settled a little over 3 in. with proportionately smaller deflections throughout the rest of the dome.

The completed structure provides a pleasing appearance both from the outside and from the spectator's viewpoint. The dome roof, with K-frame sidewalls and massive grade levels, blends well with the surroundings. The arena with acoustical metal panel ceiling, light rings, finished walls, and colored seats can only be comprehended when one enters the structure.



The only Bicentennial exposition building of its type in the nation today is helping Boston celebrate America's 200th birthday. The $1.2-million Bicentennial Pavilion, a steel-framed, air-pressurized structure located on the Prudential Center South Plaza in the heart of the city. Festive in appearance with a gaily colored red, white, and blue 16,000-square-foot vinyl-coated fiberglass roof and exposed steel trusses at either end, the structure is unique — if not "revolutionary" — in its design.

Since June 1975 and throughout 1976, this focal point of Boston's recognition of the nation's birthday year has and will continue to offer visitors three major exhibitions. These include an outside oversize portrait gallery, historical displays in an inside lobby, and a multi-image slide presentation of modern city life — known as "Where's Boston?" — in a 300-seat theater.

Two Double-Arched Steel Trusses

Ninety-three tons of A36 structural steel have gone into the framework of the unusual 162-ft x 96-ft, 33-ft-exposition building. The framing material was used primarily in two major 8-ft-deep double-arched steel trusses joined by steel angles and for a single segmented internal arch.

For visual drama, the double-arched trusses have been painted black and left exposed at either end of the structure, while the single internal arch is supported by steel framing at the projection booth platform, which separates theater and lobby display areas. However, the steelwork has been designed and engineered for more than just visual effect. Its main function is to support the 1½ tons of vinyl-coated fiberglass roofing in the event the building loses the slight positive air pressure that keeps the structure inflated.

Six ½-in.-dia. longitudinal cables attached to the top chord of the trusses and to the fabric are designed to support the roof envelope much like a tent structure, should air pressure ever be lost. Air pressure to support the roof envelope is provided by a single three-horsepower blower located beneath the plaza level. Also kept in reserve, at the site, to meet emergency situations are a second blower (not normally in use) and two diesel generators to provide electricity in case of a power failure.

Additional lateral cables contained in the roofing material are attached to framing elements at ground level. The lateral cables restrain the roof's vinyl stripes against air pressure and give the roof a corrugated appearance when the airtight building is inflated. The interior segmented steel arch is slightly lower than the exposed trusses on the ends, so that in the inflated mode, the fabric roofing floats about 1½ ft above it. Carpeting has been glued to the top of this core arch to prevent abrasion of fabric when deflated, and the interior arch serves to offset an unbalanced load condition.

Advantages of Steel

Use of the steel framework also solved a legal problem, since the Boston building code technically does not permit air-supported structures. Because of its design, the pavilion is considered to be basically a tent structure whether or not it is inflated. In addition, the steelwork serves to frame airtight revolving door entrances and exits at either end of the building.

For normal operation the roof can carry a load equal to 1 in. of water for the air pressure provided — or a roof load of 5.5 psf. In case of emergency, more than normal air pressure can be added to bring the roof load up to 1½ inches of water pressure — or a loading of as much as 8 psf. In the deflated state, a snow load of as much as 20 psf of roof surface can be supported. In the deflated mode horizontal loads in the longitudinal cables are taken by the arches at each end of the structure.

The building itself is situated on a former ice-skating rink site. Its external arches are anchored to piers inside existing planters on the plaza. Use of the planters to anchor the steelwork not only proved convenient for structural purposes, but should help simplify and reduce costs of site restoration when the Bicentennial Pavilion is taken down. To balance horizontal forces and uplift, steel angles brace a 6-ft-high outside wall of the building. Steel channels cantilevering over the top of the planters serve as the line of attachment for the fabric.

For the core area of the interior segmented arch, anchorage was accomplished primarily by anchor bolts mounted in the 6 in. of post-tensioned ice-skating rink slab, located over the 12-in. slab of the main plaza level. In some areas, 18-in. bolts were taken through the slabs to secure the steelwork.

Protection of the roof is accomplished at ground level by an open-air portrait gallery of 154 giant photographic panels by well-known photographer Constantine Manos. Interior walls also shield the roof membrane.

Architect:
Cambridge Seven Associates, Inc.
Cambridge, Mass.

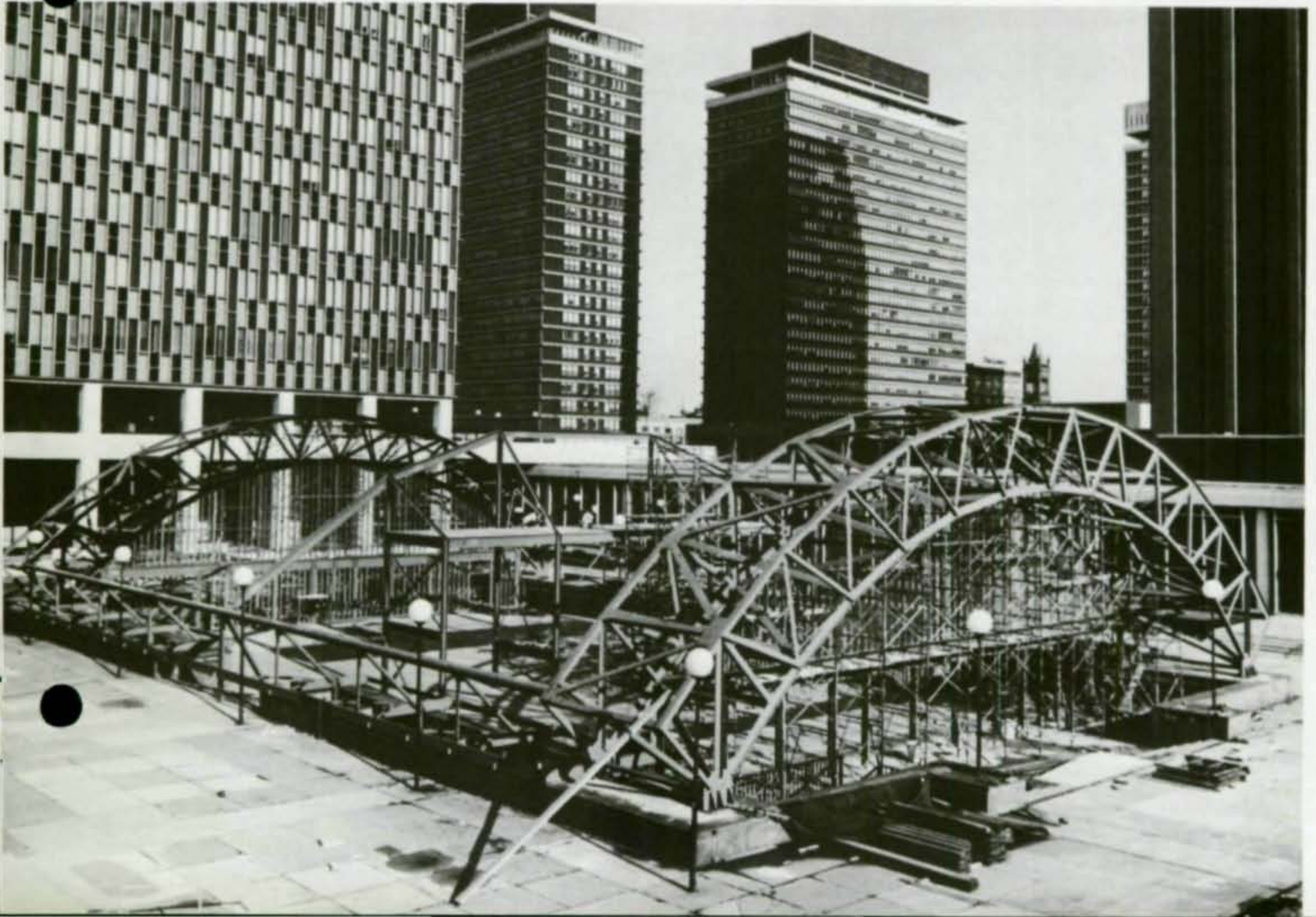
Structural Engineer:
Weidlinger Associates
Cambridge, Mass.

General Contractor:
R. M. Martin and Company, Inc.
Boston, Mass.

Steel Fabricator:
L. Antonelli Iron Works, Inc.
Quincy, Mass.

"REVOLUTIO

NARY" BICENTENNIAL PAVILION



EXPANDING A HI-RISE BUILDING

by Roy Becker

One of California's most extensive high rise renovations can bee seen at the 16-story, 1010 Wilshire Boulevard, Los Angeles. Formerly, the corporate headquarters of the Signal Oil and Gas Company, the building has been significantly revamped and expanded to house the *Pacific Telephone and Telegraph* Company's Southern California Region Headquarters.

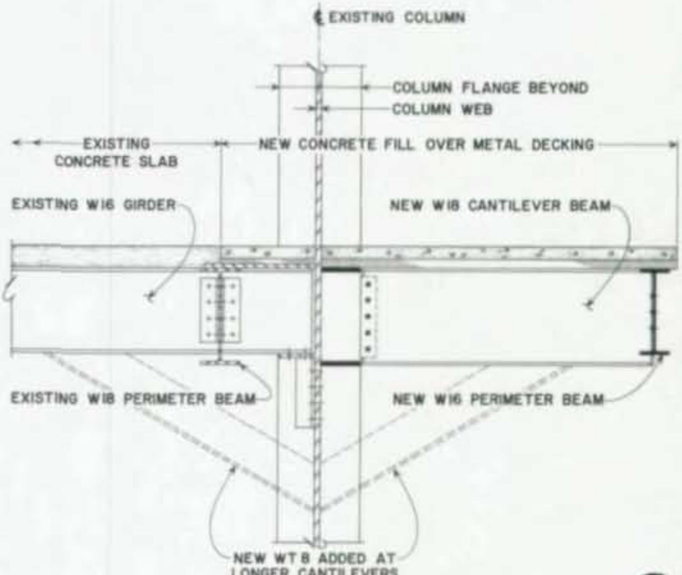
Ceilings, curtain walls, and other architectural features were replaced. The floor area was doubled by extending the north, south, and west sides of the building. Yet, almost all of the structural steel framing in the original building was retained in the expanded structure.

Exceeding the 160-ft Height Limit

Designed in 1958 and completed in 1959, the Signal Oil Building was the first high-rise building constructed in Los Angeles to exceed the 160-ft height limit, previously imposed on building construction due to potential earthquake hazards.

When this restriction was lifted in 1958, the Los Angeles City Building Code required that all buildings in excess of 160 ft have a ductile space frame for resisting earthquake forces. Therefore, the structural engineer utilized steel frames in both the transverse and longitudinal directions to resist lateral forces due to earthquakes and wind. No provisions were originally made for a possible future horizontal expansion of the building.

Roy Becker is AISC Regional Engineer, Los Angeles, California.



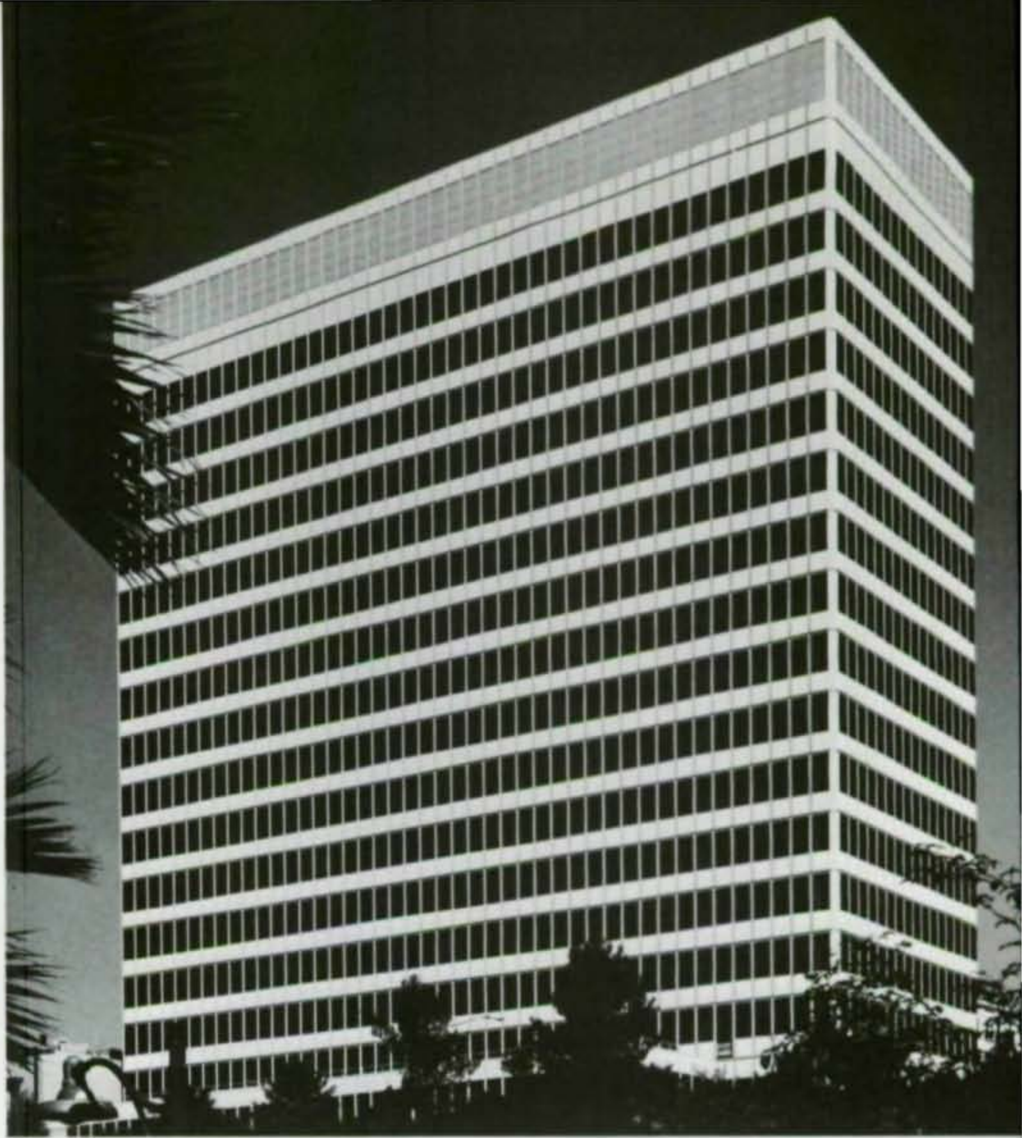
SECTION (A)

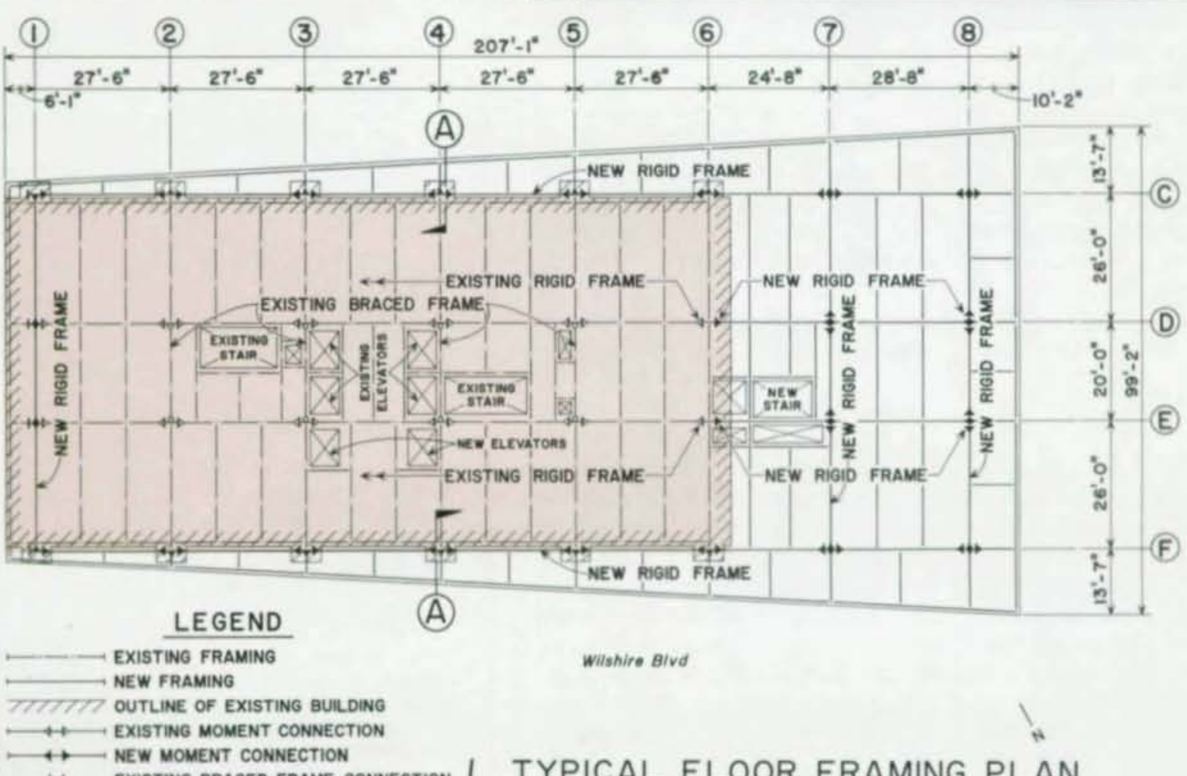
A New Plan

When the new owner purchased this building, they originally planned to renovate only the architectural features of the structure. However, as they began to consult extensively with their architect and the original structural engineer, it became apparent that a significant horizontal expansion of the building could be economically and efficiently achieved along with the renovation of the existing portion. A new plan was then conceived to increase the floor area from 150,000 sq ft to 269,000 (these figures do not include the two parking levels below grade). The wedge-shaped configuration of the floor plan was determined by the northern property line and the desirability of keeping the building symmetrical about its east-west axis.

Cantilevered Steel Beams

Although the north and south sides of the building were not originally designed to accommodate a future horizontal expansion, the structural engineer determined that cantilevered steel beams welded to the existing columns would provide an efficient means of accomplishing this expansion. This, of course, meant that it was not necessary to add new columns along the north and south sides of the building, thereby eliminating considerable costs.





TYPICAL FLOOR FRAMING PLAN

Although the working stresses in many of the existing columns were larger than those used in the design of the original building, relatively little column reinforcement was required. This is primarily because higher weak and strong axes bending stresses are permitted for steel columns in today's AISC Specification than were permitted in 1958. In addition, the steel columns were found to conform to ASTM A36 requirements, even though A7 material was originally specified.

A new soil investigation indicated that the existing footings were adequate for the increased column loading.

Seismic Design

To meet the earthquake requirements of the 1972 Los Angeles City Code, it was necessary to install girders with moment connections on the north and south column lines C and F, in order to achieve the required strength and stiffness in the east-west direction (see the typical floor framing plan.) To meet these new requirements in the north-south direction, additional high strength bolts were used to strengthen some of the connections of the existing braced frames on lines 2, 3, 4, and 5. Also, moment connections were added to the frame on line 1, and moment frames were provided on lines 7 and 8. Using a large computer frame program, it was possible to link the many lateral resisting elements together in order to accurately determine the proportion of total lateral load resisted by the many members of both the braced and moment frames allowing the structural engineer to better balance the lateral load according to the stiffness of each system.

Rapid Erection

Erection of the 1,100 tons of structural steel for the extensions, including reinforcement of existing members, proceeded at a rapid pace. In three months' time the structural steel and metal decking were in place, and most of the concrete fill for the floors had been poured. Even though the structural steel was prefabricated, very little of it had to be cut or reamed in order to meet actual field conditions; this indicated the exacting tolerances to which the structural steel had been fabricated and erected for both the original building and the extensions.

A New Building — Within and Without

The extensive renovations have completely changed the architectural features and appearance of the building. Both from within and without, it is not possible to discern that most of the building was constructed in the late fifties — it seems to be a completely new structure.

The existing curtain wall has been removed and replaced by an aluminum curtain wall with a baked enamel finish, glazed with solar gray glass. Due to the improved thermal properties of the new curtain wall, it was not necessary to increase the air-conditioning system to accommodate the increase in the floor area occasioned by the north and south building extensions. However, additional air-conditioning capacity was required for the westerly expansion.

Because of the increased occupancy load, it was necessary to add two elevators and one stair shaft, and in the process the four existing elevator cabs were refurbished.

Most of the existing architectural features on the interior have been replaced with attractive modern ones. These include a new concealed spline ceiling having recessed light fixtures with integrated air returns, new carpet and ceramic tile floor covering, new plumbing and light fixtures, and new office partitions with full height solid core walnut and oak doors. Although the existing partitions at the core have not been replaced, they have been either repainted or veneered with ceramic tile.

Conclusion

The Southern California Region Headquarters Building for the Pacific Telephone and Telegraph Company is indeed an attractive, modern office building. It should be emphasized that the significant horizontal expansion of this building would not have been possible if it had not been for the fact that it was framed with structural steel. The steel frame made it possible to economically and efficiently expand and, at the same time, meet stringent new earthquake requirements.

Architect:
Russell McCaleb
Phoenix, Arizona
Craig Elwood Associates
Los Angeles, California
(Design Consultants)

Structural Engineer:
Brandow & Johnston Associates
Los Angeles, California

General Contractor:
Henry C. Beck Company
Phoenix, Arizona

Steel Fabricator:
Federal Steel Corporation
Long Beach, California

Energy Saving Building

The U. S. General Services Administration (GSA) is out to prove a multimillion-dollar point: that an office building can be constructed with readily available materials and will operate on at least 30 percent less energy than other similar structures built in the past. The money is being used to build the federal government's first "energy conservation demonstration project," an $8.8-million seven-story, two-basement-level, steel-framed federal office building in Manchester, N. H.

Energy Study

Designed by the architectural firm of Isaak and Isaak, in Manchester, working with an independent energy conservation consultant (ECC), Dubin-Mindell-Bloome Associates, New York and West Hartford, Conn., the 176,000 gross-sq-ft structure, scheduled for completion in late summer, will be a virtual laboratory designed to study energy conservation.

Numerous devices, techniques, and systems have been designed into the structure to minimize energy consumption, to recover normally discarded waste energy, and to monitor actual building performance. For example, no less than five major systems of lighting and six variations of heating and air conditioning will be tried on various floors to study the relative efficiency of different systems. Even a solar heat-gathering and dispensing system, utilizing banks of solar panels on the roof, will be evaluated.

The National Bureau of Standards (NBS) will monitor the building's performance through an extensive computerized instrumentation system designed into the building with the aid of Dr. Tamani Kusada of the NBS Institute for Applied Technology.

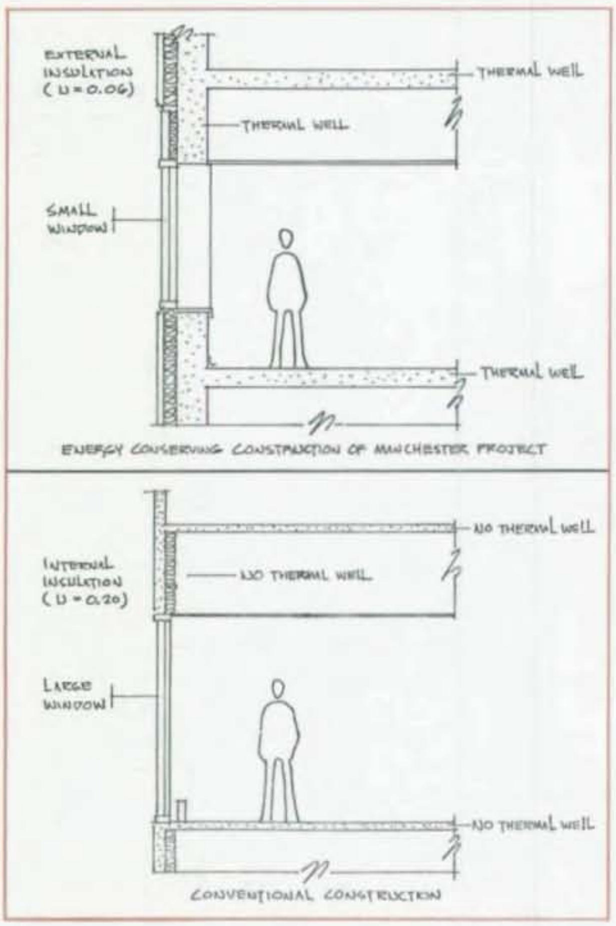
Just how well the federal building performs after the more than 430 personnel take occupancy could have a major impact on the entire construction industry. Actual performance results could play an important role in setting future federal energy standards for building design. Data collected by NBS and GSA from the federal building most

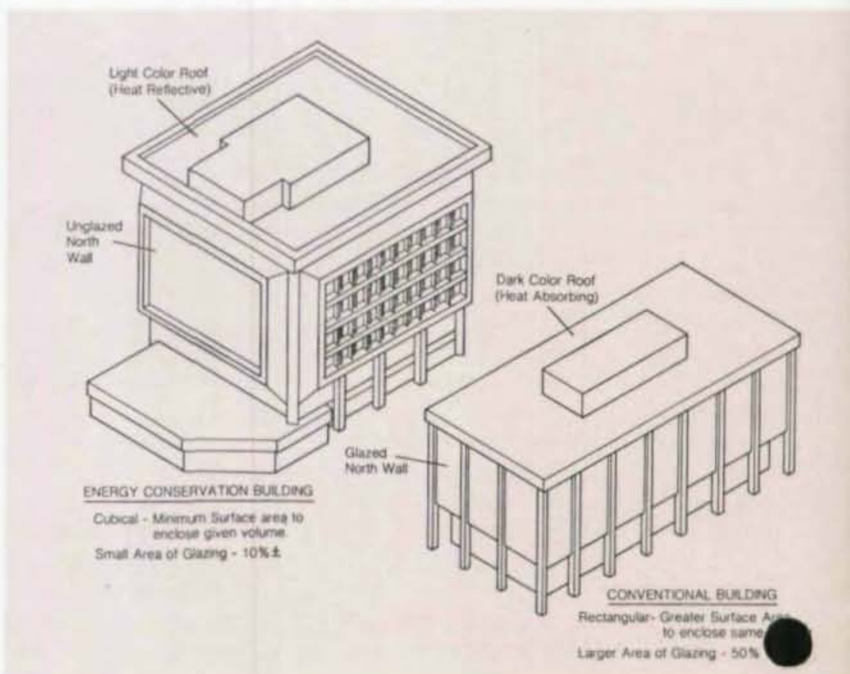
likely will be made available to architects, engineers, owners, and materials manufacturers—and could have a dramatic impact on other future energy-saving building designs.

Andrew C. Isaak, speaking for his architectural firm and for the late Nicholas Isaak, who was the firm's chief architect for the federal building, for one believes that " in the final analysis, we think we will get more than a 30 percent savings in energy use during operation as compared to typical office structures built previously. In fact, we think we will get an energy savings of somewhere between 40 to 50 percent with this structure."

The Manchester federal building was originally proposed as a conventional, rectangular-type combination post office federal facility. However, by the early 1970s, the construction industry was becoming concerned with energy conservation, and GSA responded to this concern by undertaking this energy conservation demonstration project. Shortly afterward, a final design team including GSA Washington Project Administrators, GSA Boston regional staff, NBS, the architect/engineer, and ECC went to work on the project.

Also involved with the architect/engineer, Isaak and Isaak, in the design development work were the structural consultant, Rose, Goldberg and Associ-





ates, Londonderry, N. H., and the mechanical consultant, Richard D. Kimball Company, Cambridge, Mass., and the solar energy system design engineer, Dubin-Mindell-Bloome Associates, West Hartford, Conn.

Unusual Design

The final design produced a building that is seven stories above grade, 130 ft x 110 ft, *plus two below-grade levels* of parking, for a total of approximately 176,000 sq ft of gross area. Changes in the building's shape to a more nearly cubical mass was one of the most noticeable departures from the original rectangular pre-energy conservation design. By changing the shape of the building, the exterior surface area, which is the greatest source of heat loss, will be minimized.

Other departures from conventional office building design include limiting fenestration to 12 percent on the east, west, south facades, and none at all on the cold north wall and the use of solar shading devices on the exterior. Another dramatic difference in the building design is the amount of mass used for walls, roof, and floors.

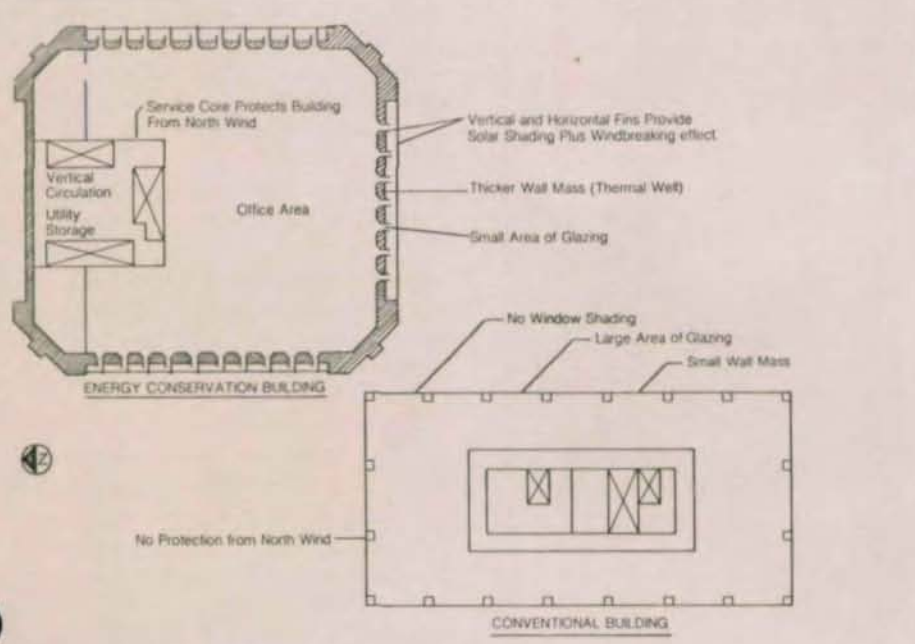
Initial recommendations by the ECC suggested that exterior walls, roof, and floors should have a mass of approximately 100 pounds per square foot of surface. In the final design, some trade-offs in favor of lower initial cost were made by exempting interior floor slabs from these specifications and reducing the mass weight to 80 psf for the remaining components.

"Thermal Well"

The object of all this mass is to create an exterior wall that will act as a "thermal well." (This thermal well is *simply a large material mass which acts* to minimize and delay temperature swings in response to solar radiation, exterior temperature and internal heat gains.) In colder climates like New Hampshire, the primary function of the thermal well is to absorb heat from the interior spaces as well as the solar gain through the windows during the normal working hours and to return heat to the space during periods when interior climate conditioning is not in operation. In actual building design, the existence of the thermal well permits heating systems to be operated for shorter periods of time than in a building without the thermal well. The thermal well also reduces the peak cooling requirements thus permitting the use of smaller-sized cooling equipment.

To create the thermal well in the federal building, the entire exterior wall of the building was designed with backup masonry wall consisting of 12-inch thick concrete block. Added to the backup wall on the exterior are either 3-in.-thick insulated metal panels or, in some areas, granite panels backed by 4 in. of dense fiberglass insulation.

Completing other elements of the thermal well concept are an 8-in.-thick concrete roof slab and reinforced concrete basement level slabs ranging from 15 to 17 in. thick. Overall, the exterior was designed to attain a U-value (*representing the coefficient of heat transmission*) of 0.06 for the walls, roof, and floor slab immediately above garage level. Internally, composite construction is used with cellular composite deck to provide floors with a total thickness of 5½ in. each.



Steel Framing

Steel was specified for the framing of the structure to carry all this weight, and for additional reasons as well. Approximately 950 tons of high-strength A572 GR 50 steel were used primarily for columns and exterior girders, and A36 steel shapes and plates for the remaining framing. Steel for the project used a combination of shop welding and high-strength bolting to join framing members.

Because of the nature of the building unusually heavy connections were required. This particular structure utilizes some 14 sections that are the heaviest rolled in the steel industry at 730 lbs/ft and bolt sizes that might normally be found in a 20-story building. For field connections 7,200 high-strength bolts were used, A490 bolts, 1⅛ in. in dia. and 6-in. long, were used to splice column sections, ranging up to 398 lbs/ft, and for some beam connections A325 bolts, 1½ in. in dia. and 7½ in. long, were used for most beam connections.

In addition to being specified to carry the great mass required for the structure's thermal well, steel also was used for the framing for a number of other reasons:

- Because of soil conditions, steel was selected to achieve a lighter foundation load. (A heavier structure constructed entirely of concrete probably could have satisfied the thermal well design, but would have required much larger foundations.)
- Manchester is a Seismic Zone Two area and steel easily satisfied earthquake design requirements.

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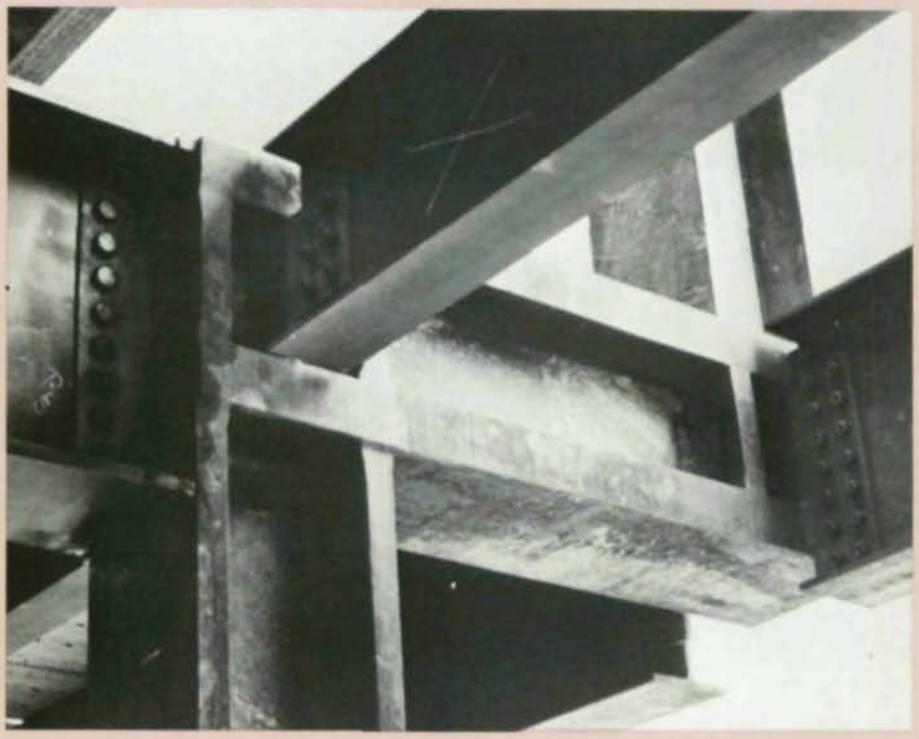
Energy Saving Building (cont.)



• Mechanicals for the many energy-savings systems to be tried in the building can be accommodated more easily by the steel framing system since framing members are reduced in thickness as compared to a possible concrete design.

• A key concept in the overall energy-saving design is the use of "open planning" floors, where the number of ceiling-high partitions is kept to a minimum. Steel framing made it possible to create large clear span areas for the various floors. (Typical bay size for the structure is 30 ft x 35 ft.)

When completed, the federal building will become a focal point of the Manchester Civic Center complex. It is designed within the framework of the Civic Center master plan, complementing the already existing buildings such as the County Court House, the Central Fire Station, and the hi-rise housing for the elderly.