VOLUME VII / NUMBER 1 / FIRST QUARTER 1967

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MODERN STEEL CONSTRUCTION

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Published by

American Institute of Steel Construction

101 Park Avenue, New York, N. Y. 10017

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ARCHITECTURAL AWARDS COMPETITION

All registered architects are invited to submit entries in the 1967 Architectural Awards of Excellence Competition. Any type of steel framed building completed after January 1, 1966 is eligible.

Five distinguished architects, engineers and art directors will serve as the Jury of Awards. They are:

- *Henry J. Degenkolb/H. J. Degenkolb & Associates, Engineers/San Francisco, California*
- *Robert L. Durham, FAIA/1st Vice President, American Institute of Architects/Durham, Anderson & Freed, Architects/Seattle, Washington*
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- *Walter Sharp/Director, Tennessee Fine Arts Center/Nashville, Tennessee*
- *David N. Yerkes, FAIA/Director, Middle Atlantic Region of AIA/Deigert and Yerkes and Associates, Architects/Washington, D.C.*

Competition rules are available from AISC, 101 Park Avenue, New York, N. Y. 10017. Entries must be postmarked prior to June 1, 1967.

NEW SPECIFICATIONS AVAILABLE

Two new specification publications are now available to architects and engineers and may be obtained without charge from AISC headquarters.

Longspan Steel Joists and Open Web Steel Joists *is an updated version of the earlier AISC publication "Open Web Steel Joists". It contains the new Standard Specifications and Load Tables for Longspan Steel Joists, LJ- and LH-Series, which became effective January 1, 1967, superseding two earlier separate specifications covering an LA-Series and an LH-Series. Also included in the booklet are the Standard Specifications and Load Tables for Open Web Steel Joists, J- and H-Series, effective March 1, 1965.*

Specification for Structural Joints Using ASTM A325 or A490 Bolts, *revised September 1, 1966 by the Research Council on Riveted and Bolted Structural Joints, has been endorsed by AISC. This revised specification contains several important changes over the March, 1964 specification.*

At one point the 60-passenger cabin of the tramway soars 1,400 ft off the ground. In the right background is Tower No. 2.

SANDIA PEAK AERIAL TRAMWAY

A decade ago Americans returning from vacations in Europe spoke of thrilling rides on aerial tramways in the Swiss Alps. Today even Swiss engineers are impressed with North American tramway installations, especially the Sandia Peak Aerial Tramway located six miles east of Albuquerque, New Mexico.

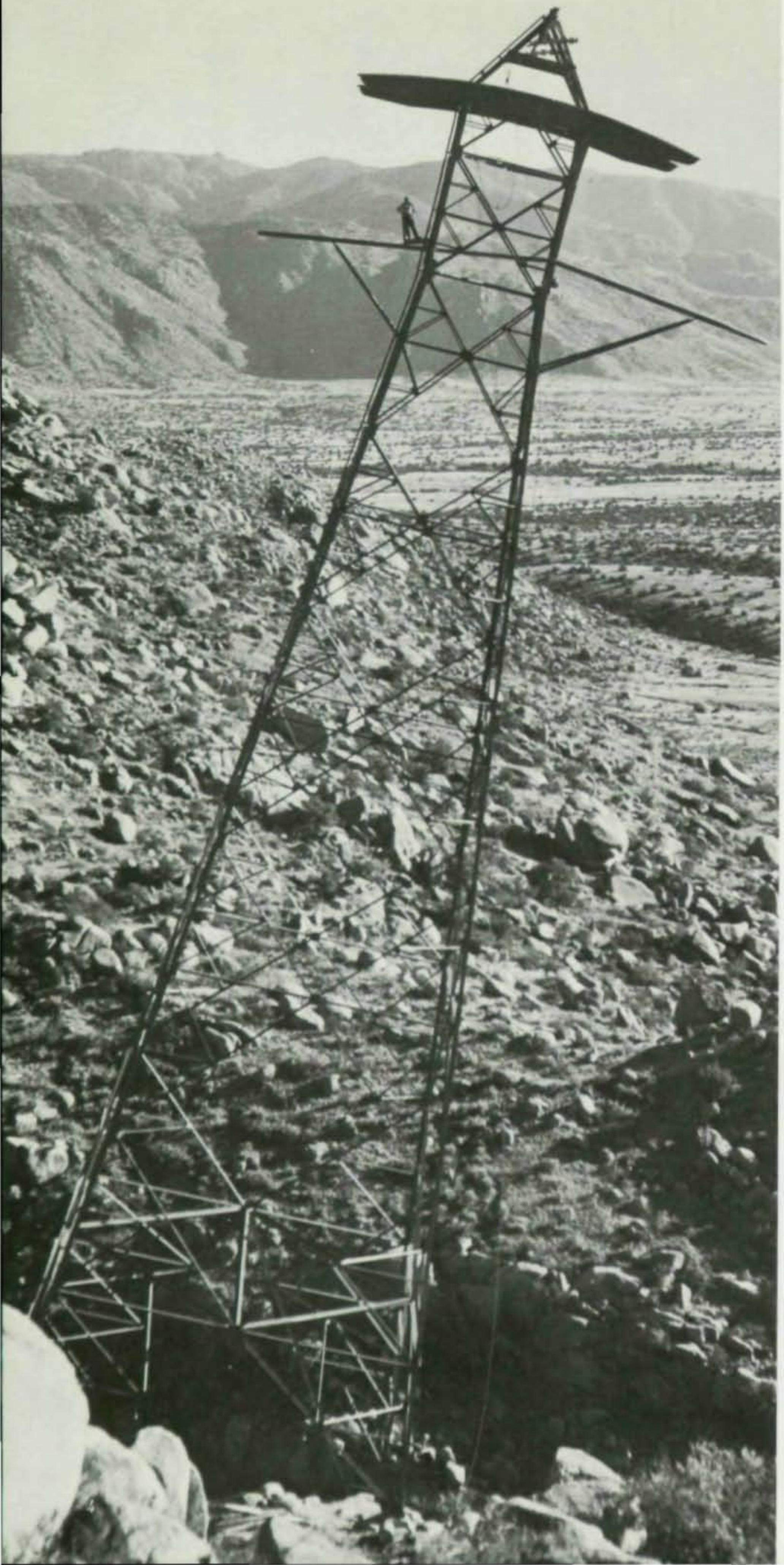
Built on the rugged west face of Sandia Crest, it is the world's longest "jigback" tramway. There are only two cabins; as one goes up the other comes down, like buckets in a well, at 22 miles per hour.

The upper terminal atop Sandia Crest is 10,378 ft high. From the viewing platform over 11,000 sq miles of New Mexico are visible. Below is the winding Rio Grande River and Albuquerque; on a clear day Mt. Wheeler, New Mexico's highest peak, is visible. This 13,150 ft peak is 140 miles away.

Anchored deep in concrete at the upper terminal are four track cables. Each is 1⅝-in. diameter, weighs 56 tons, and is 14,657 ft long. From their anchorage these cables rise, pass over steel "breakovers", and arc downhill.

The profile of the west face of Sandia Crest, aside from the weight of the cables, precluded a single cable span. Instead, 7,720 ft from the summit the track cables rest on steel guides atop Tower No. 2.

This tower is 80 ft tall and perches on an 8,750 ft rock ledge that is accessible only on foot or by helicopter. During construction of Tower No. 2 helicopters airlifted in 44 tons of steel in 2,500 pound loads. The erection of the tower was handled by a guyed steel column, or gin pole.



Tower No. 1 is 232 ft high and 18 degrees off the vertical, so that structural loading is normal to the face of Sandia Crest.

Tower No. 1, at the 7,010 ft level, is 232 ft tall, 22 ft higher than Albuquerque's tallest building, and is canted 18 degrees off the vertical to direct the loads from the track cables directly into the mountainside. Anchoring Tower No. 1 are 30 ft deep steel rods.

At the lower terminal the four track cables are not visibly anchored. They enter the shed-like terminal building, pass over sheaves atop a steel framework, and exit behind the terminal building.

Outside, each cable bends over sheaves mounted on an I-beam framework atop a 70-ft deep pit. Attached to the end of each track cable is a 90-ton counterweight. These counterweights are designed to provide constant tension as the cable length varies due to temperature, or, as tension varies when the cabins move along the track cables. As the cabins skitter up and down, the counterweights slowly rise and fall.

The elevation of the lower terminal is 6,559 ft, and the total vertical rise to the summit is 3,819 ft.

Towing the track cables into place required almost a year. It began the morning a B-204 helicopter flew west from the summit terminal. Attached to the fuselage was one end of 15,000 ft, ⅜-in. diameter "straw cable."

Near Tower No. 2 the straw cable was prematurely dropped – the weight was too great for the helicopter to safely tow. Men then climbed into the rocks, found the straw cable, and finished pulling it to the lower terminal by hand. Then, one by one, the track cables were inched into place.

The two fire-chief-red cabins are 10 by 22 ft, hold 60 passengers plus a crew of two, and weigh 3½ tons. Built into the floor of each cabin is a 500-gallon stainless steel water tank that is used to haul water to a restaurant at the summit. Each cabin hangs on two track cables. Connecting the cabins are two 1¼-in. diameter hauling cables. Each is 14,750 ft long and has a 20-ton counterweight at the summit terminal to maintain constant tension. At one point in the system, each cabin is 1,300 ft above the ground.

The breakovers at the summit support 224 tons of track cables.

Elevation of Lower Terminal	6,559 feet
Elevation of Tower No. 1	7,010 feet (232 feet high)
Elevation of Tower No. 2	8,750 feet (80 feet high)
Elevation of Upper Terminal	10,378 feet
Total vertical rise	3,819 feet
Diagonal distance between:	
Lower Terminal and Tower No. 1	1,825 feet
Tower No. 1 and Tower No. 2	4,640 feet
Tower No. 2 and Upper Terminal	7,720 feet
Total diagonal length	14,185 feet
Total length of track cables (4)	14,657 feet
Size of track cables (4)	1⅝ inch diameter
Size of hauling cables	1¼ inch diameter
Number of cabins	2
Weight of each cabin (empty)	7,000 pounds
Maximum cabin speed	1,950 ft./min., or 22 mph
Trip time (one way)	15 minutes

Workmen install the two 60-passenger cabins at the lower terminal.

For the acrophobic, the cable safety factors and braking system are of special importance. Each cabin dangles from two track cables; just one of these cables is strong enough to safely support a cabin filled with 60 passengers.

Above each cabin the hauling cable is connected to a hydraulic actuator assembly below the wheels, holding the cabin on the track cables. Wedge-shaped jaws grip the track cables until tension of the hauling cable releases them. Should a hauling cable ever break or slacken, the jaws automatically clamp shut. They will hold a fully loaded cabin in place without damaging the exterior sheath on each track cable. Should power to the drive motor fail, the jaws automatically clamp shut.

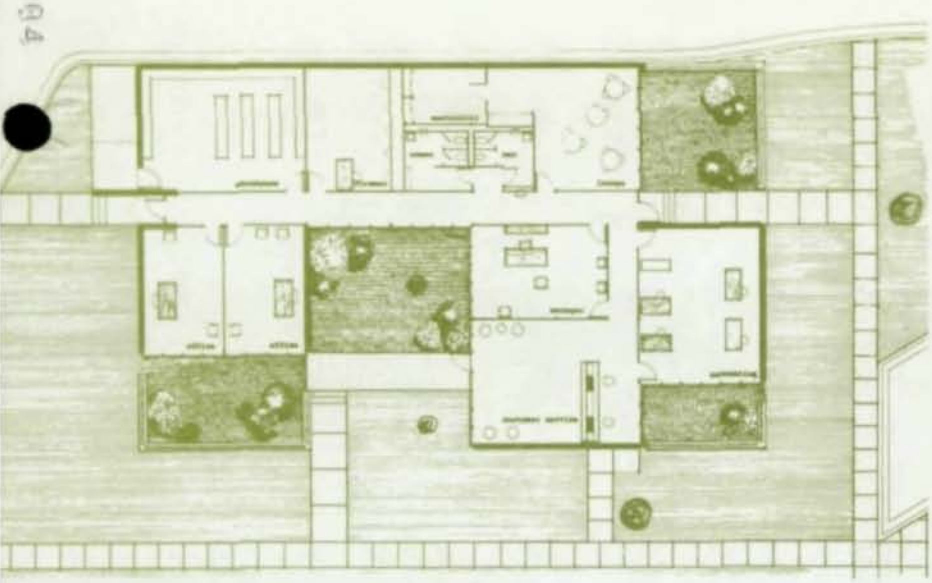
The contractor for this impressive tramway was Martin & Luther, Albuquerque, New Mexico. The engineering design was by Bell Engineering, Lucerne, Switzerland. Bell engineers, who have built over 50 tramways around the world, say the Sandia Peak project was one of the most difficult operations the firm has ever tackled.

OFFICE BUILDING FOR A RESIDENTIAL AREA

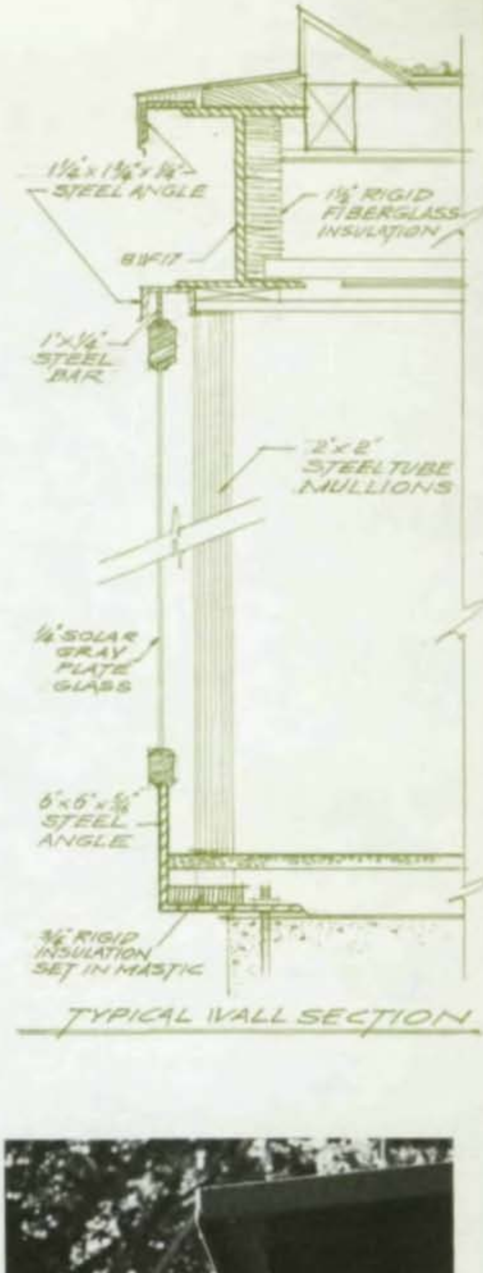
by Lyman S. Reed, AIA

At one time or another, we're probably all confronted with the task of designing a commercial structure for a residential or semi-residential area. It's practically inevitable with today's constantly changing neighborhoods. This office building for the Community Public Service Company in Alvin, Texas, is a good example. According to our client, a public electric power company, and the neighbors in the immediate area, the building is an entirely acceptable solution to the dichotomy.

We would attribute its apparently successful design to several factors. The broken horizontal and vertical planes are, of course, more interesting to the eye. Our insistence that the contractor leave as many trees standing as possible, and particularly the huge oak tree to the right of the entry, allowed us to take advantage of the site's natural beauty. And structural steel paved the way for a design that is light, delicately-webbed,



FLOOR PLAN north



TYPICAL WALL SECTION

and very much in keeping with the residential flavor of the neighborhood.

Exposed outside and, to some extent, inside, the structural steel frame is a strong part of the total visual impression. Curtain walls of glazed brick and glass fill in the framing, and made the system quite economical by floating the glass in neoprene gaskets fitted directly over the steel.

Main columns are 4-in. square tubular steel, and these support 8-in.-deep wide-flange beams (8WF17), which enclose the roof. With a drip cap overlapping the top flange of the WF beam by about an inch, and the top of the glass little more than 2 in. from the bottom flange, the exposed steel fascia becomes a surprisingly delicate profile.

Junior beams, 6 in. deep and spaced 4 ft on center, are framed into the WF beams. The bottom flanges of the junior beams carry 1 in. fiber insulation board, which, in turn, supports the poured lightweight insulating concrete deck. The deck was poured to the top of the WF beams and 2 in. above the junior beams, then topped with a standard built-up roof.

To continue the concept of thin profiles, we specified 2 in. square tubular steel uprights at intermediary points along the glass, and 3 in. sections at the columns, when columns were required directly behind the glass.

The foundation consists of a monolithic, steel-reinforced slab and beam supported on under-beam footings. Interior partitions are 2½ in.-thick solid gypsum board with a decorative vinyl covering. Floors are terrazzo, and the ceilings are made up of suspended acoustical tile and lighting panels.

One of the integral design goals was to reflect the company's product—electric light and power. As a result, we paid particular attention to the lighting. Inside, there are combinations of luminous ceilings, low voltage lighting, and an interplay of fluorescent and incandescent fixtures. Outside, floods and spots were hidden in trees and recessed in the ground and foundation in the courtyards. And an all-electric heat pump with supplementary resistance heat provides year round heating and cooling.

Power company officials are pleased with the low-maintenance characteristics of the steel-glass-brick structure, and have stated that it not only solves the immediate design goals, but should set the pace for new commercial structures in the neighborhood – buildings that are bound to be constructed sooner or later.

Our firm, Cummins, Reed and Clements, served as architect for the project. Structural engineer was Ellisor Engineers of Houston, and the general contractor was B-W Construction Co., Bellaire, Texas.

Mr. Reed is a partner in the architectural firm of Cummins, Reed and Clements, Houston and Texas City, Texas.

STRUCTURAL STEEL HELPS MAK

by C. M. Deasy, FAIA

In essence, this building is a suspended structure carried by heavy steel trusses spanning between terminal towers. The trusses and cantilevered girders crossing them carry all the floor loads through tension rods expressed on the exterior of the building.

Importance of Aesthetics

The immediate question, I suppose, is why we selected this structural form for the building over other, more obvious ones. The choice was primarily aesthetic. As you can tell by the load path, this isn't the most economical structural system. The weight of a load on the second floor must be transmitted by the hangers to the trusses above, across the trusses into the towers at each end, and down the towers to the ground. This same load could be supported more efficiently by a short column between the second floor and the ground.

But the aesthetic advantages were considerable, and this was important. The Lincoln Savings and Loan Association had acquired a prime commercial corner in Sherman Oaks, California, a prosperous area in Los Angeles. The institution's policy is to establish relatively autonomous branches in landmark structures that can become a focus for the community and a reflection of Lincoln's progressive policies and interest in the community.

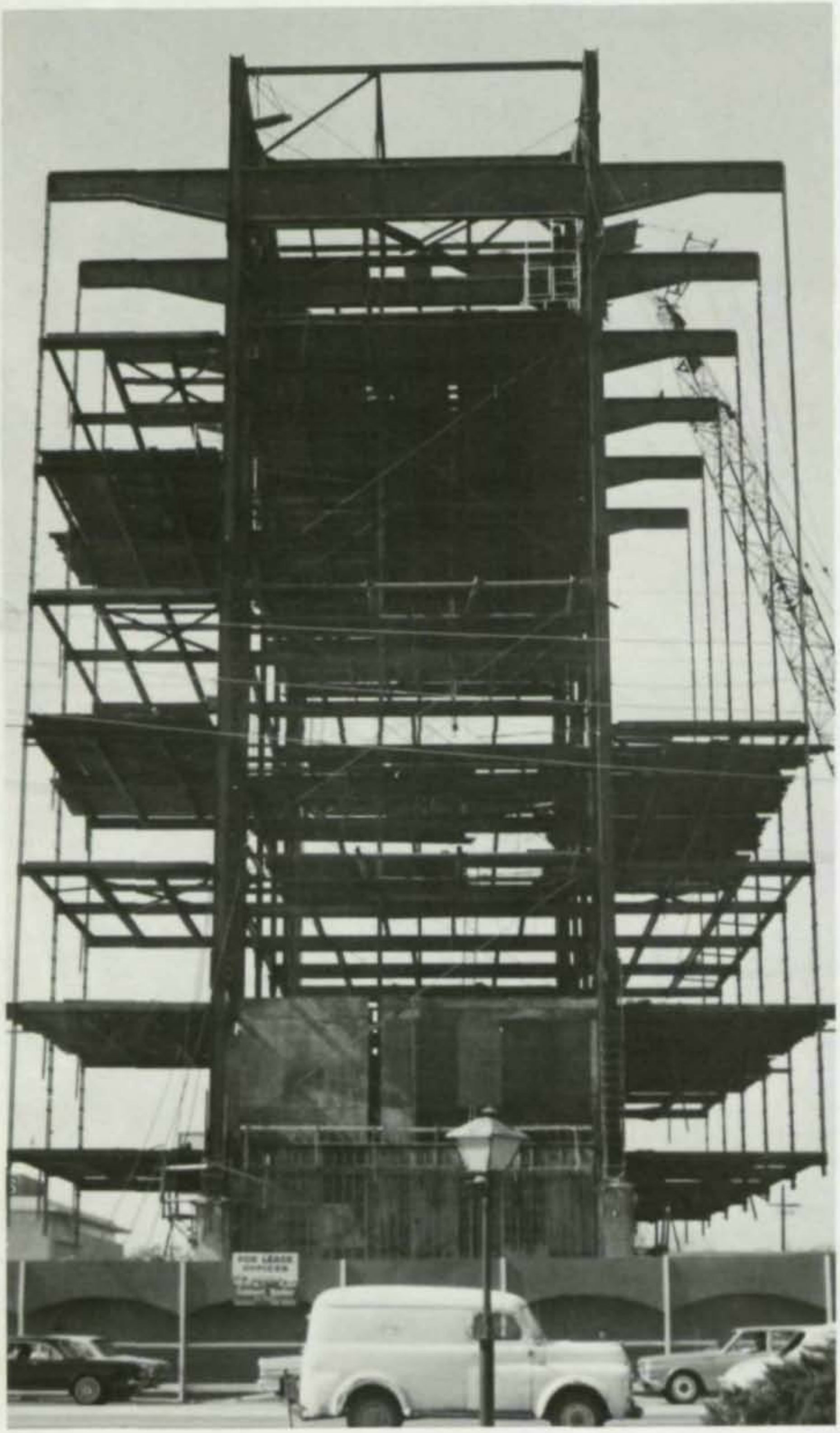
Thus cost was not the first consideration. The suspension system was more expensive than a typical steel frame. (However, it's more than possible that an equivalent amount of money might easily have been spent on certain exterior finishes, such as marble or granite.) Suffice to say that the client feels the added cost of construction was well justified by the results.

What we developed, then, is a structure in which the system itself becomes one of the foremost architectural expressions. The thrust of the cantilevered girders from which the hangers are sus-

(See page 10)

Mr. Deasy is a partner in the firm of Deasy and Bolling, Architects, Los Angeles.

AN AESTHETIC STATEMENT



by William T. Wheeler

Since the design of the Lincoln Savings & Loan Association Building in Sherman Oaks, California, employed known concepts in a unique and imaginative way, it's not surprising that a number of special considerations were required in planning and assembling the structural elements.

The heart of the structure consists of two service towers at either end of the building, and two 80-ft long steel trusses resting on steel columns encased in the tower walls. Looking like an inverted, squared-off and thickened "U", this basic shape carries the entire center section of the building.

Floors 2 through 8 are carried by a system of tension H columns projecting directly from the trusses, and square tension rods at the exterior building lines. These rods are supported from welded plate girders located at the level of the roof trusses and supported on the trusses. Plate girders were prefabricated, then lifted into place, and were threaded through the trusses without difficulty.

Unusual Erection Procedure

During erection, the roof trusses were assembled in place. The total weight of each truss – 90 tons – made it impractical to lift the finished truss as a unit. Basically, all of the connections on the truss were made with A325 high tensile bolts.

The sequence involved during erection of the structural steel and encasement of the roof trusses in concrete called for care. The erector elected to use temporary columns in the first story in line with each of the interior tension H columns and extending to a temporary foundation, until the entire overhead truss assembly was completed. The sequencing of the encasement in concrete was also controlled to permit as much dead load deflection as possible prior to encasement of the rigid truss ends at the two tower units.

(See page 11)

Mr. Wheeler is a partner in the consulting engineering firm of Wheeler and Gray, Los Angeles.

pended gives the building a distinctive profile, easily identified at a distance. The slender hangers impart a light, floating quality to the structure and change an essentially square facade to a series of slender vertical bays. The ground floor is completely free of fixed supports and has a spatial quality readily apparent to anyone entering the building.

The hangers also contribute to the aesthetic qualities of the interiors on the upper floors. The effect is to define the building space at the outer edges of the balconies.

It's been interesting to observe that laymen, although they don't understand the technical nature of the building, are instantly aware that something is fundamentally different from buildings they are accustomed to seeing. They appear to be intrigued by it without knowing quite what it is that excits their interest.

Architectural Features

The eight-story building contains a ninth level for mechanical equipment, and an underground parking garage. The seventh floor is used by the institution as a Lincolniana Museum, featuring displays from the extensive collection owned by the Association. An auditorium off the museum is used for a narrated film in conjunction with dioramas illustrating high points in Lincoln's career.

The eighth floor is used as an employees' lounge, and is made available to civic organizations in the area for evening meetings. The symmetrical utility and circulation towers not only provide a base for the trusses but constitute the essential resistance to seismic forces. Within the towers are the elevators, stairs, mechanical equipment spaces, telephone equipment rooms, janitor closets, and toilets. The continuous balconies at each floor were incorporated for the benefit of the tenants – primarily professional people – though they are also an essential part of the sun control system.

Trusses and girders are encased in concrete. The hangers are steel rods coated with fireproof plaster and encased with aluminum covers. Other smooth exterior surfaces are concrete, except for the facing on the balconies and end towers, which is ceramic veneer. The wood details on the ground and eighth floors are of teak, and the building entrances have slate floors.

Structural Design Considerations

Anticipated deflections, both during construction and during use of the building also received consideration, with particular emphasis on temperature changes. Interior tension columns are enclosed within the environmental walls of the building where temperatures are controlled. But exterior tension columns are subject to a large degree of temperature variation. Special floor and window joints were installed to permit differential movement.

We designed the roof trusses for a calculated deflection of ¾-in., and camber was provided. The actual deflection amounted to ¼-in. to ½-in., and after the truss was encased in concrete, no further deflection was recorded.

Our compensation for column elongation was made by requiring floor slabs over metal decking to be placed in sequence from top to bottom of the structure. And, allowance for deflection and elongation was made in crowning the fill slabs from ¼-in. to ½-in. on the floors.

In designing for earthquake requirements, we classified the building as a one-story structure in the longitudinal direction and as a pendulum-type structure in the transverse direction. These requirements were established for the City of Los Angeles Department of Building and Safety by an advisory committee of the Structural Engineers Association of Southern California.

The total horizontal shear in a longitudinal direction is based on a factor of 0.133 times the dead load, giving a total shear of 1210 kips at the base of the structure. The shear in the transverse direction is based on a factor of 0.3 times the dead load, giving a total shear of 2730 kips at the base of the structure.

Secondary stresses in the truss system, although having some effect on the member sizes, did not affect the trusses as much as we anticipated.

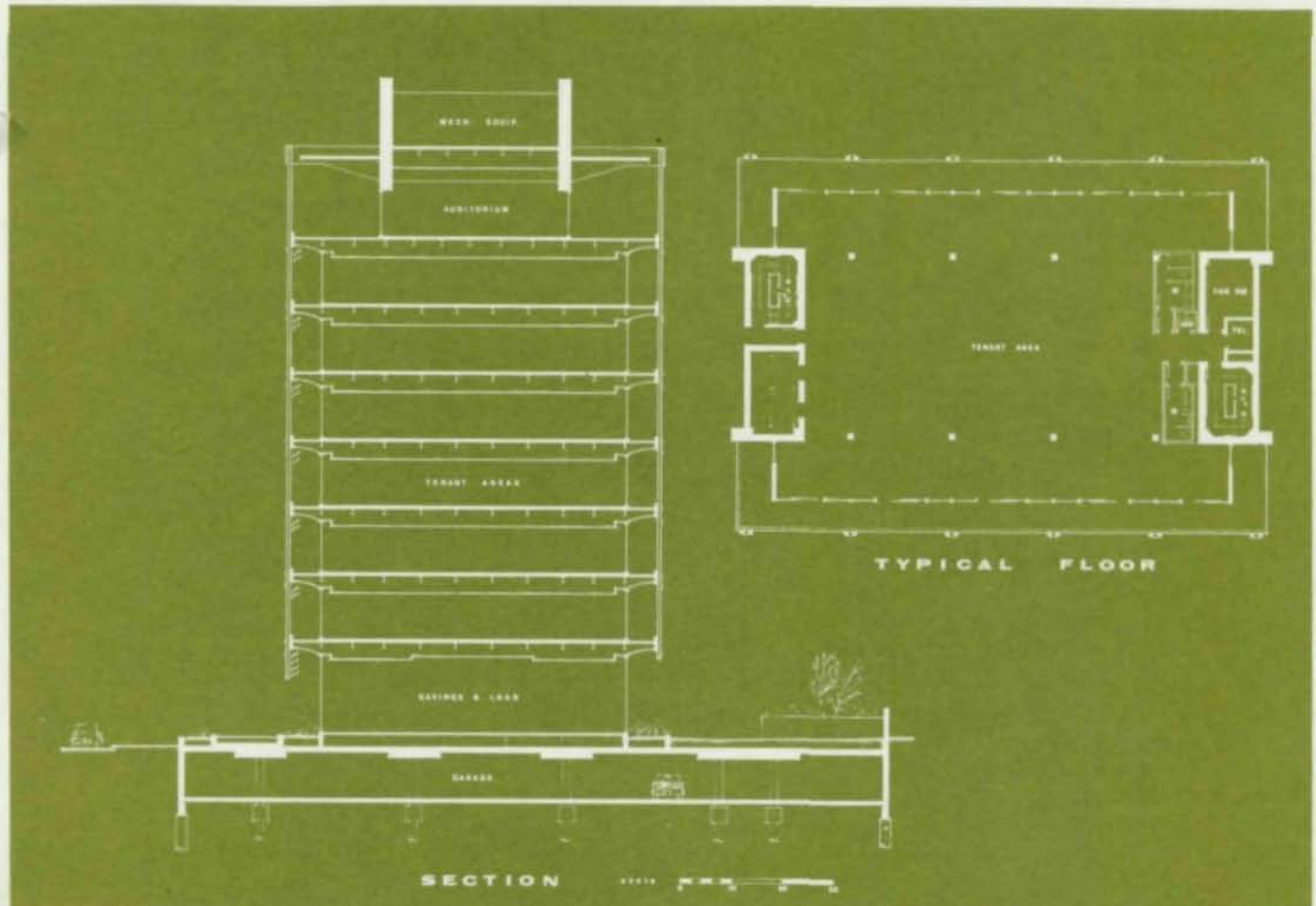
Total structural steel in the building amounted to about 770 tons. There are eight floors above grade, each approximately 71 ft x 105 ft, and one parking level below grade. Above the mechanical housing on the ninth level, we allowed for a future helistop.

Architect: Deasy and Bolling, Architects, Los Angeles, California

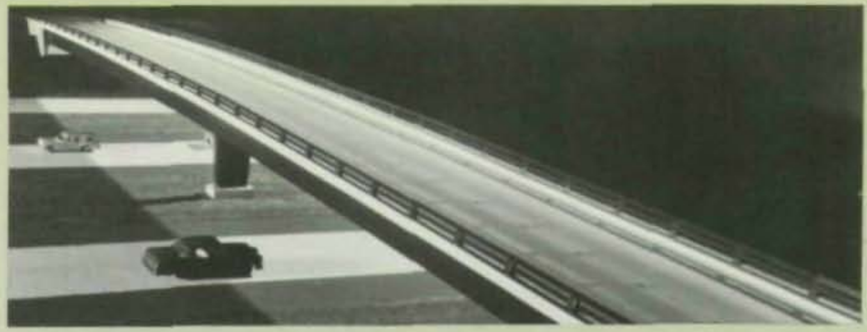
Structural Engineer: Wheeler and Gray, Los Angeles, California

General Contractor: C. W. Driver, Inc., Los Angeles, California

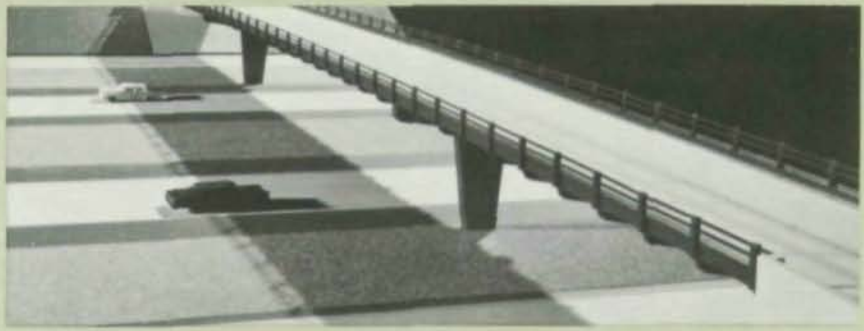
Steel Fabricator: American Bridge Div., United States Steel Corp., Pittsburgh, Pennsylvania



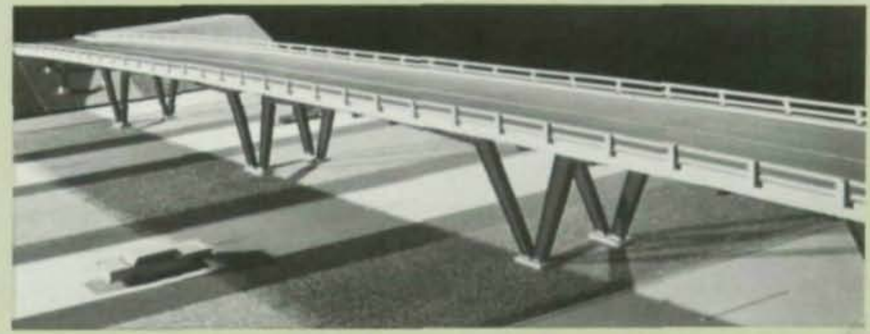
Use of atmospheric corrosion-resistant steel in this two-span continuous box girder design won the first place award in the professional category for William J. Jurkovich. The design calls for two box girders, one supporting each bridge lane, and allows for the elimination of cross frames for the spans.



Five members of the New York design engineering firm of Vollmer, Ostrower Associates collaborated on this design for a three-span box girder highway bridge to win the third place award among professional engineers. The design has a single box girder of continuous design supporting the full roadway width. The deck is semi-orthotropic steel plate with a concrete slab bonded at the top. The two intermediate supports are single-legged steel columns designed to act continuously with the single box superstructure.



Two 1966 graduates of the Cooper Union for the Advancement of Science and Art, New York, designed this eight-span highway bridge to win the first place student award. The design, submitted jointly by Charles Scawthorn and Charles Hofmayer, features a series of haunched girders to support an orthotropic plate deck, producing a series of steel rigid frames connected by short constant-depth spans.



PRIZE HIGHWAY BRIDGES

Tomorrow's highway bridges will have longer spans and fewer piers. They will be more pleasing to look at and may cost less to build. These conclusions can logically be drawn from the recent United States Steel Corporation International Competition for Highway Overpass Structures. Ten out of thirteen top award winners were either two-or three-span designs rather than the usual four-span arrangement.

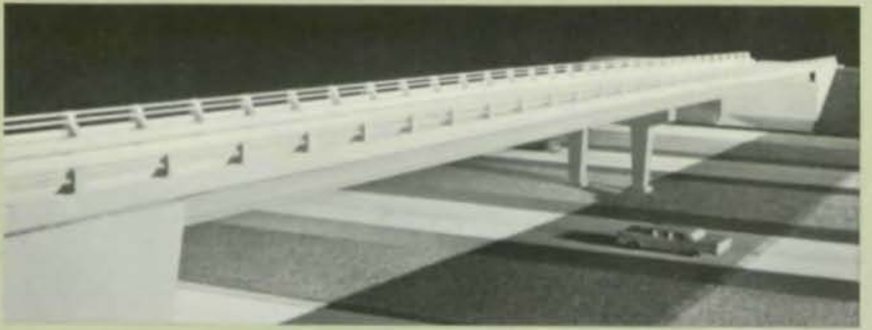
Aesthetics and safety appear to have motivated the removal of piers from highway median strip and shoulders. Elimination of a center pier improves the motorist's view and emphasizes the lightness of design.

First award winner among professional engineers was William Jurkevich, Senior Bridge Engineer for the California Division of Highways. He took the $15,000 big prize for his two-span continuous box beam bridge. Second prize of $10,000 went to Anthony P. Sousa for a four-span composite plate girder bridge with a continuous deck. He is Assistant Project Engineer—Structures with Porter, Armstrong, Ripa & Associates of Newark, N. J. Five members of the New York design engineering firm of Vollmer, Ostrower Associates collaborated on a three-span box girder bridge to win third award of $5,000. They were Arnold H. Vollmer, Donald A. Ostrower, Lawrence H. Lehman, Robert L. Rotner and Phillips H. Lovering.

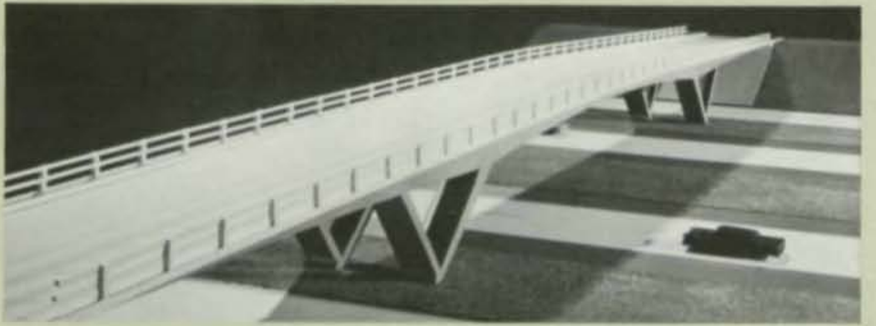
The objective of the competition was to stimulate greater creativity in bridge construction. The specific problem was to design an overpass structure in steel to carry a 2-lane highway at right angles over a 4-lane Interstate Highway, with frontage roads, on level terrain. Entries were judged on originality of design, degree to which steel was used, economy (in design, fabrication, construction and maintenance) and appearance.

New Technologies Used

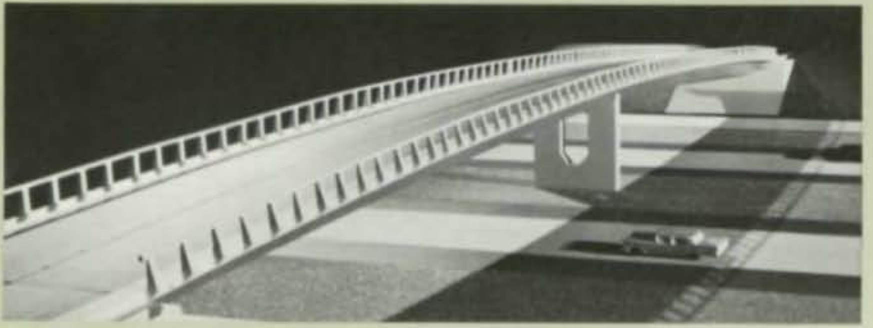
New technologies were well represented in the entries which came from 33 states and 26 foreign countries. All entries capitalized on steel's special advantages of high strength, attractive appearance, and the economies gained from prefabrication and lack of maintenance. All entries utilized welding to some degree. Most made use of high strength steels, recently developed by steel producers. Many used composite action, orthotropic decks, prestressing, and folded plate construction. To offset a part of the cost of longer spans, prefabrication, precasting, and modular construction were frequently called upon. Shop-welded assemblies were used within the limits possible for ship-



This unusual bridge design, featuring two very short end spans of 25 ft and two intermediate spans of 136 ft was judged winner of the second professional award. The designer is Anthony P. Sousa. The end spans were hidden in closed abutments to create a negative moment at the front of the abutment, cutting down the effective center span lengths from 136 ft to 90 ft. At the center of the bridge the plate girders are supported by a two-legged steel frame pier.



Combined engineering talent of two students from Denmark produced this design for a three-span steel highway bridge judged the Second Student Award winner. The students are Jorgen Gimsing and Peter Engberg, both 1966 graduates of the Technical University of Denmark. The bridge is a continuous box-girder structure. It features interior delta columns integral with the twin superstructure box girders and inclined away from the main traffic lanes. The two-box girders act compositely with a reinforced concrete deck, are six feet wide and have a variable depth.



Two simple span box girders using a combination of A36 and high-strength carbon steels make up this design which won the Third Student Award. The designer is Edwin B. Workman, Villa Park, California, a 1966 graduate of California State Polytechnic College, San Luis Obispo, California. Precast concrete slab units are slotted and grouted over shear connectors for composite action with the steel superstructure members.

FEATURE LONGER SPANS

ping. Multiple use was made of various structural elements. In most entries, safety and appearance took precedence over weight and cost.

The box-girder design of Mr. Jurkevich's first-award two-span bridge, while not completely novel, has not been widely used in over-crossings. Because box-girder construction combines the pleasing appearance of longer spans with economy, it is expected to have extensive use in the future.

The two spans of Mr. Jurkevich's bridge measure 145 ft each. The two box-girders, one supporting each bridge lane, allow for elimination of cross frames for the spans. Increased traffic could be accommodated beneath the structure by excavating the fill slope at the abutments. The structure itself could easily be widened to handle additional traffic lanes.

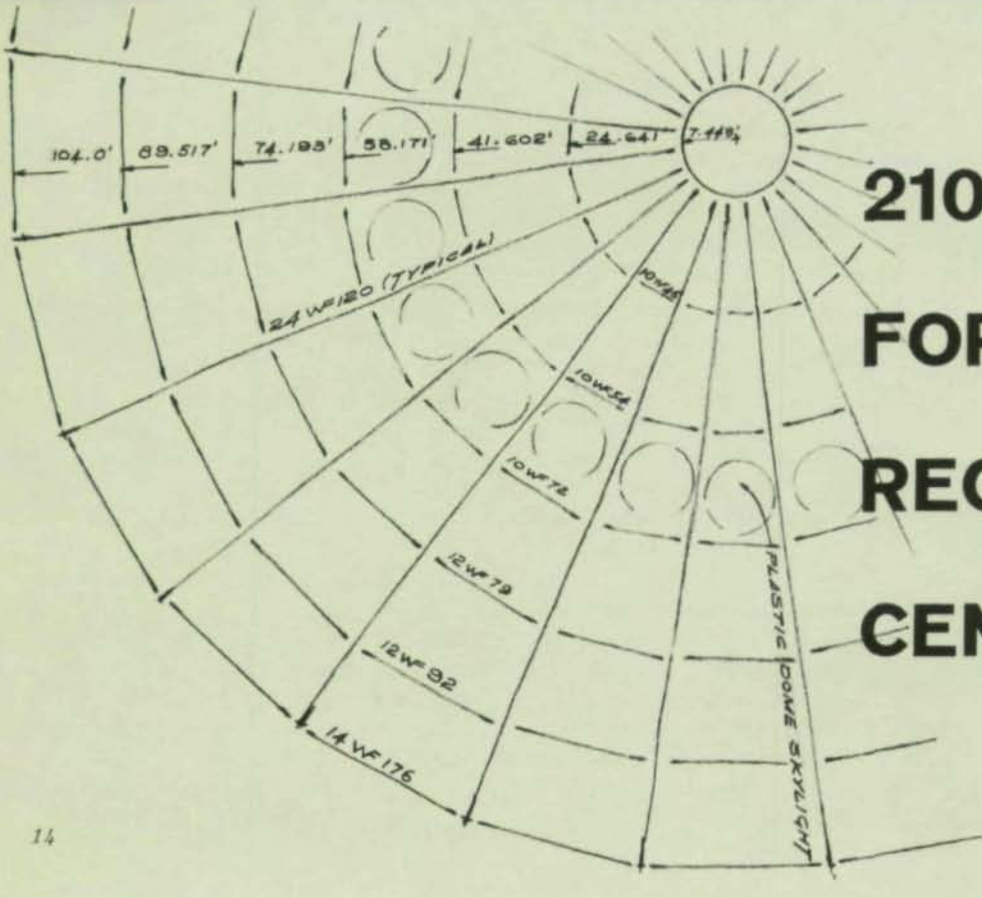
The design requires 137 tons of steel. Corrosion-resistant steel was specified. The reasons: its natural weathering to a rust-brown color would contrast pleasantly with concrete, blend well with the environment, and minimize maintenance.

Mr. Sousa's second-prize plate girder design has two very short end spans of 25 ft, hidden in closed abutments. This arrangement creates a negative moment at the front wall of each abutment, and cuts the effective span length of the center spans from 136 ft to 90 ft. It also permits a reduction of structure depth to 3 ft-9 in. At the center of the bridge the plate girders are supported by a two-legged steel frame pier. Construction would require 133 tons of steel.

The prize competition was open to students as well as professional engineers. The $5,000 first award for students was taken by the team of Charles Scawthron and Charles Hofmayer, with an almost completely prefabricated orthotropic plate design requiring only 222 tons of steel. Both are recent graduates of Cooper Union.

Jury of Awards

Ward Goodman was chairman of the Jury of Awards. He is deputy director and chief engineer of the Arkansas State Highway Department. Other jurors were Arthur L. Elliot, bridge engineer—planning, California Division of Highways; George E. Danforth, chairman of the Department of Architecture at Illinois Institute of Technology; J. Philip Murphy, senior corporate officer of Murphy Pacific Corp. and president of AISC; Harold B. Schultz, chief bridge engineer, State Highway Commission of Wisconsin; and the late Maurice N. Quade, partner of Parsons, Brinckerhoff, Quade and Douglas, New York City.



210-FT DOME FOR RECREATION CENTER

by Samuel H. Marcus,
AISC Regional Engineer

An unusual 210-ft diameter steel-framed dome is the focal point of one of the nation's newest and largest suburban recreation centers, the $1.9 million Cantiague Park Swimming Pool and Skating Rink Complex in Hicksville, Long Island, N. Y. Resting 13 ft above-grade on inward-leaning precast concrete tee-columns, the 43-ft high steel dome is structurally independent of the supporting tees.

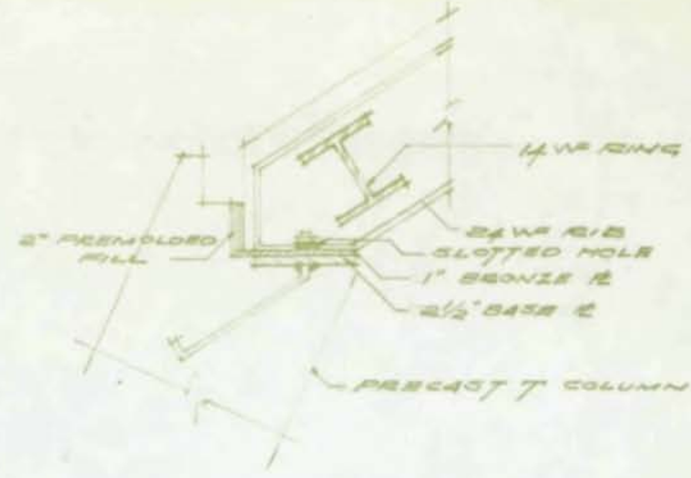
The domed structure will be used for skating, theater-in-the round, and other year-round activities. Three small flat-roofed circular buildings interconnect with the main structure to provide shower and dressing rooms and indoor-outdoor dining facilities. Four outdoor swimming pools, landscaped grounds, and extensive open parking facilities complete the complex.

Architects-engineers Frederick P. Wiedersum Associates, Valley Stream, N. Y. investigated several alternative design concepts for the project. They selected the steel-framed dome design on the basis of cost, function and aesthetics. A concrete dome of the same size would have been economically unfeasible, because of the prohibitive amount of form work required. A. A. Abadalian, New York, N. Y. was Consulting Structural Engineer on the project. With precise specifications and calculations as well as careful pre-planning of all details, construction proceeded on schedule with virtually no hitches.

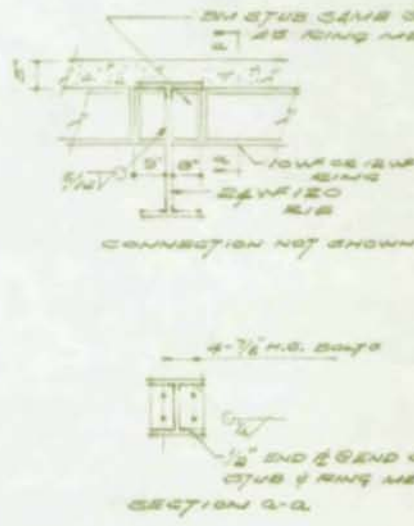
In effect, the precast concrete tees form an elevated footing for the structurally independent steel dome. The ribs of the dome rest on lubricated bronze plates which allow movement during normal expansion and contraction due to temperature change.

Construction Procedure

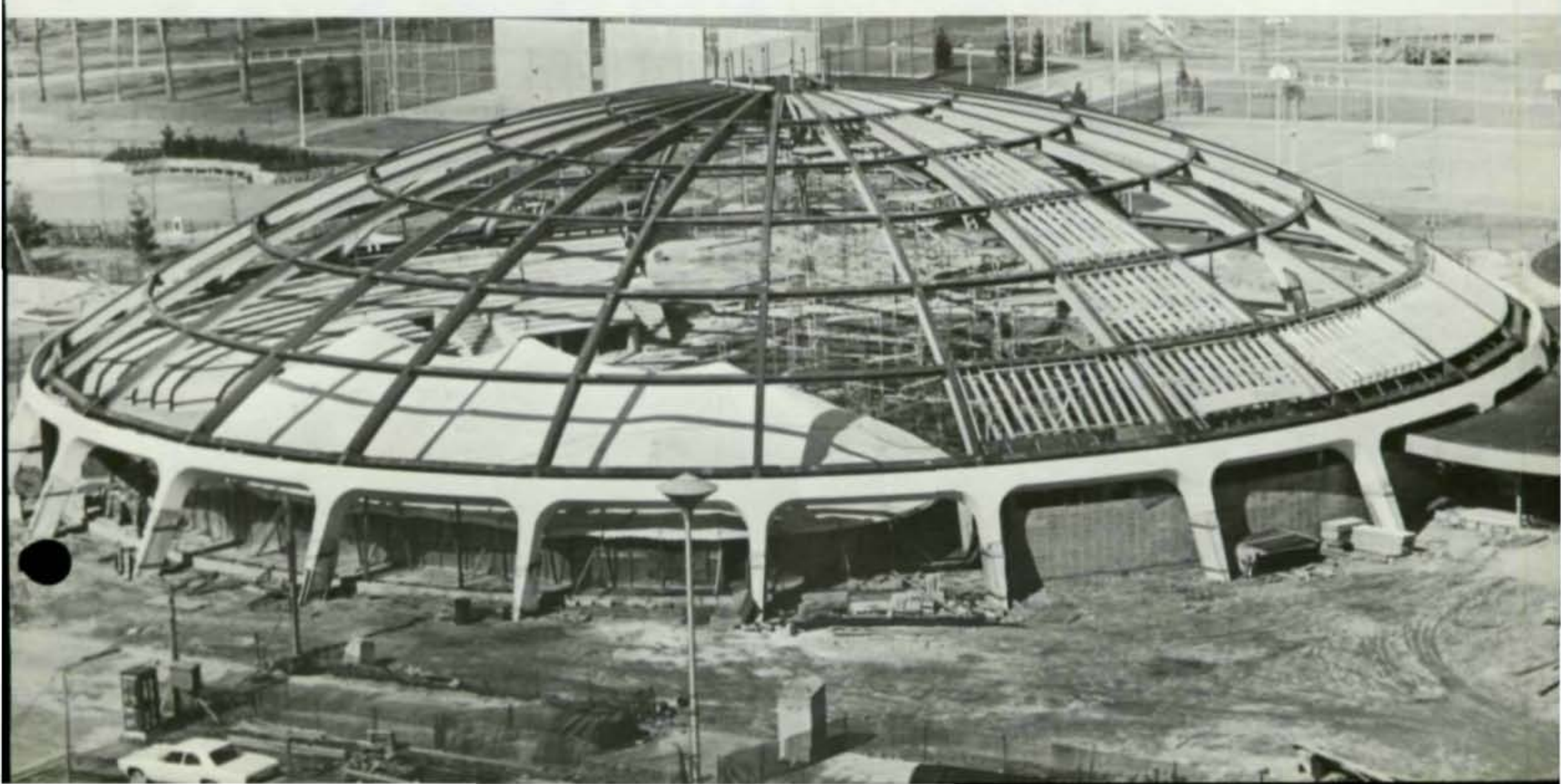
During the initial phase of construction, 24 precast tapered tees, each 13 ft high and weighing 13 tons, were set in



TYPICAL DETAIL AT T-COLUMN



DETAIL AT RING JOINT



Dome for Recreation Center (cont'd)

a circle at an inward inclination of 25 degrees from footings outside the dome's perimeter. Each tee was supported by two 8-in. diameter screw jacks. Connecting precast spandrel beams were then hoisted into place between the tees, forming a circular compression ring. The spandrel beams and tees were connected by means of structural steel channels precast into the abutting ends of the members.

Construction of the steel dome started at the top with a 6-ton, 14-ft diameter steel compression ring lifted to the top of a 56-ft high guyed pipe scaffold tower. Twenty-four curved vertical steel rib beams, each approximately 105-ft long, were then bolted to the top ring and their lower ends connected with anchor bolts to the precast tees.

Six sets of ring beams around the circumference were then bolted to the ribs. The ring beams were cold bent on two axes during prefabrication to precisely conform to the spherical shape of the dome. The lowest of these six concentric rings is actually a tension ring, fabricated of A440 high strength steel with a yield point of 46,000 psi. This tension ring is the structural force that holds the dome together. All steel except the tension ring is A36. All field connections are A325 high strength bolts. The ribs were fabricated in three separate pieces, then were butt welded together in the shop and shipped to the site as a unit. Stubs to support the ring members were shop welded to the ribs.

All structural steel for the dome structure was installed in three weeks.

Construction Details

The dome roof is 5-in. thick lightweight concrete, with 2-in. thick wood fiber acoustical plank used as a form deck which remained in place after the concrete pour. This deck provides a lining with sound absorption qualities, thus eliminating the need for additional acoustical treatment. Lightweight aluminum beams spanning the steel work were used as temporary supporting ribs, and were later removed.

A white neoprene-hypalon coating was applied to the surface of the concrete roof to obtain a smooth, weatherproof surface, which also reflects the sun's heat away from the building. A 14-ft diameter canopied vent exhausts used air from the interior, and projects above the central and highest point of the dome. A low acoustical block wall under the dome protects the interior and spectators from inclement weather, but is not carried up to the underside of the dome. A 2-ft space is maintained between the circular wall and the dome. This void space, combined with the canopied vent, permits adequate air movement inside the the structure and eliminates the need for air-conditioning. During the winter, infrared heaters, hung from the ceiling, provide warmth.

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