VOLUME XI / NUMBER 4 / FOURTH QUARTER 1971

MODERN STEEL CONSTRUCTION

1

2

3

MODERN STEEL CONSTRUCTION

Published by

American Institute of Steel Construction

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

VOLUME XI / NUMBER 4 / FOURTH QUARTER 1971

CONTENTS

AISC ANNOUNCES SPECIAL CITATION AWARDS

Several prominent professionals have been named to receive AISC's Special Citation Award for 1971.

This was the first year of the Special Citation Program created to give national recognition to architects, engineers, public officials, educators, and others who have made outstanding contributions to the advancement of steel framed construction.

AISC is pleased to recognize and applaud them for their professional achievements.

Stephenson B. Barnes *S. B. Barnes & Associates, Los Angeles, California*

Werner Blum *Fraoli, Blum and Yesselman, Norfolk, Virginia*

Ward Goodman *Director of Highways, Arkansas Highway Department, Little Rock, Arkansas*

John M. Hayes *Professor of Structural Engineering, School of Civil Engineering, Purdue University, West Lafayette, Indiana*

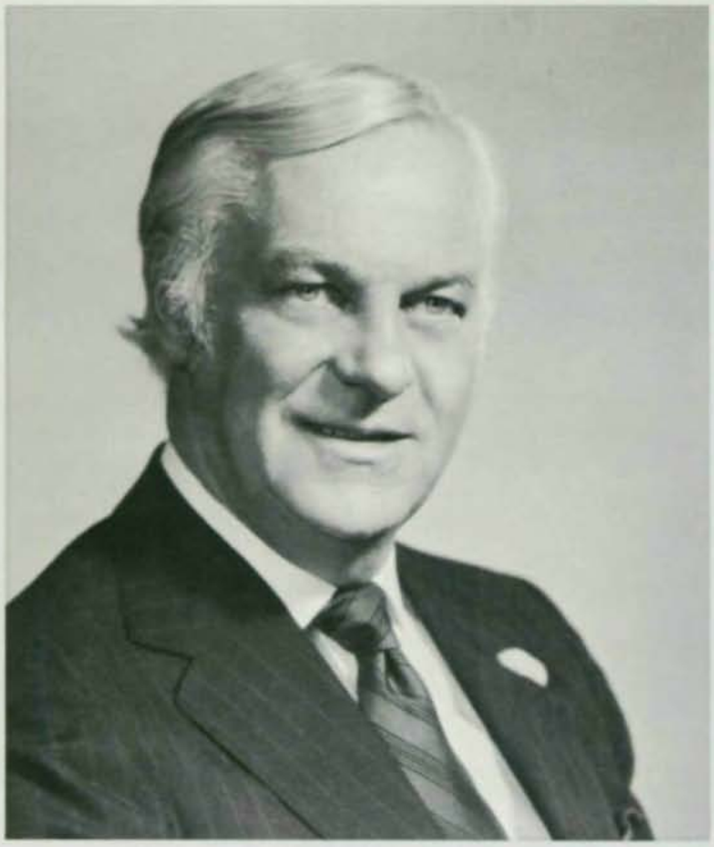
Nelson C. Jones *Chief, Bureau of Engineering, Michigan Department of State Highways, Lansing, Michigan*

Fazlur R. Khan *Skidmore, Owings & Merrill, Chicago, Illinois*

Van Rensselaer P. Saxe *Saxe Welded Connections, Baltimore, Maryland*

Skilling, Helle, Christiansen, Robertson *Consulting Engineers, Seattle, Washington*

At award ceremonies in his local community each award winner will receive a Special Citation Award plaque with the inscription "In recognition and appreciation of exceptional professional achievement and creative contribution to the art of steel construction."



Max O. Urbahn, FAIA, president of the American Institute of Architects, was chairman of the Jury of Awards for the Twelfth Annual Architectural Awards of Excellence Competition for steel-framed buildings, sponsored by AISC. Other members of the jury were: John P. Eberhard, AIA, Dean, School of Architecture and Environmental Design, State University of New York at Buffalo, Buffalo, N. Y.; James H. Finch, FAIA, Finch Alexander Barnes Rothschild & Paschal, Atlanta, Ga.; Dahlen K. Ritchey, FAIA, Deeter Ritchey Sippel Architects, Pittsburgh, Pa.; Edward J. Teal, M.ASCE, Albert C. Martin and Associates, Los Angeles, Calif.

"Humanity, Our Client"

by Max O. Urbahn, FAIA

We hear so much about what divides the construction industry that it is good to be reminded of some of the things that unite it. Among them are efforts like the sponsorship by the American Institute of Steel Construction of its annual competition, now in its twelfth year, for steel-framed buildings of high architectural quality, "the most beautiful steel buildings of the year."

What a wonderful thing when it is recognized that more extensive use of a material — the proper concern of an organization like AISC — is effectively promoted through encouragement of quality in its use!

Concern with quality unites many in the construction industry, and, hopefully, will continually unite many more, as the public demand for environmental quality becomes more and more compelling. Architects are certainly united in their concern with quality, and just as certainly are eager to make common cause with all who share that concern.

Entries in this year's competition reflected some major current tendencies in architecture — restraint in expression, structural directness, programmatic involvement and environmental consideration. They also reflected, to a degree that should delight the program's sponsors, both the sophistication and the imagination with which architects are designing in steel.

The jury of four architects and an engineer, of which I had the honor to be chairman, was impressed by the generally outstanding quality of the entries. And that statement is not a euphemism intended to console those whose buildings were not cited, but a fact. It is also a significant reflection of the present state of architecture. The level of architectural performance around the country has been steadily rising. And today there are more architects doing better buildings than ever before, and in all parts of the country. The fifteen buildings selected to receive awards cover a wide range of building types and scales and are widespread geographically, although three states have multiple winners; including California with five, Illinois with three, and New York with two.

The other five buildings honored were located in the following states: Arizona, Kentucky, North Carolina, Pennsylvania, and Virginia.

To a striking degree, the jury praised buildings with words like modest, straightforward, honest, truthful, simple, clean. Words like bold, strong, forceful, imaginative, and exciting were also words of praise; but the emerging architectural ideal of our time was embodied in words that connoted restraint.

For architecture is responding now, as throughout all of history it has responded, to the human needs and aspirations of its time. And so, in their work, architects are responding to the need for solving highly complex problems in terms that human beings can comprehend. They are responding to the human need for a sense of continuity in a time of tumultuous change. And they are acting on a new concept of their public responsibility that seems to correspond at last to John Ely Burchard's prophetic phrase of more than 20 years ago, "Humanity, Our Client."

1971 ARCHITECTURAL AWARDS OF EXCELLENCE

PIERCE STREET APARTMENTS
Gilroy, California
Architect: Dukor Associates

TEMPE MUNICIPAL BUILDING
Tempe, Arizona
Architect: Michael & Kemper Goodwin Ltd.

RICHMOND COLISEUM
Richmond, Virginia
Architect: Ben R. Johns, Jr.

UNITED STATES STEEL BUILDING
Pittsburgh, Pennsylvania
Architect: Harrison & Abramovitz & Abbe

NORTHWAY 10 EXECUTIVE PARK
Elnora, New York
Architect: Robert F. Lavery

▲ **ALZA CORPORATE OFFICES AND MEDICAL RESEARCH CENTER**
Palo Alto, California
Architect: McCue Boone Tomsick

▲ **PARKER HANNIFIN CORPORATION IRVINE FACILITY**
Irvine, California
Architect: Albert C. Martin and Associates

▲ **SEARS, ROEBUCK AND CO. PACIFIC COAST ADMINISTRATIVE OFFICES**
Alhambra, California
Architect: Albert C. Martin and Associates

▲ **MALCOLM X. COLLEGE**
Chicago, Illinois
Architect: C. F. Murphy Associates

BURLINGTON CORPORATE HEADQUARTERS ▶
Greensboro, North Carolina
Architect: Odell Associates Inc.

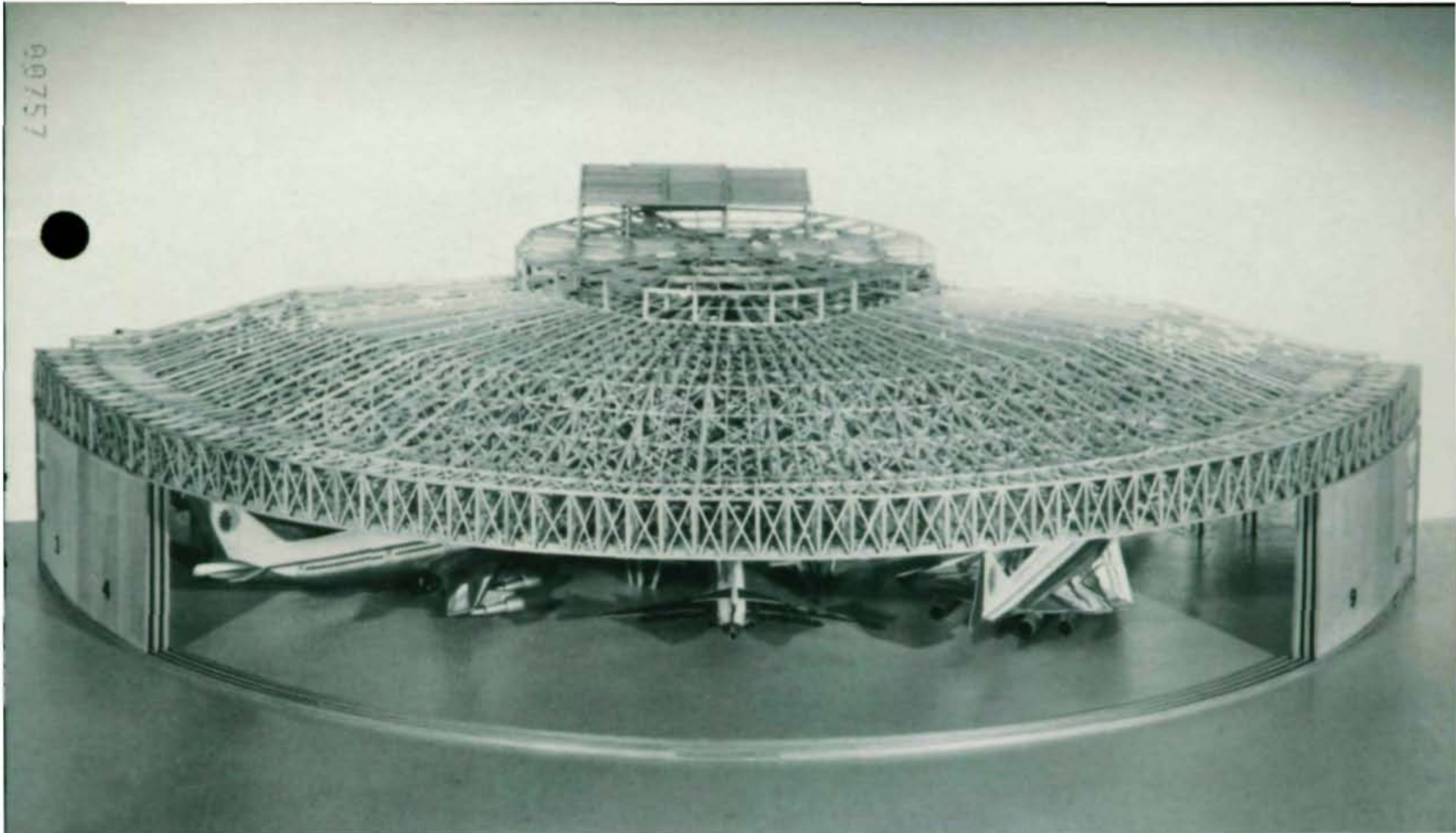
SERVICE GROUP
State University of New York
College at Old Westbury, Long Island, New York
Architect: James Stewart Polshek and Associates

RAPID TRANSIT STATIONS ON DAN RYAN AND KENNEDY EXPRESSWAYS
Chicago, Illinois
Architect: Skidmore, Owings & Merrill

PARADISE STEAM ELECTRIC GENERATING STATION, UNIT 3
Near Drakesboro, Kentucky
Architect: Tennessee Valley Authority

JOHN HANCOCK CENTER
Chicago, Illinois
Architect: Skidmore, Owings & Merrill

SUPERBAY MAINTENANCE FACILITIES
San Francisco International Airport, San Francisco, Calif.
Los Angeles International Airport, Los Angeles, Calif.
Architect: Conklin & Rossant, Architects



A PERFECT COVER FOR JUMBO JETS

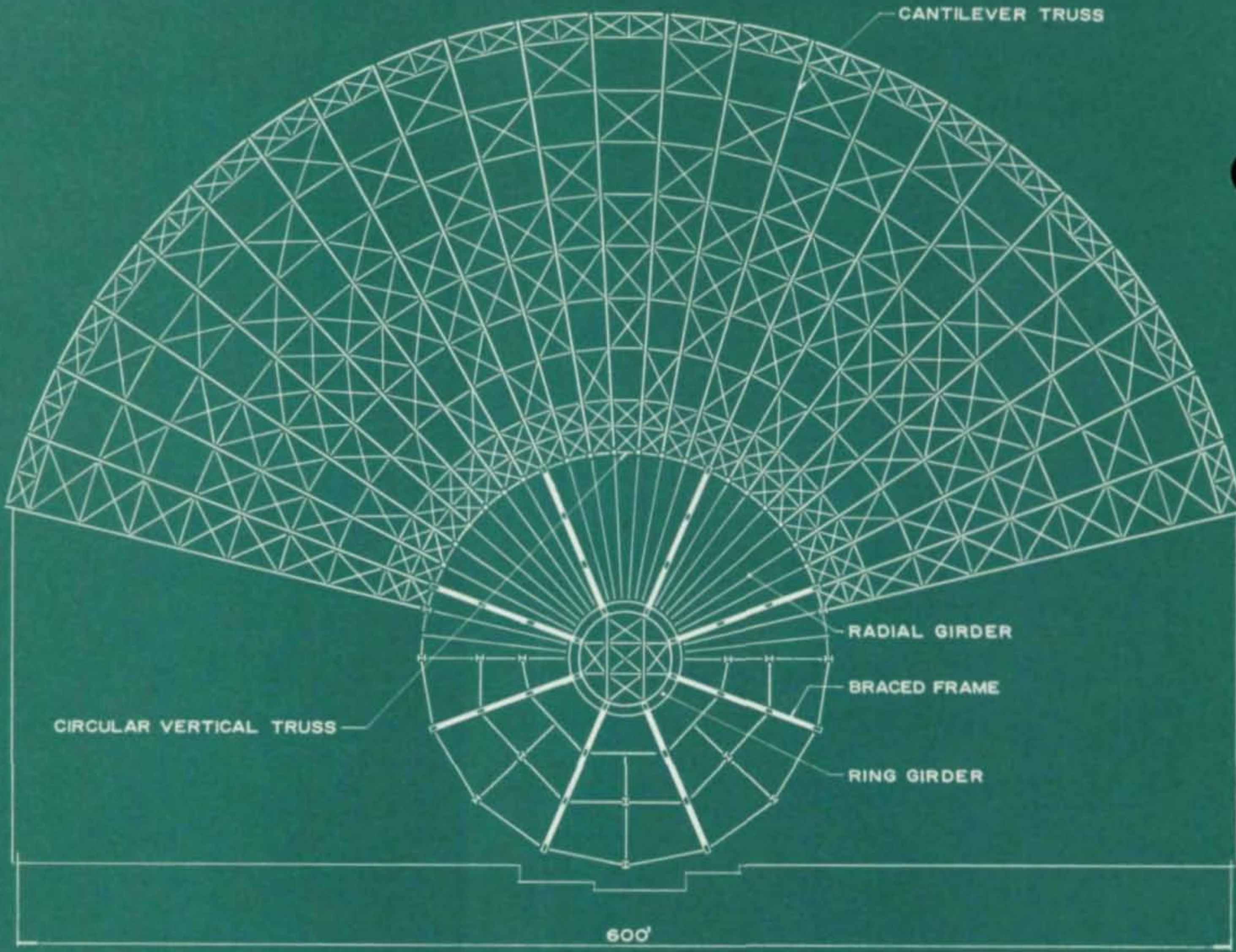
Architect: Greenleaf/Telescan
Miami, Florida
Structural Engineer: Kellerman & Dragnett, Inc.
Little Falls, New Jersey
General Contractor: Blount Brothers
Montgomery, Alabama
Steel Fabricator: Allied Structural Steel Company
Hammond, Indiana

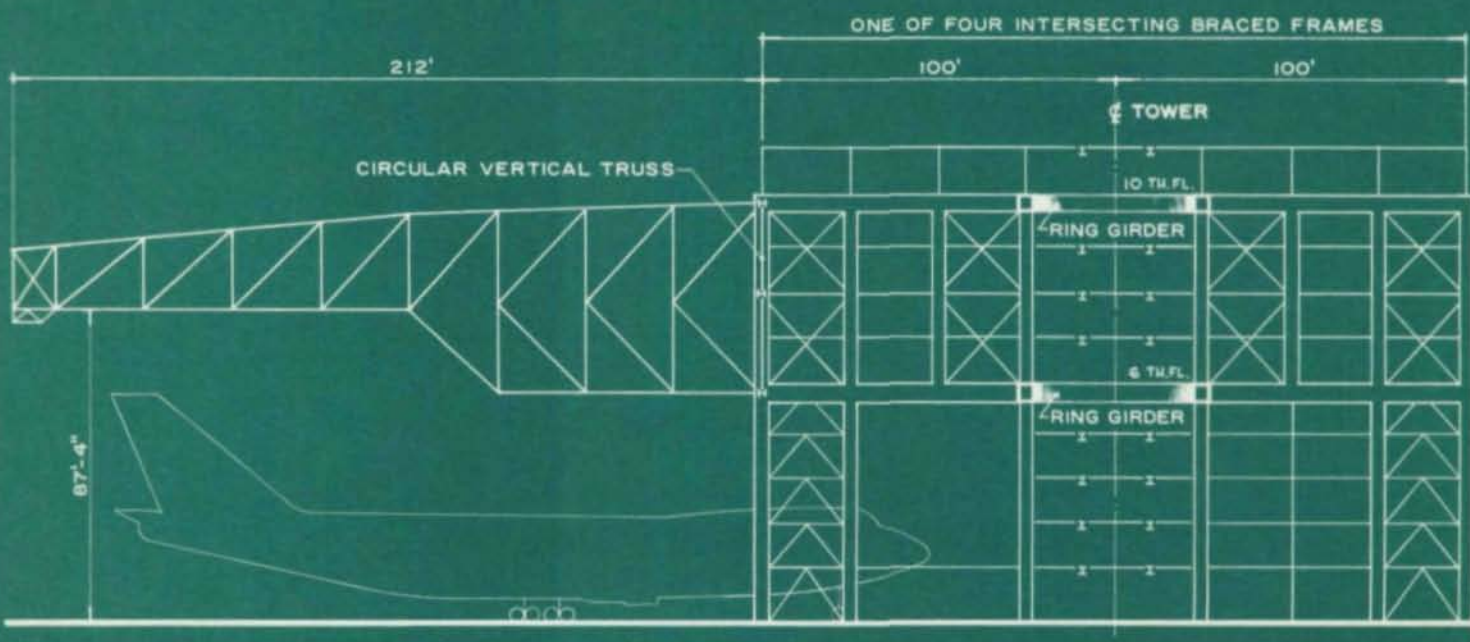
by Frederick M. Law

The evolution of the design of a monumental structure is always an exciting process. Rarely does a designer come up with an aesthetically appealing solution that also serves the requirements of function and the restrictions of the site. An exception to this general rule can be seen at the new National Airlines Hangar, now under construction in Miami, Florida.

This hangar is part of a complex of structures designed to provide the National Airlines fleet with "the most modern jet and supersonic aircraft maintenance facilities in the airline industry," according to L. B. Maytag, president of the airline. Specifically, the new maintenance hangar is designed to accommodate two of the largest anticipated future generation supersonic transports (approximately 398 ft long, 211-ft wing span, and 46-ft tail height), or two of the largest anticipated future generation Boeing 747 Jets (approximately 289 ft long, 215-ft wing span,

Dr. Law, Chairman of the Department of Civil Engineering, Southeastern Massachusetts University, North Dartmouth, Mass., served as Structural Consultant with Kellerman & Dragnett, Inc., the structural engineers for this project.


CANTILEVER TRUSS
RADIAL GIRDER
BRACED FRAME
CIRCULAR VERTICAL TRUSS
RING GIRDER
600'


ONE OF FOUR INTERSECTING BRACED FRAMES
212'
100'
100'
℄ TOWER
CIRCULAR VERTICAL TRUSS
10 TH.FL.
RING GIRDER
6 TH.FL.
RING GIRDER
87'-4"

and 64-ft tail height), or two or more of the largest aircraft presently in use in this country.

Semicircular Plan

A preliminary study of the site indicated that a semicircular plan would be the most feasible solution for the number of ground facilities required in the limited area available. This shape allows a floor area of only 180,000 sq ft as compared with 200,000 to 210,000 sq ft required by a rectangular plan designed to house the same combination of aircraft. The possibility of aircraft interference, especially on approaches and departures from the hangar, brought about an early decision to leave the circumference column-free, except at the ends.

Initially, some form of suspended roof system was considered for the hangar. However, investigation proved that any system of hanger struts employed to suspend the roof would suffice only to resist downward loads. The hung cantilever roof system was rejected as inadequate, since the structure also would require uplift resistance. Subsequently, a semicircular, completely cantilevered roof structure evolved as the most logical form for the hangar. Next came the obvious question: How to economically frame a semicircular cantilever roof extending 212 ft from its supports?

The simplest cantilever framing is a series of parallel cantilever trusses projecting from a solid rear area — a framing usually employed for a structure having a rectangular plan. But for this semicircular plan, any series of parallel cantilever trusses would have to be of different lengths causing problems in roof slopes and deflections and, in general, fabrication difficulties. Additionally, this type of framing would require some form of costly, heavy solid rear anchorage.

Cantilever Trusses

Further investigation revealed that cantilever trusses projecting radially from a solid central core would be the most logical framing plan. This framing was firmly adopted when it was determined that office and shop facilities, originally planned for another building, could be housed efficiently in the core area of the hangar. The office and shop facilities, by their very existence, provide the weight necessary to balance the large cantilever loads. The housing of these facilities in the hangar core meant the added bonus of eliminating a building from the complex of structures, at an obvious saving in the total cost. All members of the 212-ft cantilever trusses, which project radially from the core, are W14 rolled sections.

The top and bottom chords of all the 212-ft long cantilever trusses are tied into the central core of the hangar in two ways — one to carry the end moment and the other to carry the end shear. To carry the end moment, both the top and the bottom chords are extended by means of 5-ft deep radial plate girders to 50-ft dia., 5-ft sq box section ring girders in the center of the core. The ring girders distribute all the horizontal loads (end moment couples) from the trusses to four intersecting vertical braced frames. These frames are oriented as diameters of the circular core and comprise the heart of the core area. The exact orientation of these frames was dictated largely by the nose pocket requirements of the radially parked aircraft. The braced frames are composed of 2 ft x 4 ft box section columns, 2 ft x 5 ft box section girders, and H-section bracing members.

To carry the end shear, the cantilever trusses are connected to a circular vertical truss consisting of W14 rolled sections. This circular truss carries the vertical shear loads from the cantilever trusses to columns of the four intersecting braced frames.

X-Bracing System

Torsional stiffness for the roof as a whole is provided by the system of X-bracing between the cantilever trusses. This bracing transfers load into the four intersecting braced frames by means of both the circular vertical truss and the extension of the top and bottom chords of the cantilever trusses to the ring girders.

A circular stiffening truss, which connects the outer ends of all the cantilever trusses, has been provided to balance end deflections as well as to support the door guides.

The structural steel in the hangar will be A36 and A441 except for portions of the 2 ft x 5 ft box girders comprising the four intersecting braced frames. A588 steel will be used for portions of these girders in order to maintain a constant depth section.

In-Depth Analyses

For preliminary design purposes the cantilever roof was considered to consist of individual pie-shaped segments. Each segment was designed as an independent cantilever truss carrying only the loads on that segment. Similarly, the core area was considered to consist of four intersecting but independent braced frames. Consequently, only a two-dimensional analysis was made for preliminary design.

For the final analysis, the entire cantilever roof, consisting of approximately 4,000 members, was considered to be a space truss and was analyzed as a single unit. Likewise, the hangar core was considered to be a space frame and was analyzed as a single unit. Finally, a three-dimensional structural analysis was made. The STRUDL I Subsystem of the Massachusetts Institute of Technology developed ICES computer system was employed for this analysis.

Various combinations of loads were naturally considered in the analysis, including wind loads resulting from hurricane winds of 130 mph (highest velocity of wind at 30 ft above ground for a 100 year period of recurrence) with the hangar doors closed and 75 mph with the hangar doors open. The wind pressures, or more precisely the shape factors used to determine the wind pressures, used in the analysis as well as the critical wind directions, were determined from a 1/312 scale model wind tunnel test conducted at the University of Maryland.

The final analysis indicates a maximum downward deflection at the end of the cantilever roof trusses of approximately 5 in. due to the design live loads. The analysis shows a maximum upward deflection of approximately 4 in. due to a 75 mph wind load with all hangar doors open. The upward deflection of the roof, due to the full 130 mph design wind load, is being kept to a minimum by engaging the hangar doors as tie-downs during hurricane winds.

Estimated completion date is slated for late 1972.

BUILDING WHILE THEY NAP

by Arnold A. Bitterman

Architect-Engineer: Sargent-Webster-Crenshaw-Folley
Syracuse, New York
General Contractor: A. Friederich & Sons, Co.
Watertown, New York
Steel Fabricator: Smith & Caffrey Steel Corp.
Syracuse, New York

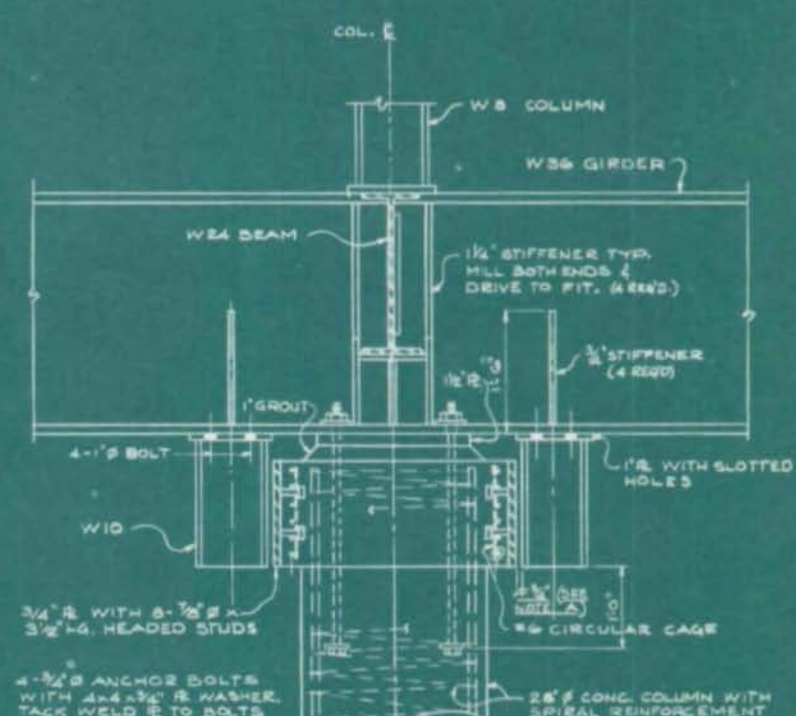
Patients at the E. J. Noble Hospital in Alexandria Bay, New York, could either sleep or observe while a new structural addition went up over their heads.

The new addition was designed to provide vertical expansion of hospital space without disrupting existing facilities. Limited site area, large areas of rock outcroppings higher than the existing hospital first floor, and steep embankments dictated the requirement for vertical expansion rather than for an adjacent horizontal addition. Due to these existing conditions and the fact that the present hospital structure could not support any more load, the architects decided to build the "addition" as a free-standing structure above the existing building, with the supporting structure straddling the existing building. The addition, therefore, completely bridges the existing two-story, light steel and bar joist framed building built in 1950. Two existing stairs at the ends of the building were elongated horizontally into two new stair towers that are free of the existing construction. The old elevator shaft was extended up through the new addition, with a new machine room located in a new penthouse enclosure. The new addition doubles the number of existing hospital beds and is designed to accommodate a future floor.

Comparative cost estimates established that the vertical addition cost less than any of the horizontal alternates and had the further advantage of eliminating extensive rock excavation unacceptable to patients and staff.

The structural, mechanical, and electrical designs had to provide complete use of the existing facility during the construction period.

Mr. Bitterman is Chief Structural Engineer of Sargent-Webster-Crenshaw-Folley, Architects-Engineers-Planners, Syracuse, New York.



TYPICAL STEEL GIRDER TO CONCRETE COLUMN MOMENT CONNECTION

NOTE A:

MAINTAIN ¾" GAP UNTIL APPROX. 80% OF TOTAL DEAD LOAD HAS BEEN APPLIED ON THE STRUCTURE. THEN SLIDE W10 MEMBER AGAINST ¾" CAST ℞, TIGHTEN THE 4-1" ø BOLTS AND FIELD WELD.

Design Features

The structural system selected used 36-in. deep steel girders spaced 24 ft o.c., spanning the 55-ft width of the existing building and cantilevering an additional 10 and 14 ft over their supports. The girders are supported on 28-in. round concrete free standing columns that were placed next to the building and anchored into rock at their bases. The floor and roof deck is 8-in. precast prestressed hollow core plank spanning the 24 ft between girders.

The combination concrete columns and steel girders were designed as moment resistant bents to resist horizontal loads. The horizontal movement of these bents was designed for a maximum ¼-in. horizontal deflection. The moment connection between the 28-in. round concrete columns and 36-in. girders was accomplished by a combination of high strength steel anchor bolts and four adjustable W-shape steel stubs that were field welded in place after 80 percent of total dead load was applied to cantilevered ends of girders. All of the 18 concrete piers were fixed at their bases by providing four 1½-in. round post-tensioned steel rock anchors drilled 12 ft into rock.

In one week, nine of the 12 ton 36-in. deep girders were in place. Some temporary moving of patients from their rooms was necessary during erection as a safety precaution. The steel frame and concrete plank were erected in six weeks.

Mechanical Considerations

A new electrical room was located at the first floor level, adjacent to the existing building. This room contains the new electrical equipment. The main feeders to the new addition were then extended up to the existing roof area, which is the space between the new floor construction and the existing roof. Using this space facilitated the power connections to all the new feeder panels in the additions. The location of the electrical room enabled the new electrical work to be done with minimum disruptions in the existing building and only a short duration power outage for electrical service changeover.

After completion of the new outdoor pad-mounted transformer and underground service to the new riser pole and new main switchboard, the electrical system was ready for its power changeover. While the power company installed its connections at the riser pole, the electrical contractor made the necessary connections to the existing building main distribution panel. New feeders from this existing main distribution panel had already been installed in the existing basement ceiling space of the new electrical room. The existing service was de-energized and abandoned, and the new service energized. After this was accomplished, the existing electric vault in the basement was stripped of its old equipment and converted into a food storage room.

The heating system for the addition is completely separated from the existing heating plant because the present system was too small to heat the new addition. To accomplish this, a penthouse was provided to house all mechanical equipment for the new addition, including two new boilers. The existing stack was enlarged and extended up through the new penthouse. The new heating system is designed for the future floor addition. Further, it provides 30 percent air conditioned spaces in the building with a provision to increase this to 80 percent at a future date. The separate heating system technique permitted the hospital to function without a shutdown.

A Tough Test for STEEL

by Philip Wesler

The Hartford Communications Center for the Southern New England Telephone Company posed many structural problems, among which were up to 400 psf live loading and minimum clear height requirements of 14 ft-6 in., exclusive of structure or mechanical work.

In order to keep the construction depth at each story to a minimum, wind forces are carried into vertical wind frames by horizontal trusses within the floor depth. Built of heavy W14 column sections and W8 horizontal and diagonal wind bracing members, and encased in a concrete wall 16 in.-thick for both fireproofing and additional stiffness, these vertical wind frames resist the entire wind force without the need for any moment-type wind connections between beams, girders, and columns. Due to the large story heights and the ultimate height of the building itself, such wind connections could have deepened the floor construction by as much as two or three feet in the lower floors, as well as drastically increased the column sizes because of induced wind moments. Cable slot configurations running continuously along the column line made it extremely difficult to provide the normal type of moment connections between girders and columns.

The floor beams and girders are designed compositely, with headed-type shear connectors. (A total of 45,000 shear connectors are being used in the initial phase of construction.)

Ground was broken in March 1970, and complete occupancy is scheduled for May 1972.

Mr. Wesler is a Resident Partner of the Hartford consulting engineering firm, Fraioli-Blum-Yesselman of Connecticut.

Architect: Louis J. Drakos & Associates
Hartford, Connecticut
Structural Engineer:
Fraioli-Blum-Yesselman of Connecticut
Hartford, Connecticut
General Contractors:
The Industrial Construction Co.
Hartford, Connecticut and
Edwin Moss & Son, Inc.
Bridgeport, Connecticut
Steel Fabricator: Topper & Griggs, Inc.
Plainville, Connecticut

another tall story

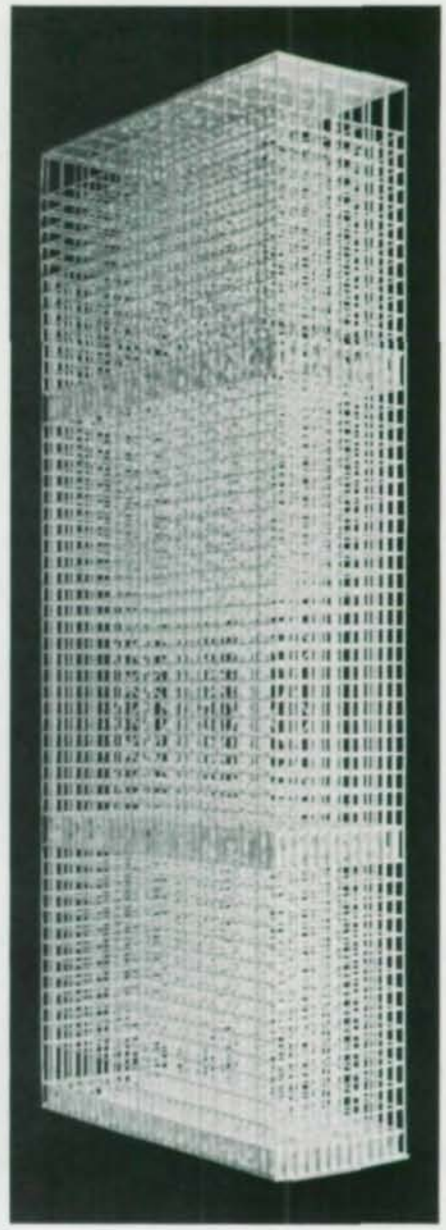
Tallest in a trio of new office buildings is the corporate home for Standard Oil Company of New Jersey, located in New York City's expanding Rockefeller Center.

Early in its inception the clients, Standard Oil Company (NJ) and Rockefeller Center Inc., set down the requirements for this building. The architectural-engineering team had to meet the following conditions and yet preserve the aesthetic values of the structure:

- Provide a 34 ft-3 in. column-free floor area from face of core wall to interior faces of exterior wall.
- Allow no column projections at either exterior or interior faces of the perimeter wall.
- Use minimum size columns at the perimeter and sustain a 4 ft-8 in. module.
- Maintain an 8 ft-10 in. clear ceiling height while keeping story height to a minimum.
- Minimize steel penetration for HVAC requirements. Use an economical shallow floor system.

The architects decided that W12 maximum exterior columns at 9 ft-4 in. centers would suit the fascia conditions best. This meant that there would be three exterior columns opposite each interior column. Since the height to width ratio of the building was 7:1, an unusual engineering design was necessary. Although it was possible to brace the core for wind, the stiffness of the exterior columns was required to control the drift and to minimize tonnage.

The mechanical levels at the 15th, 40th, and 54th floors were mobilized to provide stiff points of resistance. At these levels, stiff outrigger arms were used to load a perimeter truss which,



in turn, enforced participation of the exterior columns in wind resistance. Most buildings bend under lateral forces into a cantilever shape; here the stiff points created points of contraflexture between mechanical levels.

The availability of high strength steel made this concept possible. Without A441 the W12 exterior columns would have been severely overstressed under the loading conditions. Where stress was not the paramount factor, A36 steel was used.

The shallow floor system consisted of 2½-in. lightweight concrete on 1½-in. composite cellular floor supported by composite W18 A36 filler beams at 9 ft-4 in. o. c.

Employment of the unique wind system eliminated deep wind girders and minimized moment connections. The design reduced story heights, exterior column size dimensions, and facilitated steel fabrication as well.

The vertical facade is composed of 12 ft-4 in. high by 2 ft-2 in. wide channel shaped limestone laminated precast concrete units with 2 ft-6 in. wide window units. This gives a slender, graceful effect to the building. At the same time the owner has achieved a 34 ft-3 in. clear flexible space for his office requirements.

Gross floor area of the building is 2.3-million sq ft. The plan dimensions are 303 ft by 117 ft.

Architect: Harrison & Abramovitz & Harris
New York, New York
Structural Engineer: Edwards & Hjorth
New York, New York
General Contractor: George A. Fuller Co.
New York, New York
Fabricator: Bethlehem Steel Corporation
Bethlehem, Pa.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION
101 Park Avenue • New York, New York 10017

Address Correction Requested

Low Cost Housing On A Lean Budget

by David T. Evans

Given three weeks to design a 13-story, low-cost housing apartment building, with a meager, two-year old budget and on a steep site, is no mean assignment. Yet, this was the program the architect-engineer took on and met, complete with architectural, structural, mechanical, and electrical plans, for the Messiah Baptist FHA Housing project, in Yonkers, New York.

Faced with severe inherent design and erection limitations, the architect-engineer decided on steel as the most practical and economical material for construction. The general contractor, whose last four jobs involved flat plate concrete construction, concurred with this decision, citing steel to be the only answer for "this impossible design, budget, and construction schedule."

Architectural and Structural Aspects

Plans for all 13 floors are identical with overall dimensions of 150 ft x 70 ft. A typical floor includes four 3-bedroom, four 2-bedroom, and two 1-bedroom apartments.

Mr. Evans is an AISC Regional Engineer based in New York, New York.

Floor-to-floor distances are 9 ft-1¼ in.; ceiling to floor thickness is 9¼ in.

Advantage was taken of the sloping terrain by locating the lobby in the basement, and shifting the boiler room to the roof. Adjacent to the 130 apartments will be a parking garage for 130 cars.

The fascia consists of brick and 4-in. block carried by spandrel beams.

The 40 psf live load (100 psf in the corridors) and the dead load on each floor is supported by 1½-in. metal decking (2½-in. fill) on 8-in. joists. The joists are supported by W12-in. beams which frame into 8 and 10-in. columns.

Steel Framing

Most of the structural frame is A36 steel. However, the designers chose a W8 A572-50 column rather than the W12 column that would have been required if A36 had been used. The steel frame, including the joists, weighs about 10 psf. A307 and A325 bolts are employed in the moment connections of the unbraced frame.

Architect-Engineer: S & B Associates
Brooklyn, New York
General Contractor: Modular Technics Corp.
West Hempstead, New York