AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC.

101 Park Avenue / New York, New York 10017 / MUrray Hill 5-7374

March 1965

Dear Reader:

I think you'll be particularly interested in these three articles in the current issue of Modern Steel Construction:

1. How the World's Largest Building Was Designed

The Vertical Assembly Building--the vast structure now being built at the Kennedy Space Center, Florida, to shelter U. S. moon rockets--will enclose more space than the Pentagon. Eventually it will have 178 million cubic feet and its doors will be 456 feet high. This story tells how the unique design requirements were--and are being--met.

2. Steel-and-Wood House Solves Structural, Aesthetic Problems

Seattle sits on seven hills with 400 miles of waterfront "...and the most attractive waterfront lots," says architect Robert L. Durham, "are often the most difficult ones on which to build." But Durham likes challenges and knows how to get the most out of the materials he blends, as he shows in this steel-and-wood house.

3. Atlanta's New Stadium-in-the-Round to Stop Rubbernecking

The voice of the faithful has been heard in the land, and so this 736-foot-diameter arena will have no columns to obstruct the view from the grandstand. Its frame has 80 identical, boxed steel plate bents, with the topmost arm of each cantilevering 70 feet toward the field to support the roof deck.

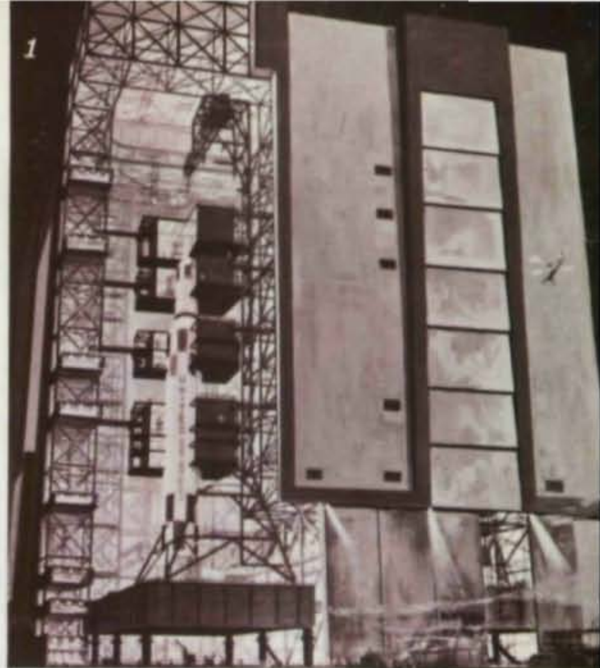
Cordially yours,

A. M. Hattal, Editor
Modern Steel Construction

P.S. Modern Steel Construction is available on request, without charge, to professional architects and engineers. If you do not now receive it regularly, please write, on your letterhead, to the American Institute of Steel Construction, Inc., 101 Park Avenue, New York, N. Y., 10017, Room 1501.

VOLUME V / NUMBER 1 / FIRST QUARTER 1965

MODERN STEEL CONSTRUCTION



MODERN STEEL CONSTRUCTION

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CONTENTS

National Engineering Conference to Be Held in Memphis

Several hundred architects, engineers, and educators are expected to attend the 17th National Engineering Conference, April 22-23, in Memphis, Tenn.

The Engineering Conference, conducted annually by the American Institute of Steel Construction, is the nation's leading Symposium devoted to the design and fabrication of steel structures. Leading authorities in the field of steel design, research, and construction will participate as speakers or members of panel discussions.

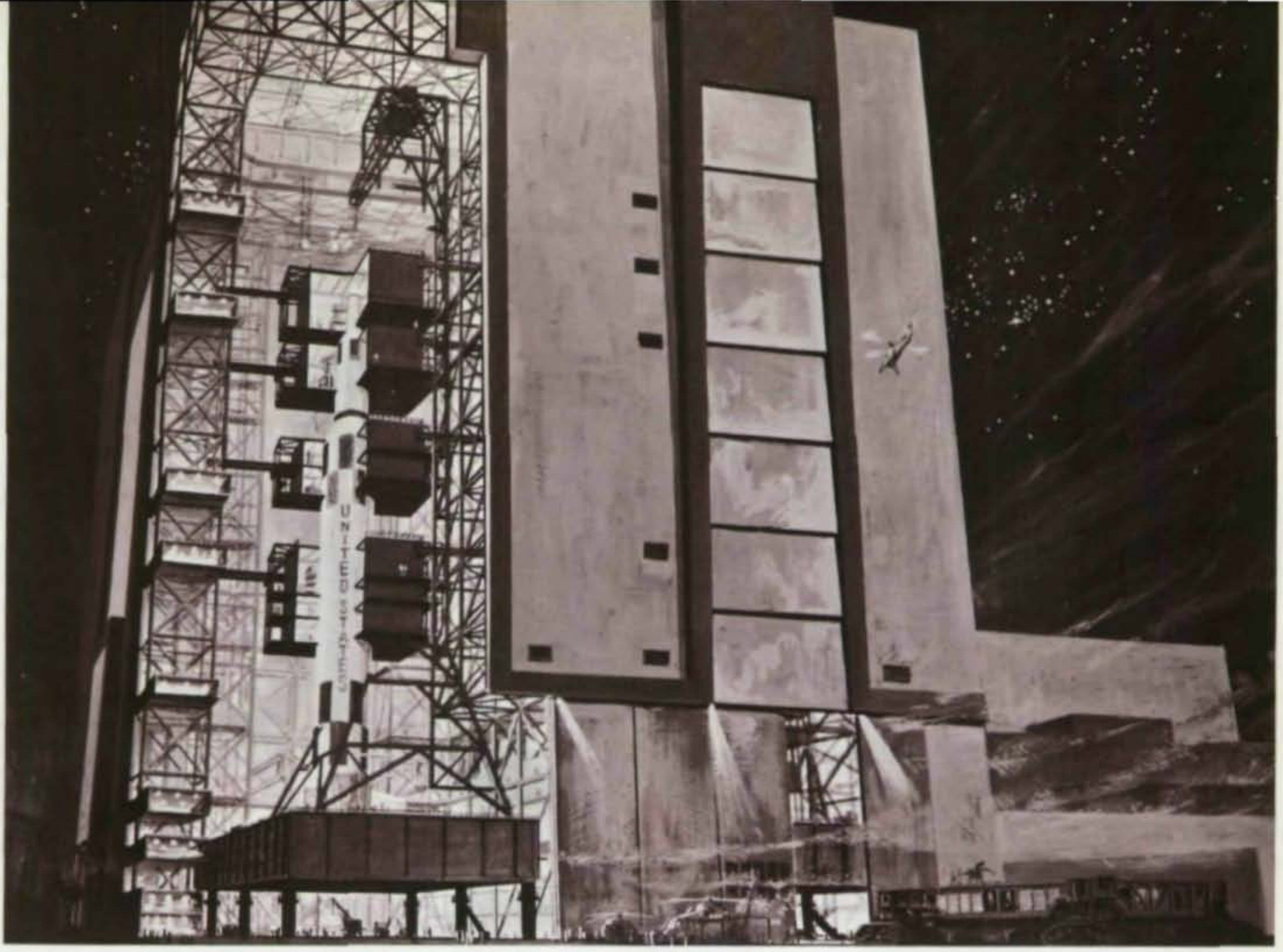
A social evening aboard the Mississippi River Boat "Memphis Queen" will be one of the highlights of the two-day program.

Details of the Conference are on page 14 of this issue.

For further information and reservations, write to AISC, 101 Park Avenue, New York, N. Y. 10017.

Sixth Annual Architectural Awards Program Opens

All registered architects practicing in the United States are invited to submit entries in the 1965 Architectural Awards of Excellence Competition. Any type of building completed after January 1, 1964 is eligible for entry. Contest closes May 1, 1965. Rules are available from AISC headquarters. Be sure to enter this program which recognizes the professionals who design the nation's buildings—using structural steel in imaginative and aesthetic ways.



Artist's rendering of the Vertical Assembly Building (VAB) shows 456-foot-high doors to accommodate the Saturn Moon Rocket. Cutaway shows extensible service platforms and structural framing.

DESIGN OF THE WORLD'S LARGEST BUILDING

By Marvin E. Warner

The Vertical Assembly Building – the vast structure that will shelter U. S. moon rockets – is as revolutionary in some ways as the space vehicles it will house.

Design requirements are, of course, unique, since it was necessary to provide a building equipped to permit simultaneous assembly of four vehicles, including the 362-foot-high Saturn rocket. The Saturn, it was determined, will be unable to withstand excessive wind forces in vertical, or "launch-ready," position.

The V.A.B. consists of four assembly bays, as shown in Fig. 1. Stages of the vehicle arrive at Kennedy Space Center and enter the V.A.B. at the low bay end of the transfer aisle. The first stage (booster) is raised from its transporter by a tandem operation of one of the two 250-ton cranes along with the 175-ton crane and is transferred to one of the assembly bays, where it is positioned on the mobile Launcher-Umbilical Tower (L.U.T.). Upper stages, after initial processing in the low bay checkout cells are mated to the booster in the assembly bay.

Thus assembled, the vehicle is serviced from extensible platforms at 11 levels in preparation for moving. Upon completion of pre-launch checkout within the V.A.B., the vehicle is moved to the launching pad for addition of fuel, last-minute hardware, final checkout, and, finally, the countdown and blastoff for the moon and beyond.

Structural Design

The V.A.B. was analyzed structurally as a space frame. The system consists of three towers arranged in plan as two E's placed back to back and connected by diaphragms as shown in Fig. 1. All three towers act as cantilevers against north-south wind forces, distributing the load horizontally to the diaphragms and vertically by frame action at each column line. The towers are rigidly supported at the foundations, as well as at the roof, which acts as a horizontal diaphragm. East-west wind is carried directly by frame action of the towers.

Preliminary analysis of the structure, requiring many simplifying assumptions, was limited to a four-week period. The basic structural system adopted at this time was selected to accommodate the many operational requirements and limitations of the vehicle and has changed very little, to date. Wind forces were assumed on the basis of research of available wind tunnel and meteorological data. Gravity loads, including crane reactions, extensible platform loads, electrical and mechanical equipment,

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Marvin E. Warner is project structural engineer for Urbahn-Roberts-Seelye-Moran (URSAM).

and the 456-foot-high main entry door weights, were analyzed to determine reactions and column loads. Several floor framing systems were considered with lightweight concrete slabs made composite with steel beams by means of stud shear connectors finally being selected. Wind shears were equally distributed to diagonal bracing members for preliminary sizing. From this initial design an estimate was made which varied from the final design in both dollars and tonnage by less than 10 per cent.

Truss Analysis

Final analysis of the truss was carried forward in several ways. Attempts were made to analyze the framed trusses by iteration methods, successive addition of redundants to a statically determinate system and by frame analogy. The excessive required time and susceptibility to error ruled against these methods. The design ultimately adopted analyzed each north-south frame as a pin-connected truss by a stiffness matrix method; the east-west trusses, all of which were similar in geometry but varied in loading, were analyzed by a flexibility matrix method.

Results of the planar truss analyses were then combined into a simulated space action by introducing compatability forces to equalize deflections, similar to a side-sway problem. All of this work was made possible within the job's time frame by the use of a U. S. Navy-owned program known as GISMO, which is tailored for calculation with the IBM 7090 computer. With the rather extensive analysis described, and including considerable debugging time of the many sub-routines introduced to facilitate combining loading conditions, less than 30 hours of computer time was required.

Input for the design included member sizes based on the preliminary work, 49 different loading conditions, and basic geometry of the trusses. A "get out routine was added to the program, which printed maximum positive and negative forces for each of the approximately 7,000 members considering 88 different loading combinations. Output of the program also provided coordinate deflections, which were used to satisfy the operational limitations of a maximum movement of six inches under operating conditions of any member adjacent to the vehicle.

Coincidentally with this program, the consulting firm of Simpson Grumpertz & Hager, Boston, analyzed the structure by the use of a program known as STAIR, which treated the truss as a three-dimensional stiffness matrix. This method was limited by core storage to consideration of only five loading conditions, but results were sufficiently complete to assure URSAM (Urbahn-Roberts-Seelye-Moran) that its computations were adequately checked.

Structural Details

Several "firsts" were developed for this design. To the writer's knowledge, no structure has ever before been designed using lightweight concrete slabs to carry horizontal forces by diaphragm action to the steel beams while providing composite action for gravity bending. Test data on lightweight concrete acting compositely are quite meager, but sufficient information was gathered to convince the designers that 85 per cent of the shear value for connectors in stone concrete could safely be used for design.

Column sizes were limited to a space envelope of 24 inches square. Investigation revealed that column sections could reasonably be rolled considerably heavier than the handbook 14 WF 426. Accordingly, two "jumbo" sections were specified at 513 and 734 pounds per foot, made by spreading the standard 14 WF rolls. These were chosen by the fabricators in preference to an alternative design of a built-up welded plate section. (The jumbo sections proved to be economical to produce and the mills have since indicated that several sections up to 730 pounds per foot are commercially available.)

The basic column section was made up of the heavy core strengthened by plates as shown in Fig. 2. This section

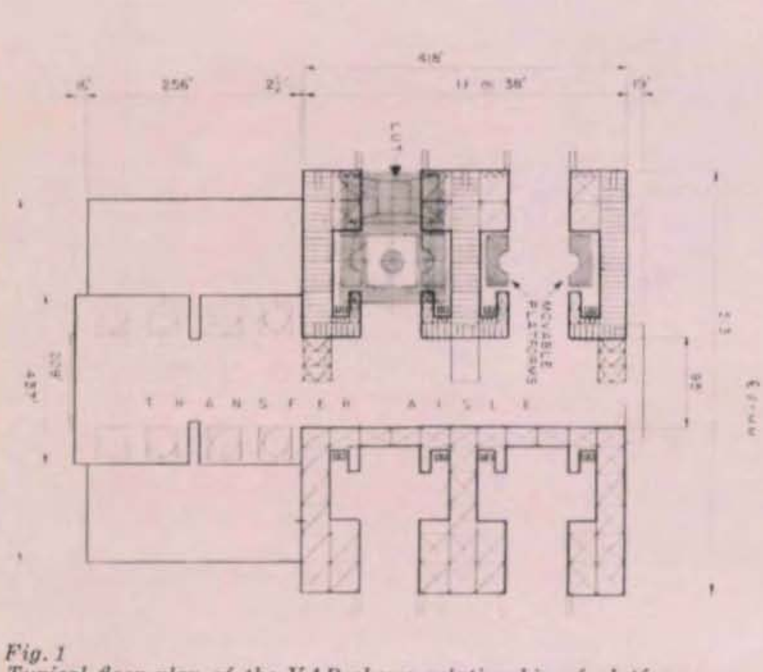

Fig. 1
Typical floor plan of the VAB shows relationship of platforms, transfer aisle, and LUT to the four Assembly bays, as well as the structural framing.

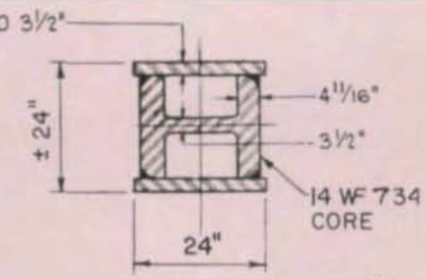

Fig. 2
Typical section using heaviest rolled section and cover plates to form economical building column.

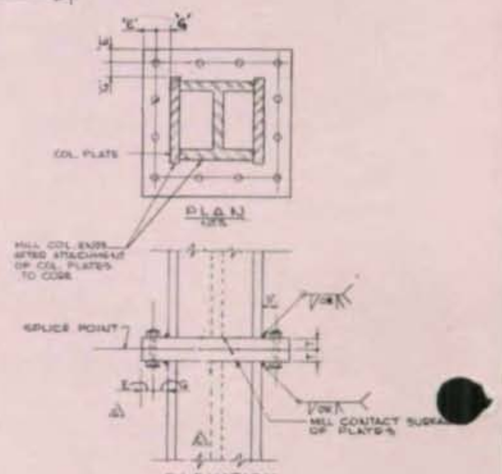

Fig. 3
Typical column splice used to develop full moment capacity of column section.

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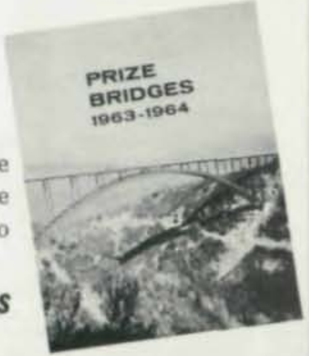
The Editors



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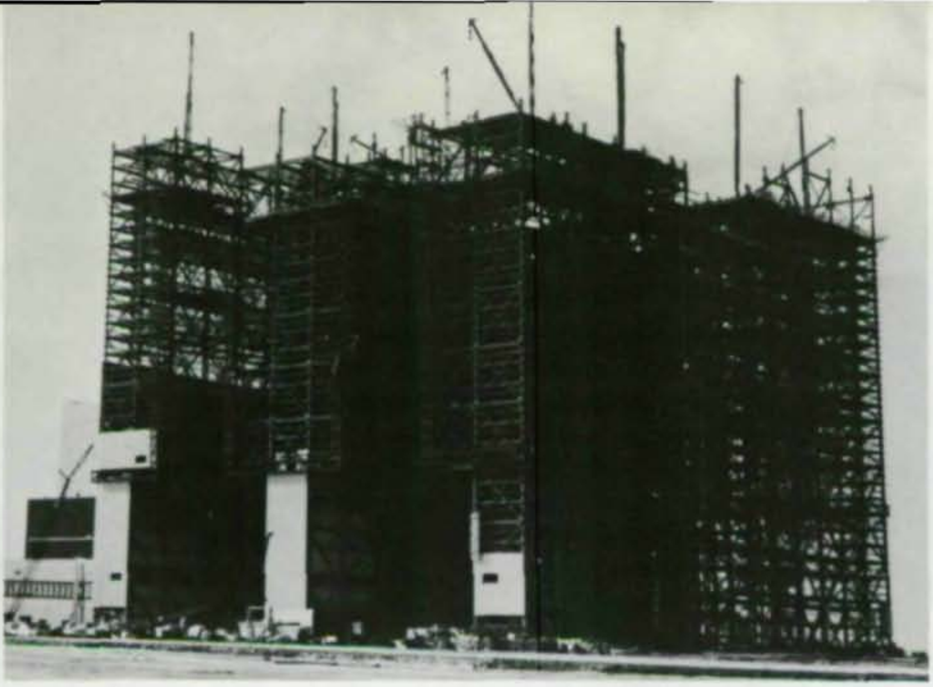


Recent progress photo depicts the structural framework about two-thirds complete. Structure is scheduled to "top out" in April.

was found to be economical due to the long, unsupported column lengths (38 feet). Because of this, the advantage of the higher strength steels was not exploited in the columns; A36 was used throughout the building.

The box section required all shop connections to be welded with field connections made with high-strength bolts. Column splices were made with butted plates welded to the columns and bolted together as indicated in Fig. 3. These splices could, with sufficient bolts, develop the full moment capacity of the column adjacent to eccentric connections of the extensible platforms and crane girders. The thick column flanges (up to 4⅞ inches) and plates caused concern over lamination in the steel, especially in the vicinity of the connections. Ultrasonic testing was specified for all members more than one inch thick, but the rejection rate was remarkably low.

Protective Coating

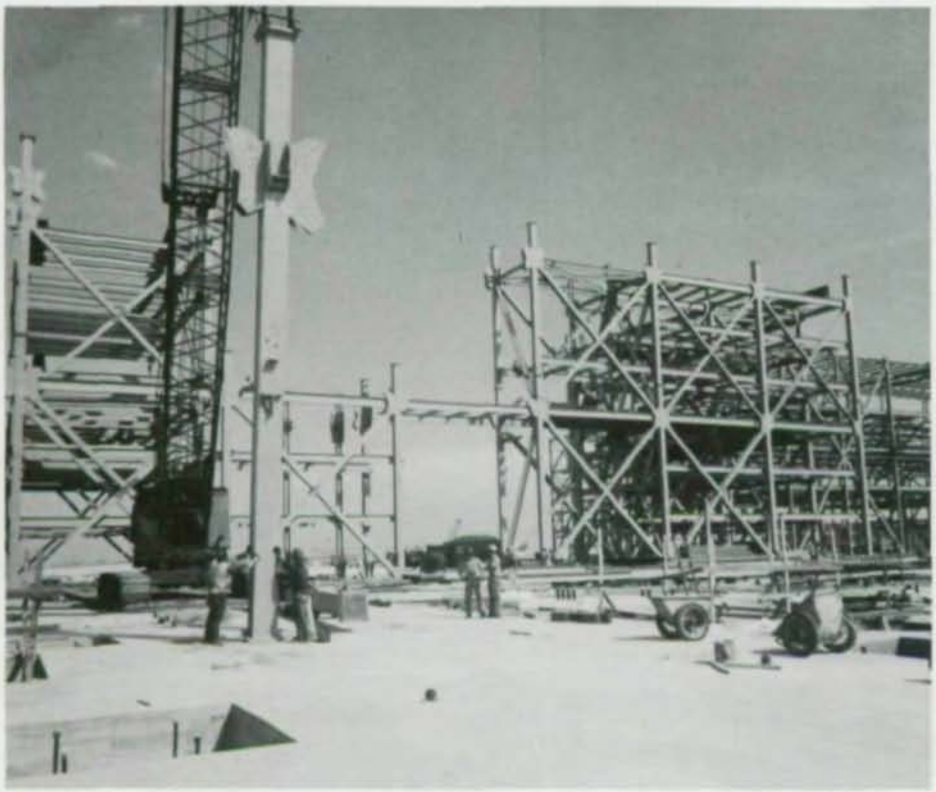
Due to the inaccessibility of most steel members after completion of the building, a special protective coating was required. Specifications required all fabrication to be completed with raw steel, after which the members were sand-blasted and painted with a zinc-rich coating. Faying surfaces were masked with special tape prior to painting to preserve the qualities for friction connections, as well as electrical contact for grounding. Masking remained in place until shortly before making connections. Tops of beams were also masked to facilitate stud welding.

The main doors consist of two lifts as shown in the illustration at left. The lower section, 114 feet high, 150 feet wide, is of conventional, horizontally sliding leaves; the upper section, 342 feet high and 75 feet wide, consists of seven leaves which lift vertically to the top of the building. Each leaf is separately counterweighted and has its own drive. Framing of the door utilizes trusses similar to open-web joists, specially designed to resist wind forces and provide stability at absolutely minimum weight. Framing to support the door consists of horizontal Vierendeel trusses required by clearance requirements of the counterweights.

The multiplicity of members meeting at panel points in all three planes required considerable ingenuity on the part of the fabricators. Suggested details included in the contract drawings were used as models to develop the connections, examples of which are shown at left. Development of the secondary stresses was unavoidable, owing to eccentricities introduced by space limitations. Preparation of more than 6,000 shop drawings was required, which took a squad of checkers averaging 15 men several months to complete.

Credit for this building, the largest in the world in terms of enclosed volume (125 million cubic feet), belongs to the National Aeronautic & Space Administration (NASA) and the Canaveral District of the U. S. Army Corps of Engineers. American Bridge Division of U. S. Steel Corp. is fabricating and erecting the steel.

Architect-engineer for the design, which was a joint venture, was Urbahn-Roberts-Seelye-Moran (URSAM), consisting of: The Office of Max O. Urbahn (architectural work), Roberts & Schaefer Co. (structural), Seelye Stevenson Value & Knecht (mechanical, electrical, and civil work), and Mueser, Rutledge, Wentworth & Johnston (foundations).



Early progress photograph shows complicated connection details for space truss.

SEATTLE HOUSE BLENDS STEEL WITH WOOD

Like Rome, Seattle has seven hills — which may be romantic, but they also present some neat architectural and construction problems. The typical lot in that Northwestern city is a view lot, not always economical to develop for houses.

Normally this would not be a concern to architect Robert L. Durham, FAIA; he's primarily involved with the design of larger institutions and commercial buildings. But this time the client was a steel fabricator who had a waterfront lot and some challenging ideas about the kind of house he wanted to live in. Durham was intrigued and accepted the challenge.

Naturally, the client, William S. Leckenby, chairman of the board of Leckenby Structural Steel Co., Seattle, wanted to use steel. But Durham had his own reasons for using it, as the ingenious solutions shown here testify.

"In the next decade," says Durham, many lots previously not considered practical upon which to build will be dramatically improved. I believe that steel can be a major factor in leading to the economic development of such sites. Because of our traditional use of wood in the Northwest, such homes will probably be constructed with wood platforms hung on steel columns. The long spans which steel makes possible will allow full utilization of the dramatic marine and mountain views."

Light and Airy

In preliminary planning of the house, Durham determined that, because of its location nearest the beach, it should appear light and airy. Thus it would not detract from the view of Puget Sound which its neighbors behind it should enjoy. Happily, a steel-framed home fitted this requirement.

"There are 400 miles of waterfront in the city," says Durham, "and the most attractive waterfront lots are often the most difficult ones on which to build. Steel-frame construction is one way to make these lots practical building sites. Steel is simple to erect, and obviates drainage problems which might occur with the use of other materials."

A 30-foot difference in elevation from the waterfront to the upslope boundary of the lot called for a two-level house. Architect Durham placed the main living area on the second floor to take full advantage of Puget Sound's magnificent water, green islands, and snow-capped Olympic Mountains beyond.

A bridge approach to the second-level main entrance from the uphill side permits the lower floor to have daylight on four sides. The bridge, supported by steel beams, spans an excavated area which slopes away from the house and is attractively landscaped in relation to the bedroom joining it.

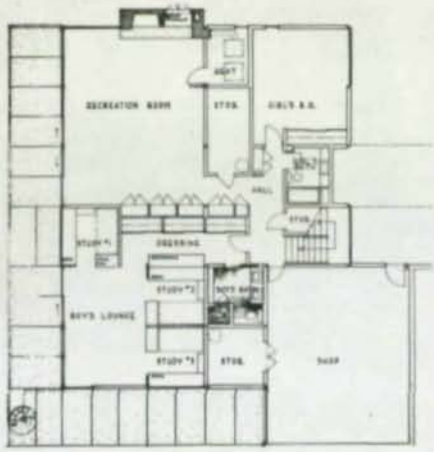
The resulting plan is more suitable to the activities of a family with teenage children than a home with a conventional daylight basement would be, since it is actually a two-story house with each level approached on grade.

On the view side a spiral steel stairway leads from a cantilevered second-level deck down to the ground level, permitting freedom of movement between living areas and the beach.

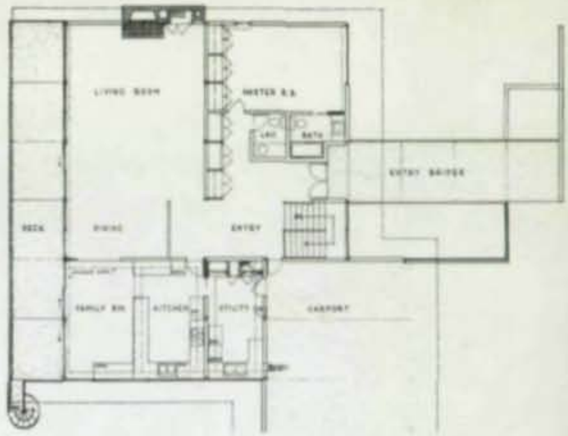
The exterior finish blends with gray driftwood scattered along the sandy beach in front of the house. The exposed steel frame has been painted vanilla bean, a gray-brown, to create a weathered appearance.

Steel decking forming the roof is left exposed inside and outside and painted

Steel frame eliminates need for load-bearing walls, permits broad view of nearby Puget Sound.



Floor plan of lower level.



Floor plan showing room arrangement on top level.

bone-white. The resulting color combination is attractive but unobtrusive.

Maintenance-Free Exterior

The exterior finish is designed to be as maintenance-free as possible. Stained cedar siding and anodized metal windows require minimum attention, even in the salt-water atmosphere.

The steel frame, fabricated and erected by Leckenby Structural Steel Co., was wheelabrated (a shot-blasting process in which shot is propelled by centrifugal force) down to bright metal before receiving a shop coat of corrosion-resistant primer. With this careful shop preparation, the finish coat applied at the site will require even less maintenance than more conventional building materials.

A warm, homey interior was created through the use of natural-finish wood paneling, providing a rich background for the Leckenbys' antique furniture. Warm tones are accentuated by the crisp lines of exposed steel beams and decking. Since a structural steel frame eliminates the need for load-bearing walls, the window walls open the view side completely to the vista of Puget Sound.

On the upper level are located the living room, dining room, kitchen, master bedroom, utility room and three-car garage. Below are children's rooms, recreation room, and a large shop area.

The main floor is oak on a 3-by-6 tongue-and-groove subfloor. This subflooring spans eight feet between steel floor beams. In order to nail the subflooring down, 2-by-6 nailers were shop applied to the top flanges of the beams with Nelson studs welded three feet on center.

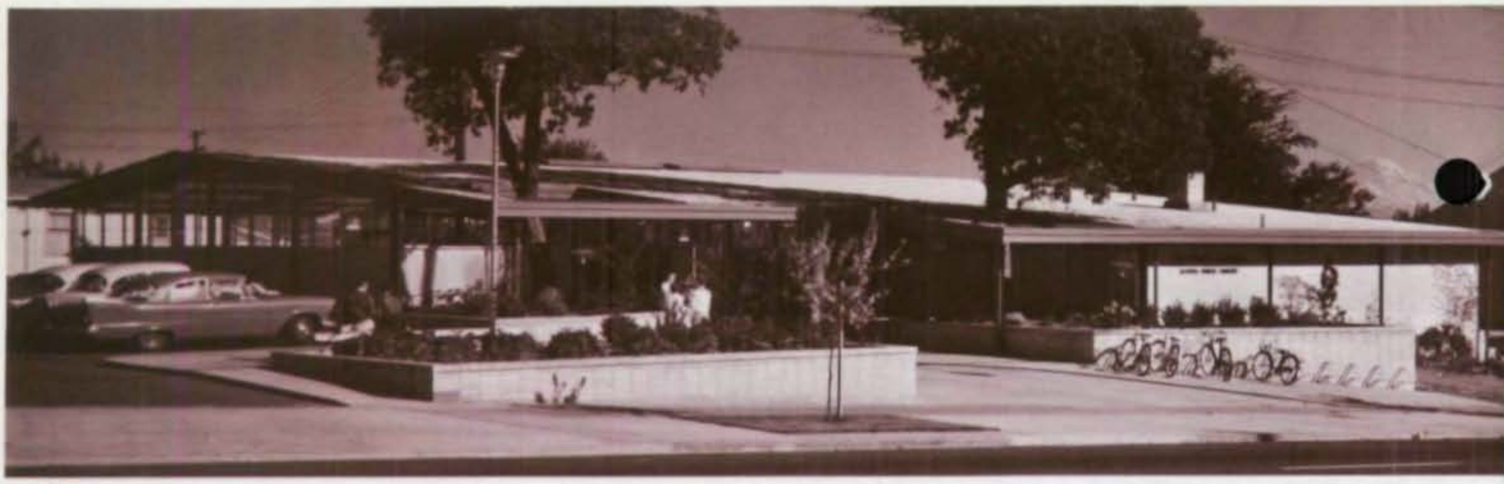
Crisp lines of exposed steel beams and decking emphasize and complement warm feeling of wood.

The steel frame, designed by structural engineer Harold Rowe, is composed of four-inch wide-flange columns supporting the 12-inch floor and roof beams. Approximately 22 tons of structural steel, supplied by Bethlehem Steel Co., were required. The framework rests on shallow spread footings poured on the sandy subsoil. After the steelwork was erected with the aid of a truck crane, general contractor Harold Sternberg began work on the rest of the house.

Architect Durham feels that steel framing will come into its own in the Seattle area by offering a practical solution to problem building sites.

"Perhaps a word of caution ought to be said," says Durham. "The very flexibility of steel requires a greater discipline on the part of the architect. I note, in recent news items from California, criticism of stilt-type houses, especially when viewed from below. Obviously, all architecture should be designed with three-dimensional repose. It is certainly not enough to stick a conventional house on top of steel stilts and expect it to be anything but ugly from the viewpoint of the neighbors down the hill."

In the Leckenby House, Durham describes the steel frame as "an effective expression of the structure of the house when used as a finished material." The use of steel decking, he says, provides "uncluttered lines that blend well with contemporary styling."



Library's low roof maintains harmony

Fundamental concept of this design for the Seattle Public Library's Southwest Branch was the creation of a low sheltering roof in order to harmonize with the residential neighborhood while simultaneously providing unlimited flexibility on the interior. "This concept," say architects Durham, Anderson and Freed, AIA, "could best be carried out by the continuity of connection between the steel roof beams and H-columns which form a natural recess for the brick filler walls. This structure affords a light and airy lift within the center of the space and on the exterior low protecting eaves for sun control perforated by the native Madrona trees at the entrance." Harold K. Roe, Seattle, was the structural engineer. Atlas Iron Works, Inc., Seattle, was the fabricator.

STEEL CONST

Chicago's largest high-rise office bays

The Continenal Center, designed for the Continental Insurance Companies, has 42-foot-square office bays — largest in Chicago's high-rise structures — permitting economical use of 19,000 square feet of unobstructed space on each floor. One problem faced by architects C. F. Murphy Associates was the need to maintain a floor-to-floor height of 12 feet to permit a connecting link between each floor of the new building and the corresponding floor of the existing building. The restricted floor-to-floor height, combined with the long spans, required the cutting of regular openings in the center of the typical framing members to accommodate ducts and other mechanical services within the depth required by the structure. The 23-story building rests on only 20 columns, which are of high-strength A440 steel, reducing the total column area at ground level to 120 square feet. Caisson foundations extend to 100 feet below street level to bedrock. Allied Structural Steel Co., Chicago, was the fabricator.

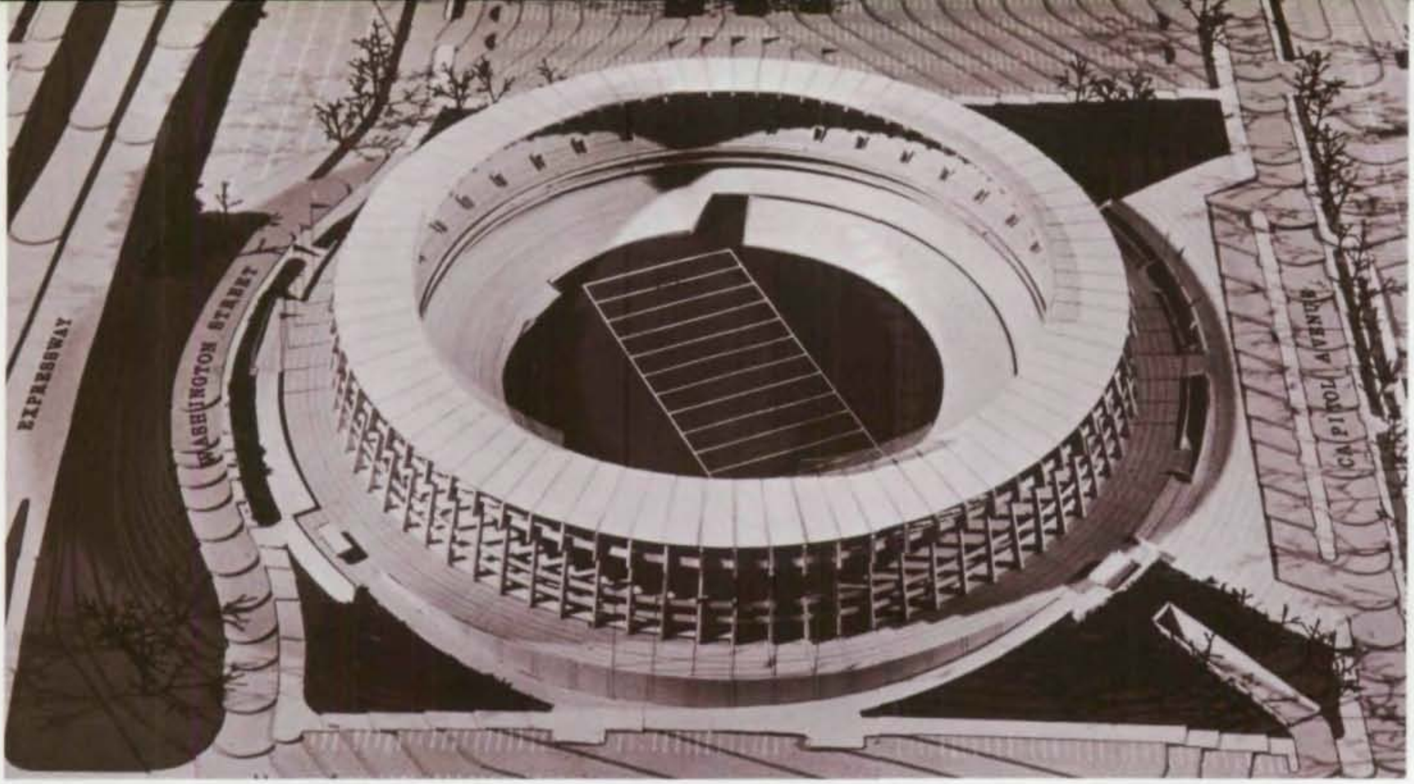
Plastic design for automobile showroom

Plastic design proved extremely efficient for this automobile showroom in Anaheim, Calif., for the Steffy Buick Co. "Utilizing the principle of readjustment of stresses and greater inherent strength of steel," says architect William P. Ficker, AIA, "the steel structure for this building, including roof decking, was approximately $1.22 per square foot." Lightweight metal decking minimized dead load, and, consequently, lateral seismic considerations were minimized. The metal decking was used as a horizontal diaphragm. This design permitted some very long spans, while using the very shallow beams. Sherer-Baumann & Associates, Santa Ana, Calif., was the structural engineer and Pacific Iron and Steel, Los Angeles, was the fabricator.

RUCTION IDEAS IN ACTION

San Francisco airport shuns tunnel design

San Francisco International Airport's new South Terminal was conceived as a curved structure in order to take maximum advantage of the exterior of the 800-foot-long building, and to allow the interior to unfold itself to the traveler in intimate sections, rather than present a long, narrow tunnel. The 320,000-square-foot structure was planned on two levels. Steel was selected for the second level of the terminal to provide a clear span for its vast lobbies, lounges and dining facilities. Broad steel columns rise 34 feet from the top of the ground level to the roof. These columns support eight-foot-deep trusses which extend 130 feet along the width of the roof. Architect Welton Becket and Associates chose to express the entire steel frame on the building's exterior, utilizing the structural steel ribs as a major design element to add strong character to the terminal, segment its long form, and cause an ever-changing pattern of light and shadows to play along the roof and upper walls. John A. Blume and Associates, San Francisco, was the structural engineer.



NEW ATLANTA STADIUM TO STOP RUBBERNECKING

People who plunk down $2.40 to see a ballgame don't enjoy finding their seats blocked by a thick, square column. But in most ballparks now in use there's a daily quota of such unhappy fans.

Fortunately, sports entrepreneurs and city fathers are now turning to professionals for design aid. Los Angeles with its Dodger Stadium, New York with Shea Stadium, and Houston with Harris County Stadium are the better for it. In 1966, Atlanta will become a major-league city with a unique, new stadium and perhaps its solution to the archaic, fan-frustrating annoyances mentioned above is the finest. First, it's a stadium-in-the-round, 736 ft. in diameter. Designed by the collaborating Atlanta architectural firms of Heery and Heery and of Finch, Alexander, Barnes, Rothschild and Paschal, the stadium also eliminates the need for neckbending, since there aren't any columns.

Innovations

This column-less state can be traced to a grandstand frame of 80 identical, boxed-steel plate bents supported on a basement building. The topmost arm of each bent cantilevers 70 ft. toward the field to support the roof deck above the grandstand. Precast concrete treads and risers span the bents to carry the upper level of seats. Lower-level stands are fastened to a cast-in-place concrete apron circuiting the arena in front of the grandstand.

Designing a stadium for both baseball and football is a difficult enough assignment, but in this case the architects have added a few interesting innovations. For example, the seats added for football do not look makeshift. These demountable sections exactly resemble the permanent seating. They will be dropped into the slot around the outfield and behind home plate. This will add 6,000 seats for football to the 51,000 for baseball. Big spenders will find their high-cost box seats in the same spot for both sports. The fields were planned so the 50-yard line bisects home plate.

Also located behind home plate on the middle, or club, decks will be (1) the extensive press club and press box located properly for both sports and (2) a plushy Stadium Club lounge. Members will be able to view the playing field in conditioned comfort, or do an about face to marvel at the sights of downtown Atlanta, since the lounge is to be glassed on two sides.

Not unlike other new stadiums, the Atlanta stadium will have seats with backs, arm rests, and flip-up bottoms. The average chair width is 20 in. with back-to-back dimensions of 34 in.

One day, perhaps within the next five or six years, the stadium will be completely roofed. The owners saved themselves a nice chunk of money by allotting an extra $400,000 now to pay for heating and air conditioning equipment and the roof base. When finished, the roof will be held from above by a system of eight 300-ft. towers and catenary suspension cables. As planned, the skin will be foamed plastic laminated to translucent fiber glass.

To Seat 57,000

Once closed in, the stadium will be used for conventions, exhibitions, and rallies. Its dimensions should swallow up the biggest confab going. The field will provide a 720-ft.-diameter room (about 168,000 sq. ft. of floor space.) The future suspended roof will hover 220 ft. above the floor, making one giant, columnless enclosure. And seating for 57,000 people will remain unchanged. For comparison, Atlantic City's Convention Hall has 140,500 sq. ft. of columnless floor space, and room for 41,000 seats.

When the stadium opens in April, parking for 4,000 cars will be completed. (Room for another 3,500 cars is available now in the six-block area surrounding the stadium.) There will also be space allotted for buses and taxis.

At this writing, construction is still on schedule – a statement more amazing than it may sound. The contractor, Thompson-Street Co., Charlotte, was given exactly 12 months to finish it, beginning last April. Normally, the time limit would have been 18 months, and if Shea Stadium in New York or the Harris County Stadium in Houston is any example, the time needed is closer to two years.

Critical Path Method

Thompson-Street is shaving the time by employing the critical path method which the architects specified for its construction timing and by getting a computer check on progress every two weeks. This appears to be continuing proof that CPM is more than a current fad. Comparing pre-CPM construction with post-CPM results is somewhat like matching the limits of grade-school arithmetic with differential calculus.

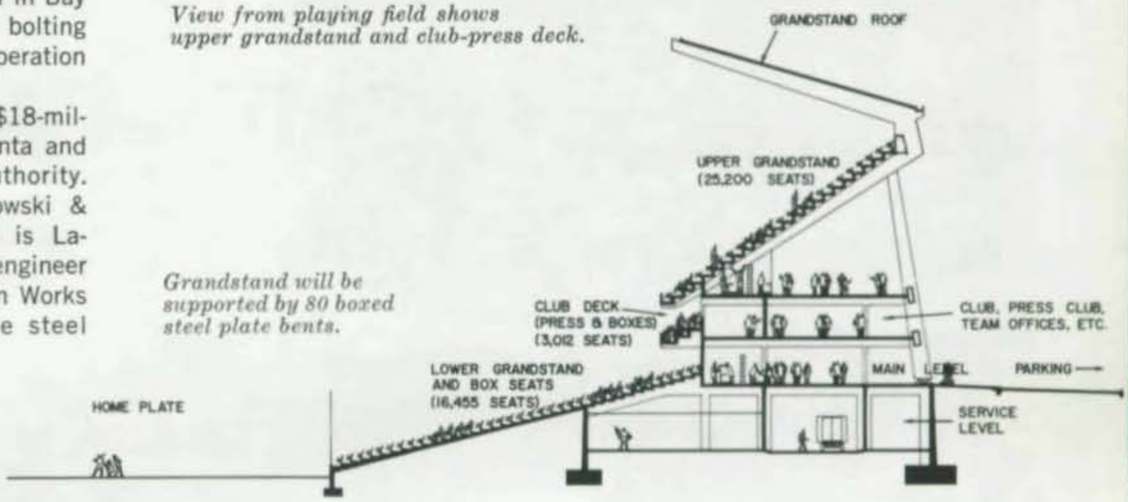
Of course, Thompson-Street is considerably encouraged to keep on schedule. It pays the stadium authority $2,000 for each day past April 15 the stadium is incomplete.

The 14-day, CPM computer check has already done more than police the job. For example, Thompson-Street originally planned to erect the structural steel in one continuous operation. A computer rundown showed this to be inefficient. So plans were altered. Steel work in each bay was finished before the crews moved to the next bay. And, like leg following leg on a centipede, the steel men were followed by concrete crews and these, in turn, by seat crews. Thus, when the steel erectors were on Bay No. 3, workers were laying out and fastening precast concrete seat decks to the steel in Bay No. 2, and another crew was bolting down seats in Bay No. 1. Each operation took a full working day.

Total cost for the project is $18-million. Official owner is the Atlanta and Fulton County Recreation Authority. Structural engineer is Prybylowski & Gravino, mechanical engineer is Lazenby & Borum, and electrical engineer is Earl Blakely. The Ingalls Iron Works Co., Birmingham, Ala., is the steel fabricator.

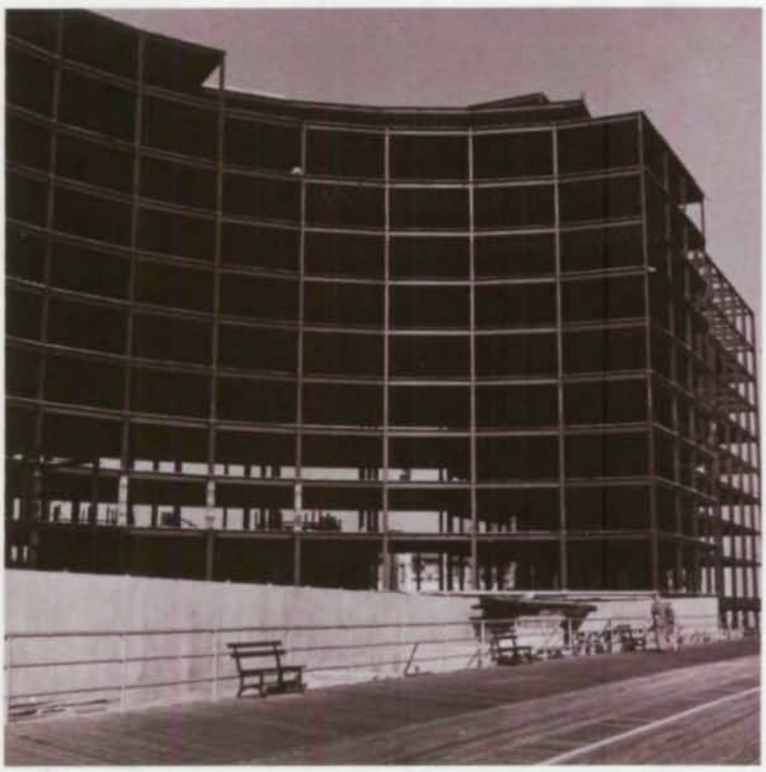
Steel construction leaves no spectator behind a post on either grandstand level.

View from playing field shows upper grandstand and club-press deck.



Grandstand will be supported by 80 boxed steel plate bents.

Steel framing saved 12.5% in construction of $4.5-million Ocean Manor Apartments on Atlantic City boardwalks.



BOARDWALK APARTMENTS FOR SENIOR CITIZENS

Structure contains 348 units, 330,000 sq. ft. Faster steel construction saved $1 per sq. ft. on labor, materials, interest charges.

Not every elderly person plans to retire to Florida; most prefer to go right on living where they have, in the communities where they've sunk their roots and have family ties.

With fewer obligations and reduced income, many older people do seek less expensive housing. No longer in need of roomy houses, some move to more economical, easier-to-maintain apartments; others who have lived in luxury apartments look for comfortable but less expensive ones.

One builder who knows how to satisfy this market is Anthony P. Miller of Atlantic City, who has erected high-rise apartment houses in several cities. He recently completed a 348-unit, high-rise building for "senior citizens" right on the boardwalk in Atlantic City. Another 14-story apartment is under construction and plans are being drawn up for a 500-unit, middle income building designed for families displaced by urban reconstruction projects. Other Miller projects include apartments for senior citizens in Philadelphia, Pa. and Menlo Park, N. J.

To make such housing attractive as well as economical, Miller specifies steel construction. This goes not only for senior citizens housing but for luxury apartments and middle-income residences as well. Steel framing, he says, provides savings in either materials, labor, or time.

Save $1.00 per Square Foot

The Atlantic City project, known as Ocean Manor Apartments, contains 330,000 square feet. Its cost of $4.5 million, according to Miller, represents savings of about 12.5 per cent as a result of using steel construction. This works out to about $1.00 a square foot less than with other materials.

These figures reflect savings on materials and labor as well as on interest charges, he says, because the faster steel construction permitted occupancy about four months earlier than would have been possible with reinforced concrete. That represents income of $50,000 a month, less expenses. Also, he was able to minimize the duration of his construction financing and produce income sooner.

"*I saved on foundation costs,*" says Miller, "and I saved interest on construction money because the steel went up fast, and during winter weather. I saved by using high-strength steel. I saved $50,000 on electrical installation alone by running wiring through open-web joists."

Conventional Post and Beam

Design of the 11-story Ocean Manor apartments is conventional post-and-beam type requiring about 1,700 tons of structural steel. Basically, the structure consists of steel beams and columns with open-web joists supporting corrugated steel floor deck and a concrete slab floor.

Because of high wind velocities along the Atlantic Ocean, extra bracing was required and was added easily by welding stiffeners at beam-to-column connections. Structural connections in the field were made with high-strength bolts.

Corrugated floor deck was spot welded to the top of the steel joists, which ranged from 12 to 16 inches in depth, depending upon location within the building. Use of steel floor deck provided several advantages. Chiefly, it eliminated forms and shoring which are normally needed for concrete construction. Electrical, heating, and plumbing trades could work easily from below without interference from forms or delays caused by concrete curing or forming crews. This, Miller estimates, saved at least 25 per cent on time needed for electrical construction and about 15 to 20 per cent on mechanical work.

The Ocean Manor Apartments building is sheathed in a window wall consisting of 3,500 steel sandwich panels 1⅛ inches thick. Each is 15 square feet and is faced with porcelain enameled steel sheet backed by a core of insulating material and a sheet of painted galvanized steel.

Time Savings

This window wall also resulted in some time savings, compared to a similar installation on a reinforced concrete building. Because the steel mullions could be welded directly to the building's steel frame, Miller figures that window wall installation time was reduced by about 15 per cent.

Another factor of steel construction emphasized by Miller is the assurance of quality. For example, structural steel can be accurately fabricated in the shop and easily assembled in the field without damage or delays caused by weather. Also, because steel is a uniform material, expansion and contraction can be calculated accurately and the building designed accordingly. Miller cites several Atlantic City area jobs on which concrete construction has run into post-construction difficulties on this score.

Architects for Ocean Manor Apartments were Keast & Hemphill; structural engineers, Keast & Hood. Steel was erected by Cornell & Co. of Woodbury, N. J. Samuel J. Creswell of Philadelphia supplied miscellaneous and ornamental Iron. Bethlehem Steel Co. was the fabricator.

17th ANNUAL AISC NATIONAL ENGINEERING CONFERENCE 1965

Chisca Plaza Motor Hotel, Memphis, Tennessee [see page 2]

PROGRAM

THURSDAY, APRIL 22, 1965

8:00 A.M. — REGISTRATION

Chairman: Dr. T. R. Higgins,
Director of Engineering and Research, AISC

Welcome
Robert C. Palmer *President, AISC*
John K. Edmonds *Executive Vice President, AISC*

Computers in Steel Design
Jackson L. Durkee, Moderator
Automatic Design of Building Frames
Jack G. Sams
Design of Industrial Plants
John H. Wells
Design of Bridges
R. Gordon Elliott
Panel Discussion
Durkee, Sams, Wells, Elliott

Welded Apartment House Framing
Horatio Allison

AISC Short Span Bridge Program
Robert L. Haenel
William A. Milek

12:15 P.M. — LUNCH

Welcome by Eugene J. Pidgeon
Second Vice Presdent, AISC

1:30 P.M. — Recent Developments in High Strength Bolted Connections
W. A. Milek, Moderator
Dr. John L. Rumpf
Edward R. Estes
Frederick E. Graves

Panel Discussion
Milek, Rumpf, Estes, Graves

Plastic Design in Multi-Story Buildings — A Progress Report
Dr. George C. Driscoll, Jr.
Joseph A. Yura

Efficient Framing for High Rise Structures
Dr. John B. Scalzi

Buses leave hotel for transportation to dock area for cocktails, dinner and entertainment aboard the Mississippi riverboat "Memphis Queen"

FRIDAY, APRIL 23, 1965

8:00 A.M. — REGISTRATION

Chairman: Robert O. Disque, *Chief Engineer, AISC*

Motion Picture: "The Port Mann Bridge"
Courtesy of the Canadian Institute of Steel Construction

Composite Design with Lightweight Aggregates
Daniel P. Jenny, Moderator
Dr. James Chinn
Irwin A. Benjamin
Victor F. Leabu

Panel Discussion
Jenny, Chinn, Benjamin, Leabu

Latticed, Box Framed High Rise Structures
William J. Mouton, Jr.

Fatigue Strength of Composite Beams
Dr. A. A. Toprac

12:15 P.M. — LUNCH

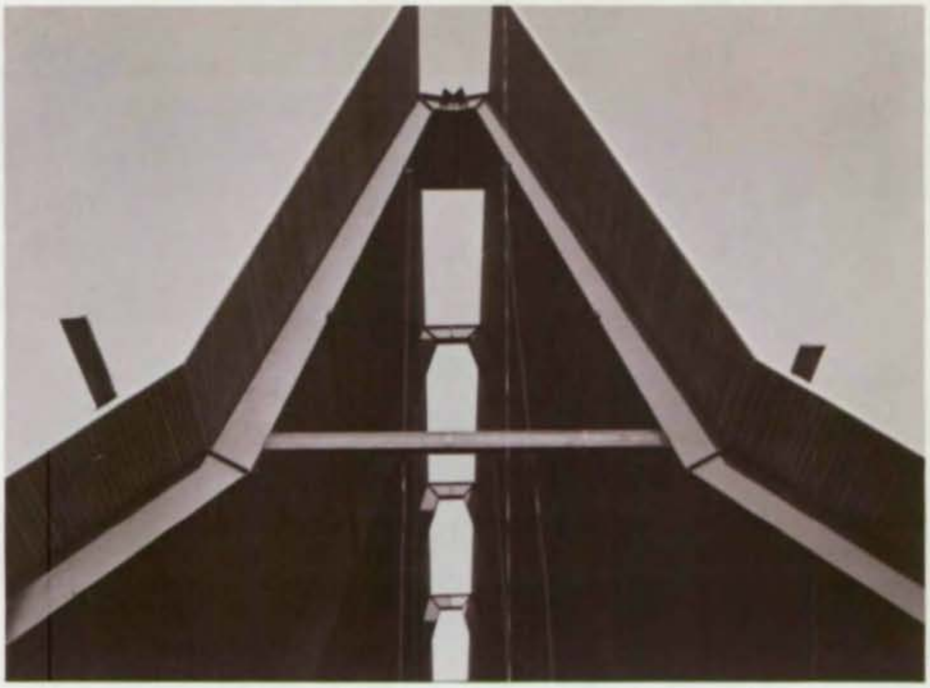
1:30 P.M. — Connections for Tubular Members

Roland R. Graham, Moderator
Dr. Jack G. Bouwkamp
Dr. Richard N. White

Panel Discussion
Graham, Bouwkamp, White

3:15 P.M. — ADJOURN

STEEL FRAME SAVES CHURCH $15,000



Modified A-frame bents create soaring, reaching effect for St. Paul's Methodist Church, Oxnard, Calif.

Economical in time and money, bents were fabricated in two pieces and field connected.

Because of its strength, easy fabrication, and adaptability to unusual forms, steel is making a big contribution to the renaissance of church architecture in the United States. An example of a successful design that puts these qualities of steel to good use is St. Paul's Methodist Church in Oxnard, Calif.

The architects, Miller & Crowell, took account of another basic fact about steel: its economy. They subjected their striking structural idea to a close analysis of costs and found that steel would give them a $15,000 saving under the figures for the other material considered.

Special A-Frame Bents

The soaring, upreaching effect, distinctive yet dignified, is achieved by specially fabricated A-frame bents. The plate girder fabrication facilities of the Ross-Carter Corp. of North Hollywood were an important factor in the planning of construction procedures. The bents were produced in half units and were then trucked to the job site. The halves were then connected with a horizontal member at the top of the A to form an outsize truss.

The joined A-bents were then lifted into place and braced. Because of their great height – over four stories – and their narrow span in the upper section, they required careful coordination between the fabricators and the general contractors. The job received an unexpectedly severe test immediately after completion in the form of a violent wind storm. The roof members were installed after the storm. A seamed copper roof caps the dramatic structure, which catches the eye even in California, where special purpose buildings have a reputation for imaginative but not always dignified design.

Each side of the A-frame is angled twice – a structural challenge that could be accomplished both easily and economically in steel. The bottom member is cantilevered out over the supporting bulkhead to form an overhang.

52 Feet High

Bulkheads are steel-reinforced concrete eight feet high, lifting the A-frames to a total height of 52 feet. Interior space is 65 feet wide and 120 feet long; the square footage is 7800. The nave seats 506; the choir, 40. The altar is of white concrete, the cross of aluminum and teak.

Running along the exterior walls, defined by and suspended on the bulkheads, are 66-foot-long panels of Italian stained glass, eight feet high, set on quarter-inch plate with epoxy. The design is abstract, deploying colors in progression from grays and mauve to orange and gold.

Because of the shop prefrabrication and ease in transportation, the entire job of connecting the custom-designed bents and erecting and bracing them took only three days—a fortunate fact in view of the onset of the wind storms hard upon the completion of that phase of the construction. The general contractor, Macleod Construction Co. of Ventura, coordinated closely and effectively with the Ross-Carter staff. Triangle Steel and Supply Co. of Los Angeles provided the plate and structural shapes.

MULTI-PURPOSE COMMUNITY CENTER

By Leo C. Peiffer

The Riverside Community Center in Cedar Rapids, Ia., is a framed, exposed-steel, circular structure serving the many year-round activity requirements of the city. We chose steel because it provides the durability and permanence required for such a hard-used structure.

In the summer, the rolling steel doors lift to give an open feeling and provide 40 booths for truck gardeners to sell their produce. Community plays and meetings and art and cultural exhibitions are some of the other summer programs.

In the winter, with the outside walls closed and the building heated, some of the multi-purpose activities include athletic events, shows and displays, square dancing, and banquets.

General storage, kitchen facilities, and public rest rooms are also provided in the 84-foot-diameter building.

Eighteen steel rigid frame bents radiate from a 14-foot raised compression ring eye in the center of the structure. A nine-foot steel, cantilivered canopy provides additional protected area for the many activities. Along with the masonry walls and insulated roof deck, the building is completely framed in A-36 steel, bulb tees, metal roof deck, steel doors and door frames, and 24 rolling steel doors.

Colors have been selected to contrast and emphasize the steel bents and main structural members.

John McGranahan and Iowa Steel & Iron Works, Inc., both of Cedar Rapids, were the structural engineer and fabricator, respectively.

Leo C. Peiffer is head of the Cedar Rapids architectural firm of Leo C. Peiffer and Associates.