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MODERN STEEL CONSTRUCTION

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CONTENTS

AISC STRUCTURAL STEEL DETAILING—A NEW TEXTBOOK

A new one-volume textbook "Structural Steel Detailing" is being published by AISC and will be available about October 31 of this year. The textbook reflects the many technological changes and advancements that have taken place in the structural steel fabricating industry in recent years.

Using numerous design examples, the textbook is an updated presentation of the material formerly included in Volumes 1 and 2 of the previous three-volume textbook "Structural Shop Drafting", published by AISC between 1950 and 1955.

The text is cross-referenced to the principal six Parts of the 6th Edition "Manual of Steel Construction" and keyed to the latest AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" adopted April 17, 1963.

Although it is written primarily as a textbook for the training of structural steel detailers, some of the more complicated phases of detailing will be of interest to engineers, designers and others desiring a knowledge of 15 years progress of the industry.

Printing of the now obsolete Volumes 1 and 2 of "Structural Shop Drafting" has been discontinued and their distribution will end when the present supply is exhausted.

The price of the new textbook is $10.00 per copy. Orders should be directed to American Institute of Steel Construction, Inc., 101 Park Avenue, New York, N. Y., 10017.

1966 Architectural Awards of Excellence

Each year since 1960, the American Institute of Steel Construction has conducted an annual competition to recognize and honor outstanding architectural design in structural steel and to encourage architects to explore the many aesthetic possibilities inherent in steel construction.

This year, a distinguished jury of five architects and engineers named four buildings for the Architectural Award of Excellence and three buildings for the Architectural Award of Merit.

The 1966 Jury of Awards included:

Lawrence B. Anderson, FAIA, Anderson, Beckwith & Haible, Dean, School of Architecture & Planning, Massachusetts Institute of Technology, Cambridge, Mass.

Mario J. Ciampi, FAIA, Mario J. Ciampi Architect & Associates, San Francisco, Calif.

Charles M. Nes, Jr., FAIA, President, American Institute of Architects, Fisher, Nes, Campbell & Partners, Baltimore, Md.

John C. Portman, Jr., AIA, Edwards & Portman, Architects & Engineers, Atlanta, Ga.

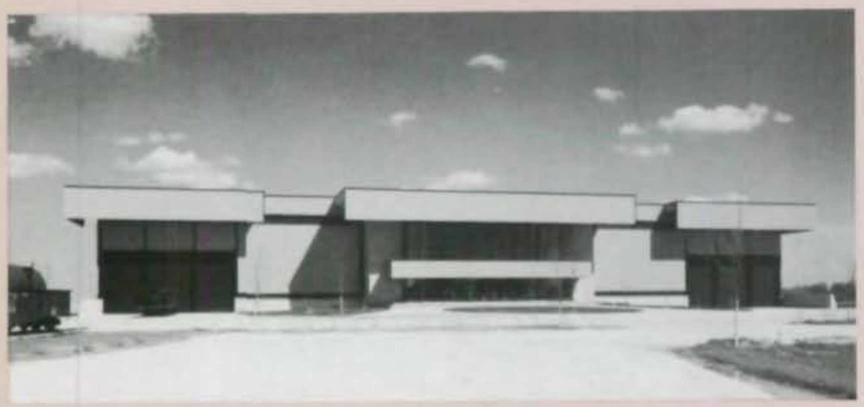
Dr. Lev Zetlin, FASCE, Lev Zetlin & Associates, Consulting Engineers, New York, N. Y.

The jury was particularly seeking the utilization of structural steel for its maximum architectural potential, and the award winning buildings were chosen as outstanding examples of aesthetic leadership and direction. In summing up their reactions, the jurors noted that to an increasing degree aesthetics are playing an important role in the design of buildings of monumental size as well as in the smaller and more delicately detailed structures being built across the country.

Exterior design which clearly expresses the structure of the building was one of the architectural concepts favorably viewed by the jury. An outstanding example of this type of architectural expression is one of the fea-

AWARD OF EXCELLENCE
Chicago Civic Center, Chicago, Ill.
Architect: Chicago Civic Center Architects
C. F. Murphy Associates (Supervising)
Skidmore, Owings & Merrill and
Loebl, Schlossman, Bennett & Dart (Associates)

AWARD OF EXCELLENCE
Equitable Building, Chicago, Ill.
Architect: Skidmore, Owings & Merrill



AWARD OF EXCELLENCE
Inland Steel Products Company, Calumet Road Plant, Milwaukee, Wisc.
Architect: William P. Wenzler, in association with
The Engineers Collaborative, Ltd.

AWARD OF EXCELLENCE
Birmingham-Bloomfield Bank, Wixom Branch, Wixom, Mich.
Architect: Ziegelman and Ziegelman

tures of the impressive Chicago Civic Center, designed by Chicago Civic Center Architects (C. F. Murphy Associates, Supervising Architects; Skidmore, Owings & Merrill and Loebl, Schlossman, Bennett & Dart, Associate Architects). Since all of the structural elements were required to be fireproofed, the architects decided to cover them with a steel cladding, to express the steel within. For the cladding material they chose a corrosion-resistant high-strength, low-alloy steel, which allowed painting to be omitted and will give the building a handsome russet finish. Frames for the floor-to-ceiling windows were special shapes rolled from the corrosion-resistant steel. Interior columns were eliminated to give greater flexibility in accommodating the large courtrooms. The enormous clear spans that resulted were bridged with open steel trusses 5 ft-4 in. deep and 87 ft-0 in. long, which permitted all ductwork to pass through them. The Chicago Civic Center demonstrates once again that a simple, direct solution to problems can result in forceful architecture.

The Inland Steel Products Company building, Milwaukee, Wisc., designed by William P. Wenzler and Associates, Brookfield, Wisc., in association with The Engineers Collaborative, Ltd. of Chicago, is an outstanding example of imaginative industrial architecture. The building is designed to allow for efficient fabrication and handling of a product up to 75 ft in length. The architectural treatment conveys the simple orderliness and harmony inherent in that product, with a humanism that reflects the management-labor and human dignity philosophy of the company. One of the primary concerns, aside from plant layout, was the need for adequate, glare-free light and positive ventilation. In the architectural solution, reflected and subdued light is admitted through clerestories and through glare-reducing glass behind sunshades. Mechanical ventilation is aided by the natural gravity action of grilles at the floor and ceiling and in the clerestory. Structural steel trusses and fold-out joists and deck sections form the entire roof area.

An unusual award winner is the Birmingham-Bloomfield Bank — Wixom Branch, Wixom, Mich., designed by architects Ziegelman and Ziegelman, Birmingham, Mich. The building was designed to provide an interim facility until permanent construction could be completed. It had to be inexpensive, mobile, adaptable to any site condition, and able to attract the public. It was also required that the building be reuseable at another site. The solution was a prefabricated structure based on a modular system. All panels and glass are interchangeable to fit any site condition. The rigid steel frame enables the building to be lifted with all glass and panels in place, and all interior finishes complete. It can be shipped to another site by truck or railroad, ready for immediate reuse.

The well-planned relationship to its site and the older buildings around it is one of the architectural features which impressed the jurors in granting an award to the Equitable Building in Chicago, Ill. The building is clad in bronze-colored aluminum, granite and glass to reflect its rigid metallic structure and provide a strong but quiet solution compatible with its environment. A continuous welded orthotropic steel structural system with composite floor construction was selected as a means of obtaining the greatest number of floors (with a minimum floor-to-floor height) within the height limitation permitted and without sacrificing normal tenant ceiling height requirements. The perimeter zones of the building are air-conditioned, using a vertically fed system with supply ducts integrated into the column structure. Piping is incorporated into the mullion structure. This permitted the use of low floor-to-floor heights which resulted from the structural solution. The shape of the exterior columns results from the integration of the mechanical system into the structure.

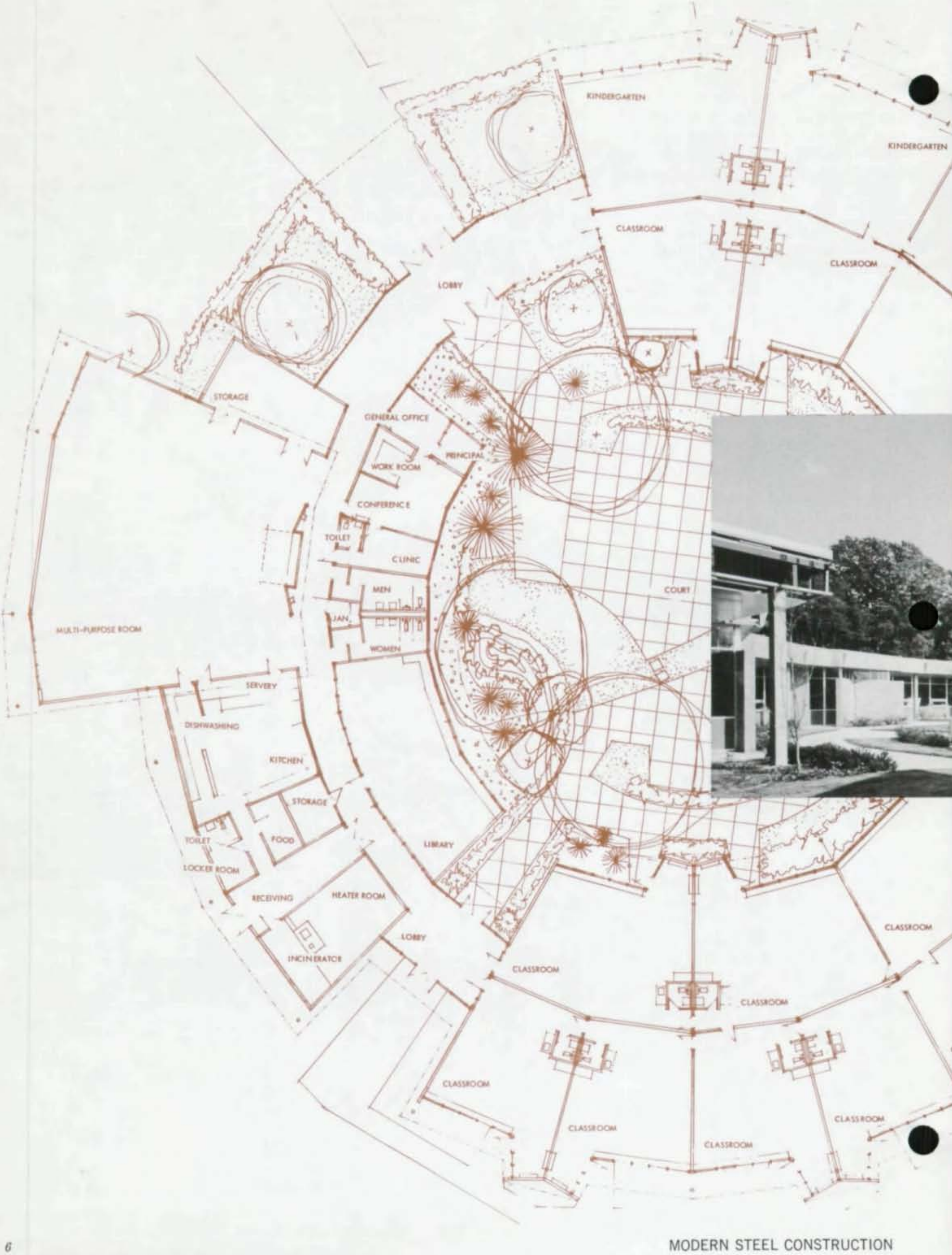
In addition to these four buildings which received Architectural Awards of Excellence, the following buildings were selected for Awards of Merit:

The Atlanta Stadium, Atlanta, Ga. Heery and Heery • Finch, Alexander, Barnes, Rothschild and Paschal — Associated Architects; State Street Bank Building, Boston, Mass., designed by Pearl Street Associates (a joint venture of F. A. Stahl & Associates, Hugh Stubbins & Associates, and William J. LeMessurier Associates); First Federal Building, Detroit, Mich., Smith, Hinchman & Grylls Associates, Architects.

AWARD OF MERIT
Atlanta Stadium, Atlanta, Ga.
Architect: Heery and Heery • Finch, Alexander, Barnes, Rothschild and Paschal — Associated Architects and Engineers

AWARD OF MERIT
State Street Bank Building, Boston, Mass.
Architect: Pearl Street Associates (A Joint Venture)
F. A. Stahl & Associates
Hugh Stubbins & Associates
Wm. J. LeMessurier Associates

AWARD OF MERIT
First Federal Building, Detroit, Mich.
Architect: Smith, Hinchman & Grylls Associates


KINDERGARTEN
KINDERGARTEN
CLASSROOM
CLASSROOM
LOBBY
STORAGE
GENERAL OFFICE
PRINCIPAL
WORK ROOM
CONFERENCE
TOILET
CLINIC
MEN
JAN.
WOMEN
MULTI-PURPOSE ROOM
COURT
SERVERY
DISHWASHING
KITCHEN
STORAGE
TOILET
FOOD
LOCKER ROOM
LIBRARY
RECEIVING
HEATER ROOM
LOBBY
INCINERATOR
CLASSROOM
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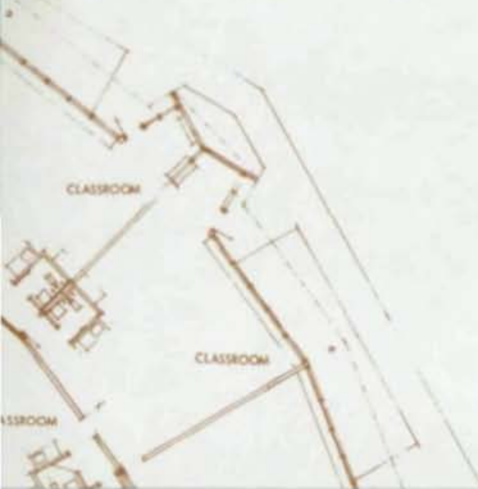
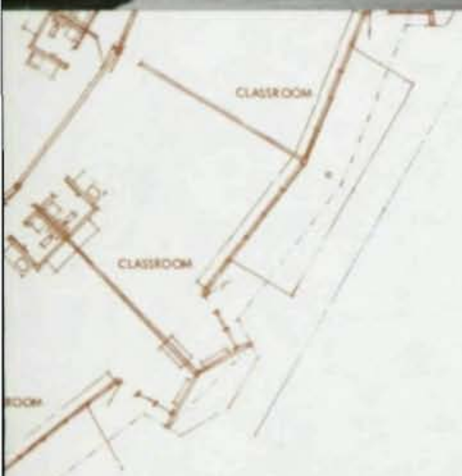
STEEL FOR A SCHOOL IN THE ROUND



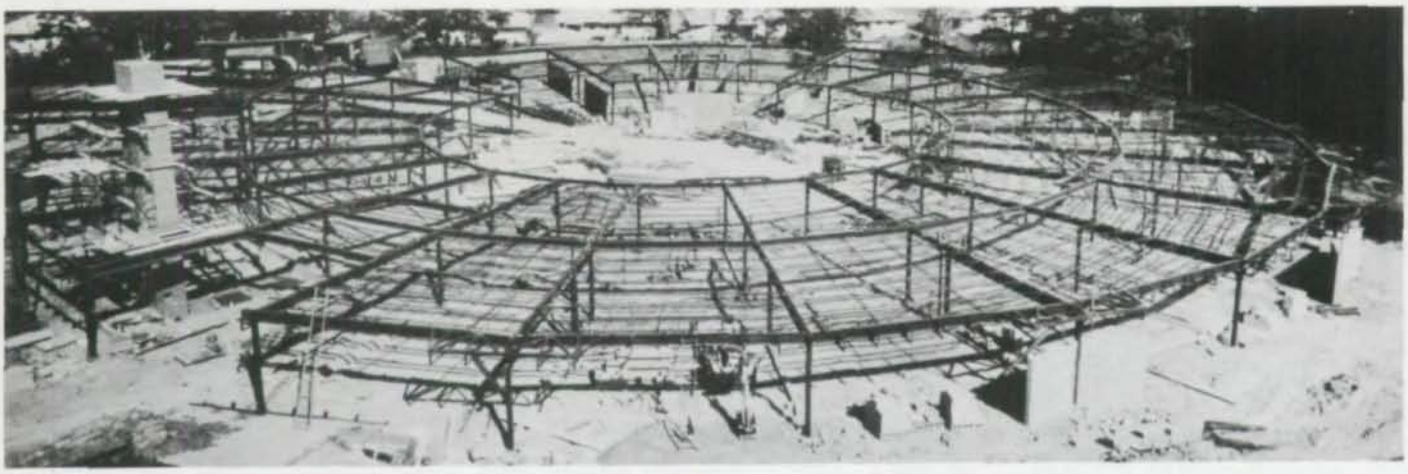


Twenty years ago, a steel-framed school "in the round" would have been as rare as a 75-carat diamond. Today, this shape is among the most popular, and for some sensible reasons. Principal among them is the capacity of the circle to provide more usable interior space.

John F. Lipaj Associates, architects for the Arlington Elementary School in Parma, Ohio, have succeeded in squeezing out what is probably very close to the ultimate in usable classroom space. They've done it by eliminating connecting corridors between classrooms. The classrooms are arranged in two concentric rings. Each classroom can be reached directly through an outside door; each has a toilet room, work sink, wardrobe area and storage cabinets.

In all, there are 20 classrooms, two kindergartens, offices, a library, and a high-ceilinged multi-purpose room. Considered together, these rooms amount to slightly over 37,000 sq ft. Total cost was $629,882, which works out to a moderate $16.93 per sq ft, or $954.36 per pupil.

Steel was a factor in keeping the costs down. The architects comment, "a steel skeleton system comprised of WF beams, tubular columns, bar joists and a steel deck was selected for reasons of economy, erection speed during bad weather (which also saved money), and design flexibility." They added that freedom to design the kind of structure they wanted – within the budget given them – was made possible in large part by the full, widely-varied supply of stock steel components available locally.



The main assembly or multi-purpose room in the school is used to serve lunch (to 300 students at one sitting). In addition, the room features a portable stage and a built-in sound system, with space for 500 folding chairs.

The roof joists are sloped within the wide porcelain steel sculptured fascia to permit roof water drainage toward the inner court. A suspended ceiling of acoustical tile covers all the interior ceilings, and asphalt tile covers most of the floors. The exterior walls are paneled in aluminum and glass, with porcelain steel accent panels, and a six-ft overhang protects the windows from direct sun and rain.

The architects, John F. Lipaj Associates, are based in Cleveland, Ohio, as are the structural engineer, R. M. Gensert Associates, and the steel fabricator, Republic Structural Iron Works. General contractor on the job was Dileno Construction Co., South Euclid, Ohio.

TULSA EXPOSITION CENTER

by David R. Graham, F. ASCE and Bert E. Griffin, AIA*

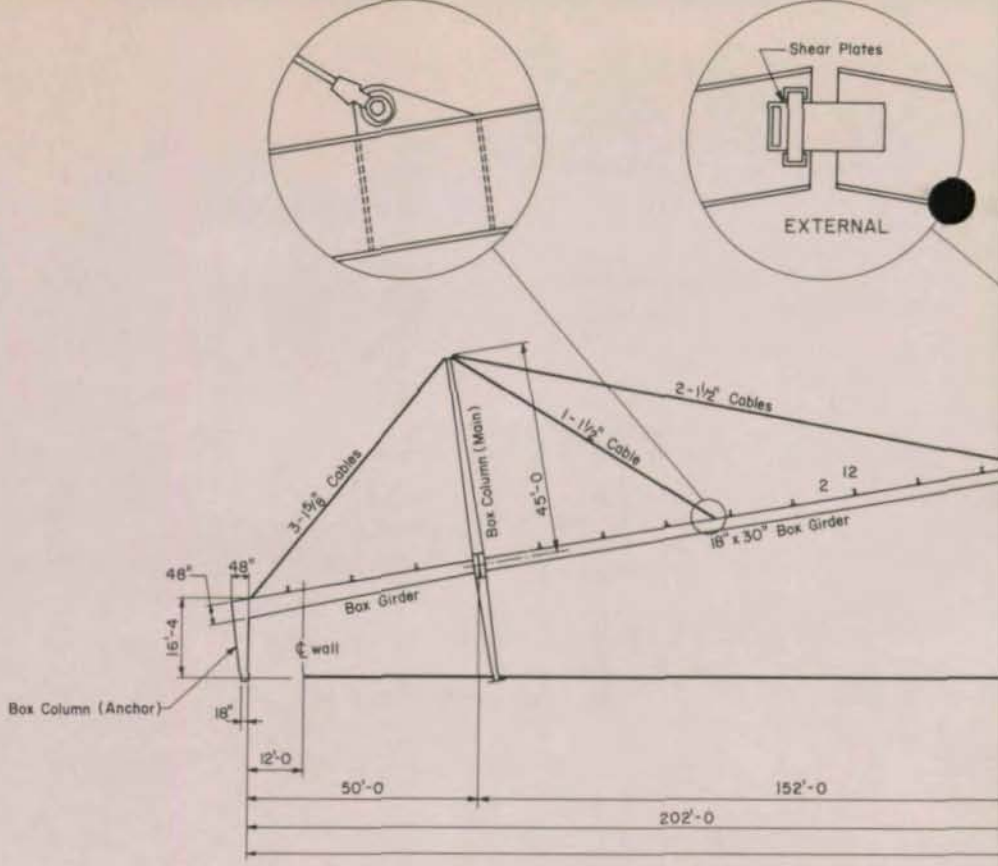
In spite of our combined years of experience, we are occasionally brought up short by the thought that we were responsible for designing the largest unobstructed inside exhibit space in the world.

There are over 10 acres in all underneath the roof of the Tulsa Exposition Center, Tulsa, Oklahoma, and approximately 8.4 acres of this space is without a single post or pillar. In public relations terminology, there is space inside for seven regulation football fields (including the end zones), and enough

*Mr. Graham and Mr. Griffin are principals in the engineering and architectural firm of David R. Graham and Associates, Inc., Tulsa, Oklahoma.

TULSA EXPOSITION CENTER

Torsionally stiff box girders, cable-suspended from tapered steel masts, frame the floating roof of the Tulsa Exposition Center. Note 12-ft drop in floor area to accommodate large exhibits and provide a "balcony" for visitors.



roof left over for the bench-warmers to run through some practice plays.

Why so big? For practical reasons. The building's first purpose is to house an immense oil trade show featuring more than a billion dollars worth of equipment, from microminiature instruments to mammoth deep-sea oil drilling rigs. This gigantic exposition is held once every several years. At other times, the building will be used for the Tulsa Fair, and for many other industrial trade shows.

Before this building went up, expositions were held on approximately the same grounds in a cluttered collection of shelters, sheds and shacks. Clearing the grounds of these assorted structures and collecting the shows under one roof constituted one of the motivating forces for designing and building the new center. Since this was a city project, Tulsans had to vote on a big bond issue to get it going. We think it's interesting to note that the project inspired such confidence and enthusiasm, the vote soared to a 70 per cent majority in favor of the issue – a near record for a public referendum, especially one that calls for spending money.

Our architectural goals – to produce a dramatic, landmark structure which would memorably impress exhibitor and visitor alike – blended nicely with our functional goals – to provide the required column-less space and height (for exhibiting tall oil rigs) and the proper environmental conditions on a limited budget.

From its original concept, the architectural form was planned to clearly demonstrate the structural form and clear spans, as viewed from outside or inside the building.

This form dictated the use of structural steel for lightness in fact, and for the sake of appearance. All the main framing is fabricated in box sections which provide enough stiffness to practically eliminate extraneous bracing, and allowed us freedom to vary the depth of sections to achieve maximum economy of weight.

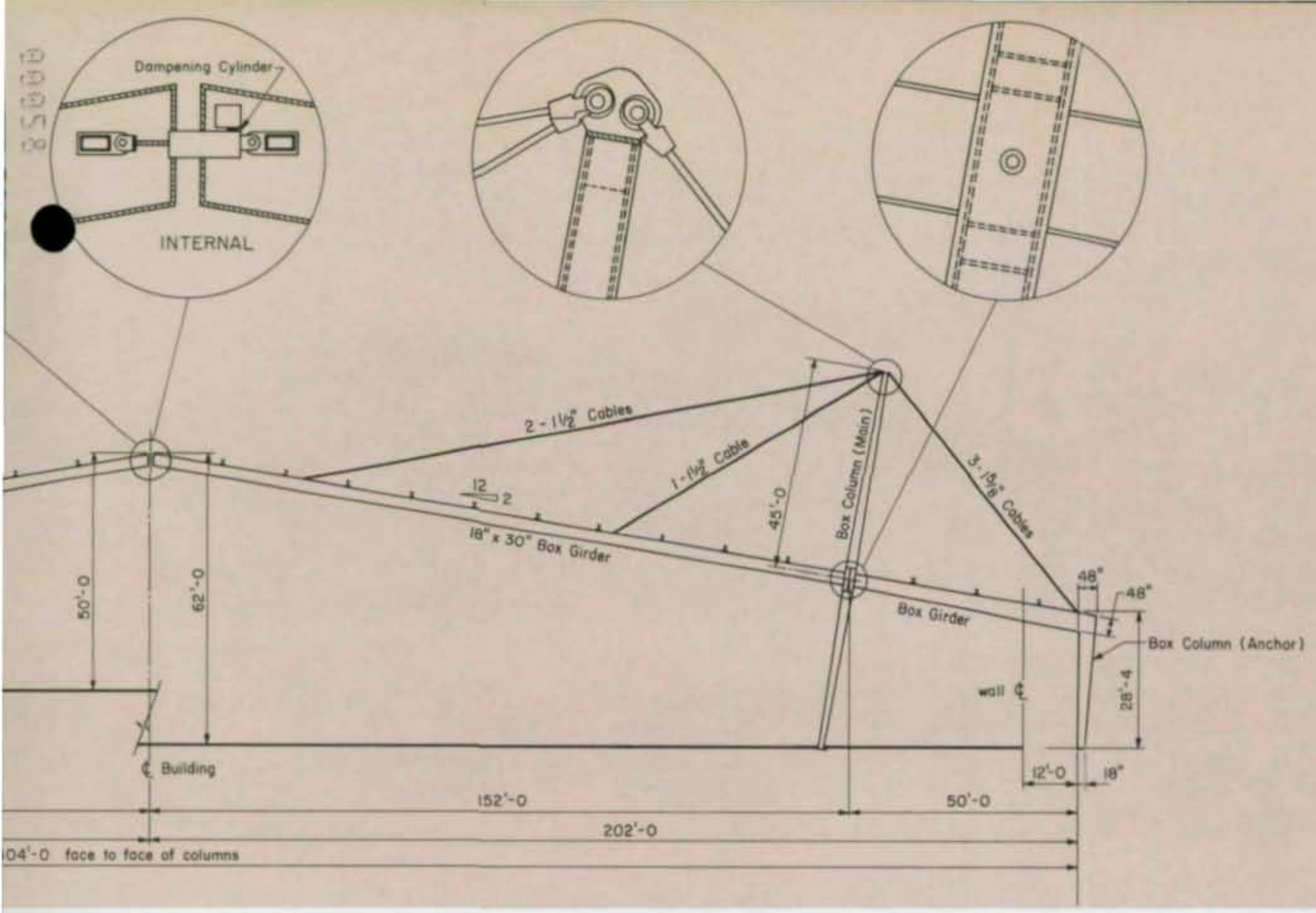
These box section members aren't fabricated in the usual perfect box shape, but have an overhanging flange at each corner. The flange produces a shadowline effect that becomes a part of the architectural form, and provided a clamping base for fixtures during welding operations. The flange also carries the purlins, thus eliminating the cost of clips and attachment plates.

Detailing at the intersections and connections along the saw-tooth eave line was done to break the building length into refreshing rhythm, as well as to expose the diagonal bracing at each frame, giving a visual concept of the ease with which the steel skeleton spans the space.

The 3,500 tons of A36 structural steel literally floats in space as part of a cable suspension system which finally supports the marble-chip, white roof. The combination of box-section, welded steel columns and beams, and the pre-stretched, bridge-type cables are the heart of the structural system for the Center.

The cables are attached with clevis fittings to the tops of the masts, and connect from there to the main beams and outside columns, again with clevis fittings. The mast was designed as a separate column, having its top loaded by cable, but supported in only one direction. This means it would have no extraneously-introduced bending from deflection of the main beam. To assure this, both in theory and in practice, the main beam extends through a slot in the column, and is connected to the column with a round pin. Thus, only perfectly axial loads are introduced into the mast by the beam.

We think it's worthwhile noting that none of the clevis fittings have a provision for length adjustment. The high degree of accuracy specified and achieved in fabrication of the structure and manufacture of the fixed-length


Dampening Cylinder
INTERNAL
2 - 1½" Cables
1 - 1½" Cable
45'-0
Box Column (Main)
3 - 1⅝" Cables
12
2
18" x 30" Box Girder
48"
48"
Box Girder
Box Column (Anchor)
50'-0
62'-0
wall ℄
28'-4
℄ Building
12'-0
18"
152'-0
50'-0
202'-0
04'-0 face to face of columns

cables – all of which permitted erection of the structure without adjustment – is, we feel, a tribute to modern structural steel fabrication methods.

The main frames are free to move vertically at the center of the building, but a sliding arrangement is provided to prevent differential vertical movement between the frame ends. The main beams are connected at the center, under the ridge, by hydraulic dampers, the movement of which is restricted in one direction. Thus the roof can breathe under wind loads without sustaining rhythmic motion.

The masts bear on concrete piers placed in drilled holes extended into a plateau of solid sandstone which occurs approximately 12 ft below grade. The exterior columns, sustaining vertical uplift loads, also rise from cast-in-place concrete piers, and are attached to them with prestressed tendons extending from the column base plate to the pier bottom. These steel tendons anchor the column to the pier, and assist in maintaining uniform shearing stresses throughout the pier length.

Some 100,000 pounds of welding electrodes were used in the project. Most of this went into machine welding the box sections – a cost of small proportions when weighed against the structural advantages of the box section members. Shop welding was accomplished with tandem submerged arc equipment using low carbon steel wire electrodes. Field welding was performed with shielded arc electrodes of varying compositions.

The side and end walls of the structure are a combination of steel framing, laminated porcelain steel insulated panels, specially-designed lightweight concrete block, and glass. End walls are completely free-standing, in order to permit vertical movement in the main frames. And the side walls are attached in such a way as to allow for expansion and contraction. The side walls also contain large bi-parting doors to provide access for large vehicles carrying in exhibit equipment.

One-third of the floor area in the building is 12 ft lower than the balance. The offset makes space for setting up unusually large exhibits, and also provides a "balcony" on the upper level from which visitors will be able to view these exhibits more easily. Clear height at the center of the building on the main floor is 50 ft, and in the offset section, 62 ft. A railroad spur on the site terminates at the building. Eave heights were designed to permit future entry of the track into the building, if this ever proves desirable.

All principal structural members are painted a red-orange. The steel wall framing is blue, blending with pale yellow panels and gray masonry. As mentioned earlier, the roof is white. These bold, bright colors, provide an open, festive, fair-like design, very much in keeping with the modern facilities elsewhere on the fairground. These contrasting colors also emphasize the equilibrium of a structural system in coactive tension and compression.

The main public entrance is located at mid-point along the side of the upper floor level. The entrance canopy, in keeping with the design concept, jets out from the structure 45 ft, and is 90 ft wide. By sloping away from the eave line and tapering toward the entrance, the canopy focuses attention on the entrance. An elaborate underfloor distribution system of electric power, water, gas, drains, compressed air, and telephone lines is provided in all areas of the building.

As an illustration of the groundbreaking aspects of this project, we have applied for several patents on new design innovations which had to be developed before the center became a reality. Tulsans seem to be quite satisfied with their new Exposition Center, and, to be perfectly candid, we feel the building has fulfilled our goals beyond any original expectations.

Architect: Bert E. Griffin, AIA, Tulsa, Oklahoma

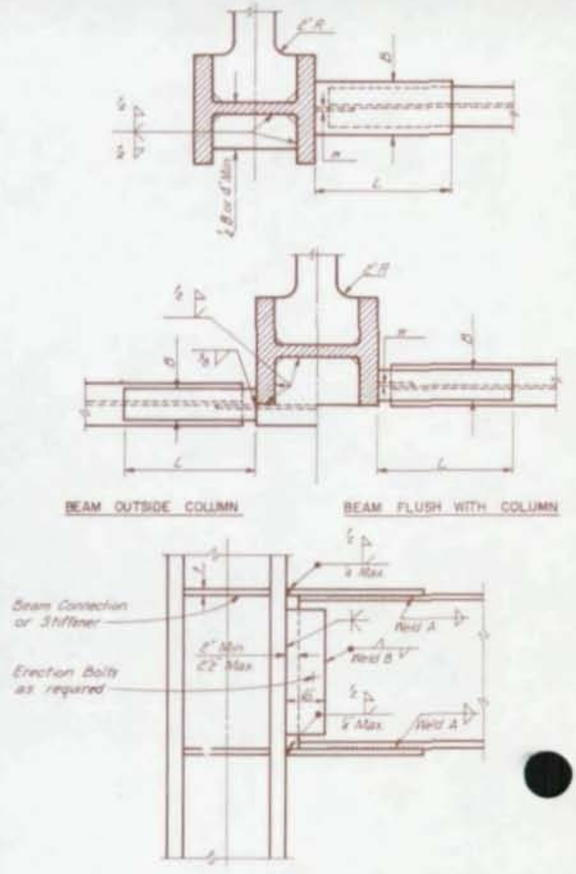
Structural Engineer: David R. Graham and Associates, Inc., Tulsa, Oklahoma

General Contractors: Cowen Construction, Inc., Shawnee, Oklahoma;

Dyer Construction Co., Tulsa, Oklahoma

Steel Fabricator: Flint Steel Corp., Tulsa, Oklahoma

CAN LONG-SPAN GIRDERS LOWER TAXES?



Column Detail

Steel long span girders are helping to play a part in lowering federal spending. For example, consider the case of the new 18-story Federal Building in Kansas City, Missouri, dedicated April 22, 1966.

By moving a variety of federal agencies, formerly scattered throughout the city, into this one building, the U.S. Government will save a considerable sum in rents over the years. Moreover, because the girders permit maximum flexibility in the arrangement of office space, changes in agency size and numbers of agencies can be made inexpensively. The building will house approximately 5,000 government employees.

Built-up girders run on 20 ft centers through the thickness of the high-rise portion of the building. They are haunched, welded sections with sufficient depth at the columns to resist wind forces, and enough clear space at midspan for ductwork. The girders clear bays of 36 ft, 42 ft and 36 ft, respectively.

Columns are generally rolled, wide-flange shapes. A few welded H-sections are used in heavily loaded lower floor areas. All connections in the main framing were field welded.

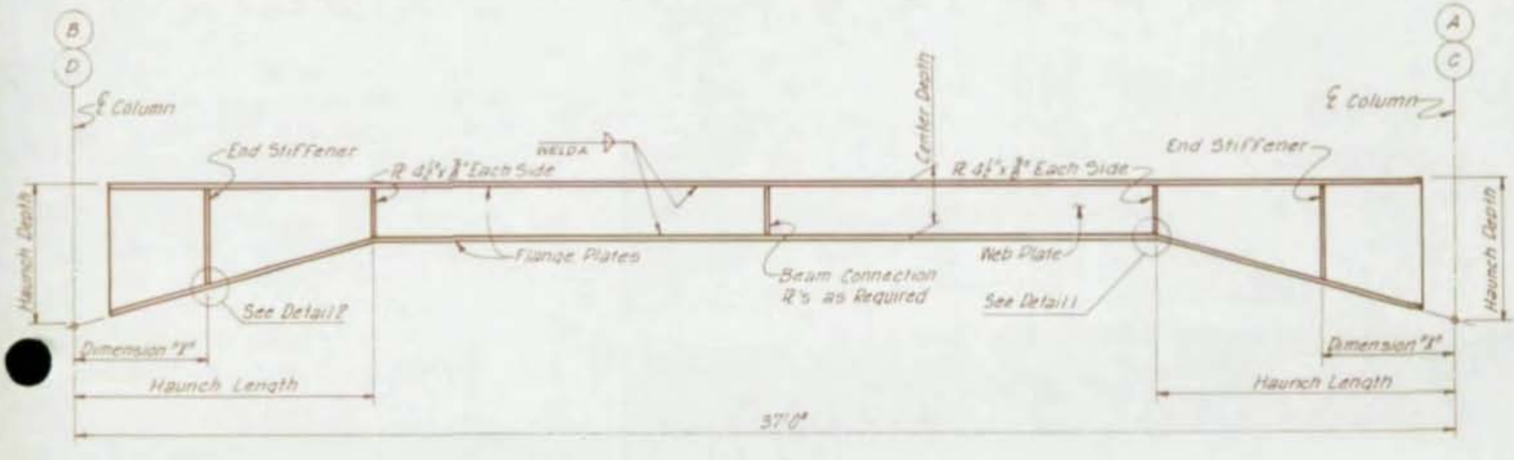
Filler beams between the girders are primarily 14WF30 members. On the perimeter, and where extra strength was required, the designers used 18WF50 filler beams. Connections for these beams and columns were made with high-strength bolts. The structural frame utilized about 8,700 tons of A36 steel and 1,300 tons of A441 steel.

The $26 million structure contains a gross area of 1,250,000 sq ft, and a net area of 800,000 sq ft. The typical floor contains 48,500 sq ft. The long faces of the building are paneled, checkerboard fashion, with aluminum and glass, while the end walls are covered with variagated brown marble.

There are three reasons for the offsets at either end of the building. First, the shape conforms to the functional requirement for corridor windows, and assists in shading them. Second, the space is utilized for stairways, toilets, ductwork and wiring closets. Finally, from an architectural standpoint, the offsets break up what could have been a rather ordinary "slab" look.

Only 31 percent of the site is covered by the building. The structure is set back from the streets for distances of 100 ft, 45 ft, 55 ft and 75 ft. This helps establish the openness which is an integral part of the Kansas City Civic Center, the master plan in which the Federal Office Building plays a major role. It also allows for extensive landscaping around the structure.

Architects for the project included Voskamp and Slezak, Everitt and Keleti, and Radotinsky-Meyn-Deardorff, all of Kansas City, Mo. Consulting architect was Harris Armstrong, AIA, St. Louis, Mo. Structural engineer was Howard, Needles, Tammen & Bergendoff, of Kansas City, Mo., while the general contractors were Frank Briscoe Co., Inc. and Huber, Hunt, Nichols, Inc., of Newark, N. J. Steel fabricator was Kansas City Structural Steel Co., Kansas City, Kansas.



Girder Details

OPEN TRUSSES FRAME CIRCULAR CHURCH

An open-web steel truss framing a church? And why not? This is the Unitarian Church of Lexington, Lexington, Kentucky. Says its designer, architect Herb Greene, a member of the school of architecture at the University of Kentucky, "The open-web steel was selected, among other reasons, because it blocked the view least from the low glass windows separating the roof wall from the upper floor. This view of the lovely open field of blue grass is consistent with the congregation's interest in working with the world at hand, rather than aspiring now to the heavens."

Functionally, the rigid-frame trusses were chosen for their superior combination of strength-to-weight and for the chance to speed erection time.

Each of the 10 trusses is formed with tubular steel sections. The upper chords are 4 in. x 2 in. x ¼ in., while the lower chords are 4 in. x 2 in. x 5/16 in.

The lower ends of the trusses were bolted through a ¼-in. setting plate to a reinforced concrete pier. The upper ends were field welded to the ends of 12B16.4 members, used to maintain a 12-in. depth to carry ceiling joists evenly. These bridging members were, in turn, field welded to a compression ring that resembles a cable spindle: an 11-in. deep section of 6-in. diameter steel pipe with decagon-shaped, ½-in. thick steel plates, top and bottom. All steel members arrived on the job with a prime coat of zinc-chromate paint, and when erected, all exposed sections were hand-painted white.

Referring to the trusses, architect Greene comments, "the combination of structure and pattern was germane to the total architectural concept." By filling in with wood framing, siding and sheathing and concrete block, the architect was able to keep the cost down to $13.50/sq ft, and still come up with a striking expression of the congregation's requirements, which Greene explains:

"The round form resulted from a program calling for church services for a maximum of 275 people in space that will also be used for theater-in-the-round productions, square dances, musicales and meetings. The shape also produced good spaces on the lower level for a board room, library, offices and classrooms. The flat roof was felt to be appropriate to the theology expressed in the Unitarian Church."

Structural engineer for the project was J. Palmer Boggs, Norman, Oklahoma, and the general contractor was Owen Construction Co., Lexington, Kentucky.