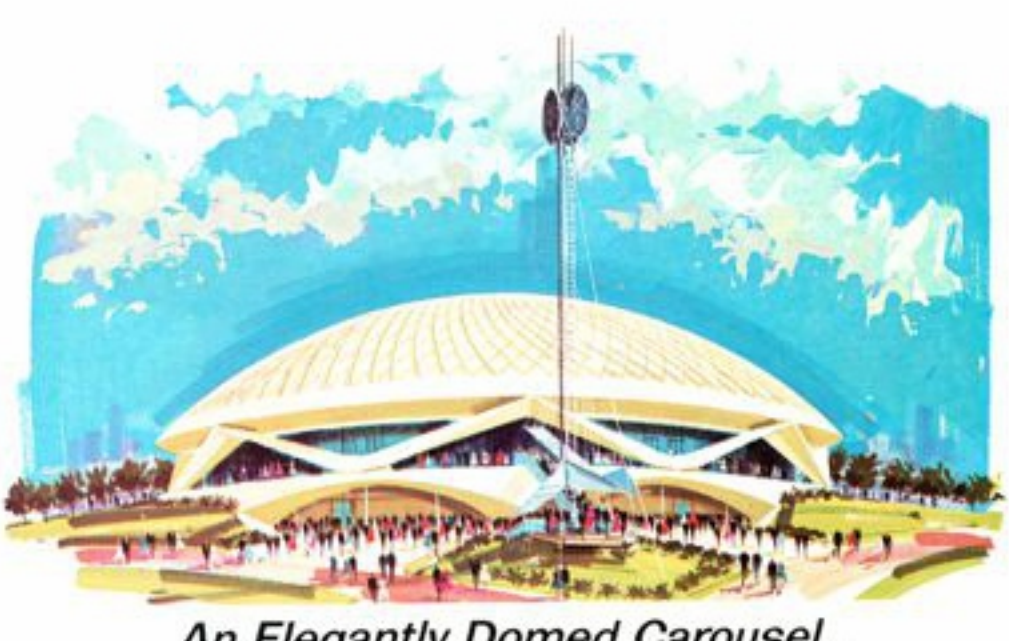


An Elegantly Domed Carousel...

A Colossal "Floating Wing"...

World's Fair Preview

OCTOBER, 1963

A "Hovering" Hollow Square...

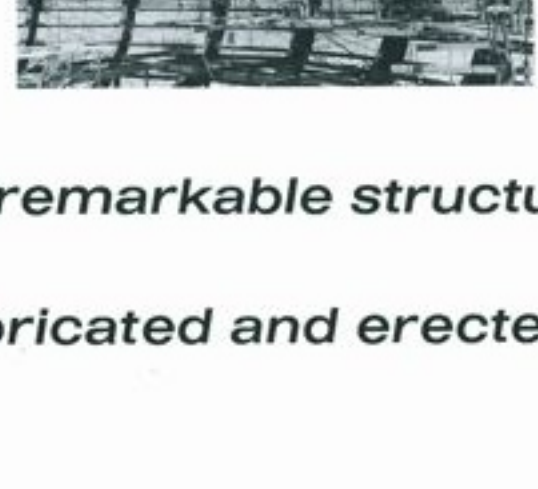
A New Concept in Space Structures...

...all described on the following pages

BETHLEHEM STEEL

A lamella steel pipe dome crowns the General Electric Company Pavilion

Steel U-frames connected to curving trusses frame the ride for the Bell System Exhibit



Lofty steel towers support eight giant trusses for the United States Pavilion

All-welded steel ribs, unique space structure, highlight The Travelers Insurance Pavilion

Four remarkable structures . . . all framed with steel . . .

fabricated and erected by **BETHLEHEM STEEL**

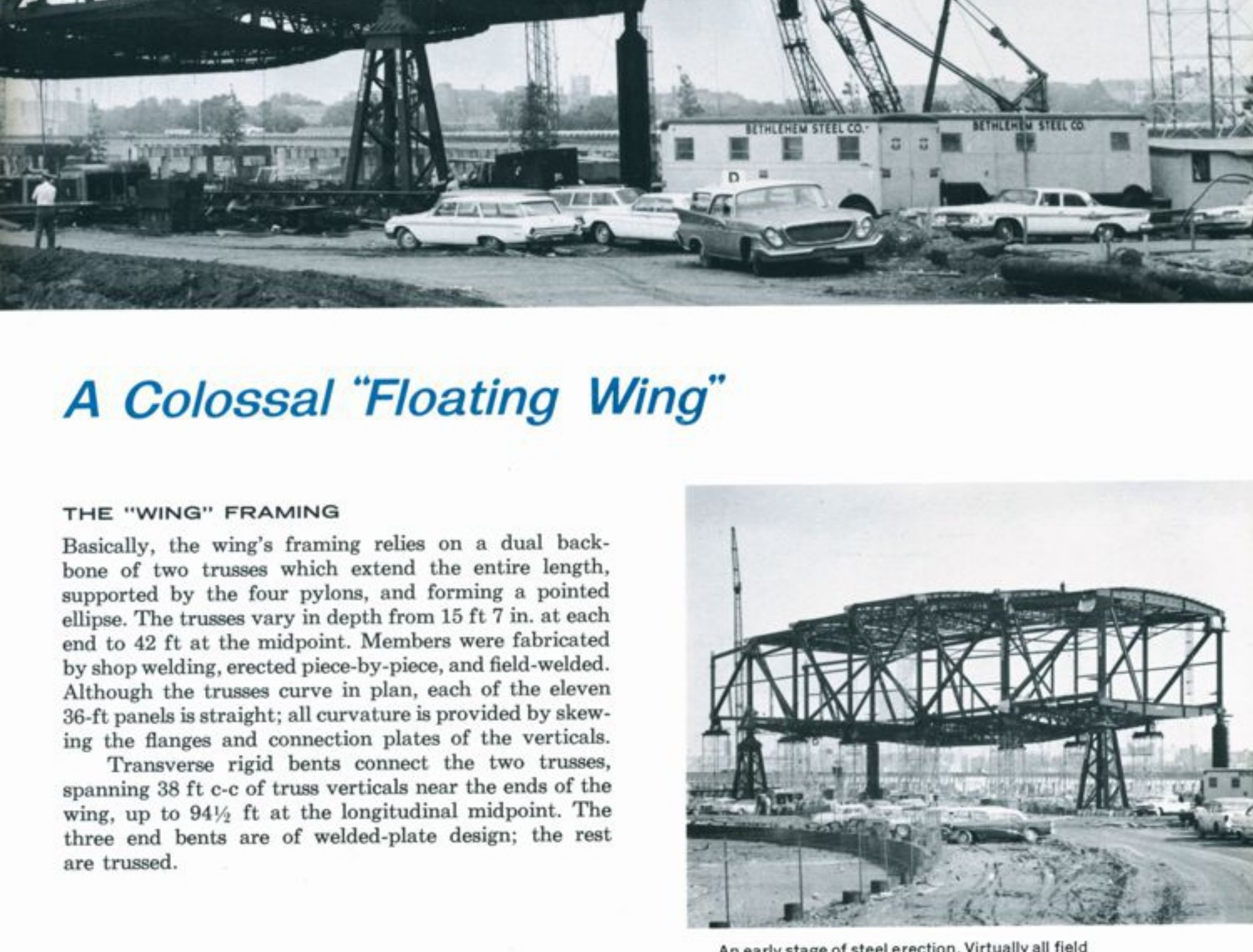
THE BELL TELEPHONE SYSTEM EXHIBIT BUILDING

A typical truss vertical shown at Bethlehem's Pottstown Fabricating Works illustrates some of the complexities of the structure. All of the verticals were built up of steel plate, with precisely skewed web plates. Note the extreme thickness of these plates.

This structure would be notable if it were just a fraction of its actual size; in fact, it is 400 ft long, and 200 ft wide at its longitudinal midpoint, where it is about 60 ft deep. It spans 180 ft between supports, and cantilevers 108 ft beyond them. Also, along the entire 400-ft length of the structure, it cantilevers from the trusses as much as 66 ft toward the front, and 38 ft to the rear.

This vast volume is supported on just four steel piers, two of which are designed for a load of 4,200 kips each, and the other two for a load of 2,500 kips each!

These steel supports, each 35 ft high from bottom of base plate at grade to center of bearings, rise through a base structure which occupies virtually the full 105,000-sq-ft site. This structure, which contains exhibits, offices, VIP reception rooms, etc., is not described here. We shall confine our description to the "wing", which houses a chair ride which transports visitors through a series of theaters.



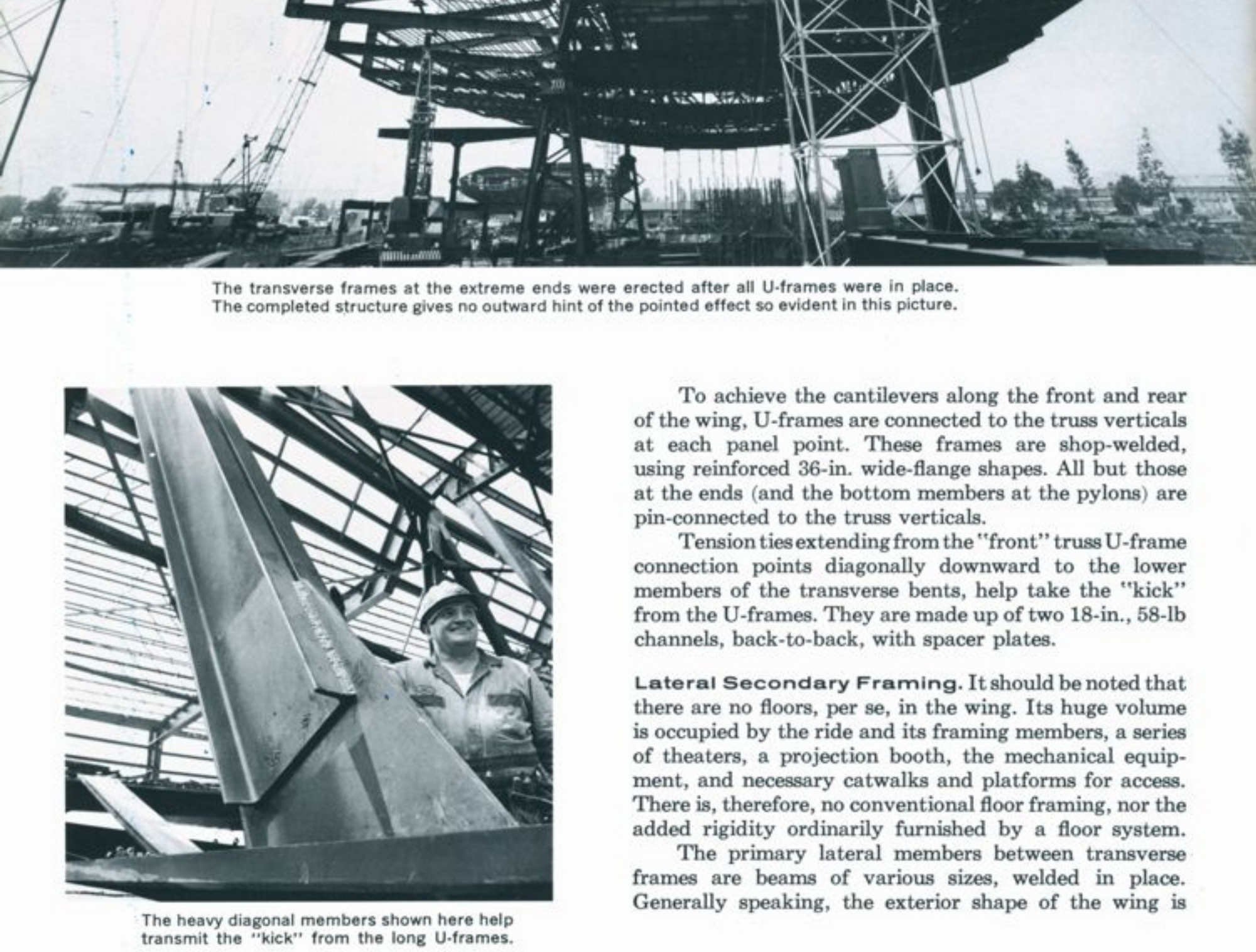
A Colossal "Floating Wing"

THE "WING" FRAMING

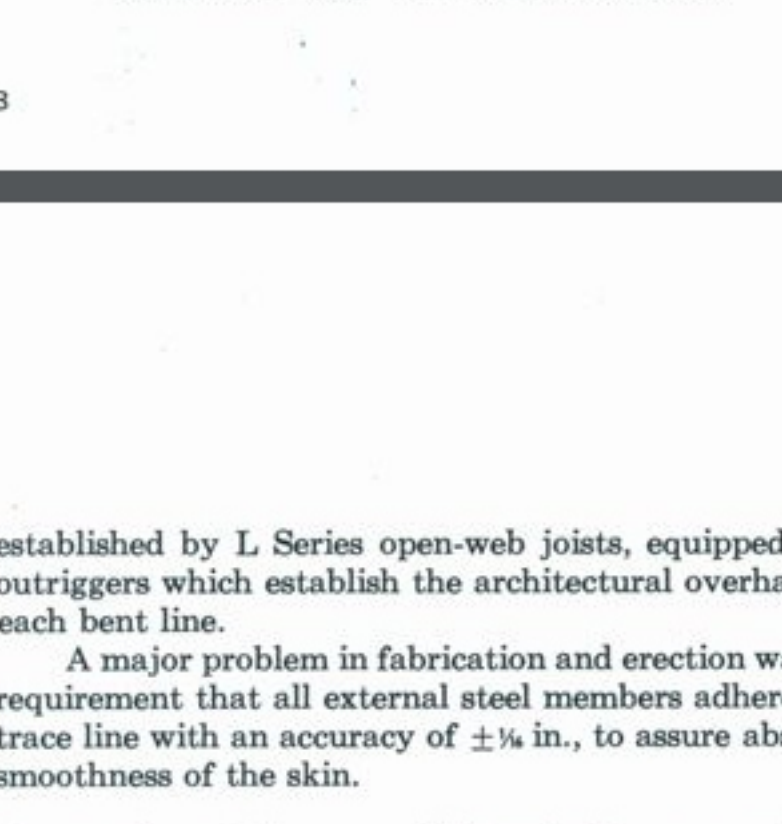
Basically, the wing's framing relies on a dual backbone of two trusses which extend the entire length, supported by the four pylons, and forming a pointed ellipse. The trusses vary in depth from 15 ft 7 in. at each end to 42 ft at the midpoint. Members were fabricated by shop welding, erected piece-by-piece, and field-welded. Although the trusses curve in plan, each of the eleven 36-ft panels is straight; all curvature is provided by skewing the flanges and connection plates of the verticals.

Transverse rigid bents connect the two trusses, spanning 38 ft c-c of truss verticals near the ends of the wing, up to 94½ ft at the longitudinal midpoint. The three end bents are of welded-plate design; the rest are trussed.

An early stage of steel erection. Virtually all field connections were welded and radiographed.



The transverse frames at the extreme ends were erected after all U-frames were in place. The completed structure gives no outward hint of the pointed effect so evident in this picture.



The heavy diagonal members shown here help transmit the "kick" from the long U-frames.

To achieve the cantilevers along the front and rear of the wing, U-frames are connected to the truss verticals at each panel point. These frames are shop-welded, using reinforced 36-in. wide-flange shapes. All but those at the ends (and the bottom members at the pylons) are pin-connected to the truss verticals.

Tension ties extending from the "front" truss U-frame connection points diagonally downward to the lower members of the transverse bents, help take the "kick" from the U-frames. They are made up of two 18-in., 58-lb channels, back-to-back, with spacer plates.

Lateral Secondary Framing. It should be noted that there are no floors, per se, in the wing. Its huge volume is occupied by the ride and its framing members, a series of theaters, a projection booth, the mechanical equipment, and necessary catwalks and platforms for access. There is, therefore, no conventional floor framing, nor the added rigidity ordinarily furnished by a floor system.

The primary lateral members between transverse frames are beams of various sizes, welded in place. Generally speaking, the exterior shape of the wing is

established by L Series open-web joists, equipped with outriggers which establish the architectural overhang at each bent line.

A major problem in fabrication and erection was the requirement that all external steel members adhere to a trace line with an accuracy of ±1/16 in., to assure absolute smoothness of the skin.

Supporting Columns. Although given an architectural finish that disguises their structure, the wing's supports are structural steel. The trussed pylons, used at the front of the wing, have 14 WF 228 legs. The one shown at right measures 30 ft 8½ in. from top of base plate to bottom of bearing shoe. Whereas all other bearings are fixed, this one has rollers which permit slight horizontal movement to compensate for expansion and contraction due to temperature changes. All bearing shoes are massive, measuring 7 ft 6 in. by 7 ft 2 in. in plan.

The two rear pylons are free-standing clusters of four 14 WF 184 columns, groove-welded to plates top and bottom. They are not braced, and permit slight bending.

Ride Framing. The chair ride, which will take 4,000 visitors an hour on a 1,000-ft-long ride lasting twelve minutes, required a rather complex framing system. It not only follows an irregular path in plan, but it has two lanes, one higher than the other, as well as a number of changes of elevation.

The main carrying beams are 18 WF 96 sections, with 6 B 15.5 filler beams. Along the front of the wing, within the U-frames, the ride rests on 18 WF beams connected to the upper flanges of the lower members of the U-frames. Elsewhere, however, the entire ride is elevated on columns.

Cutaway sketch of the structure at its midpoint shows how the ride passes through the "long" U-frames; mechanical equipment is housed in the "short" U-frames.

One of the two front, trussed pylons. It is the only support equipped with rollers to permit slight movement, horizontally on the "wing's" longitudinal axis.

Architect: Harrison & Abramovitz; *Exhibit Design:* Harrison & Abramovitz; *Consultant:* Henry Dreyfuss; *Producer-Designer, Ride:* Jo Mielziner; *Structural Engineer:* Paul Weidlinger; *Mechanical and Electrical Engineer:* Syska & Hennessy, Inc.; *General Contractor:* George A. Fuller Company; *Steelwork:* Bethlehem Steel Company