case study **Houston Astrodome**
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In the 1960s, a wealthy judge and entrepreneur envisioned bringing a national baseball team to Houston, Texas.

February 1961 voters approved a public bond issue to finance the construction of the stadium.

The Houston Astrodome was completed in 1964.

Conceived as the home of the Houston Colts and the Houston Oilers.

It was termed by many as the Eighth Wonder of the World.
Design Concept (comfort)

- The Houston weather with its heat, humidity, and mosquitoes made either playing or watching ball games an unpleasant experience.
- It was important that framing and the covering of the dome roof structure, not have a negative impact on air conditioning and air flow.
12 wedges of the lamella roof

5'-6" Deep truss with WF16x58-WF16x78

Pinned knuckle columns WF12x65 @ every 5deg around dome

38 steel towers used for construction

Compression Ring 5'-6" deep truss w/ Top Chord Highly stressed WF14x370 and Bottom Chord WF14x314

Retaining walls in some areas

Outer layer with cross bracing with moment frames in some locations
Building Components

- Staggered precast concrete and translucent glass
- Perforated concrete skin
- Cross bracing and rigid frames for people generated sway loads

Building Components
Lateral Loading Behavior

- Wind Loading:
  - Largest force magnitude
  - Analyzed through wind tunnel testing
  - Sway loading also significant value in sports arenas

- Temperature Effects
  - Causes daily change in column plumbness
  - Behavior predicted by prior calculations & analysis
  - Causes nearly 2” in dome deflection
  - Sway loading also significant value in sports arenas
Lateral Resistance

- “Knuckled Columns”
  located at every 5 degrees around the perimeter of the dome structure
  4" diameter high strength steel pins at each end of the column
  Bottom end welded as fixed connections
  Top end pinned to allow movement

- Bracing
  Used for wind load lateral stability
  Moment frames used where bracing would interfere
  Bracing also counteracts forces of sway loading
Description of Loads

- The minimum design specifications were as follows:
  - Dead load self weight of structure
  - Live load 15 PSF
  - Wind load 40 PSF
  - Sonic boom load 2 PSF

- 1/8 scale model had to withstand sustained wind velocity of 135 mph and gusts of 165 mph
Load Transfer Paths

- Outward thrust from roof resisted by the tension ring
- Loads are then transferred into 72 columns below tension ring
- Loads distributed into the footings
Foundation And Soil Description

- Geotechnical survey showed sandy soil, would produce negligible settlements
- Half of the footings placed 5 feet below playing field level, others were 10 foot combined footings and were located at the expansion joints
Foundation & Soil Description

- Retaining wall system of tie-backs and dead-man anchors used to resist lateral earth pressures
- Ranged from heights of 25 feet up to 33 feet around perimeter of building
References


