Dee and Charles

Wyly Theatre

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Project:

Name: Dee and Charles Wyly Theatre
Architect: REX/OMA
Location: Dallas, Texas, US
Type: Multi-form Theater
Area: 7700 m²
Capacity: 575 seats
Open: 2009
ARCHITECTS

REX/OMA

This was one of the first projects Joshua Prince Ramus (REX) worked on after starting their own firm leaving OMA.
"The creation of the Dallas Center for the Performing Arts is an investment in the cultural life of our city... Together with the Performance Park, the Center will become an exciting, seven-day-a-week destination that will animate Dallas and the region. This new Center ensures that future generations in Dallas and the region will have access to the best music, theatre, opera and dance from throughout the world."

–Bill Lively, President and CEO of the Dallas Center for the Performing Arts.
Before the Wyly theatre was erected the Arts District theater was probably one of the most, if not the most flexible theaters in America, but due to its financial burdens it had to remain with a fixed stage layout.

A "theater machine" that with a push of a button, a transformation began, altering the seating and the stage configuration.

The services are stacked above and below the auditorium, versus encircling it as in a normal theatre configuration, gaining flexibility and freedom.
Functional organization
PROGRAM
A proscenium, thrust, traverse, arena, and flat floor, a front-of-house and back-of-house facilities, and “administrative offices, rehearsal spaces, café, gift shop, bar, offices, costume shop, lobby, auditorium, stage support areas, mechanical rooms, production spaces and rooftop multipurpose space”.
Structure Components
Structural system:

- Material: Concrete
  Height: 125’ / 85’

- Material: reinforced concrete
  Height: 166”
  Longest diagonal: 166’

- Material: steel
  Depth: 34’
  Number of triangle: 8
1 Concrete column

2 Belt truss

3 Shear wall
Soil

The main soil is **Houston clay and calcareous clay (Taylor marl)**. Water may cause it expand by as much as 30%. Combine with hot dry summers, fierce thunderstorms that drop heavy rains. As a result, foundation will be unevenly lifted by those expansive soil, up to 6 inches, then crack, shift or fail will happen.
Wyly’s structure begins with a decent 20 feet down a ramp to the Lobby. The lobby makes up the basement floor and is enclosed by the concrete foundation walls. The foundation footings are located 40ft below the ground floor.
Methods to protect foundation

(1) Drilled pier foundations

(2) Extend building foundations beneath the zone of water content fluctuation (Reason: first, to provide for sufficient skin friction adhesion below the zone of drying; and second, to resist upward movement when the surface soils become wet and begin to swell.)
The 6 concrete super-columns meet the foundation at the basement level.
Along with carrying the load of the columns, the foundation, via the foundation walls and shear wall, are the primary support for the house level above.
Loading analysis
1. Live and Dead Loads collected from floor slabs transfer to beams
2. Beams transfer load to belt truss system
3. Belt Truss transfers forces to six super-columns
4. Super-columns transfer loads to foundation walls, foundation, and piers
Lateral Load Transfer

1. Lateral Loads are picked up by exterior cladding

2. From exterior cladding, loads is transferred to belt truss or east facing concrete shear wall

3. Loads collected by belt truss are transferred to the super-columns
Multi-frame model
The highest level of shear is located in the foundation walls.

There is also significant shear in beams holding up the upper floor. In reality, this floor gets more support from the belt truss system, thus minimizing the shear force.
Bending moment

The bending moment diagram shows the moment distribution in all the frame members. Basically, the moment distributed in most frames equally, and the largest bending occurs on the foundation structure.
Axial force

The moment of inertia in bending could determine the size of each frame member. This diagram shows the relative sizes of the forces on each member. The largest forces occur in the six columns, and the truss belt. That helps us to figure out the reason Wyly has the huge reinforced concrete diagonal columns and the deep trusses.
In addition to self weight the floors have uniform distributed loads that have an occupancy live load of 100 lb/ft^3

The roof hold a dead load of 30 lb/ft^3 and a snow load of 50 lb/ft^3

The shear walls hold a wind load of 20 lb/ft^3
Deflection

Deflection due to the large cantilever can be seen in the large truss belt

Deflection in the columns is due to lateral loads. Shear walls may have not been fully modeled.
Joint detail
Connections and joints
Truss belt to super columns connection
Tube Skin