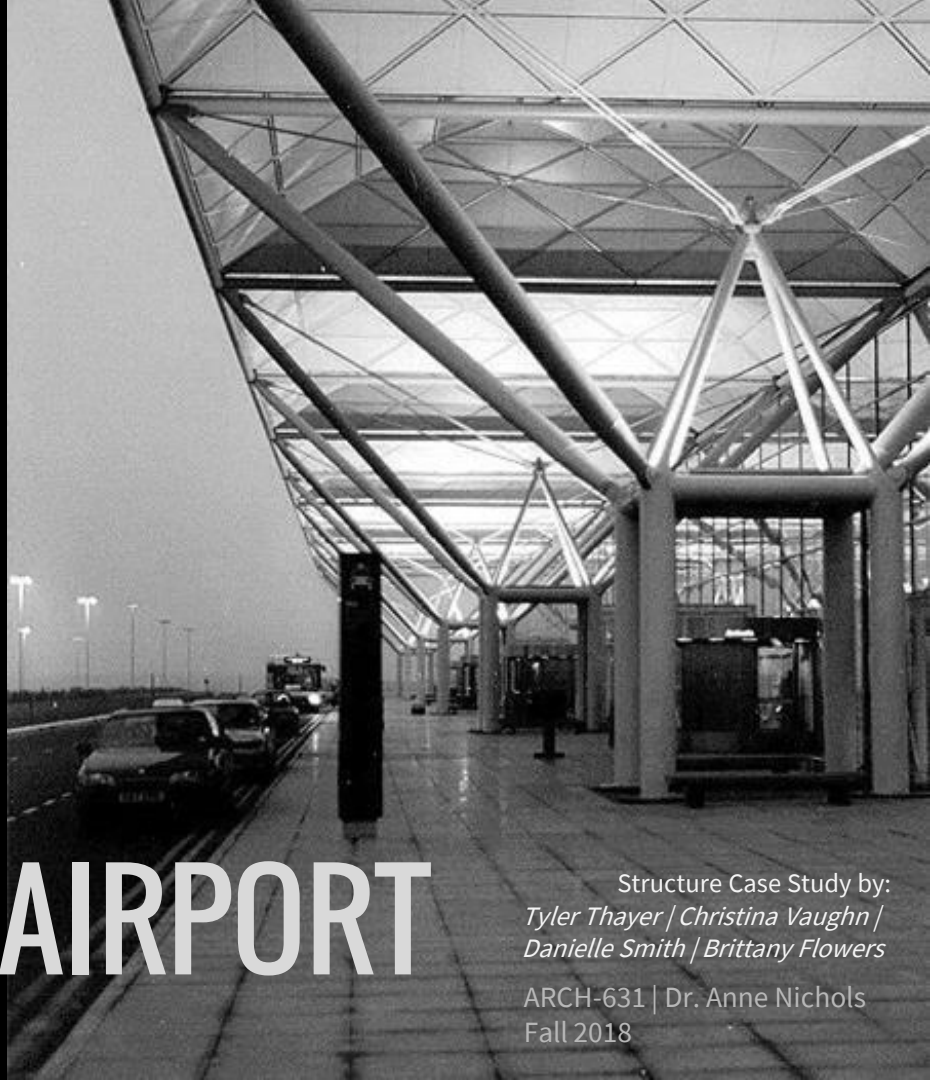
STANSTED AIRPORT



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ARCH-631 | Dr. Anne Nichols
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https://www.fosterandpartners.com/projects/stansted-airport/

general information

Architect: Norman Foster

Structural Engineer: ARUP

Square Footage: 922,467.12 sqft

Client: BAA plc

https://www.bbc.com/news/uk-england-45059001

background

Norman Foster graduated from Yale in 1962. His designs are based on structural expression and his projects number over 300 worldwide. Foster is the founder and a chairman of Foster + Partners.

https://www.fosterandpartners.com/projects/stansted-airport/

concept

The first airfields maintained a strong connection with the aircraft, containing a single terminal building, if any. Flying was still considered a majestic experience.

https://en.wikipedia.org/wiki/Great_West_Aerodrome#/media/File:View_from_Heathrow_Airport_Queen%27s_Building_1960s.jpg

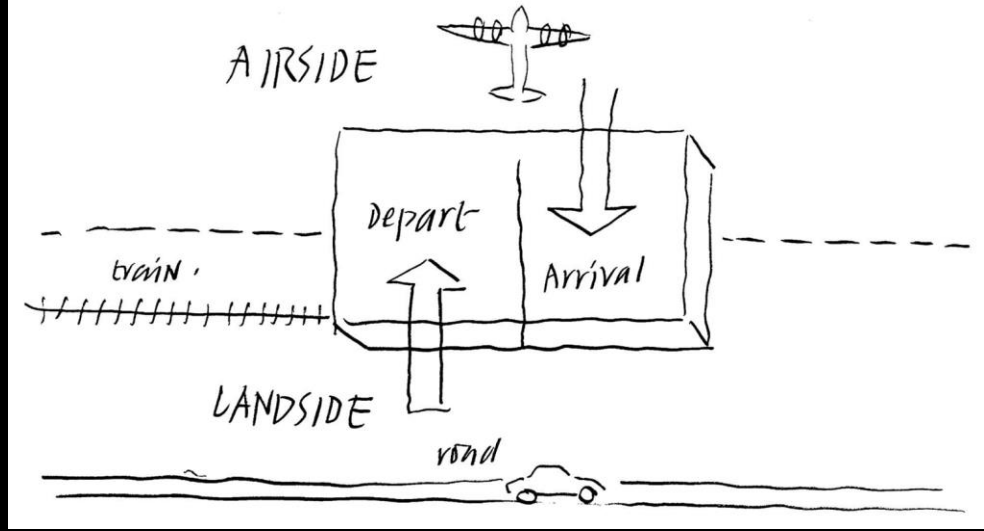
concept

Terminals compartmentalized over time; baggage, check-in, gates became boxes within a box as travelers were “herded like cattle”. They would move from space to space with little regard for the airfield.

https://www.greatbendpost.com/wp-content/uploads/2015/08/Screen-Shot-2015-08-26-at-5.08.47-AM.png

design concept

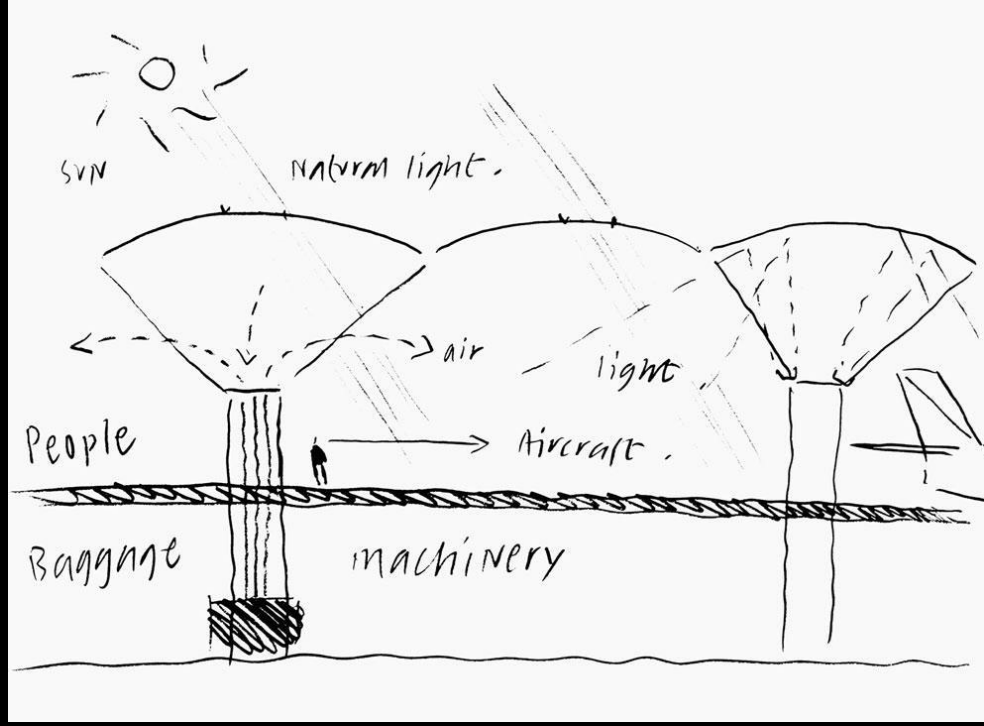
Foster's architectural design goals included an improvement in airport wayfinding and successfully hidden mechanical systems

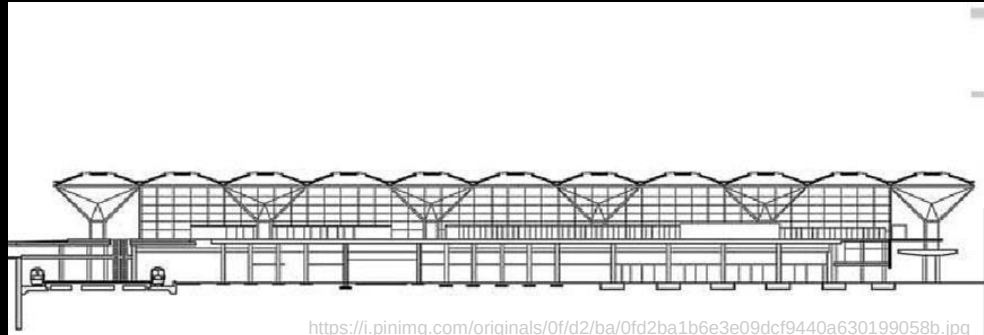


https://www.fosterandpartners.com/projects/stansted-airport/#drawings
https://www.trthaber.com/haber/dunya/londradaki-stansted-havalimaninda-teror-nedeniyle-gozalti-315950.html
https://www.fosterandpartners.com/projects/stansted-airport/

design concept

Foster's "upside down" design allows for visual and spatial connection to the airfield and structural expression

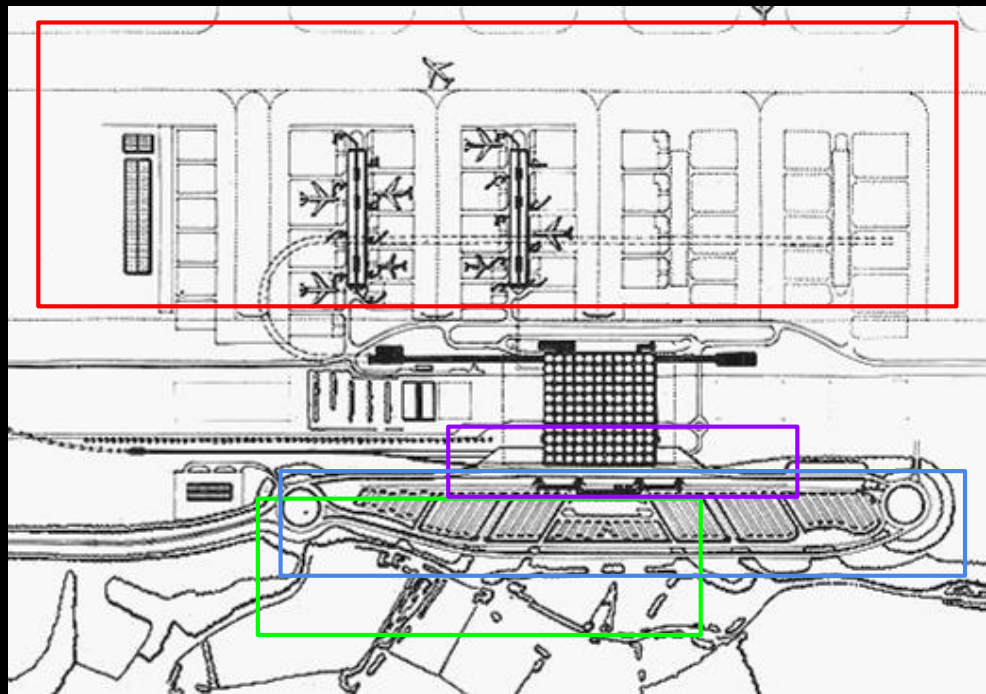




https://i.pinimg.com/originals/0f/d2/ba/0fd2ba1b6e3e09dcf9440a630199058b.jpg

site

site plan
parking
airport drop off
building
air strip



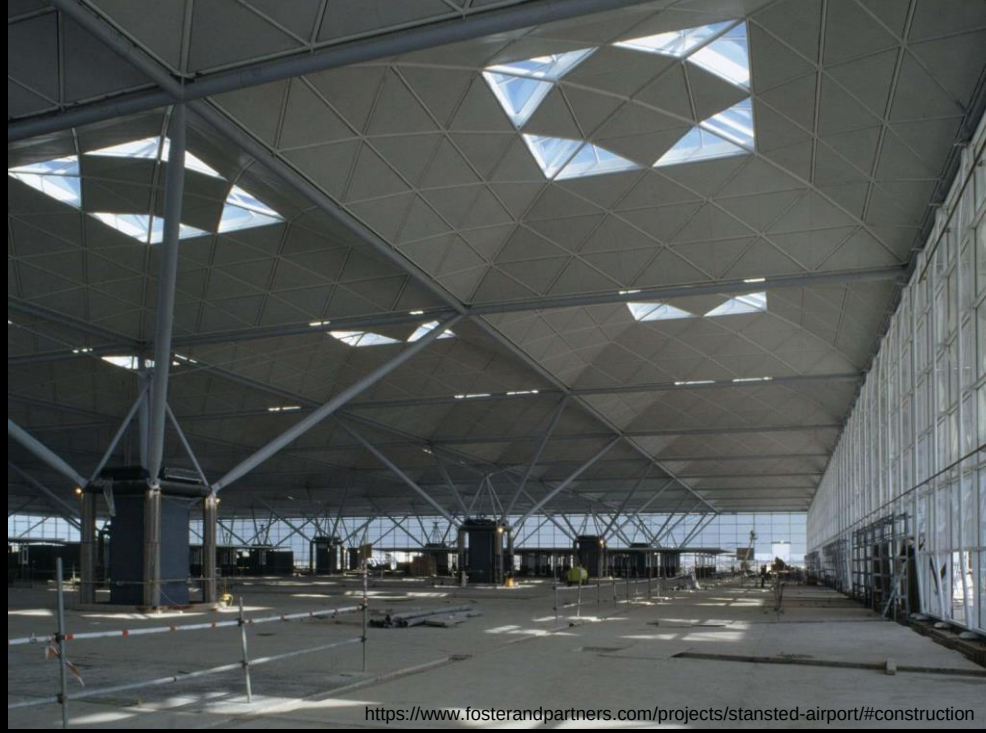
construction

Because of the UK's high-rain tendency, the roof was constructed prior to the rest of the structure in order to shield the concrete foundation curing below

https://www.fosterandpartners.com/projects/stansted-airport/#construction

construction

The method of construction further emphasizes Foster's desire to express the honesty of the structure within his design while simultaneously utilizing members for illusory effects



https://www.fosterandpartners.com/projects/stansted-airport/#construction

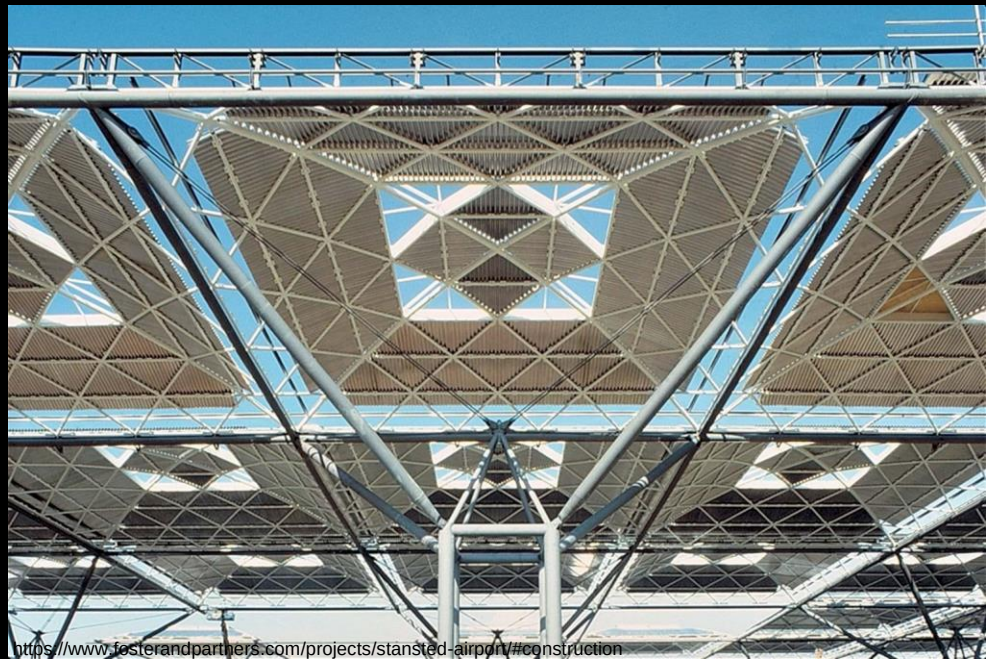
structure

structural “trees”

lightweight steel grid domed ceiling

foundation independent from columns

https://www.fosterandpartners.com/projects/stansted-airport/#development



https://www.fosterandpartners.com/projects/stansted-airport/#construction

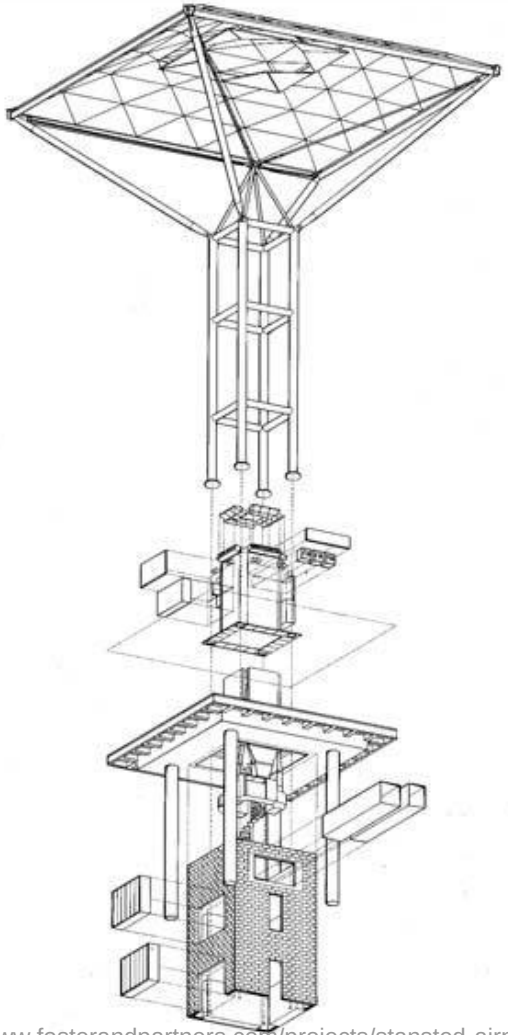
structure

structural “trees”

Four massive steel columns

Section support and cantilevered edges hold up the “floating” roof

Due to tension, the trees appear to hold the roof down rather than up



https://www.fosterandpartners.com/projects/stansted-airport/

https://www.fosterandpartners.com/projects/stansted-airport/#development

structure

domed ceiling

Trees support a square grid

Each square is infilled with a lattice steel dome

All steel members are circular in section

https://www.fosterandpartners.com/projects/stansted-airport/#development

https://www.e-architect.co.uk/london/stansted-airport-building

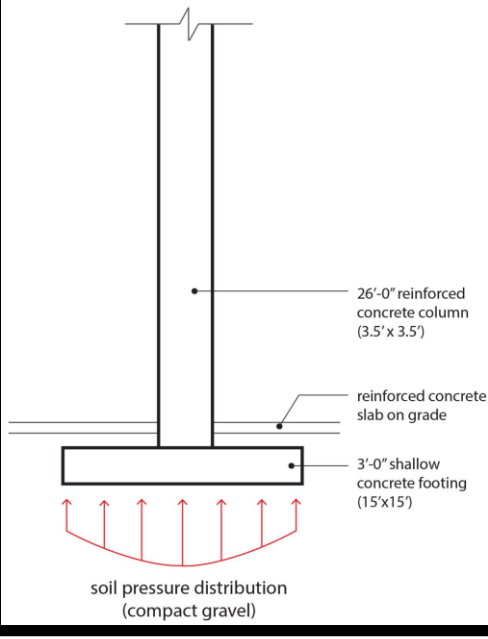
structure

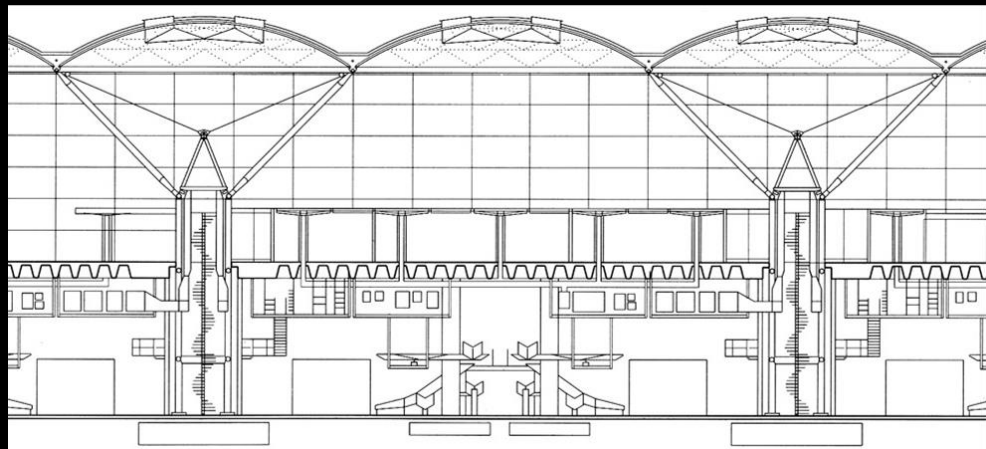
foundation

Spread concrete footings

Reinforced concrete slab on grade

Compact gravel fill





https://www.architonic.com/en/project/foster-partners-stansted-airport/5102413

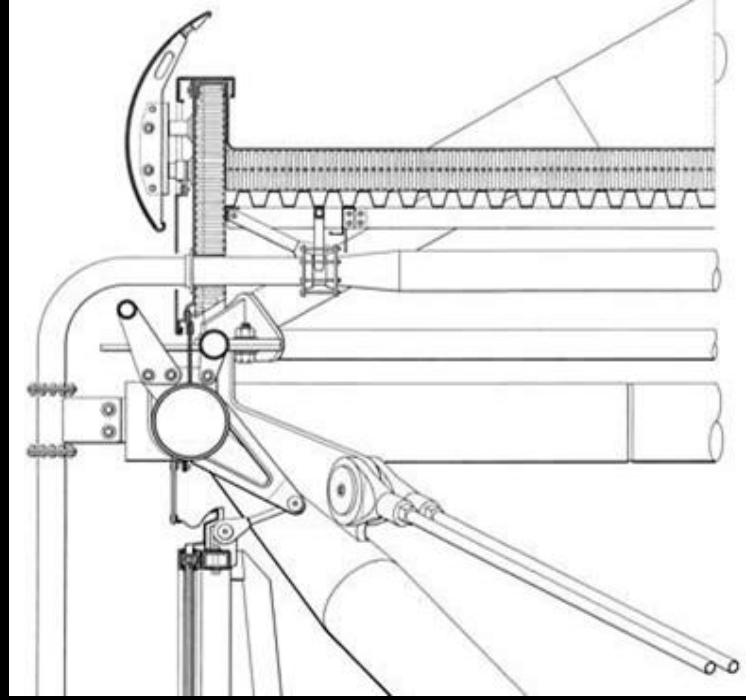
connections

Four steel columns make up the tree “trunks”, from which four branches meet the roof structure diagonally, braced by tension members attached by a single bolt to a cluster of pyramid-shaped elements at the top of the trunk. The joint has been known as the “Jesus Nut”.

https://www.e-architect.co.uk/london/stansted-airport-building

connections

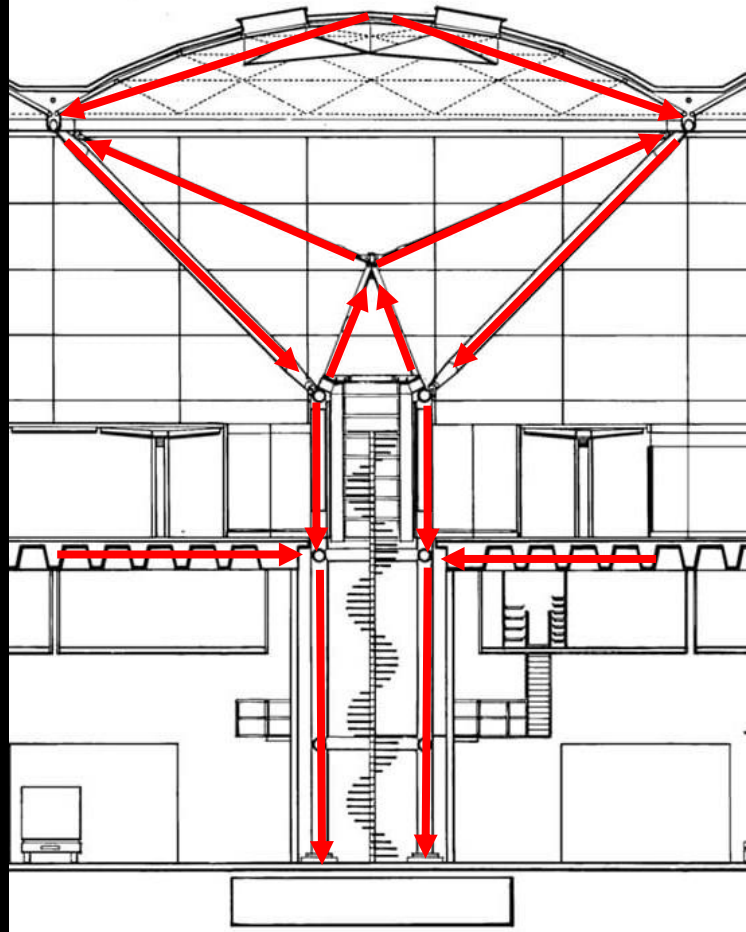
To deal with thermal expansion and deflection under wind load, a complicated hinged linkage device welded to the inside of the perimeter roof beam is free to rock up and down and side to side along a horizontal stainless steel pin at the top of the wall frame.



https://www.architectural-review.com/buildings/1951-may-how-it-was-built/8614161.article

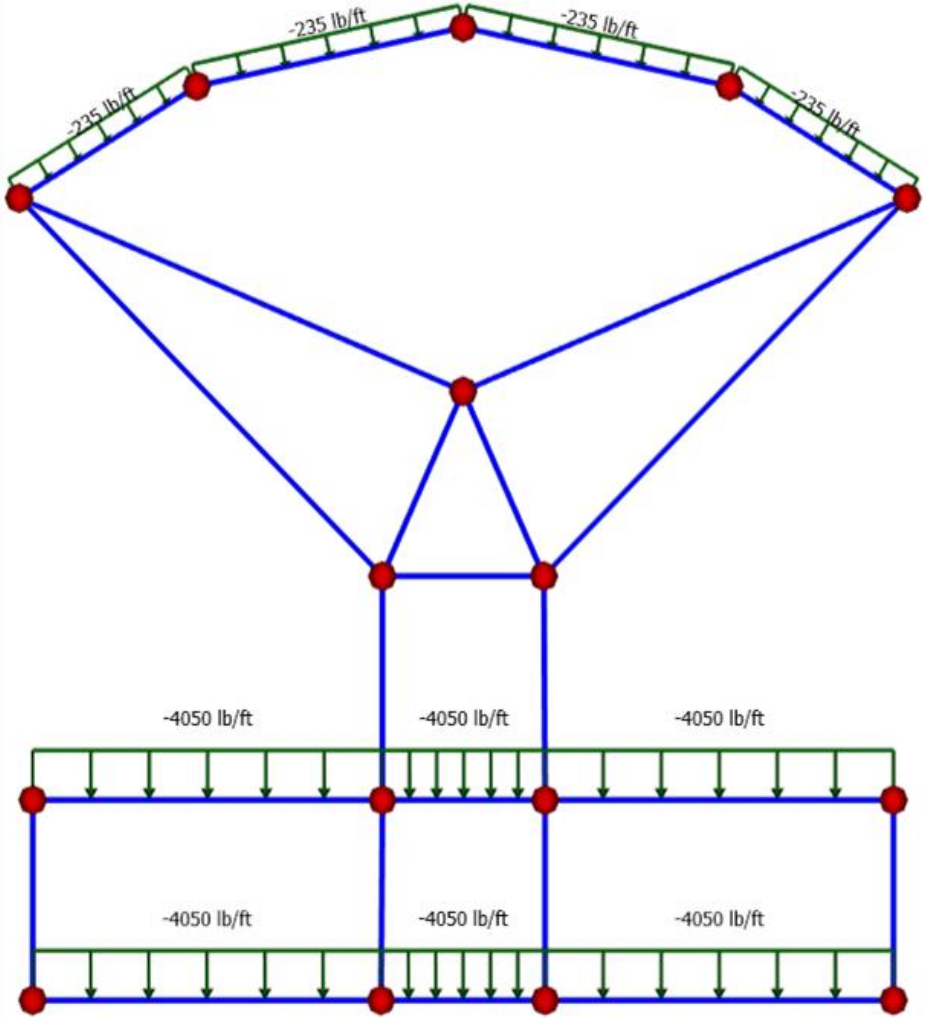
loads

- Load comes in from top
- Goes down to base
- Thrust from arch
- Uplift from tension
- Tension into base
- Waffle slab goes into column
- Goes down into foundation



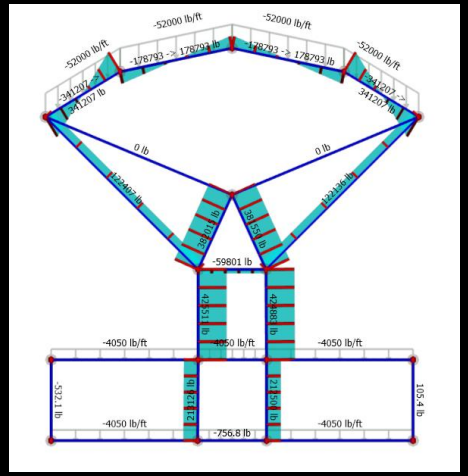
loads

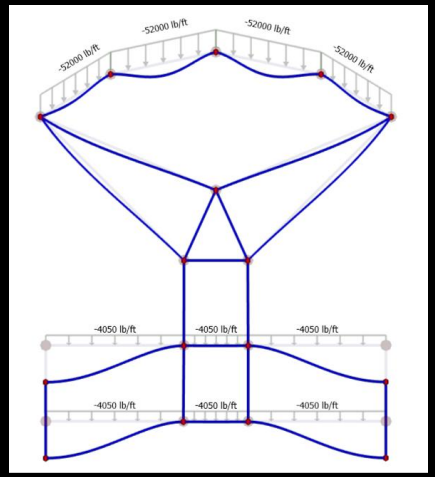
- Loading Diagram
- Using Factored Load of $1.2D+1.6L_r+(L \text{ or } .5W)$
- Occupancy Load
  - 200 lb/ft for Assembly Lobby
  - 3850 lb/ft for Dead Load
- Each tree carries 2,361,000lbs to the ground.

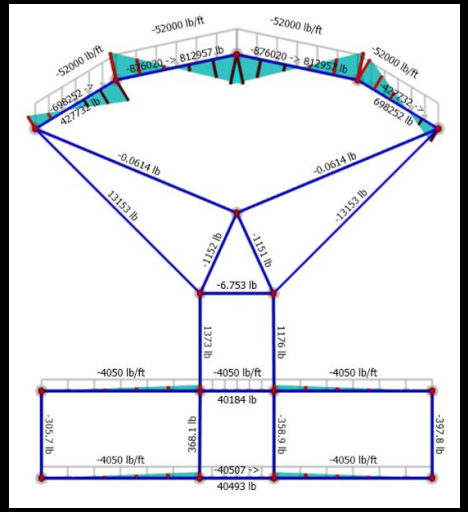


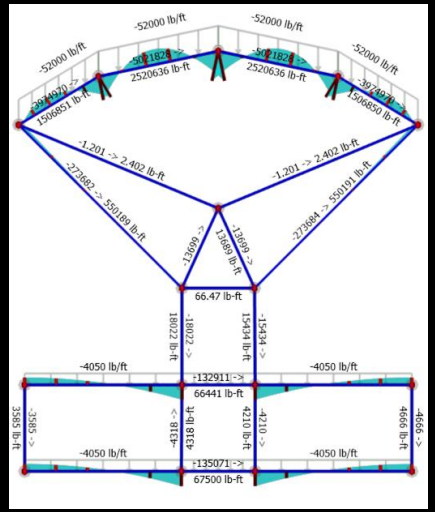
loads

- Axial Loads
  - Max 179,173lbs
- Displacement
  - Max 0.0137ft
- Shear
  - Max 867,020lbs
- Moment
  - Max 2,560,636lb-ft



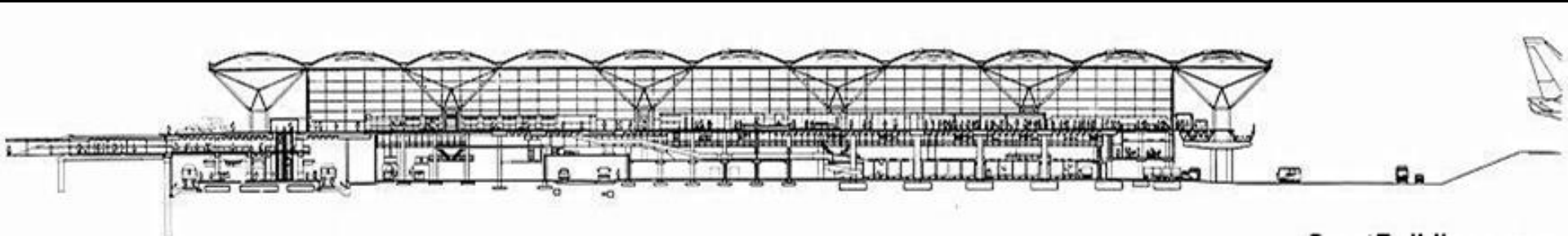






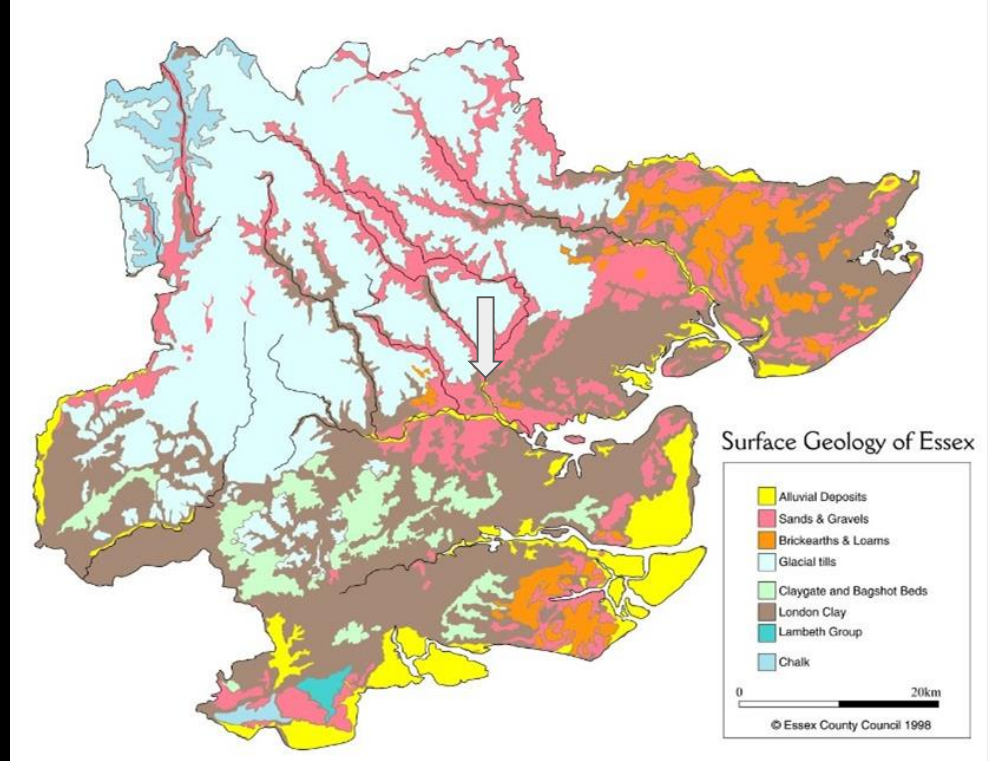
lateral systems

The lateral resisting system is made up of a series of steel cables formed in a cross bracing system. The four cables that come together in the center are pulling apart in tension. This forces that center point to want to go upward. By doing so this also is forcing the two points on the column to be in tension. This will pull the column upwards as well.



soil

- Soft alluvial and peat layer not ideal for bearing
- 1.3 million cubic meters of soil excavated
- Compact gravel fill to provide the firmness necessary to handle the foundation loads



https://www.essex.gov.uk/AnalyticsReports/CB_LCA_Essex_2002.pdf

https://lenz-enterprises.com/products/pit-run/index.html

http://www.doonesilverkerr.com/portfolio-project/stanstead-airport/