HEARST TOWER

Location: New York, New York
Architect: Foster & Partners

Victoria Adams
Austin Ash
Ashton Holliday
Lisa Milks
Jacob Richie
Frank Volpicella

introduction

- Architect:
  - Foster + Partners
- Structural Engineer
  - WSP Cantor Seinuk
- Construction Management
  - Turner Construction

- Fabricators
  - Cives Steel Fabrication and Mountain Enterprises
- New 46-Story tower completed in 2006
- Estimated Cost: $500 million
- New York City's first LEED Gold Skyscraper

background

•The **Hearst building** constructed in 1928 featured a six-story stone façade designed by Joseph Urban as the headquarters for the Hearst Corporation

Structural System

•serves as a testament to technology at the turn of the millennium and a symbol of sustainable innovation in urban construction.

Building Features

•triangular diagrid, sustainable approaches to steel construction, and the synthesis designed structure

www.tishmanspeyer.com

background

Original Function

•Hearst requested in 1928 needed a high quality office environment which he expected would continually serve employees in the future

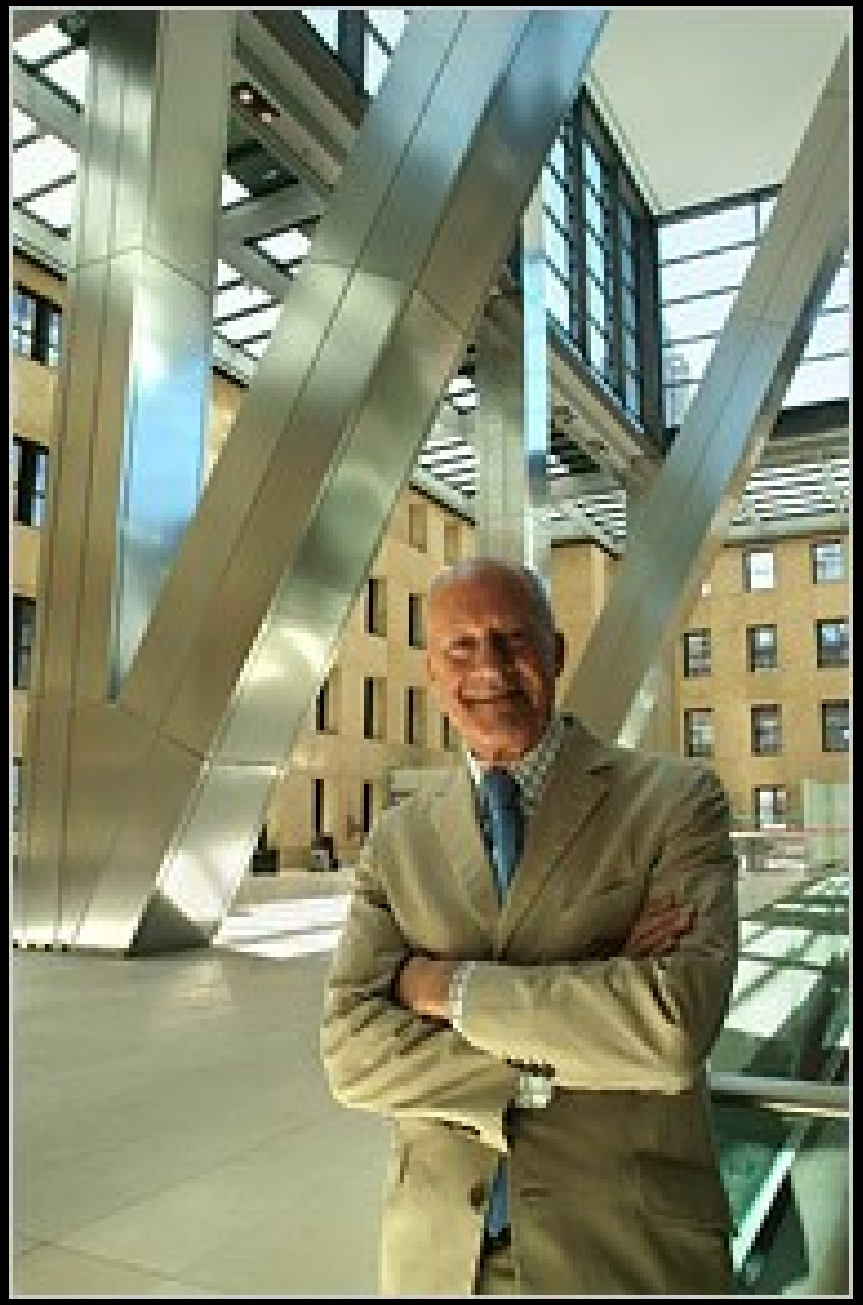
•The existing six-story façade retains the cast stone construction with fluted allegorical columns

www.worldarchitecturenews.com

www.worldarchitecturenews.com

background

This building was initially intended to serve as the base for a skyscraper expansion in the 1920s, the Great Depression financially halted construction for over 80 years. Being the tallest skyscraper erected after 9/11, The new Hearst Tower had to serve as a powerful symbol of business progression in a post-911 world



http://graphics8.nytimes.com/images/2006/06/06/arts/norm.190.jpg

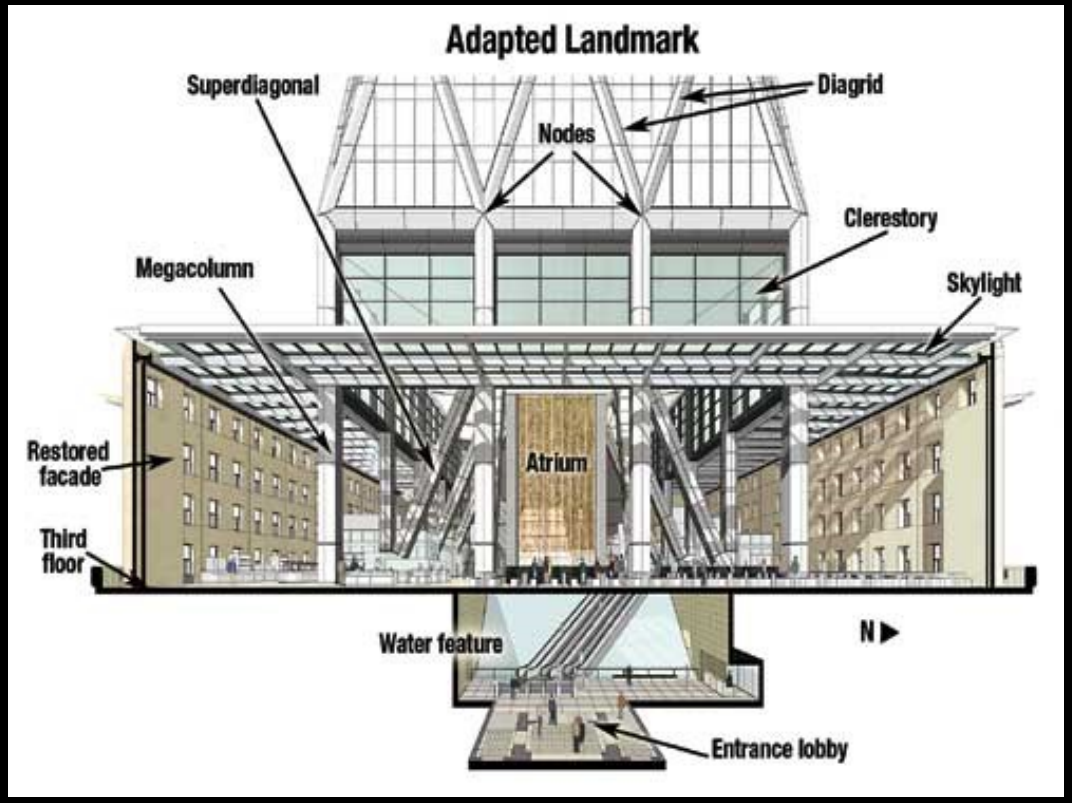
foundation

Spread Footings and Caissons

• Considering the sub-grade rock varied thirty feet in elevation, half of the tower rests on spread footings while the rest is supported by caissons embedded into the rock itself

Footprint

• The tower has a footprint of 160 feet by 120 feet



www.penrconstruction.com

preservation

Vertical Supports

•The existing supporting steel columns and spandrel beams provide full vertical support for the facades

Lateral Stability

•The engineers needed to provide lateral stability and address new seismic requirements in the New York City building code

•An additional grid of vertical and horizontal framing elements were designed behind the facades

https://www.flickr.com/photos/glemak/142359781/in/pool-hearst_tower

https://www.flickr.com/photos/glemak/126724551/in/pool-hearst_tower

preservation

Remaining Structure

•Norman Foster architects chose to retain only the façade of the old structure, while allocating the outer bay as retail space up to the third floor

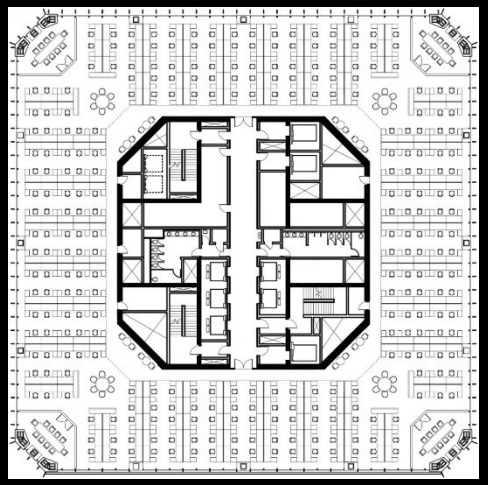
•The steel frame that had supported the original structure has been removed so that only one bay remains to stabilize the limestone façade

http://greendatabase.files.wordpress.com/2009/06/fp129064fp-hearst-lobup1.jpg

general structure

Column Free Span

• The building employs a hybrid structure of concrete and steel one-way span that allows a 40-foot interior column free span

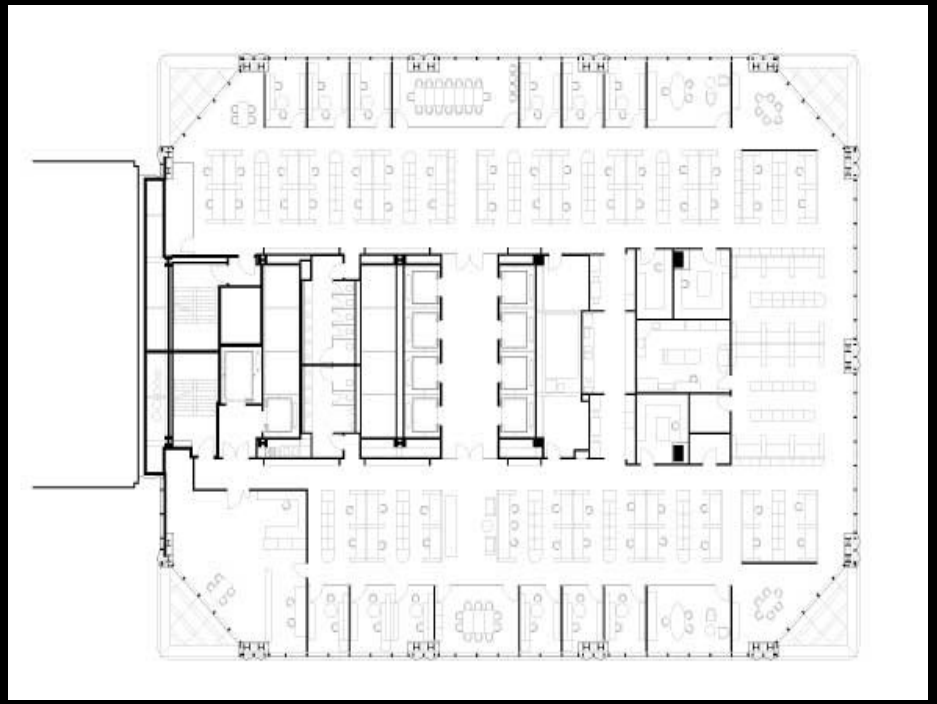


http://ad009cdnb.archdaily.net

• The exterior structural system is wrapped by a pewter-like linen finish from the Swedish fabricators Ovako

Area

•The typical office floors are 16,000 square feet in area with 9’ 6” ceiling

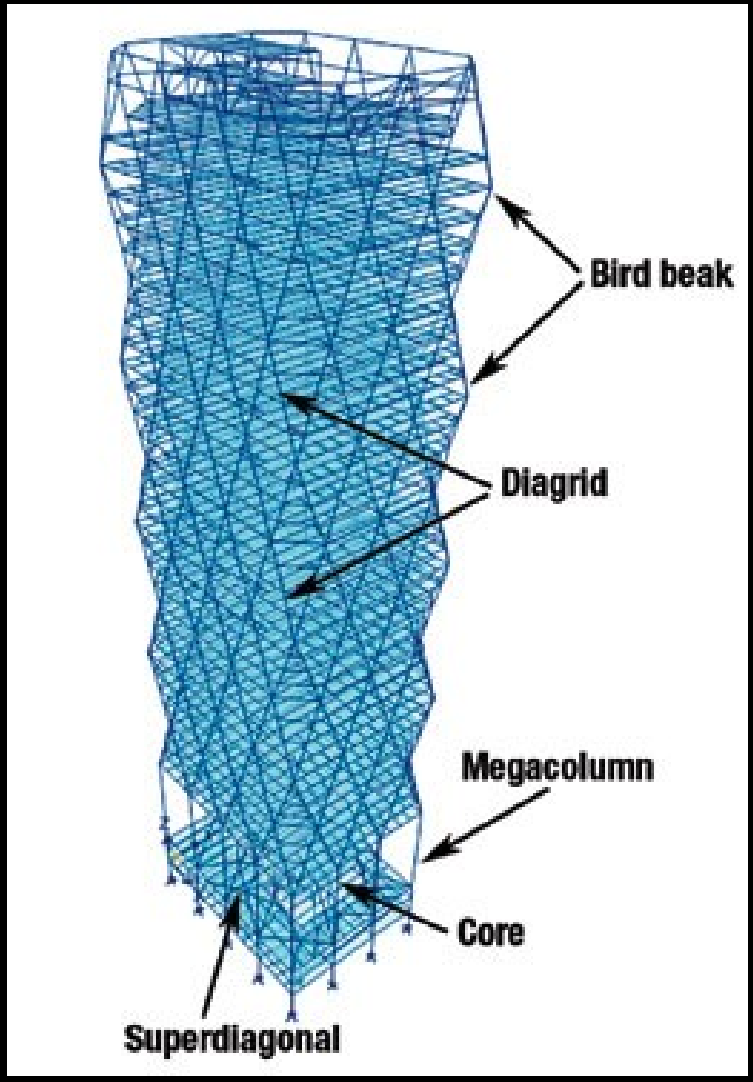


http://www.fosterandpartners.com

diagrid

Steel Tubes
Diamond web is composed of thirty-four stories of steel tubes arranged into a diagrid eight tiers high

•To provide stability under wind and seismic loads the diagonal elements are placed within a primary orthogonal structural framework

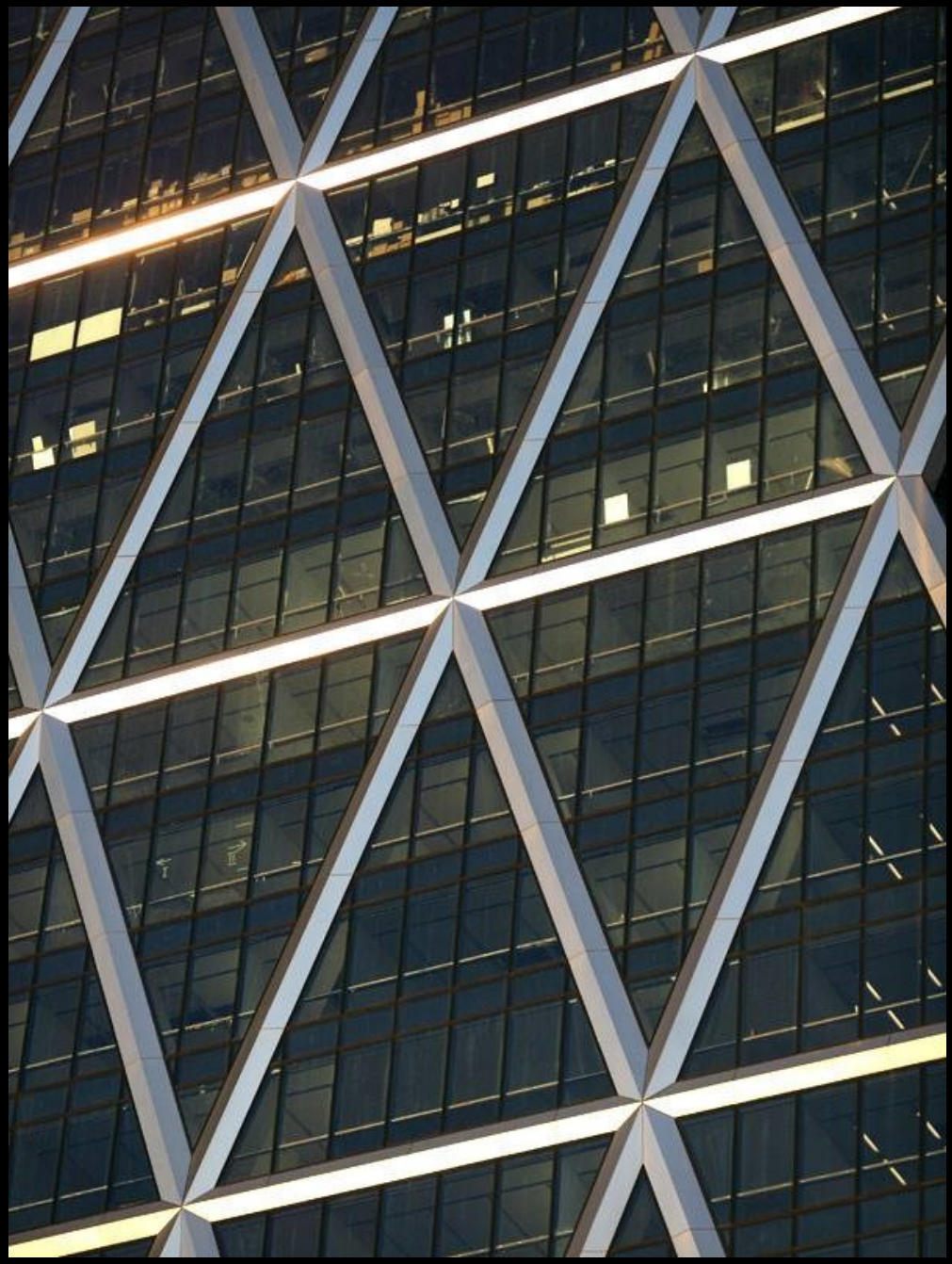


http://www.fosterandpartners.com/design-services/sustainability/case-studies/materials-waste/

diagrid

Large Open Floor
Originated from the off center elevator core to create larger open floor plates with an eastern view for editorial staff

Bird's Mouth
As the grid approaches a 45 degree angle at the corners of the building, the structure forms what is referred to as a "bird's mouth" as the frame opens up



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diagrid

Prefab Wideflange Steel
•Cives Steel used prefabricated wide-flange steel sections to form sophisticated six-ton node connectors

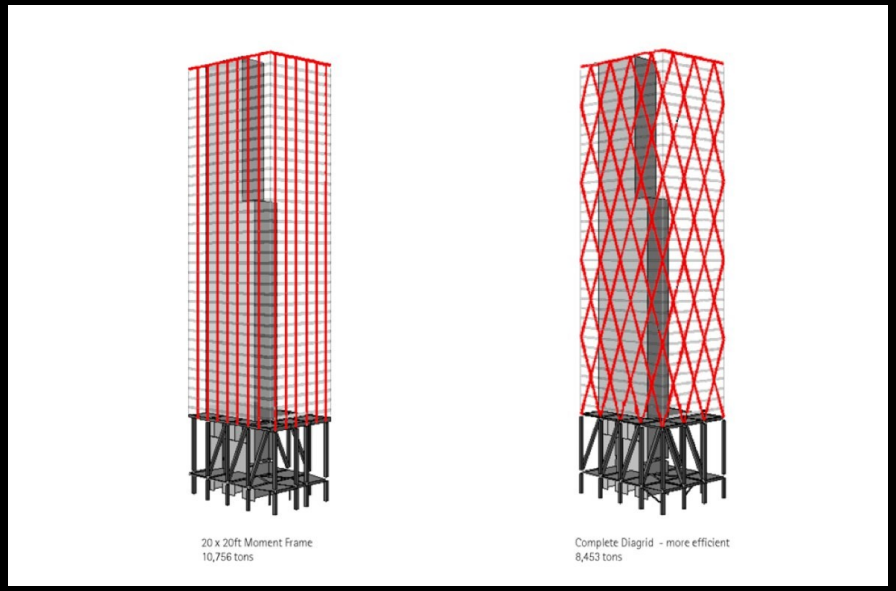
•At these intricate nodes, six different 12-inch, H-column type diagrid elements were bolted together

archdaily.net/wp-content/uploads/2012/02/1328283648-hearst10.jpg

diagrid

Stiffness
The required stiffness could not deviate from a typical 5/8 inch limitation nor 1/8 inch in certain locations

Columns
•The only two columns on each floor are necessary as the displaced elevator core lengthened the open floor plates in the east and west direction



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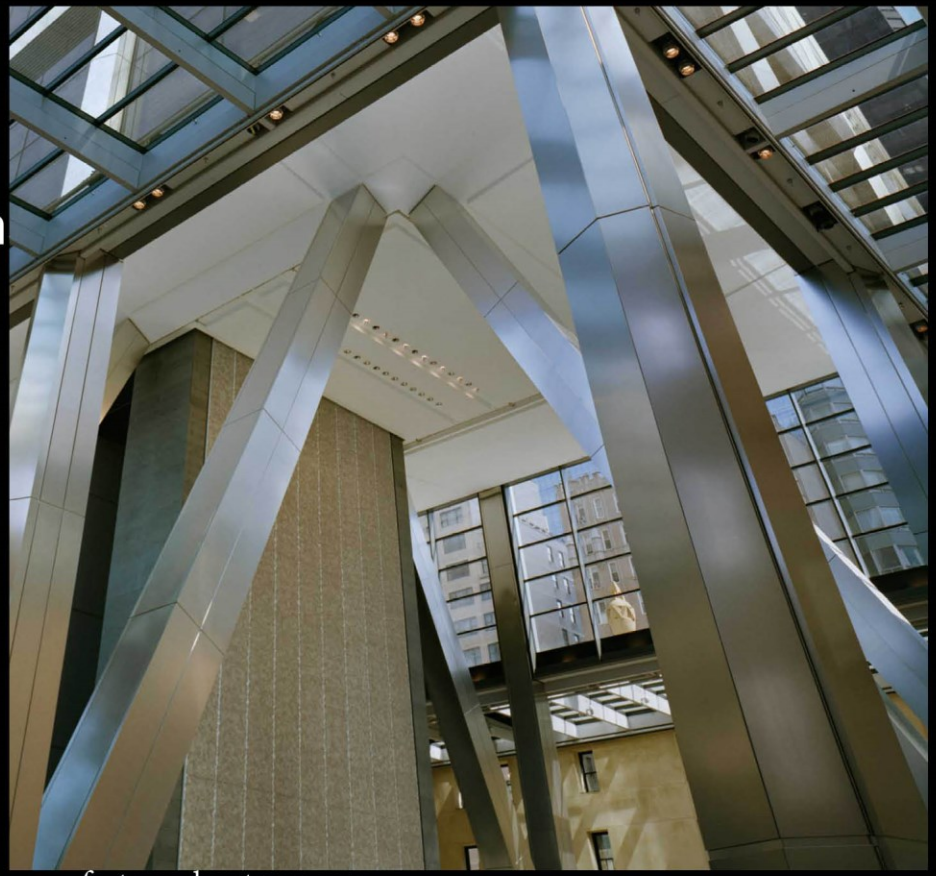
columns, mega-columns, + mega-diagonals

Mega-Columns:

location: building's perimeter
weight: 30 tons
dimension: 44" square section
material: 4" rolled steel plates



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columns, mega-columns, + mega-diagonals

Columns:

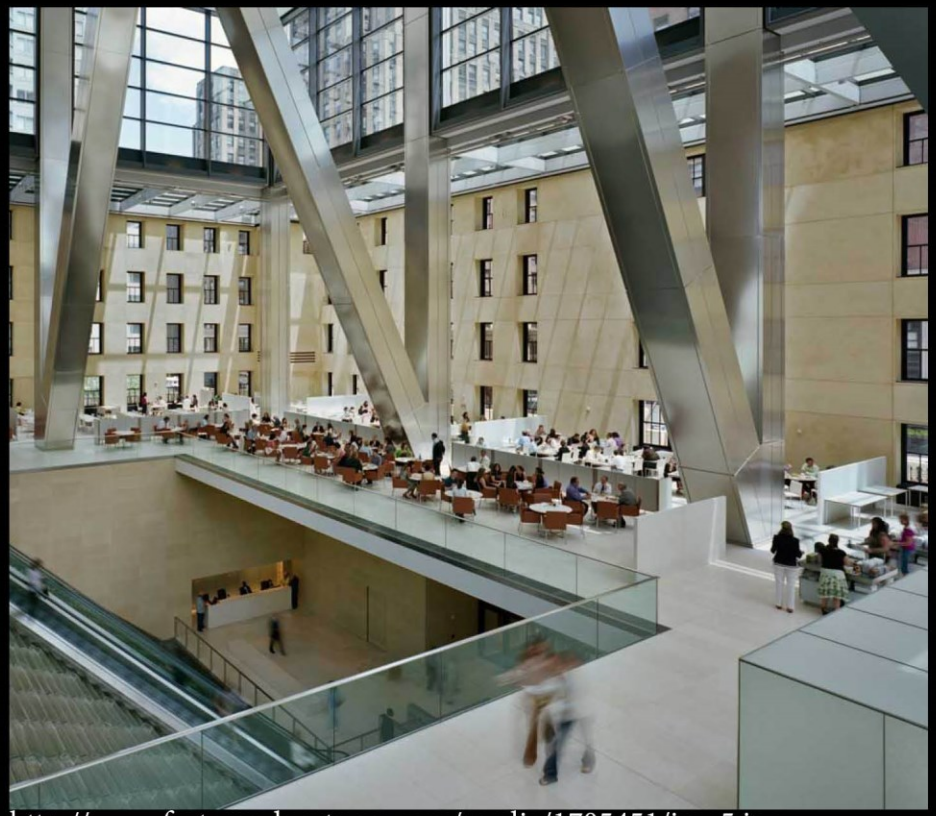
location: existing columns
kept lateral support
material: grade 65 steel

untappedcities.com

columns, mega-columns, + mega-diagonals

Mega-Diagonals (Y joints)**:**

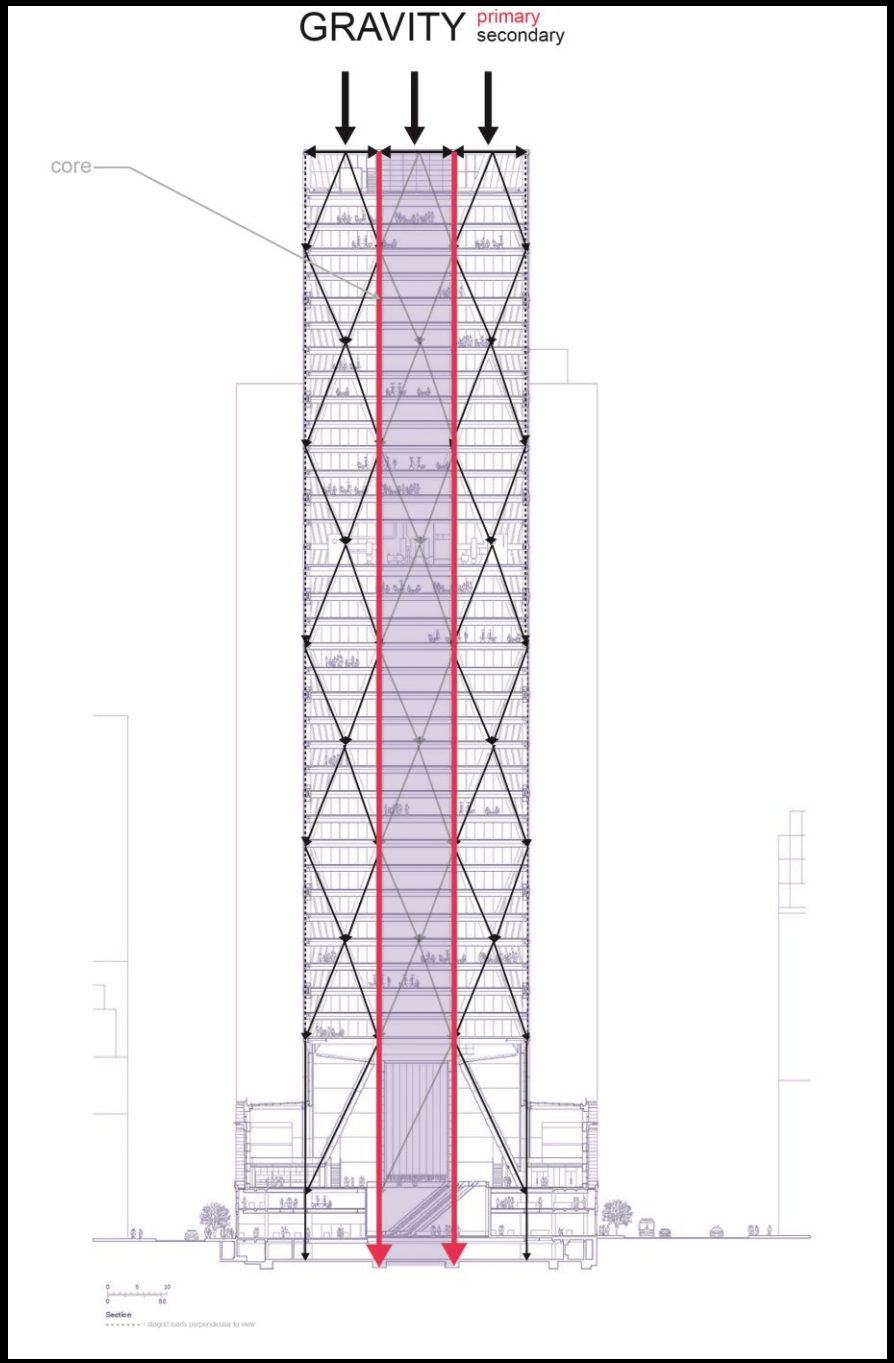
location: base of tower
weight: 24 tons
description: slope inward 89’



http://www.fosterandpartners.com/media/1705451/img5.jpg

load tracing

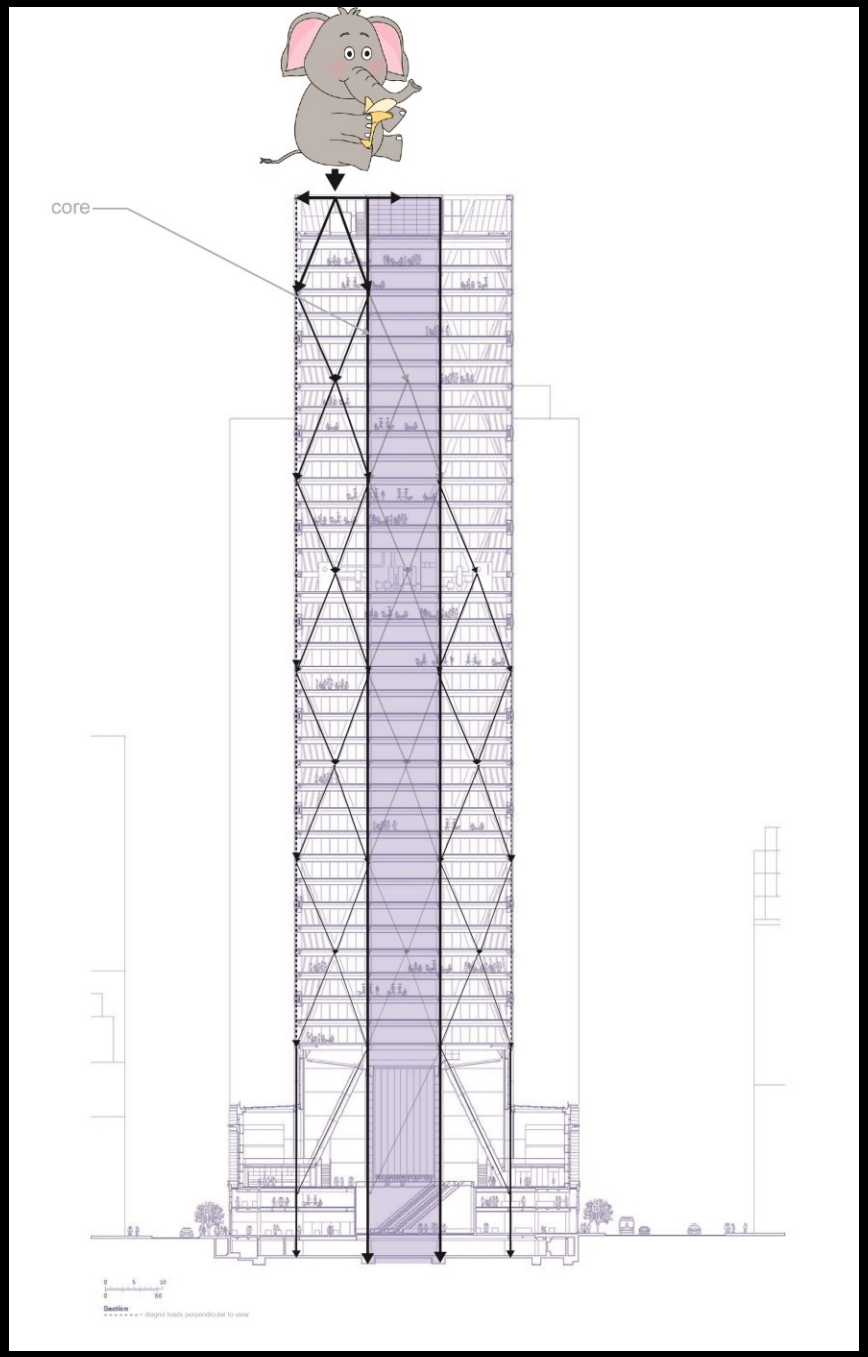
Gravity
In gravity loads, the core represents the primary structural system and the diagrid plays a secondary role. The loads are transferred through these systems down to the caisson and spread footings to the ground.



load tracing

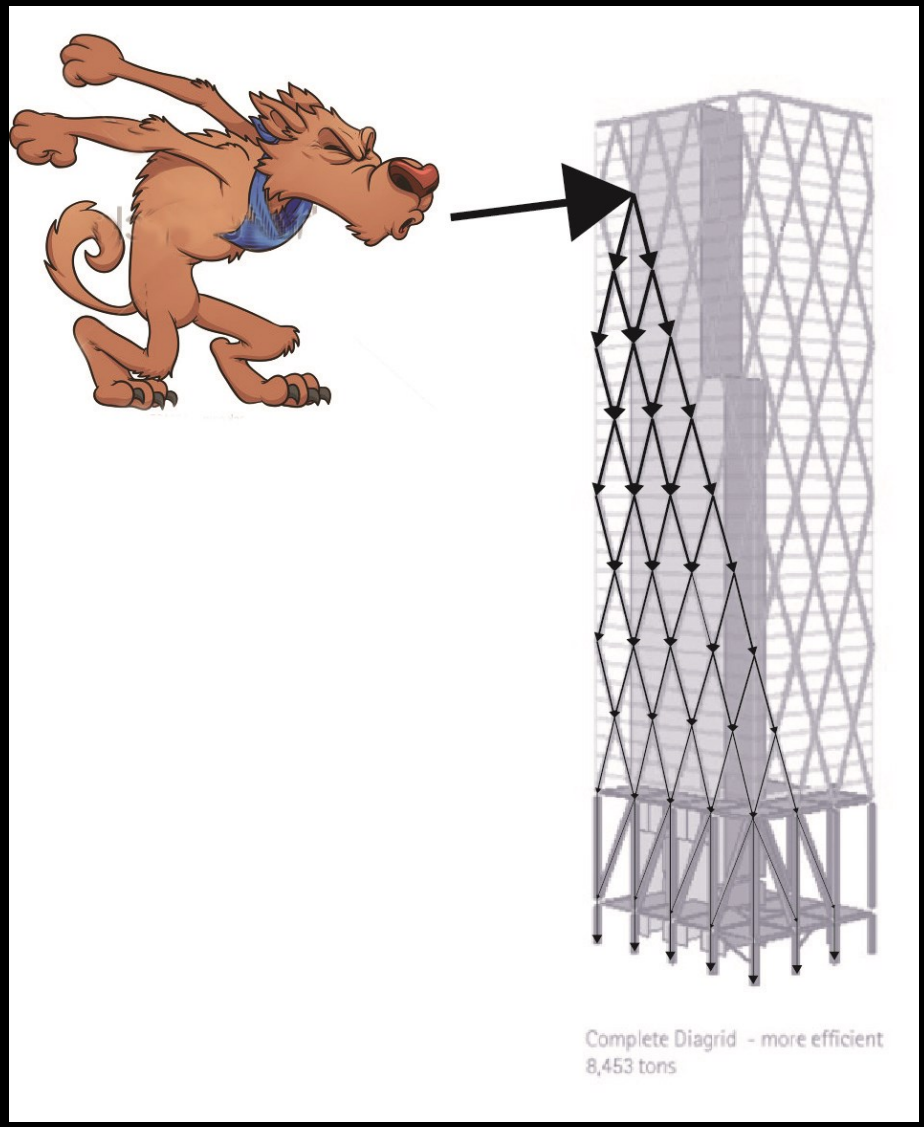
Point
The elephant causes a point load on top of the Hearst Tower. Because loads are lazy, the loads travel the shortest distance and are accordingly dispersed to the diagrids as well as the core.

The live load is transferred through the diagrid system, the primary system, down to the mega columns and mega diagonals, and down the caisson and spread footings to the ground. The load is also transferred through the core and down to the caisson and spread footings as a secondary system.



load tracing

Wind
The big bad wolf blows a gust of wind towards the Heast Tower. The wind is trasfered through the diagrid system, down to the mega columns and mega diagonals, and down the caisson and spread footings to the ground. The diagrid represents the primary structural, and the diaphragm floor plates absorb some of the load and transfer it to the core as the secondary structure.



multiframe model

3D model consists of 3 different sizes of members.

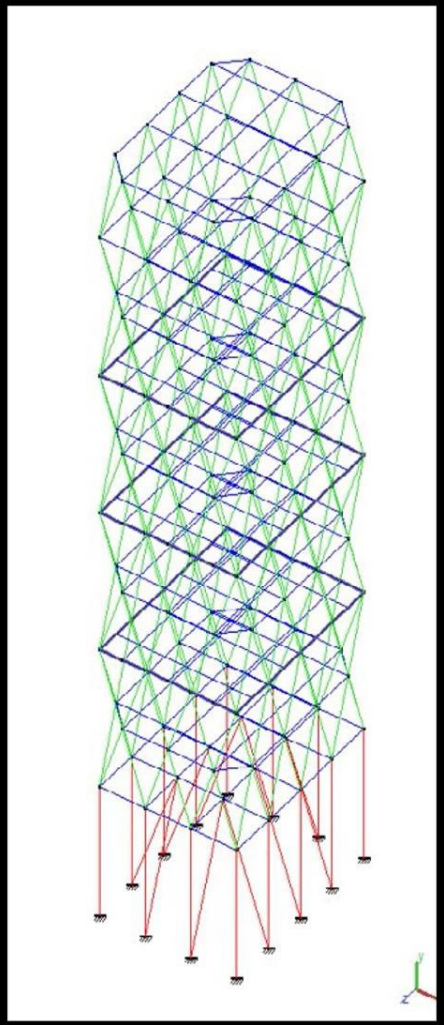
-Columns, Mega-Columns and Mega-Diagonals are sized as the largest members.

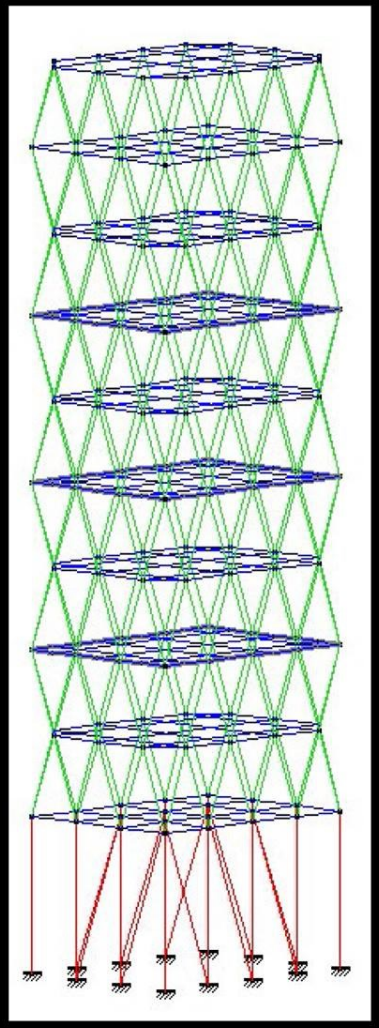
-Floor members are intermediately sized.

-Exterior diagrid members are sized as the smallest members.

All joints are made rigid with fixed base connections.

Inner nodes are created within the floorplates.

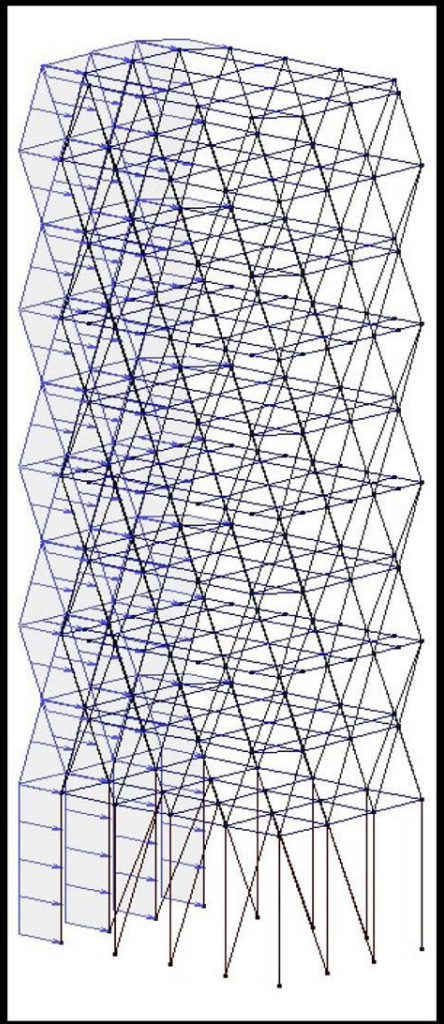


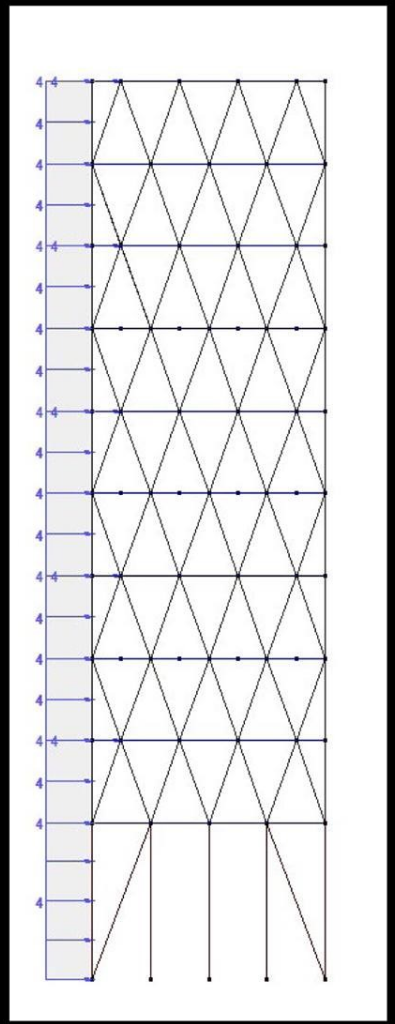


multiframe model (load)

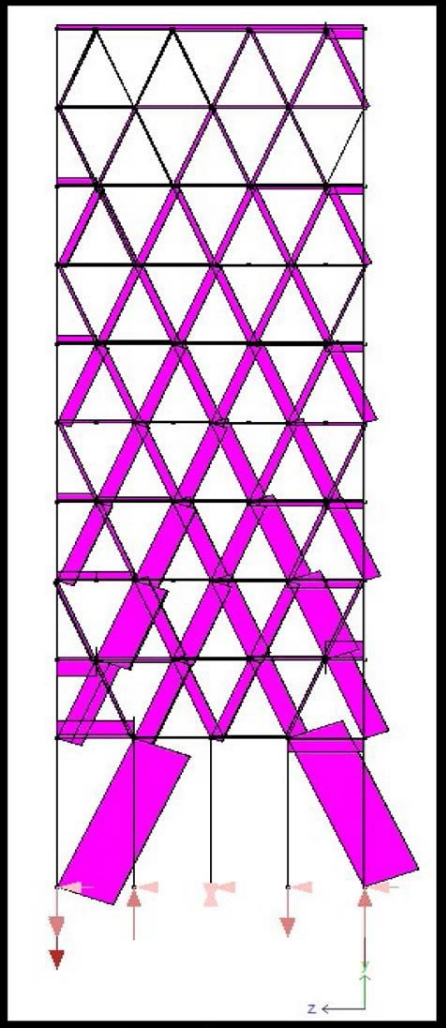
An exterior lateral wind load of 4k is applied to the exterior diagrid system.

The wind load will be transferred from the diagrid system through the floor diaphrams to the core.

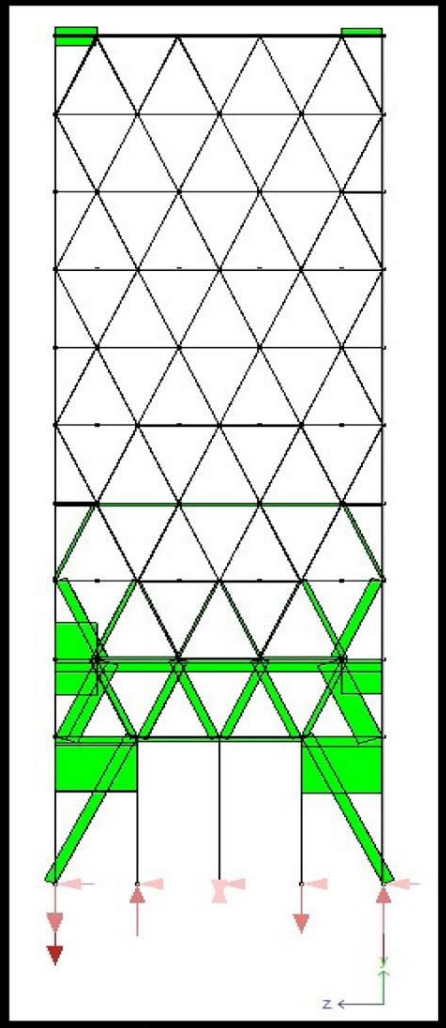




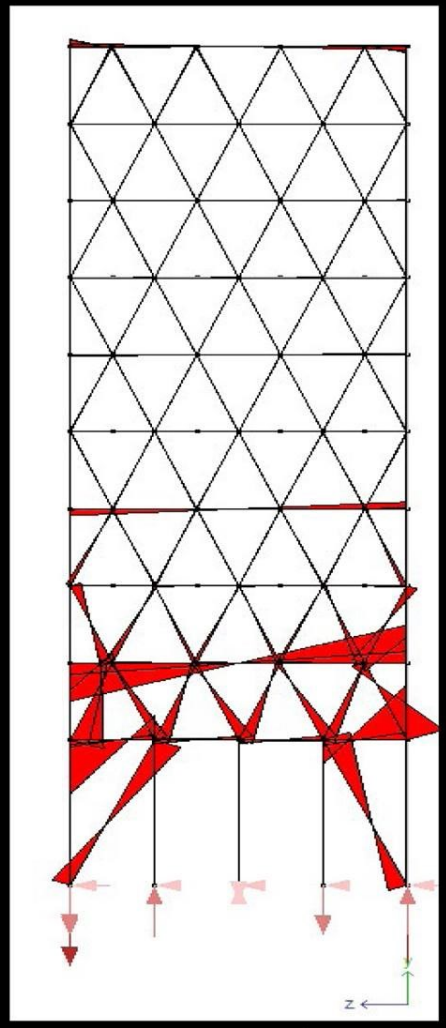
multiframe model (results)



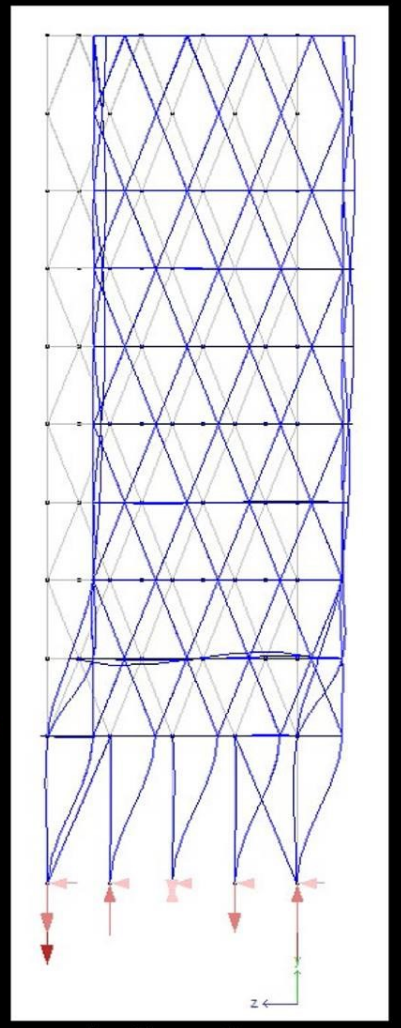
torsion



shear



moment



deflection

connection design

Corner Nodes:

Transfer loads in 3 directions

Interior Nodes:

Transfer loads in two planar directions

https://newyorksightseeingtours.files.wordpress.com/2012/04/hearstbuilding.jpg

flickr.com

connection design

Connect diagrid columns and spandrel beams
84 interal nodes made from 10” thick steel plates
16 bird’s mouth nodes
diagonal columns are connected to nodes by “paddle plates”
columns are bolted onto paddle plates through slip-critical bolts
(allow for fit-up tolerance in field construction)

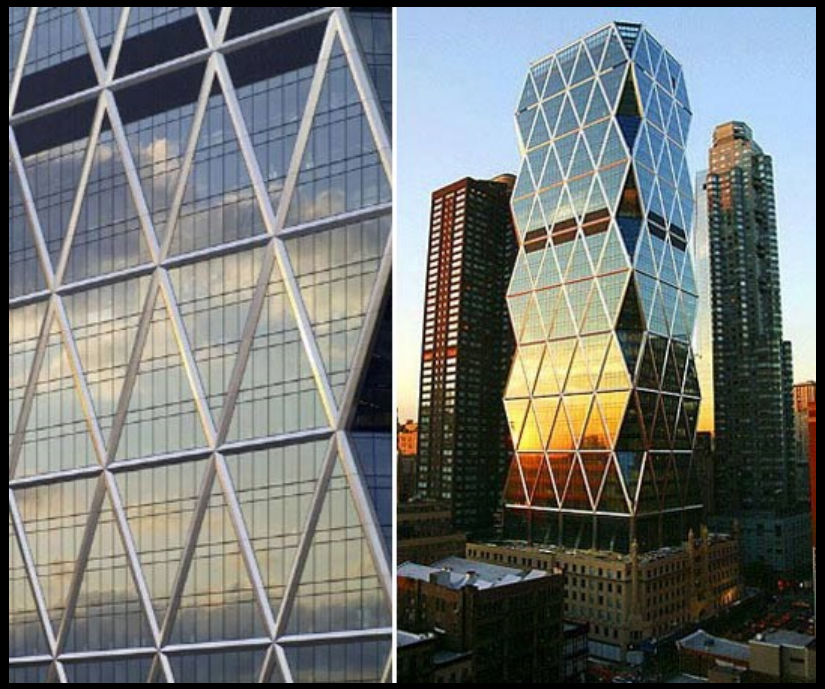
http://ominy.org/images/remote/http_www.siny.org/i/projects/ht9.jpg

curtain wall + cladding

There are as many as 30 different window configurations with double pane glass that has low E coating

To endure the event of a natural or man-made disaster, lamination on the inner pane is twice as thick compared to typical curtain walls

Between the columns a glass mullion type system was used



http://www.inhabitat.com/wp-content/uploads/hearst-tower-comp.jpg

sustainability

Hearst Tower is one of New York's first LEED Gold commercial office buildings

The efficient structural diagrid system uses 12,000 tons of steel, twenty percent less steel than a typical steel skyscraper as it eliminates the need for vertical exterior supports

This system is composed of eighty-five percent recycled steel

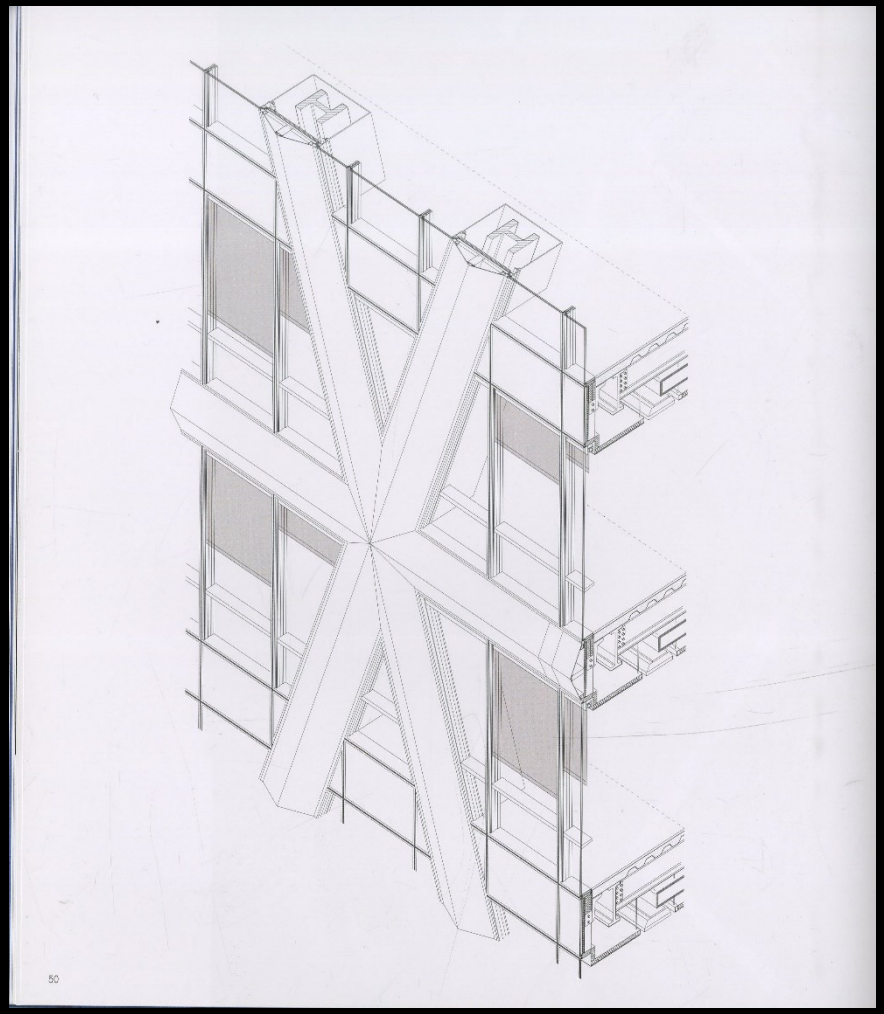
The basement houses a 14,000 gallon reservoir that collects rainfall which helps facilitate water features and air handling units throughout the tower

http://buildingdb.ctbuh.org/class-image.php/userpics/10005/?width=1000&height=800&image=/images/albums/userpics/10005/Hearst2a.jpg

curtain wall + cladding

As Cives was involved in construction of the cladding, their shared computer generated models between the curtain wall suppliers combined the information to find the discrepancies

“By expressing the structure in a sculptural way and casing it in reflective stainless steel, it becomes the identity of the tower” - Foster



httpkrg2uf.files.wordpress.com201111details001-e1320775854479.jpg

construction

Before construction began, a 3-D computer model was created to estimate the margin of flexure and deflection the structure would exhibit under various construction stages

popularmechanics.com

Cives designated two of their plants to fabricate the steel for the project so they could alternate phases.

The installation of the cladding system required a custom double-tier monorail scaffold system that was able to move both vertically and laterally.

http://www.popularmechanics.com/cm/popularmechanics/images/qJ/pmx0406Tower014_large.jpg

construction

The project was split up into six phases and two detailers.