

LINKED HYBRID BY STEVEN HOLL



LINKED HYBRID CASE STUDY

OVERVIEW

- Linked Hybrid Project is a mixed use development in Beijing, China, that consists of eight 60m tall residential towers and a 35m tall hotel structure interconnected by elevated public bridges.
- The interconnecting bridges contain a swimming pool, café, fitness room, art galleries, and other services. The development also has a film archive (cinematheque), a kindergarten, parks, and other attractions.
- Built in 2003-2009
- Architect- Steven Holl Architects & Capital Group
- Engineer- Guy Nordenson and Associates & CABR
- Client- Modern Group
- Location- Beijing, Republic of China



LINKED HYBRID CASE STUDY

BUILDING INFO

- 9 (8 Apartment towers + 1 Hotel tower) Concrete braced frame towers with cantilevered floors at higher levels, constructed using steel framing
- Concrete floor slabs are equipped with radiant heating & cooling systems
- Apartments towers -14 to 21 stories and are connected by 1 and 2 story bridges
- 8 Connecting Steel bridges (Sky Loop) serve as circulation while allowing space for cafes, retail, galleries etc.
- 2 level underground parking garage
- Green Roof open to the public
- Grass covered pavillion along the building perimeter houses a montessori school and kindergarten
- 2.4 million sq. foot (220,000 sq. Meters) development
- Located 15 minutes from a subway station



Introduction

Design Concept

Building Components

Foundation

Analysis

LINKED HYBRID CASE STUDY

ARCHITECT INFO – Steven Holl Architects

- Steven Holl is an American Architect Born – December 9th, 1947

Education

- Graduated from University of Washington and enrolled for architecture studies in Rome (1970).
- In 1976, He attended graduate school at the Architectural Association School of Architecture, London

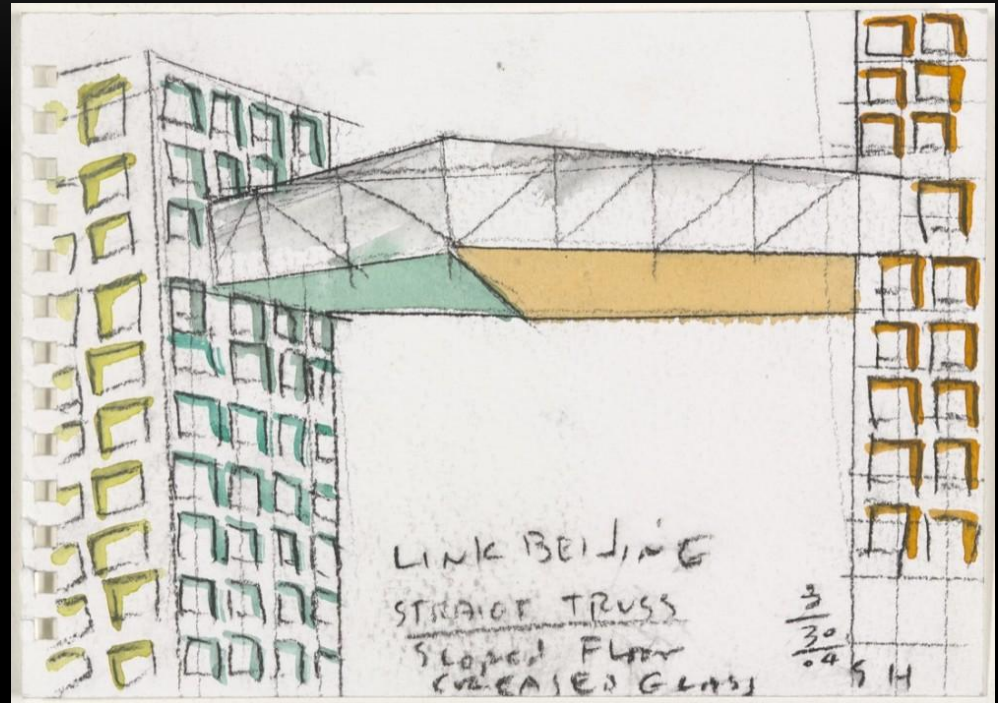
Major Projects

- Kiasma Contemporary Art Museum. Helsinki, Finland
- Simmons Hall. MIT, Massachusetts
- Addition to Nelson Atkins Museum of Art. Kansas city, Missouri
- Linked Hybrid Mixed-Use Complex. Beijing, China



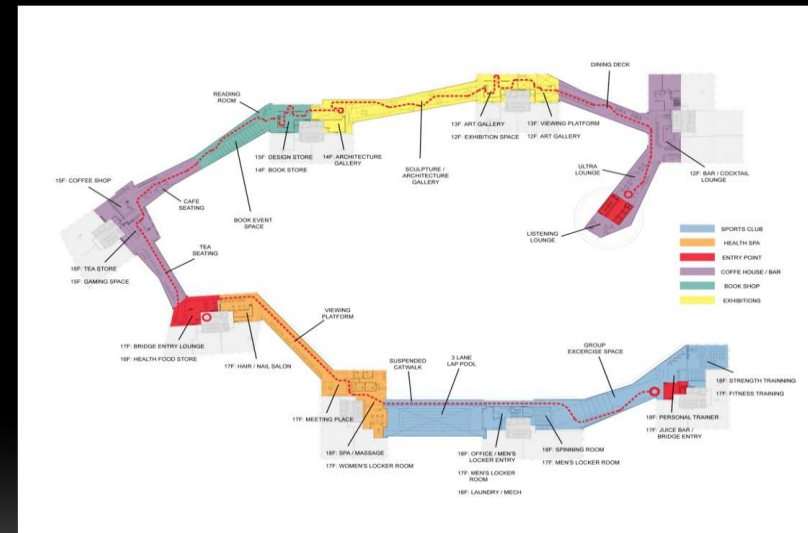
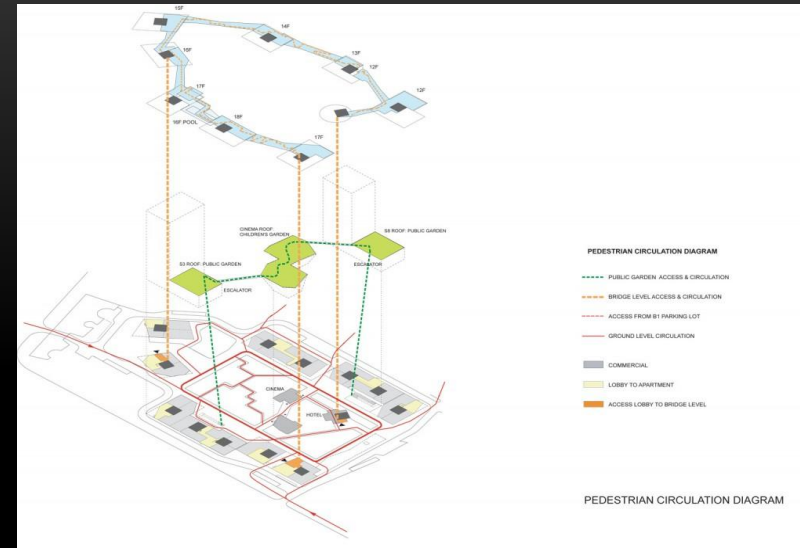
DESIGN CONCEPT

- Pedestrian-oriented Linked Hybrid complex
- Public space (vary from commercial, residential, and educational to recreational.)
- Private urban development in China
- Porous urban space
- Because of the many passages through the project, this project called "open city within a city"



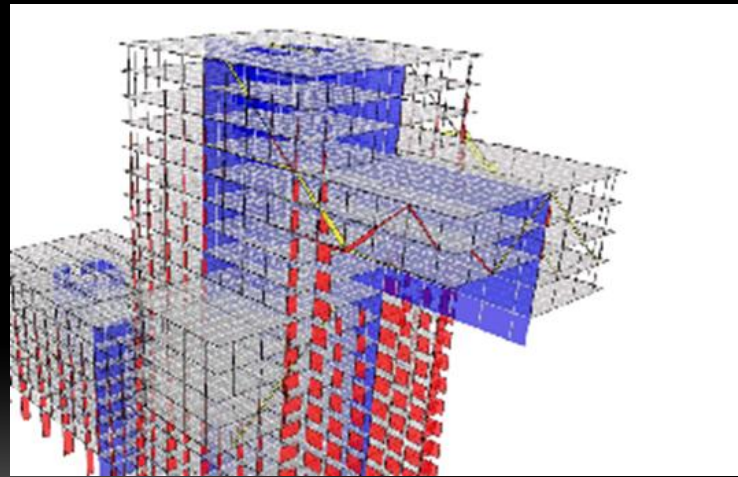
BUILDING LAYOUT

- Open passages on the ground level surrounded by shops
- There are some roof gardens on the intermediate
- At the top of the residential towers, these roof gardens are connected to the penthouses
- There are a number of sky-bridges from 12th to 18th floor
- The largest green residential projects in the world



BUILDING COMPONENTS-TOWERS

- Towers have a central core of cast-in-place concrete shear walls
- Four separate shear walls radiate off the core (a cross pattern), separating it into four sections while forming “party” shear walls for each unit
- Floors are cast-in-place beamless slabs with one large column per unit
- 900 mm deep perimeter moment-resisting frame consisting of beams and columns of cast-in-place concrete including concrete encased diagonals



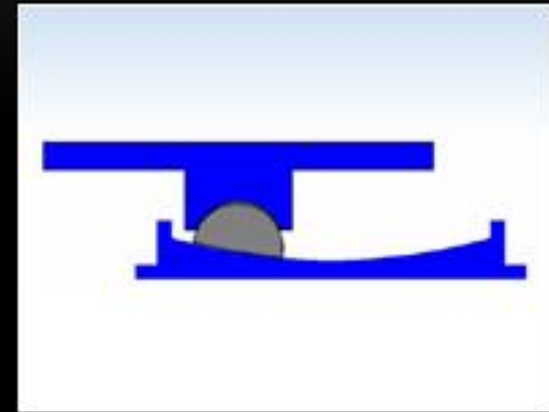
BUILDING COMPONENTS-SKY-BRIDGES

- Glazed bridges span 20m to 60m and are composed of steel units of parallel trusses –a hybrid of Vierendeel and Pratt trusses
- Top and bottom chords are composed of wide flange steel shapes with staggered vertical built-up steel members and diagonal members.
- The trusses were also designed with a Vierendeel backbone that moment connected the vertical and horizontal members to one another while providing redundancy
- Wide flange steel beams support the metal deck and concrete floor system
- The diagonal tension rod members have solid, cylindrical shapes, but required large connections between gusset plates and nodes of the columns or beams.



BUILDING COMPONENTS-SEISMIC

- Rollers and friction pendulum bearings on each side of the bridges allow them to move independently of the towers
- This separation protects the bridges from the sway in the towers and the towers from movement within the bridges
- The friction pendulum isolators are designed to a particular period by simply altering the radius of the isolator, independent of the mass and the stiffness of the bridge.
- <http://www.earthquakeprotection.com/video/TripleFrictionPendulumBearingHighSpeedTest.wmv>
- http://www.earthquakeprotection.com/pop_up_bearing_works291007.html



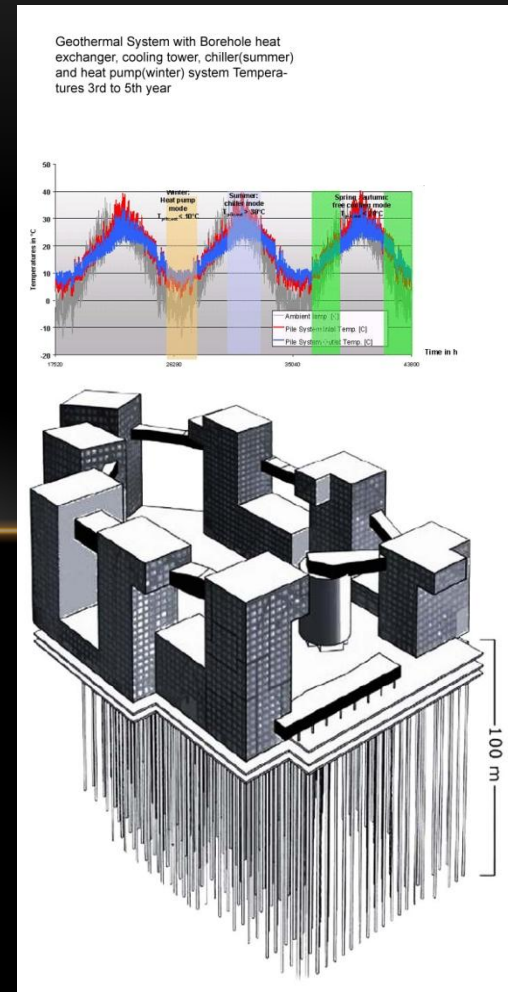
FOUNDATION AND SOILS

- Foundation System consisting of
 - Cast in place concrete retaining walls and piles
- Two Phase China Earthquake Design
 - 1st Phase
 - To design the structure so there is no to slight damage to the structural members during a minor quake.
 - 2nd Phase
 - To design the structure so that the structure would be repairable if subjected to greater concentrated earthquakes.

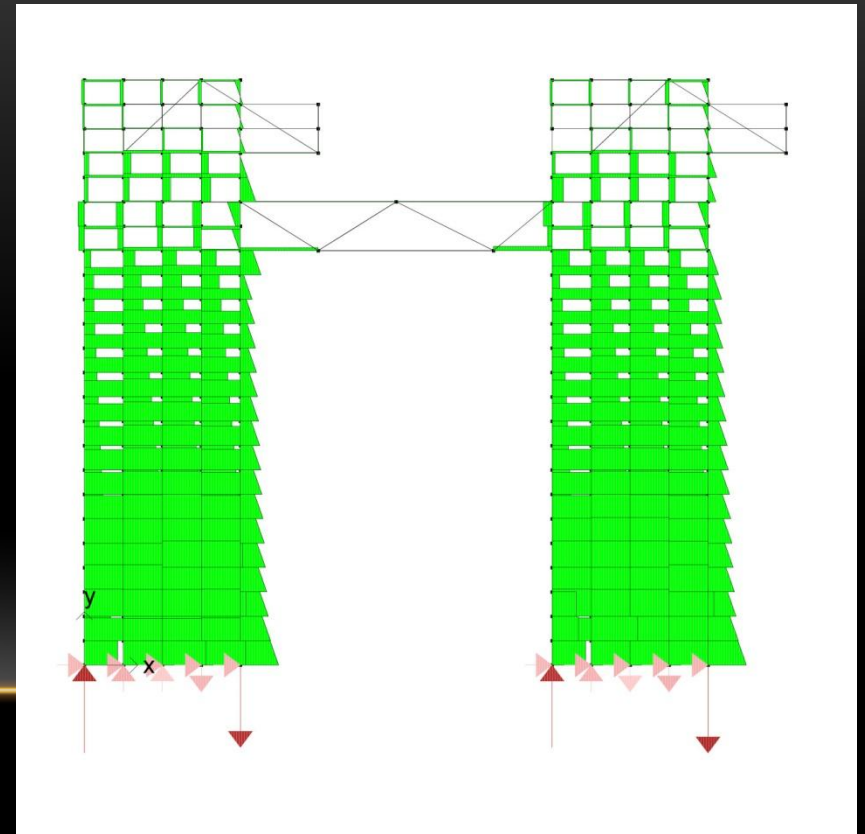
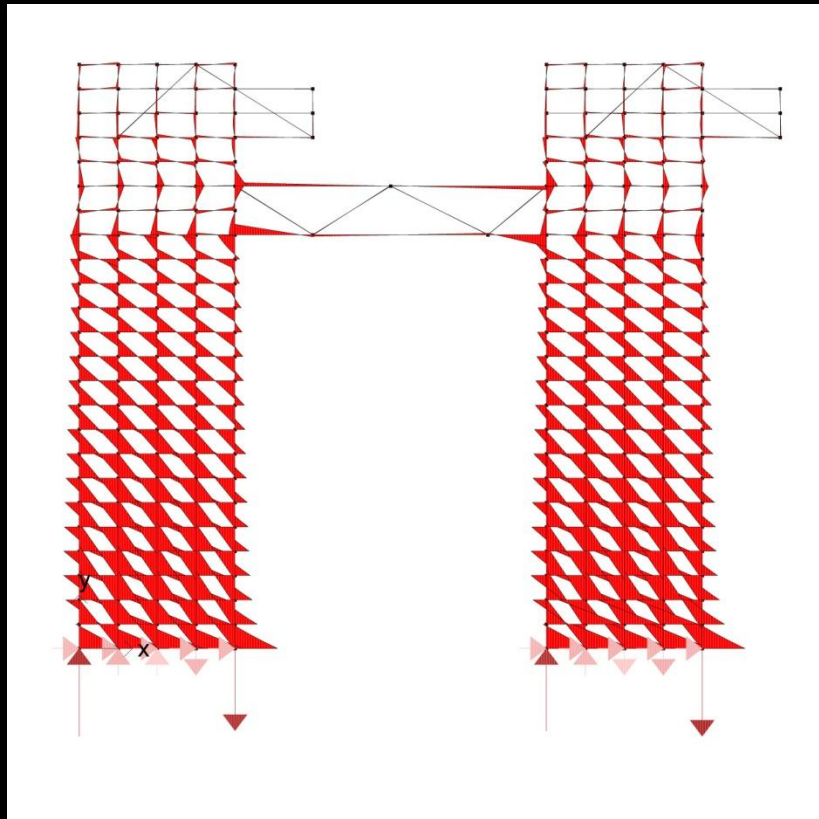


FOUNDATION AND SOILS

- **600 Geothermal Wells**
 - Each at 100 meters below the base of the foundation
 - Provides 70 percent of cooling in the summer and Heating in the Winter
 - One of the largest in the world
- **Underground Parking Garage**
 - Features a regularly space column grid system
 - Occupies entire footprint of site
 - Supports the cinematheque and a large reflecting pond that is located in the center courtyard

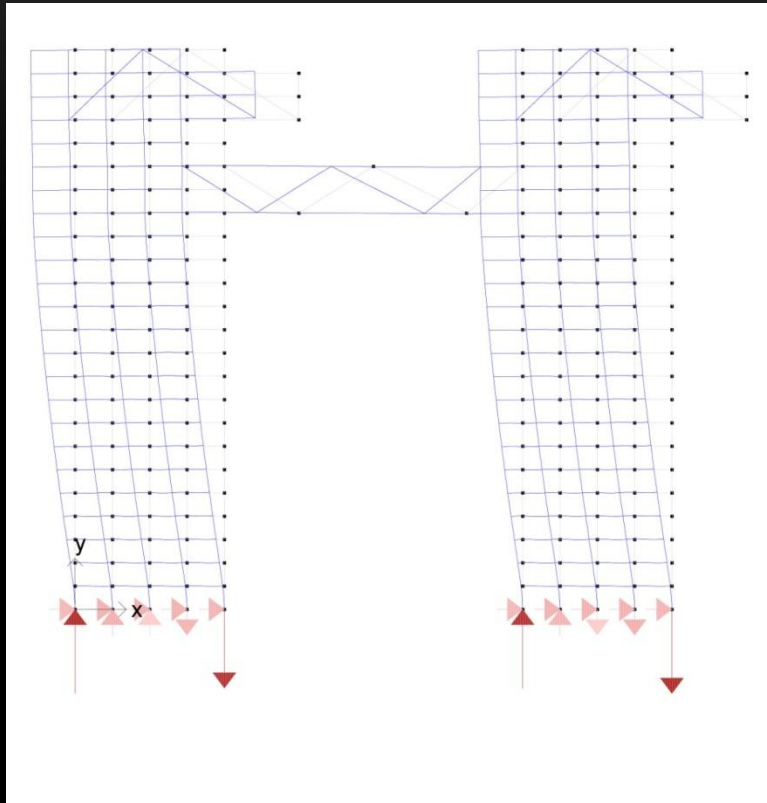


LATERAL LOADING

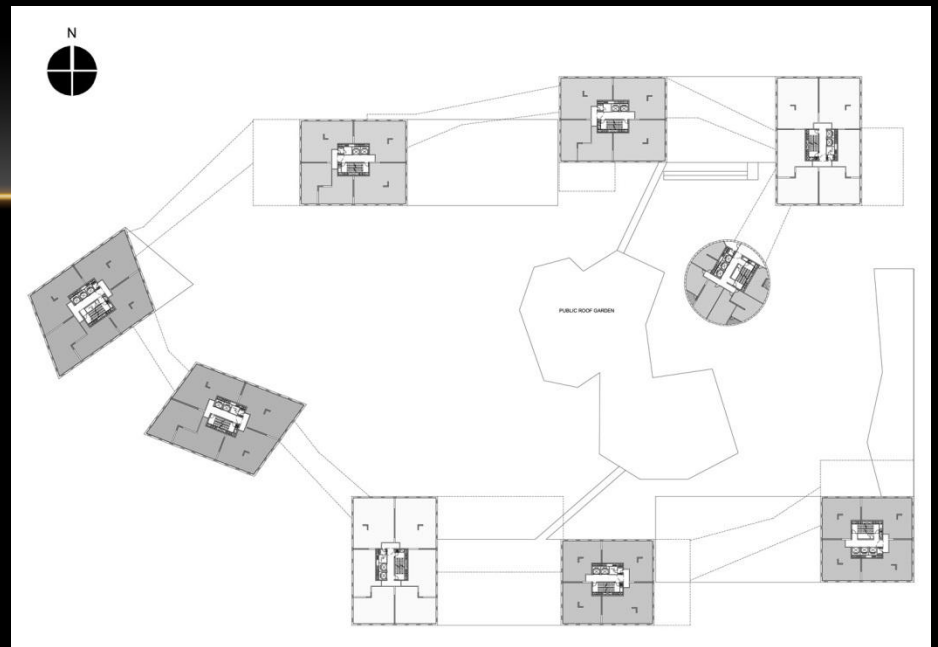


Moment and Shear Forces:
- Smallest at Top
- Increase at Base

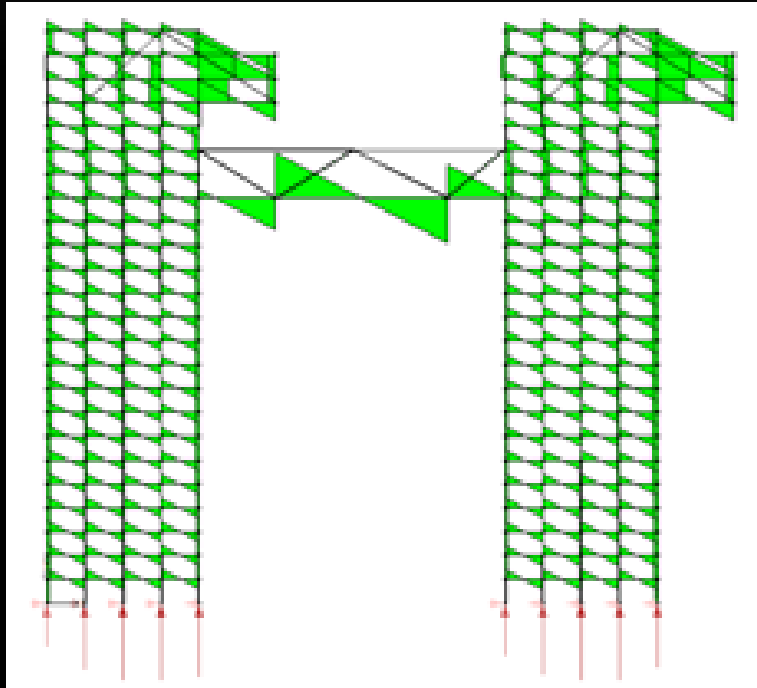
LATERAL LOADING



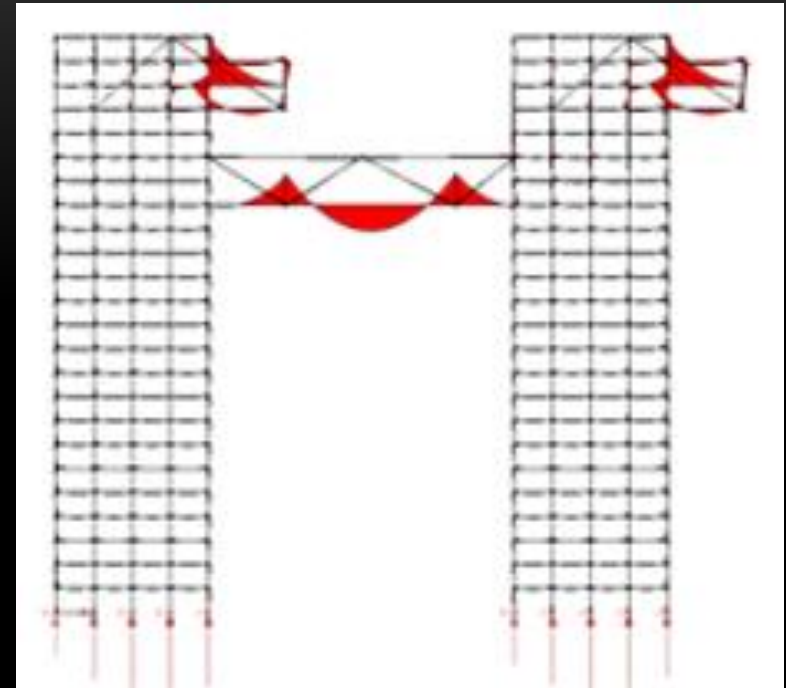
Deflection Diagram:



GRAVITY LOADING

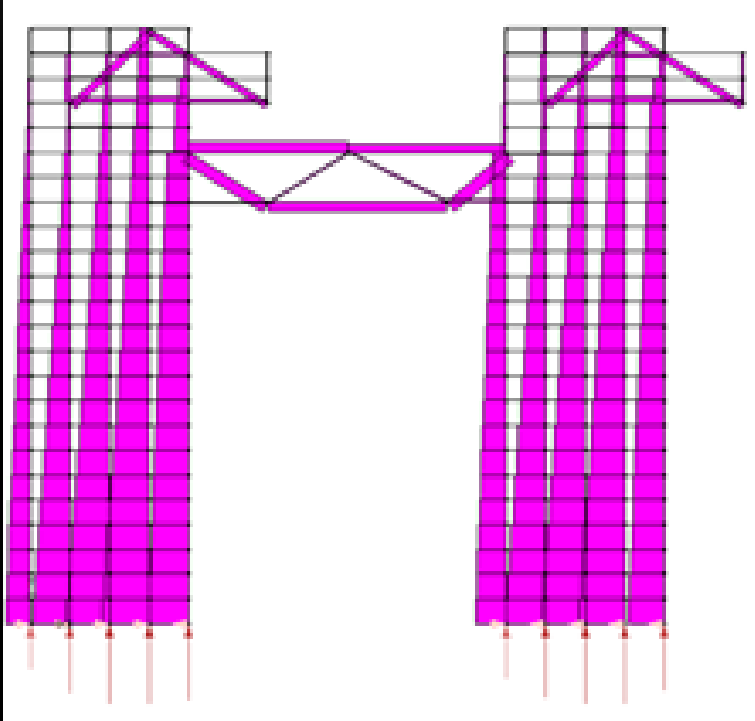


Shear

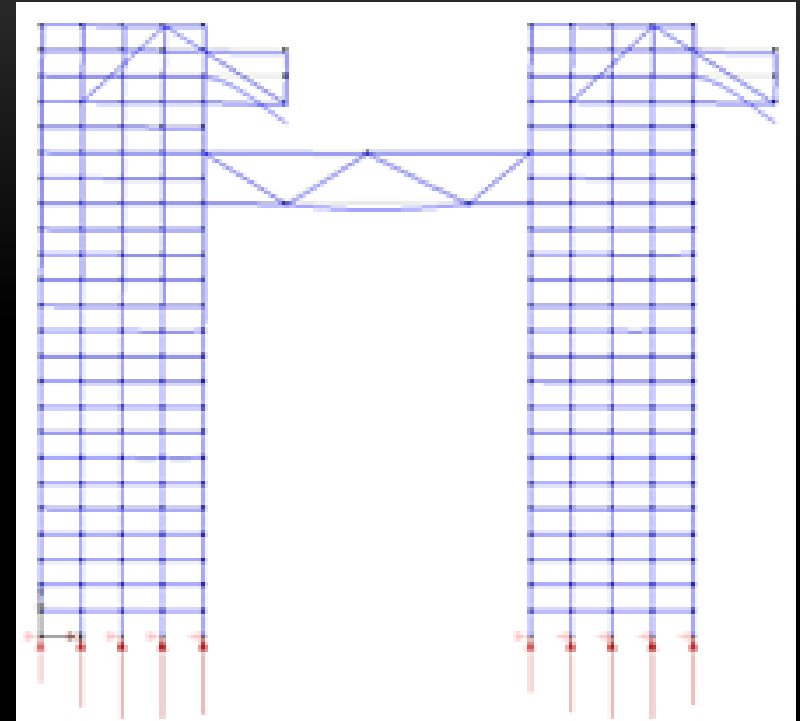


Bending Moment

GRAVITY LOADING



Deflections



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