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, contracted 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
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.
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/popup_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
Moment and Shear Forces:
- Smallest at Top
- Increase at Base

Introduction      Design Concept      Building Components      Foundation      Analysis
LATERAL LOADING

Deflection Diagram:
GRAVITY LOADING

Shear

Bending Moment
GRAVITY LOADING

Deflections
REFERENCES:

- [http://www.structuresworkshop.com/07000linkedhybrid.html](http://www.structuresworkshop.com/07000linkedhybrid.html)