

# Conceptual Design for Chongna City Tower(450m) in Korea

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## Abstract

Chongna site is a symbol space that makes a synthesis of economic, industry, science and technology which Korea intends to pursue for. This project is planned for a monumental landmark to contribute to the national vision and ethos at the center of this area.

Taeguk(The Great Absolute) represents the principle of Yin & Yang, which means “change of the universe”, in oriental philosophy. Especially, Gun(sky), Gon(earth), Gam(sun) & Rhi(moon) means spirits of bright future like eternal, infinite sun and moon. On the basis of such philosophical symbols, this project is planned and intended to express the meaning of this areas, namely the pursuit of Korea and world’s prosperity and peace.

Adopting a modern technique of tensegrity structure which leads in 21st century, this projects make a plan of new prospective hi-tech & morphology. The structural system of city tower(450m) is that the axial force of central core and truss structure in held observatory both for a distant and near view transmit to the central column through the lower part of the hinge support. The lateral force by the wind load which gives the effect of upper structure imposes on the tensegrity structure.

**Keywords:** Taeguk, Yin & Yang, tensegrity structure, tower, observatory, Chongna, Korea

## 1. Design summary

Cheongna site is a symbol space that makes a synthesis of economic, industry, science and technology which Korea intends to pursue for. This project is planned for a monumental landmark to contribute to the national vision and ethos at the center of this area.

The high-technical, high-rise observation city tower which be erected at the central lake in the site involves the symbol of a free economic zone as a landmark of the area. Also the polyhedron of jewel is adopted as a basic motive of meaning of window for world at the best international city(fig. 1).

The city tower will play an important role not only as in the function of monumental landmark that can be harmonized with creativity and sculptural aesthetics, but also as the complex town that can be practically used to the places of tour, resort, event so on.



Figure 1: Bird view from airplane

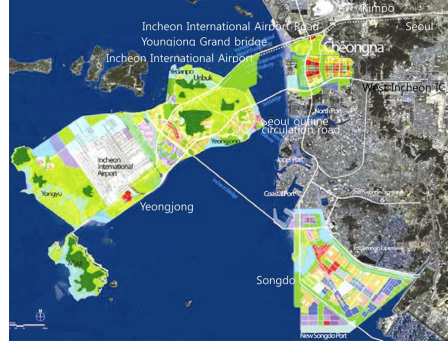


Figure 2: Site location near Incheon

## 2. Site analysis

Cheongna site will be strategic point connected Incheon international airport with Seoul and other cities. Furthermore the center of the best business city will be constructed in this specially planned area, where the optimal free enterprise will be given a guarantee (fig. 2).

### City Tower

The gateway to Korea: the location to take the first step to Korea in case of making way into Seoul through Incheon international airport.

The center park: the tourist route of leisure and sports

The role of landmark: a flat land where there is a fine view

## 3. Master plan

### 3.1 Design Concept

Taeguk (fig. 3)

- the infinity of having no end or limit
- the state of chaos
- the harmony and union

Infinity → Cycle → Circle

The program and movement routes of city tower is the circulating structure

Gun, Gon, Gam, Rhi (fig. 4)

Four trigrams represent concretely the changing and development shapes of Yin(陰/-) and Yang(陽/+). In the Korean national flag, four trigrams lie around the Taeguk, they are the symbols of the Korean's development and eternity

Gun (乾) : sky, spring

Gon (坤) : earth, summer

Gam (坎) : water, fall

Rhi (離) : fire, winter

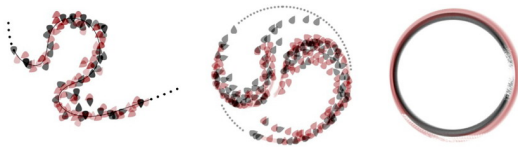


Figure 3: Taeguk(Infinity-Cycle-Circle)

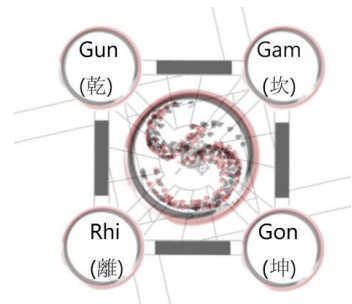


Figure 4: Gun, Gon, Gam, Rhi

### 3.2 Zonning and Landscaping

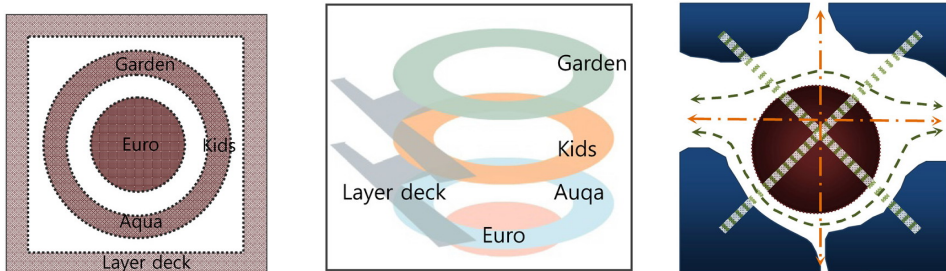


Figure 5: Zonning and landscaping

Layer deck is formed along the waterfront, and kids, garden and aqua circle are situated cross the bridge. Inside the circle, there's a theme circle. In the cross section, garden, kids, aqua and theme circle are field in order. The bridges are built diagonally through the island circle, and along these bridges the green networks and water front landscape are formed. People can enjoy the island circle variously at the different direction along the canal.

### 3.3 Planning and Programming

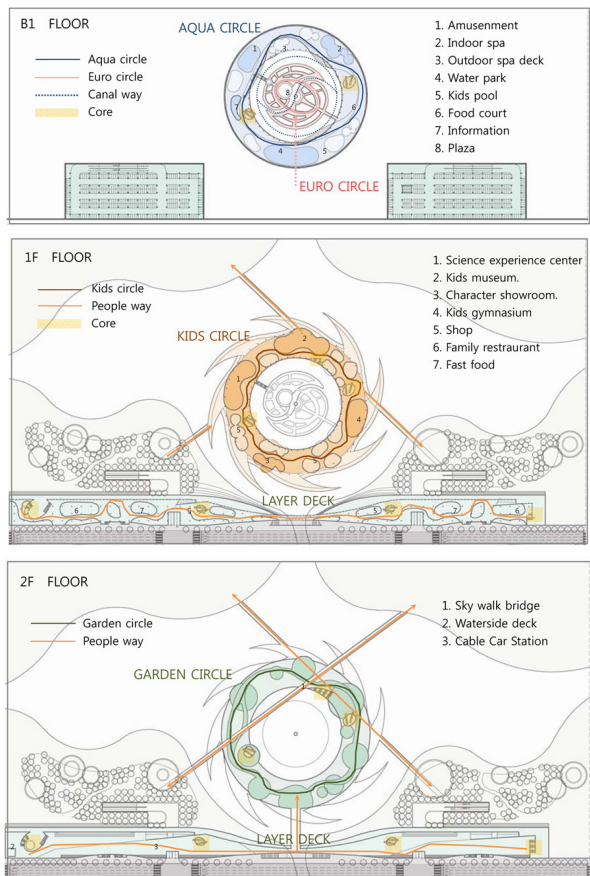


Figure 6: Planning and programming

## 4. City Tower

### 4.1 Design Concept

Tradition:

Taeguk(The Great Absolute) represents the principle of Yin & Yang, which means “change of the universe”, in oriental philosophy. Especially, Gun(sky), Gon(earth), Gam(sun) & Rhi(moon) means spirits of bright future like eternal, infinite sun and moon. On the basis of

such philosophical symbols, this project is planned and intended to express the meaning of this areas, namely the pursuit of Korea and world's prosperity and peace.

Technology:

Adopting a modern technique of tensegrity structure which leads in 21<sup>st</sup> century, this projects make a plan of new prospective hi-tech & morphology.

Energy:

Considering the neighborhood of sea, city tower is planned an eco-friendly and sustainable structure by using the wind force

## 4.2 Symbol and Image

Cheongna site is divided into six zoning parts, according to the meaning of 6 jewels (crystal, sapphire, ruby, emerald, jade, pearl, diamond). This city tower is designed to emphasize the whole meaning of thematic panorama by applying a cubic figure(fig 7-8).

The ground plan of project is symbolized the Taeguk of Korea national flag. And the meaning of 4 trigrams (Gun: sky, Gon: earth, Gam: sun, Rhi: moon) is dynamically shown up as a spiral 3-dimensional element. By expressing the symbol of Yang(+) and Yin(-) in Taeguk as the compression and tension which is a basic principal of mechanics, this project is planned a minimal element size structure, avoiding a bending moment.

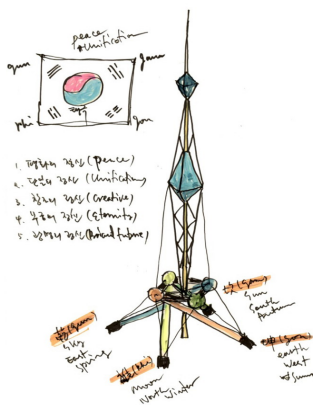


Figure 7: Design concept

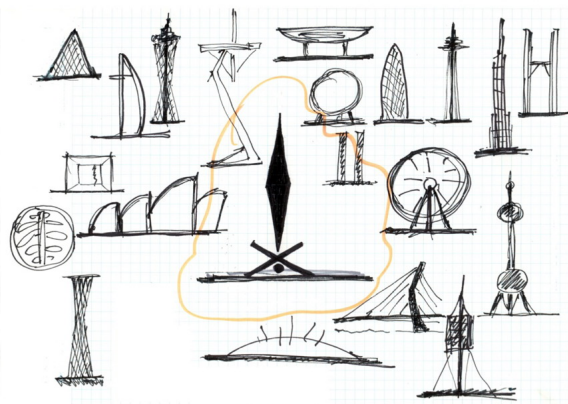


Figure 8: Symbol and image

## 4.3 Circulation

The provision of the vehicle routes directs to the underground sites from a road, and the separation between vehicle route and pedestrian routes can relieve congestion. People make their way into the circle island and go through theme, kids, aqua and garden circle, then get to the lower part. Each bridges link four spots to the central core. Three elevators go up to the middle observation platform, and there another again one elevator goes up to the upper observation platform

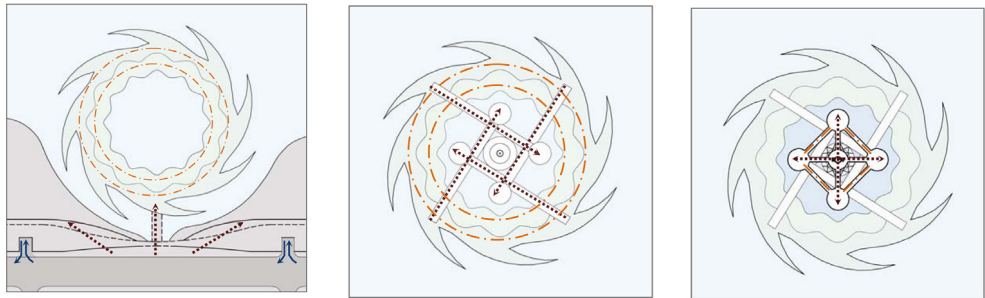


Figure 9:

— — — — — Vehicle route  
..... Pedestrian main-route  
- - - - - Pedestrian sub-route

#### 4.4 Program(plans, sections and elevations)

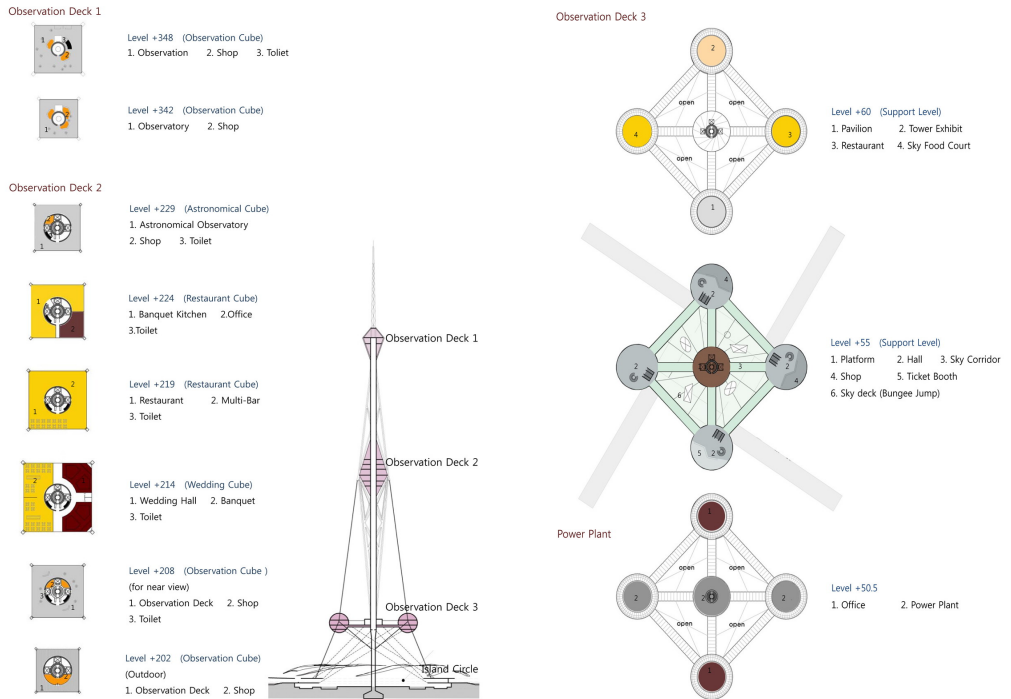


Figure 10: Plans, sections and elevations

### 4.5 Structure

The structural system of city tower is that the axial force of central core and truss structure in held observatory both for a distant and near view transmit to the central column through the lower part of the hinge support. The lateral force by the wind load which gives the effect of upper structure imposes on the tensegrity structure (fig. 11).

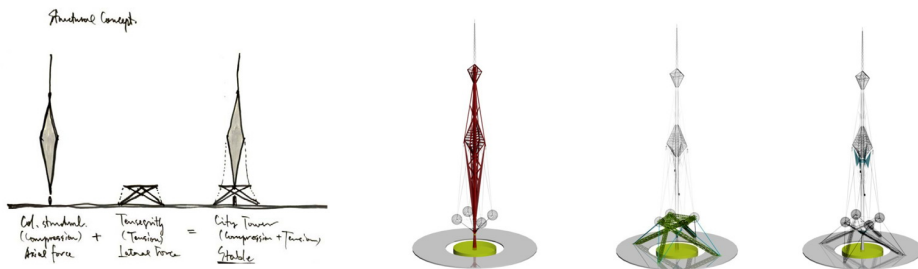


Figure 11: Basic structural system



Figure 12: Modelling process for structural system

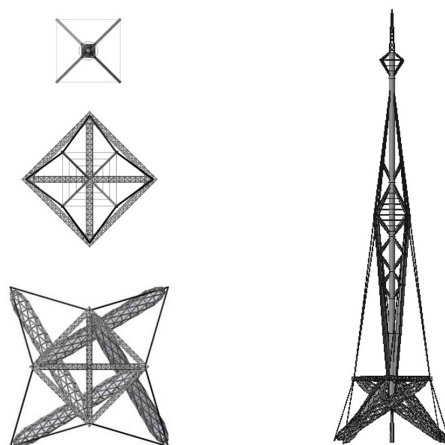


Figure 13: Horizontal and vertical sections in tower frame

Structural devices against lateral forces :

This structure is designed with a Building Mass Damper (BMD) to ensure aerodynamic stability and, by the use of BMD, the tower has also a margin of safety against earthquake ground motion as well as the ability controlling undesirable vibration. Besides, excessive cable vibrations may be caused by vortex shedding, galloping, parametric excitation (deck/pylon and cable interaction), and wind and rain-induced vibrations are suppressed by calming effects of a cable damping against cable vibration. BMD as a device mounted in structures to prevent discomfort, damage or structural failure by vibration are moved in opposition to the resonance frequency oscillations of the structure by means of springs, fluid or pendulums. Cable Damping, Several countermeasures are available; cable surface treatments such as the use of a helical rib, dimples and longitudinal grooves, mechanical friction dampers.

Deflection and displacement contour(fig. 14)



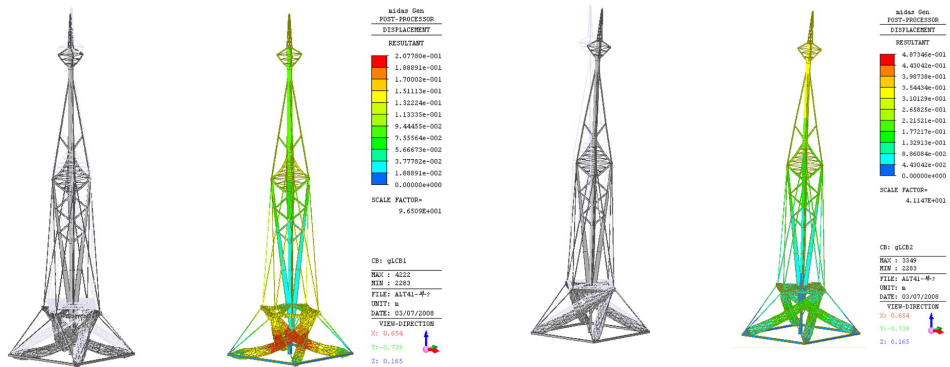


Figure 14: Deflection and displacement(DL+LL, DL+LL+WL)

Truss stress and moment(fig. 15)

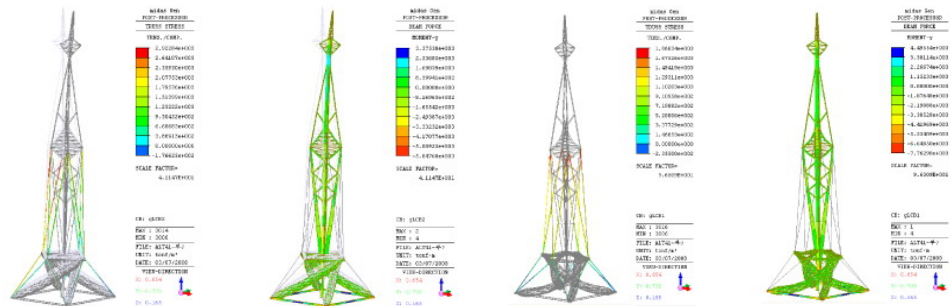
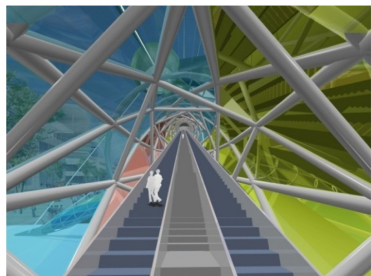


Figure 15: Truss stress and moment(DL+LL, DL+LL+WL)



Inside Passage view



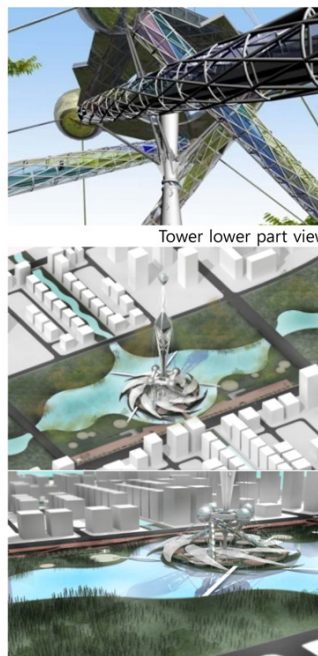
Perspective view 1



Perspective view 2



Perspective view 3



Tower lower part view

Perspective view 4

Figure 16: Perspectives