Millennium Tower 150-Story (Japan)

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Designed by Foster and Partners
Engineered by Obayashi Corporation
Presented by Keizo Shimizu Nippon ERI
for CTBUH 2004 at Seoul

CONCEPT
IMAGE
ENGINEERING
ARCHITECTURE
Architectural Concept

**Helical structure**
- tapering cylindrical form
- Total edifice: 800 meters
- The gross area: over 1000000m²
  - Intelligent office accommodation for 17000 working people
  - Residential accommodation for 2000
- **150 floors** with the five Sky Centers located at every 30 floors
- Rapid linear motor lifts
- Through the Sky Center to their final destinations
- **Entertainment center** (auditorium, cinemas, concert hall)
- **Retail group** (department store and associated shops)
- **Fitness facility** (gymnasium, pool, saunas)
- **First class hotel** and a multi-cuisine restaurant complex

CTBUH 2004 October 10–13, Seoul, Korea
Structural Concept

*Structural system*

**Helical structure :**

*The effect of the open lattice at tower top*

*To reduce aerodynamic actions*

- Perimeter frame consisting of 12 helical members combined with Vertical members
- a rigid net-like structure

**Tube-in-Tube Structure:**

**Mega-structure :**

*Story-high transfer girders every 30 stories, allowing Sky Centers below to have flexible column-free spaces*
SKY CENTRE SECTION.
Structural Concept

Design Criteria

Seismic Design:
- to withstand the Kanto Earthquake (1923)

Wind Design:
- the whole structure is designed
to remain elastic
to resist strong wind forces (return period of 500 years)
- the vibration control for human comfort
Structural Concept

Vibration Control Systems

Active Vibration Control System (AVICS):

to control bending deformation

Water Tanks Vibration Control System:

Tanks located at the upper two Sky Centre
utilized both a passive and an active vibration control system

✓ For smaller levels of vibration (passive control force)
  
  by the flow of water between the two tanks due to gravity

✓ For larger levels of vibration (the active water flow)
  
  by computer-controlled actuators
Building Service

Service Principles

Cogeneration system

- electric power is generated by gas-driven generators
- the heat produced is utilized for air conditioning

Incineration and heat recycling

Desalination system
Building Service

*Lift System*

*A combination of linear-motor lifts and conventional lifts*

**Linear motor lifts:**
- Rapid transportation
- ✔ Stopping only at Sky Centers
- ✔ double-decker type
- ✔ maximum capacity of 80 persons

**Conventional lifts:**
- ✔ Double-decker type
- ✔ From a Sky Center to all floors as branch lines
Building Service

Disaster Prevention Plan

In case of fires…

Escape stairs are provided to four-hour-rated refuge zones above each Sky Center.

✓ these zones are protected by double fire walls
✓ smoke prevention enclosures around all voids and shafts
Construction

Construction method

Core Construction Plant all-weather self-lifting
For the erection and welding of the steel frames

*The perimeter helical steel frame will be erected by heavy duty mobile cranes mounted on already constructed floors*

Lift Up method
For the construction of the tower’s top portion
## Construction

### Time schedule

10 years to complete the whole construction

<table>
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<tr>
<th>Civil engineering works</th>
<th>4 years</th>
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<tbody>
<tr>
<td>Foundation works</td>
<td>(3.5 years)</td>
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<tr>
<td>Bridge construction works</td>
<td>(3.7 years)</td>
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<table>
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<tr>
<th>Architectural works</th>
<th>6 years</th>
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<tr>
<td>Foundation and basement</td>
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<td>Superstructure</td>
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<td>Steel work</td>
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<td>Exterior finishes</td>
<td>(2.5 years)</td>
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<tr>
<td>Linear motor lifts</td>
<td>(1.5 years)</td>
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<tr>
<td>Interior finishes</td>
<td>(3.5 years)</td>
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</tbody>
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## Conclusion

*Millennium Tower will provide a totally new urban concept.* It will demonstrate an alternative to alienating, polluting, fragmented existing urban development. It will stimulate a revival of man’s enjoyment of his environment and endeavor. It will contribute to the primary task of making better places to live and work. Informed by the past, conscious of the problems of the present, *Millennium Tower will provide a stunning prototype for the future.*