CTBUH 2006


Towers by Zaha Hadid, Daniel Libeskind and Arata Isozaki in Milan, for CityLife

Chicago International Conference

Thinking Outside the Box
Tapered, Tilted, Twisted Towers

Program

October 25-26, 2006
Chicago, Illinois

Shigeru Hikone
Ove Arup & Partners Japan Ltd.

"Twisting in Tokyo: Unusual Buildings in High Seismic Regions"
10:20 a.m. Wednesday, October 25, 2006

Mr. Hikone transferred to Ove Arup & Paqrtners Japan Ltd. as Principal in 1997, previously having spent five years with Arup in London, working in multi-disciplinary design groups. Mr. Hikone has over 30 years of experience in engineering design for a wide range of buildings and industrial facilities. Prior to joining Ove Arup & Partners he worked with leading Japanese engineering consultancy Nikken Sekkei where he achieved the position of senior structural engineer. Mr. Hikone is a member of the Architectural Institution of Japan, the Institution of Structural Engineering (UK), FEANI and the Japan Structural Consultants Association.

Akira Wada
Tokyo Institute of Technology

"Twisting in Tokyo: Unusual Buildings in High Seismic Regions"
10:20 a.m. Wednesday, October 25, 2006

Professor Wada is head of the structural engineering research center at the Tokyo Institute of Technology. His research interests are structural engineering of architecture and buildings, seismic design, seismic isolation, damage controlled design and computer simulation of structures. In 1995 he received an award from the Architectural Institute of Japan for his work with colleagues on "Invention and realization of damage controlled structures." He is one of the most active researchers in seismic design of building structures in Japan and manages many research committees concerning these fields in the Architectural Institute of Japan. Currently, he is a collective member of the Science Council of Japan and chairman of the research committee of structural design at the Architectural Institute of Japan

Twisting in Tokyo; Unusual Buildings in High Seismic Regions

Twenty percent of earthquakes in the world occur in Japan. The nature and strength of these earthquakes initially led Japanese engineers to believe that tall buildings would not be stable against them. For a long time a height limitation of 100 feet was imposed by local authorities. This view eventually changed, but it took more than 20 years for researchers and structural engineers to convince society that tall buildings were not always weak in seismic events. It was only after the Tokyo Olympics in 1964 that the height limitation was removed and construction proceeded above 100 feet. The relaxation of the restriction was only allowed after numerous recordings and analyses of earthquakes, response analyses using computers, and experimental structural studies.

Today, buildings in Japan are categorized, and anything taller than 200 feet is referred to as a "tall building." Currently, there are more than 2,000 such tall buildings in Japan. Preliminary projects were built on sites with good geotechnical conditions and profiles of the structures were always kept square and uniform. However, the development of base isolation techniques, energy absorbing devices, better performing materials, and computer analysis has gradually removed these limitations. In the 21st century, tall buildings with freer forms are being constructed.

In the west coast of USA and in Japan, we allow plastic deformation of structural frames in a tall building seismic design process. This is believed to reflect a more realistic seismic reaction. In case of box shape buildings i.e., where all columns are vertical and all beams are horizontal, the building will shake in all directions equally, hence the seismic energy can be absorbed by the plastic deformation of structural elements of columns and beams.

However, in the case of irregular shaped buildings i.e., where columns are not always vertical and beams not always horizontal, horizontal forces are acting to stabilize the structure for the vertical loading condition. If we allow large plastic deformation to such structures during seismic loading, the building will not shake equally in any direction but will tend to shake in the direction in which the horizontal forces are acting under the vertical load condition. This is not desirable. To overcome this problem with irregular shaped buildings, several techniques are employed.