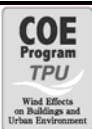


**COE Open Lecture**

# **Wind Effects on Buildings and Urban Environment**

**Tokyo Polytechnic University  
The 21st Century Center of Excellence Program**

**Yukio Tamura**



**Lecture 1**

# **Seismic Forces and Damage to Buildings and Structures**

**Tokyo Polytechnic University  
The 21st Century Center of Excellence Program**

**Yukio Tamura**

# Predictions of 20th Century

January 2, 1901

Hochi News Paper, Japan

## Predictions of 20th Century

(January 2, 1901: Hochi News Paper, Japan)

### (a) Radiophone and Phone

Further development of radiotelegraphy invented by Marconi will enable people to talk with each other from various countries around the world. Thus, a person in Tokyo will be able to talk freely with a friend in London or New York.

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (b) Long Distance Photography

Within several decades, when war clouds cover Europe, a newspaper reporter in an editing room in Tokyo will be able to catch the real-time situation via electrically transmitted colored photos (movies ?).

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (c) Extinction of Wild Animals

No wild animals such as lions, tigers and crocodiles will be seen in their natural habitats, even in wilderness areas such as in Africa. They will only be seen in zoos in big cities.

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (d) The Sahara Desert

The Sahara desert will be transformed to fertile plains a step at a time, and civilization will develop in China, Japan and Africa.

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (e) Round-the-world Tour in 7 Days

A round-the-world tour, which required at least 80 days at the end of 19th Century, will take only 7 days at the end of the 20th century.

Further, both ladies and gentlemen in the world's civilized countries will make a leisurely tour of the world at least once in their lives.

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (f) Extinction of Mosquitoes and Fleas

With the development of social sanitation works, mosquitoes, fleas and so on will gradually perish.

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (g) Freedom from Hot and Cold

New air-conditioning equipment will be invented to control and maintain room temperatures in a comfortable condition. This may facilitate development in African countries.

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (h) Photo Telephone

Equipment will be invented that will show a picture of the person who is talking on the phone.

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (i) Expedient Device for Shopping

Infrastructure such as underground steel piping will be invented that will enable checking and choosing of products via a photo telephone from a far away place, and making a trading contract, so that the product can be immediately obtained.

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (j) Electric World

Because of the shortage of firewood, charcoal and coal, electricity will become the main fuel.

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (k) Speed of Trains

Development of the cigar shaped locomotive invented at the end of 19th century will be completed. Cars will be the size of small houses, and will be provided with various equipment and facilities for passengers convenience, enabling them to forget that they are traveling. Compartments will be made warm in winter and cool in summer. Train speed will be 2miles/min (190km/h) for ordinary trains, and 150miles/h (240km/h) for express trains. Thus, it will take 2.5hours to travel from Tokyo to Kobe, and 1 entire day to travel from New York to San Francisco, which takes 4.5days at present. Furthermore, as they will of course not use coal power, they will not be smoke-blackened, nor require stops for water supply.

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (l) Medical Development

Drugs will no longer be used. An electric hypodermic needle will be used to painlessly inject liquid medicines into localized parts. With the development of X-rays and microscopes, diseased parts will be quickly and easily diagnosed, enabling immediate and appropriate treatment. More than 90% of internal medicine will moved to surgery. Then, for example, pulmonary tuberculosis will be healed by killing the virus by extracting and sterilizing the lungs. Surgical operations will be performed electrically, and will be painless.

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (m) World of Motoring

Horse drawn carriages will disappear, motor cars will become popular and they will be available at a low price. Bicycles and motorcars will be used by the military instead of horses. Horses will be bred only by dilettantes.



## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (n) Free Communication between Man and Animals

Animal language study will develop, animal language classes will be taught, and human beings will be able to talk freely with dogs, cats and monkeys. As a result, menial work traditionally done by male and female servants will be mainly done by dogs, and dogs will run errands.

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (o) Abolition of Kindergarten

Since human intelligence will be highly developed by heredity and there will be no uneducated persons in a family, there will be no need for kindergartens. Neither men nor women will be treated as independent if they have not graduated from a university.

## Predictions of 20th Century

(January 2, 1901 : Hochi News Paper, Japan)

### (p) Prevention of Windstorm

With the significant development of meteorological observation technology, natural disasters will be predicted one month or more before they occur. If a windstorm, which is the most dangerous natural disaster, is predicted, a cannon will be directed to the sky to change it to rain. Although earthquakes will not be restrained, houses and infrastructures will be designed and constructed to resist them and prevent damage.

## Recent Strong Earthquakes in Japan

Earthquakes	Magnitude	Fatalities
<b>Kanto</b> 1923	7.9	142,000
<b>Nankai</b> 1946	8.0	1,432
<b>Fukui</b> 1948	7.1	3,769
<b>Niigata</b> 1964	7.5	26
<b>Tokachi-Oki</b> 1968	7.9	52
<b>Miyagiken-Oki</b> 1978	7.4	28
<b>Nihonkai-Chubu</b> 1983	7.7	104
<b>Hokaido-Nanseioki</b> 1993	7.8	230
<b>Kobe</b> 1995	7.2	6,432

# Seismic Forces and Damage to Buildings and Structures

## Earthquake Damage



NORTHRIDGE EARTHQUAKE, Jan. 17, 1994

**A reinforced-concrete building with collapsed 1st story**



KOBE EARTHQUAKE, Jan. 17, 1995

**A 12-story building with collapsed 5th story**



KOBE EARTHQUAKE, Jan. 17, 1995

## A 8-story building with collapsed 6th story



KOBE EARTHQUAKE, Jan. 17, 1995

## Collapse of a shopping arcade



KOBE EARTHQUAKE, Jan. 17, 1995

## Collapse of wooden houses



KOBE EARTHQUAKE, Jan. 17, 1995

## Kobe Earthquake January 17, 1995

- **Magnitude** 7.2
- **Max. Ground Acceleration** 817 cm/s<sup>2</sup>
- **Fatalities** 6,433
- **Injured** 35,000
- **Damaged Buildings** 512,800  
(Engineered Buildings 10%)
- **Burned Down Buildings** 7,000
- **Economic Loss** 150 Billion USD  
(estimated)

# Kobe Earthquake

## Date of Construction of Damaged Buildings

- **Before 1971**      **535** buildings  
1971: **Minor amendment to Building Standard Law of Japan**
- **1971 ~ 1980**      **218** buildings  
1981: **Major amendment to provisions for seismic design in BSL of Japan**
- **After 1981**      **103** buildings

Due to the investigation by one major general construction company

## Seismic Force

- **Seismic Force : Inertial Force** Due to Acceleration of Ground Motion
- **Similar to “Weight” (Gravity Force)** Due to Gravitational Acceleration  
small or light weight buildings
- **High-rise Buildings in Japan :**  
designed to be light weight and flexible

## Seismic Force

- Buildings should be designed to be light weight and flexible.

### Three Piglets (Children's Story)

· Eldest Piglet:

**Straw House**

*Very good !*

· Middle Piglet:

**Wooden House**

· Youngest Piglet:

**Brick House**

× *Worst !*