



JSCE100th Anniversary Celebration

International Forum , November 20, 2014

## A Century of Japanese Civil Engineering and Future Disaster Mitigation

Masahiko Isobe, Dr. Eng.  
102<sup>nd</sup> JSCE President  
Vice President  
Kochi University of Technology

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## I. Centenary of the Founding of Japan Society of Civil Engineers

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### I-1.

#### Japanese Civil Engineering during the Meiji Period (1868-1912)

##### The Dawn of Modern Japanese Civil Engineering

- Foreign Civil Engineers who were hired by the Japanese Govt. and the Japanese young engineers who returned from their studies overseas

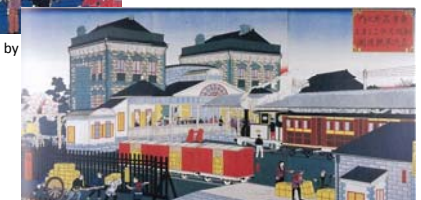
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#### The Dawn of Modern Japanese Civil Engineering

- Main projects: flood control , erosion control, harbors, and railroads
- Year1872 (Meiji 5): The 1<sup>st</sup> railroad Shinabshi-Yokohama in operation.



Steam Locomotive Railway at Yokohama Seaside by  
Ando Hiroshige©The Railway Museum



Shinbashi Railway Steam Locomotive at  
Shinbashi Sta. in Tokyo by Ando Hiroshige©The Railway Museum

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## Osakayma Tunnel in 1880 (Meiji 13)

- Advancement of technologies for the construction of bridge and tunnels
- Osakayama Tunnel (opened in Meiji ): 1<sup>st</sup> full-fledged mountain tunnel, built with the Western technologies and traditional Japanese techniques
- Tokaido Main Line completed in 1889, which linked Shinbashi, Tokyo and Kobe.



Old Osakayama Tunnel on Tokaido Main Line

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## The Lake Biwa Canal in 1890 (Meiji 23)



Nanzenji Suirokaku Waterway

©Hoichi Nishiyama



### Sakuro Tanabe

- Proposed the construction of the Lake Biwa Canal in his graduation thesis
- Graduated from the Imperial College of Engineering (the former Tokyo Institute of Eng.) in 1883



Shijyo-dori Street, one of the 3 major urban development projects in Kyoto

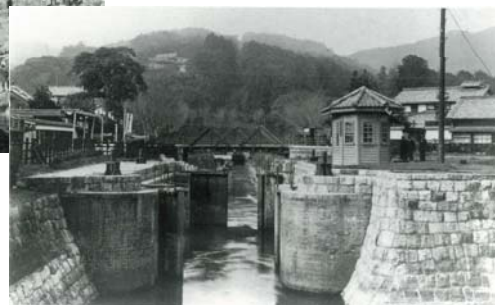
## The Lake Biwa Canal

- Completed in 1890: a 11.3 km long-canal linking Kyoto and Otsu
- Multipurpose development project to respond to diverse needs: irrigation, water supply, sewage systems, and hydropower generation



**Otsu Canal No. 1 in 1886**

Constructed by only human power



**Otsu Lock Gate** on the Canal No. 1, 1897

## Otaru Port- North Breakwater in 1908 (Meiji 41)



### Isami Hiroi

- Graduated from Sapporo Agricultural College (Hokkaido Univ.)
- The 1<sup>st</sup> Manager of Otaru Port & Harbor Office
- Constructed the 1,289meter-long North Breakwater with shape-designed concrete blocks



## “100 Year-Long Durability Test”

- Dr. Hiroi made concrete test pieces for 100 years of durability
- “100 Year-Long Durability Test” has been continued.



Otaru Port in the Meiji Era

## I-2.

### Founding JSCE and Civil Engineering in the Taisho Period (1912-1926)

- Development of Japanese Civil Engineering
- Recovery and Reconstruction after the Great Kanto Earthquake of 1923

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## Founding of JSCE in 1914 (Taisho 3)

- 1914: JSCE was founded, stemming from the Society of Engineering
- 2014: JSCE's 100<sup>th</sup> Anniversary

### The Comprehensive Nature of Civil Engineering

“There are several situations and opportunities in the civil engineering field that requires person who are equipped to command the commanders, that is, to be **the leaders of the leaders.**”

### Necessity for Advancement in All Directions

“We must seek to advance in all directions while remaining centered on civil eng.”

The comprehensive nature of civil eng. has stayed the same as it was

- Pursue **the enhancement of wellbeing of humanity**, taking root in society, local communities and the environments which projects are implemented.

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Baron Koi Furuichi  
the 1<sup>st</sup> JSCE President

## Akira Aoyama and Panama Canal in 1914 (Taisho 3)



**Drafting Force Div. Eng.  
Office of Atlantic**  
Akira, after graduating from college, went to Panama and engaged in the construction of the canal for 7 yrs.

**Akira designed Gatun  
Lock Gate**

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## Ohkozu Diversion Project in 1931 (Showa 6)



「橋田切丸」写真 橋田切丸 21 日後のようす (現在の新浜北橋)

Blessed are those who have the knowledge of natural reason,  
Work for humanity and for country.



前面一碑文「萬象二天意ヲ覚ル者ハ幸ナリ」



裏面一碑文「人類ノ為メ 国ノ為メ」

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## The Great Kanto Earthquake in 1923 (Taisho 12)

- M 7.9
- Approx. 100,000 casualties in Tokyo and Yokohama
- 46 % of downtown Tokyo and 28% of downtown Yokohama were burned down.



Kandabashi Bridge



Asakusa Ryouunkaku,  
called as "Asakusa 12-loor Building"



Hitotsubashi Bridge

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## Post-Great Kanto Earthquake Reconstruction:

Various Types of Bridges over Sumida River

Eitai Bridge  
1926



Komagata Bridge  
1926

Kototoi Bridge  
1928



Kuramae Bridge  
1927



Kiyosu Bridge  
1928



## Japan's 1<sup>st</sup> Subway between Asakusa and Ueno

Launched in 1925 (Taisho 14), and then came into operation in 1928 (Showa 2)

Department Store-Subway partnership on the construction of subway stations



Entrance of Ueno Sta.



Ginza Line running between Ueno & Ginza  
協会50周年記念事業 鉄道施設50選 ©Japan Railway Civil Engineering Association



by Hisui Sugiura, a Mitsukoshi department store staff, and the headmaster of Tama Imperial Art School

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## JSCE's report on the damages caused by Great Kanto Earthquake

- The Earthquake Investigation Commission chaired by Dr. Isami Hiroi, with 70 members
  - Published the findings and damage assessments in series: Vol. 1 in 1926, Vol. 2 and Vol. 3 in Jan & Dec 1927 respectively
  - Released detailed data and analyses
- ➔ gained high credibility and reputation throughout society, and referred to as a model of its kind.



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## I-3.

### Civil Engineering in the Early Showa Period (1926-1945)

- The basis for the development of Japanese Civil Engineering Technology

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## The Establishment of Design and Construction Standards and Specifications



Guidelines for Concrete, published in 1931 (Showa 6)

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## The Beliefs and Principles of Practice for Civil Engineers: Sense of Honor, Integrity, Modesty, 1937 (Showa 12)

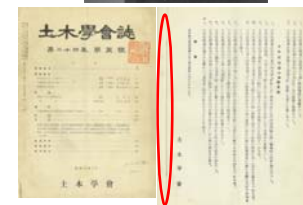
Akira Aoyama the 23rd President formulated "the code of ethics," the 1<sup>st</sup> of its kind among eng. associations in Japan.



### <The Beliefs>

Civil engineers shall

1. Contribute to the peace and prosperity of the nation and the welfare of humanity
2. Endeavour towards the development of technology, and contribute by means of their wisdom and skills, to society
3. Have a sense of honor, integrity, modesty, and cultivate and nurture virtues



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## I-4.

### Civil Engineering during the Postwar and Accelerated Economic Growth Period (1945-1973)

- Recovery and Reconstruction of Society and Effective Response to Natural Disasters
- Large-Scale Infrastructure Projects to Support Steady Economic Growth and Their Environmental Impacts

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### Responses to Frequent Large-Scale Natural Disasters and Technological Progress



Nankai Earthquake & Tsunami in 1946  
©Wakayama Pref.



Fukui Earthquake in 1948  
©Fukui City History Museum



Typhoon Kathleen in 1947



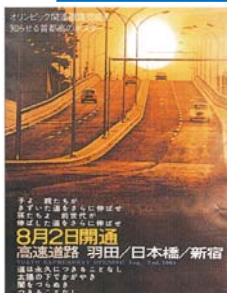
Typhoon No. 13 (Isewan Typhoon) in 1959

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### Tokyo Olympics in 1964

- JSCE's 50<sup>th</sup> anniversary:  
the halfway point of its journey to its current 100<sup>th</sup> anniversary
- Major infrastructure projects were carried out in the preparations for the Tokyo Olympics, e.g. Tokaido Shinkansen, Metropolitan Expressway network, and Tokyo Monorail network
- Then, Sanyo Shinkansen and Tomei Expressway were completed.

These major infrastructure projects support the development of industry and the life of the people



Olympic road, Aug. 2



Tokyo Monorail, Sept. 17



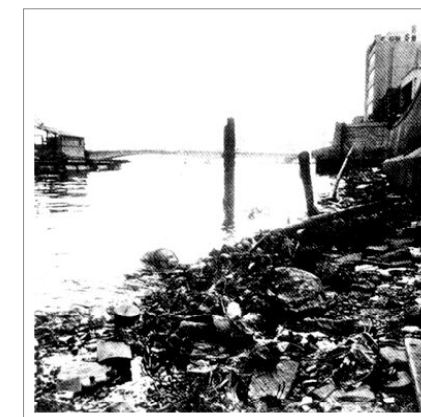
Tokaido Shinkansen, Oct 1.

photos@ Kyodo News The 23

### Emergence of Environmental Problems



Photochemical smog in Tokyo, 1971



Sumida River in 1972

Ref. The Year 1982 White Paper on Environment, Ministry of the Environment

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## JSCE's Committees established from 1955 to 1973

JSCE's responses to academic needs to cope with changes in society

Year	Committee
1955	Coastal Eng. Committee
	Special Task Committee of Earthquake Resistance
1962	Tunnel Eng. Committee
1962	Public Health Eng Committee
1963	Committee on Rock Mechanics
1966	Committee on Infrastructure Planning and Management
1969	Committee on Civil Engineering in the Ocean
1970	Committee of Civil Engineering of Nuclear Power Facilities

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## I-5.

### Civil Engineering in the Steady-Growth and Post-Growth (1973-1991)

- The Completions of Major Projects
- The Most Advanced Civil Eng. Technology and Projects
- Addressing World-Scale Environmental Issues
- Low-Frequent yet Large-Scale Natural Disasters

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## Seikan Tunnel, completed in 1988 (Showa 63)

- The highest level railway technology was achieved in the construction of submarine tunnel in those days.



Yoshioka submarine Tunnel



Main tunnel breakthrough ceremony



Seikan Rail Linking Ceremony

## New Tokyo International Airport (Narita) in 1978 (Showa 53)

- Japan's new international gateway
- The beginning of fierce competition in the international aviation routes



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## Shin-Takase River Pumped Storage Station, 1981 (Showa 56)

- The 2<sup>nd</sup> tallest dam in Japan, next to Kurobe Dam: a 176-meter rock-fill dam
- 1,280 MW installed capacity



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## Construction and Expansion of Main Airports



Kansai Int'l Airport completed in 1994



Chubu Centrair Int'l Airport in 2005  
©Centrair Japan Int'l Airport Co., Ltd.



Haneda D-Runway in 2010  
©Kanto Regional Development Bureau, MLIT

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## Honshu-Shikoku Bridges

- The Seto Bridges link Honshu & Shikoku Islands by rail
- The completion of Setouchi Shimanami Kaido in 1999 (Heisei 11), added 3 routes linking Honshu and Shikoku



Nanboku Bisan Seto Bridge, 1988

Akashi Kaikyo Bridge, 1998



Kurushi ma Kaikyo Bridge, 1999 ©Imabari District Sightseeing Association

## Great East Japan Earthquake, 2011



© Kuji City, Tohoku Regional Development Bureau, MLIT



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## Tsunami Disasters caused by the Great East Japan Earthquake



Tsunami sweeps over the dikes in Miyako city  
(Iwate Construction Association, Earthquake Memorial Museum, MLIT)



Tsunami runs up to the downtown Sendai (Sendai city)



Road-Clearing,  
Rikuzen Takata city  
©Tohoku Regional Development Bureau, MLIT

## II

### The Future of Civil Engineering

- The contribution of civil engineering to ensuring safety, the healthy environment, societal dynamism and the standard of living

“Construct the Foundation for a Sustainable Society”

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### II-1. Construct the Foundation for a Sustainable Society

Creating Sustainable Systems:

- Energy
- Mineral resources
- Hydrological cycle
- Ecology
- Industry
- Safe, comfortable living environment

→ Address constructing the Foundation of safety, healthy environment, societal dynamism and the standard of living

Civil Engineering must acquire a comprehensive approach in order to achieve the goal for society, by “breaking through disciplinary boundaries.”

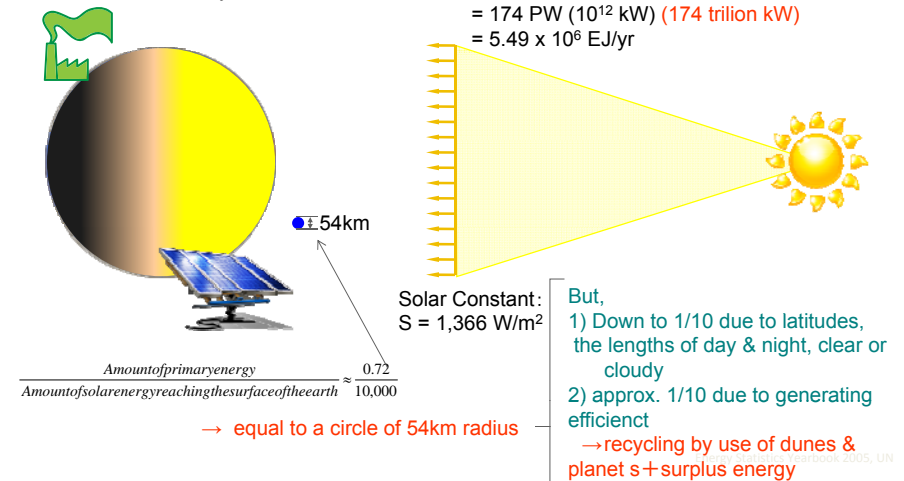
That is...  
creating a beautiful, healthy, safe, and vigorous society

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### Ratio of Solar Energy and the World's Energy Consumption

The amount of primary energy (2005)  
=  $9,980 \times 10^6$  Oil production / yr  
=  $13.2 \times 10^9$  kW (132 billion kW)  
=  $4.18 \times 10^{12}$  EJ/yr

Solar Energy  
= Solar constant x the unit area at the earth that solar energy  
=  $1,366 \text{ W/m}^2 \times 1.27 \times 10^{14} \text{ m}^2$   
= 174 PW ( $10^{12}$  kW) (174 trillion kW)  
=  $5.49 \times 10^{16}$  EJ/yr

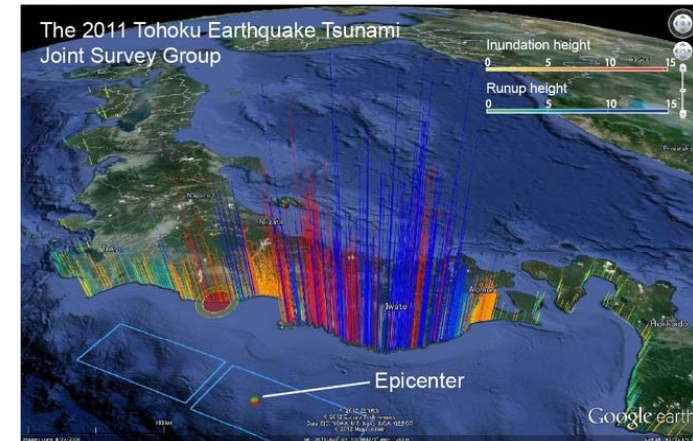


## II-2. Safety of Society

### Natural Disaster Mitigation Systems

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## Realization of a Resilient Society



**Field research on the tsunami traces**

Conducted by the Great East Japan Earthquake Tsunami damage survey group: JSCE Coastal Eng. Committee & the Japan Geoscience Union

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## Maintenance of Sound, Healthy Infrastructures and Improvement of Performance under Duress



**“Green Storm Surge Barrier”**  
along the Iwanuma coast  
Tree-Planting ceremony



**Sennen Kibo no Oka** (Hill of Millennial Hopes):  
8m above sea level



**Resilient dikes** on Natori Coast, South Sendai Bay Coast

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- Improvement of ICT and other technologies
- Establishment and Improvement of Comprehensive Disaster Mitigation Systems



**“Daiichi No. 2 captures detailed images of the landslides occurred in Izu-Oshima Island :**

Resolution at 3 mp , June 27, 2014 ©JAXA



**Radio Control Helicopter** for checking situations  
to determine business continuity capability

## II-3. JSCE' s International Contribution

### Japan's International Contribution

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## Restructure domestic business operation systems



Above: The 2<sup>nd</sup> Bosphorus Bridge/Highway  
Right: The underwater tube Marmaray line opening

Ref: JICE website  
(Above) [http://www.jica.go.jp/60th/europe/tur\\_01.html](http://www.jica.go.jp/60th/europe/tur_01.html)  
(Right) [http://www.jica.go.jp/press/2013/20131030\\_01.html](http://www.jica.go.jp/press/2013/20131030_01.html)



A speaker shows leadership at the World Road Association, aka PIARC



### ASCE-JSCE Cooperative Relationship

The two societies agree to cooperate with each other in ASCE's Global Engineering Conference in Panama and JSCE's 100<sup>th</sup> Anniversary Celebration; Akira Aoyama links the two societies, who worked on Panama Canal Construction project 100 yrs ago.

## II-4. Educating Engineers

### Responses to Meet Changing Natural and Social Environments

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**The creed of civil engineers**, set forth in 1938:

“Civil engineers must contribute to prompting the prosperity of the nation and adding to the welfare of mankind.”

That is, “**Civil engineers must ensure safety and prosperity of the people**”



**Diversity Committee, JSCE**  
**2013 Summer School for Female Junior High and High School Students.**

• The civil engineering profession, life and trivia game



**JSCE 100<sup>th</sup> Anniversary Commemorative Publication**, “Doboku Jyoshi : women in civil engineering,” Sept 10, 2014.

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Civil engineers need to acquire:

• an understanding of both local & global realities, civil engineering expertise and comprehensive knowledge

➡ **multidisciplinary perspectives**, natural sciences, humanities & social sciences

JSCE Student Chapters in colleges: students motivate themselves to plan and organize activities

e.g. Civil engineering hands-on experiences for Student Chapter and junior-high school students (in cooperation with Taisei Technology Center)



Ref: JSCE 100<sup>th</sup> Anniversary Celebration website:  
<http://jsce100.com/node/167>

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## “100-Year Vision on Civil Engineering and Society”

w/ a wide range of perspectives that cover safety, the environment, societal dynamism, and the standards of living  
< Constructing the foundation of a sustainable society >

### **Civil Engineers must...**

• Lucidly explain their thoughts to the public, and gain their understanding and support, and make contributions to society as the leaders of the leaders.

In order to achieve them,

• Jump over disciplinary barriers, and collaborate with adjacent disciplines for the continuous progress of civil engineering.

**Transcending the boundaries of civil engineering to construct the foundation for a sustainable society**

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# Thank you very much.

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