Disaster Vulnerability by Changes in Land Architecture

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Sub-committee 2

- Viewpoint: Changes in land architecture increase in nation's vulnerability to disaster.

- Task: To identify the vulnerabilities caused by change in society and change in land use

Contents

- Overpopulation in urban areas and under-population in rural areas
- Unforeseen external loads and aging infrastructures
- Decrease in public investment and shrinkage of construction industries

Overpopulation in urban areas and under-population in rural areas

1.Overpopulated urban areas are vulnerable to natural disasters

- Constant traffic congestion with narrow roads
- Densely populated wooden old houses with limited open spaces
- Jungle of concrete/steel structures with asphalt-covered road network
- High utilization of spaces, including underground
- Sprawling to hilly suburbs and low land areas below the sea level
- Concentration of economic activities and nation’s asset
- Portal for international network

Urbanization in progress

	1970	2000	2030 (projection)
World average	36.8	47.2	60.2
Developing region	25.1	40.4	56.4
Japan	71.2	78.8	84.8
China	17.4	35.8	59.5
Thailand	13.3	19.8	33.1
India	19.8	27.7	40.9

United Nations, Definition of urban population varies among countries.

(Hanaki,2006)

World megacities

2000			2015 (projection)		
Rank	Agglomeration and country	Population (millions)	Rank	Agglomeration and country	Population (millions)
1	Tokyo, Japan	26.4	1	Tokyo, Japan	27.2
2	Mexico City, Mexico	18.1	2	Dhaka, Bangladesh	22.8
3	Sao Paulo, Brazil	18.0	3	Mumbai, India	22.6
4	New York, USA	16.7	4	Sao Paulo, Brazil	21.2
5	Mumbai, India	16.1	5	Delhi, India	20.9
6	Los Angeles, USA	13.2	6	Mexico City, Mexico	20.4
7	Calcutta, India	13.1	7	New York, USA	17.9
8	Shanghai, China	12.9	8	Jakarta, Indonesia	17.3
9	Dhaka, Bangladesh	12.5	9	Calcutta, India	16.7
10	Delhi, India	12.4	10	Karachi, Pakistan	16.2

Source: United Nations. Asian cities are highlighted with yellow.

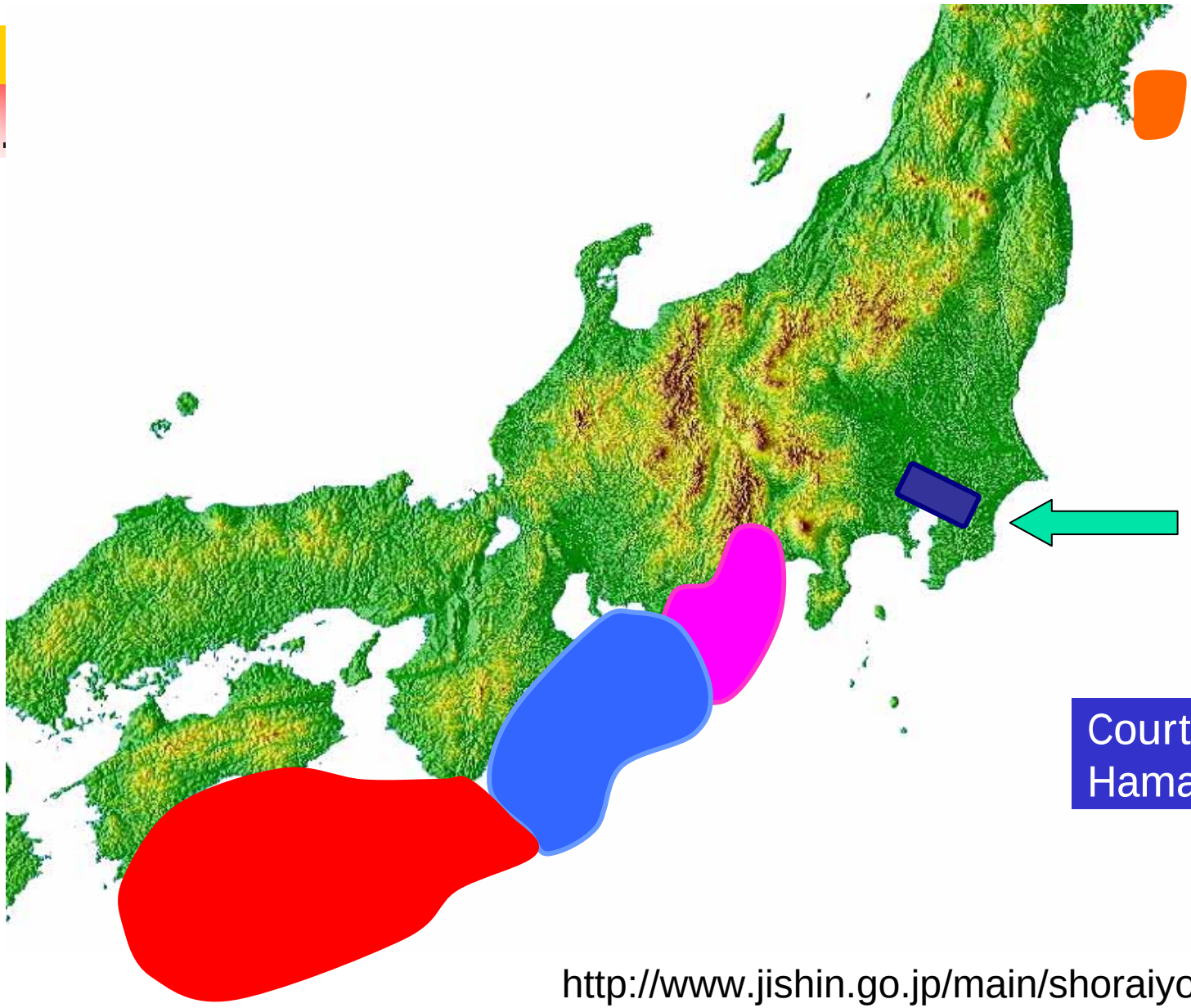
(Hanaki,2006)

City of Kobe and Kobe port immediately after 1995Hyogo-ken Nanbu Earthquake

Situations in Japan

- Since 1960s of high economic growth, a large number of people have moved to big cities such as Tokyo, Osaka and Nagoya, resulting that 80% of whole population lives in urban areas at present.
- 8,000 ha of densely populated areas are, in particular, in danger during earthquake and subsequent fire. 60 % of which are either in Tokyo and Osaka areas.
- 3 million people live below the sea level in Tokyo and Osaka.
- 25% of 47 millions houses and building still requires reinforcements against earthquake.

Anticipated earthquakes (Headquarters of Earthquake Research Promotion)



Courtesy of Prof. Hamada

http://www.jishin.go.jp/main/shoraiyosoku/orikomi.pdf

Estimated damages (worst scenario, earthquake in Tokyo bay)

- 0.85 million houses and buildings collapse
- 11 thousand people die
- Economic loss of 1.5 times nation's budget

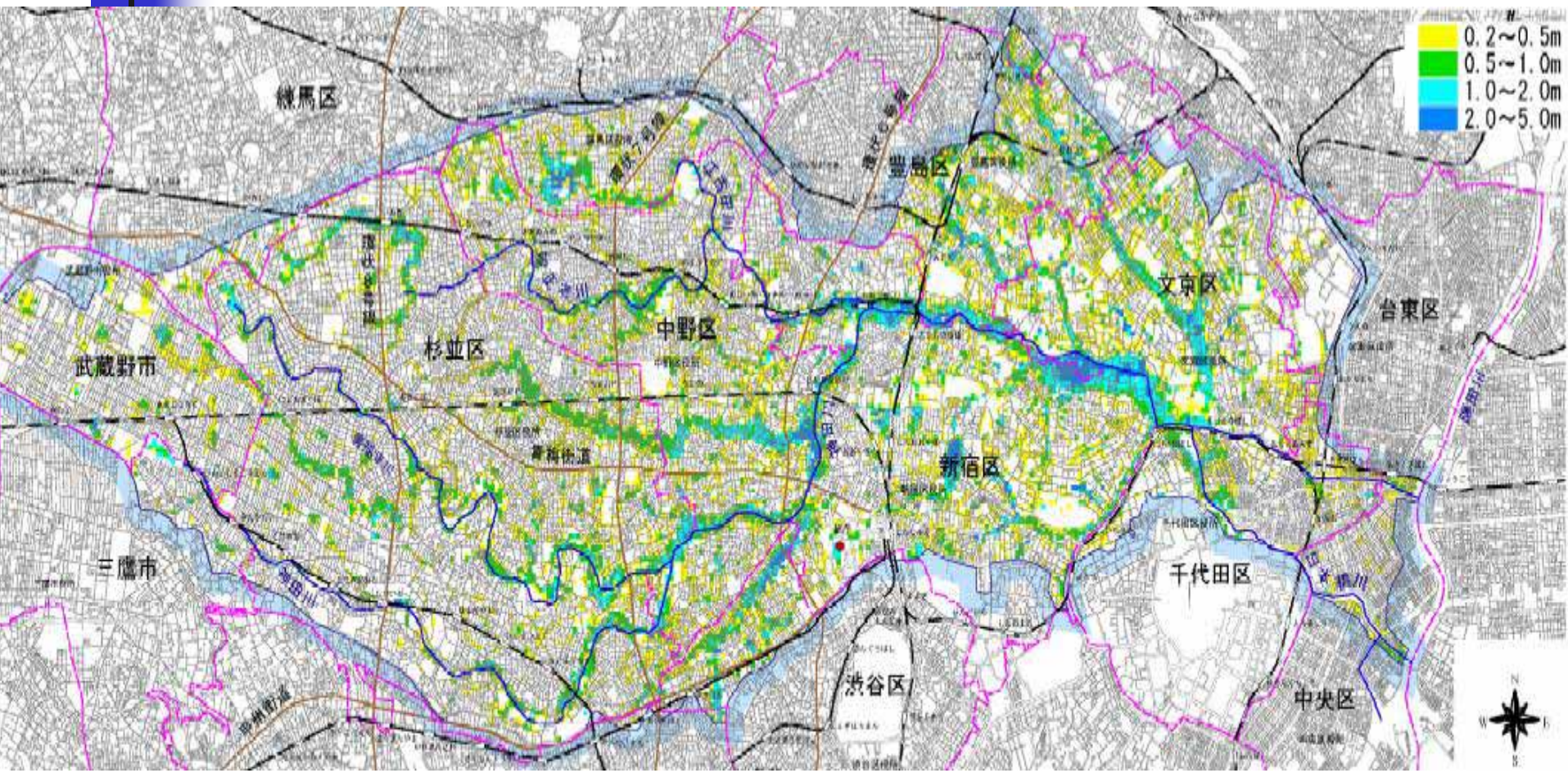
Levels of Danger for Collapse

From the report by Tokyo Metropolitan Gov.

Urban areas covered with asphalt are vulnerable also to rainfall

- Data indicate the increase in intensity of rainfall in urban areas over the last few decades, partly due to ‘heat island’ effect.
- Current design rainfall for small or medium size rivers is 50 mm/ hour with a return period of 10 years.
- Data show frequent occurrence of rainfall more than 100 mm/ hour in recent years.
- Water level rising with a short period of time
- Ingress of water into underground facilities such as underground shopping center/ subway

Estimated flooded areas for rainfall of 114 mm/ hour



From Tokyo Metropolitan Gov.

2.Under-populated rural areas are vulnerable to natural disasters

- Mountainous and coastal areas, agricultural and forestry and fishing villages
- Faster aging society with a sharp declining birth rate
- Change in industrial structures, devastated agricultural field and forest
- Weakening local community in management
- Difficulty in disseminating urgent information
- Lack of emergency medical care and lack of proper risk management
- Prolong the restoration works

Noto earthquake in 2007

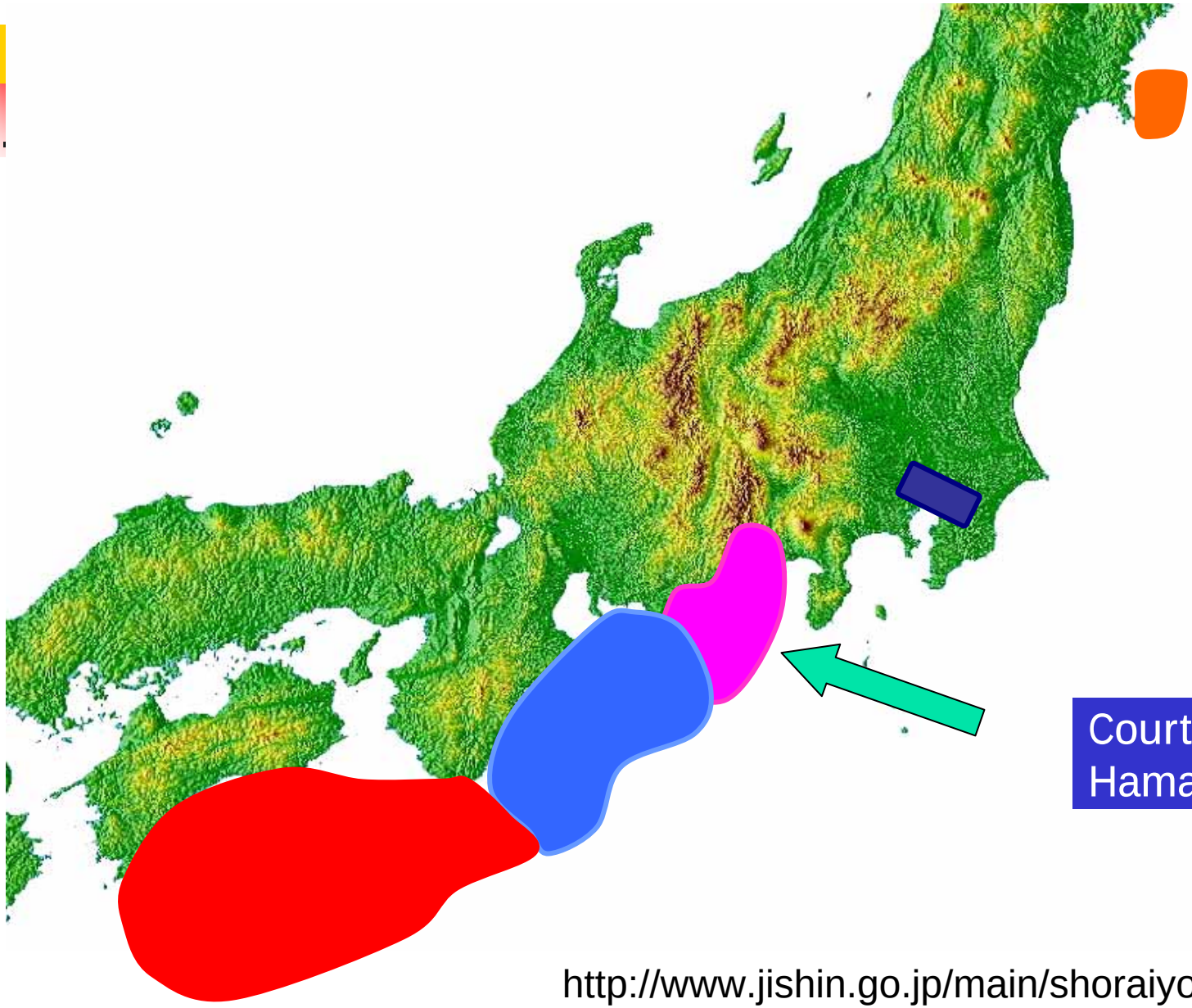
http://www.pwri.go.jp/team/volcano/notohantooki/notohantooki.htm

Unforeseen external loads and aging infrastructures

Design seismic load

- comparable to seismic intensity experienced in Kobe earthquake
- Still remains a large number of areas where soil improvement is needed against liquefaction
- Unforeseen earthquakes larger than Kobe earthquake
- Earthquakes with a longer period, storage facilities, high-rise buildings and long bridges are susceptible

Anticipated earthquakes (Headquarters of Earthquake Research Promotion)



Courtesy of Prof. Hamada

http://www.jishin.go.jp/main/shoraiyosoku/orikomi.pdf

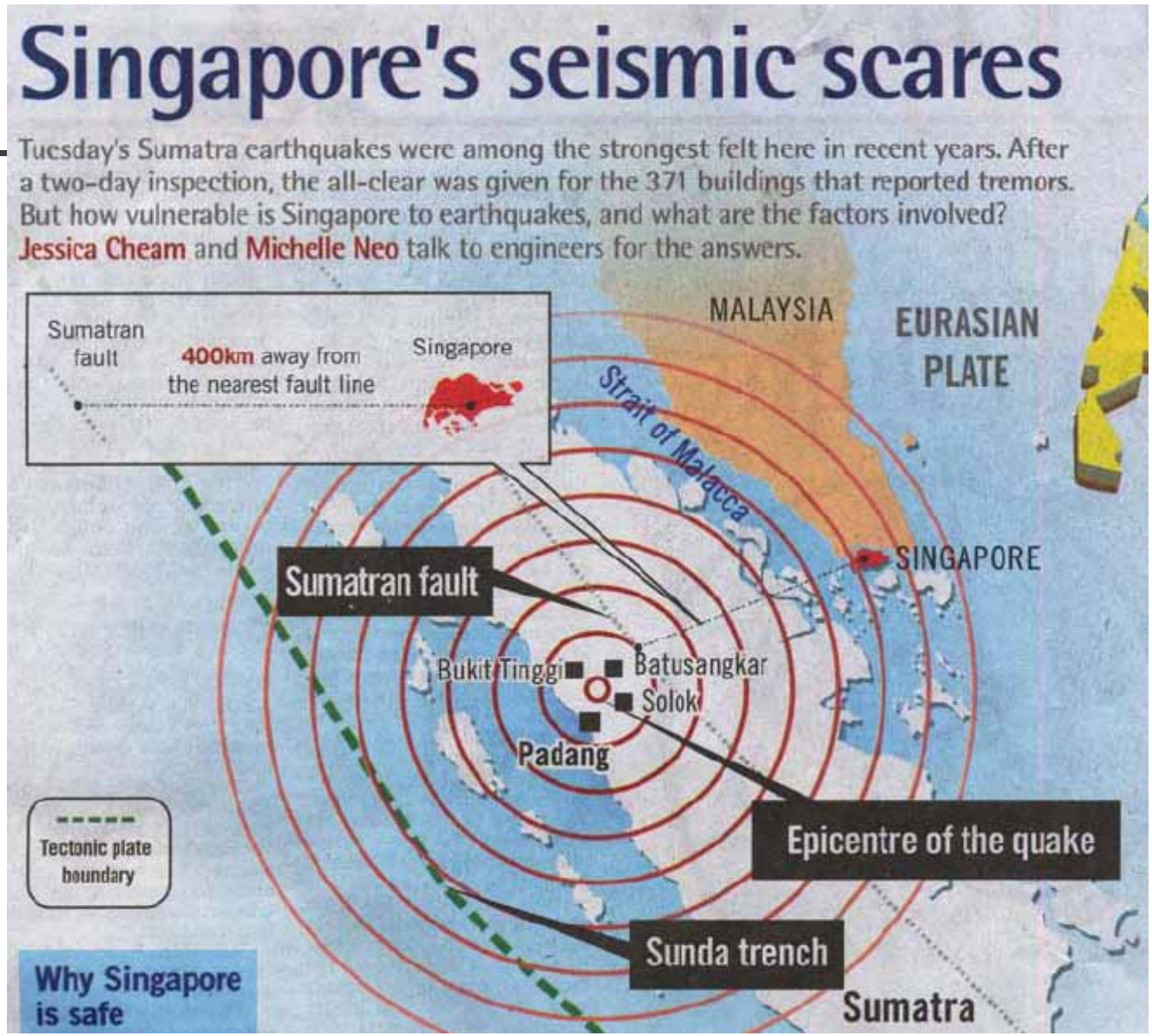
Damage to storage facilities due to sloshing

Courtesy of Prof. Hamada

Storage facilities around Tokyo Bay

(Courtesy of Prof. Hamada)

Recent earthquakes at Sumatra

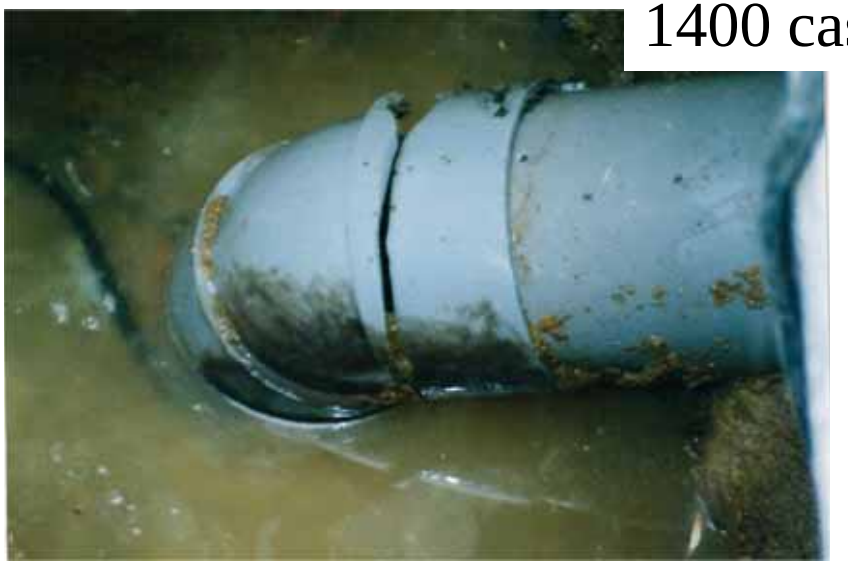


Aging infrastructures

- Every infrastructure is aging with a deterioration of its function due to aging structural materials.
- Maintenance, retrofitting, renewal are of essence for lifelines, disaster prevention structures, evacuation places, sensors and monitoring systems.

Infrastructures started aging from 1970s

Subsidence due to leakage
1400 cases per year in Tokyo



More than 60 years old buried pipes for water, sewer and gas

Disaster prevention facilities are also deteriorating

- Sabo-dam damaged by earthquake

Indonesia, 2006

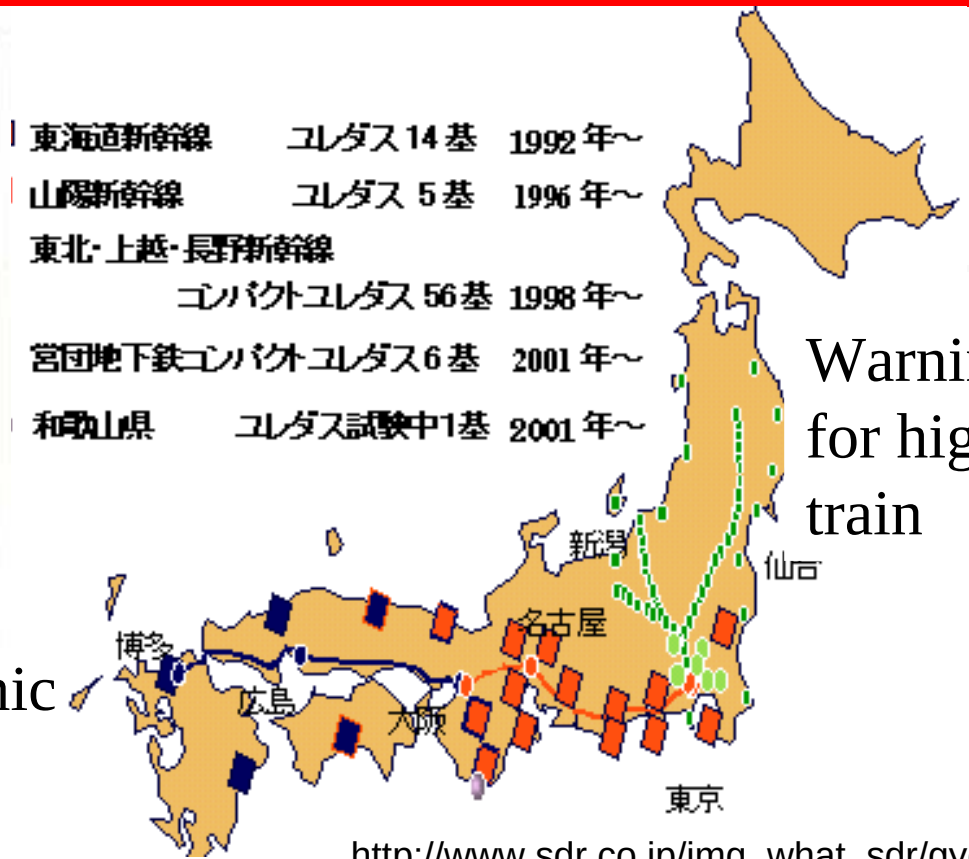
Collapse of gymnasium for emergency evacuation

Over 4000 school buildings need reinforcement against seismic intensity of 6

Kobe earthquake in 1995, Courtesy of Prof. Kawaguchi

Sensors and monitoring systems are also aging

Early warning seismic intensity meter



Warning system for high speed train

http://www.sdr.co.jp/img_what_sdr/gyoumu_ure.html

Extensometer

http://www.osasi.co.jp/contents/product/related_product/netlg_501.html

Decrease in public investment and shrinkage of construction industries

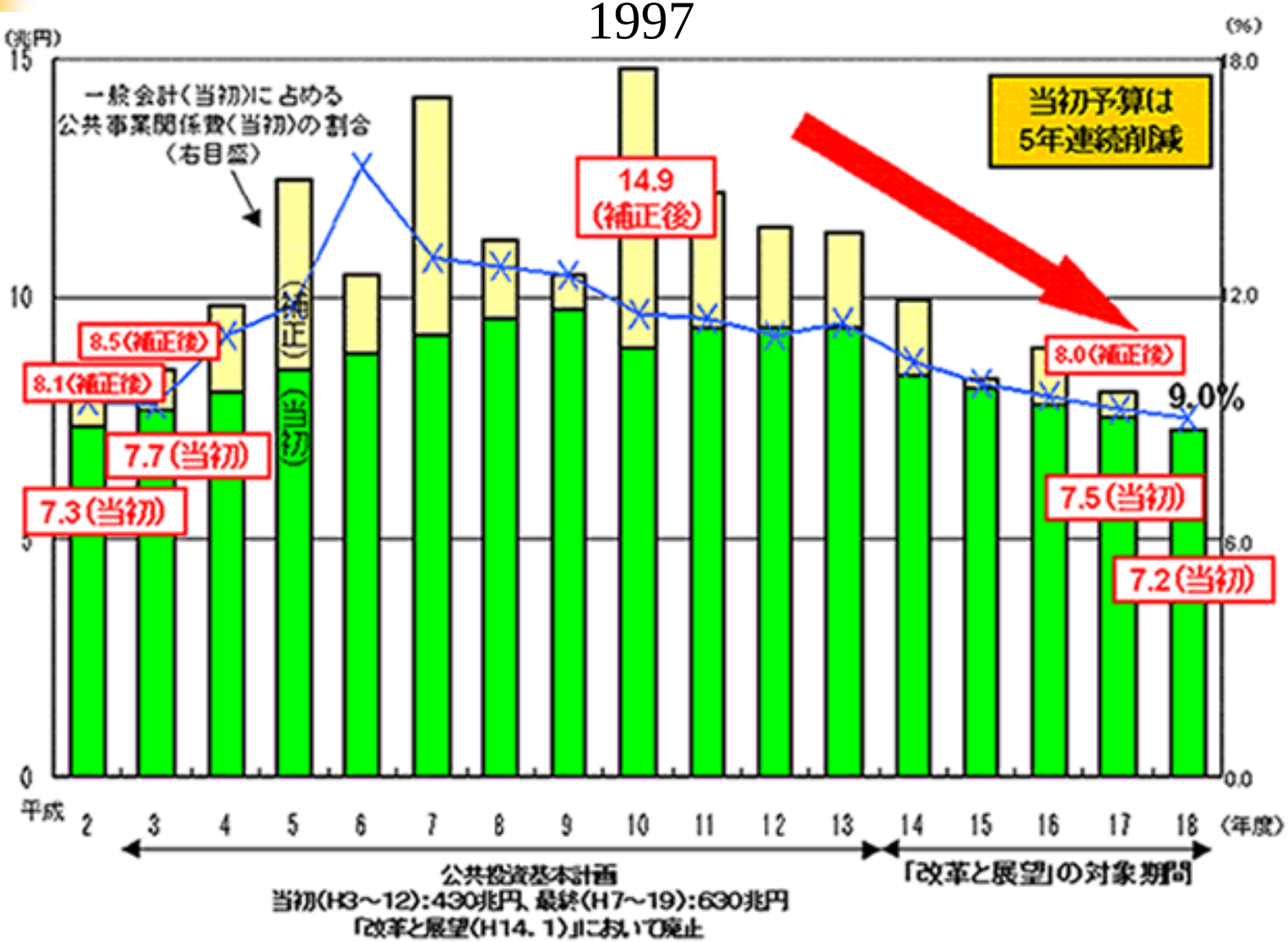
Public and decision makers' attitude and behaviour

- They do not appreciate the value and benefit of investment for disaster mitigation until disasters actually occur.
- When financial situations become tight, they cut the budget for disaster mitigation first. (It is not a urgent need !)

Financial situations in Japan

- Burst of ‘bubble economy’ in early 1990s
- Sharp shrinkage of overall budget both in national and local government
- Continuous decrease in public investment over more than ten years
- Cut budget and personnel for disaster mitigation

Government budget for public investment
50% drop from the peak in 1997



http://www.kuniomi.gr.jp/chikudo/news/2006/img/siryo01.html

Implication to disaster

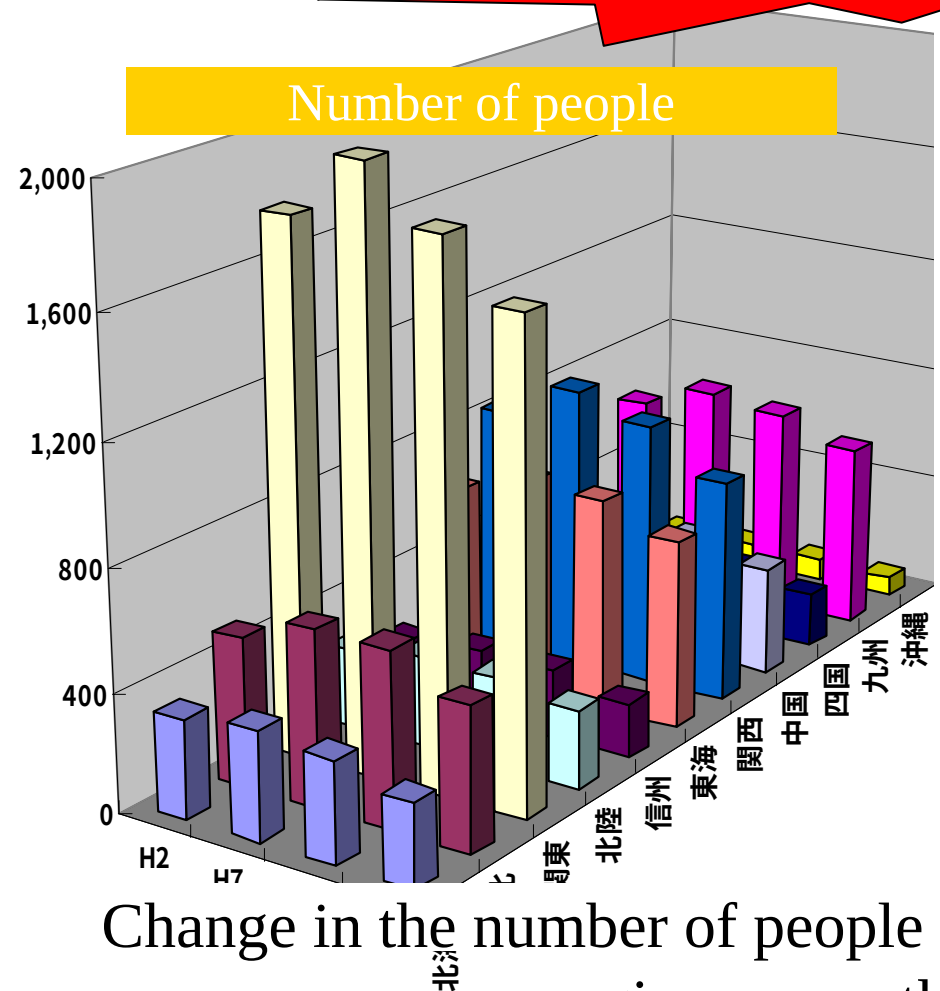
- Decrease in the number of personnel in local governments to react against disaster
- Shrinkage of construction industry
- Decrease in the number of engineers and workers for emergency measures and urgent restoration works after disaster

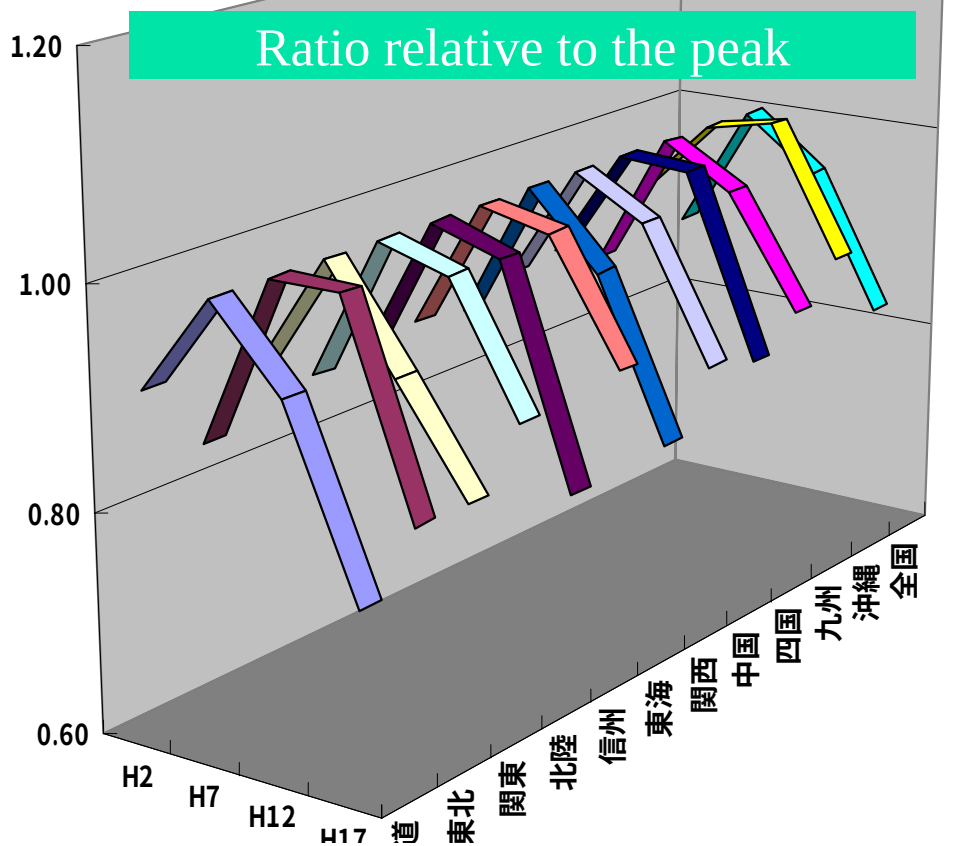
Estimated damages (worst scenario, Earthquake in Tokyo bay)

- Economic loss of 1.5 times nation's budget
- Estimated number of engineers and workers required for restoration with one year period, based on past experience after Niigata earthquake
- 1.5 million

Current number of engineers and workers in construction industry　　Tokyo area ＝ 1.6 million

Approaching to the minimum level





Change in the number of people in construction industry at various regions over these fifteen years

Concluding remarks

- Both overpopulated urban areas and under-populated rural areas are vulnerable to natural disaster.
- We must prepare unforeseen external loads for reinforcing existing infrastructures and invest for maintenance/ renewal of aging infrastructures for disaster mitigation.
- We must maintain a critical mass of engineers and workers for restoration after disaster.