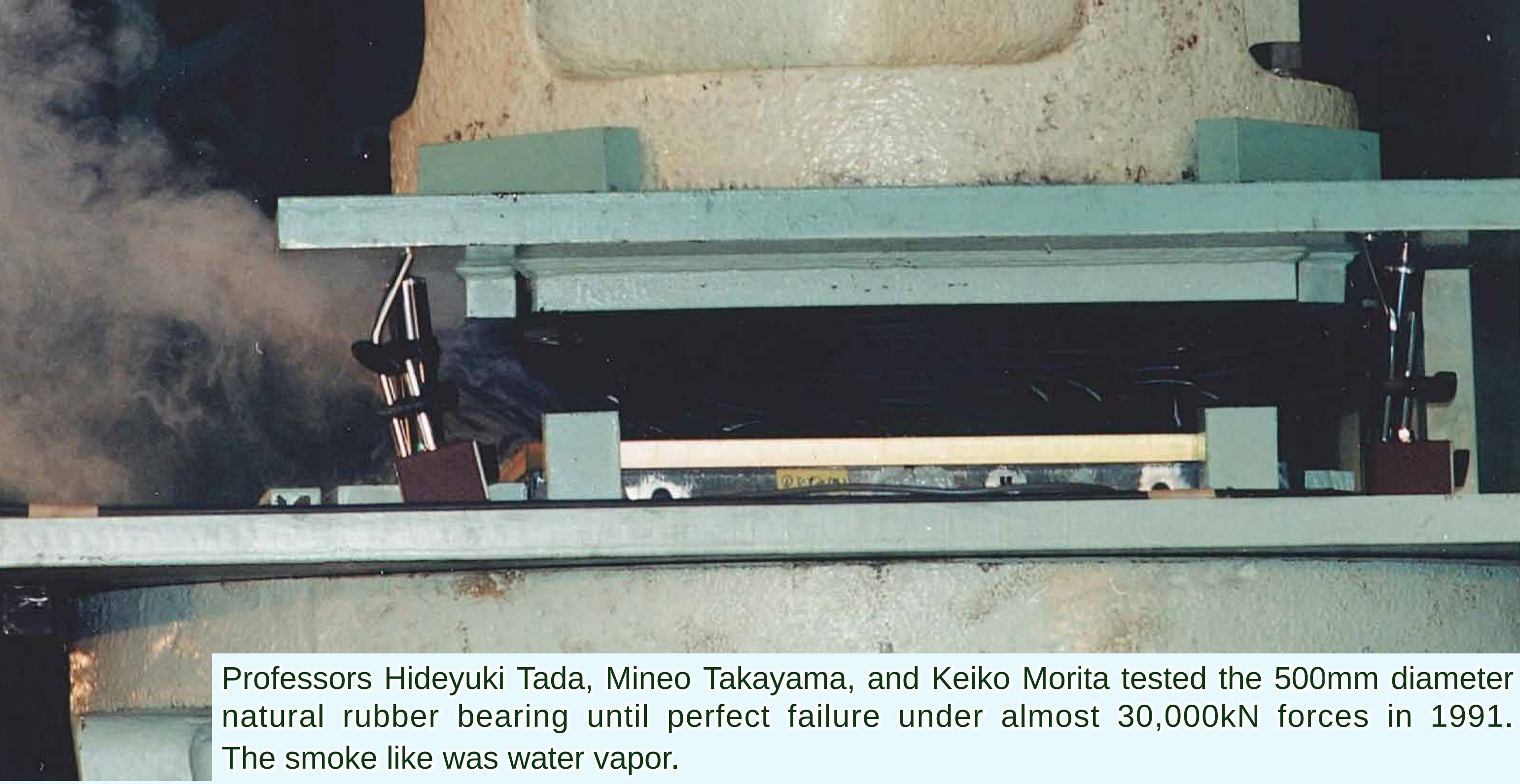


Our long-desired, high-performance, real-scale test machine started in Japan.

We, the E-Isolation research groups, respect the many professors and engineers who have attempted to test real-size devices using or constructing large dynamic testing machines in these four decades. Prof. Hideyuki Tada's ultimate test of a real-size rubber bearing in the 80,000kN strong compressing machine of the Mitsubishi Heavy Industry in 1991. He found that the maximum compression stress exceeded 150MPa, and the steel sim plates broke suddenly, but the rubber remained intact.

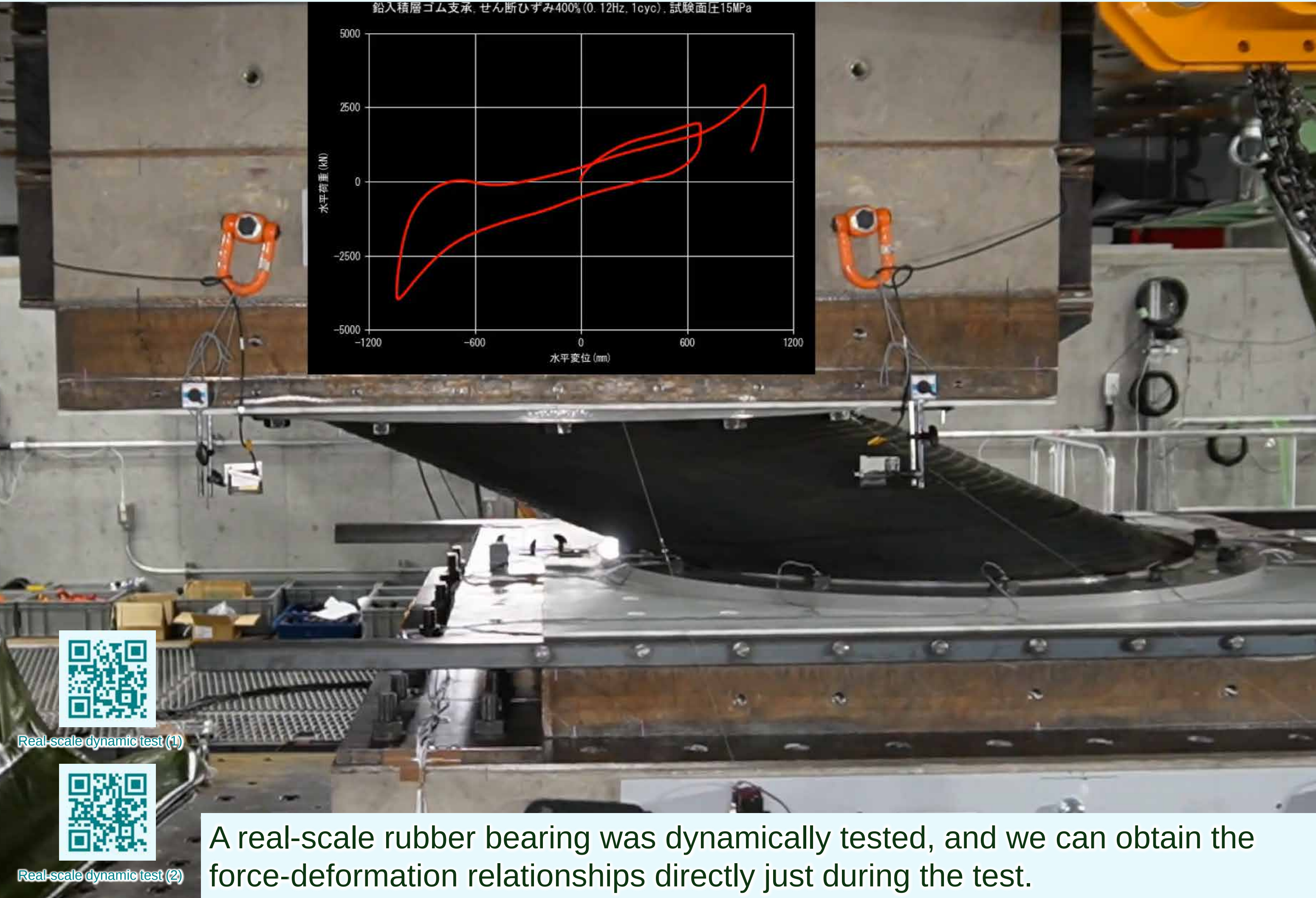
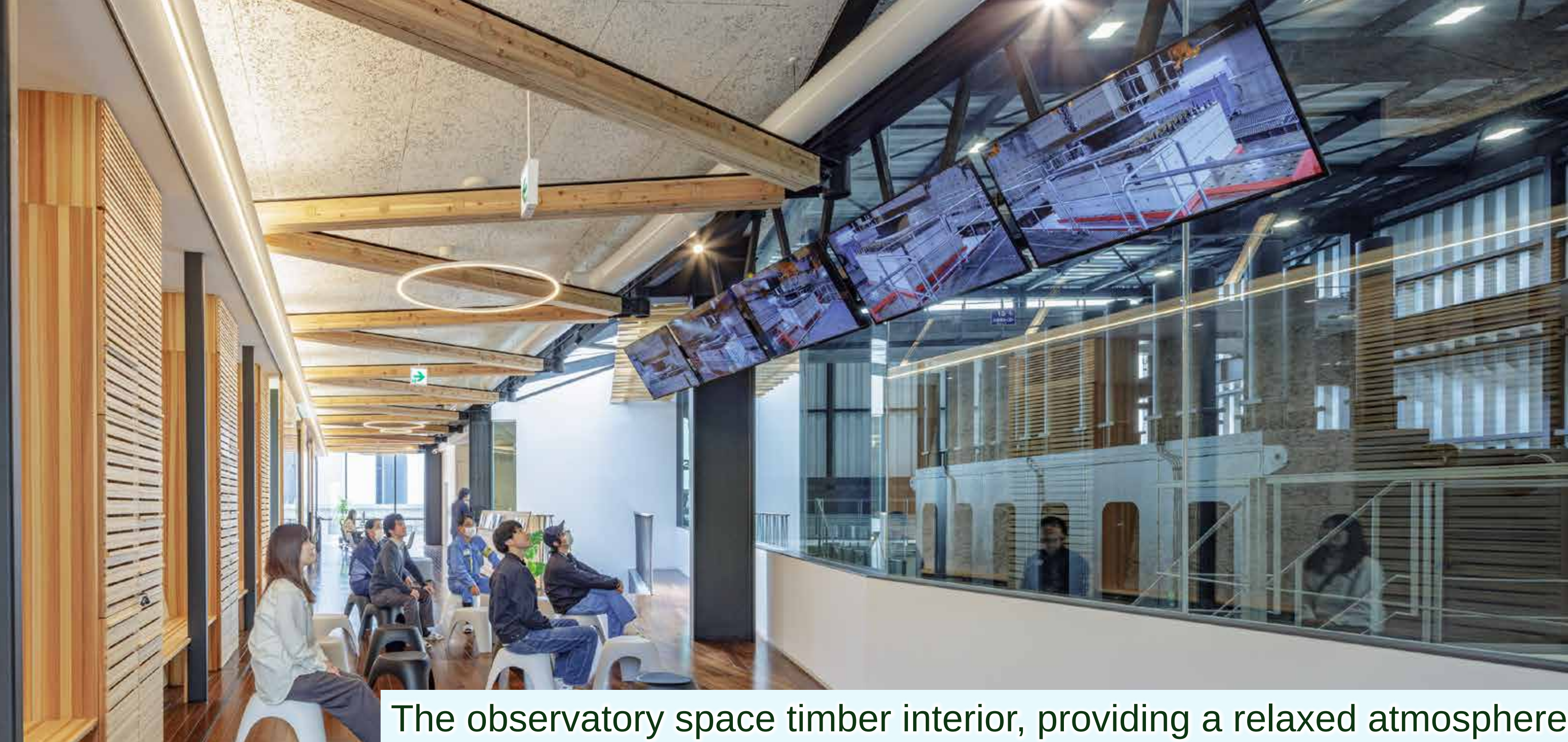
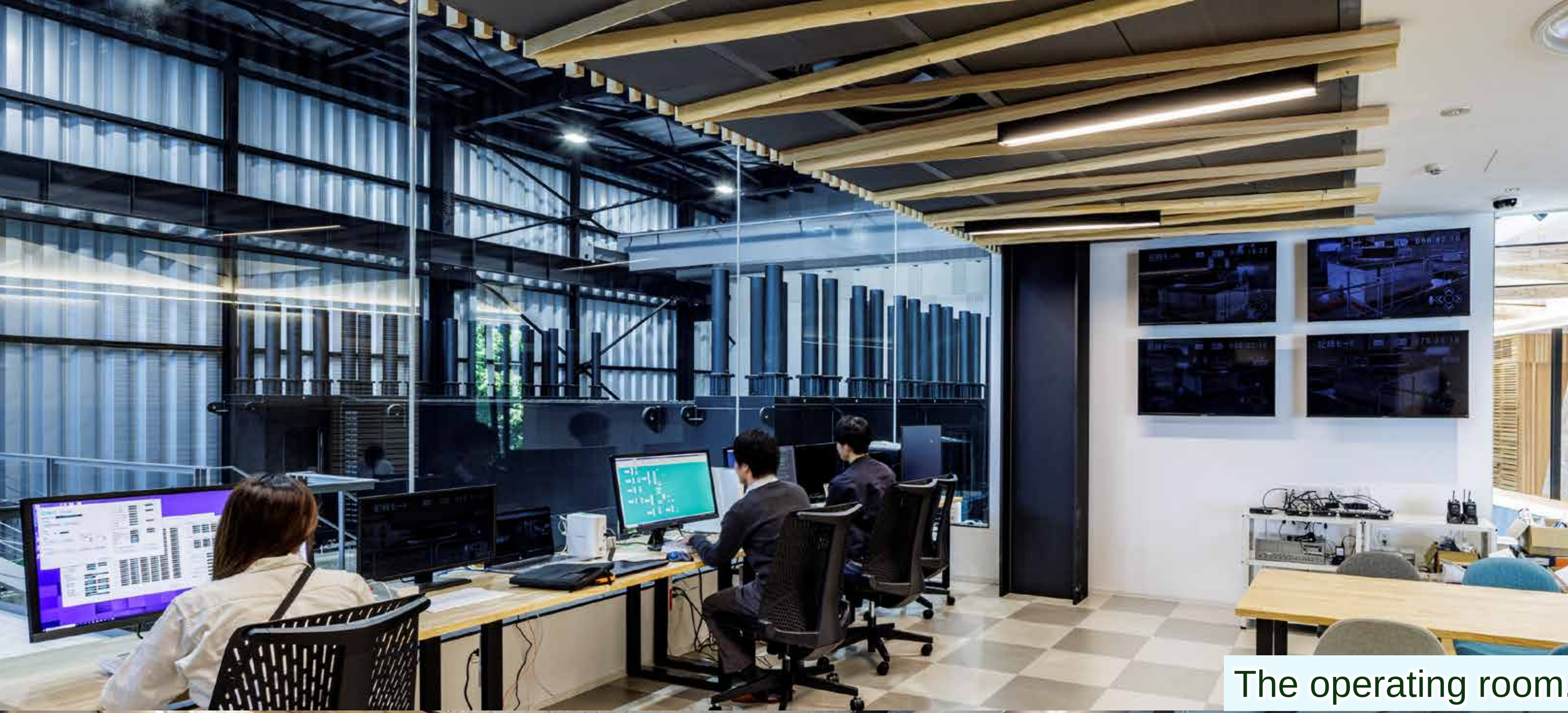
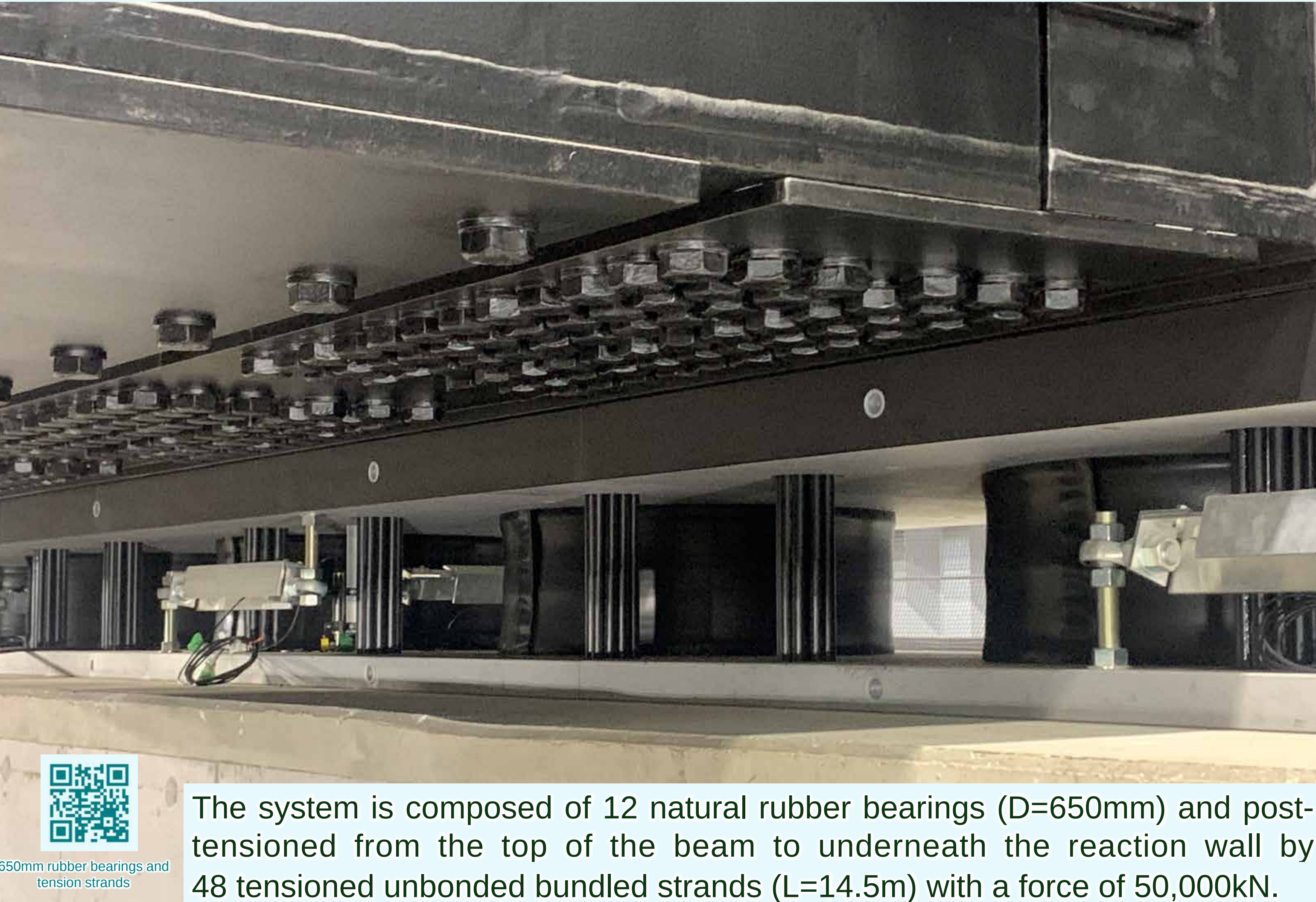
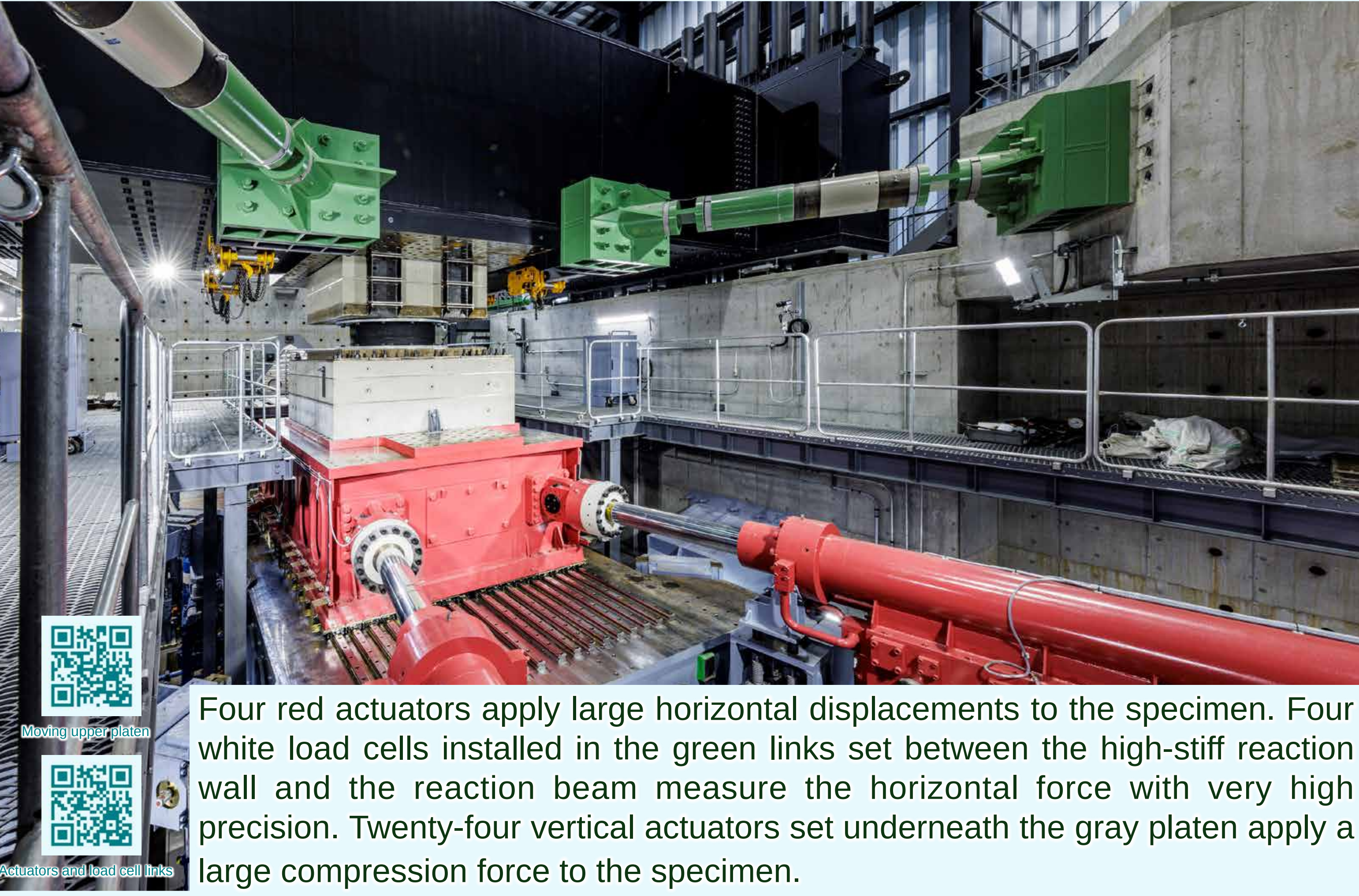


Professors James Kelly, Toshio Nishi, Fulin Zhou, Alessandro Martelli, Stephen Mahin, Hirokazu Iemura, Yozo Fujino, Michael Constantinou, Victor Zayas, Haruyuki Kitamura, Kazuhiko Kasai, Toshimi Kabeyasawa, Mineo Takayama, Masaru Kikuchi, Mitsuyoshi Akiyama, Hideo Fujitani, Keisuke Yoshie, Keiko Morita, Taiki Saito, and Structural Engineers Shoichi Yamaguchi, Ian Aiken, Akinobu Nakazawa, Hideo Katsumata, Takayuki Sakakima, Yasutsugu Kurokawa, Akihiko Kondo, Hiroyuki Ueda, Hideo Kobayashi, Xianqun Guo, Masashi Yamamoto, Tsuyoshi Sano, Shigeki Sugiura, Yasushi Ichikawa, Atsushi Watanabe, Ryota Maseki, Yusuke Noguchi, Nobuo Murota, Namihiro Inoue and many professors and engineers have been promoting to construct big testing machines for many years. USA engineers constructed SRMD at the University of California San Diego first in 2000. Now, more than 15 large testing machines are used in the USA, China, Italy, and Türkiye. Most current good news is that Prof. Fulin Zhou, Guangzhou University constructed 100,000kN testing machine in 2024.

Professors Yoshikazu Takahashi, Toru Takeuchi, Shoichi Kishiki, Masako Yoneda, Yozo Shinozaki, Koichi Kajiwara, and Akira Wada and many active people constructed the E-Isolation close to Kobe City in April 2023. So many engineers and companies continuously support the activities of the E-Isolation, and engineers Tsutomu Nakanishi, Makoto Hamada, Satoshi Sasaki, Shinsuke Inai, Shunichi Higuchi, and Keiichi Hirose strongly support us as members of the board committee. The E-Isolation is being improved functionally and operated very well by Kenji Sawada, Kazuo Tamura, Toru Tsuchihashi, Takaaki Miyabara, Masanobu Hayashizaki, Hidemi Niinai, Sakae Ueda, and many users. We appreciate very much to the excellent young researchers, Tsubasa Tani, Yuki Terasawa, Keita Uemura, Miku Kurosawa, Tomoya Ueda, Maho Kobayashi, Kazushi Sakai those who are executing good studies using the E-Isolation.

Council for Science, Technology and Innovation (CSTI) and Cross-ministerial Strategic Innovation Promotion Program (SIP) supported the project. We appreciate Cabinet Office, Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Ministry of Education, Culture, Sports, Science and Technology (MEXT), and National Research Institute for Earth Science and Disaster Resilience (NIED).

Officials of Housing Bureau of MLIT and engineers will apply the results of the dynamic test of real-size specimens or devices to the building permission process for seismic-isolated structures from 2026.

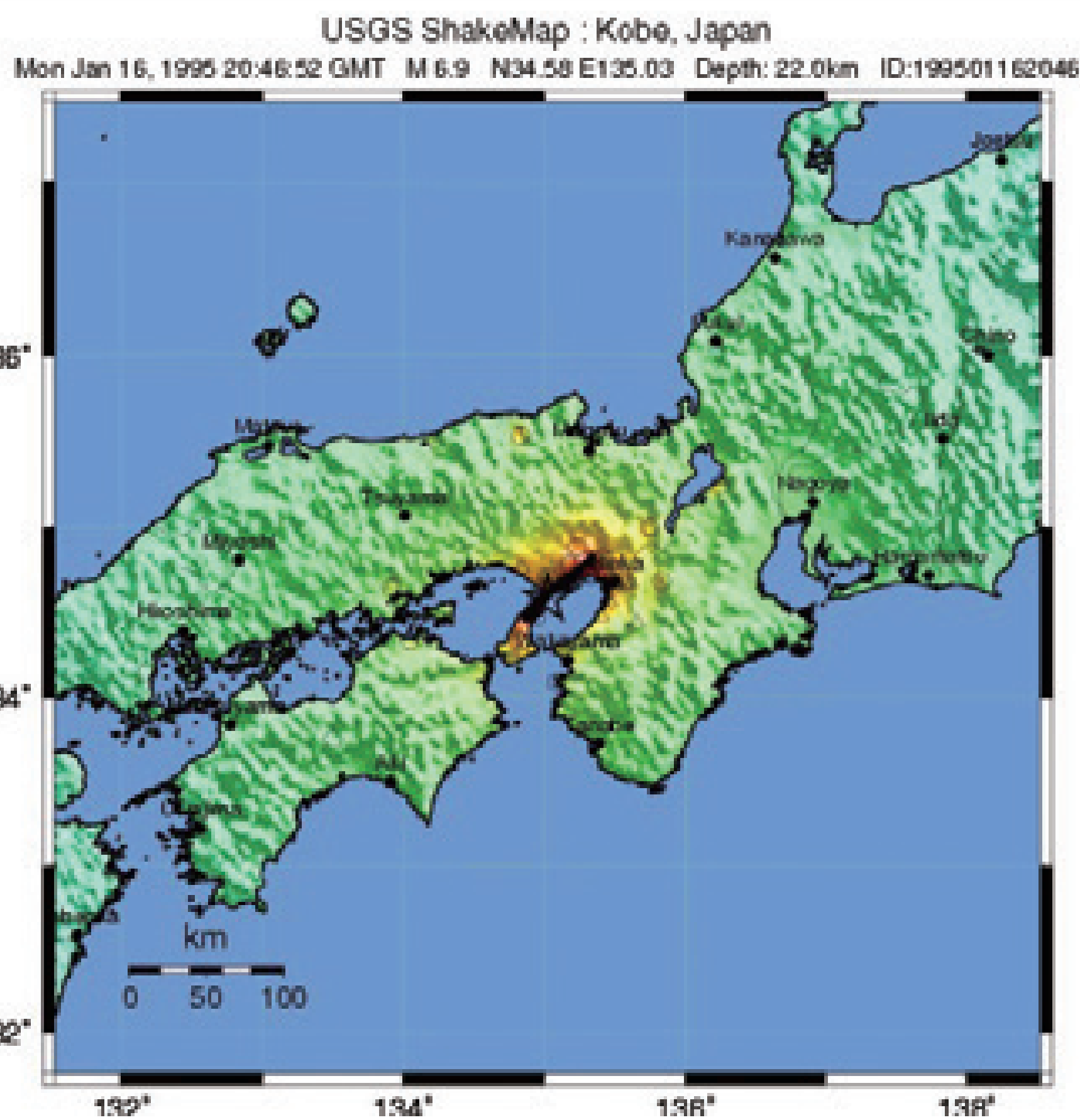


The Japan Society of Seismic Isolation & Japan Seismic Isolation Laboratory

Seismic Isolated vs Fix-Based in 30 Years in Japan

1995 Kobe Great Earthquake

It was the first time in Japan that the effectiveness of seismic-isolated buildings were demonstrated.
The evidences led the rapid spread of seismic-isolated buildings into Japan.



(Reference: USGS Shake Map)

Outline of the earthquake

- Date of occurrence : January 17, 1995
- Moment Magnitude : Mw6.9
- Type of earthquake : Inland earthquake
- Fault length : 50km
- Fault depth : 16km
- Damage : 6,434 deaths
104,906 houses completely destroyed

Many houses, buildings and infrastructures had been destroyed in Kobe



(Photo by Kobe City)

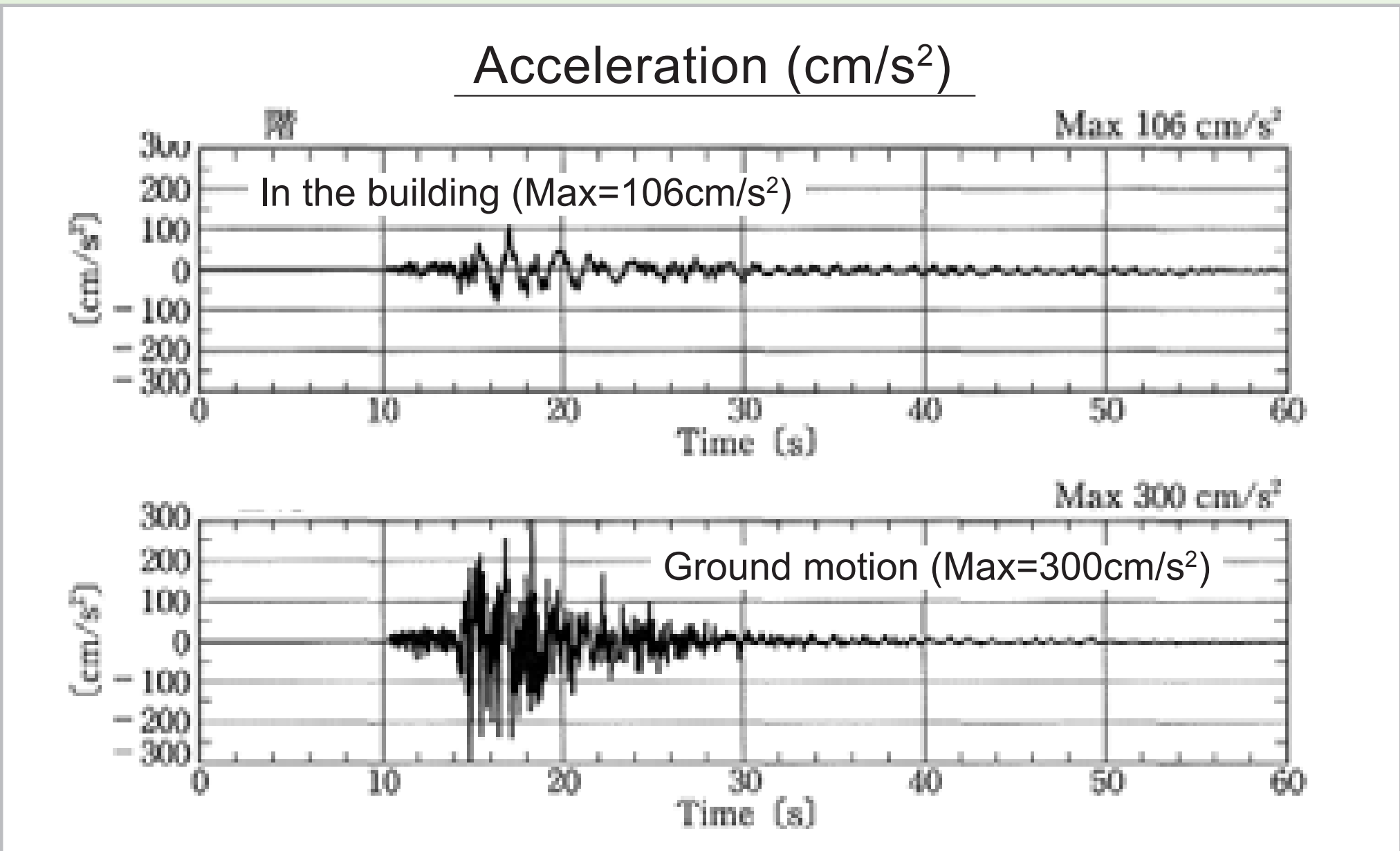
Beautiful performances of seismic-isolated buildings

There were only two seismic-isolated buildings in Kobe city in 1995.
Both isolated buildings performed very well.

WEST Building



(photo by Ian Aiken)



The acceleration above the seismic-isolated layer was reduced to about 30% of the acceleration at the foundation.

Matsumura-Gumi Technical Research Institute

Fixed-based Seismic-isolated



(Photo by MATSUMURA-GUMI Corporation)



▲ Seismic isolation layers and devices

The Matsumura-Gumi construction built two buildings of the same shape in its research center, one of which was fixed-based and the other was seismic-isolated, to collect vibration data under an earthquake.

Acceleration (cm/s²)

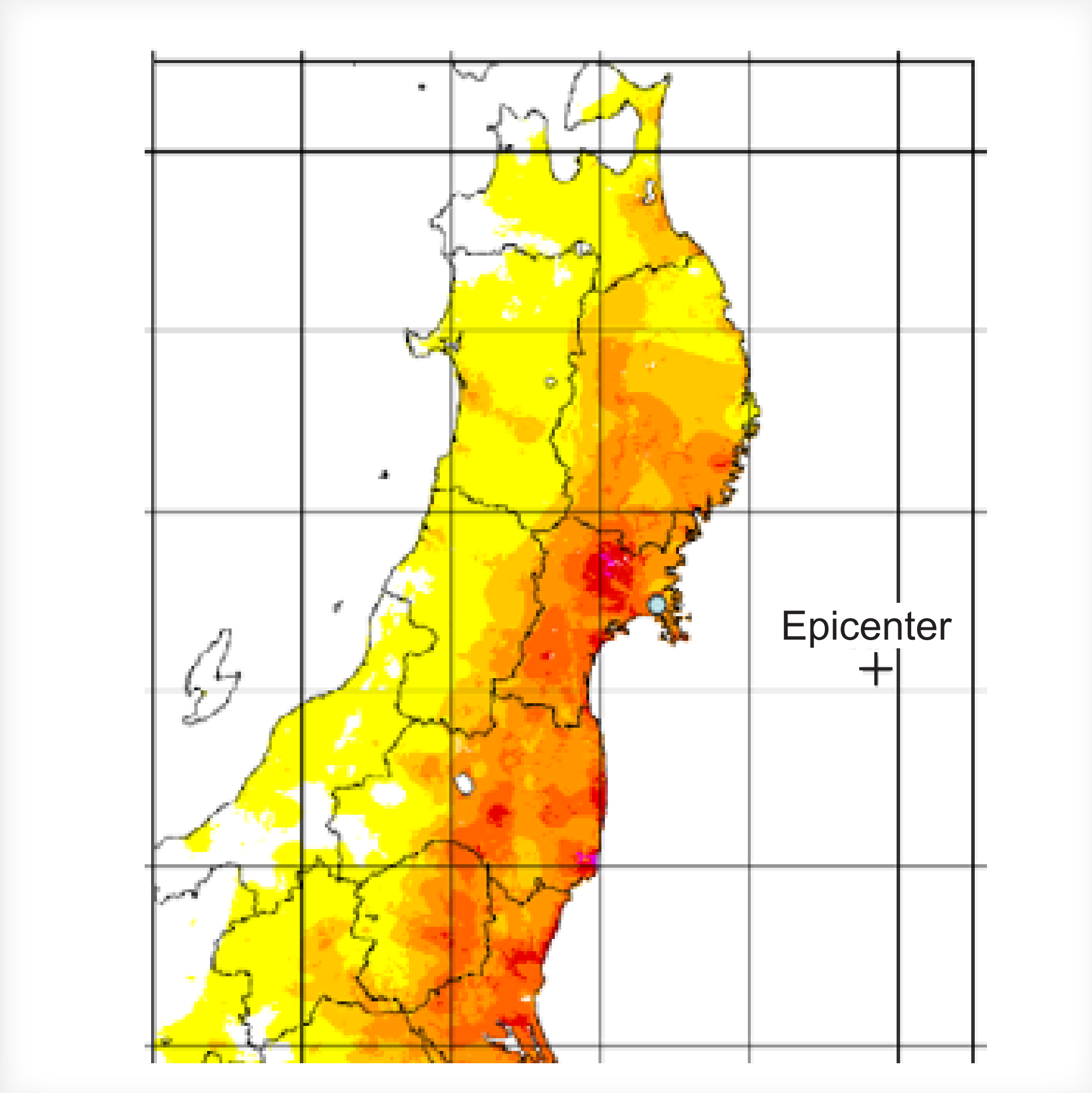
Building	Location	Direction	
		NS	EW
Seismic-isolated	Roof	198	273
	1st	148	253
Fixed-based	Roof	965	677
Foundation		272	213

The Japan Society of Seismic Isolation & Japan Seismic Isolation Laboratory

Seismic Isolated vs Fix-Based in 30 Years in Japan

2011 Great East Japan Earthquake

The largest earthquake ever recorded in Japan. The tsunami caused severe damage. There were many seismic-isolated buildings in the areas with large earthquake ground motion, but all of them overcome the earthquake, and kept their functions perfectly.



(Reference: Japan Meteorological Agency Web site
https://www.data.jma.go.jp/eqev/data/2011_03_11_tohoku/201103111446_suikei.png)

Outline of the earthquake

Date of occurrence	: March 11, 2011
Moment Magnitude	: Mw9.0
Type of earthquake	: Plate boundary earthquake
Fault length	: 450km
Fault depth	: 24km
Damage	: Over 22,000 deaths and missing 125,053 houses completely destroyed

The Ishinomaki Red Cross seismic-isolated hospital maintained its functions perfectly even after the earthquake and served as a disaster base hospital for the region.

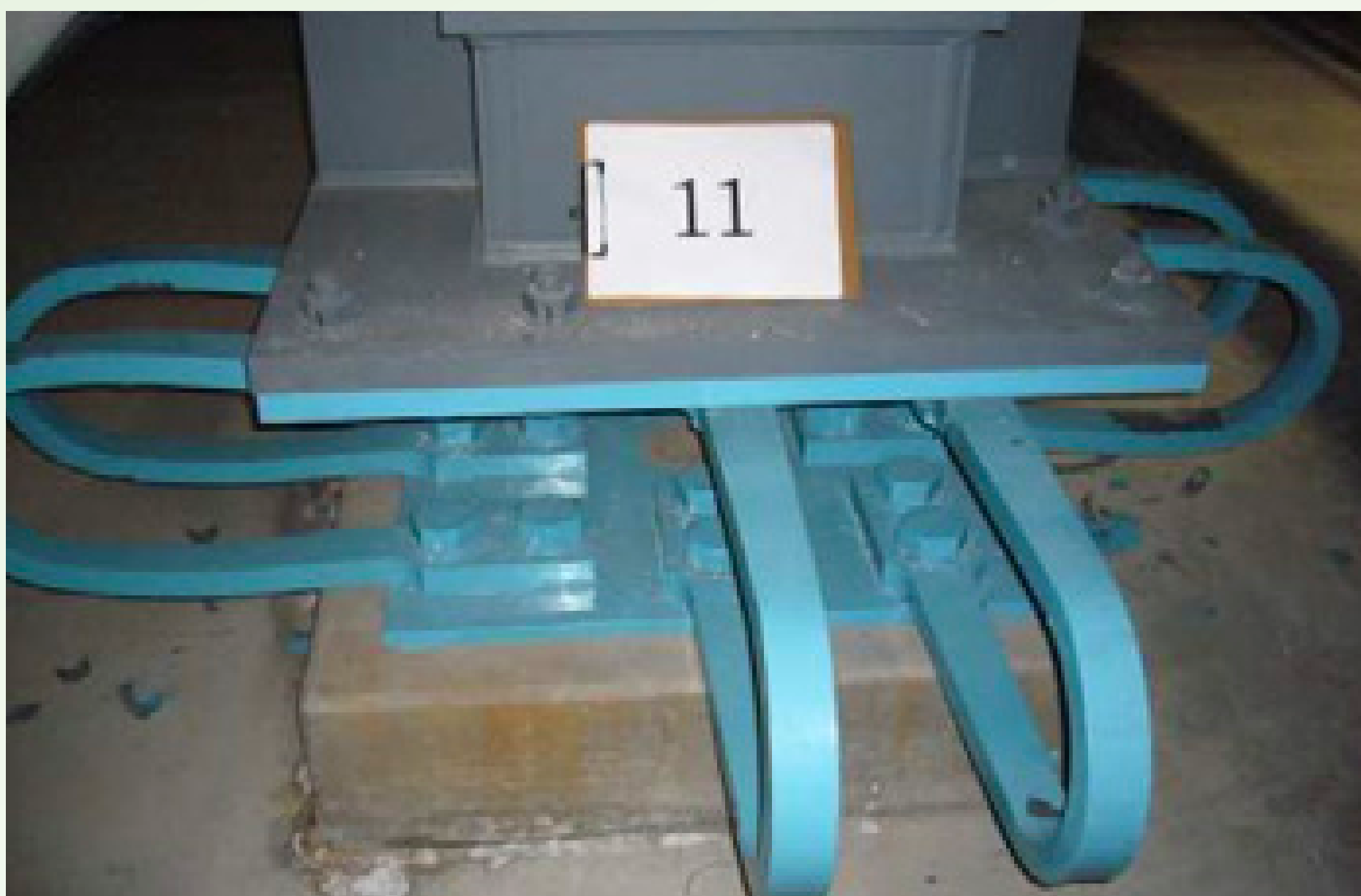
- The seismic-isolated hospital was able to continue providing medical care as a local disaster base hospital.
- The first-floor entrance hall had been planned as a space for treatment in the event of the disaster.
- The steel dampers dissipated huge earthquake energy and still active against the next earthquakes.



(Photo by Japanese Red Cross Ishinomaki Hospital)



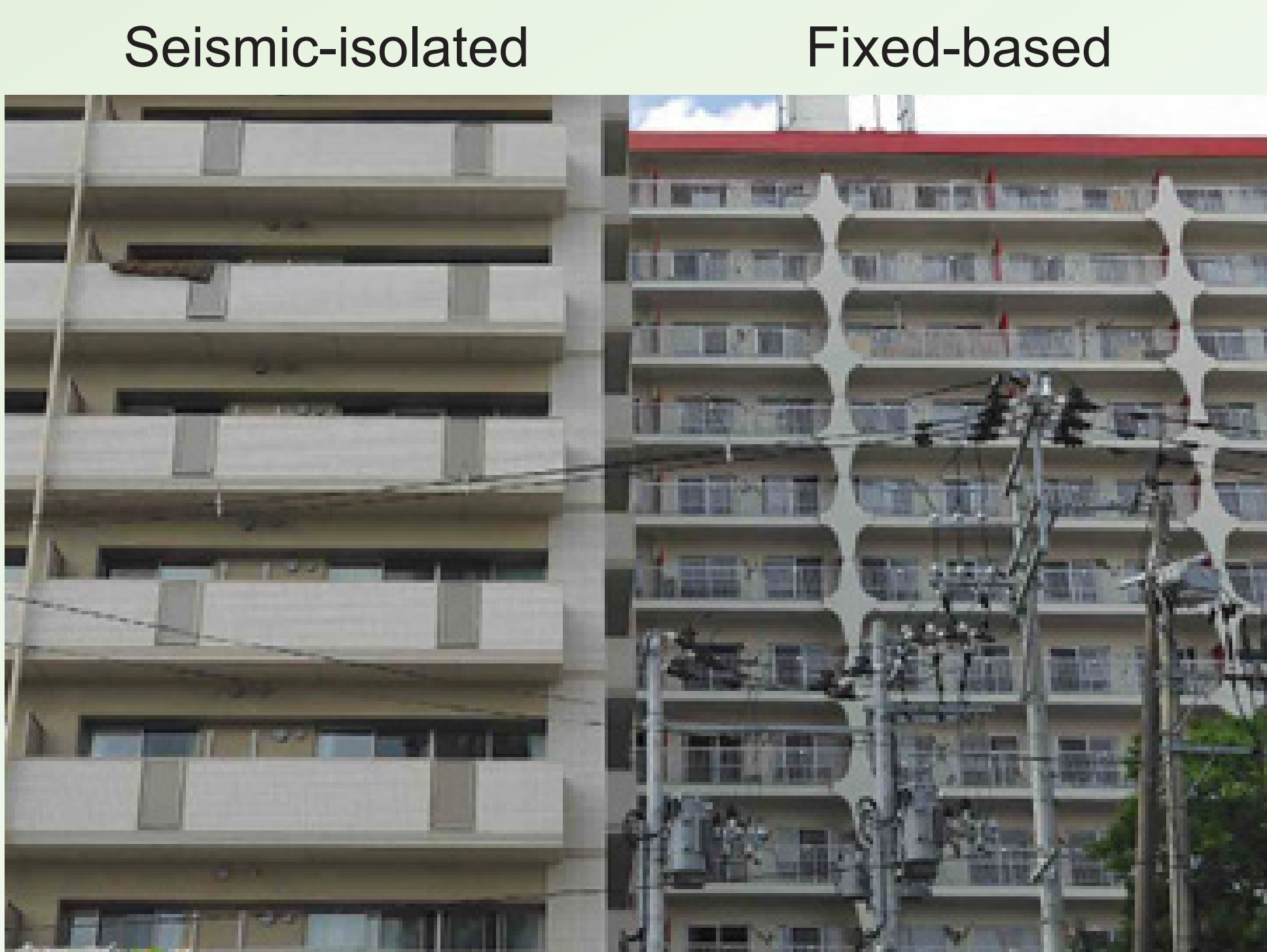
▲ Entrance hall situation immediately after the earthquake



▲ Many ductile steel dampers dissipated earthquake energy

Seismic-isolated apartment was saved perfectly, but fixed-based apartment was demolished in Sendai city.

- There were two apartment buildings adjacent to each other in Sendai city.
- One was a seismic-isolated building, and the other was a fixed-based one.
- The seismic-isolated apartment sustained no damage and people were able to live just after the earthquake.
- The fixed-based apartment protected people's lives, but the building tilted and many cracks appeared in the walls and columns.
- The fixed-based apartment was demolished because people did not want to return to the damaged rooms.



After the earthquake ►

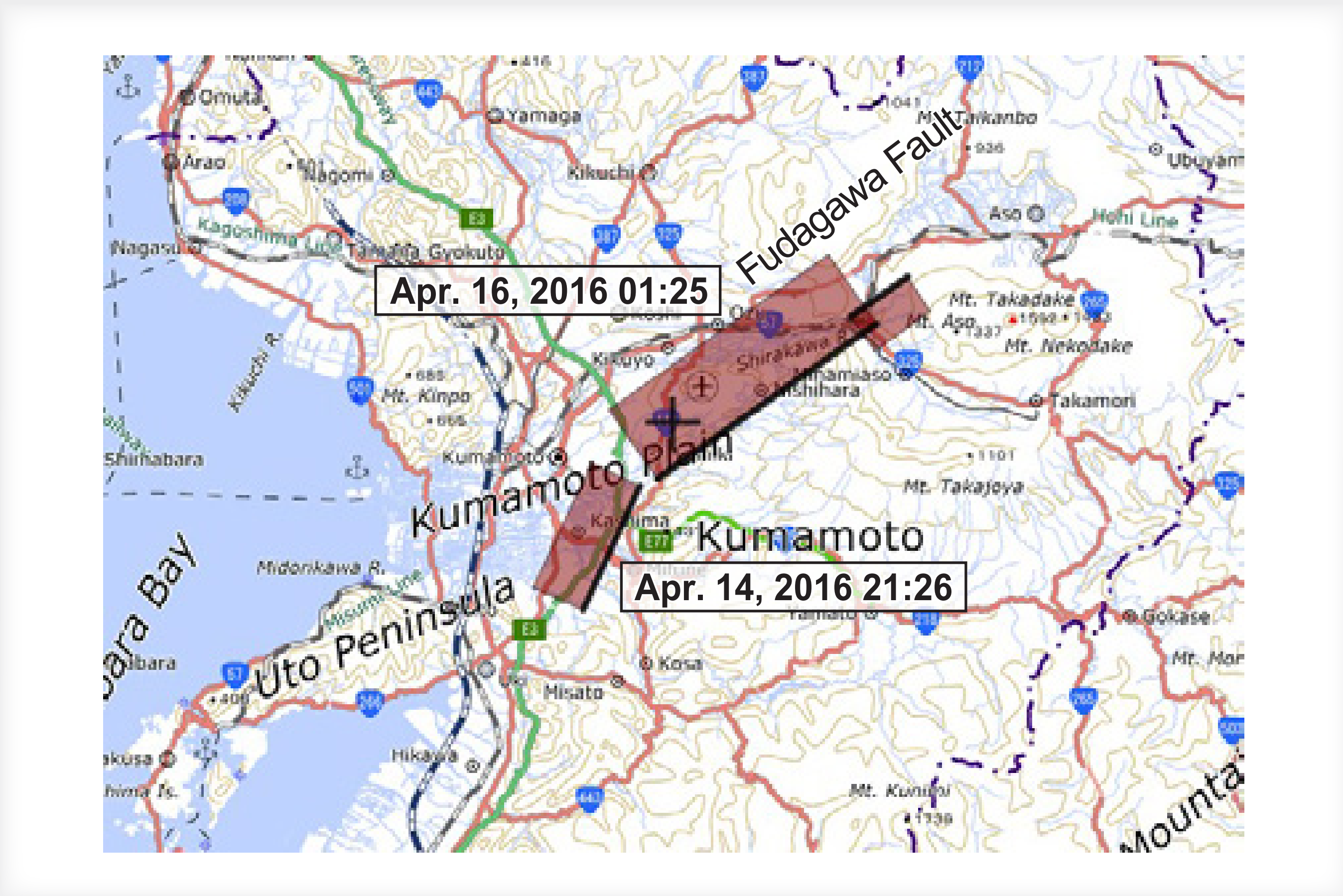
(Photo by Nikkei Architecture 2011.07.11)

The Japan Society of Seismic Isolation & Japan Seismic Isolation Laboratory

Seismic Isolated vs Fix-Based in 30 Years in Japan

2016 Kumamoto Earthquake

Two earthquakes with a maximum seismic intensity of 7 (Maximum Level in Japan) occurred.
Large displacements were observed in the seismic-isolated buildings,
but the seismic isolate saved all buildings and their functions.



(Reference : Geographical Survey Institute Web Site <https://www.gsi.go.jp/BOUSAI/H27-kumamoto-earthquake-index.html#1>)

Outline of the earthquake

Date of occurrence : April 14, 2016
Moment Magnitude : Mw6.2
Type of earthquake : Inland earthquake
Fault depth : 11km
Seismic intensity : 7 (Maximum Level in Japan)

Date of occurrence : April 16, 2016
Moment Magnitude : Mw7.0
Type of earthquake : Inland earthquake
Fault depth : 12km
Seismic intensity : 7 (Maximum Level in Japan)

Seismic-isolated hospital kept the functions. (Aso medical center)

- The maximum displacement of the seismic isolation layer was recorded at 46cm.
- The building's functions were maintained without any problems even immediately after the earthquake, so the facility was able to be active as a base of operations for disaster relief teams.

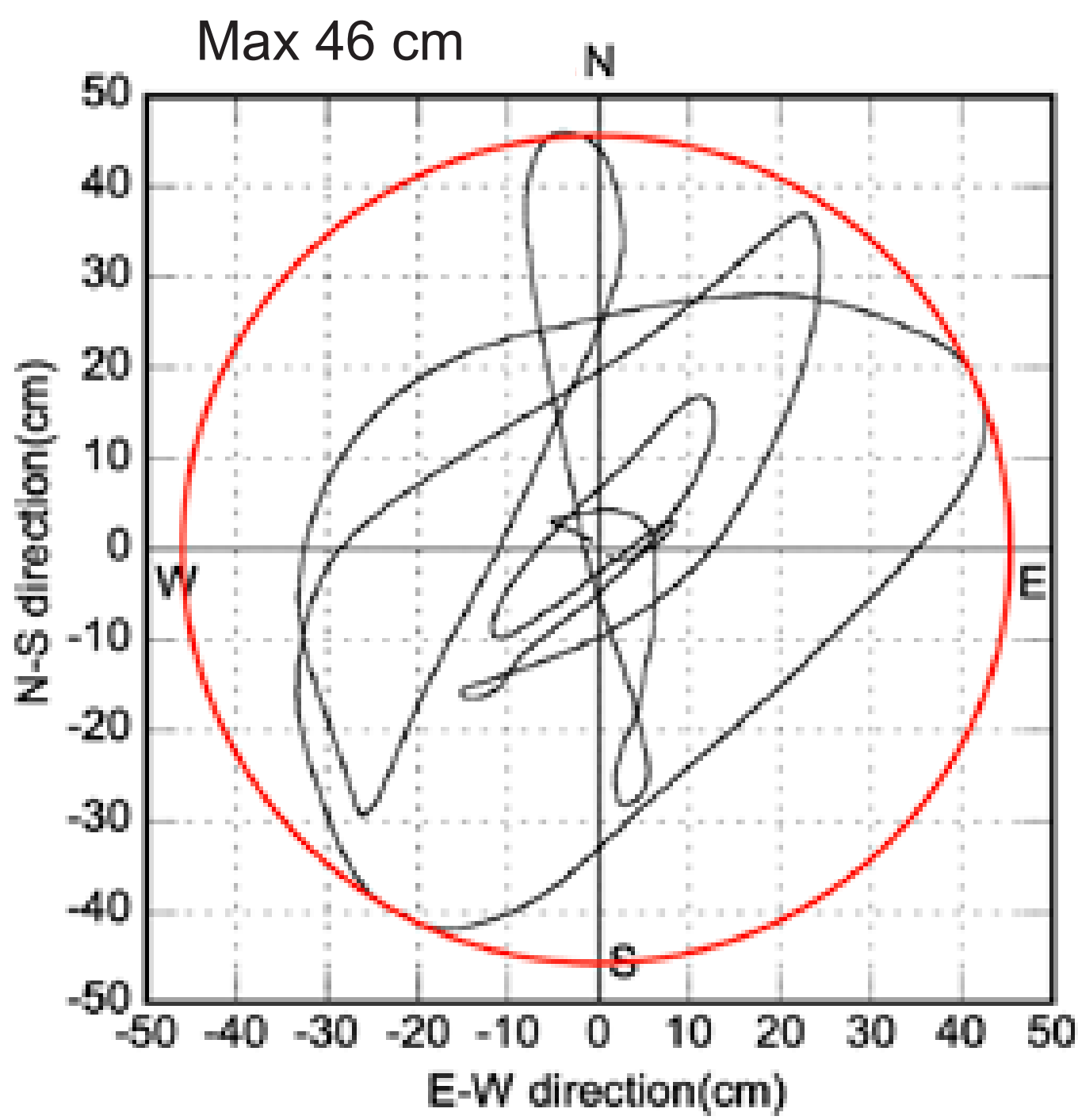


(Photo by Aso Medical Center)



Natural rubber bearing and LRB were used. The bearings remained intact even after 46cm deformation (shear strain of 330%)

Displacement record of seismic isolation layer



The fix-based Kumamoto City Hospital was closed, and 320 patients had to be transferred.

The hospital suffered significant damage, and lost its hospital functions.
It was demolished and rebuilt using a seismic-isolate structure.

The Kumamoto City Hospital, which had a fixed-based building, suffered significant damage to the building. Furniture and equipment also fell over, making it impossible to continue medical care, so 320 patients were transferred to other hospitals. After that, the building was demolished and a new hospital with a seismic-isolated structure was built.



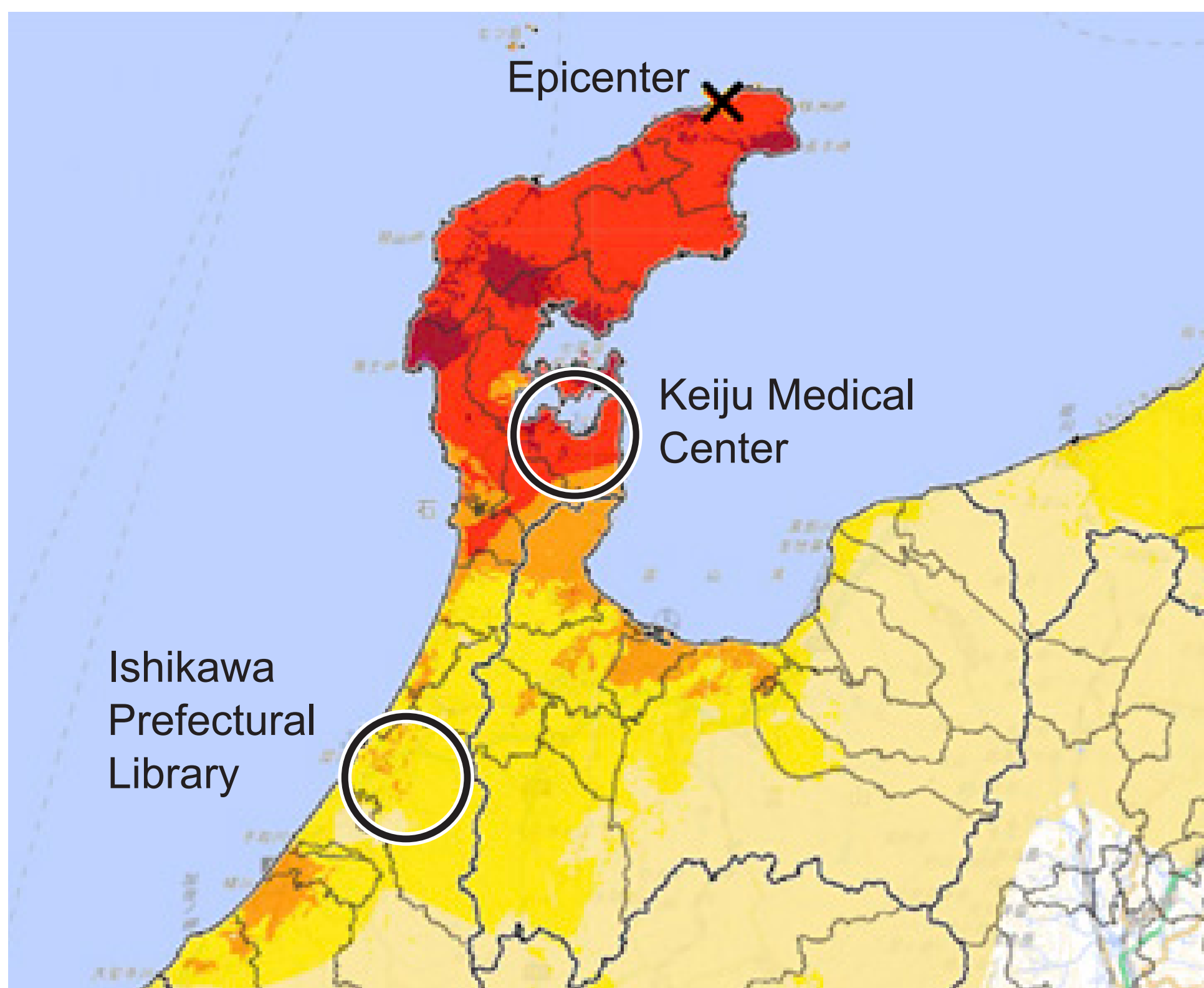
(Photo by Ministry of Health, Labor and Welfare: Report from Kumamoto City Hospital on the 2016 Kumamoto Earthquake)

The Japan Society of Seismic Isolation & Japan Seismic Isolation Laboratory

Seismic Isolated vs Fix-Based in 30 Years in Japan

2024 Noto Peninsula Earthquake

The earthquake did not cause any damage to more than 20 seismic-isolated buildings, and all of the buildings were able to maintain their functions.



(Reference: Japan Meteorological Agency Web site https://www.jma.go.jp/jma/menu/20240101_noto_jishin.html)

Outline of the earthquake

Date of occurrence	: January 1, 2024
Moment Magnitude	: Mw7.5
Type of earthquake	: Inland earthquake
Fault depth	: 16km
Seismic intensity	: 7 (Maximum Level in Japan)
Damage	: 634 deaths 6,532 houses completely destroyed

The seismic-isolated Keiju Medical Center was perfectly all right and served as a medical center for the region; Minister of Health, Labor and Welfare said "It is a Miracle of Noto".

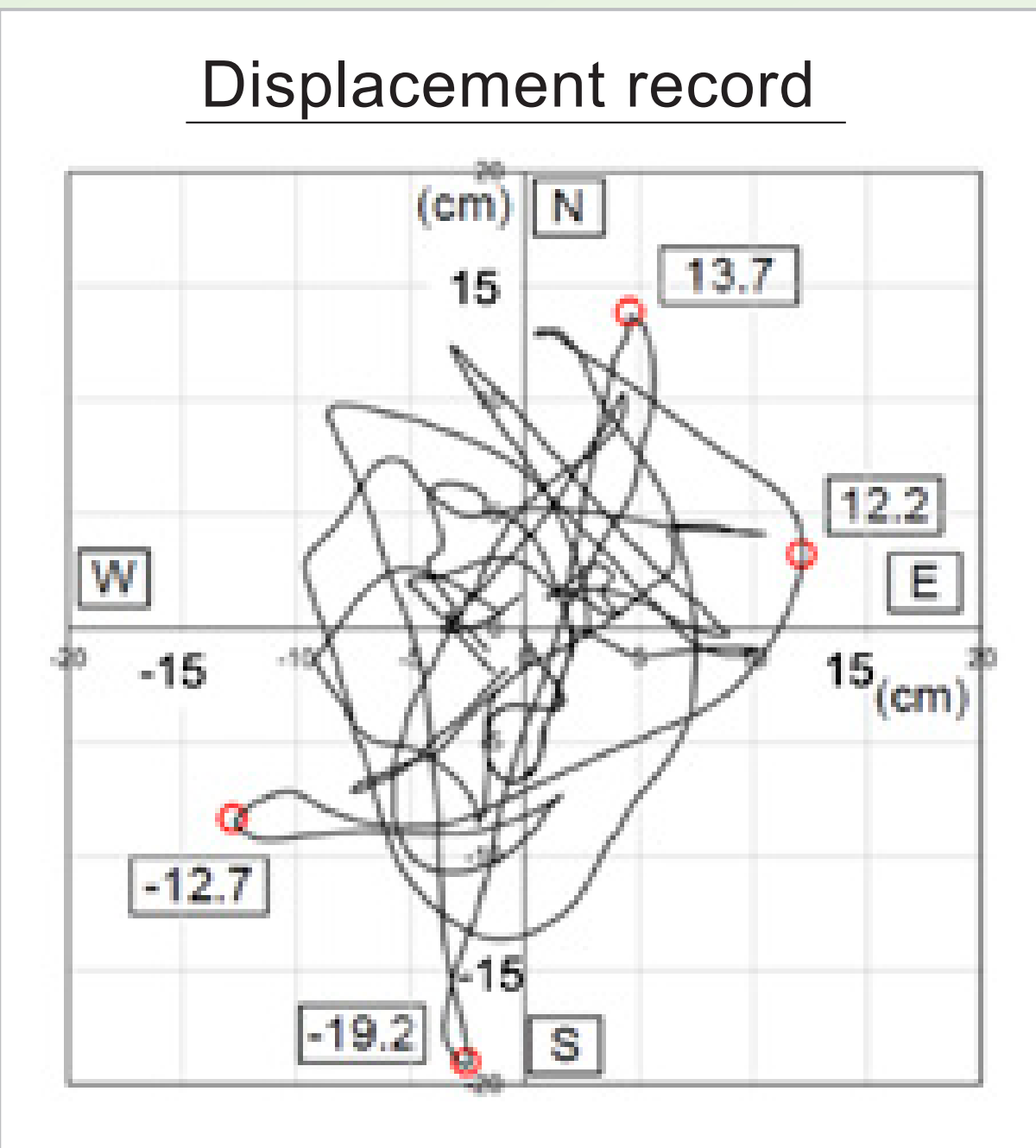
- The earthquake intensity was a lower 6. The maximum displacement of the seismic isolation layer was recorded at about 19cm.
- The building was all right, and no medical equipment or furniture was toppled. The operating room was also completely all right, active medical care to continue.



▲ Appearance after the quake



▲ Internal situation after the quake



Fixed-based hospital

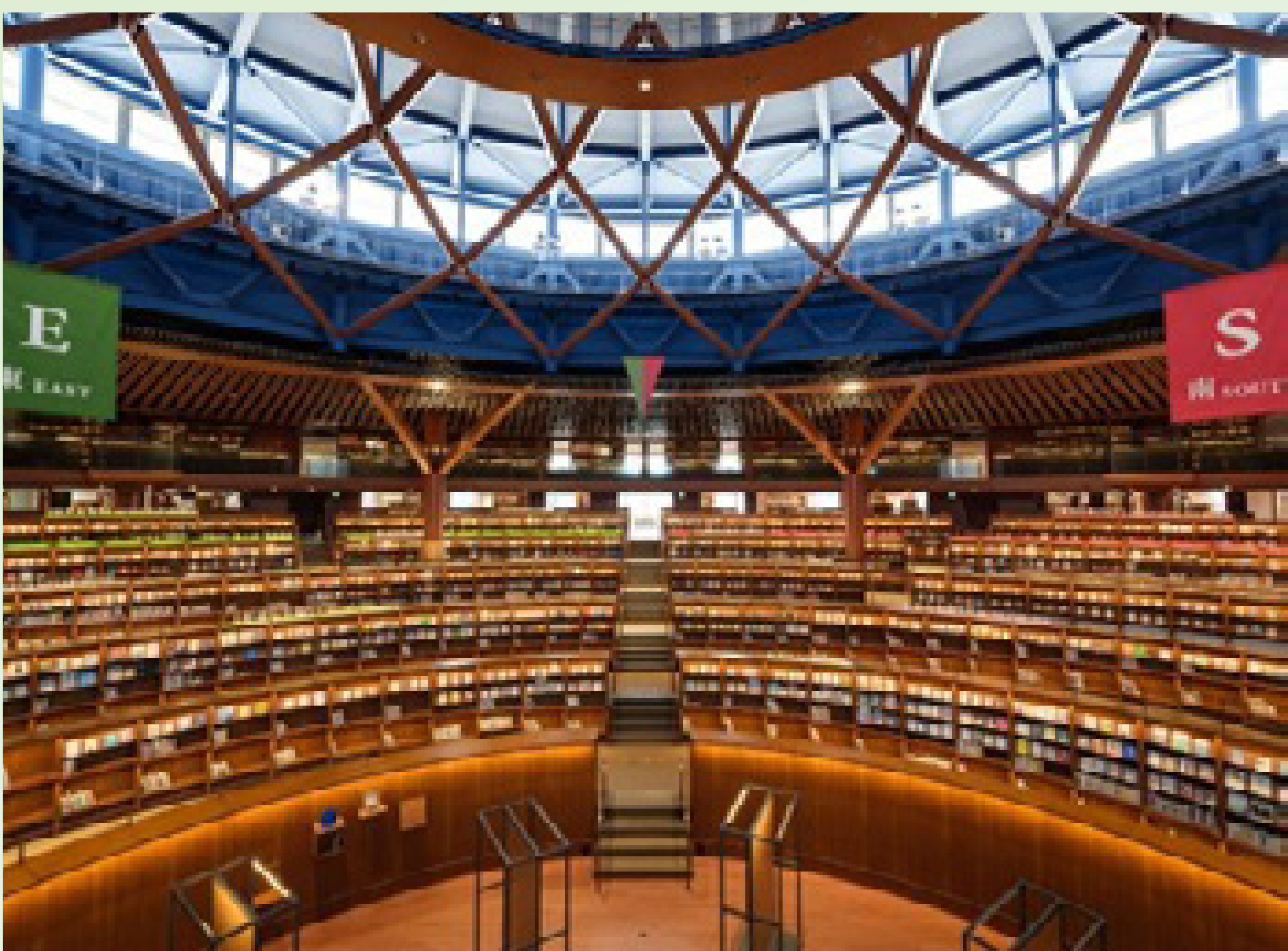
No structural damage to the building, but medical equipment, furniture, and facilities had fallen over and were damaged, became impossible for the hospital to continue functioning.



(Photo by Keiju Medical Center)

The seismic-isolated Ishikawa library was able to operate quickly after the earthquake.

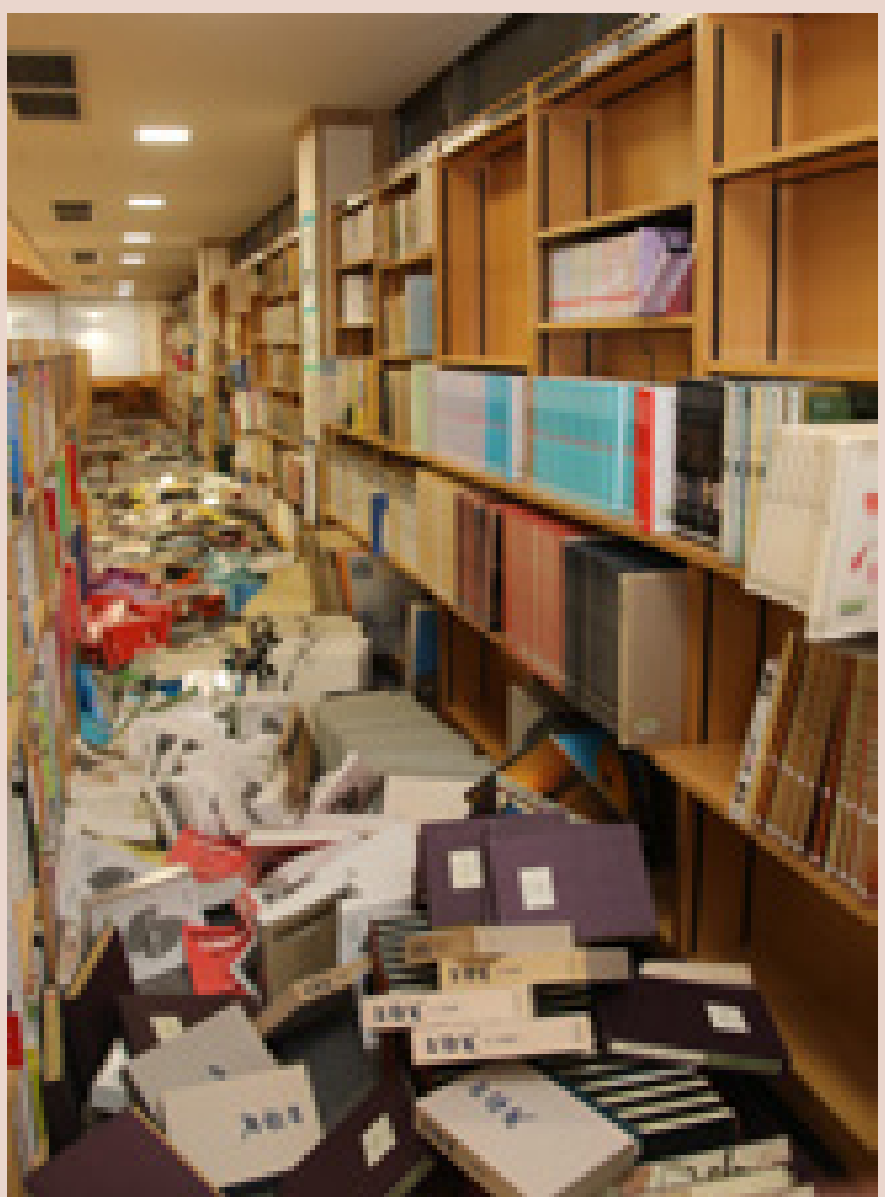
- The seismic-isolated Ishikawa Prefectural Library has a collection of about 1.1 million books.
- The library was able to reopen after only being closed for one day for inspection.



(Photo by Ishikawa Prefectural Library)

Fixed-based other library

In fixed-based libraries, so many books fell from shelves during the earthquake, and it took several months for the shelves to be restored.



(Source: 2024/1/13 Tokyo Shimbun Online Edition)