

Keiju Medical Center "The Miracle of Noto"

The seismically-isolated ward at Keiju General Hospital, part of the Tosenkai Social Medical Foundation, has continued medical services in Nanao City, which suffered severe damage with a maximum seismic intensity of 6+, and has made a great contribution to the local community by accepting patients from the surrounding area. Since the beginning of the disaster, the hospital had been proactively posting information on social media⁵⁾, and had been featured in various media outlets, including NHK. Furthermore, the hospital was introduced as the "Miracle of Noto" at the National Diet Budget Council on February 26, 2024, becoming a symbol of the effectiveness of seismically-isolated building during earthquakes.

As shown in Photo 1, Keiju General Hospital is composed of four buildings: the main building with seismically isolated structure, and the 3rd Ward, 5th Ward, and the Linear Accelerator Center, which are all earthquake-resistant buildings. The main building and 3rd Ward, the main building and the Linear Accelerator Center, and the 3rd Ward and 5th Ward are connected by corridors equipped with vibration control devices.

The seven-story reinforced concrete seismically-isolated main building, completed in 2013, shown in Photo 2, has a total of 49 natural rubber and high-damping rubber bearings installed in the base isolation layer.

The primary natural periods during L1 and L2 earthquakes are approximately 4.0 and 4.3 seconds, respectively, and the maximum displacement during L2 earthquake is approximately 410 mm, with a generous design clearance of 600 mm. As a countermeasure against tsunamis, the floors were designed to be raised 1.5 m, with the electrical room and server room located on the upper floors, and lattice-patterned ground improvement work was also carried out as a countermeasure against liquefaction.

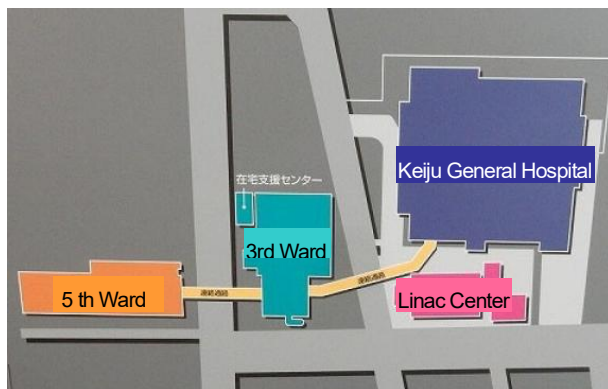


Photo 1: Layout



Photo 2: Main building (seismically-isolated building)

Figure 1 shows the trace of the displacement caused by the Noto Peninsula earthquake, with a maximum displacement of 192 mm, about half the expected displacement of L2 earthquake.

On the other hand, photo 3 shows 3rd Ward, which is about 45 years old and has outdated earthquake resistance, and has already been reinforced to withstand earthquakes, while 5th Ward was completed in 2000 and is earthquake-resistant.

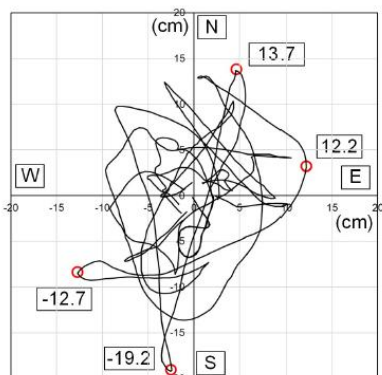


Figure 1 Trace of the displacement



Photo 3: 3rd Ward (foreground) and 5th Ward (back)

JSSI interviewed the hospital about the situation during the earthquake and learned the following.

During the Noto Peninsula earthquake, the seismically-isolated main building suffered no damage to the building or facilities, and no medical equipment toppled or fallen.

Meanwhile, the earthquake-resistant buildings suffered almost no damage to their structures, but suffered extensive damage inside, including water leaks due to damage to the facility pipes and tanks, and equipment and fixtures toppling over, making medical activities impossible.

As a result, approximately 113 patients were moved from the earthquake-resistant buildings to the seismically-isolated main building, where medical activities could continue.

As shown in Photo 4, damage occurred to panels in the walkway and Exp. J of the seismic isolation building, but there were no particular problems with movement.

Furthermore, as shown in Photo 5, ground subsidence occurred in the exterior parts due to liquefaction, causing steps and gaps at entrances and exits.

The main water supply was also cut off, but drinkable well water was used in the main building and 3rd Ward and 5th Ward.



Photo 4: Damage to the SI Exp. J panel

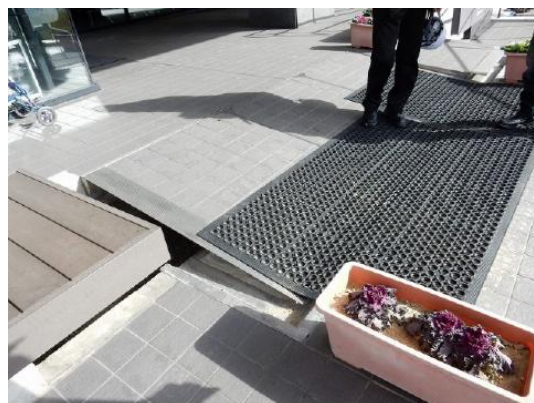


Photo 5: Building and steps separated

connected to the main building

by ground subsidence due to liquefaction

As the amount of water springing from the deep well was unclear, water distribution from the Self-Defense Forces began three days later, and dialysis treatment in the earthquake-resistant building was able to resume in a stable manner.

The sewer pipes had flexible joints, but were damaged one week later due to subsidence.

At the time of the survey, the pipes were being restored, and a sewer layer was created for emergency use.

Since there were two electricity lines, electricity was switched from the main line to a branch line, and the emergency generator did not operate, so electricity was restored without any problems.

There was enough oil to power the facility for 48 hours, and an agreement had been made with an energy sales company for continuous priority supply in the event of a disaster, so there was little concern about the oil supply.

Since the obstetrics and gynecology department in the affected area was unable to operate, pregnant women were transferred one after another from the Oku-Noto area, so one of the operating rooms was used for the obstetrics and gynecology department and obstetrics and gynecology patients from other hospitals were accepted.

Since there were no hospitals in the surrounding area that could provide dialysis, the hospital also accepts dialysis patients. The number of beds for dialysis has been increased to 40.

Overall, everything went pretty much as expected in the BCP that we had drawn up in advance, and we were able to respond to the damage and set up communication systems and divide up roles with the relevant parties with almost no problems.

Most importantly, the main building was undamaged and medical activities were able to continue, and JSSI was told that it was a great relief that we had built the building with a seismic isolation structure.