Earthquake observation records of a seismically isolated hospital in Ojiya City during "The 2007 Niigataken Chuetsu-oki Earthquake".

1 Introduction

At around 10:13 on July 16, 2007, an earthquake occurred off the coast of Chuetsu, Niigata Prefecture. According to the Japan Meteorological Agency, the characteristics of this earthquake[1] are as shown in Table 1. The distribution of seismic intensity[1] during the main shock is shown in Figure 1(Ommitted), and seismic intensity of 6+ was observed in Kashiwazaki City, Kariwa Village, Nagaoka City, and Iizuna Town.

The seismic intensity of this earthquake in Ojiya City, Niigata Prefecture, was 5+ to 6-. A seismograph recorded earthquake data in a seismically isolated building (the Suisen House, a geriatric health facility at Ojiya General Hospital) located in the city, and this data is reported here as a quick report. As previously reported[2], this building also recorded earthquake data during "the 2004 Niigata Chuetsu Earthquake", confirming sufficient seismic isolation.

Table 1 Earthquake characteristics

Mj	6.8
Epicenter	North: 37.5 East: 138.6
Depth	17 km

Table 2 Construction overview

Story	Basement, 1-5 floor, Pent
Total floor area	4,447.92 m^2
Eaves	19.29 m
Structure	RC, rigid frame with earthquake resistant wall
Foundation	Mat type, GL-3.16 m
SI Devices	Laminated natural rubber bearings (18)
	Sliders with elastomer (21)

2 Building Overview

The architectural overview and frame diagram are shown in Table 2 and Figure 2. Details are given in a previous report[2] so they are omitted here.

Photo 1: Overall view of the building

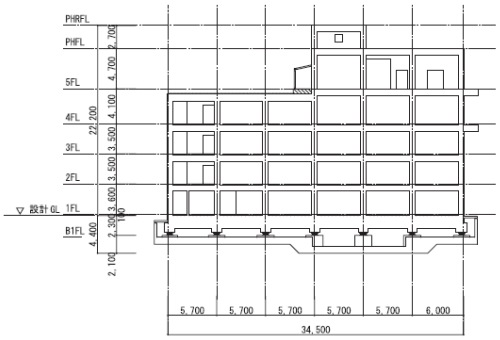

Figure 2 Frame diagram

3 Earthquake Records

Acceleration waveforms, velocity waveforms, and 5% damping constant response spectra (pseudo velocity, acceleration) at the bottom of the seismic isolation layer of this building are shown in Figures 3 and 4.

The strength of this earthquake is intermediate between the "rare earthquakes" and "very rare earthquakes" of Notification No. 1461.

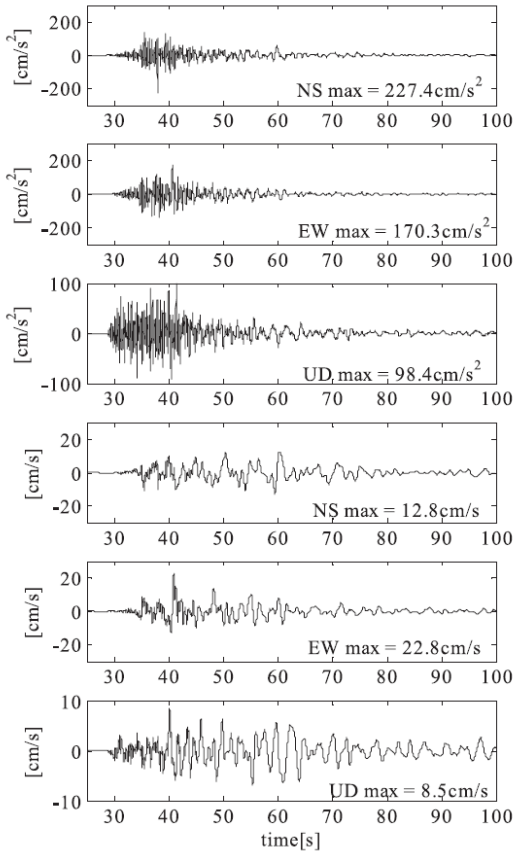

Fig. 3 Waveforms observed at the SI layer

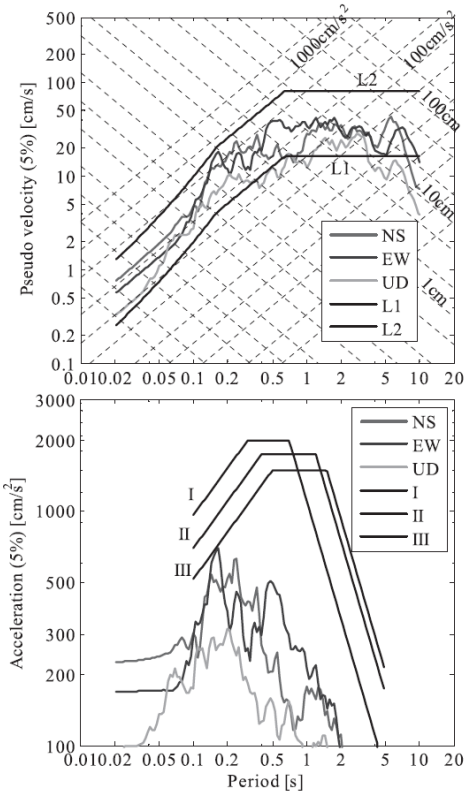

Fig. 4 Pseudo velocity, acceleration spectra

Figure 3:

From top to bottom, acceleration waveforms (NS, EW, UD), velocity waveforms (NS, EW, UD)

Figure 4:

L1: Ministry of Land, Infrastructure, Transport and Tourism Notification No. 1461 "Rare earthquakes"

L2: Ministry of Land, Infrastructure, Transport and Tourism Notification No. 1461 "Very Rare Earthquakes"

I: Highway Bridge Specifications Level 2 Earthquake Motion (Type II), Ground Type I

II: Highway Bridge Specifications Level 2 Earthquake Motion (Type II), Ground Type II

III: Highway Bridge Specifications Level 2 Earthquake Motion (Type II), Ground Type III

Figure 5 shows a comparison of acceleration records at the 1st floor and the seismic isolation layer. The maximum acceleration was 0.47 times for the NS component, 0.78 times for the EW component, and 1.2 times for the UD component. Figure 6 shows the displacement trajectory of the seismic isolation layer. The seismic isolation layer deformation was obtained by integrating after applying a high-pass filter of 0.05 Hz or more on the frequency axis. The seismic isolation layer deformation was 5.5 cm and 6.4 cm in the NS and EW directions, respectively.

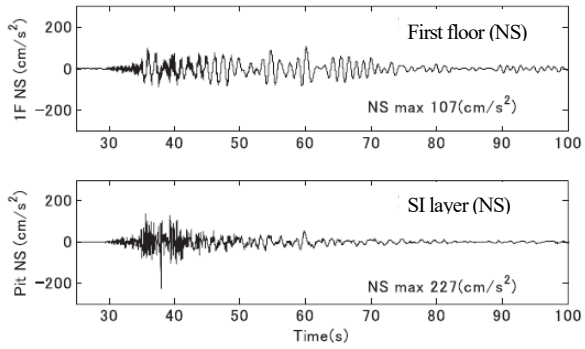

Fig. 5 (a) Observed waveform (NS direction)

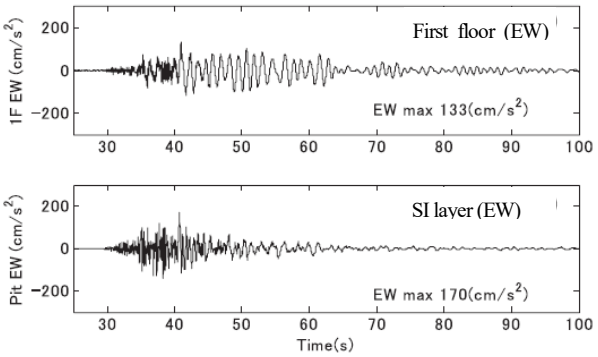

Fig. 5 (b) Observed waveform (EW direction)

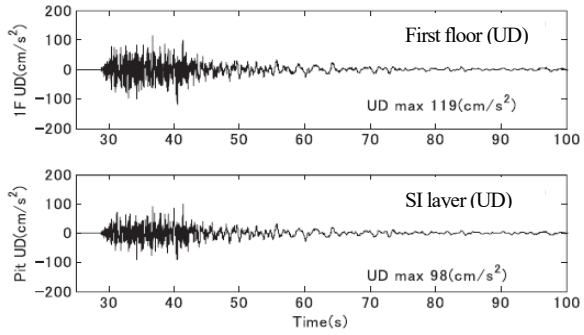

Fig. 5 (c) Observed waveform (UD direction)

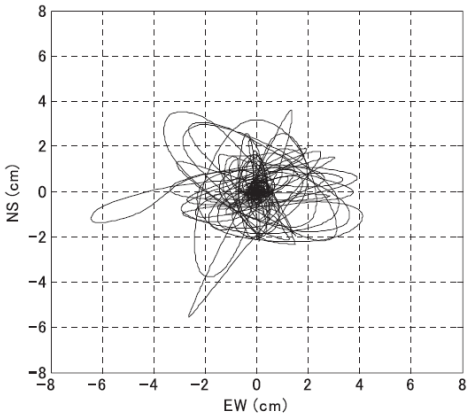

Fig. 6 Displacement trajectory of SI layer

Table 3 Maximum acceleration ratio

Direction	SI layer	First Floor	Ratio
NS	227	107	0.47
EW	170	133	0.78
UD	98	119	1.21

4 Summary

The seismic observation records of the seismically isolated building during the 2007 Niigataken Chuetsu-oki Earthquake confirmed that the horizontal acceleration was reduced by the seismic isolation device. It should also be noted that there was no damage to the building, including the interior furniture, after the earthquake.

This building was hit by the Niigata Chuetsu Earthquake, which had a seismic intensity of 6+ (maximum observed acceleration of 808 gal) three years ago, and many aftershocks, and this record serves as a proof of

concept that the seismic isolation device that experienced a major earthquake can function effectively in subsequent earthquakes.

5 Acknowledgements
We would like to express our gratitude to Ojiya General Hospital, who kindly agreed to the building inspection despite their busy schedules after the earthquake, and to the staff at Taisei Corporation, who cooperated in the collection and analysis of the observation records.

(Mitsubishi Jisho Design, Tamari Masatoshi)

References

1) Japan Meteorological Agency website http://www.jma.go.jp/jma/index.html
2) Tokita, Tamari, "Earthquake observation records of seismically isolated buildings during the 2004 Niigata Chuetsu earthquake," MENSHIN No. 47, February 2005