Aoimori Cloud Base Corporation — **Hirosaki, Aomori Prefecture**

Looking Forward to Further Advancements in Seismic Isolation

In December 2015, Aoimori Cloud Base Corporation completed the first data center in the world which utilizes snow cooling and free-air cooling systems in Aomori Prefecture. By eliminating the need for compressor-based air conditioning, our data center is one of the most power efficient and environmentally friendly datacenters in Japan.

Because datacenters store customers' valuable data, measures to protect the facility and equipment from earthquakes are a prerequisite. Because datacenter customers have a high awareness on the datacenter's anti-earthquake measures, it was very important for us to have a system that can make our customers feel secure. This means that it must withstand the scale of large-scale earthquakes like the Great Hanshin–Awaji Earthquake, the Niigata Chuetsu Earthquake, and the Great East Japan Earthquake.

There are two kinds of seismic isolation devices—one where the entire server floor is isolated, and one where the individual racks are isolated. When we compared the two, while the performance was comparable, we chose THK's floor isolation system from an overall point of view including its cost advantage.

Hiroshi Miyamoto
Managing Director
Data Center Manager
Aoimori Cloud Base Corporation

Our datacenter employs a unique modular construction design developed by Fuji Electric, where individual server building modules are built one at a time as they become necessary. At present, we have two server modules each with 80 racks, with a total of 160 racks. These modules were constructed using 2015 technology. If we were to build the third module in 2018, we can build it with 2018 technology. By that time, power, cooling as well as seismic isolation technology will have advanced from where it is today. Because our modular construction design allows us to take advantage of the latest technology, we are looking forward to see constant advancements in THK's seismic isolation devices as well.

Fuji Denki Mr. Kawashima's Thoughts:

Masahito Kawashima
Assistant Manager
Smart Facility Engineering Department
Machinery & Electronics System Division
Industrial Infrastructure Business Group
Fuji Electric Co., Ltd.

Before we installed our seismic isolation devices, we toured THK's GIFU Plant. While there, we watched as they loaded a seismic isolation device with weights to simulate what would be expected in a real server rack environment and used seismic waves to recreate major earthquakes from the past, enabling us to see what the seismic isolation device can do right before our eyes. Other companies we toured for comparison did not do the same for us.

Additionally, THK meticulously handles requests for a range of specifications only facilities with "modular data centers" would require, even taking requests which pushed them cost-wise without hesitation. At the time of their presentation, we were deeply impressed by the fact that they transported a life-sized model all the way to Aomori.

In the future, we expect servers to increase in weight, so we hope to see efforts being put into developing seismic isolation devices with a wide allowable range of weight, capable of supporting extremely heavy equipment.

Hokkaido Sumiden Precision Co., Ltd. **Naie, Sorachi, Hokkaido**

Ensuring that *Monozukuri** Never Stops

Kazuhiro Takakuwa
Section Manager
Plant Engineering & Maintenance Section
Hokkaido Sumiden Precision Co., Ltd.

Masuo Chuudo
President
Hokkaido Sumiden Precision Co., Ltd.

Our company is partnered with Sumitomo Electric Industries. We develop, manufacture, and sell cutting tools, and we mass produce replacement tools with our product line, IGETALLOY. This is a line of cemented carbide cutting tools, used when machining steel or casted material on a lathe or milling machine. Mostly used by automotive, aerospace, and railroad component manufacturers, it has become something *monozukuri* cannot function without.

Our plant is Sumitomo Electric Industries's main facility for manufacturing replacement tools, so if some unexpected problem were to occur, their supply would come to a dead halt. As a result, the production lines of the machine component and automotive manufacturers we directly supply would also be in danger of stopping. In terms of a BCP (business continuity plan), while we have long been taking a number of steps to ensure our speedy recovery even in the event of a disaster, we feel that it is especially important that we take measures to protect our production control and order receiving systems from earthquakes.

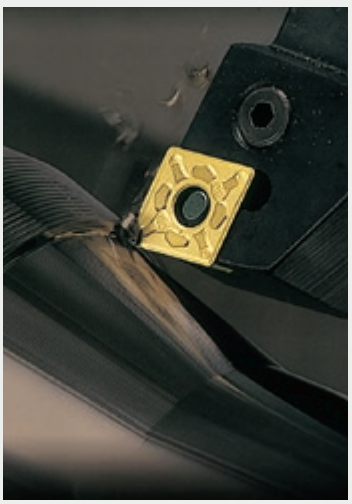
Our company has installed backups so that our core system can be back up within a day after a disaster, running in the condition it was an hour before the disaster struck. This system is implemented throughout our facility. In revising our BCP after our experience with the Great East Japan Earthquake, we built an emergency shelter to ensure our employees' safety, installed seismic isolation devices into its floor, and relocated our backup system server there, as well.

While inland Hokkaido is a region with relatively few earthquakes, our company's headquarters is in Itami in Hyogo Prefecture and suffered great damage during the Great Hanshin-Awaji Earthquake. Having gone through this ourselves, we are acutely aware of the need to be ready for earthquakes. Furthermore, during the Great East Japan Earthquake, an earthquake between magnitude 3 and 4 was recorded in Hokkaido, so we cannot be sure that we are completely secure unless we take some measures.

We chose THK when installing the seismic isolation devices in our emergency shelter because of the mechanical strength of their product against pitching. They brought their Seismic Isolation Simulation Vehicle all the way to us, and we were able to feel for ourselves the reduction of seismic intensity this technology brings. Another factor that increased our trust in THK is that we use many of their products in our tool tip production equipment, which is designed and made in-house.

Our company works with many suppliers, but whereas many of these companies have a clear division between their sales and engineering groups, THK's sales representative followed up on the equipment installation, and even members of upper management came by several times, which reassured us that we were in good hands.

While we have implemented measures to protect our emergency shelter with seismic isolation devices, we have CNC and many other high-precision machines at our plant which are at risk from seismic activity. Vibrations, conveyed along the floor by pumps and compressors, can lead to less accurate output. We can't ship our products if they show even the slightest amount of error, so we plan to put efforts into reducing vibration to maintain a high level of precision. We look forward to seeing how THK further develops the seismic isolation device, which simultaneously conducts base isolation and reduces vibration at a high level of performance.



One of our company's replacement tools being used in a cutting process

Servers in our new emergency shelter, safeguarded by seismic isolation

* Monozukuri *is a Japanese word, often translated as "manufacturing," that suggests a high level of craftsmanship.*

East Nippon Expressway Company Limited Kanto Regional Head Branch Saitama City, Saitama

Seismic Isolation: an Indispensable Technology for Safe Highways

The Traffic Control Center of East Nippon Expressway Company Limited's Kanto Regional Head Branch is located in Iwatsuki, Saitama City, and monitors the traffic on the expressways of the seven prefectures in the Kanto region, spanning the approximately 1,300 km of expressways in the area (with the exception of the Shuto, Tomei, and Chuo Expressways).

Its main functions are to receive information and respond as needed to any traffic accidents or reports of debris on the roadways. If any problems are reported for roads in our jurisdiction, we deploy our yellow patrol cars to the scene, taking appropriate action when accidents occur and clearing the road of debris. In addition, we have positioned sensors every 2 kilometers along the expressways to measure traffic volume, and this real-time traffic information is automatically collected and sent to our center. Based on this data, we display information about traffic conditions on signs above the appropriate roadways.

For instance, imagine how cracks or bulges form on roadways during large earthquakes, making certain routes impassible. In such cases, if accurate information is not provided about which routes to avoid and which to take, drivers will have no basis on which to make their decisions, and most people would be unsure of whether to keep going or to turn around. This would cause a great deal of confusion, and is a risk that absolutely must be avoided.

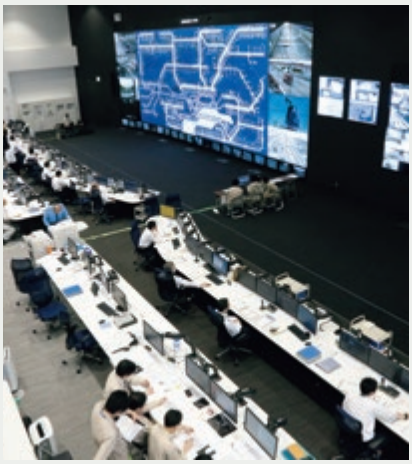
When constructing our new control center, we aimed to build the most durable building we could because of our company's direct experience with the Great East Japan Earthquake in 2011. The result is a building 1.5 times more resistant to earthquakes than a typical building.

It defeats the purpose, though, if we just protect the building and not what is inside of it. The most important thing during a large earthquake is to first protect those working inside of our center, and then to protect the control systems. Therefore, we installed seismic isolation devices beneath the floor of the entire control room, as well as smaller seismic isolation devices beneath the servers that are the foundation of our system. We will do everything we can to protect both the operators who work here and our control system, and in the event of a major natural disaster, we will continue to provide the information needed. We feel this to be our center's duty to society.

Toshifumi Hiraike
Manager
Kanto Regional Head Branch
Traffic Control Center Improvement
Team Operation Department
East Nippon Expressway Company Limited

We chose THK's seismic isolation devices because of the way their structure differed from that of other companies' devices. THK's seismic isolation devices excel at absorbing seismic waves, and objects placed on top of them will not topple over. In addition, even if an earthquake causes the devices to move, they are designed to return to their original position. When constructing ours, THK added a monitor which records the amount the seismic isolation devices move, and on top of tallying this data, there is also a video recorder which stays on at all times, allowing us to look back half a month to check on them. At this point, however, we don't have any recorded data or videos from these devices being in operation, because there hasn't been an earthquake in the Kanto region since their installation. THK gave us an in-depth explanation when the devices were installed, but if there were a case where additional work needed to be done, we hope to receive assistance at that time.

Seismic isolation devices safeguarding our servers



Control room with seismic isolation devices in the floor

Ministry of Land, Infrastructure, Transport and Tourism—Fukuoka Area Control Center Fukuoka City, Fukuoka

Protecting the Systems that Protect Our Airways with Seismic Isolation

Akihiko Matsumine
Chief Air Traffic Safety Electronics Personnel
Fukuoka Area Control Center

Masanori Sokei
Assistant Air Traffic Safety Electronics Personnel
Fukuoka Area Control Center

The Fukuoka Area Control Center is one of the Ministry of Land, Infrastructure, Transport and Tourism's four Area Control Centers nationwide. It monitors the aircraft flying in Japan's airspace. As opposed to control towers at airports, which manage departures and arrivals for each particular airport, Area Control Centers monitor the routes of every flight throughout Japan. The Fukuoka Area Control Center is located in western Japan and monitors the airspace from Kyushu to Osaka, including flights over the Pacific Ocean and the Sea of Japan.

When the control system goes down due to a natural disaster such as an earthquake, restrictions are put on planes flying in Japan's airspace. As a result, long delays for departures and arrivals occur at each airport, and in the worst cases, most of the planes flying between Kansai and Kyushu could get cancelled.

Furthermore, because these controls apply to any aircraft in Japanese airspace, this would also include flights flying to and from China or the American West Coast, as well as flights to Europe from the western part of the US. In other words, if something happens to our control system servers, its impact is not limited to Japan, but extends worldwide. Of course, in preparation for the unexpected, we make sure to have a backup system in at least two locations, such as the Air Traffic Management Center next door to our Area Control Center and the Tokyo Area Control Center, both of which have seismic isolation devices. The laws regarding seismic design criteria were revised in 1998 to mandate that information processing equipment located on the second floor of a building or higher must be on a floor with seismic isolation devices installed. In accordance with this, we equipped the floor of the server room at the Fukuoka Area Control Center with seismic isolation devices.

In these times of rapid IT integration throughout society, Area Control Center can no longer function without servers, which store systems and data. The air conditioning vent in the Fukuoka Area Control Center's server room is located on the floor, so we had to devise a way to prevent this vent from getting blocked after the installation of the seismic isolation devices. Because THK's seismic isolation devices can be customized to meet specific requests beyond the standards and conditions set by the Ministry of Land, Infrastructure, Transport and Tourism, which they already meet, we were able to get seismic isolation devices that were custom-designed to our desired dimensions.

Server room equipped with custom-designed seismic isolation devices from THK

In the Kumamoto Earthquakes this April, both of which had a magnitude of 7, Kumamoto Airport's control system servers made it through without incident thanks to their seismic isolation devices. Even in the Great Hanshin-Awaji Earthquake and the Great East Japan Earthquake, I heard no word that their servers broke. Seismic isolation devices are amazing things. Fukuoka is a region with a relatively low risk of earthquakes, but we never know when and how big the next major earthquake will be. If the worst were to happen, we expect that THK's seismic isolation devices will fulfill their purpose and contribute to keeping Japan's skies safe.

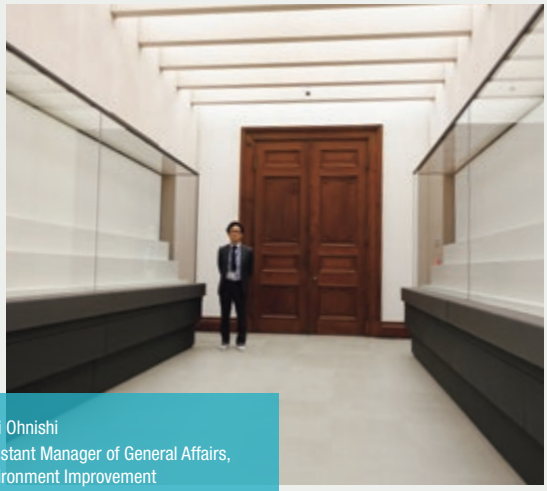
Fukuoka Area Control Center

Independent Administrative Institution, National Institutes for Cultural Heritage—Nara National Museum Nara City, Nara

Protecting Works of Art and Cultural Heritage with Seismic Isolation Devices

As can be seen in how close Kumamoto Castle came to collapsing during the Kumamoto Earthquakes in April, major earthquakes harbor the risk of destroying precious works of art and cultural heritage. Along with saving lives and safeguarding valuable data, the high expectations for what seismic isolation devices can do include protecting cultural artifacts of both tangible and intangible value.

With the completion in 2016 of the renovation of the Nara Buddhist Sculpture Hall at the Nara National Museum, which houses a multitude of Buddhist sculptures and other cultural artifacts, we spoke with Seiji Ohnishi about the events leading up to the installation of seismic isolation devices and his hopes for the technology.



Seiji Ohnishi
Assistant Manager of General Affairs, Environment Improvement
Nara National Museum

—— I've heard that all four of the national museums in Japan are investing in seismic isolation devices to protect their cultural artifacts. Could you tell me what triggered this and discuss the current progress of these endeavors? Could you also explain the reasons for installing seismic isolation devices in your renovated Buddhist Sculpture Hall?

The Great Hanshin-Awaji, Chuetsu, and Great East Japan earthquakes heightened our awareness of the need to protect cultural artifacts from earthquakes. In recent years, seismic isolation devices have been installed beneath the Kyushu National Museum and in the floor of the major exhibition room in the Kyoto National Museum's Heisei Chishinkan Wing.

We were granted a certain budget to renovate both the interior and exterior of the Nara Buddhist Sculpture Hall. Needing to improve our display and storage environment with this limited budget, we decided to employ seismic isolation devices in our display cases and pedestals. (See picture on the top right.) We chose to do this because the building itself is considered an important cultural property, so we cannot make a great deal of changes to it. We feel that it is our duty to pass Japan's valuable cultural artifacts on to the next generation.

Western facade of the Nara Buddhist Sculpture Hall (Former Imperial Nara Museum Original Museum Building), designed in a Western style

—— What factors did you consider most important in introducing seismic isolation devices?

Earthquake vibration takes the forms of pitching, rolling, and long-period ground motion. Among the cultural artifacts we house are Buddhist sculptures which, in contrast to dishes, have a high center of gravity. For these, I felt that seismic isolation devices that could withstand rolling and long-period ground motion would be highly effective in preventing these sculptures from falling over. We expect that, even if an earthquake were to occur, our collections will be protected thanks to the seismic isolation devices.

—— Please explain your future plans and hopes for the Nara National Museum.

In addition to providing an even better exhibition environment for our guests, we need to create a safe storage environment for our artifacts. Seismic isolation is an important step in making this a reality.