The Many Applications of THK Products

Did you know that THK products are used all around you? In every CSR report since 2007, we have published special features and interviews highlighting examples of customers using our products. There are still many more places where our products are being used around you, so we will continue to cover them in future CSR reports. The testimonials in this edition illustrate, in the words of our customers, how our products are being used for medical equipment, renewable energy, seismic isolation and damping systems, and robots.

Category	Series/Model		User	Location	CSR Report
Historical buildings	Seismic isolation (building)/CLB	1	Aichi Prefectural Government Office	Beneath the government office	2010/2011
	Seismic isolation (equipment)/TSD	2	Ganjoju-in Temple	Beneath Unkei's Buddha statue	2010/2011
	Seismic isolation (building)/CLB	1	Heijo Palace	Beneath the palace floor	2010/2011
	Seismic isolation (building)/CLB & RDT	1 3	Honno-ji Temple	Beneath the floor, roof, and statuary in the main hall	2013/2014
Public transportation	Seismic isolation (floor)/TGS	4	Fukuoka Area Control Center	Server room	2016/2017
	Seismic isolation (floor)/TGS	4	East Nippon Expressway Company Limited	Beneath the control center floor	2016/2017
Housing	Seismic isolation (housing)/CLB & RDT	1 3	The Soutome family	Beneath floor of residence	2011/2012
	Seismic isolation (housing)/CLB & RDT	1 3	The Haneda family	Beneath floor of residence	2012/2013
Medicine	Actuator/KR	5	The University of Tokyo	Tele-surgical robot	2008/2009
	Seismic isolation (equipment)/TSD	2	Tohoku University Hospital	Blood analyzer	2013/2014
	SEED Solution/SEED-MS	6	Yamanashi University & Kofu Municipal Hospital	Assisted-gait robot	2014/2015
	Syringe unit	7	HORIBA, Ltd.	Automated blood-cell counter	2014/2015
Welfare	LM Guide/UGR	8	Imasen Engineering Corporation	Electric wheelchair	2014/2015
Robotics	SEED Solution/SEED-MS	6	National Institute of Advanced Industrial Science and Technology	Robotic household technology	2013/2014
	SEED Solution/ Robotic hand for use in space	9	Japan Aerospace Exploration Agency	International Space Station	2013/2014
	SEED Solution/SEED-Noid	10	The University of Tokyo	Platform robot for research/ academia	2016/2017
Renewable energy	Water-powered generating system	11	Kanagawa Prefecture Sagami River Left Bank Land Improvement District	Irrigation canal	2015/2016
	Low-Torque Shaft Unit/WLS	12	Sylphid Inc.	Strawberry farm	2016/2017

Reducing Vertical Vibration

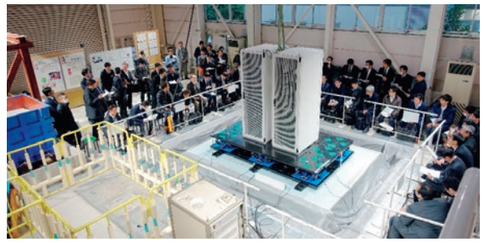
In recent years, major earthquakes such as the Great Hanshin-Awaji Earthquake, the Great East Japan Earthquake, and the Kumamoto Earthquakes struck one after the other, and many expect another to happen soon in the Tokai region, the Tonankai region, or directly beneath Tokyo. However, THK has long provided customers with seismic isolation solutions for buildings, equipment, and servers that protect lives and allow people's surroundings to remain constant even when an earthquake occurs. We want to make sure to protect everyone's valued property during future major earthquakes, so we developed a three-dimensional seismic isolation system that incorporates a new vertical seismic isolation system with the existing (horizontal vibration-absorbing) Seismic Isolation Module Model TGS already used by many customers.

The features of the three-dimensional seismic isolation system allow it to: (1) deflect horizontal earthquake vibrations as previous seismic isolation systems do, (2) absorb vertical vibrations, and (3) make use of the LM Guide technology developed over the years to keep structures and equipment level even as the system itself moves up and down to reduce vibrations.

The effectiveness of the three-dimensional seismic isolation system was verified through three-dimensional vibration testing. We placed server racks on seismic isolation systems and subjected them to the same kind of tremors as Mashiki observed during the Kumamoto Earthquakes, with horizontal and vertical acceleration exceeding 1,000 Gal.* With a two-dimensional seismic isolation system, the horizontal acceleration was reduced to about 1/5 the value input, but the LM Guides were only able to prevent amplification of the vertical acceleration, not reduce it. In comparison, the three-dimensional seismic isolation system reduced vertical acceleration to about 1/3, and it curtailed horizontal acceleration even more than the two-dimensional system.

We want our customers to know about our seismic isolation technology and consider it for their BCP plans, so we held demonstrations in October and November 2016, which about 200 customers attended.

* **Gal:** *Unit of acceleration used for earthquake tremors. 980 Gal is equivalent to 1 G. A magnitude 7 earthquake is 400 Gal or more.*



Demonstration

Attending the Three-Dimensional Seismic Isolation Demonstration

UNIADEX, Ltd.
Sales Division Ⅱ,
Facility Business Dept.,
Facility Sales 2 Director
Kazuaki Kusano

Sales Division Ⅱ,
Facility Business Dept.,
Facility Sales 2
Yasuyuki Yagawa

UNIADEX, Ltd., is a total ICT (information and communication technology) support company belonging to the Nihon Unisys Group. As a one-stop service provider, we offer everything from designing, constructing, and installing an ICT base to operation/management, equipment set-up, cloud service, and maintenance.

As we operate in a multi-vendor environment, we also sell THK's seismic isolation systems.

Because THK has amassed an unparalleled, diverse product lineup of seismic isolation systems for equipment, buildings, and floors, we are able to offer products that meet the varied requests of our customers.

We typically recommend installing a seismic isolation system when setting up equipment, especially when hard disks or servers are involved, as any damage they receive in a major earthquake can significantly harm a customer's systems. When we were recently invited to see a demonstration of the three-dimensional seismic isolation system, we were eager to attend.

During the demonstration, THK used a vibration table to replicate the tremors felt during the Chuetsu Earthquake, the Great East Japan Earthquake, and the Kumamoto Earthquakes. We were able to visually see how well the three-dimensional seismic isolation system installed on the table suppressed vertical vibrations in comparison with the two-dimensional system. The numbers also showed how effectively vertical vibration would be reduced in a major earthquake. In light of these results, we now have a new option to present to customers who consult us about reducing vertical vibrations. We have worked with THK for a long time and view them as a reliable partner. We hope they will continue to develop exceptional products and provide them to the market.

Hitachi, Ltd., Healthcare Business Unit — Hitachi, Ibaraki Prefecture

The Joint Circular Arc-Type R Guide Makes Compact, High-Precision Particle Therapy Equipment Possible

Hitachi, Ltd.
Healthcare Business Unit
Radiation Oncology Systems Division, Particle Therapy System Division
Irradiation Equipment Design Group, Particle Therapy Systems Design Department

Section Manager
Tsutomu Yamashita

Engineer
Takenori Nishimura

What is particle therapy equipment?

There are three primary methods of treatment for cancer: surgery, chemotherapy, and radiation therapy. Particle therapy equipment is a type of radiation therapy equipment. A proton beam irradiates cancer tissue, shrinking or killing cancer cells without any incisions or side effects from medication.

X-ray therapy is a widely used radiation therapy, but x-rays radiate much more energy near the surface of the body, and they can damage normal tissue around the cancer tissue. In comparison, with particle therapy, the peak energy emitted from the proton beam can be matched to the specific location and depth of the cancer tissue. The radiation will not reach the surrounding tissue, so this treatment method makes it possible to have a minimal impact on normal tissue. Particle therapy causes little pain and few side effects, enabling patients to balance their treatment and regular life through outpatient care.

Minimizing equipment size is key

Particle therapy equipment is essentially made up of a particle accelerator and a gantry. In the accelerator, protons are accelerated to 2/3 the speed of light. The protons are transported to the gantry, and then they are delivered from the beam transport nozzle to the cancerous area. The gantry can be rotated 360 degrees to the required angle and deliver the proton beam from any direction while avoiding vital organs.

The gantries used in particle therapy equipment are massive, with weights in excess of 100 tons because of the many magnets of various sizes that transport the protons. The size was a major obstacle for the widespread use of this equipment, as hospitals would require a dedicated facility on their campus for this large-scale equipment.

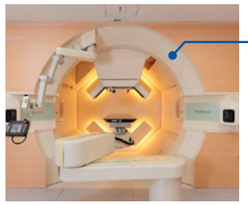
With the gantry being supported from beneath, the rotation tracks on previous models of equipment would deform and become slightly elliptical just from the gantry's weight. Because of that, the support structure and rotating parts were made to be larger and heavier to achieve the necessary rigidity. However, the equipment we provided to Hokkaido University uses Circular Arc-Type R Guides to support the gantry. Rotation accuracy was much improved due to the smoother rotation provided by the preservation of a true circular shape. At the same time, the equipment also became lighter and more compact. Gantries are required to achieve the highest precision, with the position error of the center of radiation being no wider than 2 mm for a 360-degree rotation. It was the Circular Arc-Type R Guides that made it possible for this equipment to meet those size and precision requirements.

Working with THK to create solutions

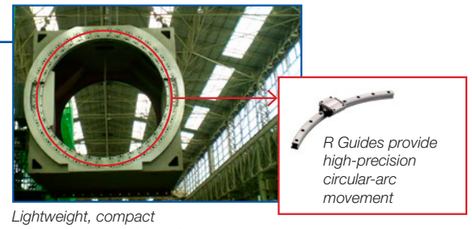
We faced many challenges before this equipment was complete, but we overcame them with the help of THK, who worked with us starting from the design phase. Combining our respective fields of expertise allowed us to move forward with this project, as THK provided design support, assistance during assembly, and more. The end result was a success. It took very little time to go from starting the design process to finishing the assembly process.

Thanks to THK, this equipment is highly regarded, and the next customers in line are also asking us to give them the same state-of-the-art particle therapy equipment that we provided to Hokkaido University.

We hope to continue collaborating with THK to create better products and help create a better society.



State-of-the-art particle therapy equipment that excels at targeting cancer tissue



Lightweight, compact gantry made possible with Circular Arc-Type R Guides

Kyoto University Graduate School — Sakyo, Kyoto, Japan

SEED Solutions Expands Research Possibilities for Industry-Government-Academia Innovation Programs

Graduate School of Medicine, Kyoto University
Division of Human Health Sciences
Development and Rehabilitation of Motor Function, Doctor of Medical Science
Tadao Tsuboyama

The Research Promotion Institution for COI (Center of Innovation) Site at Kyoto University is developing the Orthobot® (a wearable mobility assistive device) for the rehabilitation of people with disabilities, helping them regain the ability to walk naturally after suffering paralysis from a stroke or spinal cord injury. With a focus on attaining a "flexible and comfortable society," we at Kyoto University, "the Last 5X innovation R&D Center for a Smart, Happy, and Resilient Society," pursue various research projects, and our Orthobot® research is one COI program that advanced through the industry-government-academia collaboration sponsored by JST (Japan Science and Technology Agency) and the Ministry of Education, Culture, Sports, Science and Technology.

With this mobility assistive device, we are endeavoring to create a robotic walking aid that can be installed to the KAFO (knee-ankle-foot orthosis) devices that most patients are already comfortably using.

Kyoto University's role is to plan the overall design and collect measurements and data from the patients who wear the Orthobot®. The specific movements necessary for walking assistance are different for each person, so we need to collect basic information about the way each individual patient walks.

When regular robotic walking aids are used to collect data, the force used to move a unique individual's leg with a machine naturally generates an opposing force. Only the force that tries to move the leg back gets stronger, forming a lingering habit that exacerbates the symptoms. In contrast, the Orthobot® assists the bending and extending of the knee in a way that matches the movement of the leg while walking. It calculates the timing best suited to the wearer's walking speed and stride length to create a natural gait. Therefore, the timing of the driving motors sent by our robot is crucial. THK's **SEED Solutions** units are used in this critical function, receiving information from the sensors that detect how the individual is walking, and then operating the actuator motors that determine the amount of force used to move the leg up and down.

The Orthobot® is equipped with two ***SEED Solutions*** *units*

The data collection is currently done through wiring, but a single **SEED Solutions** unit has the capability of communicating wirelessly, so we will consider using wireless communications in our future research. One application would be for patients requiring control for not just one, but both legs. If the pace of the left and right legs do not match, the patient will experience difficulty walking. To control the timing of both legs, the sensors in the robots on the left and right legs need to be able to communicate. This is a situation where the wireless communication function of **SEED Solutions** would prove useful.

We are currently in the development phase of rehabilitation robots primarily for use at medical institutions, but we will also broaden our scope in the future to research robots that support independent living, which can be worn by private individuals to make their everyday lives easier. By wearing the Orthobot®, we hope that people with bad hips or knees and those whose return to their community has been limited by lingering symptoms from a serious illness will be able to go to work and live their lives like those without such disabilities.

Challenergy Inc. — Sumida, Tokyo, Japan

The Model WLS Low-Torque Shaft Unit is Crucial in Making the Magnus Vertical-Axis Wind Turbine a Reality

Shocked by the Fukushima Daiichi nuclear disaster caused by the Great East Japan Earthquake in March 2011, I wanted to realize a world that does not rely on nuclear power. I looked into renewable energy, but what I found was that wind power generation was lagging behind in Japan. Despite its great potential for wind generation, Japan's wind conditions are unstable, and typhoons or sudden winds can easily cause accidents and malfunctions. With that knowledge, I embarked on the challenge of making the Magnus Vertical-Axis Wind Turbine, the first in the world of its kind, which enables steady power generation even in a harsh environment like Japan.

The Magnus Vertical-Axis Wind Turbine has cylinders in place of propellers. The rotation of the cylinders in the wind generates a Magnus effect, which causes the whole turbine to spin. This is the same principle that causes curveballs to swerve in baseball.* The adjustment of the cylinders' rotation based on the wind speed allows power to be generated in the presence of both normal and strong, typhoon-like winds. An additional benefit of the vertical-axis structure is that inconsistent wind directions have no effect on its performance. I obtained a patent in 2013, and made the leap to establish Challenergy in 2014.

I first got in contact with THK when I saw their Model WLS at WIND EXPO. THK is the only manufacturer that sells shaft units with such low-torque rotation, which is essential for efficient power generation, so I felt like I had found exactly what I was looking for.

We faced a series of difficulties during development, but during our trial of the turbine in Nanjo, Okinawa Prefecture, which began in August 2016, we successfully achieved stable rotation even during near-typhoon level winds with instantaneous wind speeds up to 25 m/s. Various problems have occurred during the trial, but THK's shaft unit has withstood the sea breeze with almost no rusting, and even now, it has maintained its performance with no change in torque.

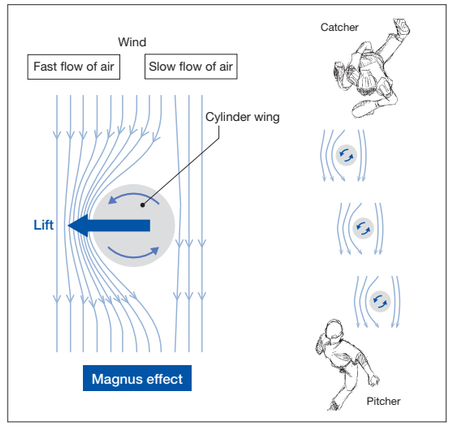
Our current goal is to utilize mass-produced turbines with a power output of 10 kW by 2020. In the future, we would like to make 1 MW turbines a reality, but that would require a bearing unit dozens of meters long. We will have to rely a lot on THK's technical expertise, but I hope to continue our successful collaboration in the future.

Challenergy Inc.
Founder, President & CEO
Atsushi Shimizu

Magnus Vertical-Axis Wind Turbine set up in Nanjo, Okinawa Prefecture

***The principle behind the Magnus Vertical-Axis Wind Turbine**

1. When a pitcher puts spin on a ball, the ball encounters a headwind as it flies to the catcher.
2. The curveball rotates counterclockwise when viewed from above.
3. The left side of the ball is rotating in the same direction as the headwind, so air flows faster on the left.
4. The right side of the ball is rotating in the opposite direction of the headwind, so air flows slower on the right.
5. The ball curves to the left because of the difference in the flow of air on the left and right sides of the ball.
6. When spin is applied to a turbine cylinder instead of a ball, the force of the cylinder trying to swerve in the wind rotates the whole turbine.



Nippon Becton Dickinson Company, Ltd. — Minato, Tokyo, Japan

Advancing the World of Health

Nippon Becton Dickinson Company was founded in 1971 as a Japanese subsidiary of the US corporation Becton, Dickinson and Company. We provide sophisticated products with safety features supported by advanced technical expertise in medical research, diagnostics, and treatments. Our products you may be familiar with include blood collection tubes and insulin pen needles, of which we hold the greatest market share in the world. One of the key products that our diagnostics division offers is the blood culture system. Blood culture tests involve collecting blood samples in blood culture vials, inoculating the vials, and screening for microorganisms. The blood culture system is a vital piece of diagnostic equipment that enables health care providers to select the optimal antibiotics for the patient.

I am sure many of you are familiar with the term *sepsis*. Sepsis is a life-threatening condition that is caused by infections and results in organ and tissue damage. Sepsis has a much higher mortality rate than heart attacks or strokes, which are cited among the three leading causes of death in Japan. However, the cause of death in such cases is often reported as cancer, heart disease, or something else, so this fact is not well-known.

When large-scale earthquakes such as the Great East Japan Earthquake and the Kumamoto Earthquakes occur, many people become injured, and those who lose their homes experience fatigue, which weakens their immune systems and makes it easier for them to become infected with microorganisms. This means it is especially important that our blood culture systems be operational immediately after an earthquake. We recognized that our vertical instruments were at high risk of falling over during an earthquake, so we searched for a solution. The moment we saw THK's seismic isolation system at their exhibition booth at a medical conference and exhibition in Hamamatsu, we knew it would work for us because its compact structure lets it be installed beneath existing equipment. During our subsequent meetings, we obtained a plastic model of the seismic isolation system that makes it easy to see how it works. We were amazed by how far this technology has progressed and realized that information could prove useful by enabling us to provide clear explanations of this technology at hospitals. At later medical exhibitions, when we introduced the blood culture system that comes installed with the seismic isolation system, many customers told us that they already had taken measures for seismic isolation at their facilities. However, when we inquired further, we realized that they were talking about having earthquake-resistant structures, not seismic isolation systems. It is certainly possible to prevent equipment from falling over by securing it tightly to the floor with anchor bolts, but this will not prevent internal damage to the equipment during major tremors. If the blood culture test is stopped longer than a set amount of time, it may not be able to resume. Furthermore, if the instrument is damaged, it cannot be used for some time even after power is restored. With the seismic isolation system, however, you can prevent both toppling and internal damage. We had to conclude that the difference between earthquake-proofing, seismic damping, and seismic isolation is still not widely understood, and that few are familiar with seismic isolation.

Now, we always keep earthquake precautions in mind and recommend THK's seismic isolation system to the customers who purchase our blood culture systems. Our aim is to work with THK to promote seismic isolation systems and deepen everyone's understanding of how important they are for equipment. We believe that developing instruments that will protect the lives of patients even directly after an earthquake will allow us to achieve our corporate philosophy: "Advancing the world of health."

Nippon Becton Dickinson Company, Ltd.
BD Life Sciences - Diagnostic Systems,
Business Director,
Kazuhiro Hamaji

The seismic isolation system safeguards the blood culture system from the risk of falling over during an earthquake

Ofunato Fire Department

Ofunato, Iwate Prefecture

Protecting the Key to Fire Fighting and Disaster Prevention with Seismic Isolation

The old Ofunato Fire Department building was constructed in 1963, but significant deterioration of the building led to the city of Ofunato making plans in 2009 to rebuild the facility as the Disaster Prevention Center. The original plan had been to simply update the old building, and designs for this project were completed. However, in 2011, while the office was thankfully able to avoid significant damage from the Great East Japan Earthquake, the tsunami reached within 200 to 300 meters of our facility, so we temporarily suspended our operations and moved our office to its current elevation. The Ofunato City Disaster Prevention Center officially began operations in April 2017 in a newly constructed, four-story government office building. The facility houses the fire department and its headquarters, the volunteer fire department and disaster response office, and an exhibition hall and touring space. In addition, the facility has a smoke simulation room, the first indoor pool for sea rescue exercises in Iwate Prefecture, and a separate building for training exercises. We installed the seismic isolation system in our Disaster Prevention Center on the third floor, where we receive all 119 calls and other emergency transmissions in our jurisdiction and:

1. Use this information to constantly track the locations of our 90 emergency vehicles so we can mobilize the most appropriate dispatch team,

2. Provide information and support to our dispatch teams while contacting federal and prefectural government bodies to keep damage and injuries to a minimum, and

3. Contact medical facilities to get injured parties transported to hospitals.

When necessary, we arrange for air ambulances or helicopters from disaster prevention aviation units to immediately respond to injured parties. We act as a hub for conveying information during emergencies, so it is of the utmost importance that all our systems are operational in emergency situations.

We expressed our desire for seismic isolation to be incorporated into the building's design. Buildings are constructed to a certain strength based on the importance of that building. There is a strength–importance coefficient for government buildings that is the standard used to compare buildings and determine the strength they require. A typical building would get a 1, a police station would get a 1.25, and our center was given a 1.5, the same level as the prime minister's office. We had originally planned on constructing our facility using seismic damping, but we decided to go with seismic isolation because of the importance of ensuring the equipment in the Disaster Prevention Center's server room does not get damaged or cease functioning during a disaster. We were impressed by the effectiveness of THK's seismic isolation system while visiting a disaster prevention exhibition in Tokyo. We got to see a seismic isolation demo machine absorb vibration right before our eyes. We then physically experienced how much a seismic isolation system reduced vibration during historical earthquakes recreated by THK's seismic isolation simulation van. While we did not direct the company designing our new building to use a particular company's seismic isolation system, we were greatly reassured when we saw they had chosen THK's product in the proposal they submitted.

Ofunato Fire Department
Fire Captain **Eietsu Niinuma**
Battalion Chief **Yoshiharu Murakami**
Fire Lieutenant **Wataru Ogino**

Front view of the Ofunato City Disaster Prevention Center

Installing seismic isolation systems has become commonplace in the world of fire fighting and disaster prevention, but we also hope to see them used in municipal government buildings and other places that handle important information about city residents.

In addition, to increase awareness of fire fighting and disaster prevention among the general public, we intend to have an exhibition room and area to tour so children can visit our facility and learn about fires and natural disasters. We plan to display a model of a seismic isolation system in this area so we can tell visitors about our own seismic isolation system and the importance of seismic isolation in general.

Kyushu Nissei Denki Co., Ltd.

Kamimashiki District, Kumamoto Prefecture

Seismic Isolation Dramatically Improves Production Recovery by Eliminating Earthquake Damage to Our Systems

Our company boasts over 30 years of experience as a mass production facility that performs post-processing for semiconductors. We endeavor to craft a business continuity plan (BCP) that will ensure the safety of our employees, secure the trust of our business partners, and maintain stable management particularly during large-scale disasters.

The Kumamoto Earthquakes consisted of two severe tremors: a foreshock and a mainshock. The foreshock had a magnitude of 6.5 and occurred on Thursday, April 14, 2016, at 9:26 at night. We had a number of employees working the night shift on our production floor that evening, and right after the earthquake occurred, our maintenance group contacted the BCP coordinator to inform them that a section of our ceiling panels had collapsed and our production equipment had shifted during the shock. Thankfully, all of our employees were fine. We had them evacuate right away and return home. As we were informed that our electricity was running and our servers were fine, we stayed home the night of the earthquake and waited until the next morning to check on the situation.

When we assessed the conditions in the plant the next morning, we found that our machines had moved significantly from their former positions and ceiling panels had fallen. With these and other issues, production was impossible. We promptly assembled an emergency response group and first contacted every employee to confirm they were safe and got details of any injuries they might have received. The following day, we began full-fledged efforts to get our facility back in working order, at which point we also discussed future precautions. However, on Saturday, April 16, at 1:25 in the morning, a magnitude 7.3 earthquake occurred, causing the condition of our office and production floor to deteriorate further.

At our company, even if our office building and production equipment were completely untouched, losing our servers would lead to problems for the production floor and also cause the receiving and shipping system for raw material and products to cease functioning. Having our servers protected by seismic isolation systems therefore played a major role in allowing us to quickly resume production and other management operations even after these major earthquakes. The recovery goals in our BCP policy are set to 15 days or less for temporary resumption of activities and 30 days or less for total recovery. We actually managed to temporarily resume our activities in 11 days, and we achieved total recovery in 25 days. If our servers had been damaged, it would have taken significantly longer to recover.

Kyushu Nissei Denki Co., Ltd., Production Promotion Division
Management Department
Information System
Assistant Manager
Ryouma Ogata
Manufacturing Development Department
Manufacturing Development Section
Manager
Yoshiro Inoue

Servers that kept functioning during the Kumamoto Earthquakes thanks to seismic isolation systems

It is no exaggeration to say that the seismic isolation systems were the key that enabled our company to continue operations by protecting us against earthquakes, which can occur at any time. We had customers who were forced to suspend operations at their production facilities due to damage from the Great East Japan Earthquake, so they actually had requested that we strengthen our own BCP activities as their business partner. We debated internally whether to use anti-seismic devices or seismic isolation systems to safeguard our integral servers from earthquakes. In the end, we decided to go with seismic isolation systems, as servers are delicate machinery sensitive to tremors and long-period vibration.

Our experience with the recent Kumamoto Earthquakes reaffirmed for us the importance of having a BCP. In the future, we need to further bolster our disaster readiness in every regard, from our production equipment and machines to the racks we use to store product and the pipes throughout our facility. Our experience during this recent disaster showed us what seismic isolation systems can do. Moving forward, we hope to work with THK to secure our valuable equipment with seismic isolation systems and further strengthen our BCP. Furthermore, we have promoted the use of seismic isolation among the companies we do business with.

Oita University Hospital

Yufu, Oita Prefecture

Making Use of Seismic Isolation Systems to Keep Tests Running Even During Earthquakes

In the medical laboratory where I work, we perform a variety of tests, including blood tests, immunological tests, and urine tests. These tests are used for diagnoses, so they are an indispensable part of the medical process. We work tirelessly to ensure testing equipment will function even if it gets damaged in a natural disaster because of the important role these tests play in protecting the lives of our patients.

I saw how severely the Tohoku University Hospital was damaged during the Great East Japan Earthquake. Much of its valuable testing equipment fell over and was rendered unusable. During the Kumamoto-Oita earthquakes that occurred last year, we provided medical assistance in the city of Aso. Luckily, these earthquakes only had a magnitude of 5 where my hospital is located, and the damage it suffered was negligible. At the same time, the Kumamoto City Hospital, located in the city of Kumamoto, where the recorded magnitude was 7, did not have a seismic isolation system and suffered significant damage. All of its patients had to be moved to other facilities because of the risk of the building collapsing. Having personally experienced these two major earthquakes reaffirmed for me the necessity of taking appropriate precautions against earthquakes. In particular, I felt the urgent need to secure our testing equipment with seismic isolation systems.

Therefore, when we installed new equipment during the reconstruction of our testing rooms, we used seismic isolation systems to secure our most valuable devices: biochemistry auto analyzers and blood analyzers. For our other equipment, we used standard earthquake-proofing methods, such as securing the equipment to the wall using bands. Our testing equipment is extremely precise and examines patients' bodies and responses on the micron scale. If these pieces of equipment are damaged during a major tremor, we cannot perform tests until their functions are restored, which takes a long time. As the Advanced Emergency Medical Service Center and Disaster Base Hospital, we provide medical examinations 24 hours a day to emergency patients. To perform these functions, the testing systems that doctors use to treat their patients must remain in working order at all times. We cannot turn patients away during a disaster. We must be able to conduct diagnostic tests, no matter what. From what I saw of THK's seismic isolation system at an academic conference and the results it displayed at the Tohoku University Hospital, I have placed my trust in this technology.

Oita University Hospital Department of Medical Technology
Laboratory for Clinical Investigation Chief Manager
Hiroshi Miyako

In March 31 of this year, the head of the Health Policy Bureau at the Ministry of Health, Labor and Welfare issued a revision to the requirements for disaster base hospitals, adding a business continuity plan (BCP) to the list. Because we are a disaster base hospital, I was certain that installing a seismic isolation system was the right decision from a BCP standpoint, as well.

There are many fault lines in Oita Prefecture, and its neighboring Beppu Bay has been an epicenter in the past. This area could see a major earthquake at any time, and there is even a legend that tremors once caused an island to sink into the ocean long ago. I prefer seismic isolation systems over other options such as seismic damping and earthquake-proofing for their ability to isolate objects from tremors. While seismic damping and earthquake-proofing can prevent testing equipment from toppling over and breaking, these methods will not protect what is inside of a machine from breaking due to vibration. Seismic isolation systems, on the other hand, not only prevent equipment from falling over, but also protect the interior of the device from vibration.

We have been charged with the duty of performing diagnostic tests at all times. While securing the entire hospital with a seismic isolation system is not possible, I very much hope to install a seismic isolation system under a whole floor, room, or other section of the hospital.

Blood analyzers (top right) and biochemistry auto analyzers (bottom left) installed with seismic isolation systems

Hyogo Prefectural Museum of Ancient Bronze Mirrors

Kasai, Hyogo Prefecture

Seismic Isolation Systems Protect Irreplaceable Historical Works of Art

Our museum opened on April 14, 2017, and exclusively features ancient Chinese bronze mirrors. Tadashi Sengoku, an art collector from the city of Kasai, generously donated and loaned 316 mirrors to our museum. This collection includes ancient Chinese bronze mirrors that can be found nowhere else in the world, and a number of them are on display to the public.

At our museum, you can see the different ways people have viewed mirrors over the ages. 3,700 years ago, during Ancient China's legendary Xia Dynasty, objects resembling mirrors were created out of bronze. While the general perception today is that mirrors are cosmetic tools that reflect a person's face, at the time, they were apparently used by shamans as magic objects meant to enchant people through the reflection of light. Bronze mirrors are typically circular in shape; the choice to model them after the sun and moon in this way seems to emphasize how they shine in light. During the Han Dynasty, mirrors were used to signify the bond between a man and woman and were used as wedding gifts. A couple that pledged to reunite after being separated would split their mirror in two and carry their halves with them. Even in the present day, Japan still maintains the tradition of the vanity being the first thing a bride brings with her when she marries. I hope that, through our displays, visitors to our museum can gain a sense of the feelings encapsulated in mirrors of different eras.

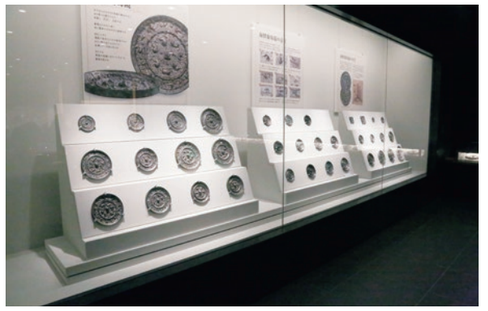
Due to the common usage of mirrors as cosmetic tools to reflect one's face, it is important to make sure they are polished to the brightest silver-white possible. Copper is a common component of the most ancient bronze mirrors. This makes them a reddish-brown color that darkens over time, preventing them from clearly reflecting an image. Increasing the tin content makes the mirror more silver-white in color, but adding too much will result in a brittle and breakable mirror. It takes a high level of technical skill to make such mirrors without causing them to break. The techniques required to create these Chinese mirrors were perfected during the Han Dynasty, but much of this technology was not passed down to future generations. Even with modern technology, we cannot recreate their techniques.

Hyogo Prefectural Museum of Ancient Bronze Mirrors
Chief Curator
Hiroshi Nakamura

These historical, artistic works are so precious, yet they are disc-shaped and as brittle and breakable as glass. Because of this, we must be extremely careful to prevent these bronze mirrors from getting damaged. The Chinese mirror specialists that make up the Sengoku Collection Research Committee proposed that we install seismic isolation systems in our museum. This was motivated in particular by Hyogo Prefecture having suffered through the Great Hanshin-Awaji Earthquake. We decided to install THK's seismic isolation system under exhibits at risk for earthquake damage.

Our display cases were designed first, so the seismic isolation systems had to fit inside of these cases while also leaving enough room for the stroke to accommodate how much the cases move with long-period ground motion. The flexible structure of THK's seismic isolation system allowed for an extremely effective design in the limited space inside the display cases. Furthermore, the company itself was flexible and worked within the short time frame we had before the day the museum was set to open.

In the future, the need to secure valuable artifacts with seismic isolation will only increase. When designing both exhibition displays and buildings, we hope to include greater involvement from specialists in seismic isolation technology as it relates to cultural artifacts. This will allow us to incorporate these specialists' insight into our designs, thereby creating a solid risk management system that will surely aid us greatly in protecting and making use of cultural artifacts.



A seismic isolation system is installed within this display case to protect these ancient Chinese bronze mirrors from earthquakes