

## Experience and achievements guide the evolution of seismic isolation technology

**People have to be prepared for crisis situations, since earthquakes pose a danger to all of us.**

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The combined population of Iwate, Miyagi, and Fukushima, the three prefectures that bore the brunt of the Great East Japan Earthquake, is approximately 5.6 million, which is roughly 4% of all the people in Japan. This is a region where earthquakes occur fairly frequently, so there were hardly any fragile structures among the buildings that were destroyed. This is also a region where people tend to be acutely aware of the danger of natural disasters and where old stories and personal experiences of tidal waves and earthquakes are commonplace, as reflected in the local saying *tsunami tendenko* (“in a tsunami, every man for himself”). Despite the fact that northeastern Japan is not densely populated and despite the heightened awareness of danger, the region incurred nearly 20,000 casualties. If a series of earthquakes struck the Tokai, Tonankai, and Nankai region, the destruction would likely be many times more extensive.

In large metropolitan areas such as Tokyo and Osaka, many high-rise structures have been built on old riverbeds, reclaimed land, landfill, and other fragile foundations, and these buildings would be severely affected by long-period seismic waves. The Great East Japan Earthquake was surely a very frightening experience for many people on the top floors of these high-rise buildings. Although the vibrations may not be that strong at ground level, long-period seismic waves cause strong, slow shaking on the upper floors that continues well after the ground-level vibrations have subsided. Structures erected in accordance with current building codes are not adequately equipped to withstand such forceful and protracted shaking.

The most essential part of preparing for a massive, terrifying earthquake of this sort is recognizing that the danger is a matter of concern to everyone. Many Japanese people mistakenly believe that they live in a safe country and that their safety is somehow being maintained by others. Each of us, however,

must be responsible for our own safety. In the past, it was taken for granted that everyone had to protect himself or herself. People learned how to live while coping with disasters and the whims of nature, and these lessons were passed on from one generation to the next. Unfortunately, this is not true of the present generation.

Even so, new means of protection exist: techniques such as damping and seismic isolation. These amazing technologies, newly available to us, were not available when major earthquakes occurred in the past. However, it costs money and takes time and effort to incorporate seismic isolation equipment and other such devices, so these techniques are not yet widely used.

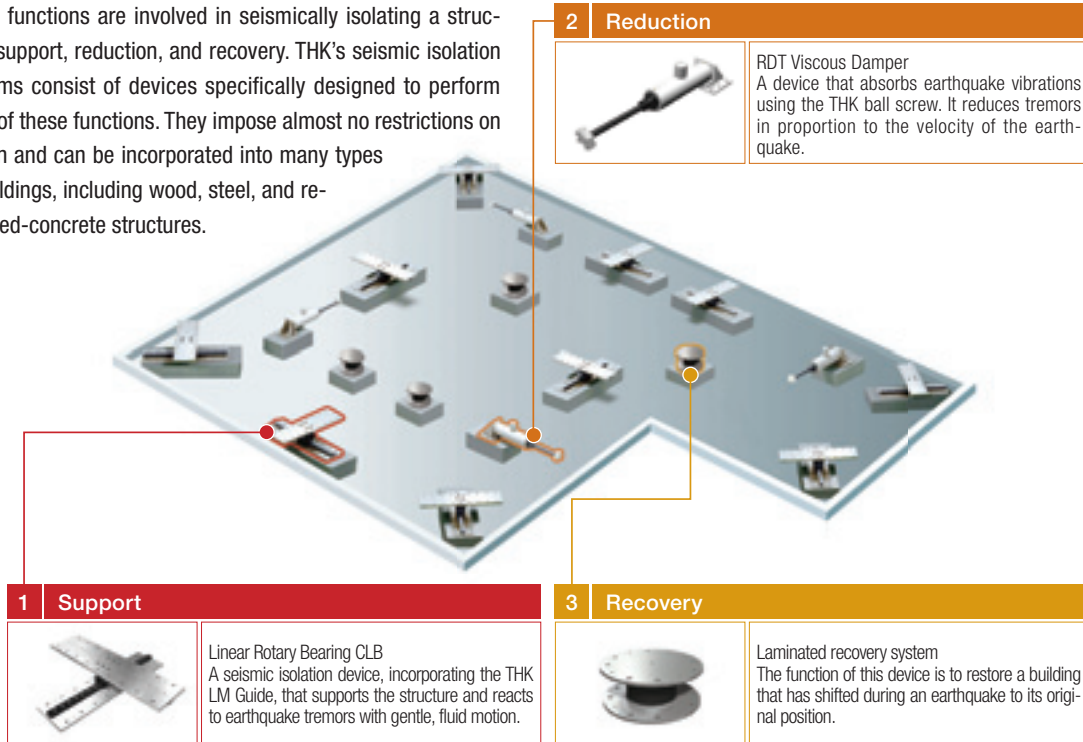
Even when they have an intellectual understanding that a need exists, people often fail to take action unless they are physically confronted with that need. I have concluded that people need to experience the horror of an earthquake in order to realize that it's in their own interest to be prepared. For that reason, in cooperation with THK, we have developed a series of earthquake-simulation devices. One such device is BiCURI, or the Bi-directional shaker and Computed Ultra-Response Integration environment. This device provides a simulated experience of the major earthquakes expected to occur someday in various locations in Japan, including the different tremors that would occur in each region and each type of ground as well as the different levels of vibration on lower and higher floors.

We need people to understand what it actually means to endure a major earthquake. Once they have had a convincing physical experience, people awaken to the realization that the threat of an earthquake is everyone's business. This inspires a determination to be prepared and prompts people to take real action by incorporating earthquake resistance and seismic isolation devices, to protect themselves against disaster.

THK's seismic isolation systems incorporate two of its principle products, LM Guides and ball screws. There are two basic types of systems, one designed to protect buildings and one designed to protect equipment. Once they are installed, seismic isolation systems can deflect earthquake vibrations, safeguarding buildings and equipment.

## Seismic isolation devices for buildings

Three functions are involved in seismically isolating a structure: support, reduction, and recovery. THK's seismic isolation systems consist of devices specifically designed to perform each of these functions. They impose almost no restrictions on design and can be incorporated into many types of buildings, including wood, steel, and re-inforced-concrete structures.



## Strong local interest in seismic isolation to protect large buildings

When we rebuilt our house, our first concern was to make it safe. Our old house was made of wood and it was quite comfortable, but that kind of construction is out of date. Plus, the city of Toyota and the surrounding area are in the Tokai earthquake zone, so we always worried whenever there was an earthquake.

When I was working in Nagoya, they started doing seismic isolation work on the western building of the prefectural government complex, and that got me thinking about seismic isolation for our house. They were using seismic isolation devices from THK. Later on I visited a model house and saw and heard about another company's seismic isolation system, but it seemed kind of one-dimensional. We had hired a builder called Haneda Construction, and they showed us some sample seismic isolation devices that THK had loaned them. We both decided that this was what we were looking for. The THK units use LM Guides, so they can handle vertical tremors quite well, and the fact

that there are no running costs is big plus. We're using the same system they use in huge buildings like the prefectural government offices, so we feel very safe.

While the construction work was being done, neighbors who saw the seismic isolation units laid out on the foundation congratulated us on building such a sturdy house and told us that, if an earthquake struck, they'd be heading for our house. In a way our house has probably become an advertisement for THK's seismic isolation systems. I hope that helps motivate more people around here to equip their own homes with seismic isolation, because it will bring peace of mind to the whole area.



Foundation for a residence, built by Haneda Construction.



Homeowner Yasuo Haneda (second from left) with Kazumi Haneda of Haneda Construction (far right).

## Seismic isolation systems for protecting equipment

Seismic isolation systems for protecting equipment provide spot coverage—seismic isolation only where it is needed, such as under a server computer or precision instrument, or under the entire floor of a data center or an operational command center.

THK offers two types of seismic isolation devices for protecting equipment: the model TSD Seismic Isolation Table and the model TGS Seismic Isolation Module.

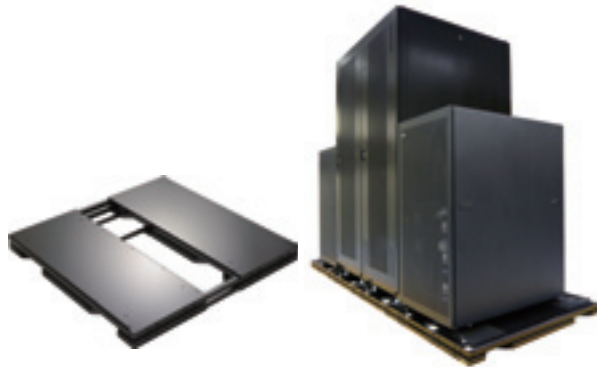
The model TSD Seismic Isolation Table is a simple device that can provide seismic isolation wherever it is placed. It is easy to assemble and extend and can be used for existing as well as newly installed equipment. It is used to protect a wide range of equipment and the like, including server computers, optical instruments, medical devices, precision equipment, and art objects.

The model TGS Seismic Isolation Module can be freely arrayed in

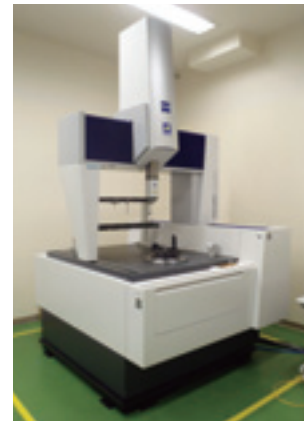
multiple-unit configurations to accommodate heavy loads, such as semiconductor production machines and other massive equipment, or even the entire floor of a data center.

The module performs the three crucial functions of support, reduction, and recovery. It also provides an analysis of its predicted response to an earthquake, based on the location where it is installed, the weight of its load, and the anticipated seismic motion, enabling the most effective possible use of its seismic isolation functions.

As part of its business continuity planning effort, THK is installing these modules to help protect three-dimensional precision measuring devices located in various plants from being damaged in an earthquake. Installation was done at the YAMAGATA Plant in February 2012 and is scheduled to be carried out at the MIE, KOFU, and YAMAGUCHI Plants as well.



At left, a model TSD Seismic Isolation Table; at right, multiple tables support a rack of servers.



At left, a model TGS Seismic Isolation Module; at right, multiple modules support a three-dimensional measuring device at the YAMAGATA Plant.

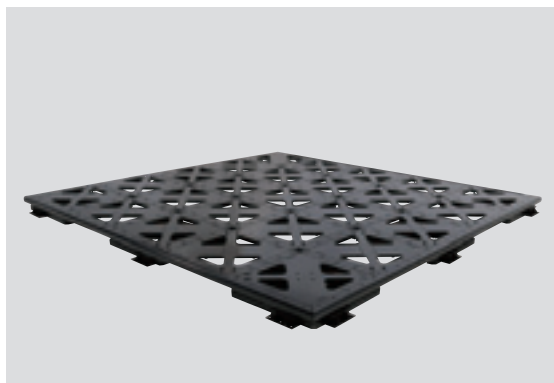
## Nikkan Kogyo Shimbun Ltd. The Best 10 New Products Award

In 2011 THK's model TGS Seismic Isolation Module was selected to receive one of the main prizes at the 54th The Best 10 New Products Awards sponsored by the newspaper *Nikkan Kogyo Shimbun Ltd.* The awards are presented for products that are developed and put into use during the current year and that contribute to the advancement of monozukuri and help make Japan more competitive in the international marketplace. The criteria state that products receiving the award must:

- (1) be creative inventions that have a major impact both within Japan and overseas;
- (2) meet the world's highest standards for performance through improved

- research and ingenuity, even if the product is not foremost in originality;
- (3) represent the resolution of highly difficult technological issues and constitute a notable contribution to Japan's industrial technology from the standpoint of product value; and
- (4) be seen to play a prominent role in facilitating progress in industry and society.

THK officials were presented with a commemorative certificate and plaque at an award ceremony held in January 2012.



A configuration of coupled model TGS Seismic Isolation Modules.



(From left) Vice President Muraio, ACE Division, THK; THK President Teramachi; *Nikkan Kogyo Shimbun* President Imizu.

## ● Optimal seismic isolation for measuring devices ●

Nano-level measurements are the norm at our company, and we have instruments capable of even more precise measurements denominated in angstroms as well. In the aftermath of the 2011 Great East Japan Earthquake, some of our clients reported that their instruments had been destroyed by the violent tremors. The measures we had taken to prepare for an earthquake protected the equipment only to a limited extent, so we decided to install seismic isolation devices for greater protection, to enable our clients to resume operations quickly after an earthquake.

When measuring equipment is seismically isolated, it is important to avoid any adverse effects on normal measurement functions. Protective devices may prevent the equipment from severe shaking in an earthquake, but if it's routinely subjected to vibrations the equipment can't function properly. Vibrations were a real concern when we first loaded measuring equipment onto seismic isolation devices. In controlled trials, low-level vibrations were detected



with seismic isolation devices made by other companies, but no vibrations were detected with the THK devices, so in the end we decided to use the THK units. Our measuring equipment comes in a variety of sizes, and THK's model TSD isolation tables, while simple in structure, are designed to accommodate many different kinds of equipment.

Our devices make measurements that go way beyond anything that can be seen with the naked eye, and considering the price, it would be unthinkable to have to replace them again. From the standpoint of business continuity, seismic isolation provides the kind of peace of mind that money can't buy.



NATSUME OPTICAL CORP employees: (from left) Kazuhiko Shirota, Section Chief, Manufacturing Department, Quality Control Section; Hidenori Honda, Senior Manager, General Affairs Department.

## ● Auto-recovery offers reassurance amid aftershocks ●

Revisions to our business continuity plan led us to employ seismic isolation for our data servers. Manufacturing automobile-related products is more than 90% of our business, so we really need to avoid defects and maintain traceability. We use information technology not just to manage data on product quality but to design unique metal molds and run the whole product quality system. All of our measurements are stored in servers at our manufacturing sites. If the servers went down, we couldn't continue to do business, and that would be the end of the company. Thus, we absolutely have to take countermeasures to prevent any breakdowns. Before the Great East Japan Earthquake occurred, our servers were sitting right on the floor. Considering how important they are, this issue took the highest priority.

We opted to go with THK's model TGS Seismic Isolation Module because it has an auto-recovery function that restores the load to its original position once it has been protected from earthquake tremors.



Without auto-recovery, the equipment would be in danger if the earthquake were to continue, which is why we went with the THK unit. We are also impressed by the rigidity and precision provided by the LM Guide, which is an important component of the module. It's the same LM Guide used throughout the world in manufacturing equipment and industrial machinery, and that provides a lot of confidence. I used to get phone calls from General Affairs whenever there was an earthquake, even in the middle of the night, which always made me uneasy. Thanks to THK's seismic isolation system, with its auto-recovery function, now I can rest easy.



Makoto Komatsu, President, KOMATSUSEIKI KOSAKUSHO, CO., LTD., located in Suwa, Nagano Prefecture.



## Reducing power consumption throughout the THK Group

THK has already converted its operations to incorporate energy-saving production equipment and fixtures, conducted assessments of energy usage, and taken other steps to conserve energy. To cope with the shutdown of the country's nuclear-powered generators in the wake of the Great East Japan Earthquake in March 2011, special measures devoted to conserving electricity were implemented throughout the entire THK Group.

In the offices at THK Headquarters and its sales branches, electric lighting was reduced and restrictions were placed on air conditioning temperatures and hours of use. In addition, THK adjusted working hours, introducing a daylight-saving system, instituted a warm-weather clothing policy in keeping with the government's "Cool Biz" campaign, and coordinated employee summer vacations to achieve maximum energy savings. At THK Headquarters and the Technology Center, the group's two biggest office facilities, a system for monitoring

the demand for electric power was introduced in an effort to reduce peak power consumption.

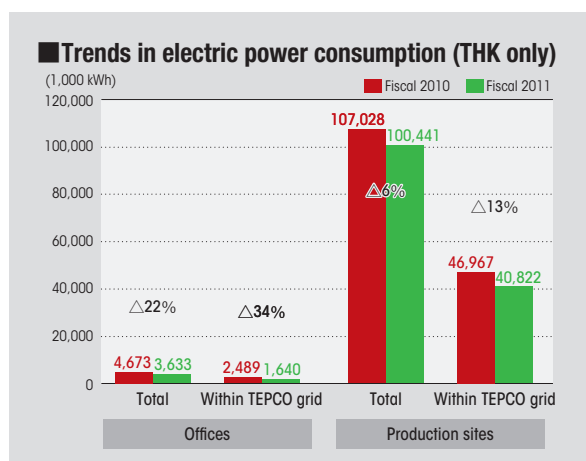
Article 27 of Japan's Electricity Business Act placed restrictions on electric power consumption within the Tohoku Electric Power and Tokyo Electric Power grids. Although only THK's YAMAGATA and KOFU Plants and the THK INTECHS SENDAI Plant were subject to the restrictions, THK launched an initiative to reduce peak power consumption and overall electric power usage at all of its production locations throughout Japan. Generators had been installed at each THK facility, but a concerted effort was made to refrain from using the generators whenever possible, through constant monitoring of power usage and tight controls on air-conditioning-related power consumption. As a result, electricity usage at the THK plants within the Tohoku Electric Power and Tokyo Electric Power grids never exceeded the legally prescribed level, and energy efficiency improved throughout the year.

### Efforts at management and sales offices

1. Demand-monitoring equipment installed at THK Headquarters and Technology Center.
2. Fans and other air-circulation devices deployed.
3. Heat-barrier film installed on windows at THK Headquarters and Technology Center.
4. Daylight-saving system introduced.
5. "Cool Biz" clothing policy moved up and extended.
6. Interior lighting reduced; air conditioning hours reduced.
7. "Green curtains" deployed at NAGAOKA, SUWA, SHIZUOKA, and ATSUGI Branches.

### Efforts at production facilities

1. Peak power consumption controlled.
2. Working hours adjusted.
3. Air-conditioning equipment updated; hours of operation reduced and staggered.
4. Light fixtures updated and reduced.
5. Generators employed more efficiently.
6. Water heaters and vending machines reduced.
7. "Green curtains" deployed at YAMAGATA, KOFU, and MIE Plants.



Newly installed electric power generator at KOFU Plant.

● Green curtains ●

At various THK locations, employees cultivated the shade plant *goya*, or bitter melon, as a part of summertime energy conservation measures. This was not a companywide initiative but a voluntary effort undertaken at individual THK locations.



NAGAOKA Branch



ATSUGI Branch



MIE Plant



KOFU Plant

**Sales office**

We started growing *goya* in the hope that it would be an effective way of offsetting the summer heat, but as time went on we also found it very enjoyable just to watch it grow. At first these cute little sprouts appeared, and several days later the plants began to send out tendrils. Less than a month after that we had flowers blooming, and about ten days after the flowers opened we had small melons. The plants grew and grew and produced a lot of melons, thanks to the efforts and ingenuity of the employees who were involved in the project, and we were able to harvest the fruit. It started as a way of conserving energy, but the pleasure of watching our plants grow may have been the true harvest.

Manager Mori, ATSUGI Branch

**Production site**

When we planted the *goya* seedlings, I doubted that they would ever grow into big plants. Contrary to my expectations, though, the plants grew larger and larger, day after day, and by the end there was a 5°C difference between the temperatures on either side of our “green curtain.” This enabled us to reduce air-conditioning hours inside our office building, so it actually had an energy saving effect. Still, the most charming thing about our green curtain was the way it looked. I got a cool, pleasant feeling just looking at it. It took time and effort to water and take care of the plants every day, but they have had a very positive effect, and not just because they help us conserve electricity.

Manager Takii, KOFU Plant

● Volunteer activities ●

A number of employees have used THK’s volunteer leave and leave of absence systems or used vacation time to take part in volunteer assistance efforts in areas that were ravaged in the Great East Japan Earthquake and its aftermath.

**KOFU Plant employees Mitsuyoshi Aoyagi, Hayato Iijima, Erika Shiojima, Ryuichi Inoue, and Tomoko Watanabe**

For three days, from October 29 to 31, 2011, these employees worked as volunteers in two areas in the city of Ishinomaki. They helped clear debris and served food at a temporary housing site in the city’s Aikawa district and helped clean up a seaweed harvesting site in the Jusanhama district. Nearly seven months after the earthquake, the seriousness of the disaster had begun to fade from some people’s minds, but problems remained, including high unemployment and a continuing exodus of residents from the area. The volunteers from the KOFU Plant felt they needed to view the situation in the disaster-stricken area with their own eyes and tell the world what they had seen.

In describing the experience, one employee remarked, “I realized how lucky we are to be able to do the ordinary things in life—working, eating, sleeping. There’s so little that one person can do, but if I can help people in the disaster area achieve even a little bit of progress, help them get their hopes and dreams back, then I’ll keep on doing this.”



Clearing debris.

**THK INTECHS SENDAI Plant employee Kyoko Honda**

In early April 2011 I took part in a volunteer project to collect school supplies, educational materials, and athletic clothes and deliver them to elementary schools in the city of Kesenuma. In working to help children who were about to start a new school year but didn’t have any of the things they needed, I received a tremendous amount of help from everyone at the SENDAI Plant, and I was able to deliver a lot of supplies. I also participated in an effort devoted to replanting flower beds damaged by seawater in the tsunami. Since last year, I’ve helped planted flower beds each season at Ohmagari Elementary School in the city of Higashi Matsu-shima, Kazuma Day Care Center in the city of Ishinomaki, the Ohharahama area on Ojika Peninsula, and the Shotaro Ishinomori Manga Museum. As the debris has been removed in the disaster area, the obstacles to communication have been cleared away as well. Through these assistance efforts, new communities are emerging. If my efforts can raise the spirits of people in the disaster area, even a little, I’ll continue to participate in these activities.



Planting flower beds.