The need for anti-earthquake measures

Seismic isolation simulating vehicle provides a jolt of realism.

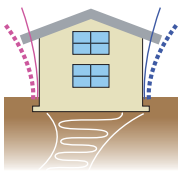
Becoming aware of the horrors of an earthquake

As an earthquake-prone country, Japan leads the world in anti-earthquake technology. There are currently three main technologies aimed at making buildings earthquake-safe. The first is “quake-resistance”, which means making a building strong enough to withstand vibrations. The second is “vibration-damping”, which means incorporating damping elements into the structure to absorb vibrations. The third technology is “seismic isolation”, which employs inserted elements to isolate the building from its foundation in order to prevent vibrations from being transmitted directly to the building.

THK has made skillful use of linear motion technology, accumulated over many years, to develop seismic isolation devices. The catalyst for development was the Great Hanshin-Awaji (Kobe) Earthquake of 1995. In the quake’s aftermath there was speculation that THK’s linear motion systems might provide a means to reduce vibrations transmitted to buildings during earthquakes and prevent buildings from collapsing in future quakes. This concept was the starting point for our development of seismic isolation devices.

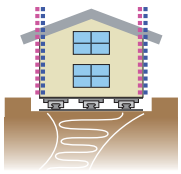
Once we actually started manufacturing and selling these systems, however, we realized how difficult it was to adequately convey in words the advantages of seismic isolation over quake-resistance and vibration-damping. The most effective way of demonstrating the horrors of an earthquake and the superior characteristics of seismic isolation devices is to let as many people as possible actually experience the difference in vibration. In 2007 THK started producing and operating seismic isolation simulating vehicle. As far as we know, this vehicle is the first of their kind ever used in Japan.

■ Quake-resistance and vibration-damping



The dotted line shows the vibration with quake-resistance; the solid line shows the vibration-damping.

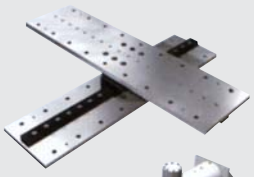
■ Seismic isolation



The dotted line shows the vibration with seismic isolation.

Basic components of the “seismic isolation system”

CLB Linear Rolling Support
The crossed “LM Guides” slide 360° horizontally in response to earthquake vibrations while supporting the weight of the building



Viscous Damper
Absorbs earthquake vibrations using a “ball screw” to reduce the impact of sudden movement

Decompression Rubber
Laminated rubber pads return the building to its original position

The importance of seismic isolation devices

Inside a seismic isolation simulating vehicle, people can experience simulated seismic events including an earthquake of magnitude 6 or greater; the Great Kanto Earthquake, the Great Hanshin-Awaji (Kobe) Earthquake, and the Niigata Chuetsu Earthquake; and earthquakes expected to occur in the Tokai, Tonankai, and Nankai regions within the next 30 years (the probability is 60%). To ensure the safety of those who experience a simulated earthquake in a seismic isolation simulating vehicle and to protect them from injury, the interior is equipped with cushions and handrails, and people are given detailed instructions before they board the vehicle. Many of the visitors who undergo this experience say they never thought the tremors could be so big and many say they have clearly felt the difference that seismic isolation makes. This is the benefit of the seismic isolation simulating vehicle.

This vehicle not only demonstrates the superiority of THK's seismic isolation devices, but by effectively simulating the horrors of an earthquake, it gives people a visceral awareness of the importance of being prepared for such an event. The experience makes people more keenly aware of the need to be prepared for an earthquake and encourages them to take anti-earthquake measures. This is an issue of concern not only for people in the construction industry but for the general public as well.

Our seismic isolation simulating vehicle is currently making the rounds of disaster-prevention events and exhibitions, which are held all over Japan. We will continue to have this vehicle travel the country in an effort to convince as many people as possible of the importance of taking measures against earthquakes. If you happen to see our seismic isolation simulating vehicle in your neighborhood, we hope you will take the opportunity to experience of the horrors of an earthquake firsthand.

Living safely

With seismic isolation devices

Mr. Abe, Taihaku-ku, Sendai, Japan

When we enlarged our house, our architect explained to us how seismic isolation devices work. It brought back frightful memories of an earthquake off the coast of Miyagi Prefecture 30 years ago, and of the Hachinohe earthquake 12 years ago. I thought it would be best to have a seismic isolation structure, to minimize the vibrations transmitted to the building and to prevent the house from collapsing and furniture from toppling over.

The Hachinohe earthquake didn't make headlines at the time, but because we were close to the epicenter, we had considerable damage, including overturned furniture, broken dishes, and severed water and power lines. We also suffered emotional trauma. More recently, during the Iwate and Miyagi inland earthquakes, the cabinet doors flew open in the main house, which doesn't have seismic isolation devices, and the pictures on the walls were all askew, but nothing fell over in the new addition, which was constructed with seismic isolation devices, although it swayed like it was balancing on a ball. I realized again how effective the seismic isolation devices is.

Since every earthquake that occurs revives fears from past quakes, I think there's also a definite psychological benefit. Thanks to our seismic isolation devices, we have greater peace of mind.

THK's "RDT Viscous Dampers" for building exteriors

Short construction period, major impact

The Board of Education in the city of Akita is currently having all of the city's elementary schools and junior high schools that were built prior to the enactment of the new building standards law in 1981 inspected for quake-resistance. School buildings that do not meet the new standards will be retrofitted for quake-resistance.

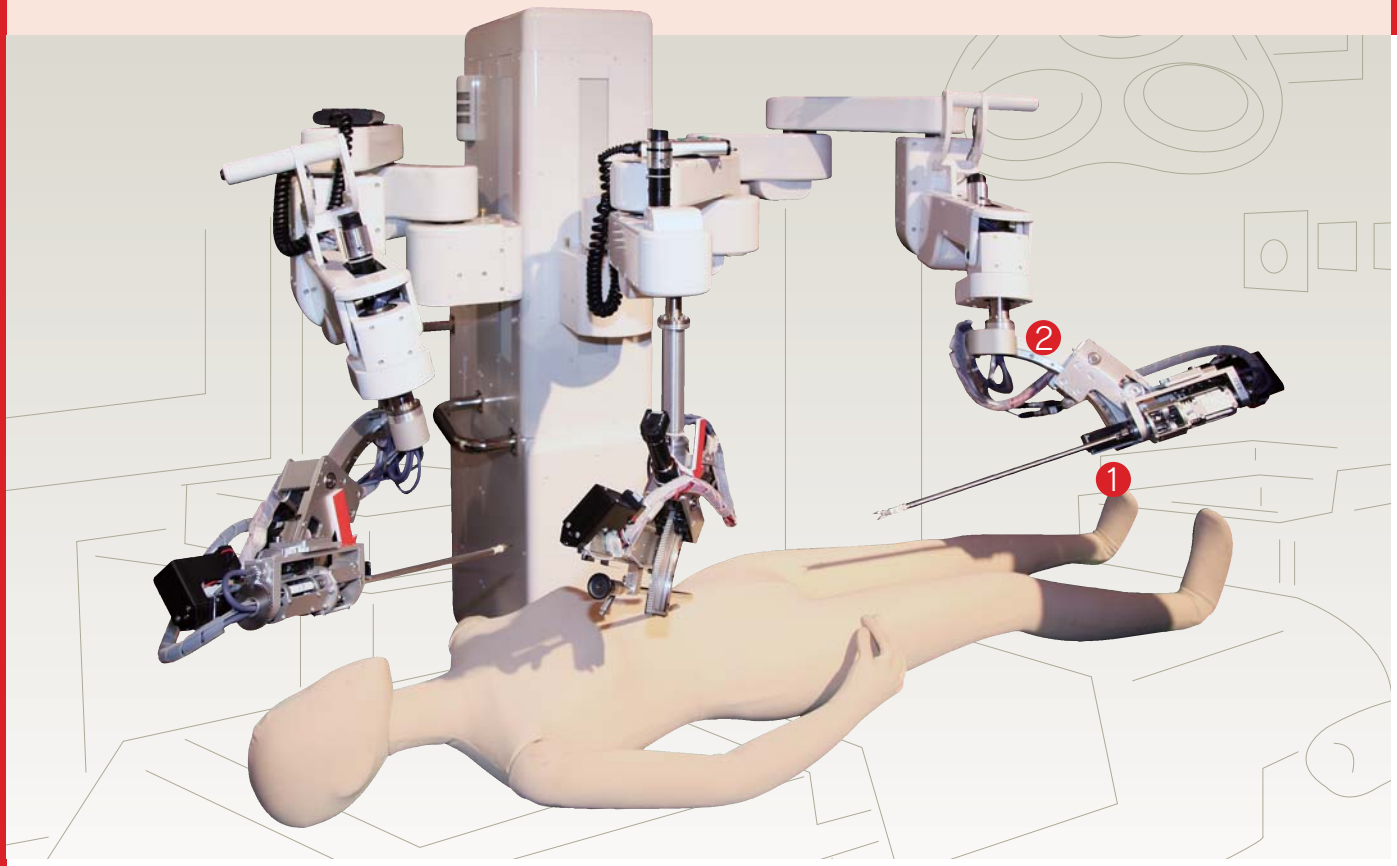
The Chikuzan elementary school in Akita has a 110-year history. The present school building, completed in 1972, does not meet the new standards. During the inspection it was determined that many parts of the building would have to be reinforced. This would have taken a great deal of time using traditional construction methods and would have required the construction of a temporary school building. Fortunately, THK's "RDT Viscous Dampers" for building exteriors offered the perfect solution. The cost was reasonable, and the construction work took only six months. This proved to be a great advantage, as it minimized the impact of the work on the school's operations. The vibration-dampings were given a covering to improve their somewhat intimidating appearance.

▲ Exterior of the Chikuzan elementary school building in the city of Akita after the installation of viscous dampers for quake-resistance

During the Iwate and Miyagi inland earthquakes, schools built using conventional methods incurred cracked walls and broken pipes, but this sort of damage was conspicuously absent at the Chikuzan elementary school. School officials reported that the building had proven to be sufficiently quake-resistance.

Robotic telesurgery: A dream comes true

Making cutting-edge medical technology available to more patients



❶Actuator (KR) ❷R Guide

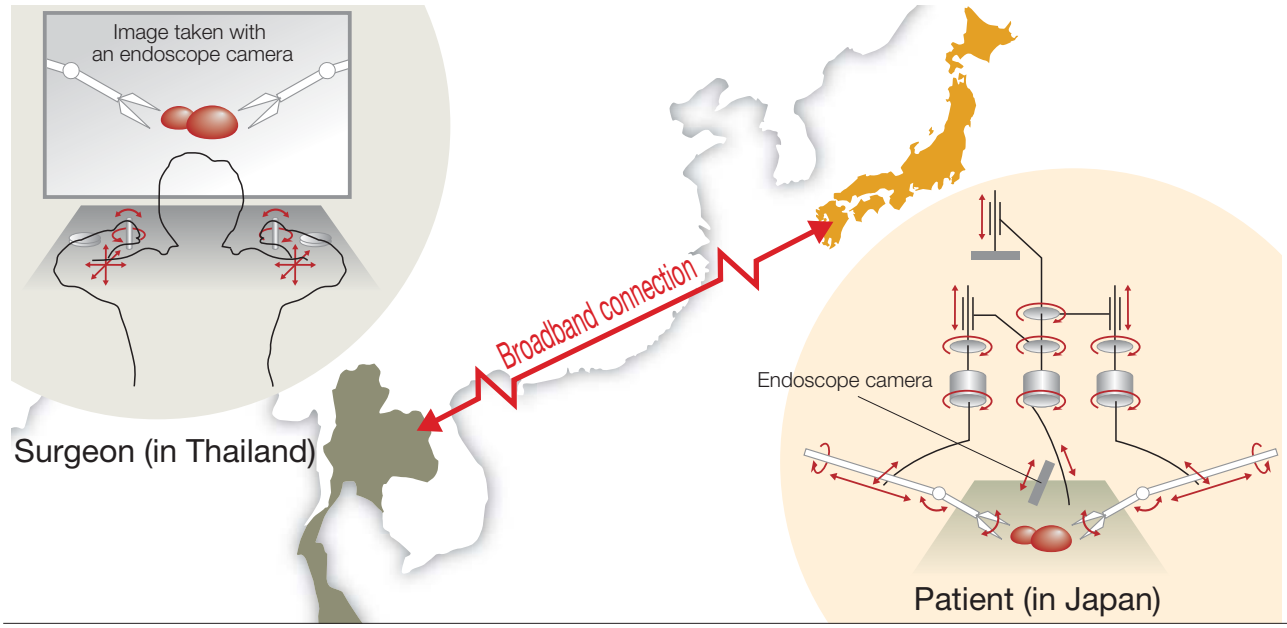
Have your operation performed by a highly skilled surgeon no matter where you are.

Aging population and declining birthrate, a shortage of physicians, and regional disparities in medical care—these are among the healthcare issues currently confronting Japan; they are in the news almost daily. One promising approach to resolving some of these issues is the use of medical robots. Among other efforts, research is progressing in the area of robotic telesurgery, which will enable a surgeon to operate on a patient who is not in the same location. While the physician operates the controls at his location, a robotic arm installed in the remote operating room moves in response to signals received over a broadband connection. The ability to have an operation performed by a highly skilled surgeon anywhere in the world is a dream come true and THK is putting its technology to excellent use in helping to develop telesurgery robots.

The development of medical robots has focused on several objectives: (1) enabling the physician to see behind or inside normally inaccessible internal organs and skeletal structures, (2) providing surgical access to confined spaces and the areas of organs that are difficult to reach by hand, and (3) making it possible to perform microsurgery and high-precision surgery. More recently, efforts have also been directed toward equipping sparsely populated areas with facilities for remote diagnosis and remote surgery, to provide patients in such areas with diagnostic and surgical services on a par with those available in hospitals equipped with state-of-the-art medical equipment.

A collaborative academic-industrial research and development project has been established with the aim of providing regions and countries that have substandard medical facilities with the same high level of health care enjoyed in wealthier countries. The project participants, including Tokyo University Professor Mamoru Mitsuishi and scholars from Kyushu University, are currently engaged in finding practical applications for telesurgery robots. The first robot designed to assist a surgical procedure—in this case, "minimally invasive laparoscopic surgery*"—was developed in 1999, and the second, an improved version of the first, appeared in 2007. In minimally invasive laparoscopic surgical robot, a laparoscope (endoscope) and forceps or an electric scalpel are inserted through small openings made in the abdomen; the doctor uses a surgical-assistant robot installed at the operating table to perform the surgery by remote control. Thus, a physician in a hospital in Japan, for example, can perform surgery on a patient in a hospital in Southeast Asia. To date, two successful remote-control operations have been performed: on two occasions doctors at Chulalongkorn University in Thailand have removed the gallbladder of a guinea pig located in Fukuoka, on the island of Kyushu. (See the illustration on the opposite page.)

* Minimally invasive laparoscopic surgery: A surgical procedure designed to be nonintrusive and to subject the patient to minimal trauma



Advances in medical care to create an affluent society

THK has participated in the development of telesurgery robots, designing and manufacturing the robot arms and the arm sections of the forceps. ❶Actuators and ❷R Guides, THK's flagship products, are used in various parts required to faithfully reproduce the movements of the surgeon and maintain patient safety during the procedure. The telesurgery robot project is undergoing further improvements with a view toward eventual practical applications. Other THK products and technologies have also been put to use in medical fields. One example is the repositioning robot, developed by Professors Ichiro Sakuma and Mamoru Mitsuishi of the University of Tokyo and others, which assists the movements of the physician during surgery.

Surgery to repair a femur fracture requires considerable physical strength to bring the bone into the proper position. The use of THK's rolling motion technology to move heavy objects using minimal force can reduce physical demands on the physician and can make it easier for women to work in the field of orthopedic surgery.

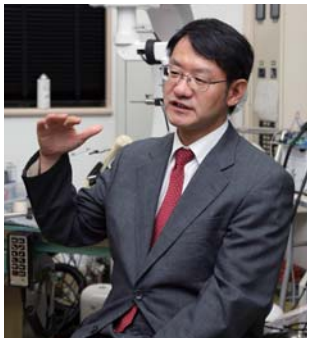
THK technology augments human physical strength. More uses for THK products are expected to be found in a variety of fields. As Japan continues to change demographically due to its aging population and declining birthrate, THK will make effective use of its technological capabilities to help create a truly affluent society.

Repositioning robot assisting a surgical procedure

Opening up great possibilities

My relationship with THK started when I was involved with intelligent machine tools* before taking up telesurgery robots. I had confidence in THK's considerable technical capabilities. Telesurgery robots, however, pose different challenges compared to machine tools. For instance, the requirements of reduced size and weight are different. Surgery is a race against time. Not only do the movements have to be more precise, but the robotic arm must react quickly and must be designed for quick installation and replacement. Another issue is cleaning and sterilization. THK took all of our demands very seriously. The telesurgery robot is a revolutionary system that not only reduces the patient's trauma but also lightens the burden on the surgeon. It offers many advantages, not the least of which will be helping to correct regional disparities in medical care and provide appropriate initial treatment in medical emergencies. I hope that THK will continue to engage in joint R&D with us, in the hope that we can put the telesurgery robot and its enormous potential to practical use.

* Intelligent machine tools: Machines equipped with the ability to analyze and make decisions



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