



Daily Nisho Article

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Japanese building technology that can withstand earthquakes



Comparison with overseas

In old Japan, we were called “Earthquake Country”. And there was a word in old Japan. “Catfish get angry, earthquaking”. If you are Japanese, you may have heard it once. It is said that this word was believed by the old Japanese until the end of the Edo period. Immediately after the Ansei Edo earthquake, there are many *nishiki-e* with catfish motifs. In this way, there have been earthquakes in Japan for a long time. Then why are there a lot of earthquakes in Japan? It is related to the location in Japan. In the first place, the earthquake is caused by the plate. The plate is the base of the ground. First, the tip of the plate is pulled in. Second, The plate is distorted. Third, An earthquake caused by that distortion. Japan exists between

four plates, Eurasian plate, North American plate, Philippine Sea plate, Pacific plate. So Japan has many earthquakes. Then, if some countries are not on the plate, the country doesn't have earthquakes. For example, Australia and Germany. So we made a hypothesis. The hypothesis is, countries with many earthquakes are better at earthquake countermeasures than countries with few earthquakes. and earthquake-prone countries may have some measures about earthquakes.

There is a reason we thought. There may be technologies that are similar to environment-adapting organisms and are suitable for earthquake-prone environments I thought. First, let's compare with Germany and Australia, which

have less earthquakes. In a country with many earthquakes, Japanese people think about earthquakes well. Because Japan had the Great East Japan Earthquake. So, it is necessary to tell about the earthquake early. A long time ago, seismic technology came from China to Japan. And it changed to Japan's original technology. The technology is very amazing. Because, Edo technology was used at Tokyo Sky Tree. I will teach you a little about it. Don't use nails. Everyone thinks it's not durable. So there is a countermeasure. It is important to choose a tree. Because the softness is different.

It is wonderful to be born from it. Are wood used in Australia and Germany? There are Stone houses. Why is stone good? Because there are few earthquakes. So what are the areas with few earthquakes? Both Japan and Indonesia are

countries with many earthquakes. So let's compare! Here is a quiz. What percentage of earthquakes happen in Japan? Answer is 10%~15%! As you think this number is closer to Indonesia's.

The reason for this is as follows. Those countries are near plate boundaries. Surprisingly, most of them are the center of population. The point is, those countries are subject to earthquakes and the damage will be greater.

Next, let's compare in seismic resistance! In Japan, a lot of earthquake countermeasures are enhancing today. For example, seismic standard is the most strongest in the world, in spite of the suburbs of Indonesia, there are a lot of brick buildings and wood reinforced concrete buildings. Dissemination of earthquakes are still low. Japan helped when the earthquake struck Sumatra. Japan also gave seismic technology.

Finally
There are many earthquakes in Japan and Indonesia. Indonesia has recently built a strong home. There is also technology given by Japan. Also, Germany and Austria have few earthquakes. Because the plate is involved. So there is a brick house and there is no countermeasure.

By Hiroki Hayakawa
Kazunari Oya
Mai Nagane

Photo by Rinako Fukui
Kitano Tenmangu in Kyoto

HISTORY

Architecture in Japan ~feedback from past earthquakes~

Japanese building technology is gaining attention around the world. Many earthquakes have occurred in Japan since a long time ago, causing a lot of damage. However, people have learned lessons from various earthquakes and evolved the technology for them. There are several types of architectural structures in Japan. This time we will discuss the evolution of two kinds of famous structures. The seismic isolation structure is a suitable structure for reducing shaking. The seismic Isolation structure installs a resistant building structure device between the building and the ground.

This device is designed to prevent earthquake tremors of earthquake tremors to the building.

【Figure 1】

So, this structure ensures less falls and damage in the rooms. Of course, people will still feel some

shaking, but they will feel a sense of security that they will not experience an earthquake of real intensity. The resistant building structure is a building that is resistant to the shaking of an earthquake. There is no seismic isolation device under the resistant building structure. The building is designed to increase the strength of the building and prevent it from collapsing as a whole.

【Figure 2】

Therefore, there are some displacement, such as furniture moving and things dropping from shelves but the resistant building structure is one that can be built in a relatively short period of time and at a low cost.

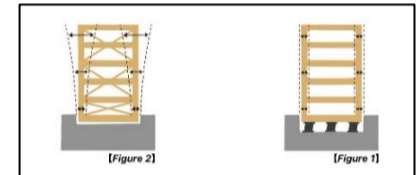
【Figure 3】

Because of this, many of the condominiums being built today have this earthquake-resistant structure. Japan has had seismic isolation structure technology for

a long time. After the Great Kanto Earthquake, various seismic isolation structures were proposed. However, few were realized because Japan didn't have enough technology at the time. Urban building laws were newly enacted in 1924 and they have been revised up until now. High-rise condominiums started using the seismic isolation technology since the Great Hanshin-Awaji Earthquake in 1995. With the seismic isolation technology, the urban building law was enacted and we must make the building walls with earthquake-resistant structures since 1924. A few years later, Japanese people realized the importance of strengthening the ground and wall because the Fukui earthquake caused many houses to collapse. then, Japan learned various lessons about architecture and the technology of earthquake-resistant structures has evolved further.

An earthquake-resistant and

seismic-absorbing structure is essential for building a safe house to live in. Japanese building technology has become a world-class technology, not only because Japan has experienced many earthquakes, but also because the Japanese have improved the technology they have learned from them.



seismic isolation structure		resistant building structure
◎	Power of the vibration	△
△	Cost	◎
×	Construction time	◎

By Shie Notomi
Ayane Kato

The emperor's residence was also devised...?

The Imperial Place is strong against earthquakes and fires. It is in Chiyoda ward, Tokyo. The

total area is 2.3 km². The Imperial

Place was Edo castle. From the mid-19th century, emperor lived in the Imperial Place.

The Imperial Place is made of a big roof, pillars and beam. The Imperial Place represents the beauty of Japanese ancient architectural.

In 1923, the earthquake with seismic intensity 6 or higher occurred at 11:58.

The Kanto area was especially seriously damaged. It began to occur when people were making lunch, so there was a lot of fires. From this experience the "street-reinforced concrete structure" has come to be widely used in Japan.

"A steel reinforced concrete structure" combines a "steel

structure" with a "reinforced concrete structure". The Imperial Place uses this structure too.

The steel structure was invented by Melan, from Germany. This structure uses parts made of iron and steel. The quality of parts is very high, so they can make buildings which can withstand earthquakes and fires.

The reinforced concrete structure was invented by Monie, from France. This structure uses

reinforced concrete, inserted as reinforced bars in the core of the concrete. This has the same strength as a steel structure. The Imperial Place has both of them structures, so it is strengthened against both earthquakes and fires.

By Mako Murakami
Ayu Sugiyama

Japanese building technique without nails

In Japan, wooden buildings which were built in former period remain. For example, "horyuji temple" is the oldest wooden building in the world. It was built about 1300 years ago. However, the wooden buildings in Nara and Kyoto are no longer their original structures. They have been given major repairs several times. It is called "Demolition repair". In a demolition repair all the parts are dismantled.

Wooden buildings can remain into modern days this way. The sturdy of the building parts are left as they are but only damaged parts are repaired or mended. Also broken roof tiles are repaired and mud walls are rebuilt. This way of rebuilding is called "shiguchi" and "tsugite". There are many types of this in Japan but we can't see much of way of rebuilding in other countries. Shiguchi and tsugite don't use nails, but they

join together piece of wood like puzzles. Shiguchi is called wood joinery in English. Wood joinery is tightly slot the wooden pieces from different angles. In order to lengthen the dimension of the material, joining with the same member is called tsugite. By adding short piece of wood, it is possible to refuse them as parts for many years. It is one of the interesting aspect of Japanese architecture technology because shiguchi

and tsugite are difficult to use such technology in stone or brick buildings.

Other than that, the Japanese people have strengthened their house roofs. It is based on technology introduced from the continent to Japan at the end of the sixth century. Japanese people have created their own techniques, such as preventing rain leaks by using straw as part of the roof.

By Rinako Fukui
Yuki Konishi

The secret of the National stadium

In Japan there are many earthquakes. So Japan had lost a lot of people and buildings. If earthquakes occur in the Olympics. It will be a serious situation. So, what do National Stadiums have earthquake-resistant equipment and disaster prevention measures? The National Stadium has floors which are from B2 to 5. And the floors divide into B2 to 1 floor which are lower floors and 2 to 5 floors which are upper floors. Each floors have different earthquake-resistant. The stands which can accommodate as many as 68000 people are three-layers.

The upper floors from the 2nd to 5th floor have diagonal beams and steel frames which will suppress and change the stadium shape in an earthquake. The lower floors which have a soft frame and oil dampers. Oil dampers are the oil and piston in the cylinder. If a piston moves, it can suppress an earthquake's shock. They put many there because it can absorb that. This facility is called "Soft First Story" damping structure which is a generic term for suppressing earthquakes in buildings. So the stadium keeps suppressing earthquakes. For example, the first floor shifts

upper floors intentionally. So it can suppress earthquakes. How does it have countermeasures when we people escape? They can go outside within 15 minutes from each seat. And from the stand of three-layers they can go outside within 10 minutes. Why is there a lot of seismic equipment? Then, why was the old stadium rebuilt? The reason is especially because of overall aging and people being worried about the stadium's seismic resistance. The stadium was aging because it is very old. The original stadium was built in 1958.

It is as many as 62 years ago. So old national stadium was aging and people were concerned about an earthquake directly under Tokyo. So they decided to rebuild it. Based on these changes were made. Finally, people think that there could be an earthquake directly under Tokyo. Japan has more earthquakes than many other countries. The National stadium is a symbol of this country. Let's think about this again in right now.

 By *Suguru Kiyatake*
Ryui Kimura

What if you can't live in your house?

What would you do if your house was broken apart by a natural disaster?

In Japan, there are 43,000 people whose house was badly damaged by natural disasters.

There is temporary housing for such people.

Temporary housing is built 20 days after the occurrence of a natural disaster and people whose house was badly damaged by natural disasters can live it for 2 years.

Its size and price limits are decided according to the Disaster Relief Act

Its largeness is 27.9 m² (as large as 16 tatamis) and price limit of temporary housing is 2,400,000 yen.

But the actual temporary housing unit construction cost was 7,000,000 yen in the Great East Japan Earthquake.

Also some people lived in them for over 2 years because they couldn't secure a new house. Therefore, the deemed temporary housing attracted attention. Deemed temporary housing is lower cost than prefab houses. Deemed temporary housing was especially used a lot in the Great East Japan Earthquake. However, there were some problems. First, there were environmental issues as thermal insulation properties, soundproofing, window's size and the size of the entrance.

Also, there is a problem that we're difficult to manage as you get closer to the disaster epicenter, it is difficult to secure there. So there are some problems with loss of community.

In the Great East Japan Earthquake, more than 50,000

units of temporary housing were built from the community.

Emergency temporary housing can be seen as having the problem of low construction delay, housing performance, loss of community, and ignoring the large number of unoccupied housing.

Summarizing performance, we did calculation work and the costs were increased by the of low insulation of prefab temporary housing.

The loss of community and temporary housing's poor conditions are important problems.

Based on these problems we thought of this solution.

To build temporary housing twice.

First, to build a simple temporary housing in a hurry.

Second, build temporary housing whose condition is better than the

hurried one while disaster victims live simple one.

Then their living conditions will improve.

We should build temporary housing which doesn't break up living alone local communities as much as possible, then we can prevent people from.

We are rooting for you as many people as possible can live without defects in the event of a disaster.

	cost	construction period	problems
temporary housing	expensive	20days	bad conditions
deemed temporary housing	cheap	no time	can't find well

 By *Moe Kuramoto*
Kenta Ohashi

Thank you! Skyscrapers in Japan

We found out 3 tallest buildings in Japan. No.1 is the Tokyo Sky Tree. It is 634m. The second tallest is the Tokyo Tower. It is 333m. And the second tallest is the Abeno Harukas commercial facility. It is 300m. They are very tall, aren't Skytree, that is 50000t will fell? It is very scary just to imagine. A lot of earthquakes have come in Japan. So, why are there such tall buildings in our country? Thanks to the

construction technology of buildings in Japan. The cross section of the skytree is a round shape. Also the skytree has 3 big steel frames supporting each other like the tripod of a camera. If you look up, you will see the cross section is round. It is one of the devices to keep it standing. This design needed precise calculation of computers. They are Japanese high technology of 21 century! There are some secret

in the underground under the skytree, the pile is being buried like big wall which is 50m deep. That is planted like root of plant. Also, the pile has a lot of flats looks like a spike shoes. By having this pile, the skytree has kept strong. Not only that, it doesn't shake easily if an earthquake comes. Also there are incorporated learning from history.



 By *Maya Yamauchi*
Maika Kanbayashi
Asami Ito

Photo by *Rinako Fukui*
Tokyo Sky Tree

Evolution of Container Houses

In Japan, there are buildings that are almost no container houses



which called Container Houses. As the name implies, it is a sturdy, simple house that uses a steel transportation container. Currently, container houses are widely used all over the world. Some of the examples are convenience stores, cafés and cottages. So, why are containers for freight transportation used as buildings? There are a few reasons. First, they have excellent Earthquake resistance. Actually, the container used is able to withstand a seismic intensity of 5 or more. Second, it has sound insulation. It can reduce the noise from airplanes and cars. Third, it has excellent fire resistance, because it uses steel materials. From all this, it is able to say it has excellent durability. It is said that a container house can be used for nearly 40 years. In Japan, container houses are being used right now. However, there

that satisfy the Building Standards Law, probably because the containers were built for transportation and weren't considered for use as houses. Such containers have been used as houses before though. This was after the Great Eastern Japan Earthquake that occurred on March, 11, 2011. In Onagawa City, Miyagi Prefecture, they were unable to prepare sufficient numbers of prefab temporary housing. However, there were people who stood up to solve the problem. The first person was Mr. Shigeru Saka, who is a world-class architect. The second person was Mr. Tsutomu Hikiji, the President of "IRON HOUSE TETSUYA". "IRON HOUSE TETSUYA" is the first company in Japan to pass the container construction standard for houses. The third person was Mr. Daisuke

Ando, a member of "IRON HOUSE TETSUYA". They worked together to build temporary houses in the disaster area. The temporary houses were inspected by the Ministry of Land, infrastructure, Transport and Tourism, and officially certified as residences. Thus, currently, container houses that can pass strength and structural regulations, can now be used as houses and buildings. On the other hand, though container houses have disadvantages a temporary housing. First of all, it is necessary for transporters of to have sufficient width for carrying and to have wide, flat land for installation. Because the container house has already been constructed, it is desirable to carry it as an assembled container. Of course, it is possible to disassemble and carry it, but the problem is that it becomes expensive and takes time. The second disadvantage is that more infrastructure equipment construction is required when compared to a trailer house. Even with these disadvantages, it can be said that a container house with excellent durability and a short construction period is excellent for me as temporary housing. That's all, the explanation of the container houses is finish. Next, let me introduce an interview with Mr. Kinoshita who is advisor of a facility that is actually using a container house.

Interviewer: How is the container house used in this facility?

Mr. Kinoshita: It is used that as a glamping facility.

Interviewer: Why do you try to introduce a container house?

Mr. Kinoshita: Because, making something new that isn't able to find anywhere house?

Interviewer: What is the good point you noticed when you actually used the container house?

Mr. Kinoshita: It's easy to modify according to people's needs.

Interviewer: On the other hand, are there any bad point?

Mr. Kinoshita: Yes, that if you put all the necessary Equipment for living in one container house, it'll become cramped. As a counter measure, at that facility, baths and showers are installed in separate buildings.

In this way, the container house can be used practically in addition to temporary housing in the event of a disaster. Finally, even now, the development of container house is continuing, and better ones are being made. Therefore, it will give you one more useful choice to stay comfortable after a disaster.

By Masataka Uchiyama
Shoichiro Matsui

Photo by Masataka Uchiyama
Steel transportation container

<Japanese building technology to prepare for an earthquake>

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