English

多文化のまちで暮らす

豊橋の防災

2017 年 3 月 11 日 (土)　13:30 ～ 17:00

総合福祉センターあいトピア

主催：豊橋技術科学大学　安全安心地域共創リサーチセンター

共催：(公財) 豊橋市国際交流協会

後援：豊橋市

Introduction of Earthquake Safety

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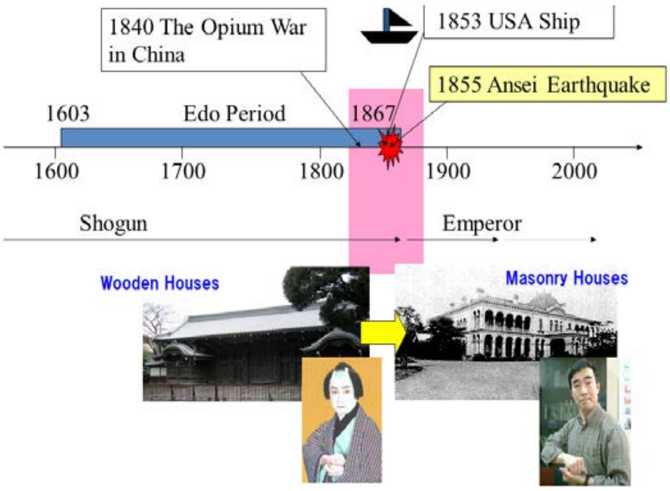
Why earthquake happens?

Let’s look back on the history of Japan. At the end of the Edo period, Western countries came to colonize Asia. In 1840, Opium war broke out between China and the UK. In 1853 American Matthew Calbraith Perry of America came to Japan boarding on a black ship. At that time, Great Ansei Earthquake occurred. Eventually Edo Shogunate was destroyed. Japan was forced to open the country to foreigners.

In order to catch up with western countries, Japanese traditional wooden houses have been replaced by Western style brick buildings. Topknot and clothing are also changed to Western style.



Namazu E
(Catfish Picture)

In that time in Japan, there was a common superstition that earthquake occurs because of Catfish living underground. People used to believe if you put a Nishiki-e (Wood block painting) of Catfish at home, that home would not be crushed by an Earthquake. In this catfish picture, God puts a big stone called ‘key stone’ on the head of the catfish and holds on to it so that it can’t cause earthquake.

Where is Key Stone?

Key stone is enshrined in the premise of Kashima Shrine in Ibaraki prefecture. You can see the stone head about 10 cm on the ground above. Legend says- Shogun ordered his servants to dig the soil for 7 days but even after that they could not reach the bottom of the stone.

The first scientific analysis of the earthquake mechanism is done by German scientist Alfred Wegener.

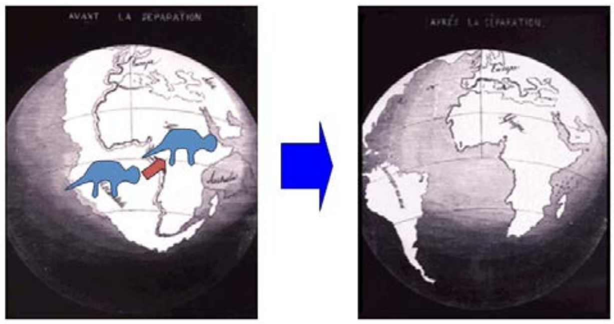
He noticed that the terrain of South America’s east matches the shape of the terrain of Africa’s west like a Jigsaw puzzle.

He thought that the two continents that are presently far apart were connected in the past. He presented it as continental movement theory at the conference, but from the scientists he was accused of lying. He believed that there must be traces of animals moved from continent to continent, if the continents were connected and for that he examined fossils.

Story of uncle Wegener

Alfred Lothar Wegener (1880-1930)

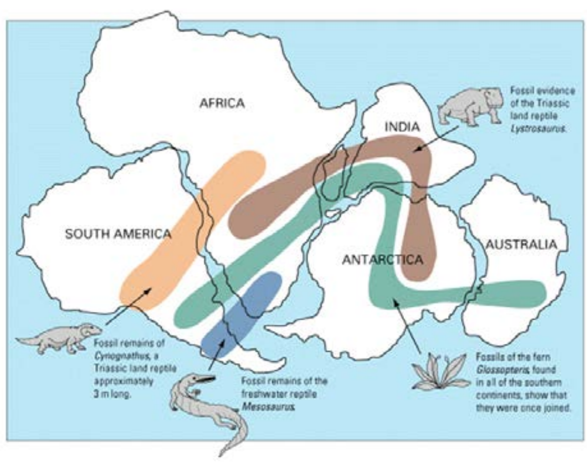
Long time ago　　Present



Liar !!

Then apparently the fossils of the same animal were found on different continents. He thought that was the evidence that the continents were connected. But other scholars didn’t agree with him.

Location of fossil



Because among the scholars of that time there was a belief that there was a presence of phantom continent in the present sea location and that all continents were connected. You must have heard of the legend of the phantom continent that is said to exist in the ocean, such as Atlantis Continent (Atlantic Ocean), Mu Continent (Pacific Ocean), Lemuria Continent (Indian Ocean) and so on. As a scientific explanation - because of the cooling of the earth, the surface wrinkled. So the land connected to the continent sunk and became sea.

(Theory of Earth Contraction)

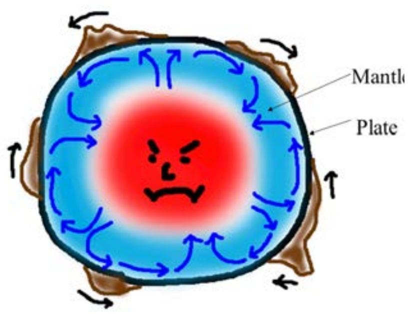
Wrinkles made on the existing land become mountains. This was believed for a long time. This is called the ‘Earth Contraction Theory’.
After all, Wegener’s continental Contraction theory was too innovative to be admitted that time.

According to Wegener, the attraction of the moon and the centrifugal force due to the rotation of the earth are the driving force for the heavy continents movement. Now we know that the moving of the continent is a convectional phenomenon occurred inside the Earth. Like the heating of cold miso soup, I think you’ve seen how miso gathered below gets boiled and comes up like volcano eruption and sink down again. If you warm liquid, it gets lighter and goes up and gets cool. Cool liquid is heavier and goes down. It creates a cyclic flow. This process called convection.

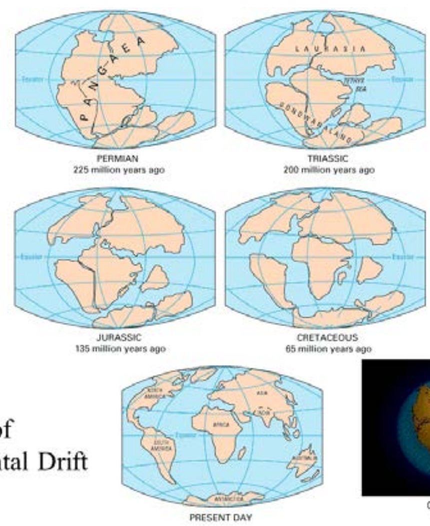
In the center of the earth, there is a mass of iron core at a high temperature , approximately 6000°C and the (outer rock) mantle is believed to be convective like a fluid over a long period of time. Outer side of the mantle, there is a thin rock layer (crust) surrounding the earth. Again, on the upper part of the earth just like a peeled orange, there are also many thin plates loaded with crust. They move at a speed of about several centimeters a year with the mantle convection. So it can be said the mantle convection inside the Earth moves the continents.

Do you know “convection” ?

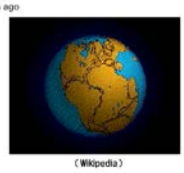
Hot ! inside Earth



Wegener believed that there was only one continent on the Earth at the beginning. That got divided and moved to become each current continent. He named the first continent as Pangea, a word derived from Greek meaning for ‘all land’. According to plate tectonics, the place where Pangea split corresponds to the current mid-ocean ridge. It’s thought that the divided continents will continue repeating the cycle of merging and breaking up in hundreds of millions years to come by.



Theory of Continental Drift (1915)



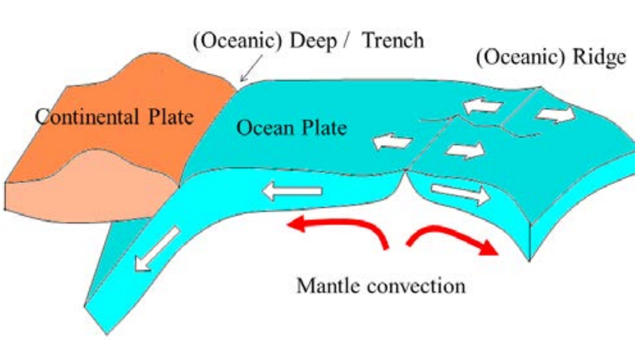
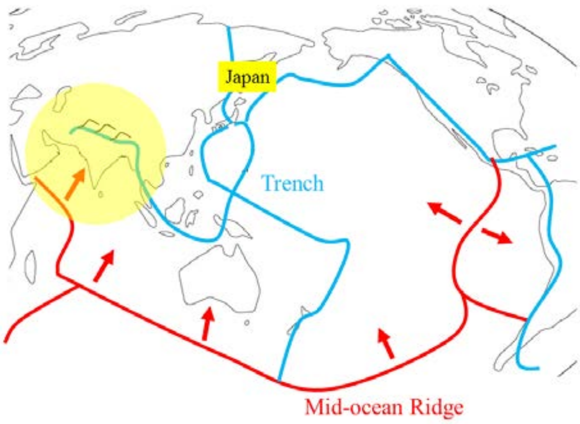


Plate Tectonics

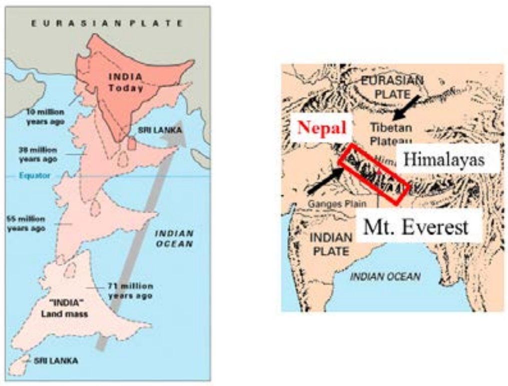
Not only the continents are moving by the mantle convection, but even the ocean above the plate are moving because of it. Continental plates are made of granite with small specific gravity but the oceanic plates are made of large specific gravity basalt. So when these two different form of plates collides, the oceanic plate goes underneath and sinks into the mantle. To compensate for it, on the other side of the subductive plate, new plates are being produced one by one from the cracks of the Ocean floor. The valley at the sea bottom where the plate sinks is called a trench and the mountain range of the ocean floor where a plate is born is called ridge. The theory that explains the movement of plates is called plate tectonics and it is a standard theory of geophysics. Currently, it is possible to accurately measure the movement of plates with satellite.

Off the coast of South America in the East Pacific Ocean, there is a mid ocean ridge that runs north to south. This is where the Pacific plate is born and it is moving northwest at a rate of about 8 cm per year and goes beneath the Eurasian plate. This is a typical example of a continental plate colliding with an oceanic plate.



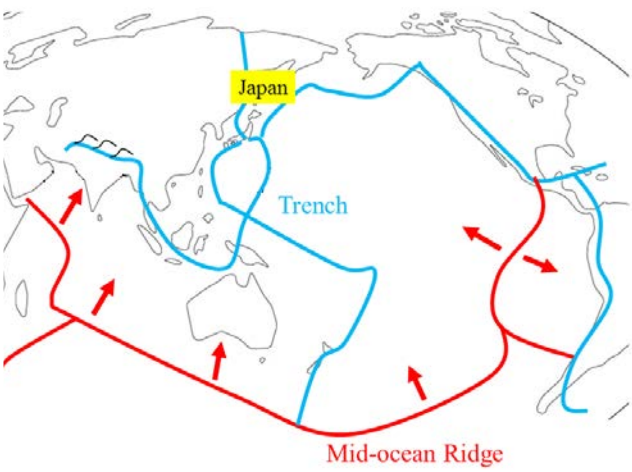
Once India was an independent small continent. By the movement of the plate, it gradually shifted northward and collided with the Eurasian Continent. By that pressure the sea floor got lifted and the present Himalayas were completed. Everest, the world’s highest peak, is also here. In fact, fossil shells were also discovered from the rocks of the Himalayas.

The Himalayas: Two continents collide



There is similar place in Japan too. The Izu Peninsula was an island floating in the ocean. It moved to the north above the Philippine sea plate, collided with the Japanese archipelago and become the Izu Peninsula. It is thought that Tanzawa mountains were made by this pushing force.

In the southern hemisphere of the earth, there are dispersed ridges where plates are born. So many of the plates originated from there move to the north and subduct under another plate. Because many of the ridges are at the bottom of the deep ocean, the eruption activity is suppressed by hydraulic pressure. However, there are places where the ridge is on the surface of the earth.

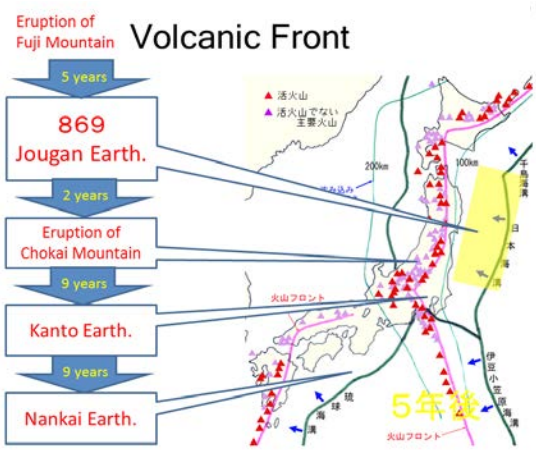


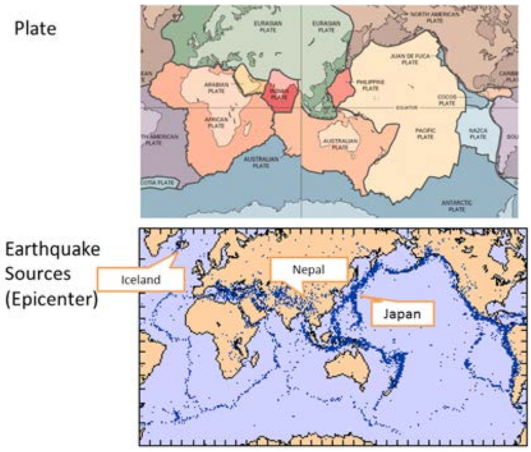
Iceland has a ridge in the middle of the country. So the area of the country gradually increases. Also, because it's a country of volcano, it has world's largest open air bath.

Largest hot spring in the world (Iceland)

Japan is near the trench where plate sinks. Even though it is not a ridge, why are there so many volcanoes? Actually, the subducted plate melts and becomes magma. Then it rises to the surface and becomes volcano. Therefore, the position of the volcano is parallel to the trench where the plate sinks, which is called the volcanic front. After the great east Japan Earthquake of Magnitude 9, Mt. Ontake erupted three years later, Mt. Aso and Mt. Kuchierabujima four years later, and Mt. Sakurajima five years later. Also, in April 2016, an earthquake of Magnitude 7 occurred in Kumamoto prefecture. It seems that along with mega earthquake, volcanic activity and seismic activity are increasing.

Actually, the same thing happened about 1000 years ago. Two years after the 869 Johgan Earthquake in Tohoku Region, Nigata's Mt. Choukai erupted, and nine years after that a huge earthquake occurred in Kanto region. A further nine years later, the Nankai Trough Mega earthquake occurred. Again, Mt. Fuji erupted five years before the Johgan Earthquake. In other words, the current Japan is considered to be in the same seismic activity period like it was about 1000 years ago.

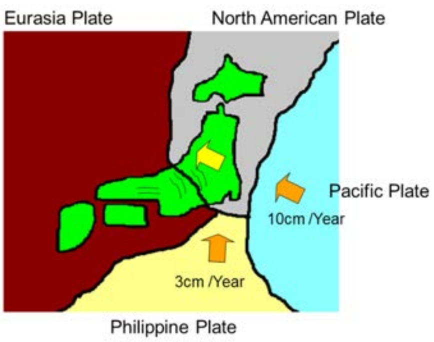


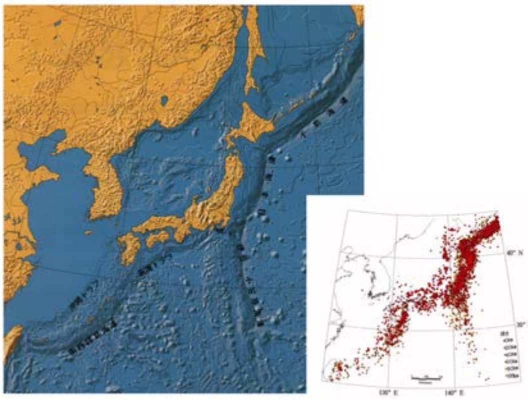


The figure above shows the positions of plates & the figure below is the distribution chart of earthquake occurrence. You can see many earthquake occurs at the boundary of plates. Also, there are more earthquakes in the trench where the plate submerges under another plate than the ridge where the plate generates.

There are many earthquakes in Japan because the Japanese archipelago is situated in a very unique place in the world where four plates collide one another.

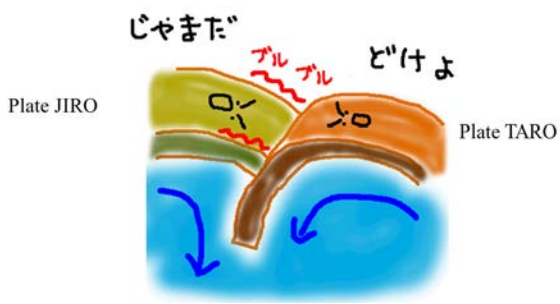
To the east of the Japanese archipelago is the Japan trench and to the south is the Nankai trough. On the trenches where the oceanic plate sinks, those with a depth of less than 6000 m are called troughs. It is understood that earthquake mainly occurs along the trench and trough.

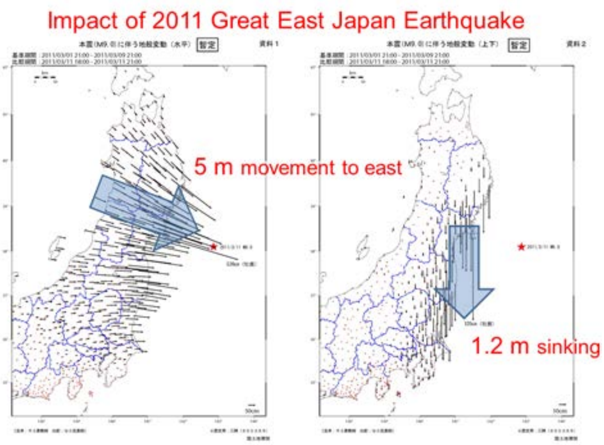




When a plate slips into another one, the opposite plate resists and strains accumulate. When the limit is reached, the boundary (fault) of the plate is destroyed and a backward push occurs. The shock waves that originates at that time is called Earthquake.

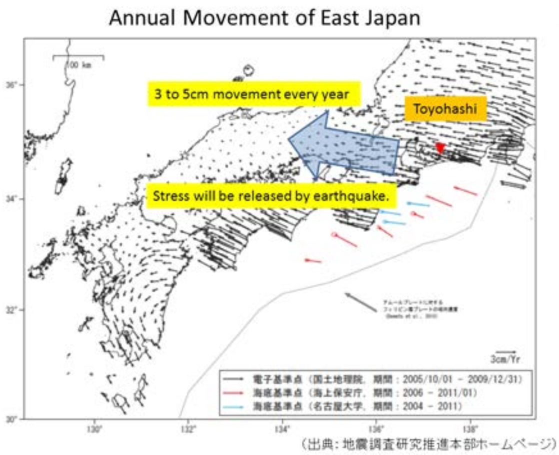
Collision of Plates produces Earthquakes





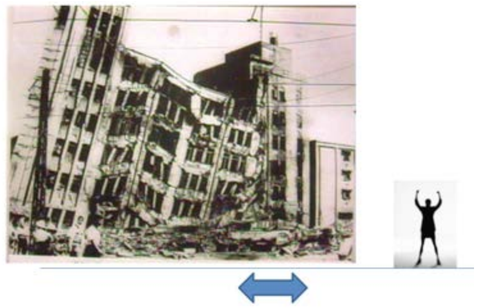
In the Great East Japan Earthquake, the distortion constituted by strain was released at once and the Japanese archipelago moved up to the east by about 5m. Again, there are even places where the ground sank more than 1m. Such ground motion can be accurately obtained from the GPS observation by the electronic reference point stretched all over the country.

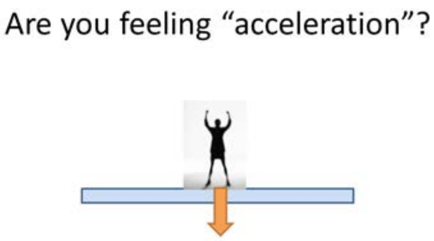
On the other hand, there is the Nankai Trough in the south of West Japan. The Philippine Sea plate is subducting with a speed of about several centimeters per year into Japanese archipelago and pushing it northwest. As no big earthquake has occurred in the past 70 years, it has pushed more than 2m by a simple calculation. The distortion has not been released yet. It's a matter of time that distortion accumulated by strains will release all at once by means of Earthquakes.



Why building is weaker than human?

If the earth shakes violently due to Earthquake, it's difficult to stand, also may lose balance and fall down. But it's rare to occur serious injury. On the other hand, buildings that are supposed to be stronger than humans may collapse due to earthquake. Why is human Ok but not the building? For this, let's think about the forces acting on the building in case of earthquake.

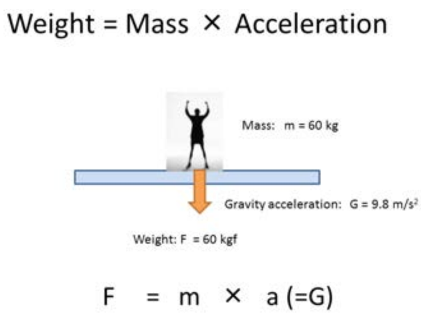


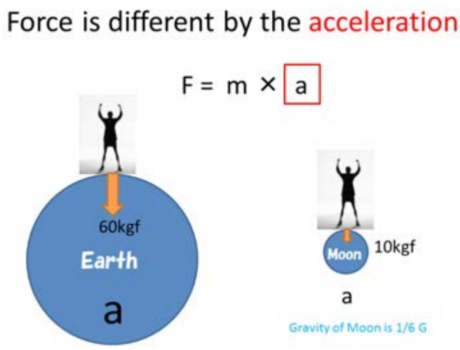


If there is no floor, this human body will fall down. This is because of the attraction of earth. The falling speed will gradually increase. The acceleration behind it, is the gravitational acceleration due to earth's gravity.

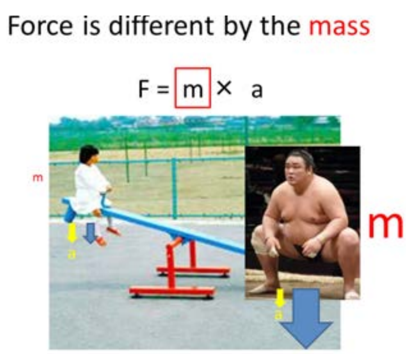
Your weight represents the scale of attraction force of the earth working on your body. The value is expressed as the product of mass and gravitational acceleration.

Mass is unique to things and the value of gravitational acceleration is different between the earth and the moon. If your weigh your weight on moon which got less gravity, the value will be much smaller. Since the gravitational acceleration of the moon is one sixth of the earth, the weight will be also one sixth of earth's.



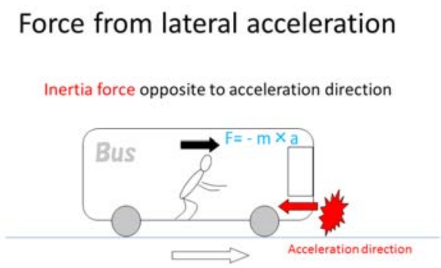


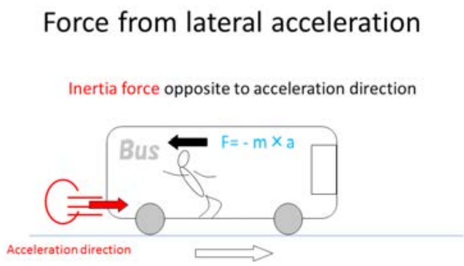
Since it is on the same planet, the downward gravitational acceleration is the same but the mass is different. Therefore, the downward force is larger for Sumo wrestler than of a child.



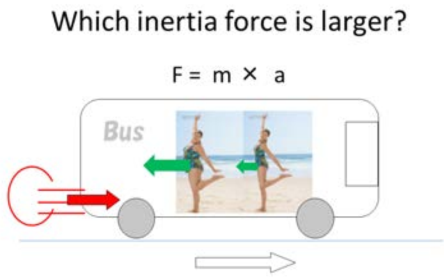
Acceleration is not always downward. When bus stops suddenly, the body is likely to fall forward. At this time, the force product of mass and acceleration works on the body. This force is called inertia force. Acceleration of the inertia force is opposite to the acceleration trying to stop the bus.

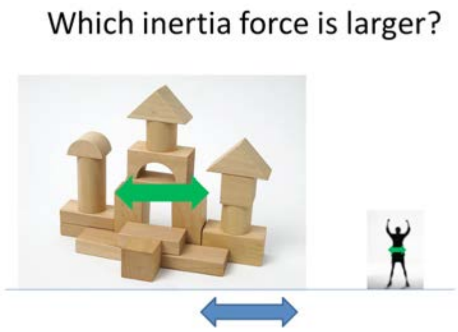
When the bus starts suddenly, the body will fall backward. Also this time, inertia force which is a product of mass and acceleration works on the body.





When a fat and a thin persons are on the same bus, at that time if the bus suddenly starts from stoppage, which person will have larger inertia force? Since the acceleration is same, the inertia force will be larger for fat person as the mass is larger.

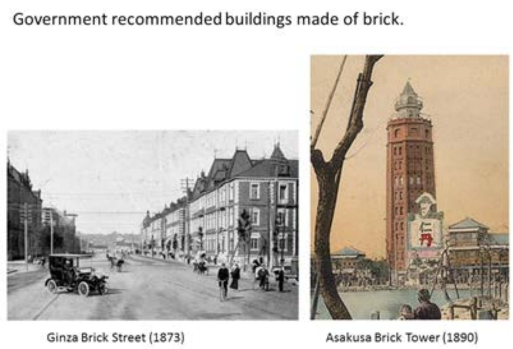




Well, let’s go back to the first question. When the earth shakes due to an earthquake, as the building got much larger mass than the person standing on the ground, there will be larger inertia force working on the building accordingly. In other words, the fact that the building collapses due to earthquake even though it doesn’t affect person is because the building can’t support the inertia force. Generally buildings are built strong enough top to bottom so that they can support against gravitational forces but weak against inertia force due to earthquake which works left to right and vise versa.

As a result, structures built with stones and bricks (commonly known as masonry) is likely to collapse due to earthquake which is not suitable for earthquake prone countries like Japan. But there are lots of masonry building overseas, and as a result, there are lots of fatalities due to building collapse during earthquake.

After the Meiji restoration, a number of western style brick buildings were built. After the incident in which a building in Ginza street in Tokyo was destroyed by fire, it was rebuilt by brick construction. Also in Asakusa of Tokyo, there was the tallest brick tower in Asia of that time.

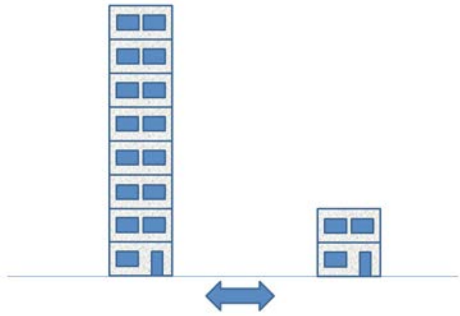


1891 Nobi Earthquake (M8.0)/ 1923 Great Kanto Earthquake(M7.9)

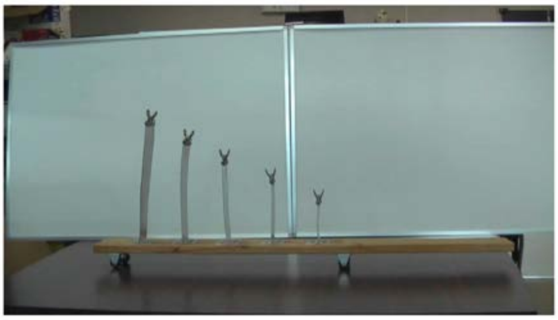
However, brick buildings suffered great damage in the Nobi earthquake of 1891 and the Great Kanto earthquake of 1913. Therefore, after that, masonry buildings were strictly regulated by law and disappeared from Japan.

Which building is safer?

Which building is safer in earthquake, the high rise one or the low rise one? Considering the inertial force which works due to the shake of earth, larger mass of high rise building seems to be a disadvantage for it. However, since the inertial force is the product of mass and acceleration, you must also consider the magnitude of the acceleration caused by the shaking of the building.



Shake the model



Let's shake these models in real. If you shake swiftly, the low rise building will vibrate but if you shake slowly, the high rise one will vibrate. Why does this phenomenon occur?

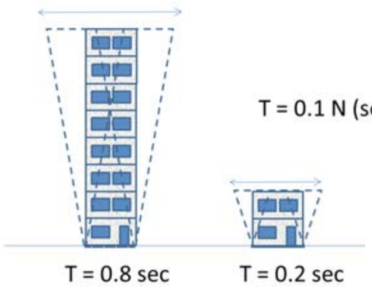
Actually, the building has it's own vibration speed and the time taken to complete one vibration is called natural period. When the period of the vibration of earth coincides with the natural period of the building, the inertia force works with good timing and the shaking of the building of that natural period gets amplified. This is called resonance.

The rough value of natural period of a building is found by multiplying 0.1 to the number of stories. It is 0.8 second for 8 stories and 0.2 second for 2 stories approximately.

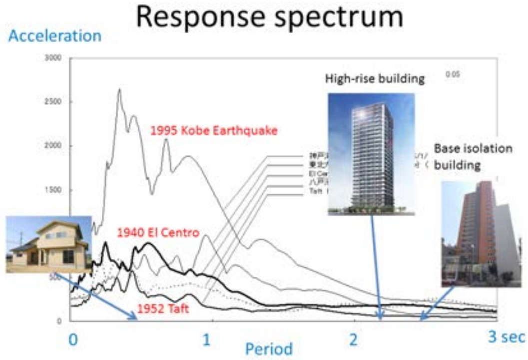
A graph plotted with the maximum acceleration of building's shaking at each natural period is called the 'acceleration response spectrum'. Let's calculate the acceleration response spectrum for various earthquake motions.

From the graph, we get that the mountain of the spectrum covers roughly 1 second or less of the natural period and the middle and low rise buildings with shorter natural period shakes heavily, on the other hand, if the natural period goes beyond 1 second like that of high rise and base isolated buildings, the shaking gets gentle.

(1^{st}) Natural period of a building

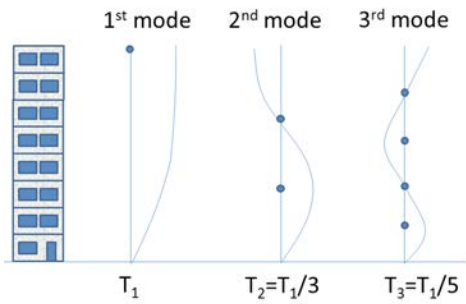


Response spectrum



With the increase of number of floors, the buildings may shake like wriggle in the middle. Since the shape of the shaking is unique to the building, it is called natural vibration mode. From the order of long oscillation period, we have first mode, second mode, third mode to till equal to the number of stories, that amount of mode.

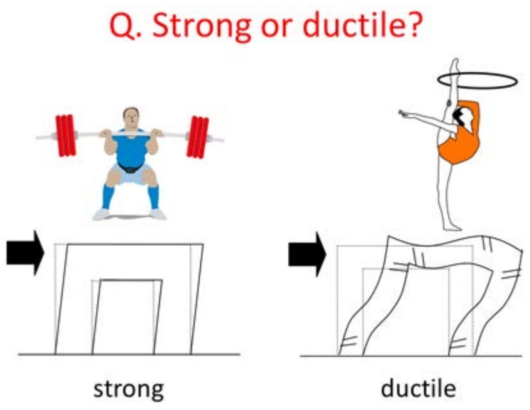
Higher mode vibration



In a skyscraper, roughly the shape of the natural vibration mode is a sine function. The ratio of the next natural period to the first natural period is the ratio of the wavelengths (1, 1/3, 1/5, ... in order). Namely, in a skyscraper with a natural period of 2 second of 1st mode, the natural period of 2nd mode will be approximately 0.7 second (1/3 of 2 seconds), the natural period of the 3rd mode will be around 0.4 second (1/5 of 2 seconds). In a rattling like oscillation, the higher modes of the shorter natural period are excited and the building shakes. On the other hand, in a gentle oscillation, first mode of long natural period gets active and the higher floors shake greatly.

How to make the building strong against

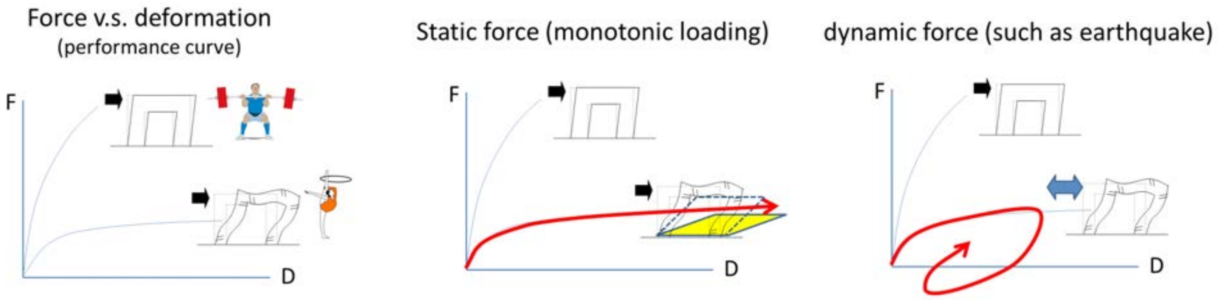
What kind of construction is suitable to prevent buildings from collapsing due to earthquake? One way is to make the columns and the beams stronger so that even if an earthquake comes, it stays well composed. But it is uneconomical to make it too strong only for the earthquake that rarely comes. So at the time of an earthquake, considering the building to be broken somewhat, but not enough to fall over , the columns and the beams are made ductile. Specifically, we use metal fittings at wooden joints or densely put reinforcing bars in the reinforced concrete members. In this way, the basic of earthquake resistant structure is a mechanism to withstand earthquakes by combining strength and ductility.

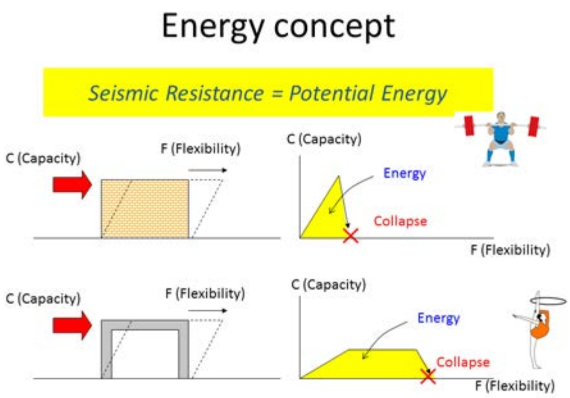


Strong types will be able to withstand large horizontal force, but not too much deformation. On the other hand, the soft type can only withstand a little force, but it will deform considerably

To tell you the truth, soft type is not good against wind and snow which put force for a long time. Since the deformation progresses gradually with time, after some time it will collapse. So it’s not good enough.

During earthquake, shakes will change to the opposite direction before getting too large deformation, therefore, it’s fine to accept ductile behavior. This is the reason behind soft type building being good against Earthquake.

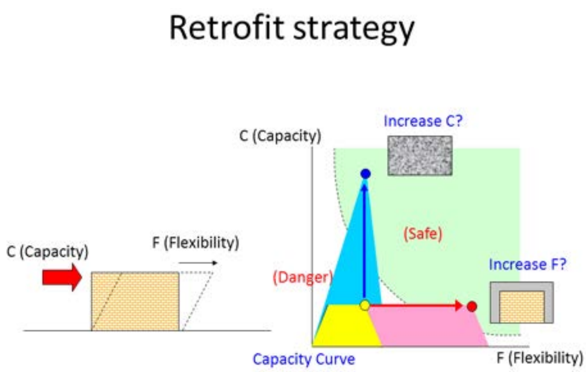




To construct earthquake resisting building, we have learned that there are two types. Strength type (Solid type) that makes the building sturdy and ductile type (soft type) that deforms without collapsing even if it breaks somewhat. At this time, if the area (which is called potential energy) of the force vs deformation graph is same for two buildings, the seismic performance can be considered to be equivalent.

For example, how can we retrofit when the seismic performance of the original building is small, that is, when the potential energy that can be absorbed by the building is small?

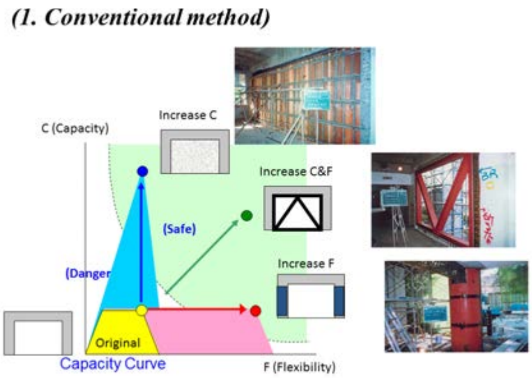
One way is to increase the walls and strengthen them. Another way is to roll carbon fiber around the column so that it doesn’t collapse but can deform. Both of these process can increase potential energy.



Now let me explain the traditional method of seismic retrofitting technology of the buildings.

As a way to increase the strength, openings are closed completely with reinforced concrete wall. This is very common. As a method to increase the deformability (ductility) , there is a method of covering the columns with iron plate or carbon fiber. In addition, there is a method of putting steel brace (called brace) which is an intermediate method of the former two. In particular, this method is often used when you want to let in external light in a south facing window like a classroom of a school.

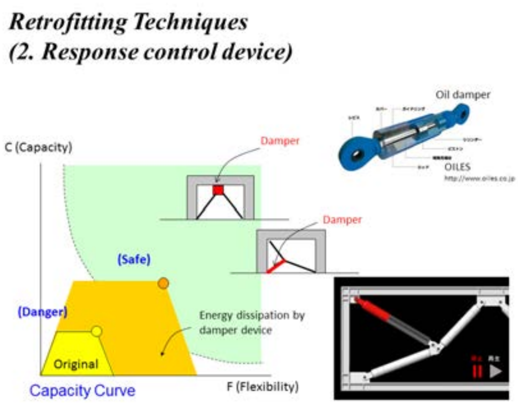
This building of Toyohashi University of Technology is reinforced by using brace on the outside.

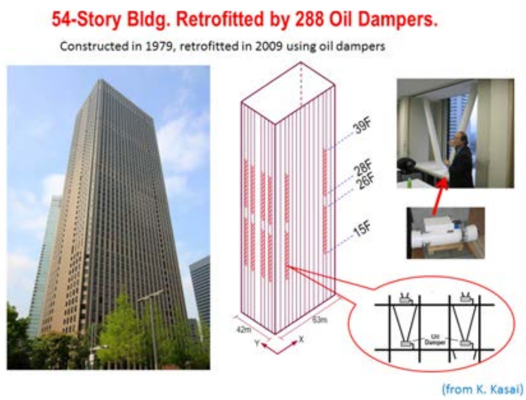


There is also method to absorb energy by putting special equipment inside the building. This device is called response control damper. The seismic performance of a building retrofitted with damper improves as the absorbed energy by the damper adds up to the potential energy of the building.

Oil damper is widely used as viscous damper. When the piston moves inside a cylinder filled with oil at a velocity, it generates a resistance force proportional to the velocity. It's mechanism is almost same as the shock absorber that suppresses vibration in a car.

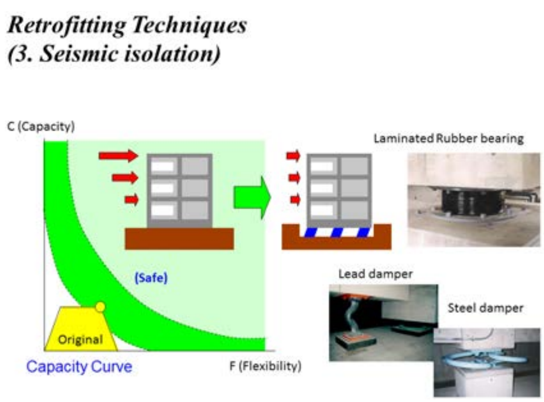
For example, oil dampers are often used to reinforce high rise buildings. In this example, 288 oil dampers were installed in the middle floors of a high rise building after construction was finished.

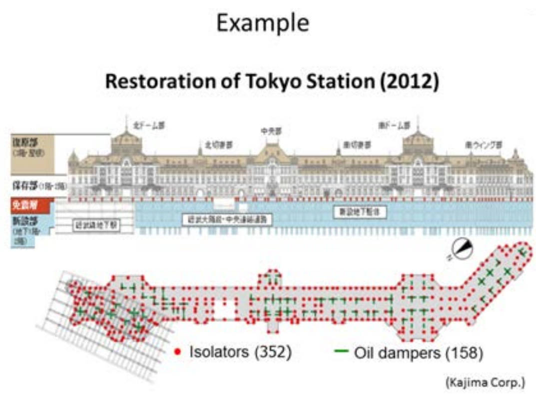




For example, if you don't want braces or dampers to be attached on buildings for retrofitting such as of historical preserved buildings, you can put rubber foundation under the building and reduce the inertial force caused by the earthquake to make it same. This structure is called seismic isolated structure.

Tokyo station is restored to the appearance about 100 years ago. Supported by 352 seismic isolation rubbers, it was possible to make it safe, even the structure at that time.

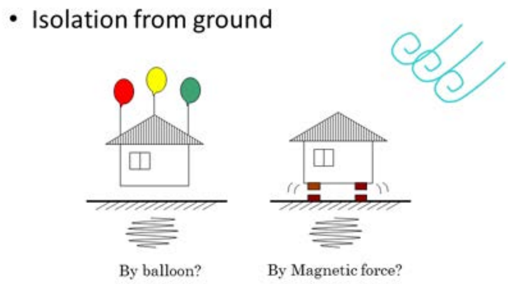




What is base-isolation?

Let’s try to understand the mechanism of seismic isolation while conducting a simple hypothesis. First of all, let us consider various ways in which the building won’t shake during an earthquake.

Perhaps the ultimate way would be floating the building in the air. With current technology, like a linear motor car, you can even float a train with the power of magnetism. So it’s not a dreamlike tale. But if a building floats in the air, it should be hard to get in or out. Besides, if the wind blows, it may be blown far away.

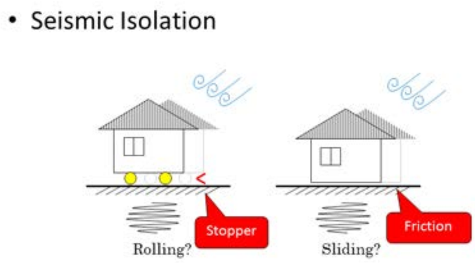


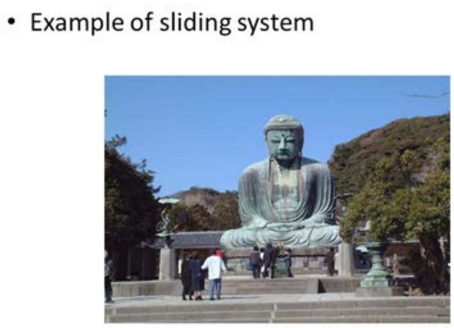
For now, let’s just give up on floating buildings and think about another way.

For example, how about laying rollers under the building? Or how about putting the building on a sliding table and slide it in case of an earthquake? In either case, when the earthquake occurs, the building rolls and slides. So the lateral force transmitted to the building can be reduced.

Weather forecast informs you in advance if typhoon comes. So when a typhoon comes in, you should fix the building with a stopper and then remove it after typhoon leaves. While sliding a building, there may be a method of adjusting the friction coefficient so that the building doesn’t move with the force of the typhoon and moves only in the case of slightly big earthquake.

The Great Buddha of Kamakura has a stainless steel plate laid between the Buddha statue and the pedestal so that the Buddha statue slides at the time of an earthquake.

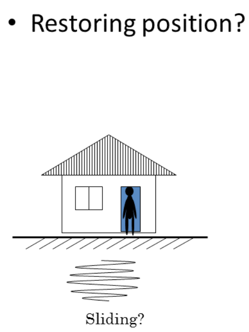


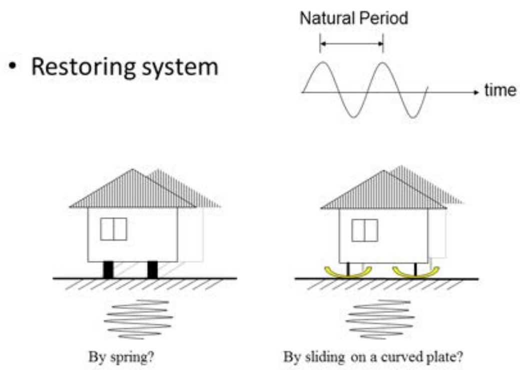


Kamakura statue was rehabilitated in 1960 adopting sliding foundation.

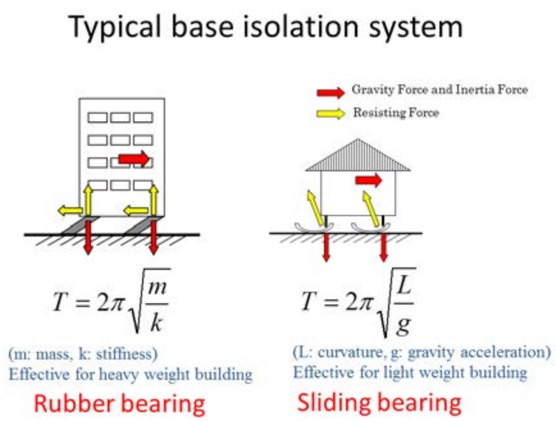
In the method of rolling or sliding a building, the building may deviate greatly from its original position after the earthquake. So, what kind of device can you make the building remain in its original position, even after the earthquake?

For example, how about connecting the building and the foundation with a spring and returning it to its original position by the force of the spring when the building moves? A soft rubber base looks good as it supports the weight of the building and deforms in the horizontal direction. Alternatively, there is a method of placing the building on a concave surface and slide it over it. Even if the building slides, it returns to its original position with the force of its own weight.

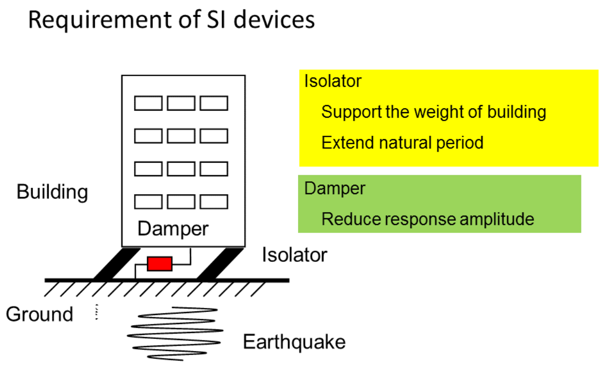




To bring it back by using spring method, the natural period will be proportional to the square root of the weight. In other words, the heavier the building gets, the longer will be its natural period. It is also inversely proportional to the square root of the spring stiffness. In other words, you can prolong the natural period, by supporting the building with (soft) spring of less stiffness.



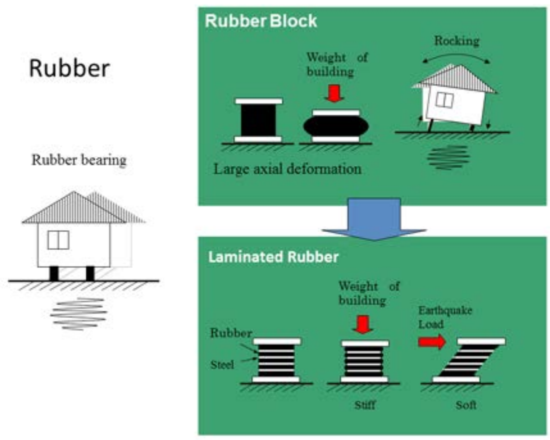
On the other hand, in the method of sliding on a concave surface, the natural period is proportional to the square root of the concave curvature radius. In other words, the more concave the surface is, the longer will be natural period of the building. Since it doesn't relate to weight, it is suitable for base isolation of light houses. It is also common to use both methods at the same time.

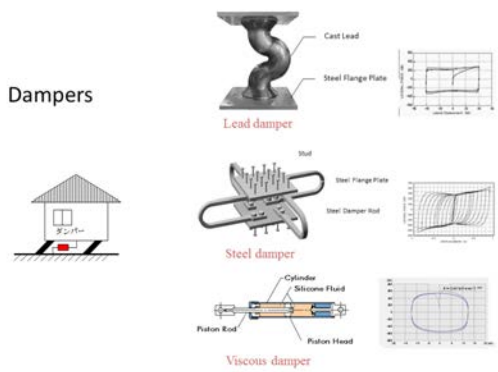


In 1969, the first base-isolated building in the world using rubber foundation was built in Skopje, the capital of Macedonia. Since the mass of soft rubber deforms not only in the horizontal direction but also in the vertical direction, when the earthquake occurred, there was a problem that the building was tilted due to the combination of the horizontal swing and the vertical swing. That is why laminated rubber bearings were invented as rubber bearing, which is hard on the vertical direction but soft in the horizontal direction. The laminated rubber has a structure in which thin rubber layers of several millimeters and thick steel plates are laminated alternately and bonded. By doing this, the steel plate constrains the lateral bulging of rubber along with the vertical deformation, and the vertical deformation due to the weight of the building can be kept small. On the other hand, it does not restrain the shear deformation of the rubber against the horizontal force, so it deforms smoothly in horizontal direction. By the invention of this laminated rubber, a seismic isolation structure that can be used practically, is made possible.

In addition, let's add a damper that will attenuate the sway of building quickly. As already explained, the damper is a device that absorbs energy of vibration depending on the amplitude of the vibration. By using a damper, you can gradually reduce the sway of the building.

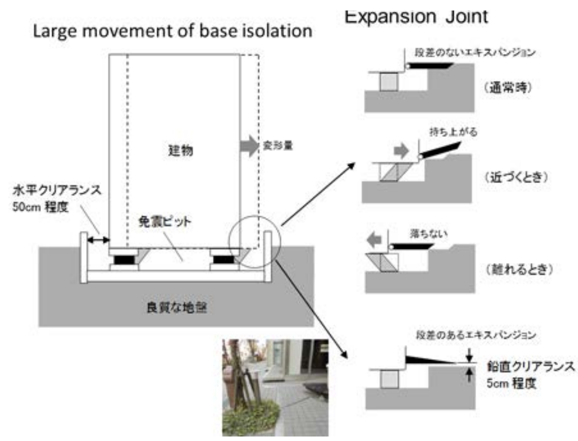
As described above, with the base isolation structure, by using the isolator that supports the weight of the building and prolongs the natural period of the building and the damper that damps the shaking effectively, the sway of the building at the time of the earthquake can be effectively reduced.





Damper used in the seismic isolation system has various shapes which makes it possible to cover relatively large deformation and to deform in any direction.

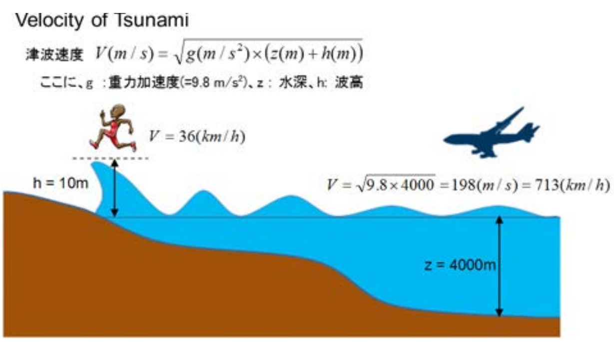
In the seismic isolation structure, it is necessary to provide an obstacle-free space (horizontal clearance) around the building so that the base isolation layer can deform. Because there are seismic isolation pits in the basement of a base isolation building, usually by setting railings and plantation around the building, prevents people from falling into the pits. Also, at the entrance and the exit, we set up a cover (expansion) to move with the building.



Let's look at the base isolation buildings in foreign countries. In the northern part of Iran, an earthquake prone country, there is a elevated-floor building with a foundation that combines logs side by side vertically and horizontally. It is said that this construction dates back a few hundred years ago. So in the event of an earthquake the log will roll and reduce the shaking of the building. Therefore, it is a splendid seismic isolation structure. Similar devices are also found in Algeria, another earthquake prone country. Wooden logs are inserted between brick arch and pillars in the 18th century temple in Kasbah, in the capital city of Algiers, to reduce the seismic force.

Even base isolation is a splendid system, there are some concerning points.
Since the isolation device is underneath the building, after the earthquake the device may be broken. If left untouched, the seismic isolation device will not work at the event of next earthquake and it is dangerous. After a earthquake of mid or large scale, let the manufacturer check the state of the equipment.

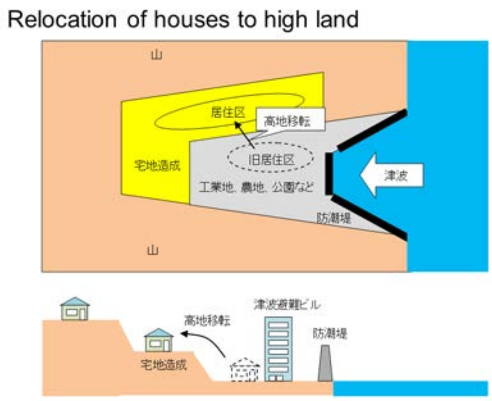
How to prepare against Tsunami

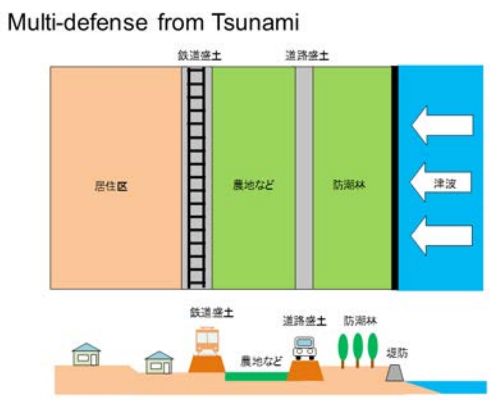


Let's change the subject about tsunami after an earthquake.
In the Great East Japan Earthquake, about 90% of nearly 20,000 victims died because of the tsunami. The speed of the tsunami is determined by the water depth and wave height. The average depth of the Pacific Ocean is about 4000 meters, and the speed of the tsunami traveling through this depth is about the same as the jet plane speed of about 713km/h. While approaching land, the depth of the tsunami becomes shallow and the speed slows down. But as the back tsunamis catch up, as a whole it gets swelled. In addition, waves are overlapped from left and right in the infiltrated bay and the wave height increases.
If the height of the tsunami on the land is assumed to be 10m, the speed will be 36km/h, and the tsunami will approach at a speed comparable to that of the athletes of 100m Olympic race.
How should we prepare for the tsunami?

An effective way to eliminate the damage caused by the tsunami is to relocate the residence to a higher ground where the tsunami does not reach. However, for those who are engaged in the fishing industry, it is necessary to develop transportation routes to the seaside, embankments and tall tsunami evacuation building.

In plain areas without high ground, multiple defensive steps that attenuates the tsunami force are necessary such as coastal embankments, sand dune, tidal forest, road embankments, etc. along with limited land use.





Japan obliges municipalities to announce the flood area and depth of water for the largest class tsunami. The tsunami hazard map created there, is the basis for maintenance of evacuation places, evacuation routes etc. Do you know whether the area where you live could be flooded by the tsunami or not?

When a major earthquake occurs, a wide range of area suffers at one time. If you can not use the lifeline such as water, electricity and gas, it will hinder living. With the stoppage of public transportation, people won't be able to go back to their home and if the roads get congested, there will be times when fire fighters and ambulance won't be able to reach to the spot in time. To prepare for earthquake disasters, it is important to take three actions. [Self help] to protect yourself and your family, [Co-aid] to help each other in the region and [Public assistance] to receive rescue and support from the country and local governments.

Toyohashi city is at the risk of Tokai and Tonankai earthquake for a long time and disaster prevention activities have been carried out enthusiastically. Let's introduce the activity with the slide borrowed from Prof. Hisada of Kogakuin University. Toyohashi University of Technology also participates in this activity.

In ordinary disaster prevention drills, it is required to act in an orderly manner as an organization in accordance with preset scenarios. However, with the implementation of earthquake, it is rare to go according to the scenario. Everyone needs to respond flexibly according to situations that change from moment to moment.

Therefore, in disaster drills conducted in Yamada Town in Toyohashi City in 2006, a method was adopted in which damage signs were installed randomly in the city without notifying the residents and they made response according to the damage sign. This method is called Emergency response training.

For example, participants in disaster prevention drills will immediately execute initial fire fighting actions when they find a fire sign in the city. At the same time, the situation of the damage is reported to the residence association and the residence association creates a disaster map by summarizing the report. The summary includes the spot of fire occurrence, which buildings has collapsed. In the end, this information is kept preserved at the disaster prevention center in Toyohashi city.

This kind of fabulous training has been done in the past but unfortunately it is not continued since then. I would like to discuss with everyone about how these activities can be continued in near future.