You thought you knew but didn't

Sumitomo Riko's Business

Episode 11: TRC dampers
(Seismic dampers for wooden houses)

Is this diagonal product a TRC damper, by any chance?

Yes, it is!

TRC stands for Total Response Control

Oh really?
Come to think of it, there are also damper products for cars

You're right
The same structure is used in anti-vibration rubber parts of car suspensions

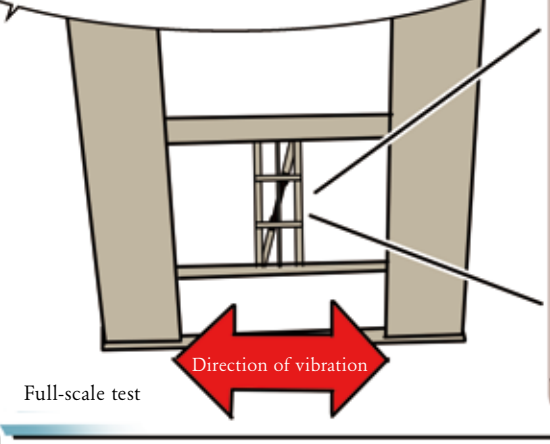
I remember!
I covered that at the beginning of my data gathering!

But how is that related to seismic control?
I seem to think it's something to do with earthquake resistance as well as seismic control ...

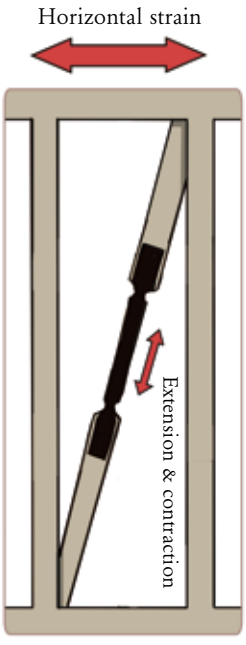
Steady on
Let me explain step by step

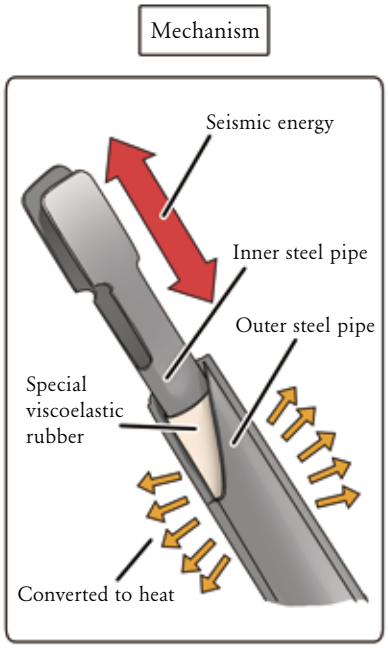
Seismic energy is absorbed by TRC dampers which include special viscoelastic rubber

These products protect houses and the people in them by instantly converting the seismic energy to heat

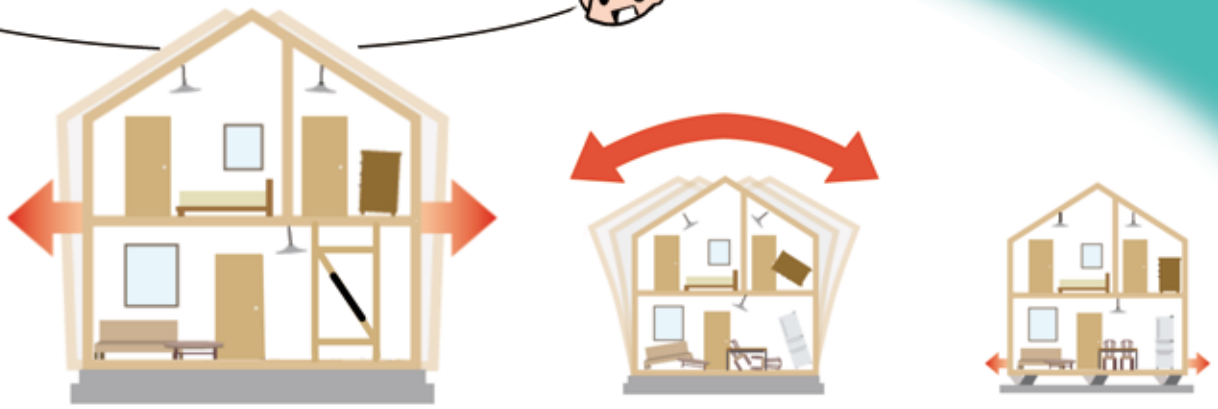


Full-scale test





Anti-earthquake technologies can be broadly divided into three types: seismic control, earthquake resistance, and base isolation
Here are their characteristics



Seismic control | Earthquake resistance | Base isolation

	Seismic control	Earthquake resistance	Base isolation
Features	Absorb the seismic energy in the walls to reduce shaking	Increase and harden walls to resist shaking in earthquakes	Install device underneath the building so that shaking from the ground is not conveyed to the building
Deformation of building	Can reduce distortion by up to 50% more than earthquake resistance	Resists with braces and plywood, but some damage may remain	Can reduce distortion by up to 90% more than earthquake resistance (Affected by period of earthquake ground motion)
Reduction in acceleration	Acceleration is reduced	Acceleration is not reduced	Acceleration is greatly reduced
Cost	Low price	-	High price
Ground limitation	No limitation	No limitation	Not suitable in case of soft ground
Comments	Can be used in new and renovated buildings *No limit to its use	Strength is lowered with repeated earthquakes	Not suitable for long-period earthquake ground motion

TRC dampers come under "seismic control"

I see

Looking at this table, seismic control seems to provide good protection while keeping costs low

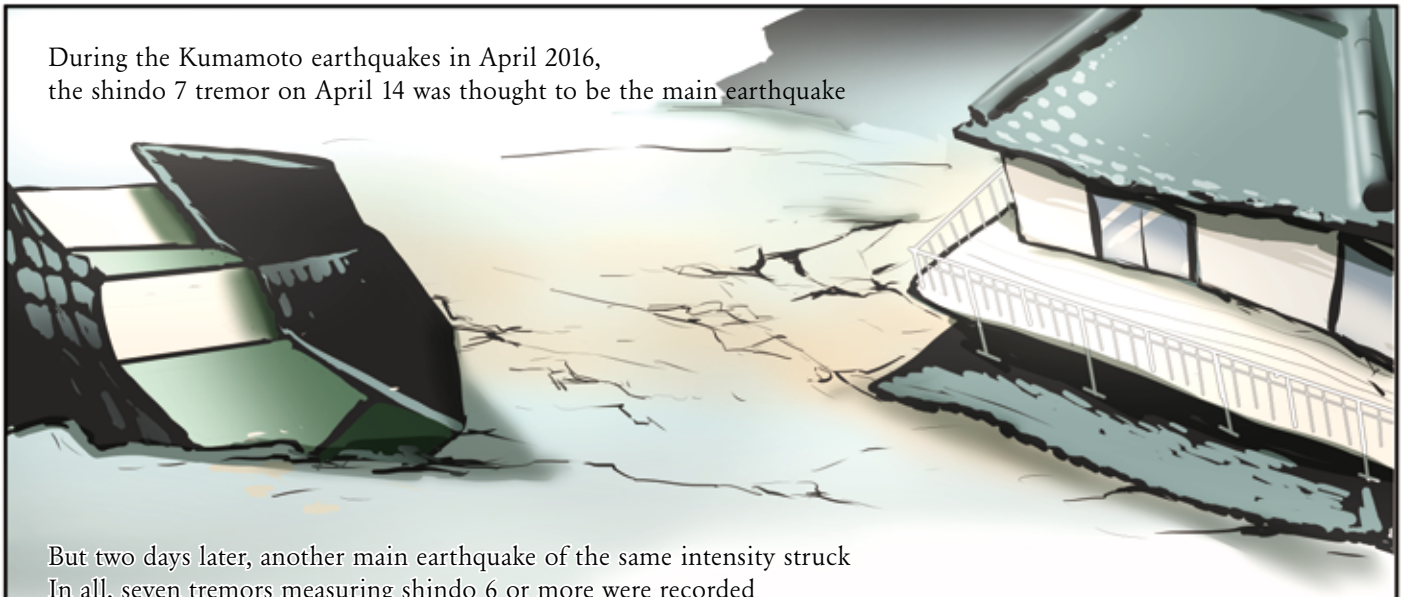
I hear earthquake resistance mentioned more often
Isn't earthquake resistance enough on its own?

Most people only care about earthquake resistance, like you

But using only earthquake resistance is problematic

Oh really?

During the Kumamoto earthquakes in April 2016,
the shindo 7 tremor on April 14 was thought to be the main earthquake



But two days later, another main earthquake of the same intensity struck
In all, seven tremors measuring shindo 6 or more were recorded

Terrible damage was caused by these swarm earthquakes

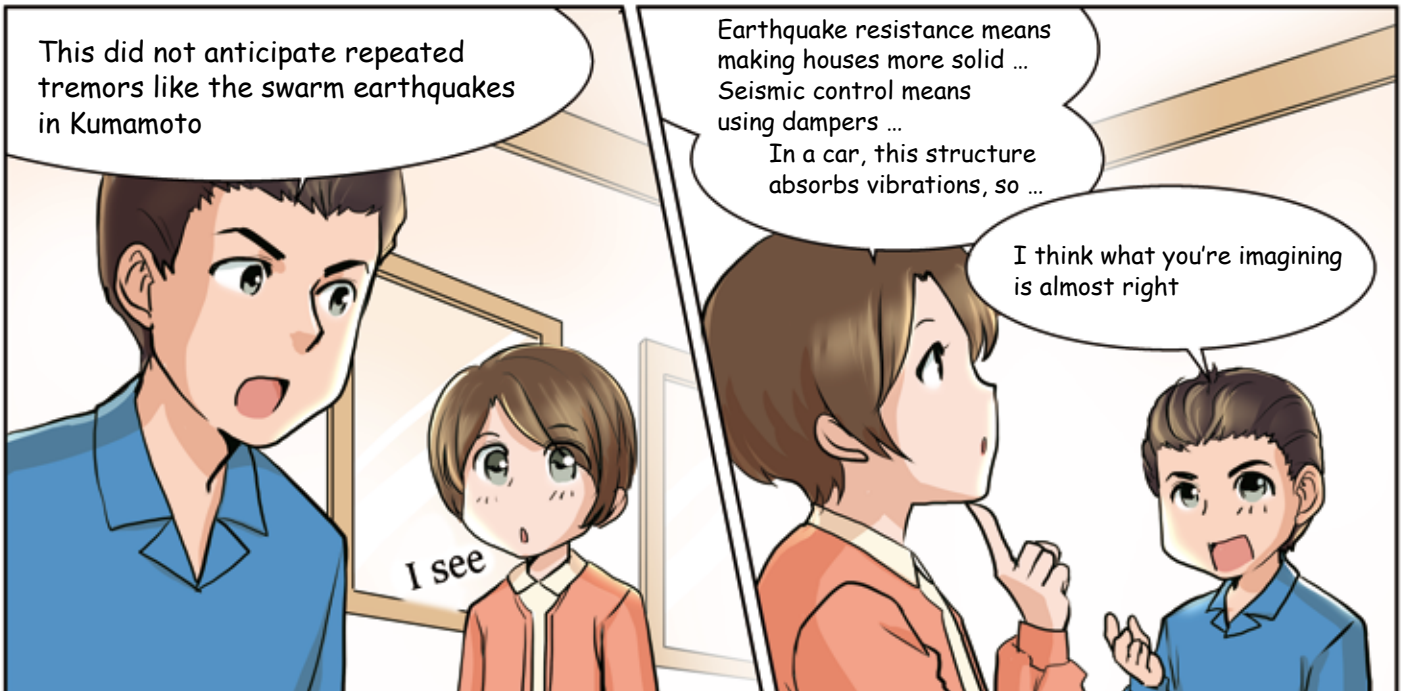
Each time a big earthquake happened in the past,
the standards for earthquake resistance were raised

It has become mainstream to think that
earthquake resistance means making houses
more solid, that it is enough to protect them
from a single major earthquake

Seismic activity status
(earthquakes measured at shindo 6-lower or more)

Time of occurrence	Epicenter	Magnitude	Max. intensity (shindo)
April 14, 21:26	Kumamoto Region, Kumamoto Prefecture	6.5	7
April 14, 22:07	Kumamoto Region, Kumamoto Prefecture	5.8	6-lower
April 15, 00:03	Kumamoto Region, Kumamoto Prefecture	6.4	6-upper
April 16, 01:25	Kumamoto Region, Kumamoto Prefecture	7.3	7
April 16, 01:45	Kumamoto Region, Kumamoto Prefecture	5.9	6-lower
April 16, 03:55	Aso Region, Kumamoto Prefecture	5.8	6-upper
April 16, 09:48	Kumamoto Region, Kumamoto Prefecture	5.4	6-lower

That is the minimum legal standard for allowing them to be built



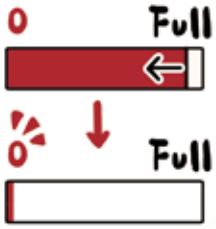
What I want you to understand first is that an earthquake is not a simple pressing force but energy.

Energy?

Yes
To put it plainly,
energy is the workload applied in order to make a restrained object move

Turning a propeller with wind or moving an automobile with gasoline is the workload…
Energy is generated

The energy does not go away unless that amount is consumed



For instance, a car moves while it has gasoline but stops when it runs out

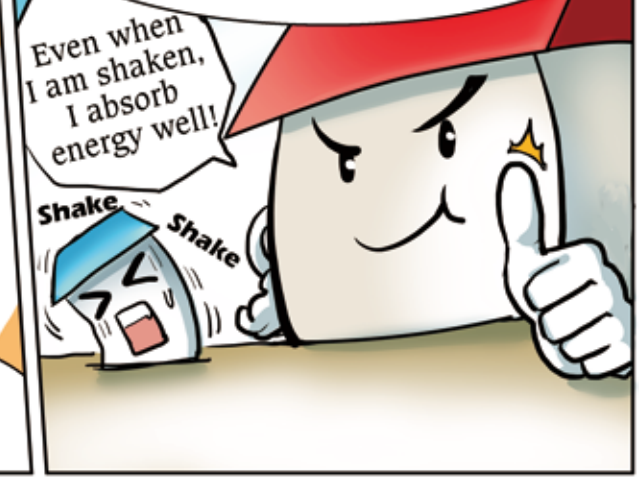
This is because there is no more energy being provided to the car by the gasoline

I will continue to shake until my energy runs out!

An earthquake, too, will only decrease when its energy has all been consumed or absorbed, like gasoline

A house that is good at withstanding earthquakes is not one with high strength,

but one with a large capacity to absorb seismic energy



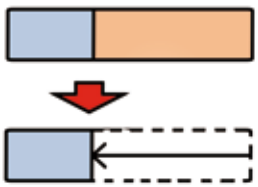
When the energy of an earthquake enters a house, it is divided into shaking energy and frictional energy

If the shaking energy is bigger, the building shakes a lot

Seismic energy enters the building and is divided into the following

I see
So increasing the frictional energy may decrease the shaking energy

If we increase the ratio of frictional energy,



frictional energy is dissipated as heat and consumed (disappears)

That's right!

To explain earthquake resistance in a bit more detail, the shaking energy of an earthquake is reduced by the walls and braces becoming deformed or damaged

But the shaking energy of earthquakes is reduced by deformation or damage, so when a building is subjected to repeated earthquakes it cannot withstand them and is unable to reduce the shaking energy

Frequent rattling

If a house is damaged, people can't live in it

Crack!

I can't protect you any more

Ouch!

It needs to be rebuilt

In other words, the ratio of frictional energy is increased and the ratio of shaking energy is reduced

With seismic control, on the other hand, TRC dampers are installed between pillars as braces, which absorb seismic energy by converting it into the frictional energy of the rubber inside the dampers

I try my best to absorb seismic energy!

This reduces the shaking energy exerted on the house itself and lowers the possibility of damage

Because TRC dampers absorb the force of earthquakes by converting seismic energy into frictional energy, they can be used repeatedly.

Shake

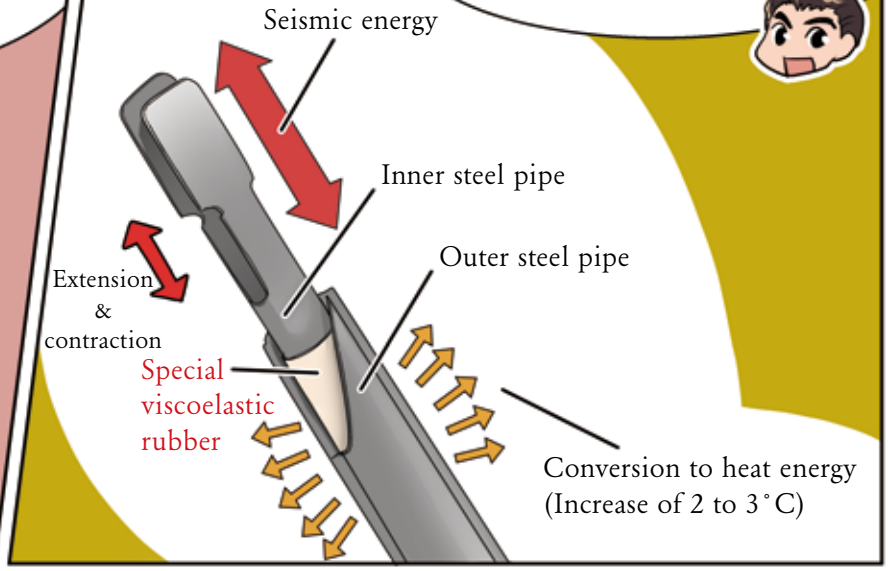
Shake

I'll absorb seismic energy next time, too!

So seismic control seems better than earthquake resistance for dealing with repeated earthquakes!

But what is the structure of these TRC dampers that change seismic energy into frictional (heat) energy?

The inside of a TRC damper looks like this



Inside a TRC damper is special viscoelastic rubber

This is where friction occurs when the damper extends and contracts, so seismic energy is converted into heat energy

Look, special viscoelastic rubber isn't as springy as ordinary rubber

The kinetic energy when it falls is instantly converted to heat energy

This rubber is one of our company's strengths and one of our core materials

Power ball
Highly elastic material

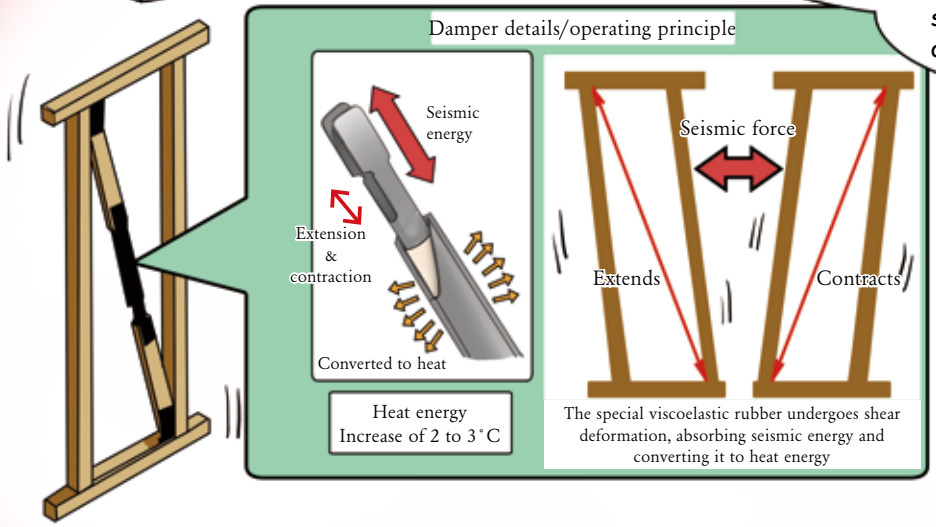
Special viscoelastic rubber ball, not springy
High damping performance material

You're right
It's hardly at all springy

Installing it into something like a brace means the force is fully transmitted to the TRC damper

A truss structure is strong

It's the structure used in skyscrapers like Sky Tree and in bridges



So Sky Tree has the same structure

I see


Also, TRC dampers were released in 2008, since when their installation has rapidly increased as their performance has been verified in one earthquake after another
They have been installed in more than 20,000 houses, including not only new-builds but also renovations
Blah blah
We also analyze free of charge where and how many dampers should be installed in a house
Recently, we have made dampers for two-by-four timber as well, so they can be used in a variety of houses
They really are suitable products for providing safety and security in our lives
And then ...
Oh
I feel dizzy
Heavy
Err...
Mr. Kotani, you're talking too much!
We're tired of waiting!
Sorry, sorry
They've come to pick up Mr. Kotani
Good, now I can go home ...
Phew
Right then, next we'll explain our other products for houses!
What?
Let's go into the next room!
S... Sorry, I need a short break
Exhausted
Huh? I suppose we have no choice
Products that support comfortable living other than TRC dampers ... What sorts of things are waiting next?