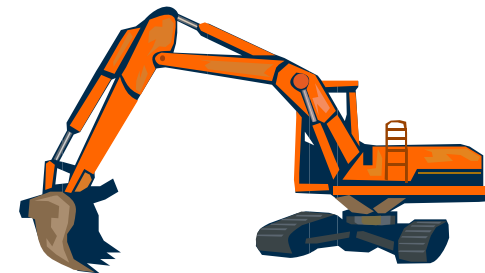




## What is bD pile (Base-, rotation-bury, steel tube pile)?

- ◉ Vibration and noise free, no soil remained only one process to install the piles.
- ◉ Do not need specialized machinery to drive a pile, only use backhoe.
- ◉ Backhoe installation is much faster than specialized machinery.
- ◉ Only steel tube pile(patent pending) to manufacture in 40 seconds without welding the tip part of the pile.
- ◉ This steel tube pile has installation results of more than 150.000 and it can be used for various purposes.
- ◉ Approved by Ministry of Land, Transport and Infrastructure. Highly reliable pile to be able to use for various construction purposes.



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## How to stabilize the structure against the earthquake force and its properties, agenda to be solved, etc.

### Aseismic structure

- ▶ Make the structure itself not to exceed the strength of the allowable stress of materials at the time of quake force.
- ▶ For giant earthquake, make the structure to possess the strength to protect human lives, even the continuation of use might be difficult.
- ▶ Easy to architect and construct. Not very high at cost.
- ▶ Most standard structure architect method.
- ▶ **Cannot be avoided to fall down furnitures or things, even the building remain unbreakable.**

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### Vibration control

- ▶ To absorb or set off the earthquake energy in various ways to minimize the vibration of the structure and not to exceed the strength of the allowable stress of materials at the time of quake force.
- ▶ Higher cost than aseismic structure
- ▶ Some materials are not to be able to re-use.
- ▶ **Not effective for ground floor.**

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### Aseismic base isolation

- ▶ To architect in many ways not to transmit the earthquake energy to the premises as much as possible.
- ▶ **It is said that this method is the most effective way for the giant earthquake.**
- ▶ **High cost**
- ▶ **Need countermeasure against wind pressure for higher buildings.**
- ▶ **Could be more dangerous than aseismic structure in case of long-term earthquake.**

E-Defense experiment to show the effectiveness of aseismic properties using steel tube pile.



Look at the tank  
and spindle

- ◉ Direction
- ◉ Acceleration
- ◉ Displacement

(独立行政法人 防災科学技術研究所)

Shows aseismic properties immediately that the tank (soil ground) shakes largely but the spindle (buildings) are not vibrating largely.

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## Period of the earthquake force and the earthquake, period of timber structure

Earthquake force against the structure = Weight of the structure (mass) × Acceleration

### Predominant period of quake

Miyagi shore earthquake 0.3 sec.

Southern Hyogo earthquake 0.5–1.0sec.

(also called the killer pulse)

### Natural period of timber structure

0.3sec~0.5sec

New timber 2 stories structure ±0.3 sec.

Old timber 2 stories structure ±0.6 sec.

From these facts, we can say that

There are more possibilities for timber 2 stories structures to resonate the quake vibration and easily to be damaged.

Also, even the premises remained without damage, could fall down the furnitures or things causing any kind of damage to human.

What is “Predominant period”?

Period of wave which has the strongest energy in any earthquake waves.

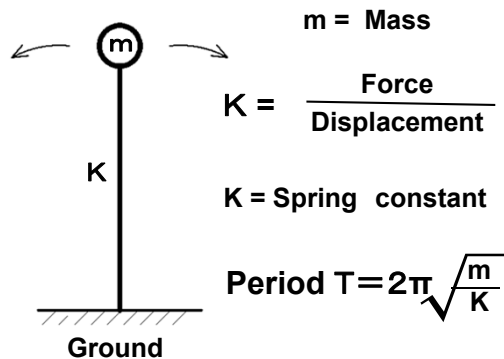
# Concept of SP Aseismic Base Isolation using steel pipe pile.

- \* The idea is that the building is supported by “spring” called steel pipe pile.  
(need more ground bearing force, therefore must install base piles)
- \* Spring constant of steel pipe pile shall be determined by bending rigidity of the pile (E·I), diameter of the pile and reaction coefficient of plain ground.
- \* Period, acceleration, reaching velocity, displacement for the building which is supported by spring shall be calculated by spring constant, considering the reaction force of plain ground.
- \* Earthquake force reaction through the pile to the building minimizes by inertial force of the building and spring movement. Therefore as aseismic property shall be

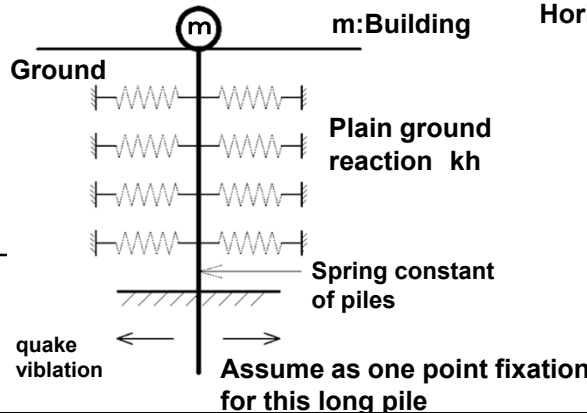
Velocity → Small      Velocity to reach Late      Displacement of pile tip pin

\* This is completely new idea of concept focusing on elasticity, shape, quantity of the piles and its dynamic properties, inertia property of the buildings, and it has been proven by earthquake response analysis.

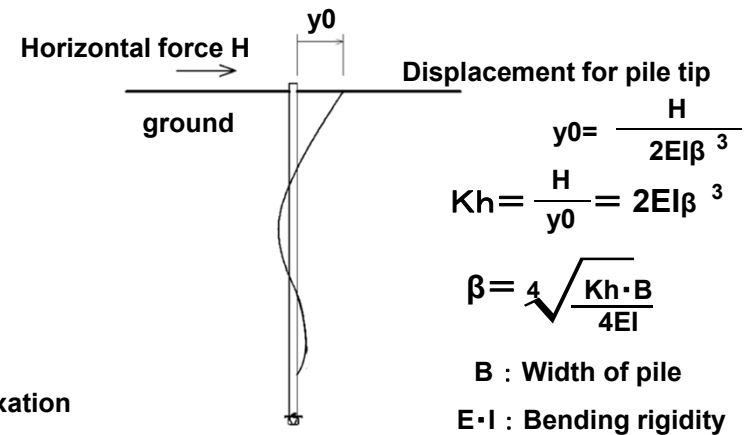
## General model



## Modelling of the pile into soil



## Displacement for pile tip pin



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## Advantages of using steel pipe pile as aseismic base isolation (In case of using bD pile, blade pile)

- ◆ No need to consider installation of aseismic devices.
- ◆ No need to have 2 base structures in case of timber structure buildings.
- ◆ Almost non limitation to design or installation.
- ◆ Prevent building' s breakdown and improve safety in the house.
- ◆ No concern for maintenance or durability for steel pipe pile.
- ◆ No concern for the countermeasure of wind pressure, even for light weight building premises. Stable due to horizontal force reaction.
- ◆ No concern for sympathetic vibration at time of long-term earthquake.  
For small velocity quake, the buildings shall shake in harmony with the ground using horizontal force reaction, therefore it is safe.

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## How we developed SP Aseismic Base Isolation Method and joint study professors.

- ✧ We considered the ground, pile and premises as overall system, taking the ground as an elastomeric bearing and do the dynamic analysis of earthquake movement and to confirm that based on quantity, placement of the steel tube pile, tip, base, shape and installation method to achieve optimal aseismic property.
- ✧ By dynamic analysis result, we have established greater design, shape and installation method of piles for aseismic properties.
- ✧ Patent pending as to “Aseismic Base Isolation Method Using Steel Pipe Pile”

### Joint development and research

Japan Univ. Engineering Div. Construction Dept. Computation Applied Dynamic Studies  
(Development of Calculation of the efficiency of SP Aseismic method and response analysis)

Japan Univ. Engineering Div. Mechanical Engineering Dept. Kato Study Group Tribology (Friction engineering)  
(Pile-head rotation, Base concrete, Joint study for Friction abatement of base and soil)