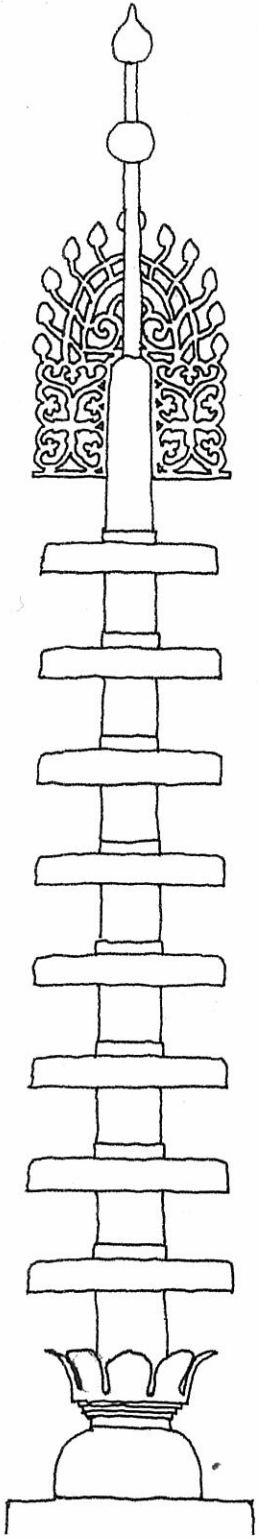


五重塔の秘密

Mystery of a pagoda

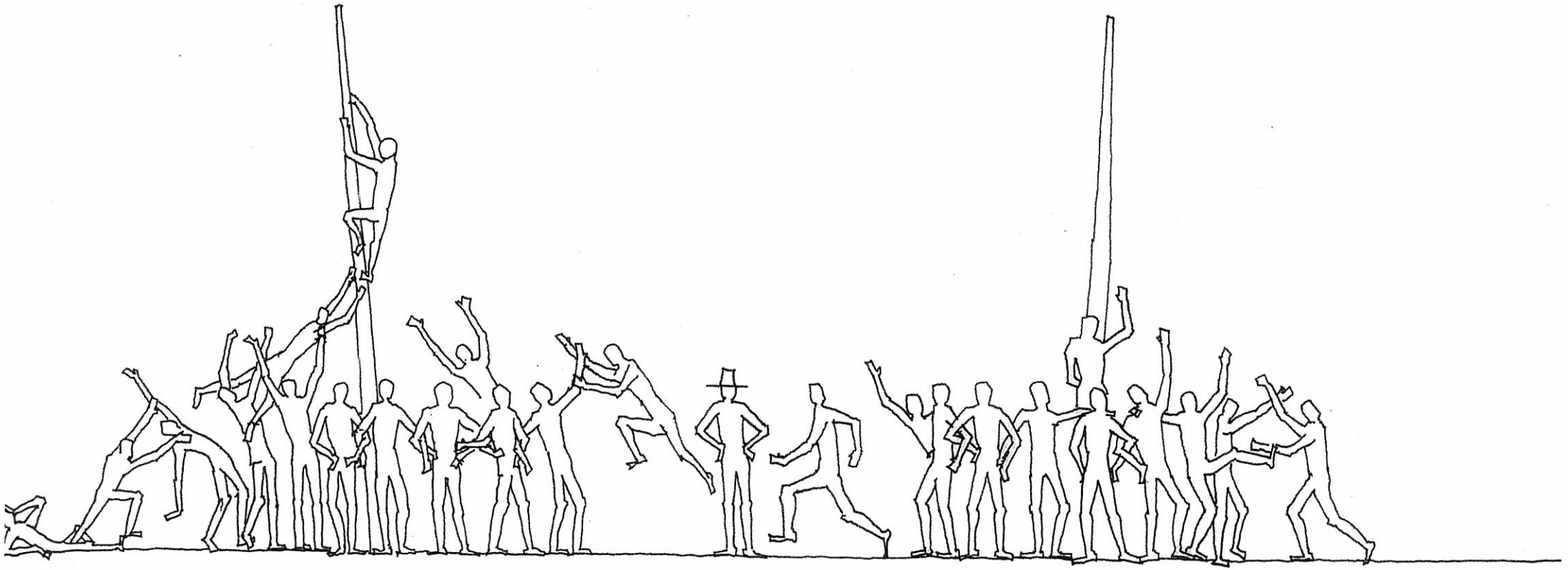
Written by Nishikawa
Translated by Keith

GAME "Botaoshi"

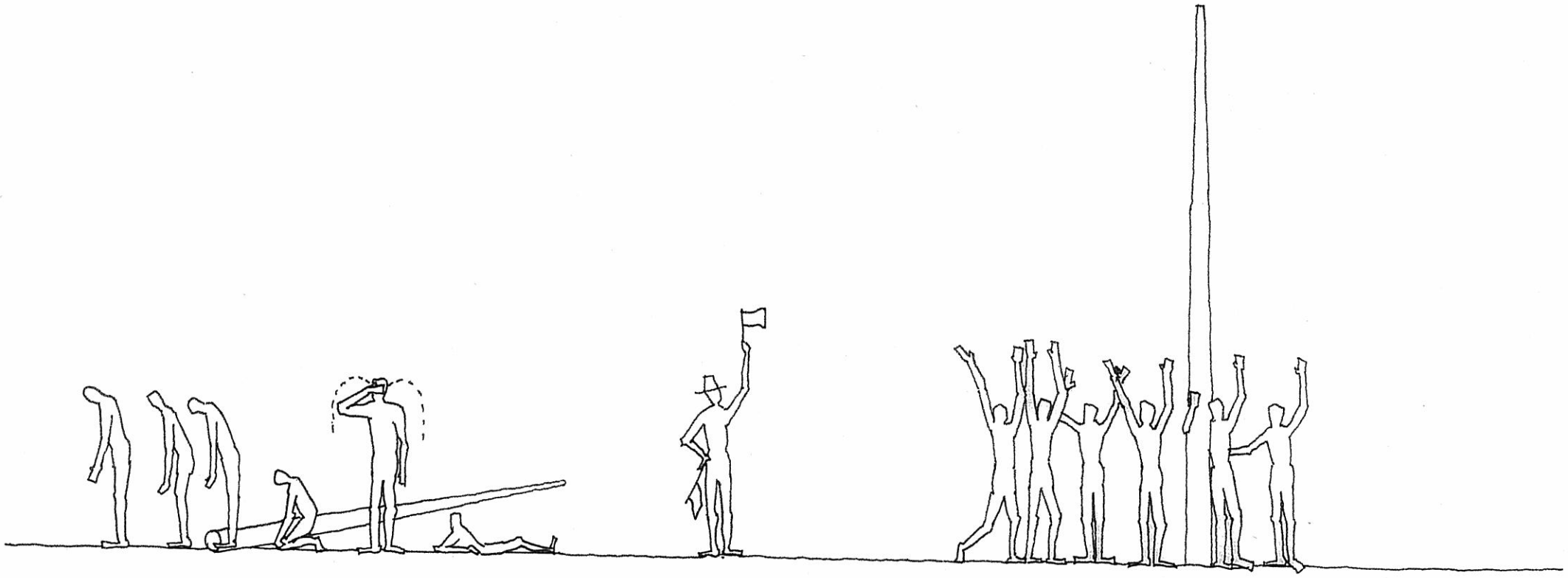
Rule 1 Log length : 5 meters

Rule 2 Game time : 5 minutes

Rule 3 Goal : push over other team's log

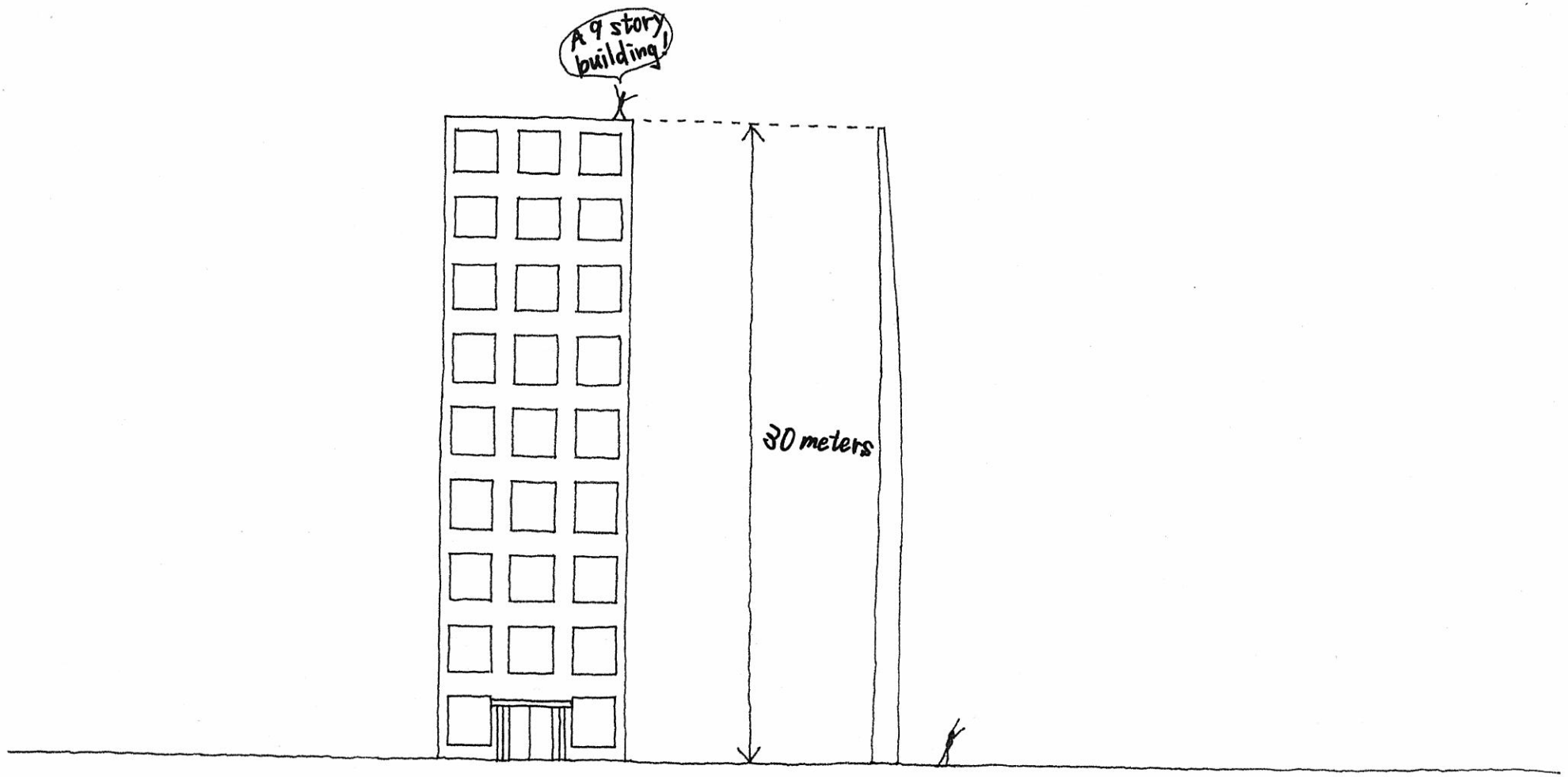


Rule 4 If your log falls over, you lose.

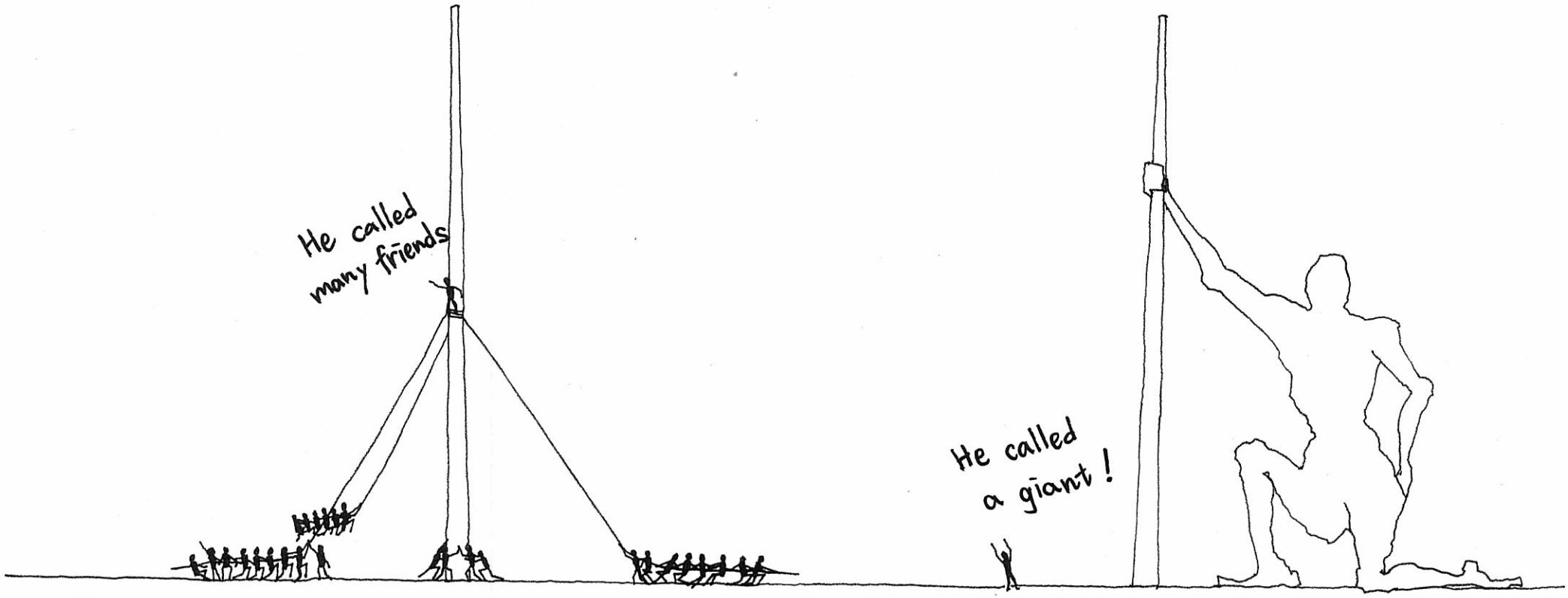


New Botaoshi

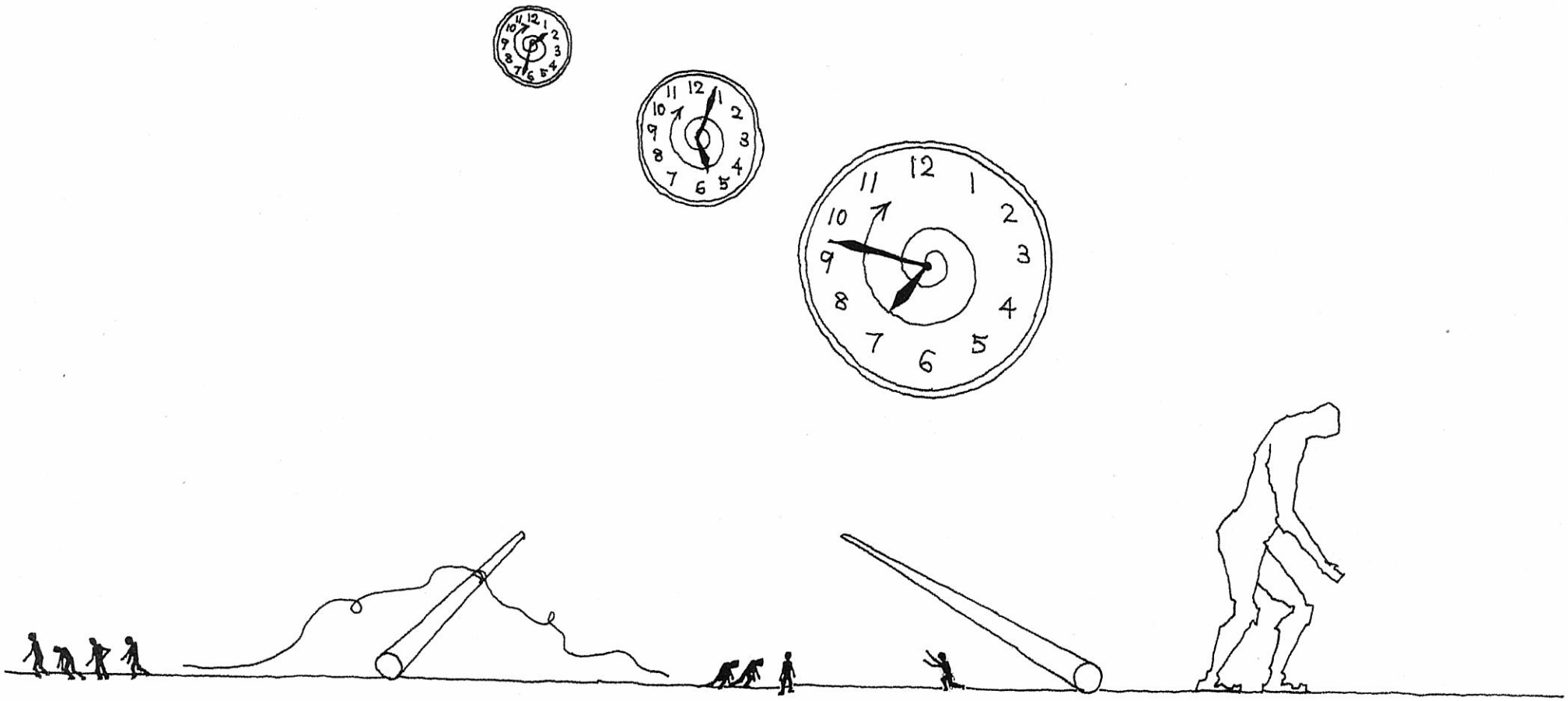
Rule 1 Log length : 30 meters



Rule 2 You can ask anyone to join.



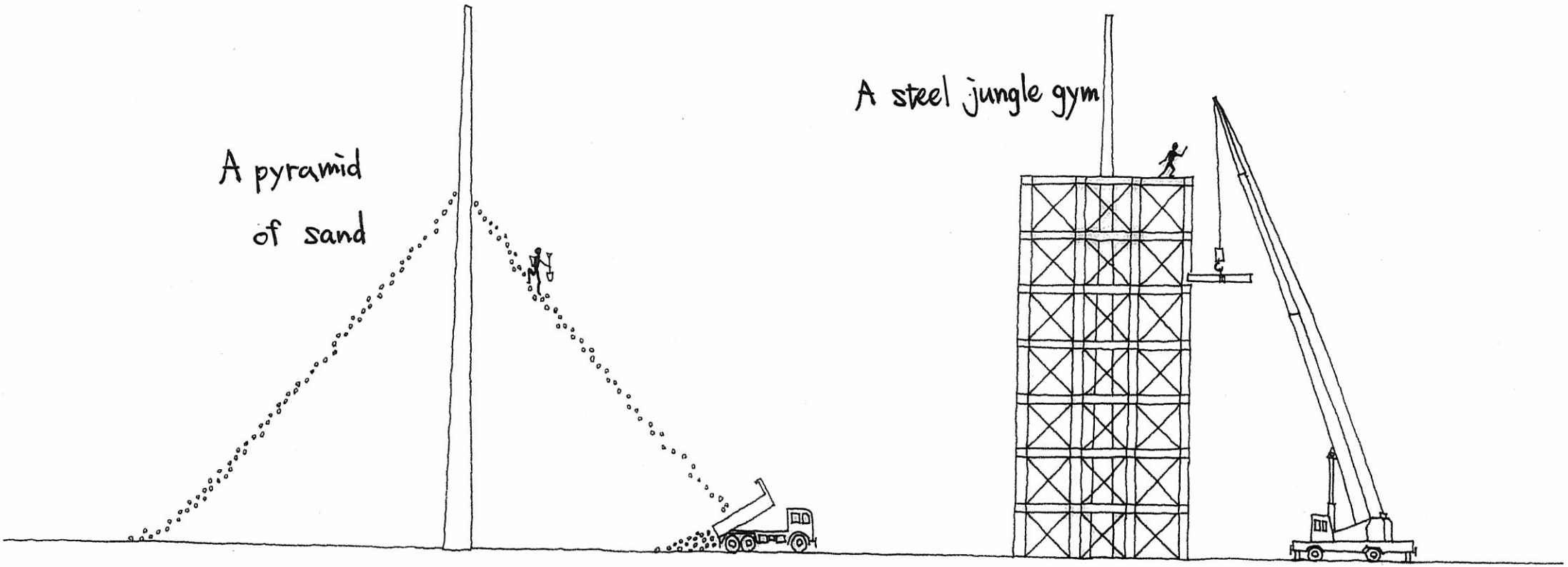
Rule 3 Game time : several hundred years

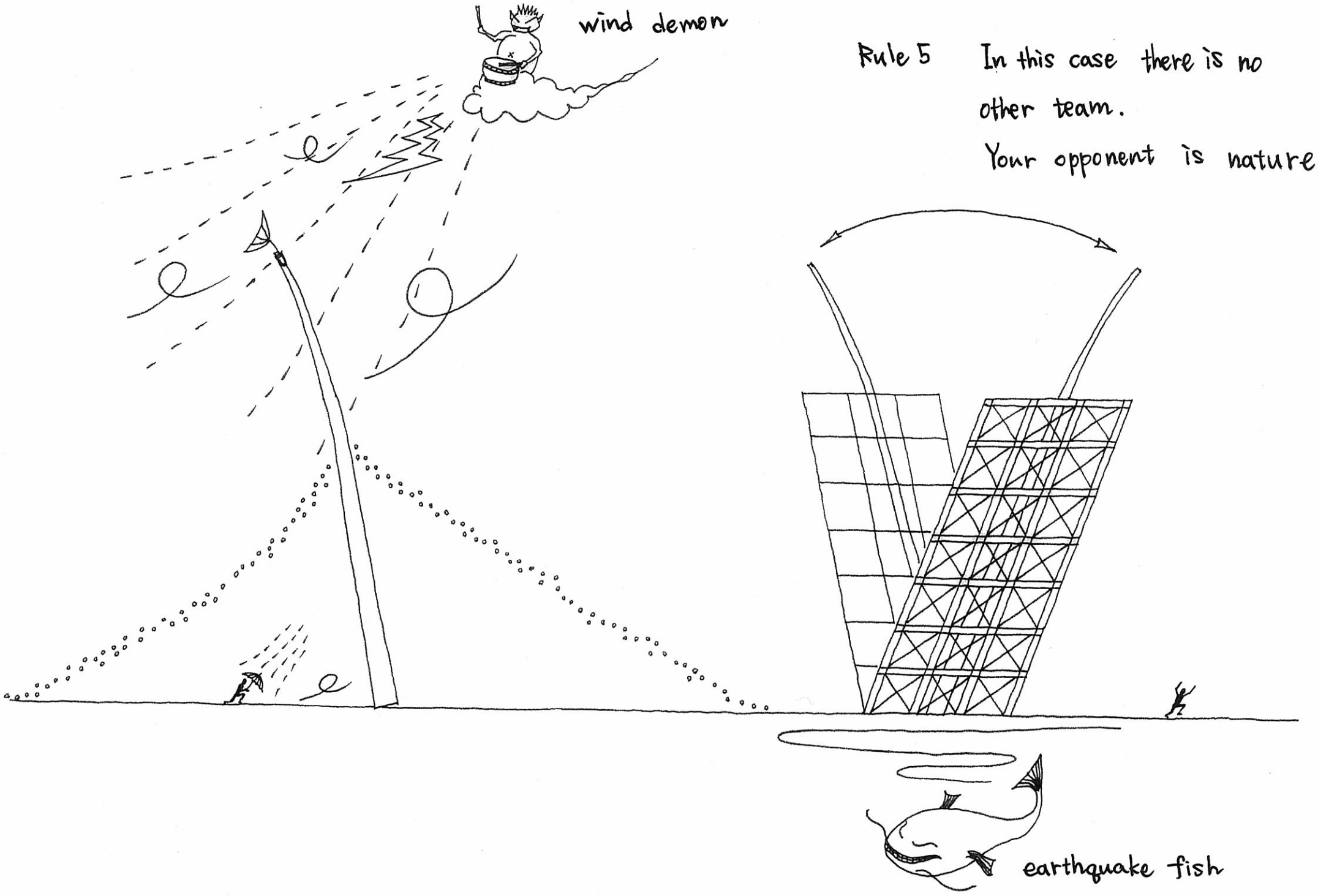


Every one gets tired

and goes home ...

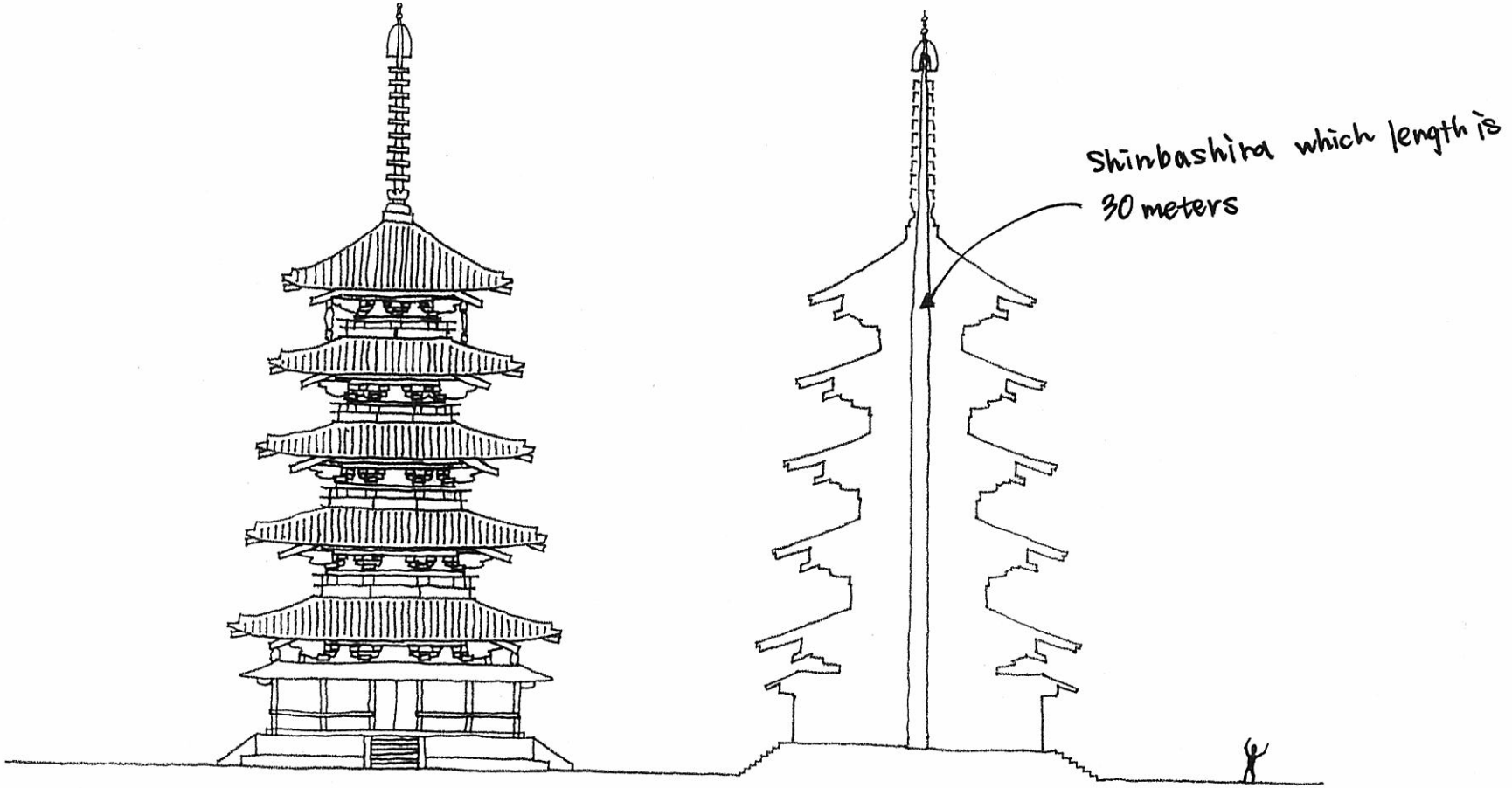
Rule 4 You can make something to help.





Rule 5 In this case there is no other team.
Your opponent is nature.

There is something in Japan that has been winning this game for more than a thousand years.

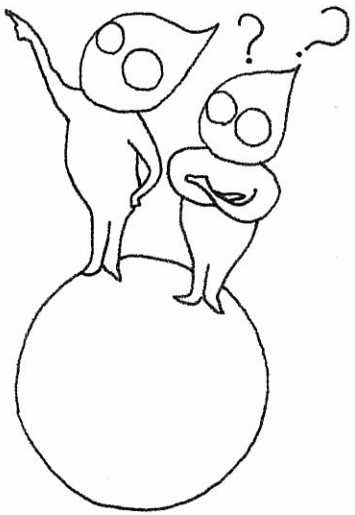


It is the 5 story pagoda.

In the center of this pagoda is a long log, called a shinbashira.

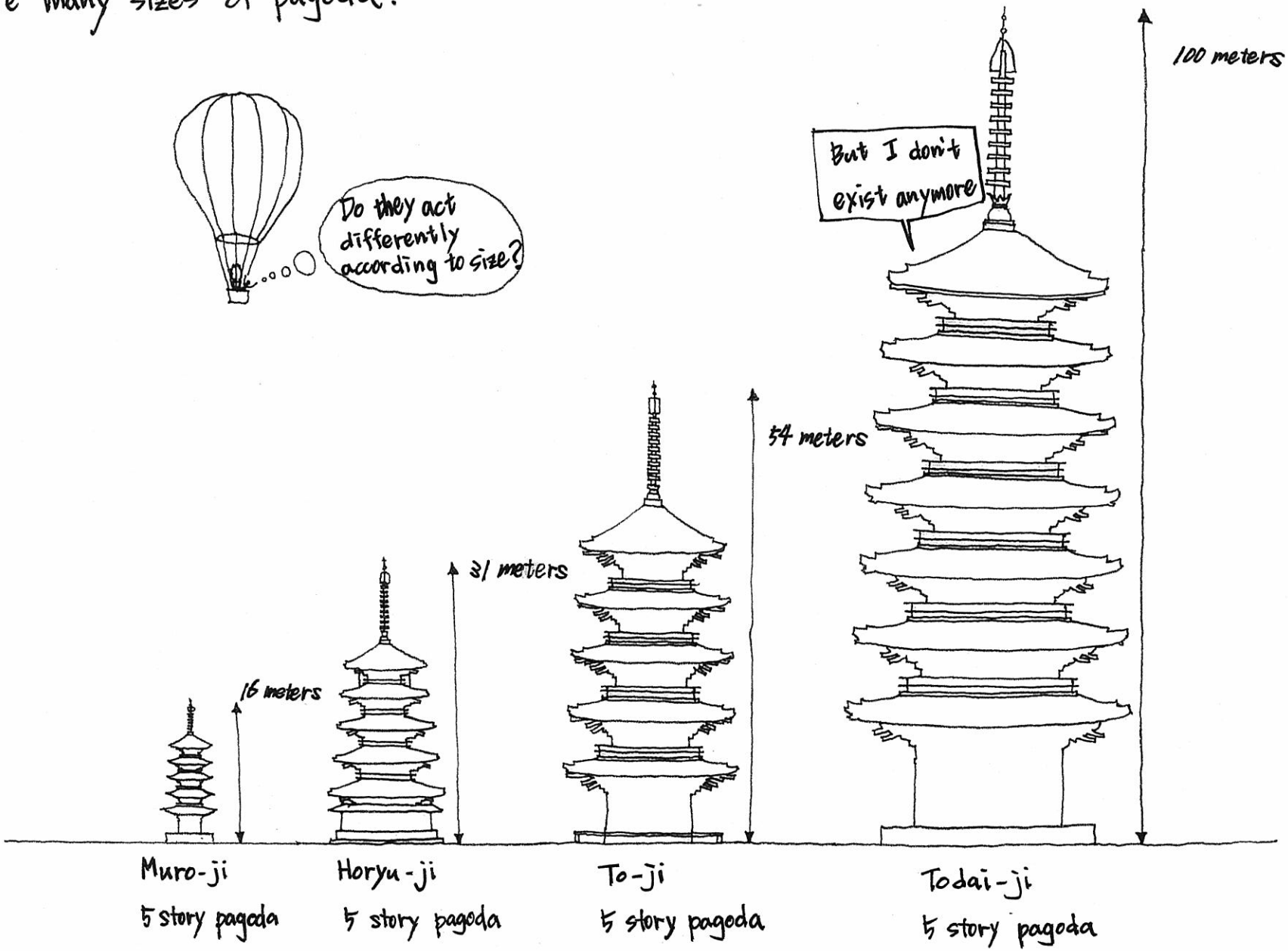
Japan has many earthquakes and typhoons

Why would there be a skinny tower there?

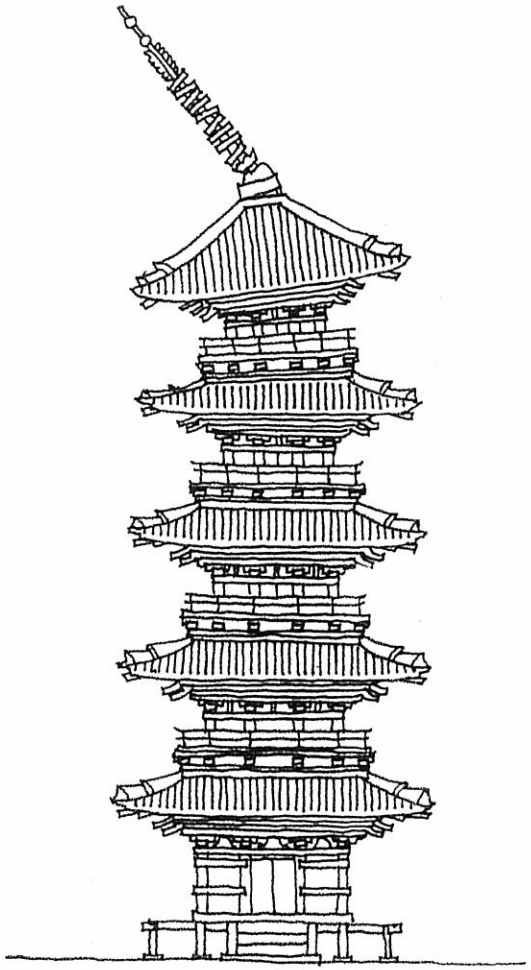


Let's discover the secret of the 5 story pagoda.

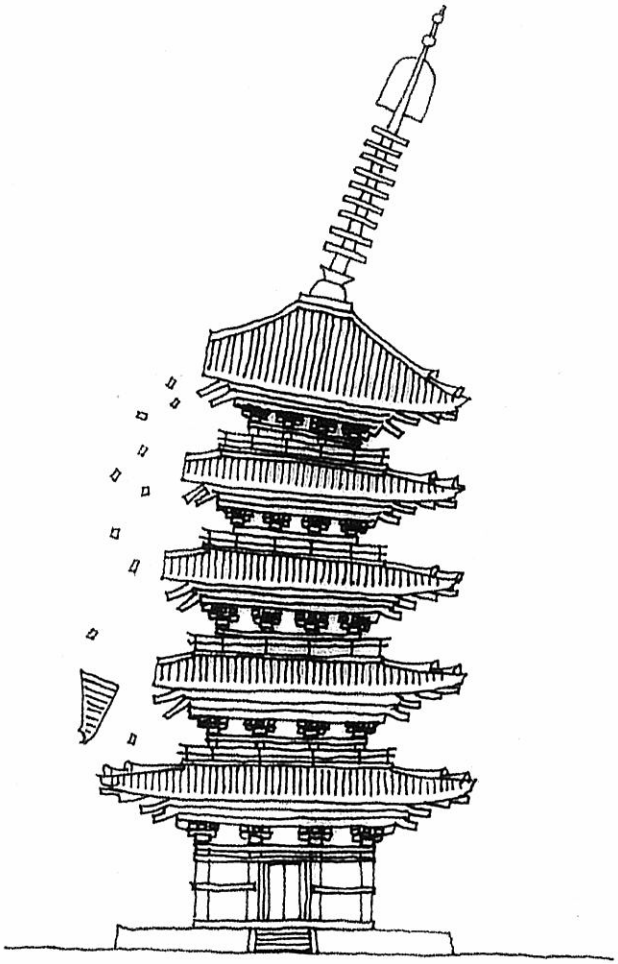
There are many sizes of pagoda.



Sometimes, the pagodas are damaged.



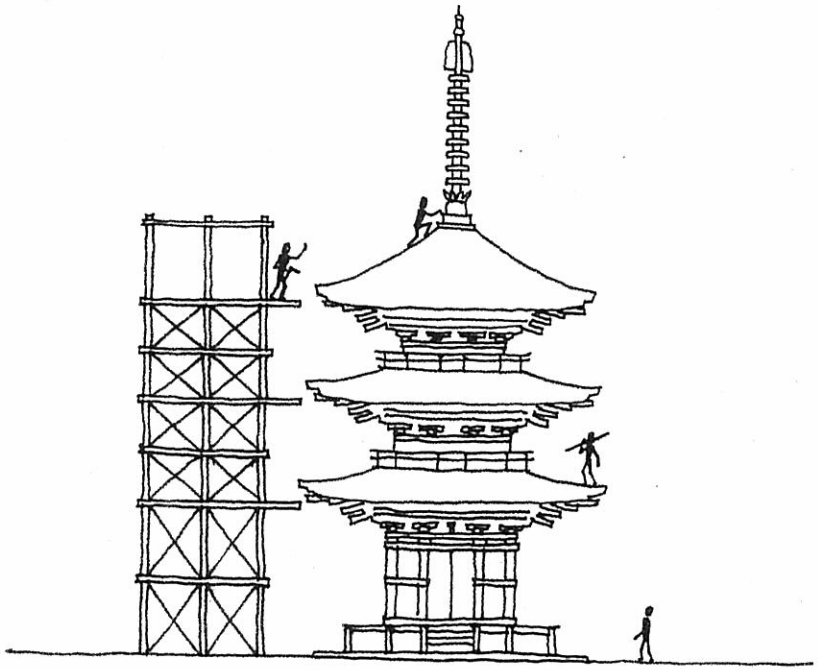
The top can fall off.



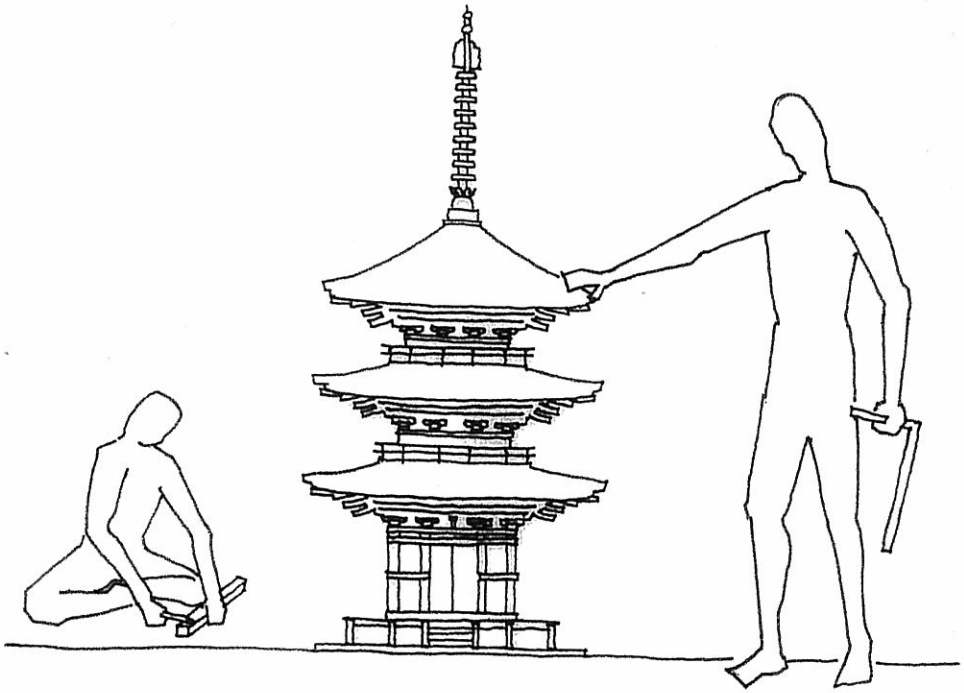
Or the roof can break.

But this can be repaired.

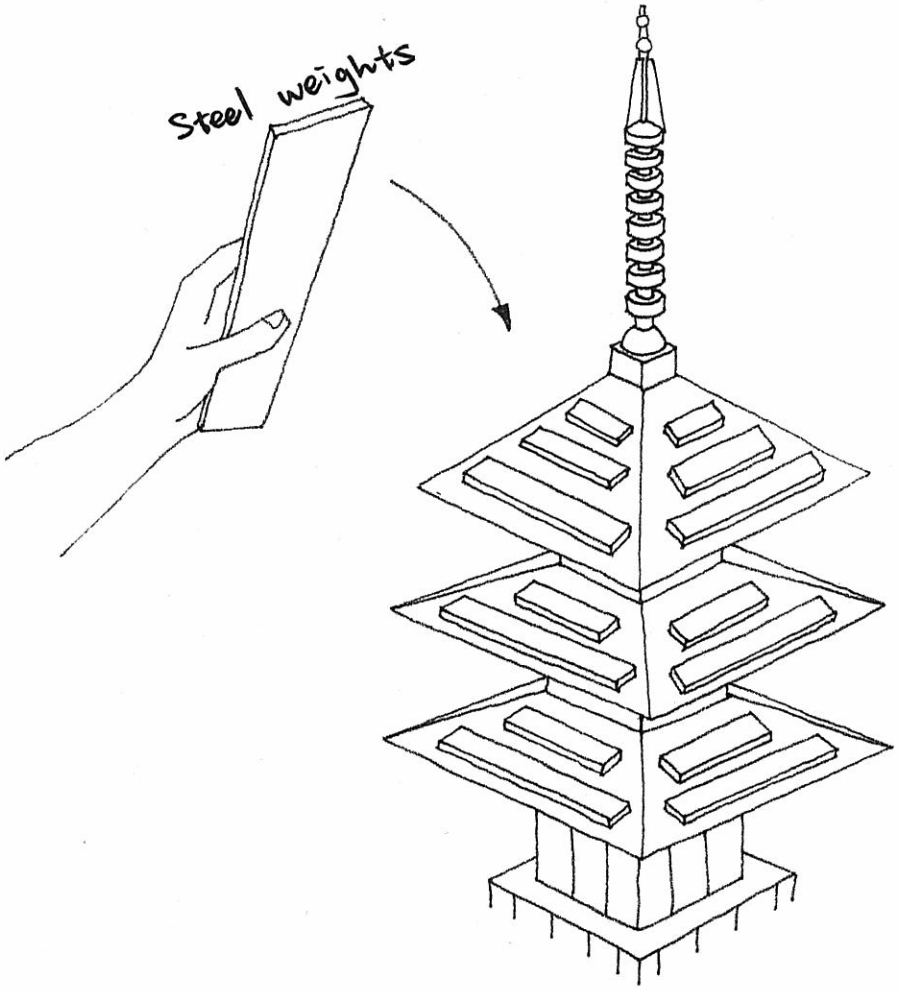
To know how pagodas act in an earthquake....



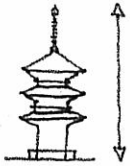
we don't make a real one,



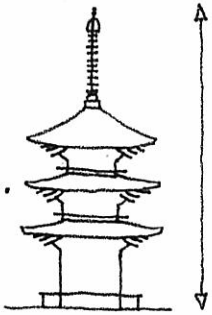
we make one 1/10 the size.



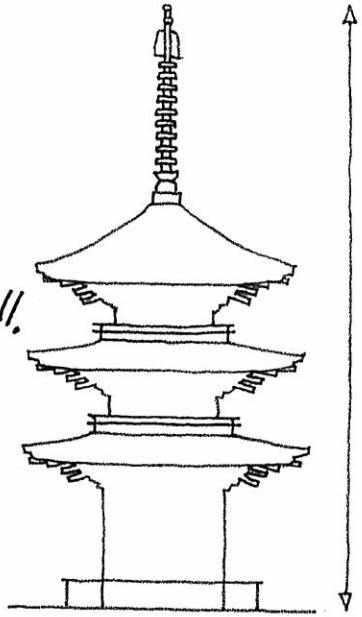
With no weight,
it acts like a pagoda 1.8m tall.



With 30kg,
it acts like a pagoda 5.4m tall.

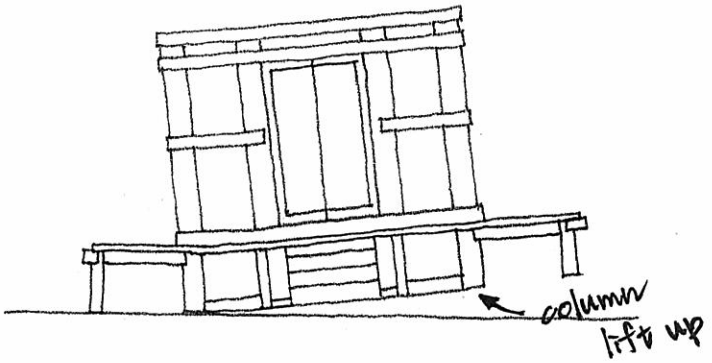


With 300kg,
it acts like a pagoda 18m tall.

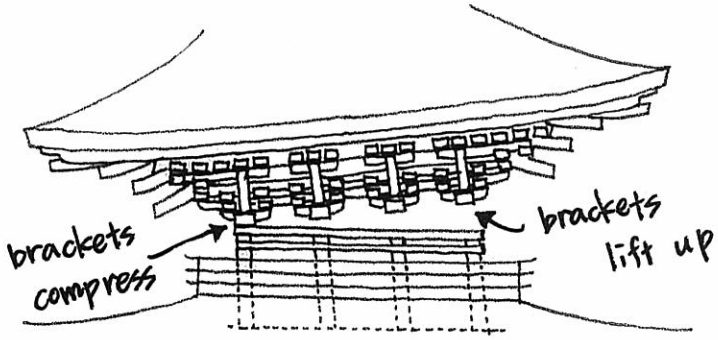


By using steel weights,

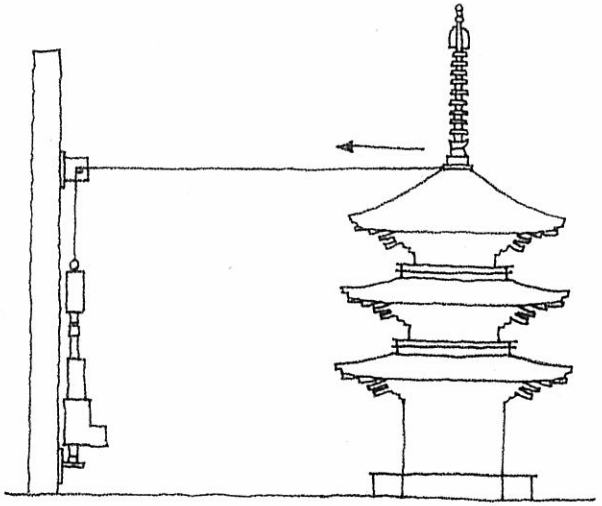
we can simulate a larger pagoda.



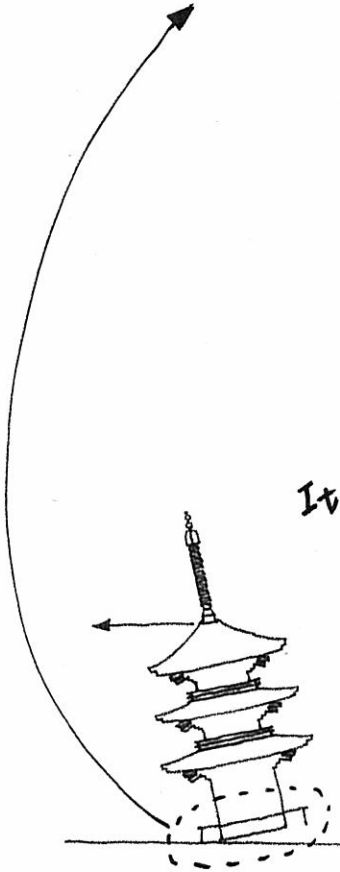
The bottom of the building lifts up.



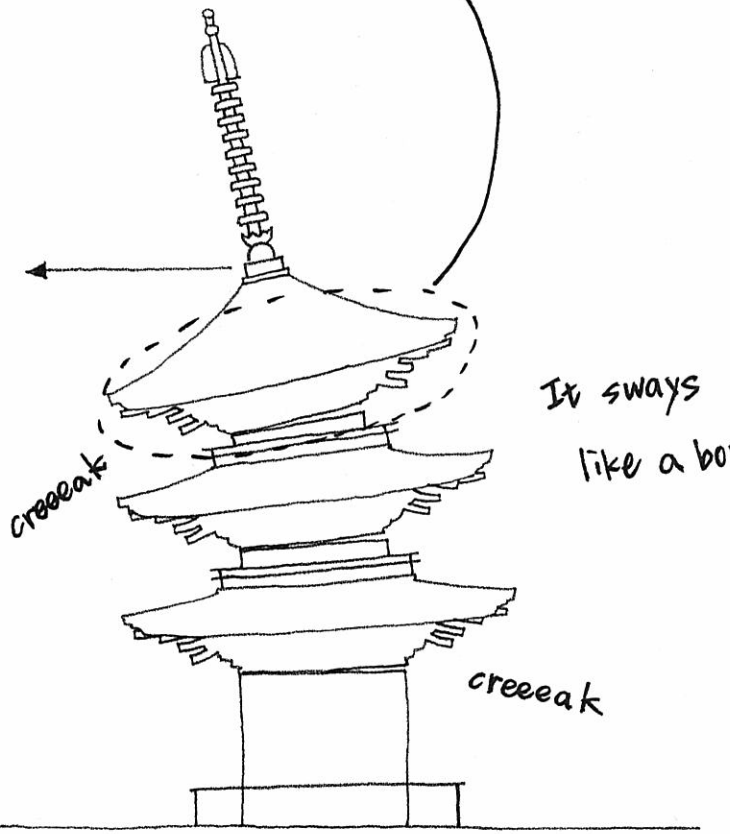
The roof deforms



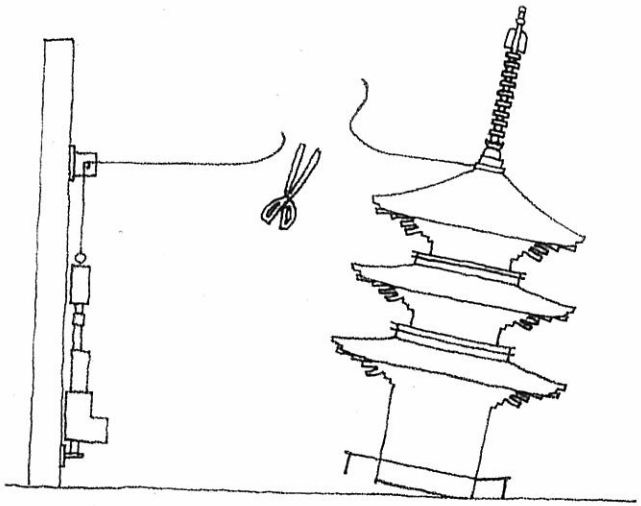
If we pull from the side .....



Small pagoda



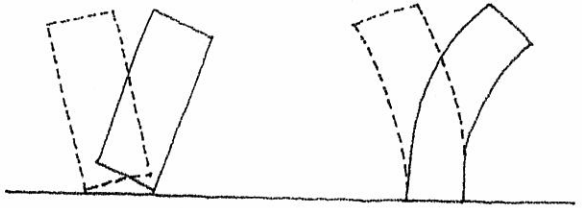
Large pagoda

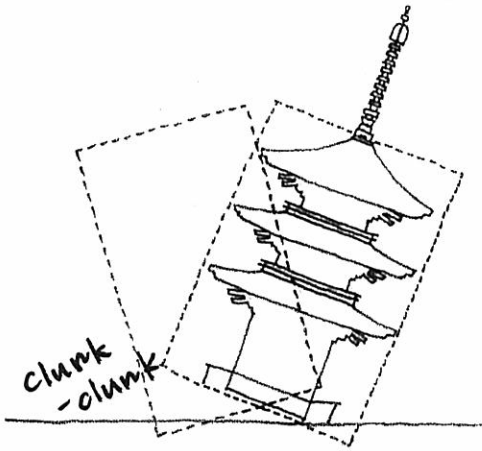


Next we cut the string....

It rocks
like a box.

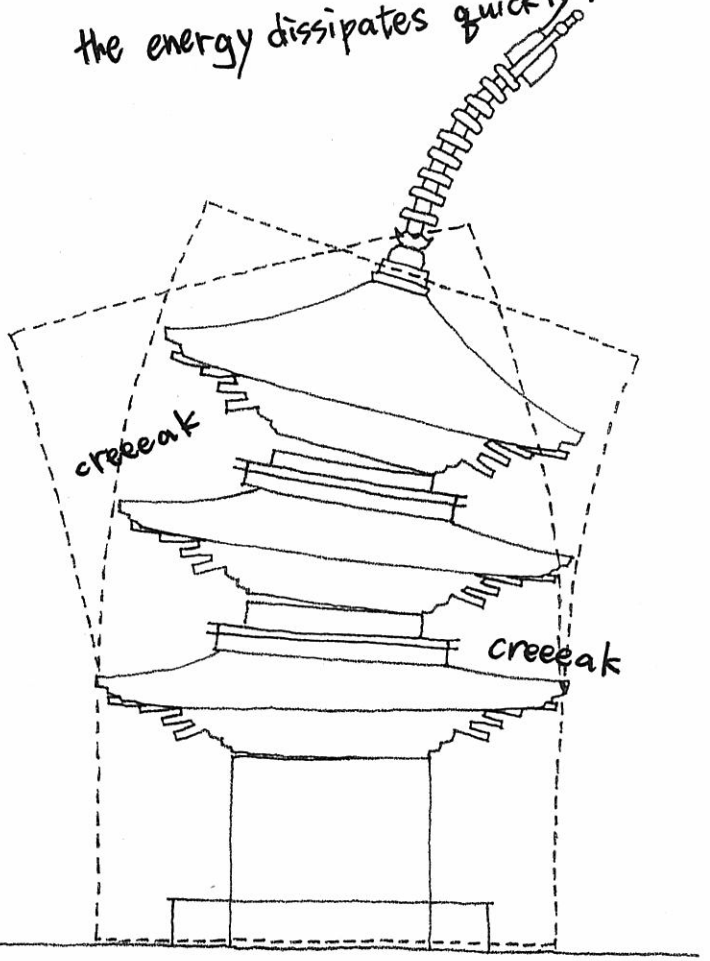
It sways
like a bow.





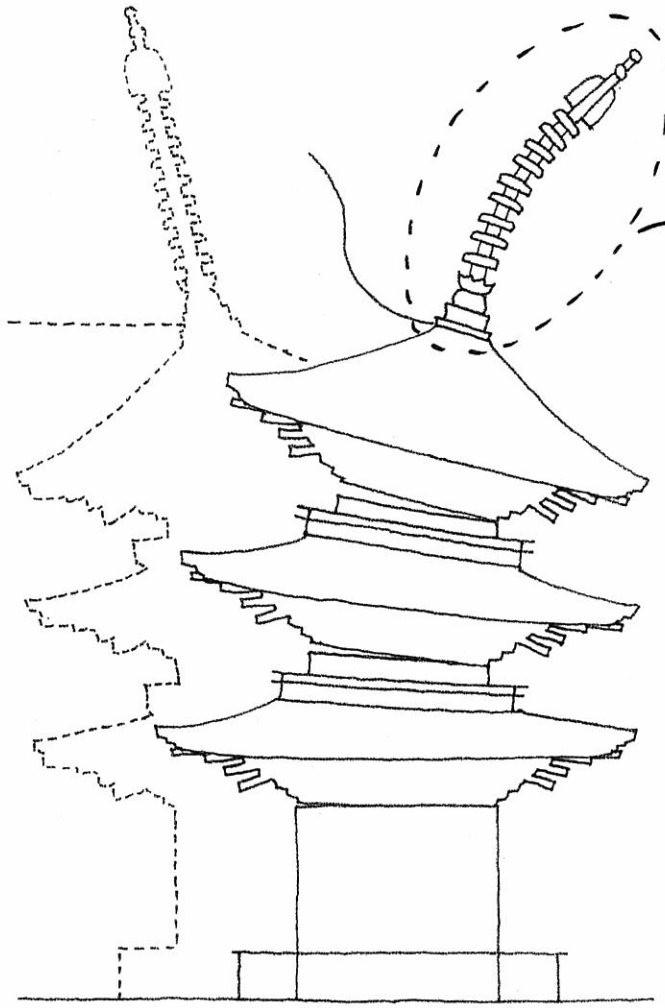
Small pagoda

In a large pagoda,
the energy dissipates quickly.



Large pagoda

Earthquake damage to the sorin.



When the sorin is heavy....

The sorin whips about.

This top part, called suien, breaks off.

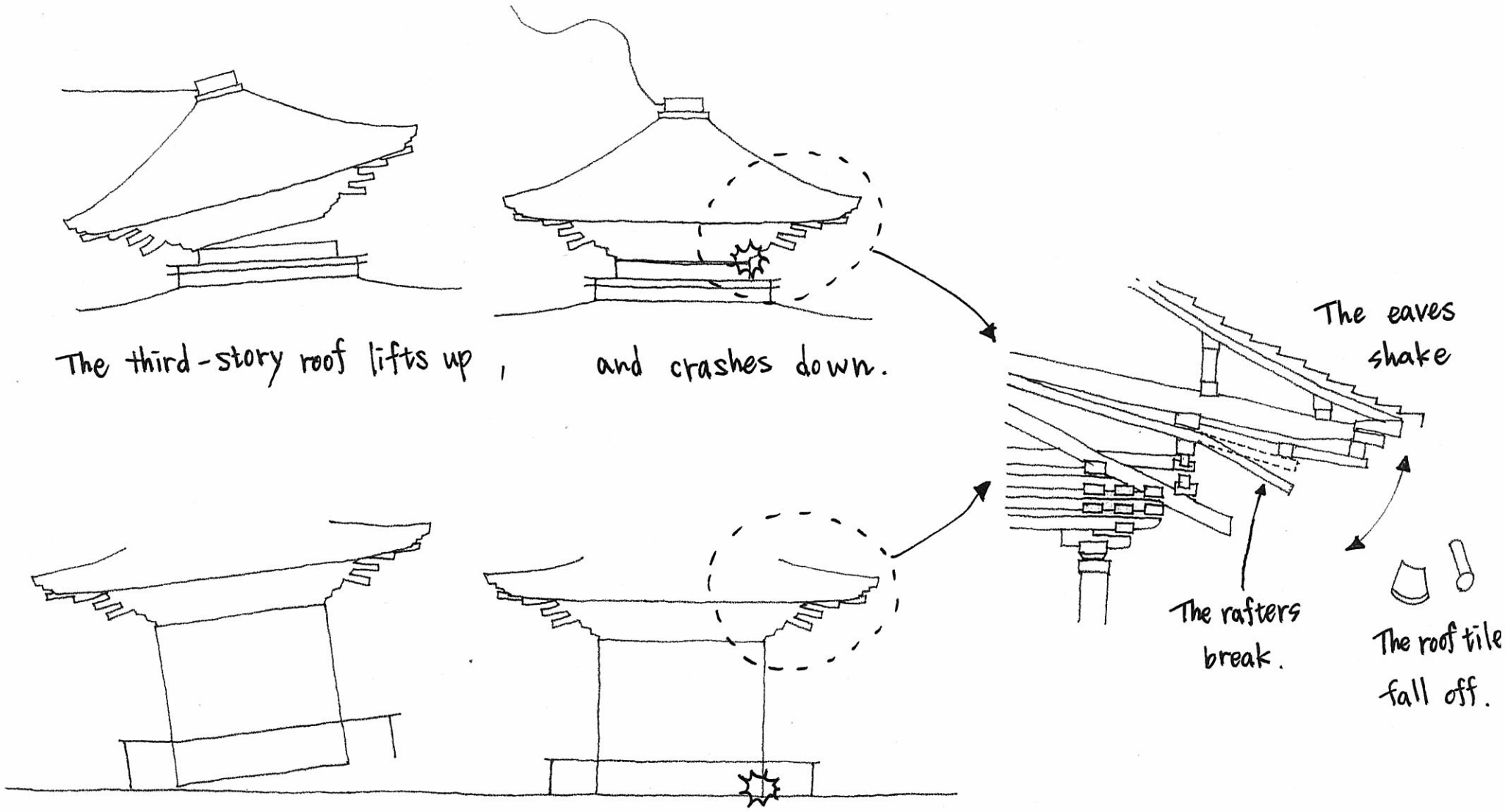
These decorations also break.

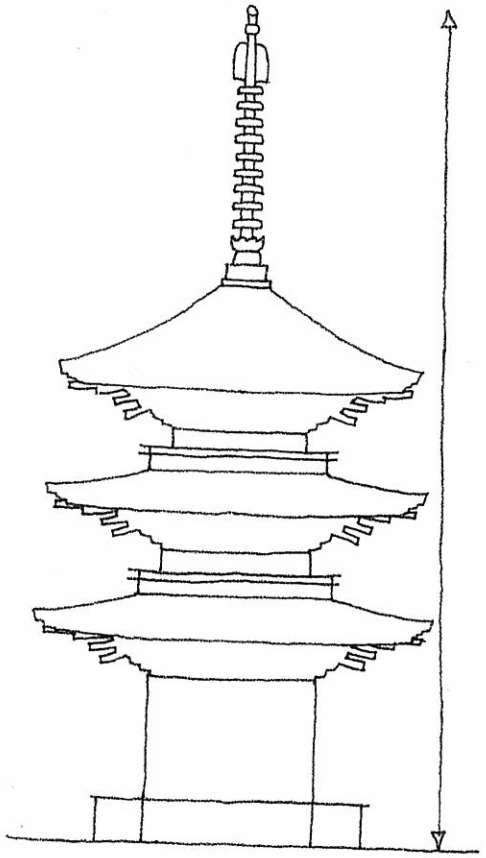
The shinbashira breaks at the base of sorin.

These ornaments also break.

The sorin sways like this in an earthquake.

Earthquake damage to the eaves





How to know if you will have damage....

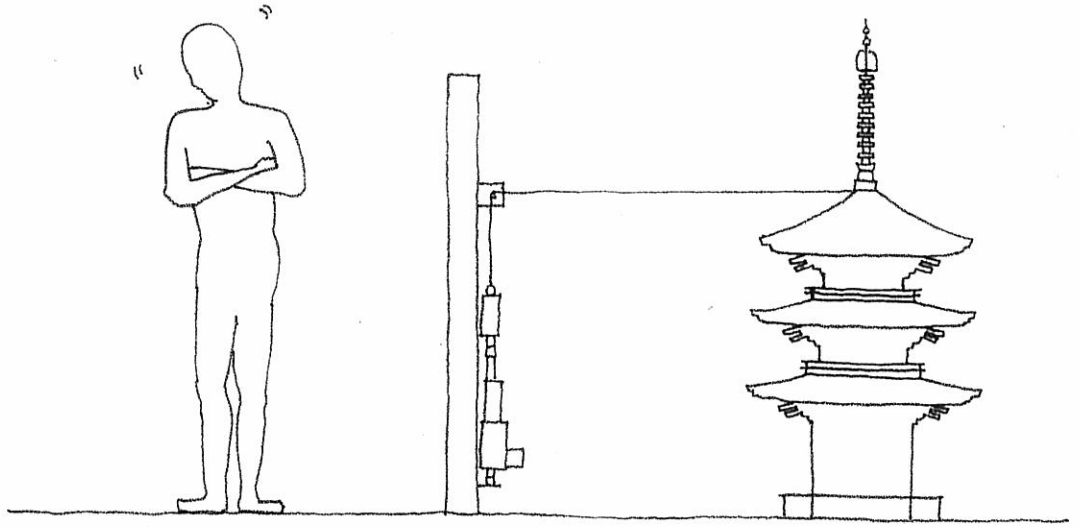
Key points:

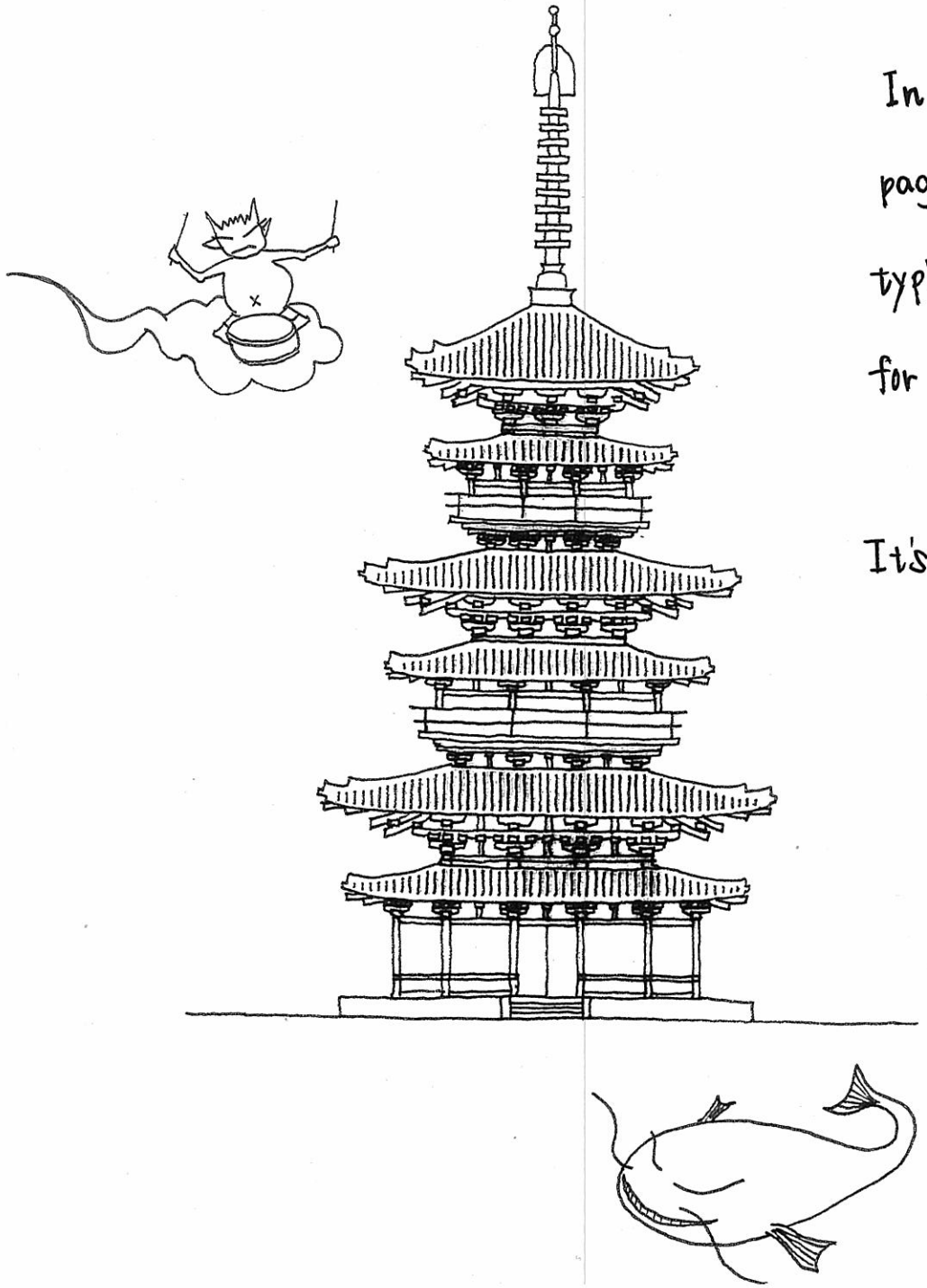
Ⓐ. The weight of the sorin.

Ⓑ. The size of the pagoda.

Ⓒ. Whether the roof can lift or not.

Ⓓ. Whether the base can lift or not

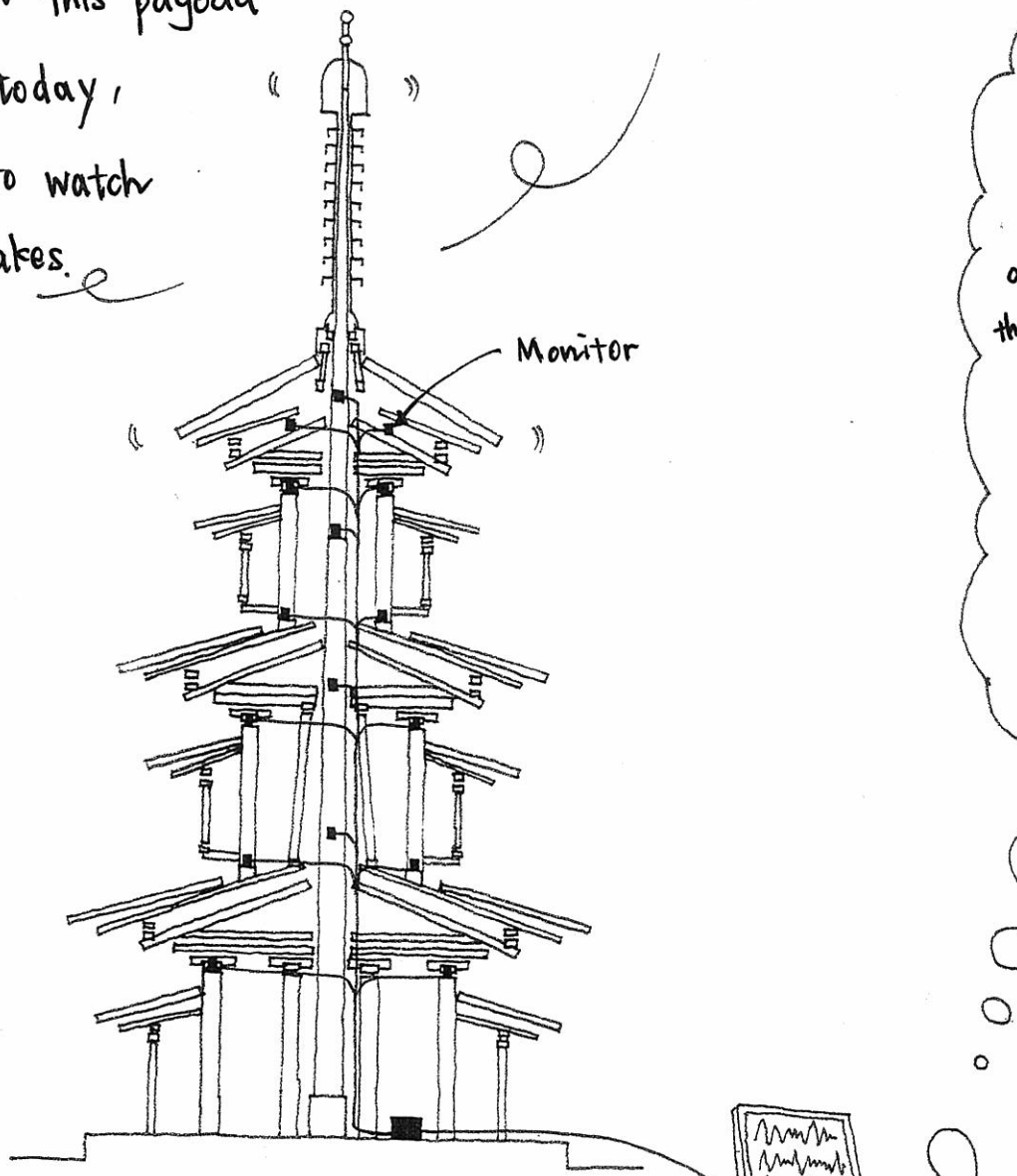




In Nara there is a three story pagoda which has withstood typhoons and earthquakes for 1300 years.

It's name is Yakushi-ji Touton.

To see how this pagoda is doing today, we went to watch how it shakes.

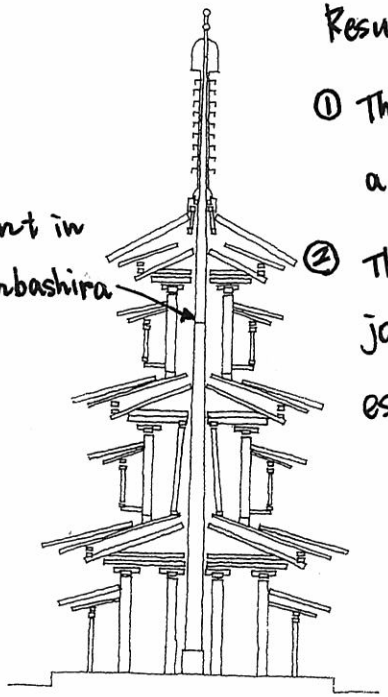


We observed how wind and earth movements moved the pagoda.

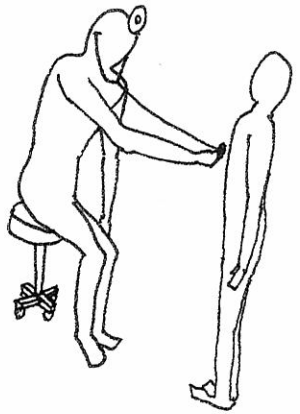
Results of observation

① The pagoda becomes a bit weaker.

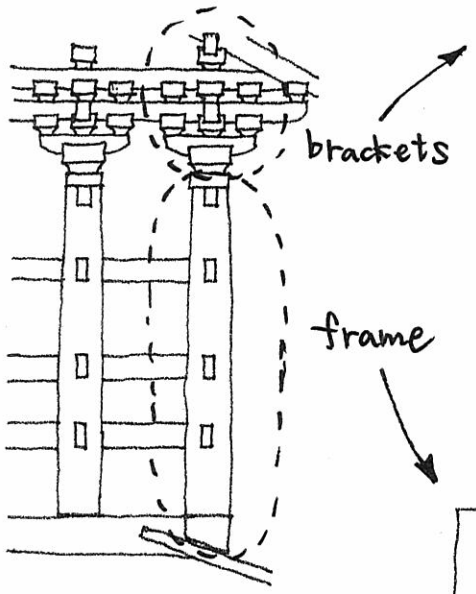
② The shinbashira's joint becomes especially weak.



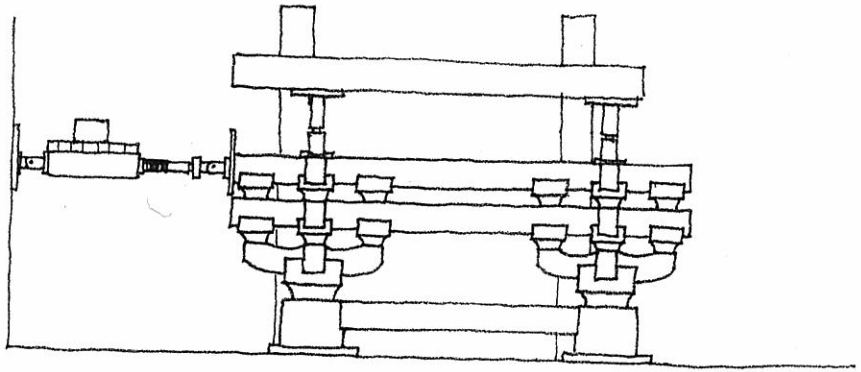
It like using a doctor's stethescope



To understand how the pagoda shakes in an earthquake,
we performed model tests and mathematic simulations.

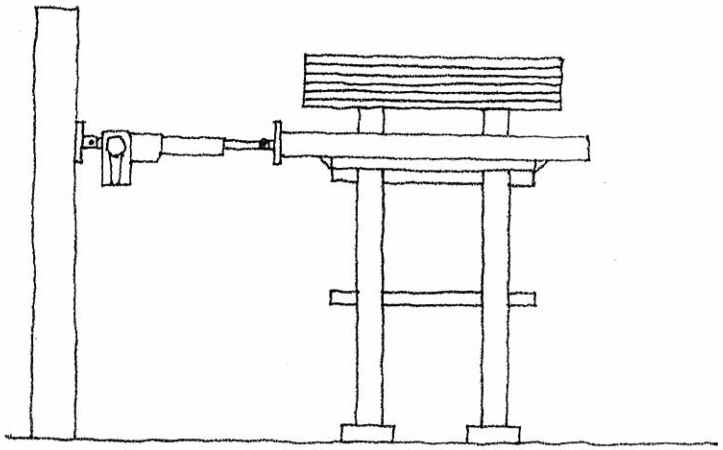


brackets



Loading test of model brackets.

frame

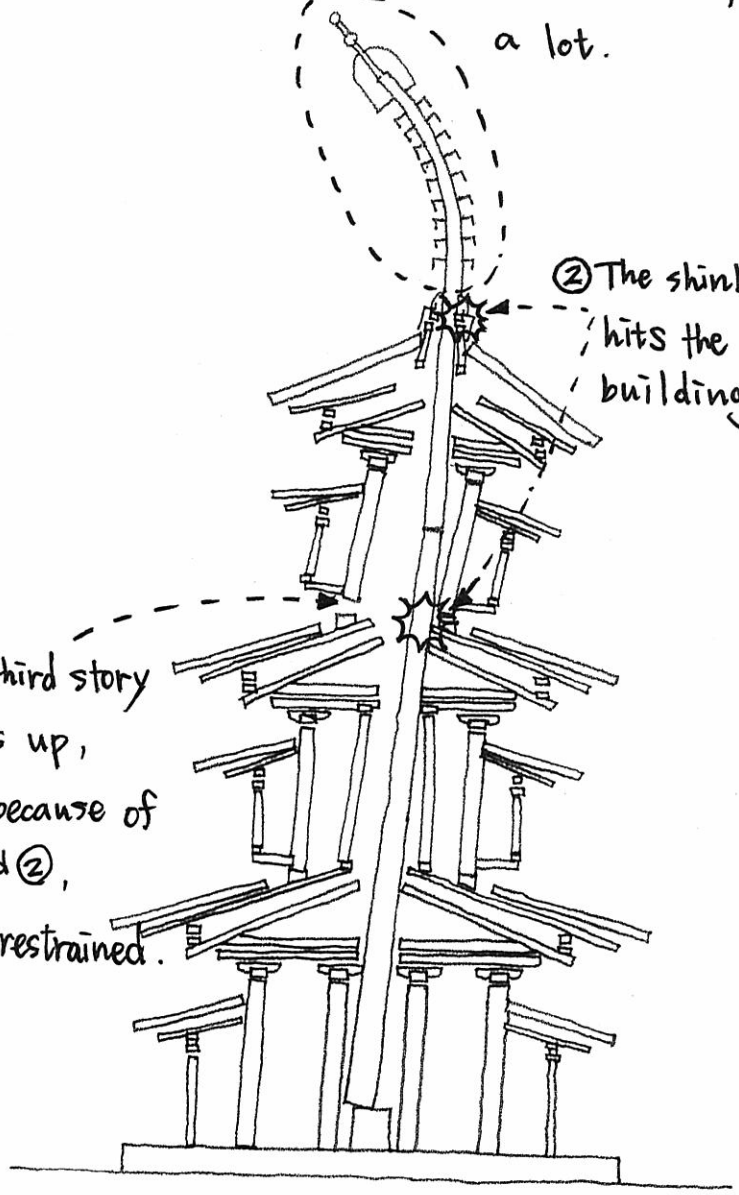


Loading test of model frame.

① The sorin sways a lot.

② The shinbashi hits the building.

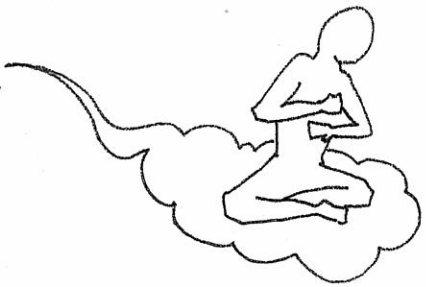
③ The third story lifts up, but because of ① and ②, it is restrained.

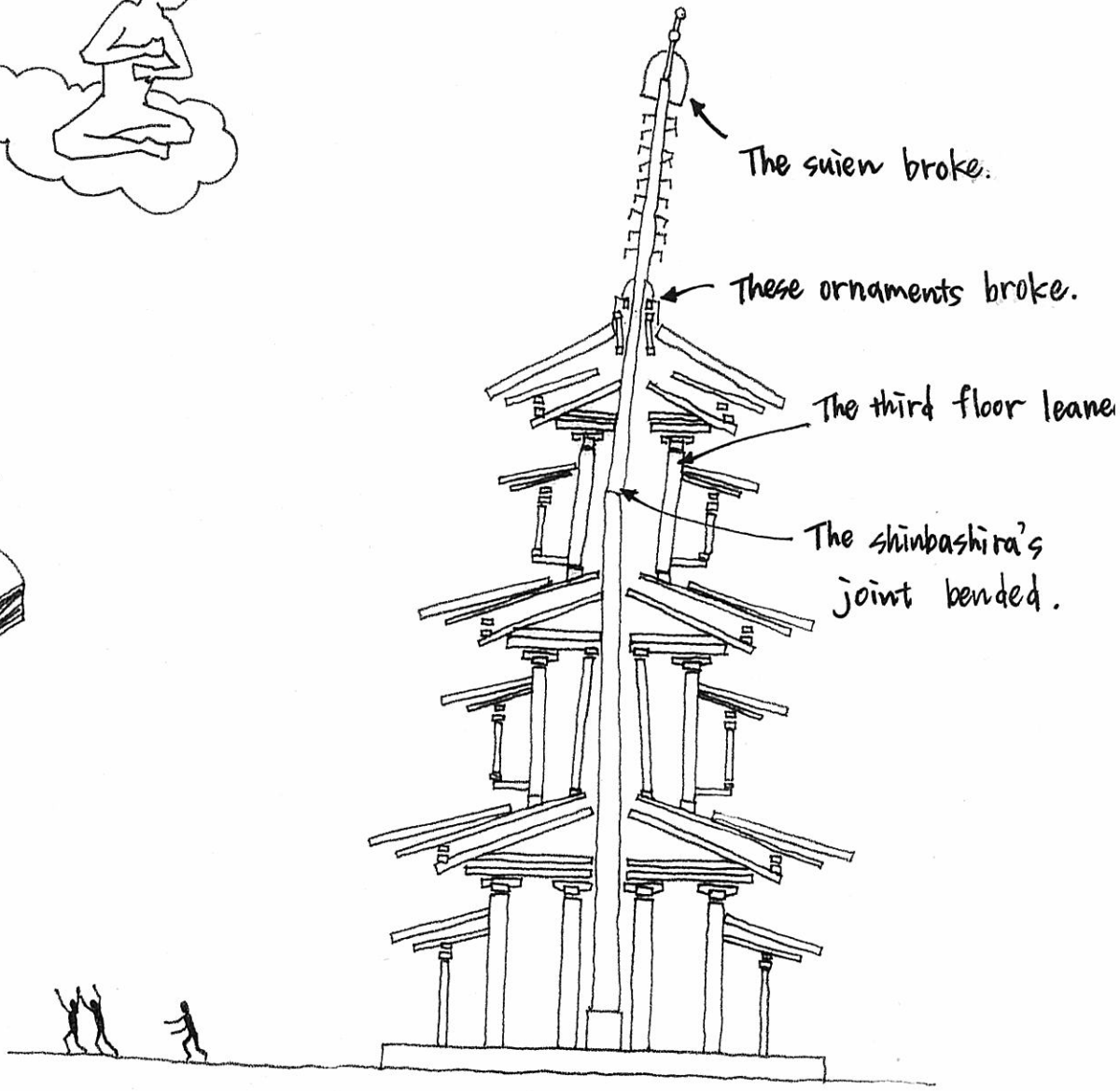


This is how it moves in an earthquke.

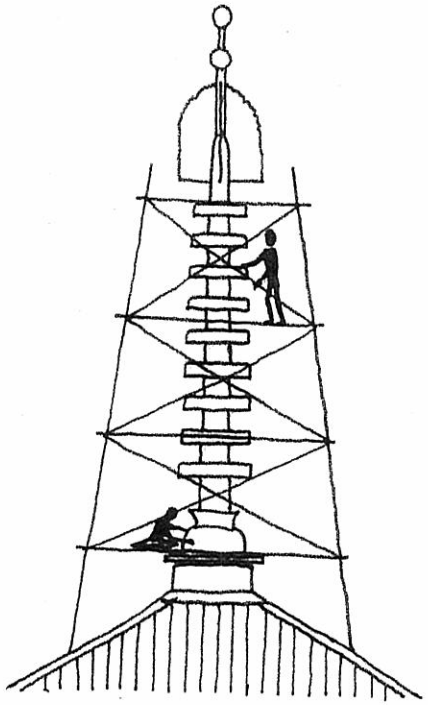
If we look at temple records of past earthquakes...

we can read about damage to Touton in 1854.

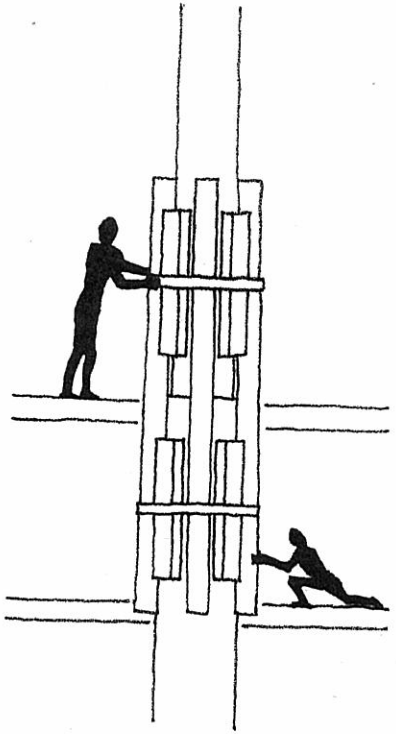




Damage to Touton



Repair of sorin



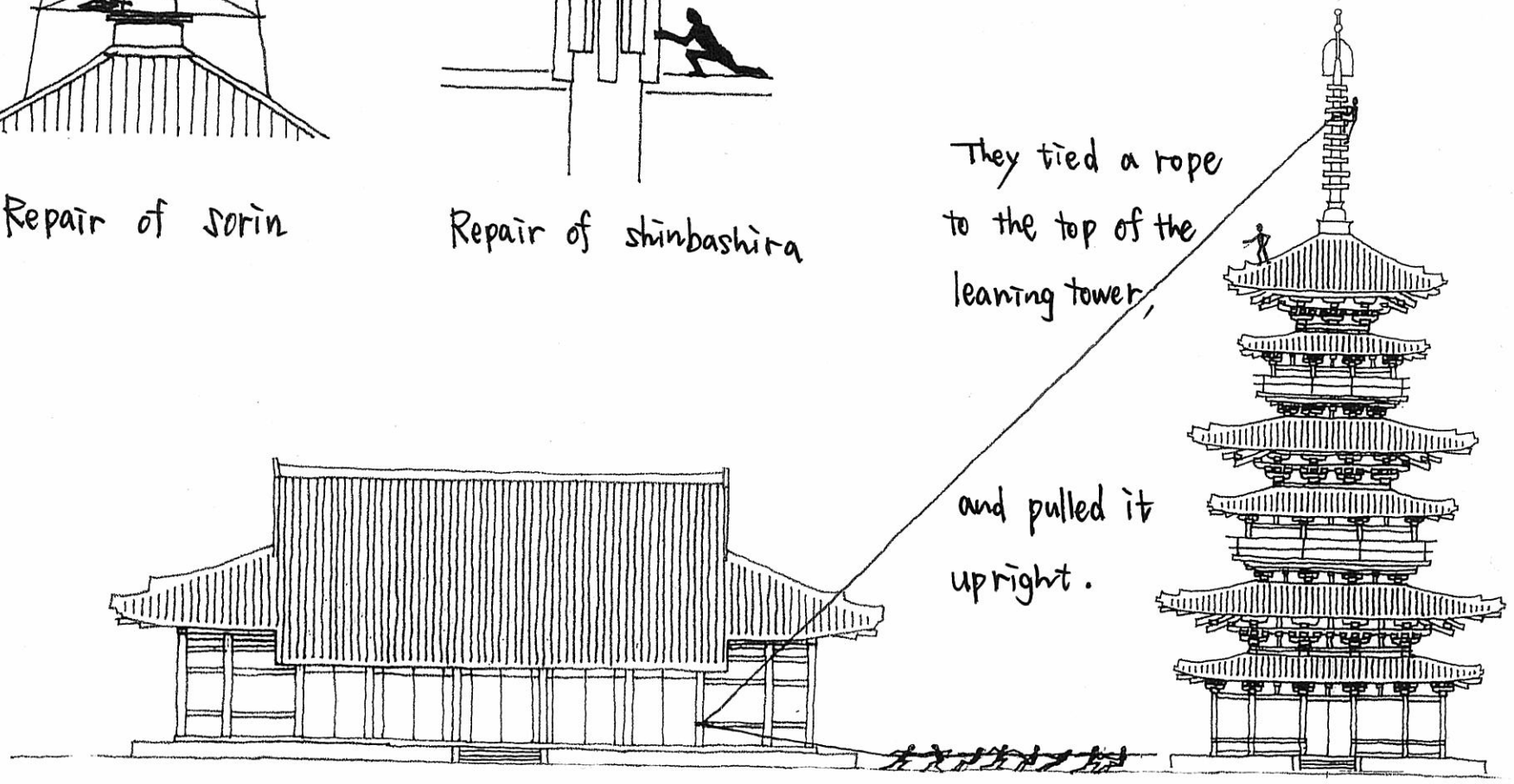
Repair of shinbashira

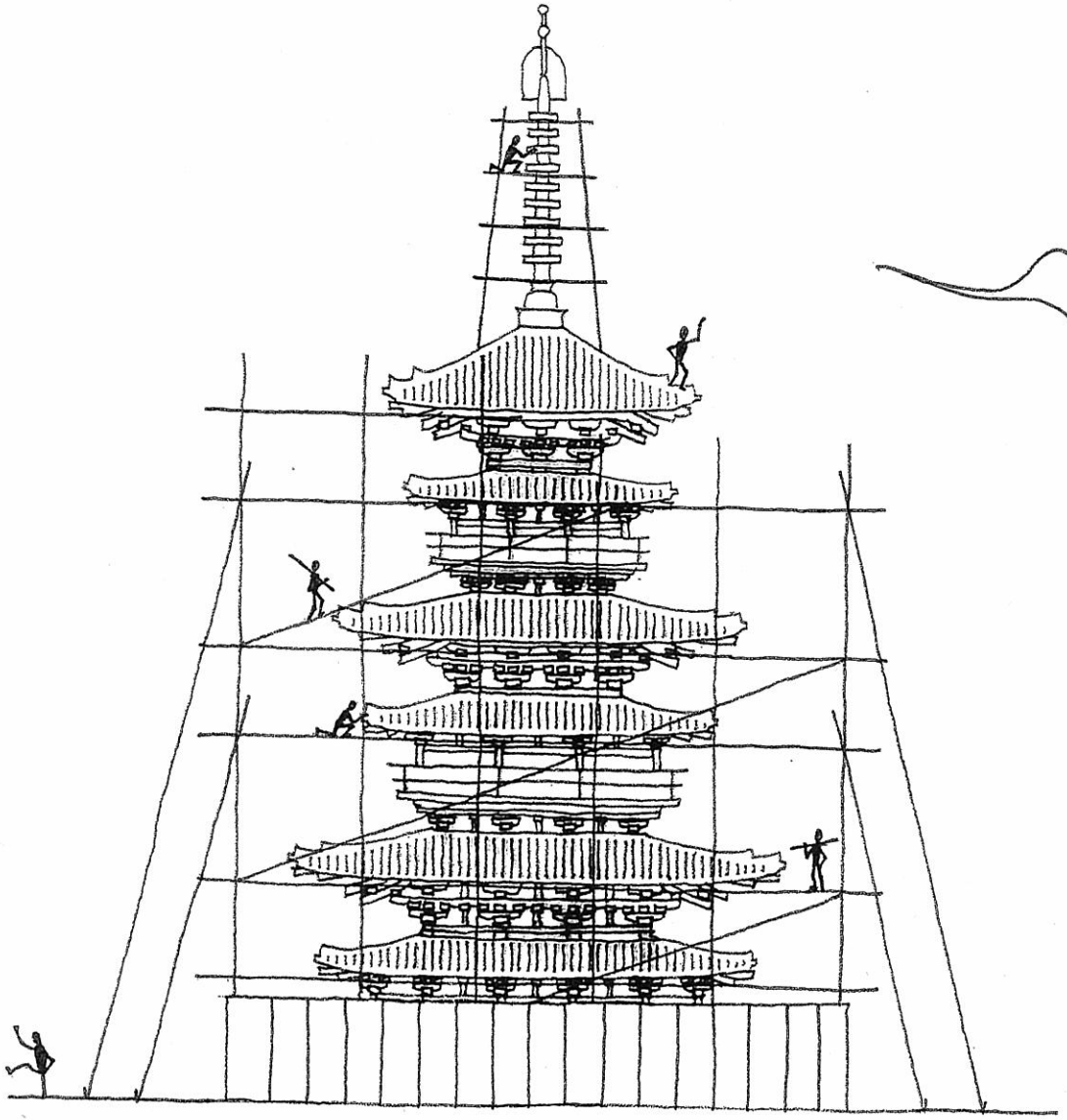
It is written in the temple diary that Toutou was repaired like this.

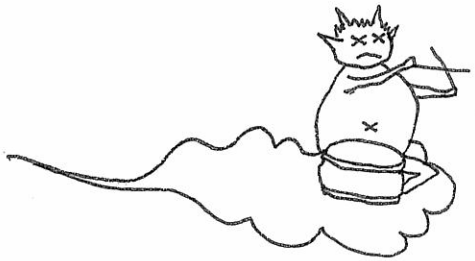
And so, it is still standing today.

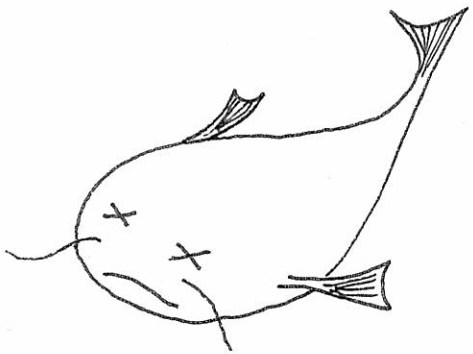
They tied a rope to the top of the leaning tower,

and pulled it upright.









In 2011, major repairs will begin.

Let's all help protect Toutou from now on.