How can we build more comfortable houses?

Outline

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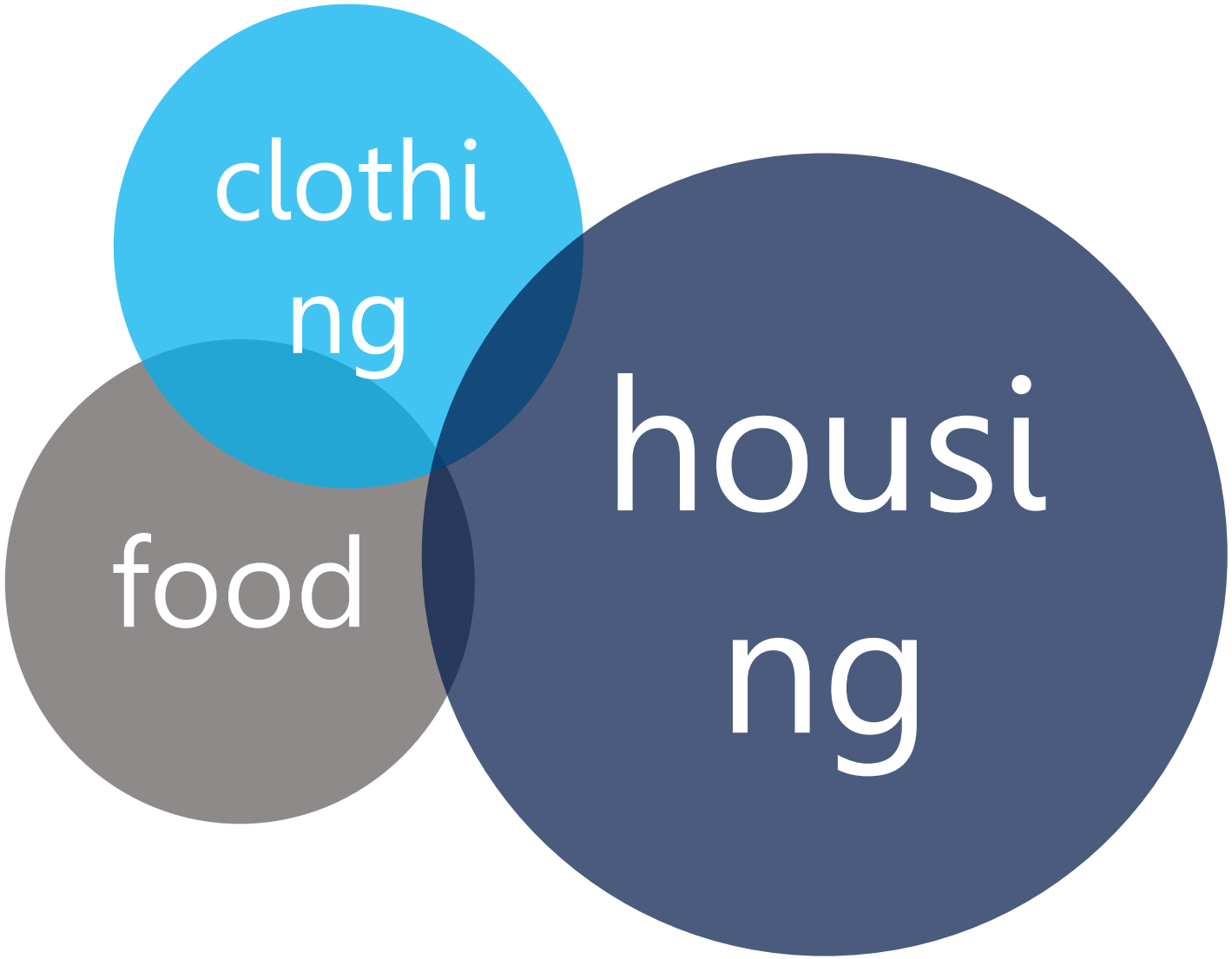
4. Consideration
5. References

Theme

Motivate



- structure
- **materials**
- design
- price

The trend of Japanese houses

WOODEN Japanese old houses

↓ After the wars

Many buildings are built with
REINFORCED CONCRETE structure

↓ These days

The number of companies which recommend
NATURAL MATERIALS is increasing

Natural materials

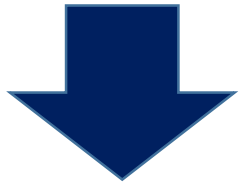
Wood
Diatomaceous earth
Japanese concrete

Artificial materials

Cement
Thermal barrier paint

All materials are NATURAL

WOODEN Japanese old houses



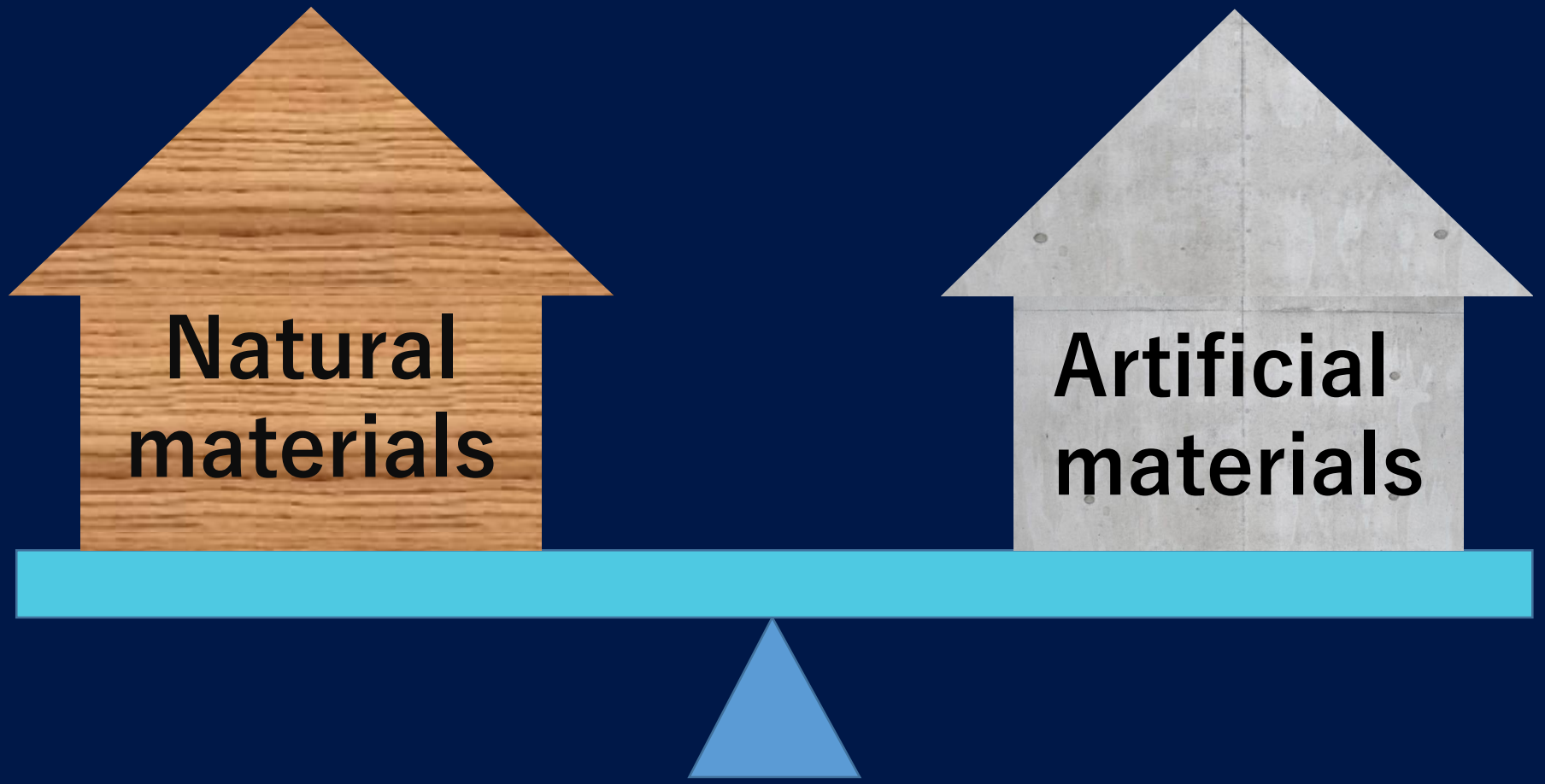
All materials are ARTIFICIAL

Many buildings are built with
REINFORCED CONCRETE structure

Almost all materials are NATURAL

The number of companies which recommend
NATURAL MATERIALS is increasing

Which is better??



Which is better, natural materials or artificial materials for Japanese houses?

Natural materials

VS

Artificial materials

Comfortable house ：The house with air temperature and humidity control

Preceding experiments

The experiments about comfort by companies and universities

(The control experiment using mice)

Experiment

NATURAL MATERIALS

wood

tataki
(Japanese concrete)

tiles

diatomaceous earth

ARTIFICIAL MATERIALS

concrete

thermal barrier paint

Artificial flooring

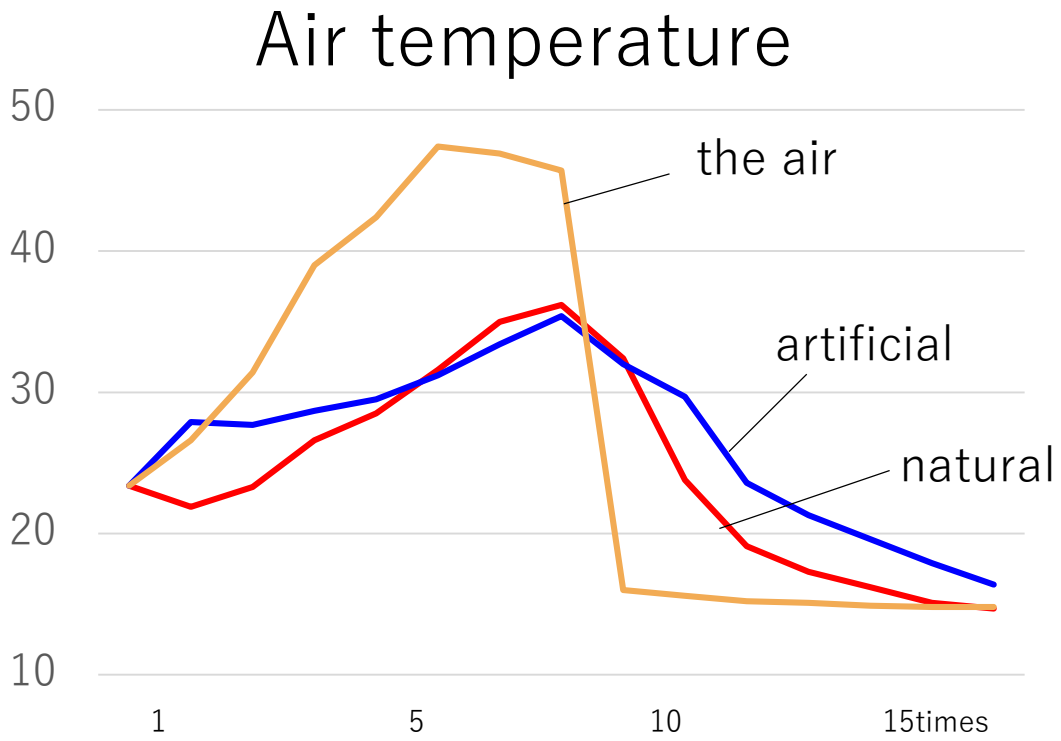
Experiment method

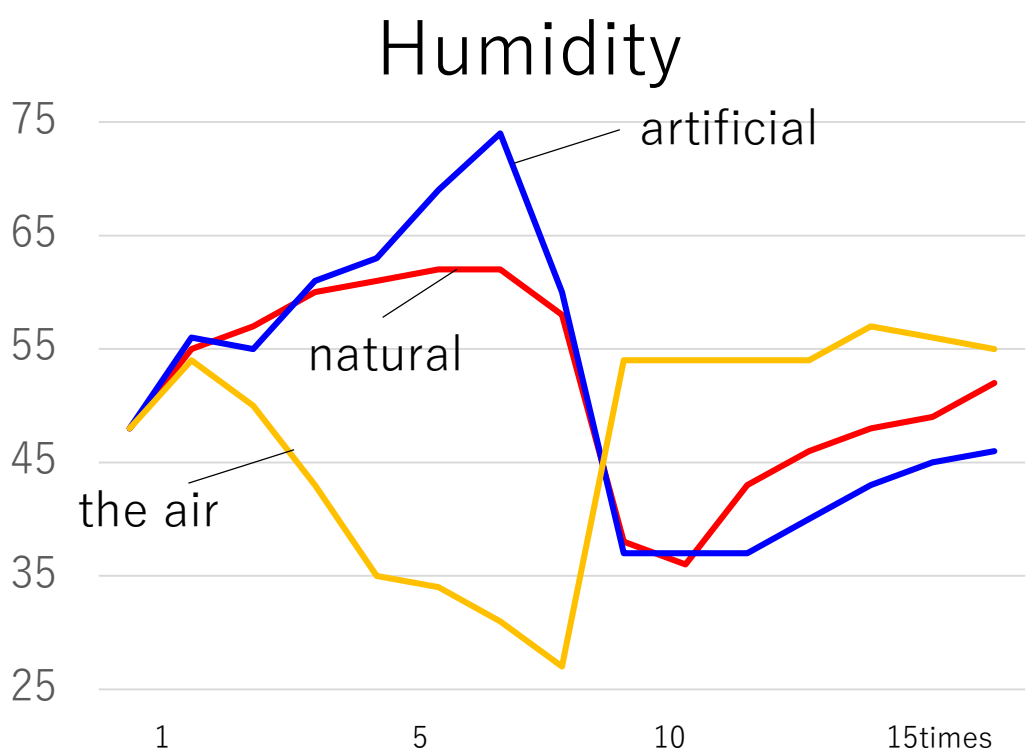
How the state in the models change with the heat and the cold ?

Heat for an hour

Cool down for an hour

Result



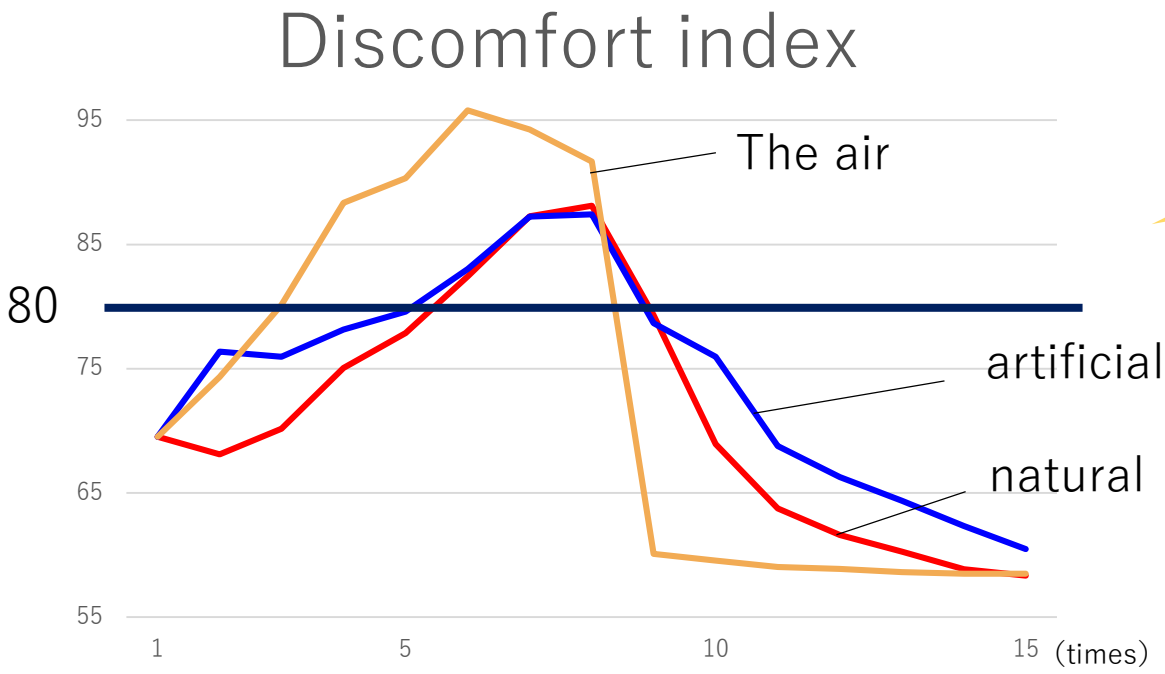


Comparing is tough!!➡

●Discomfort index

temp. : temperature , RH : humidity

$$0.81 \times \text{temp.} + 0.01 \times \text{RH} \times (0.01 \times \text{temp.} - 14.3) + 46.3$$



Discomfortable !!

The amount of change is small

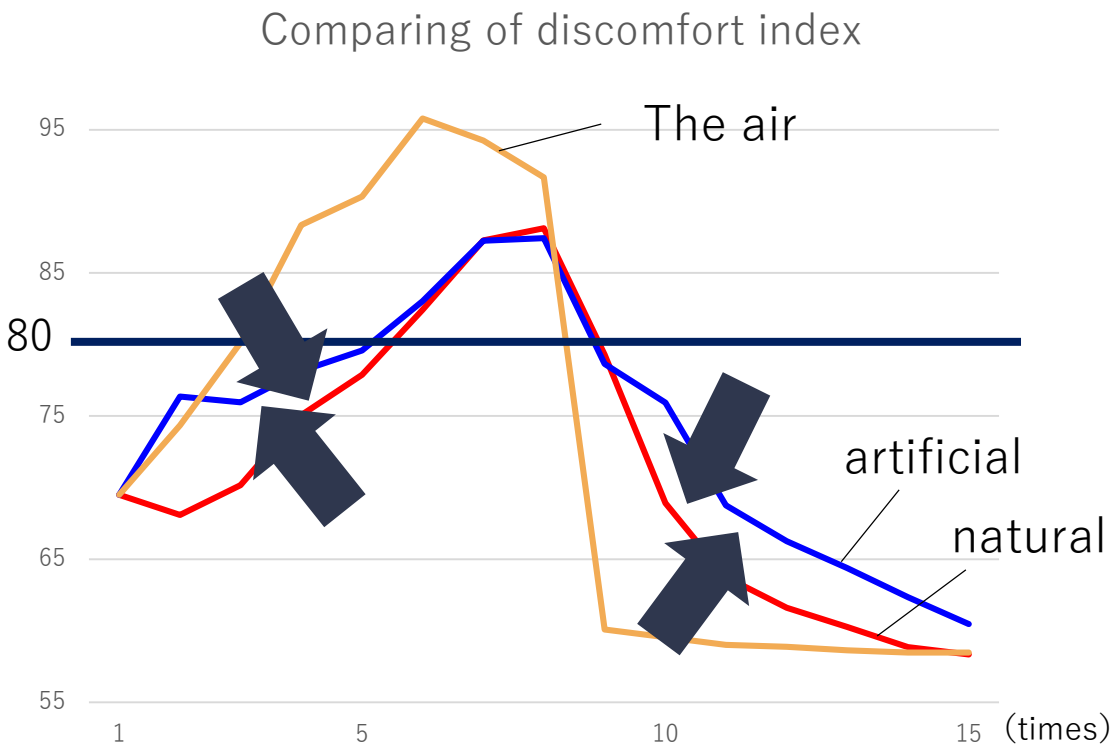
↓

The model hardly affected

↓

IT IS COMFORTABLE!

Consideration



●Natural materials

Hard to be hot and easy to be cold
⇒**Cool** in summer & **cold** in winter

●Artificial materials

Easy to be hot and hard to be cold
⇒**Hot** in summer & **warm** in winter

Natural materials suit Japanese climate

better than artificial materials.

Is the house which can't keep the warm in winter COMFORTABLE??

NO!!

Experiment 2

Procedure

①Find necessary conditions to suppress the cold

②Make an improved model

③Get the index of the new model

④Compare the indexes of a new model and an old one

① Control experiments

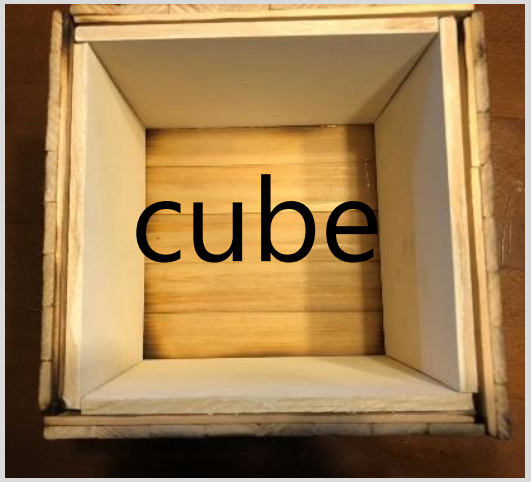
- Structure
- Roofing materials
- Size of veranda

➡ Suppress the cold

Improved model

Triangle

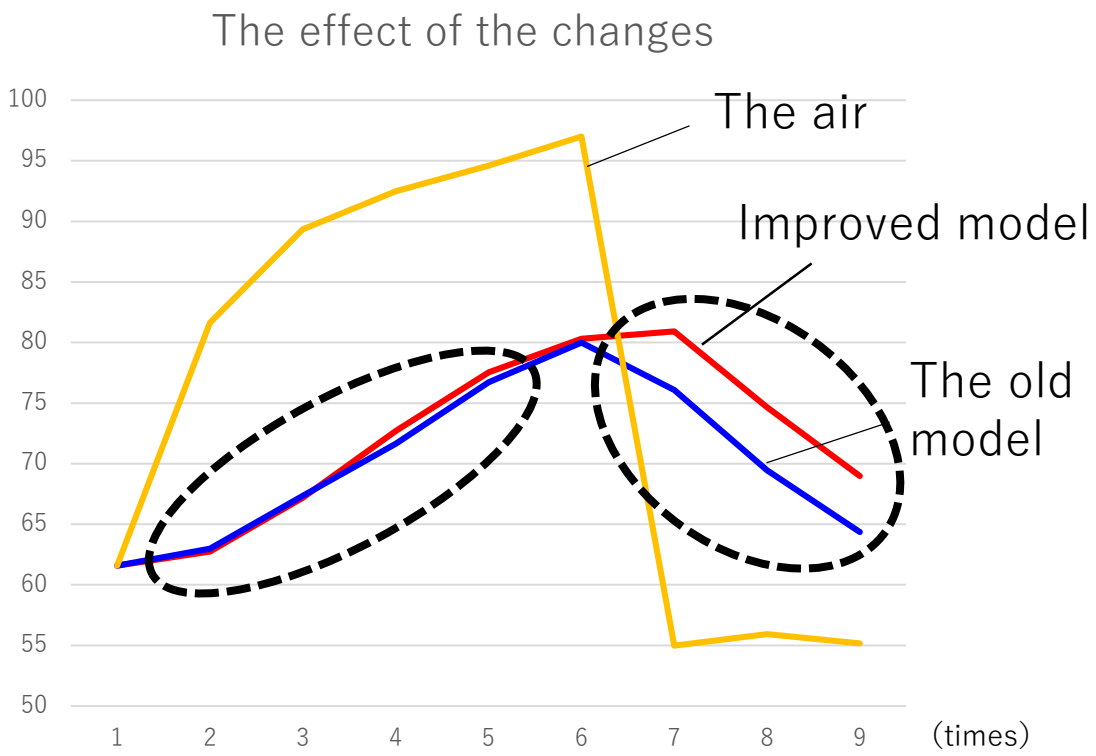
↓



Tiles

↓

Comparing a new model and an old model



■against the heat

Almost no difference

■against the cold

The new model suppressed the cold inside

Consideration

Consideration①

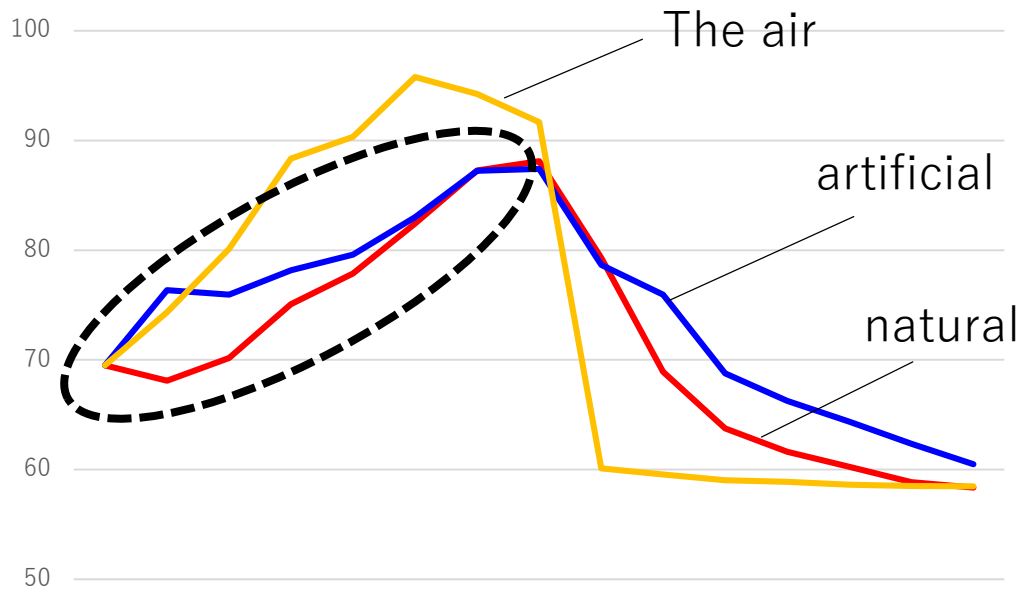
◎Natural materials suit Japanese climate better

➡It have been originally used in Japan.

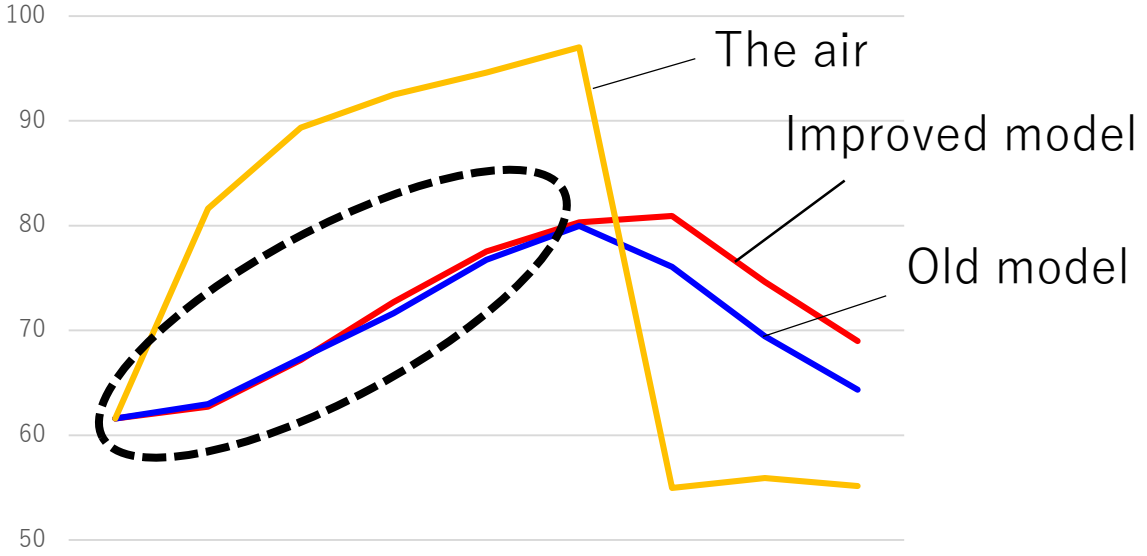
Consideration②

◎ Against the heat

1. Materials are not same



2.Structure are not same



The effect of materials > The effect of structure

Consideration③

◎Against the cold

By devising the structure, it became difficult for the temperature inside to drop.

➡The cold can be blocked by **the ingenuity of houses.**

https://www.pinterest.ch/pin/388013324119966608/

Throughout this research

The result depends on the perspective and conditions

=It’s hard to decide which is better

The house makers are **focusing on environment**

+

The result

Houses made of natural materials will become mainstream again.

References

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Thank you for your listening

Strength

Are natural materials weak?

○Earthquakes

- Only houses made of wood were left at the time of earthquake in Kumamoto.

- The weight of concrete is 2.5~8.0 times heavier than wood.

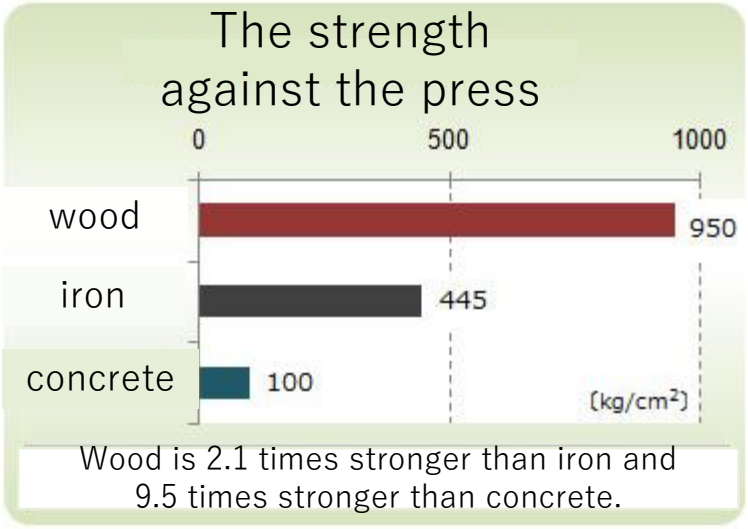
⇒Wood are lighter than sediment

○Fire

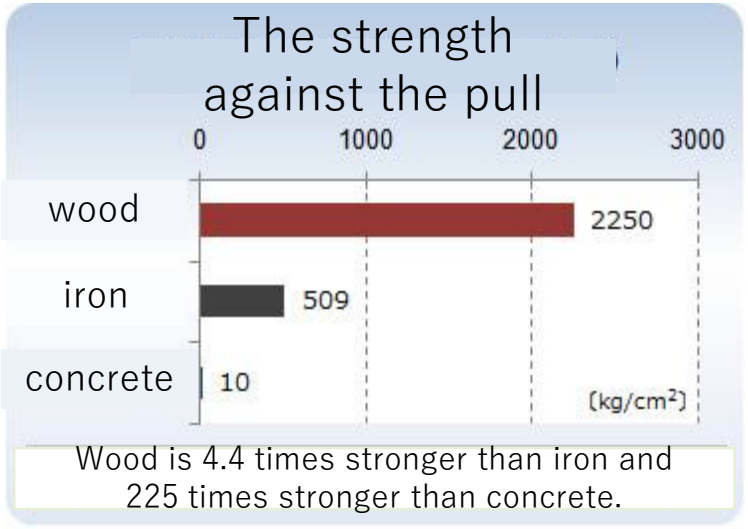
- It's hard to burn inside.
- Contain water

Wood becomes stronger with burning.

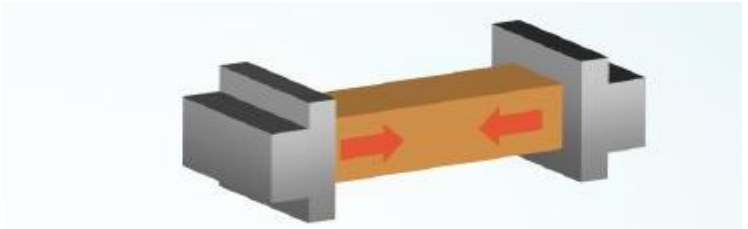
○The original strength

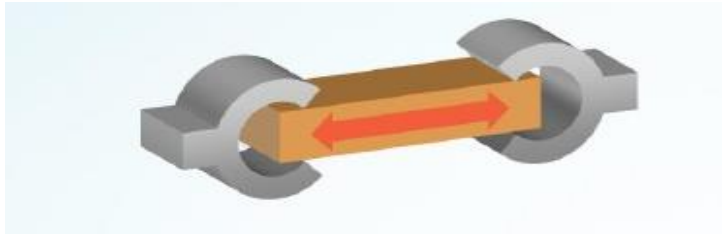


Wood is 2.1 times stronger than iron and
9.5 times stronger than concrete.



Wood is 4.4 times stronger than iron and
225 times stronger than concrete.





Wood is
not weak

Environment

The material more ecofriendly is…

natural materials !

Wood should be used for the interior !

Decreasing the amount of wood used for the building will connect to environmental conservation.

Fell trees

↓

Periodic thinning is promoted.