Analysis of Heat and Moisture Transfer in a Center-Bored Timber whose Outer Surface is Sealed

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Contents

Introduction

Introduction

large cross-section timber

Using as a structural member

for Post & beam construction

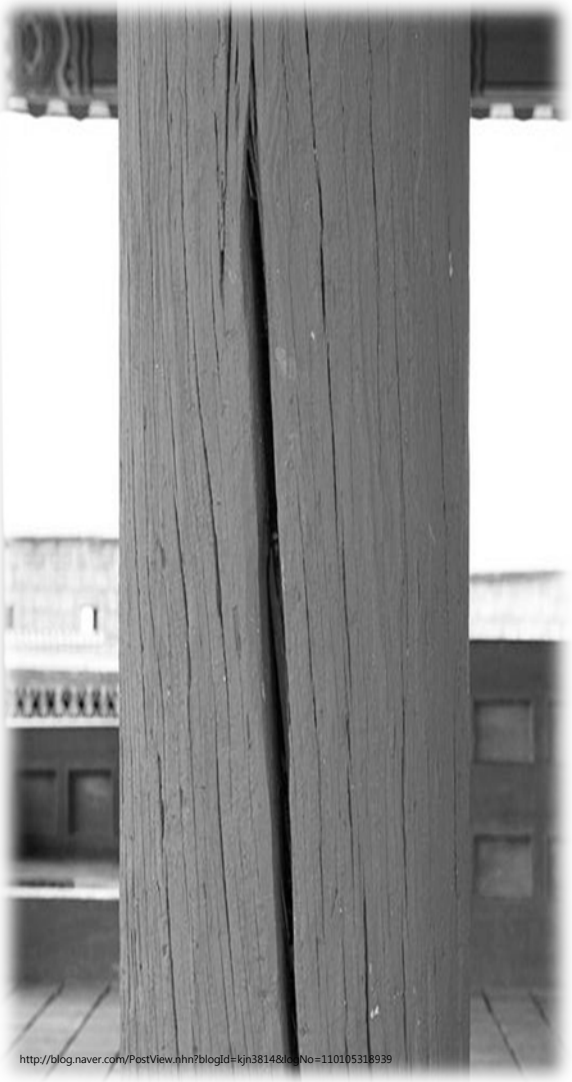
Introduction

- Drying large cross section timber

Occurrence of drying defects

Especially surface check

Forest Products Lab.1988

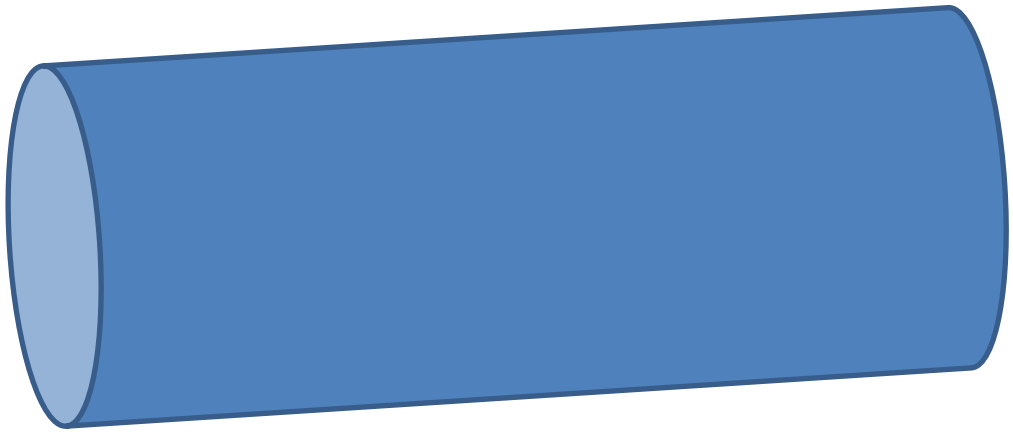


http://blog.naver.com/PostView.nhn?blogId=kjn38148&logNo=110105318939

Introduction

Manufacture of center-bored timber

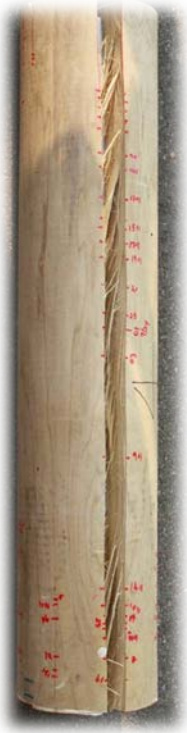
The way to reduce drying defects of large cross section timber during drying



To drill a hole
along the central longitudinal axis

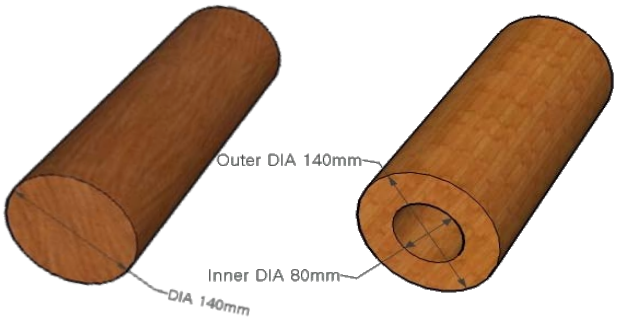
Introduction

Comparison of drying time



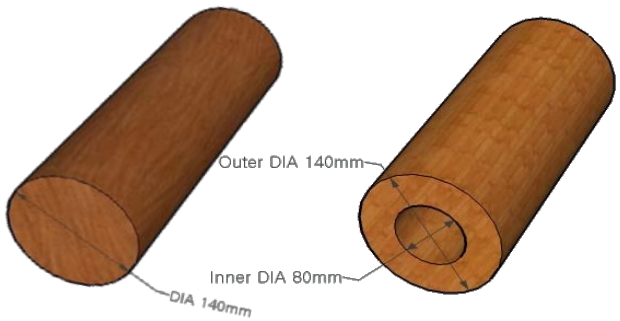
Air drying

Round wood	Center-bored wood
12months	3months



Kiln drying

Round wood	Center-bored wood
10days	2days



Introduction

Merits of center-bored timber drying

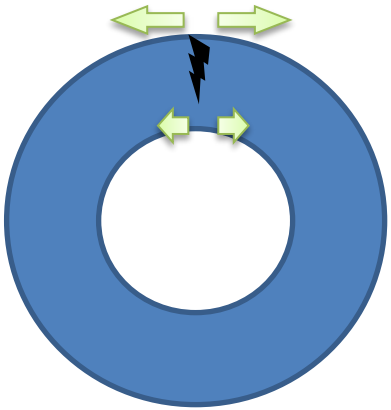
- Less strength reduction
- Restraint of drying defect
- Uniformity of mechanical property
- **Lightening the weight** : convenient to transportation & construction
- **Increment of drying rate**
- **Reduction of energy consumption**
- Uniformity of internal moisture content

Introduction

Sealed center-bored timber

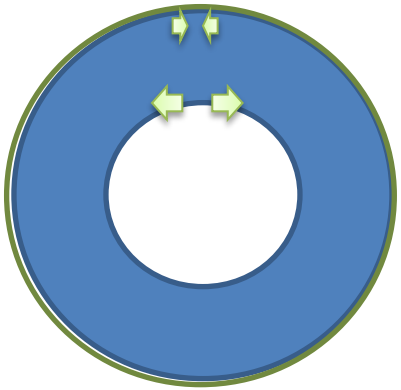
Center-bored timber
(control wood)

occurring
surface check !



Sealed center-bored timber
(Sealing wood)

reducing drying stress
of outer surface



Sealing the outer surface of wood

Water emission occurs just only on the inner surface (not on the outer surface)

Enhancing drying rate with applying high temperature drying

Introduction

Sealed center-bored timber

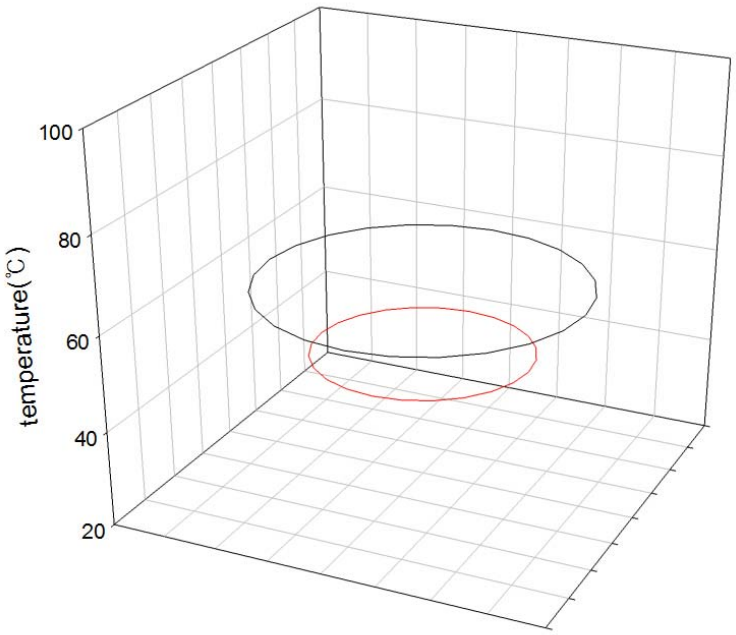
Center-bored & (outer) surface- sealed Timber Drying technology was firstly proposed and has been developed by professor Yeo's team of Seoul National University.

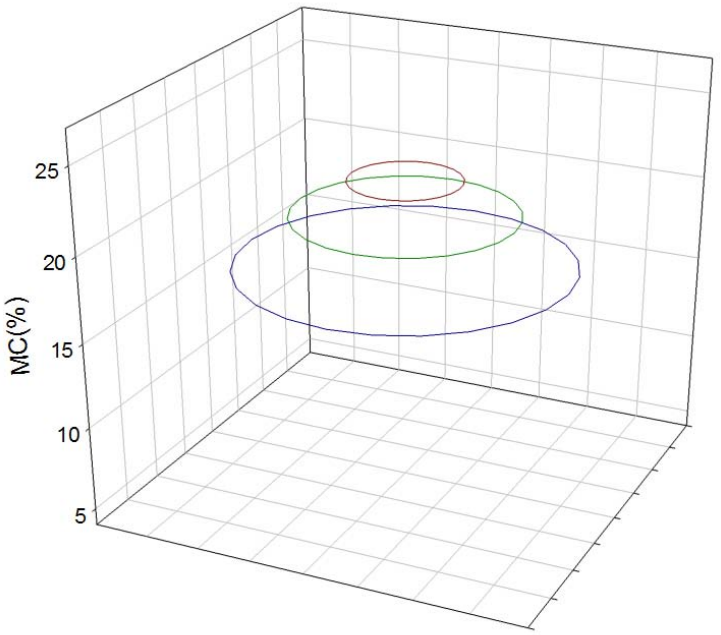
We have reported documents and acquired patents related to this method.

Materials & Methods

Materials & Methods

Analyzing temperature and MC change in woods

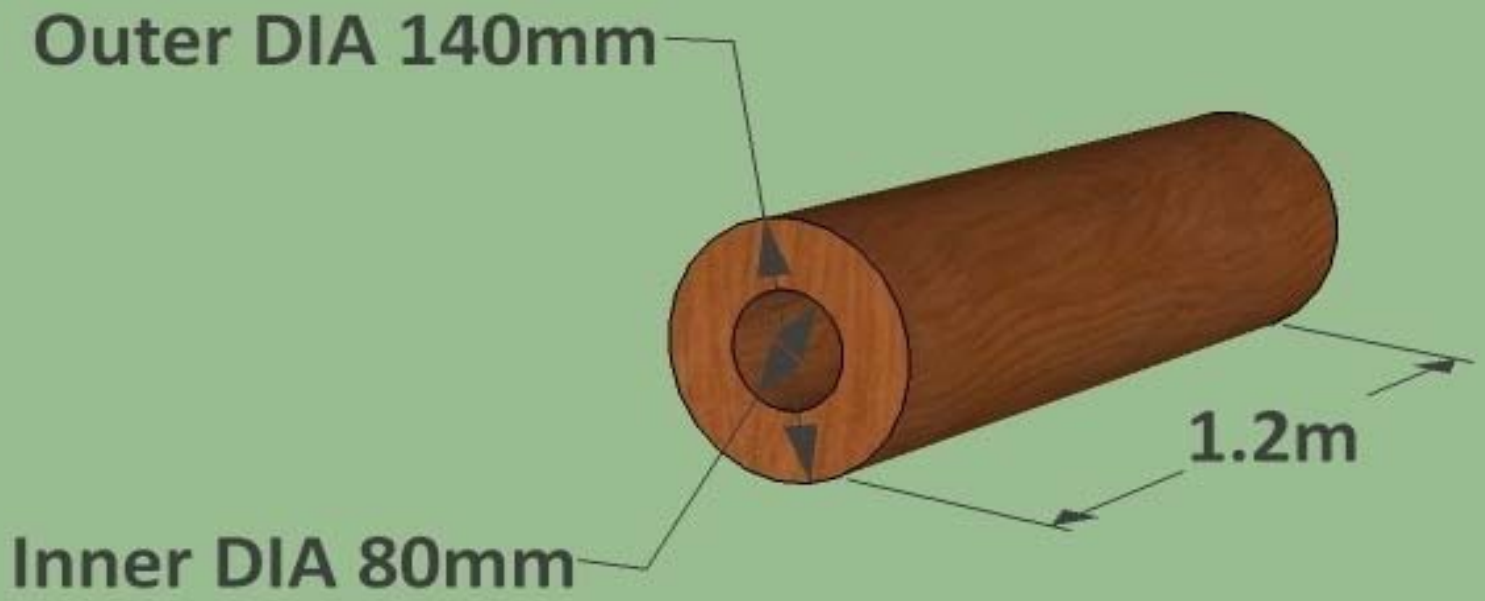




Controlling the drying time and energy

Materials & Methods

center-bored (Pitch pine) timber



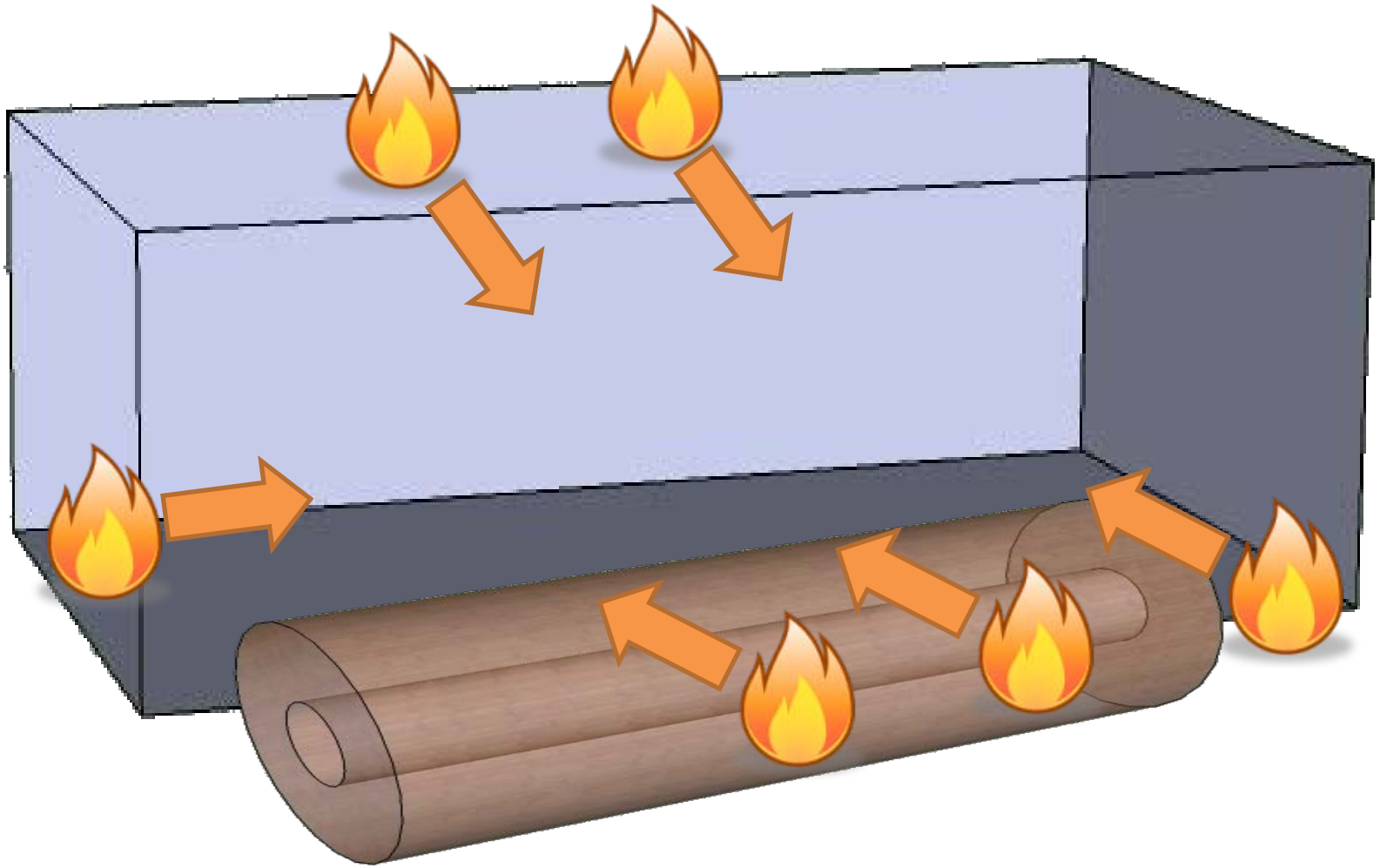
Initial MC : about 30%

Materials & Methods

Dry Kiln

Materials & Methods

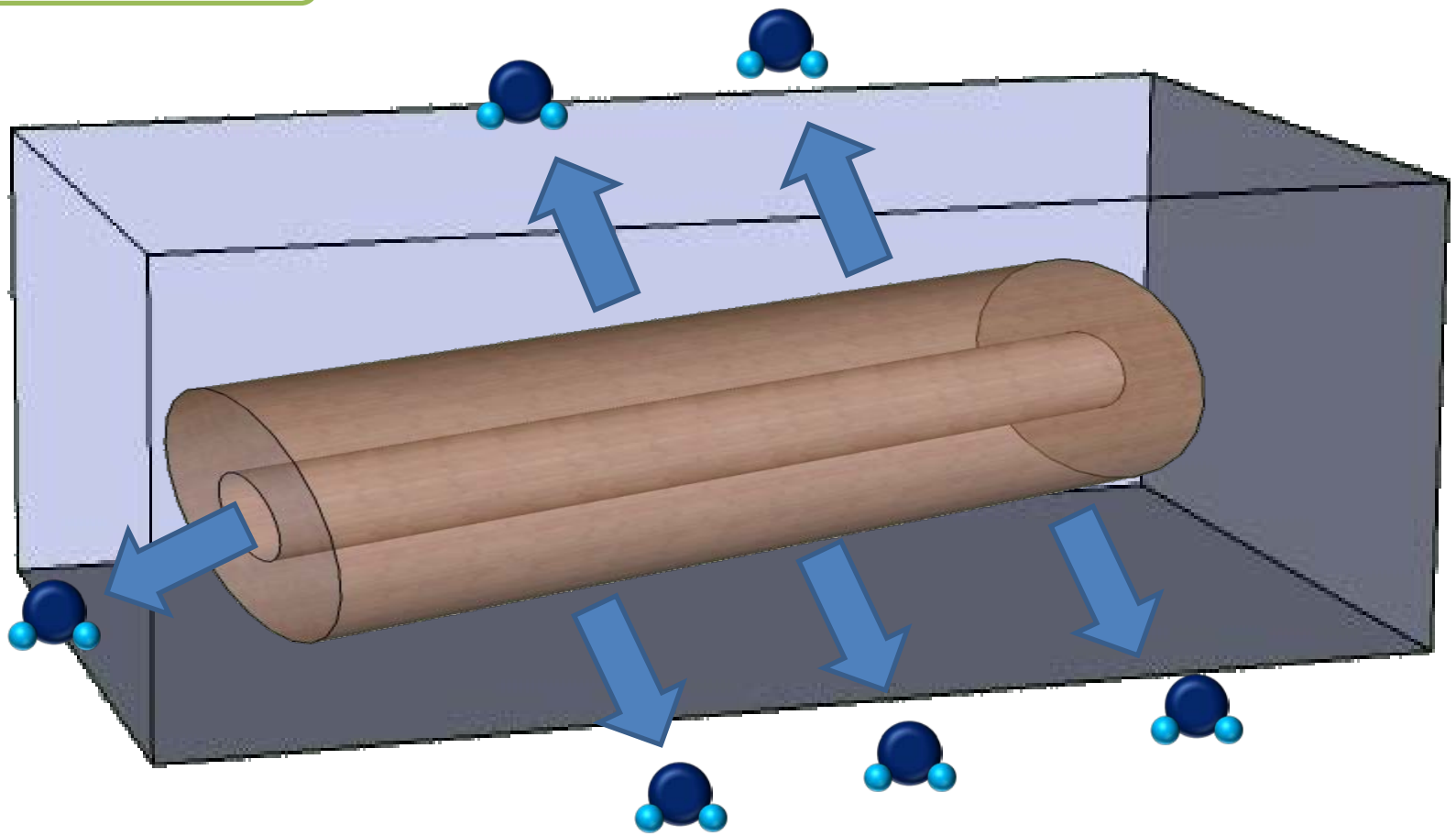
Drying of center-bored timber



Materials & Methods

Drying of center-bored timber

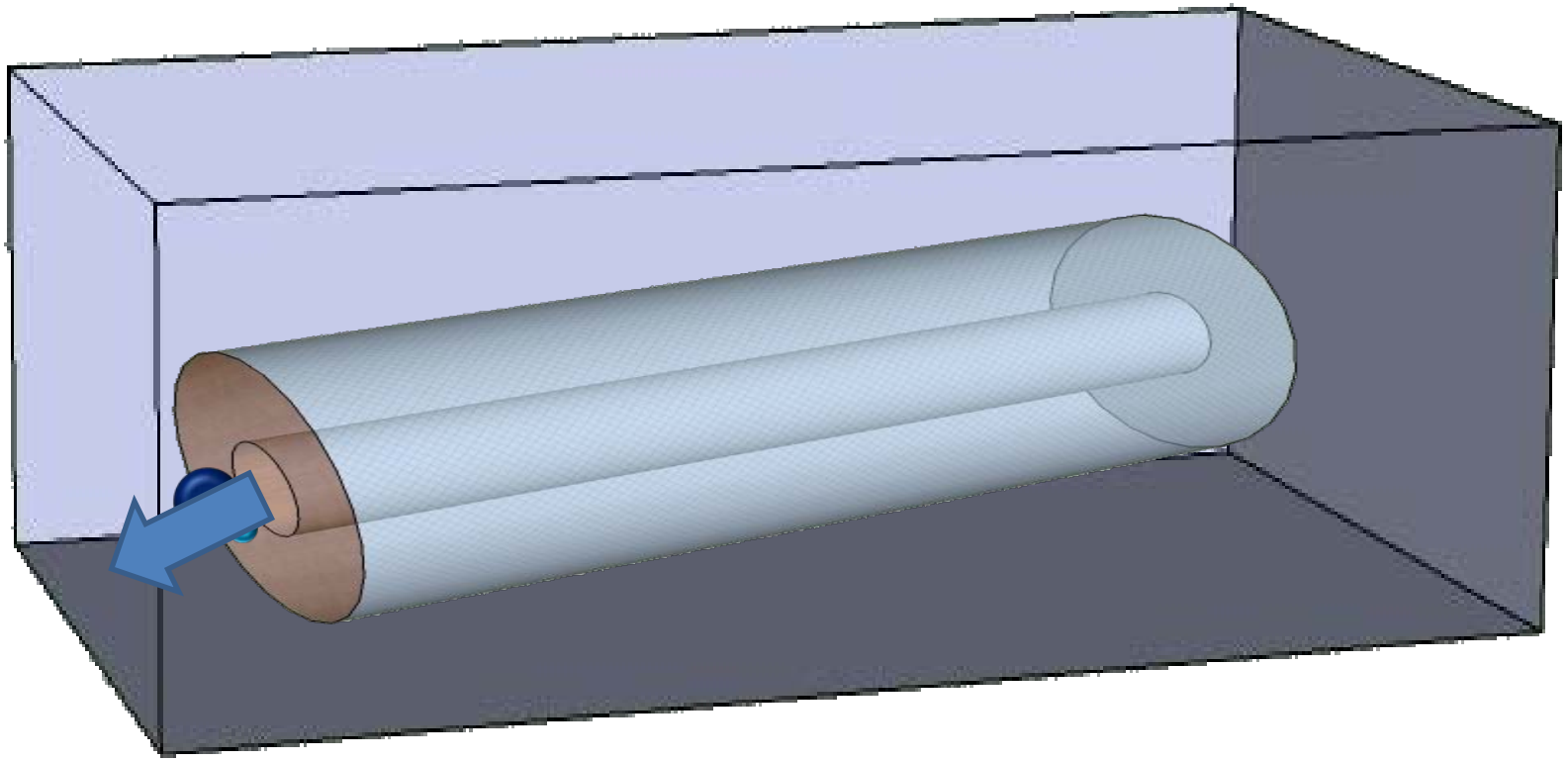
Control wood



Materials & Methods

Drying of center-bored timber

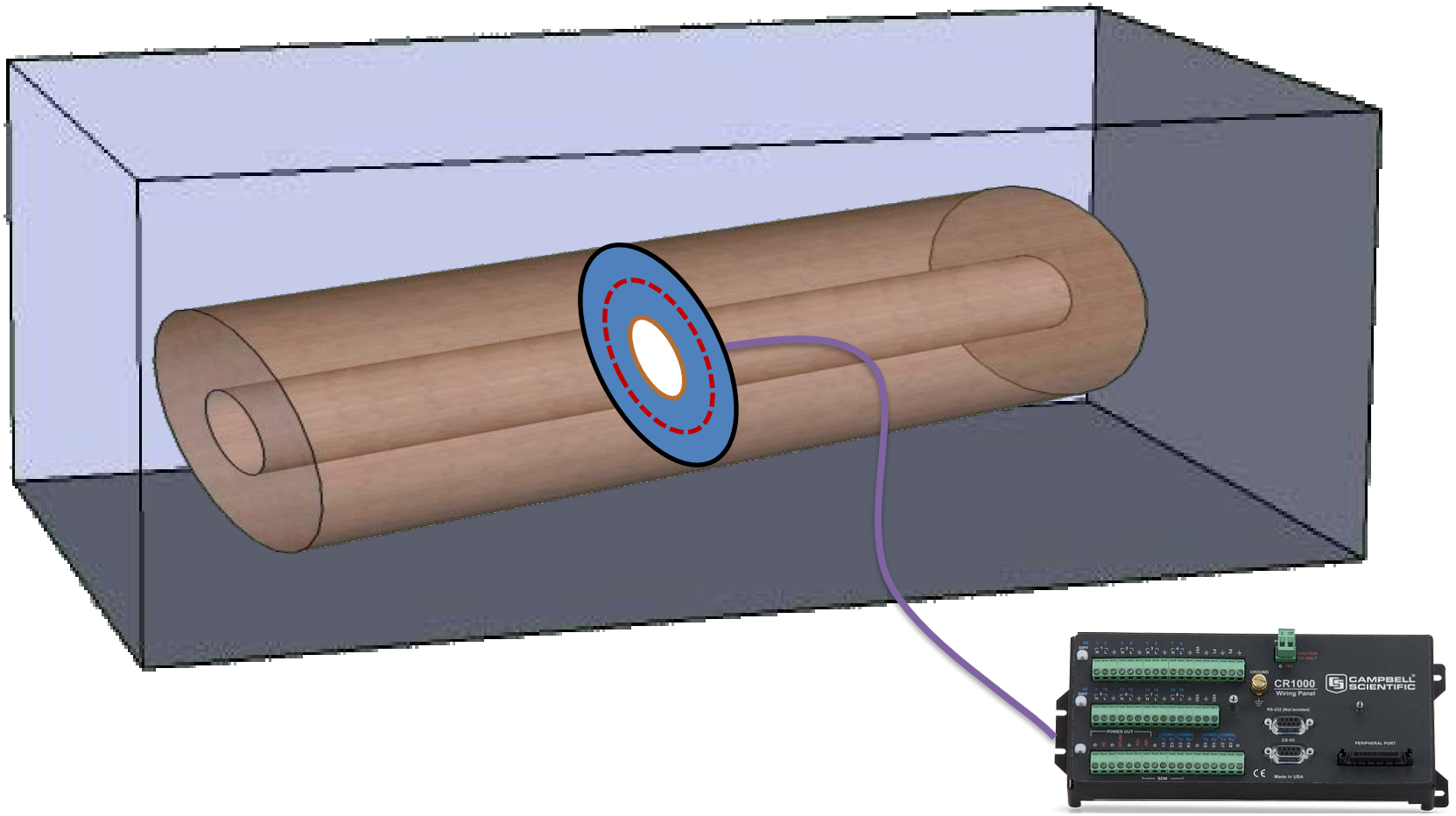
Sealing wood



Materials & Methods

Temperature change

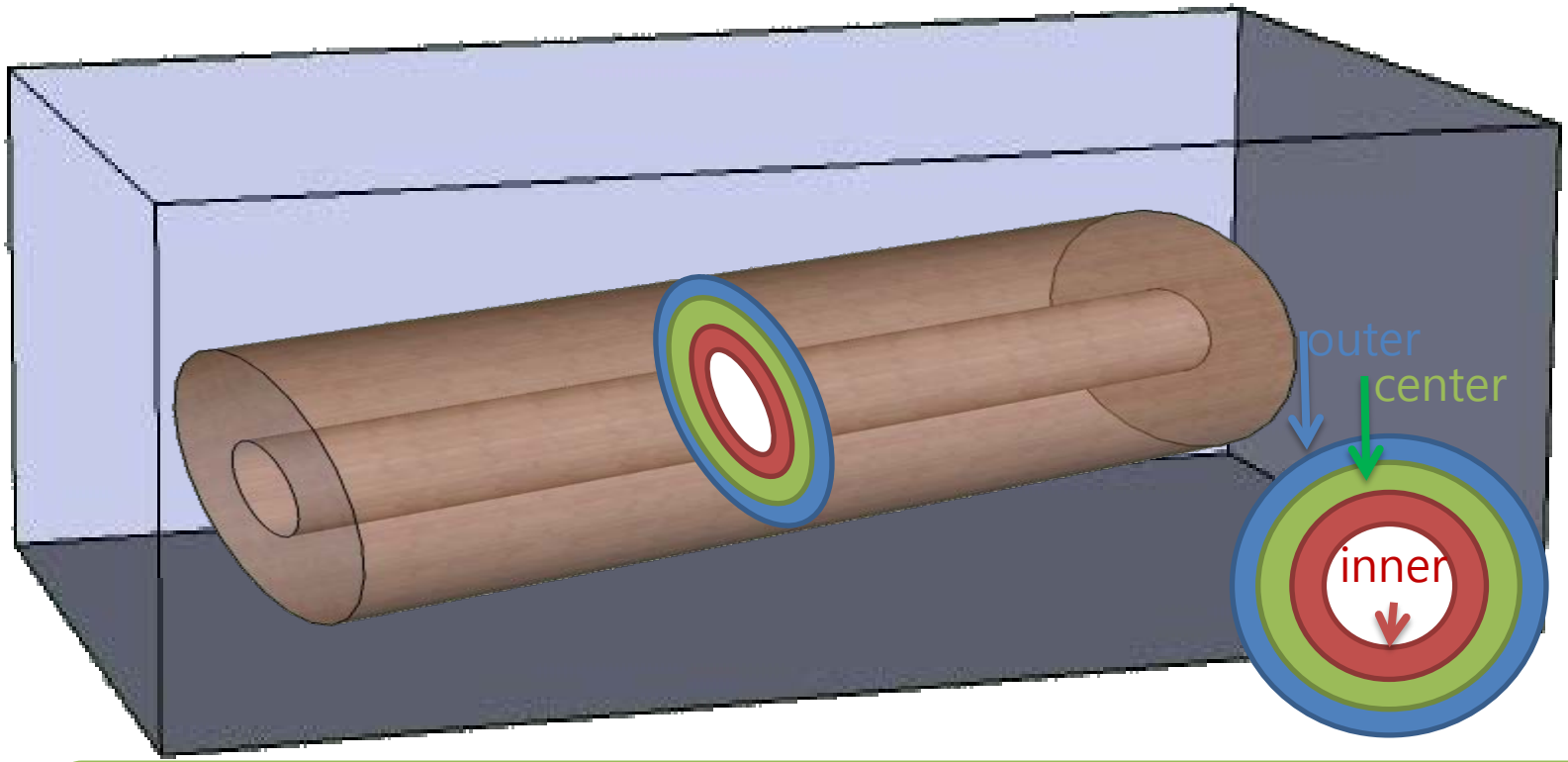
Thermocouples were inserted into the wood. temperature was measured and recorded using data logger (CR1000, Campbell Scientific Inc.).



Materials & Methods

Moisture contents

For determining average moisture content of wood,
the weight of the specimens was measured during drying.

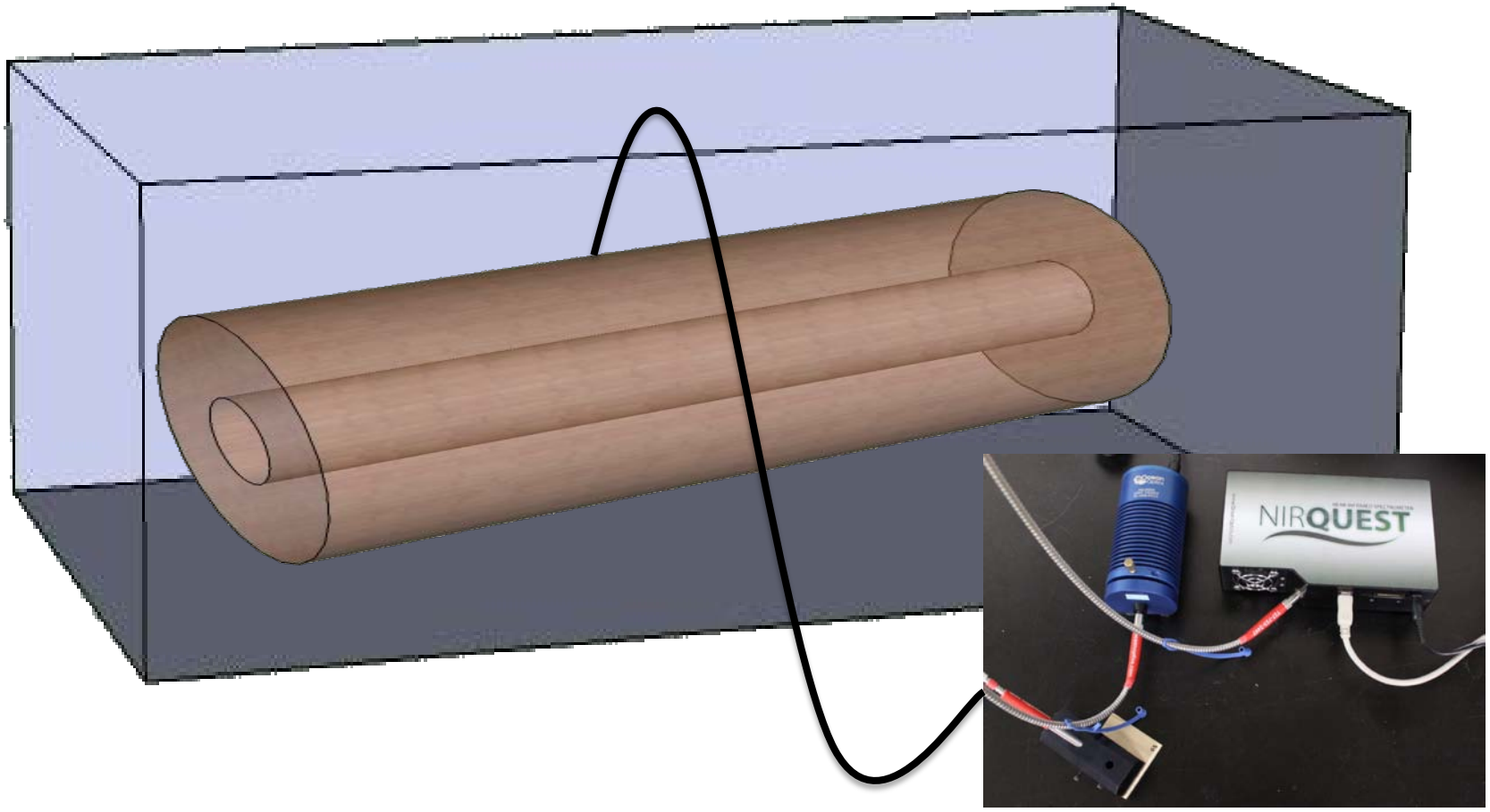


For analyzing moisture transfer, outer, center, and inner part of specimens were cut and weighed at 8 hour intervals during drying.

Materials & Methods

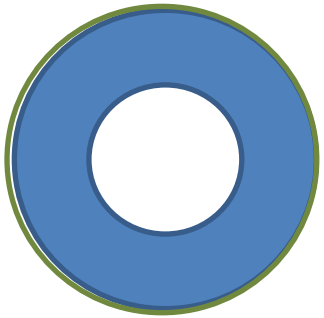
Control of drying process

Applying Near-Infrared spectroscopic method



Materials & Methods

Control of drying process

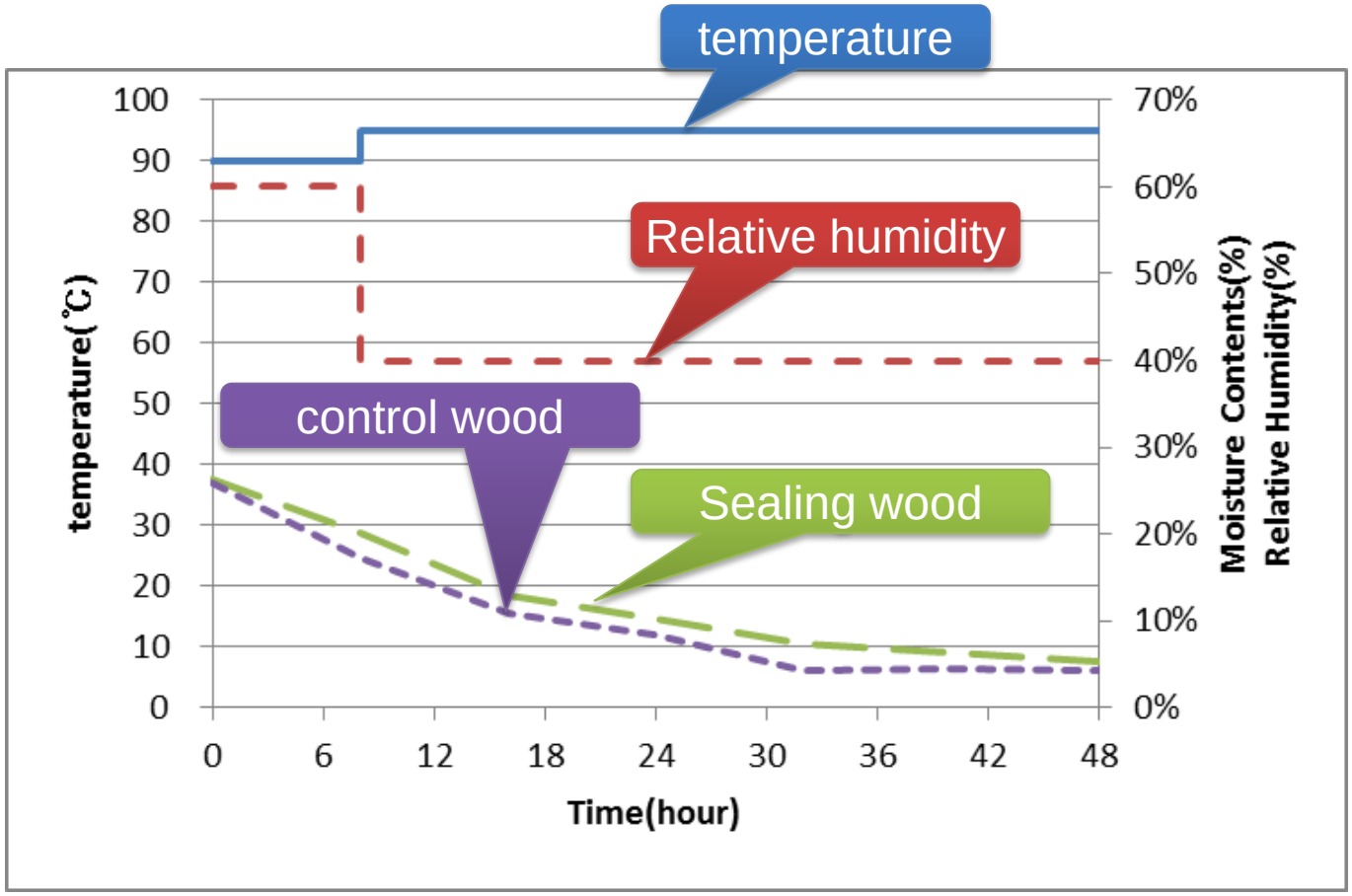


Surface moisture content was measured by NIR spectroscopic method.
Time to finish drying process is determined.

Results & Discussion

Results & Discussion

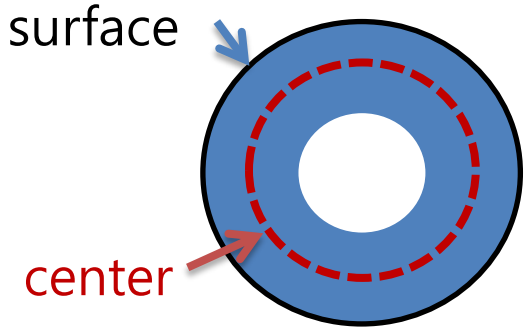
Drying of center-bored timber



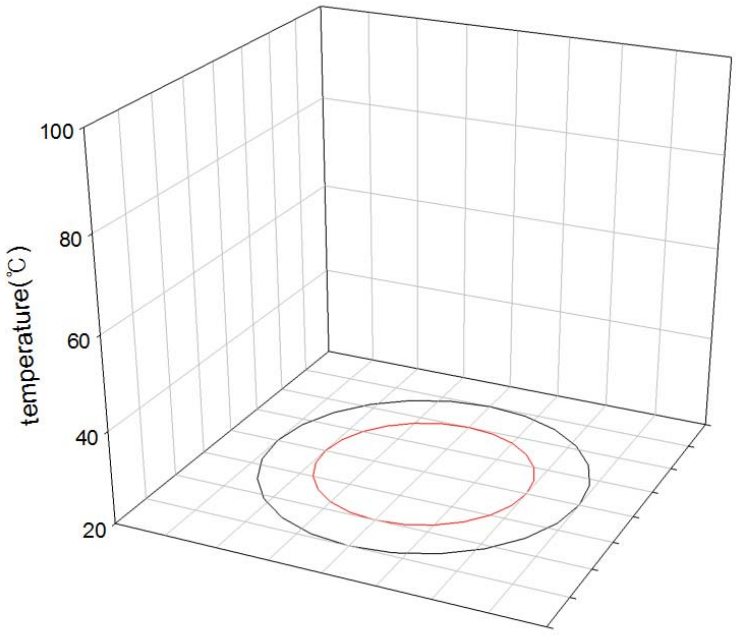
Final moisture contents : about 5%

Results & Discussion

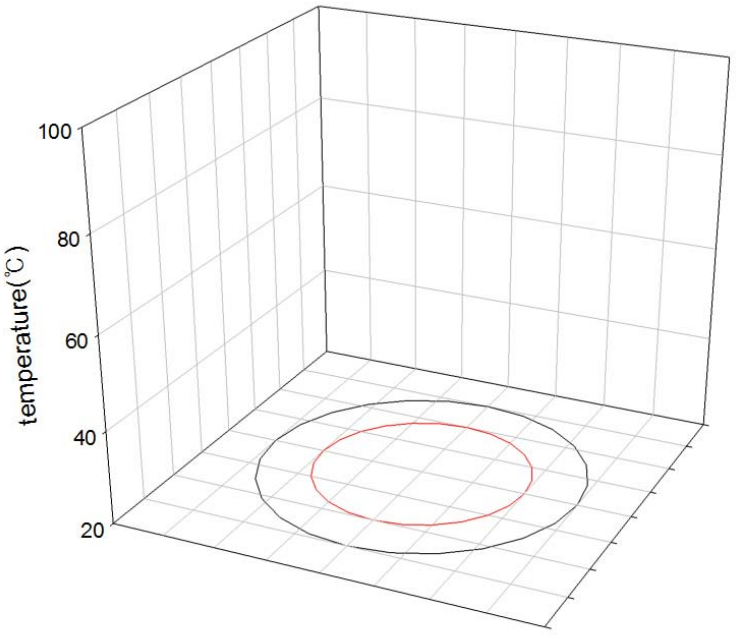
Temperature change



0 hr



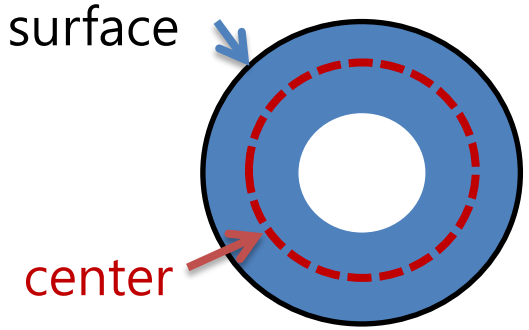
Control wood



Sealing wood

Results & Discussion

Temperature change



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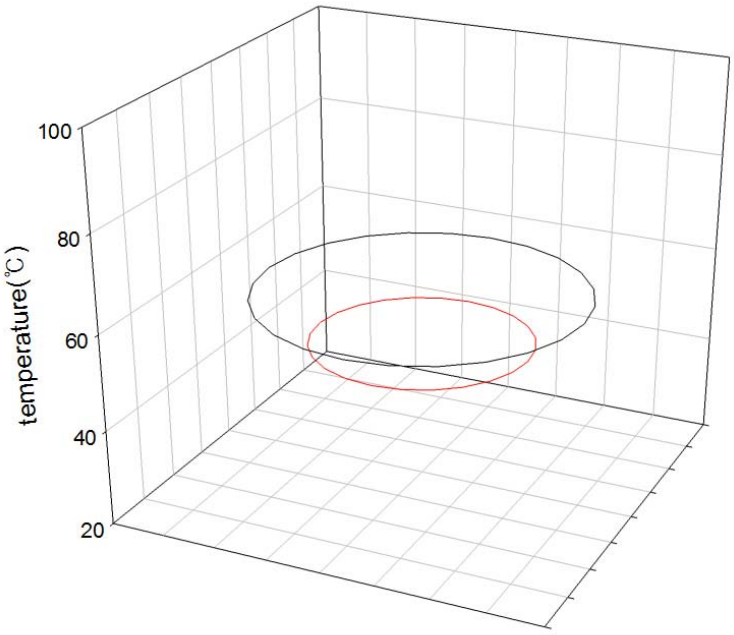
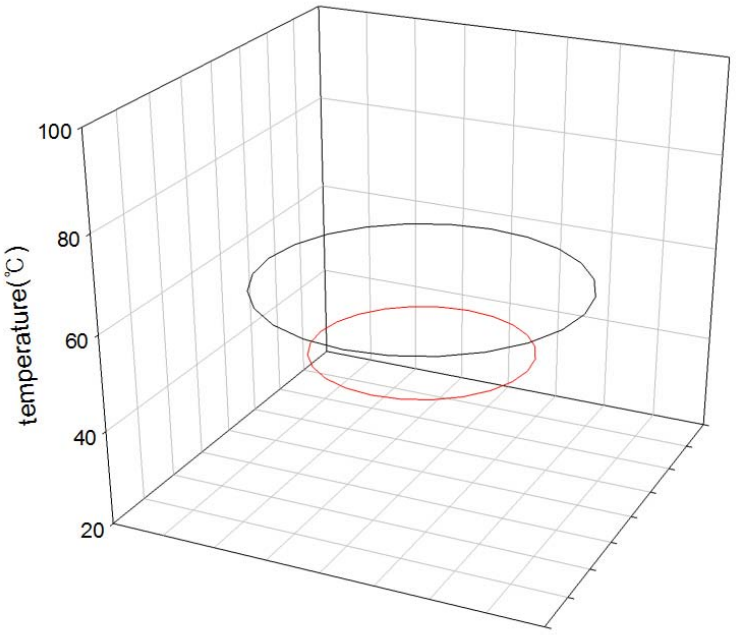


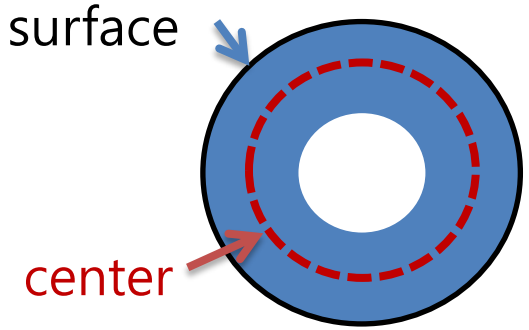
Control wood



Sealing wood

Results & Discussion

Temperature change



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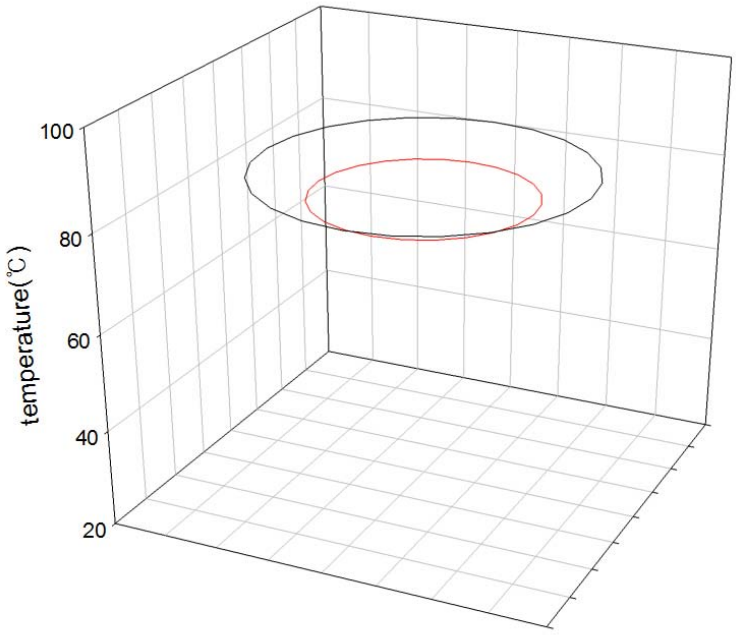
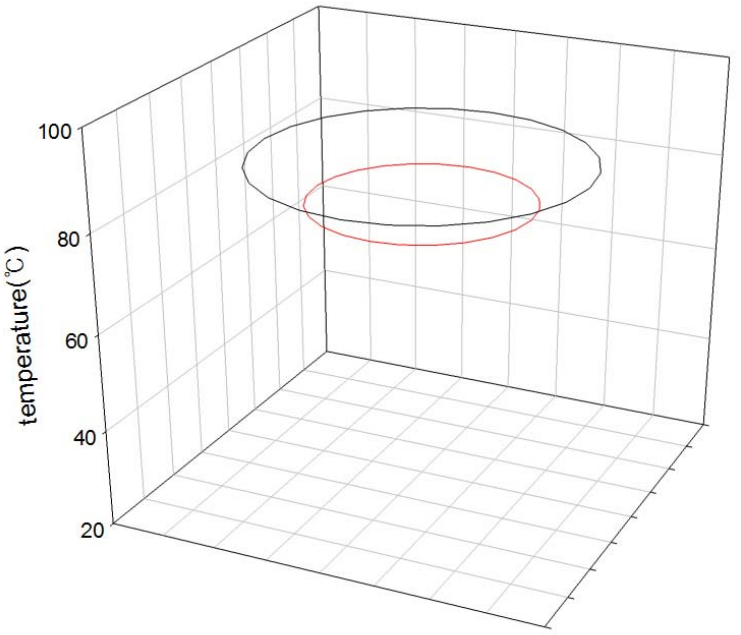


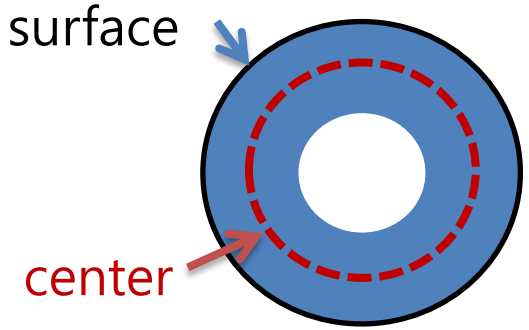
Control wood



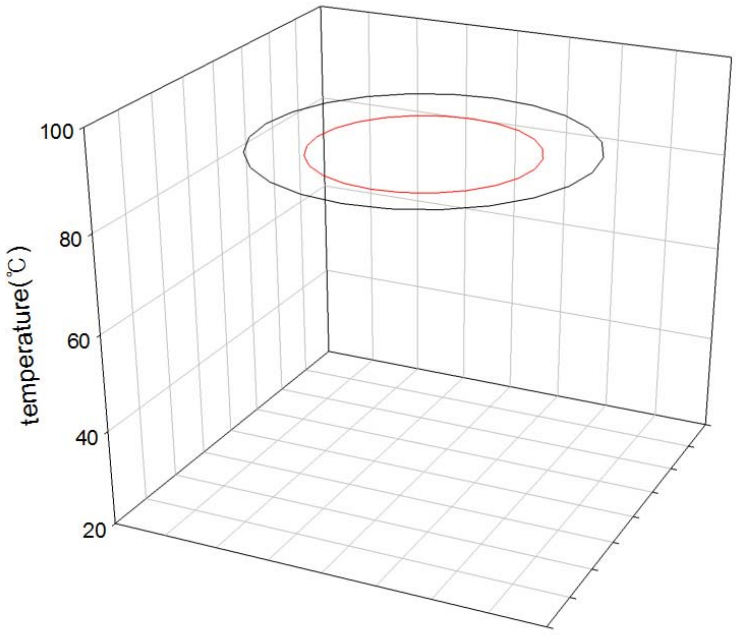
Sealing wood

Results & Discussion

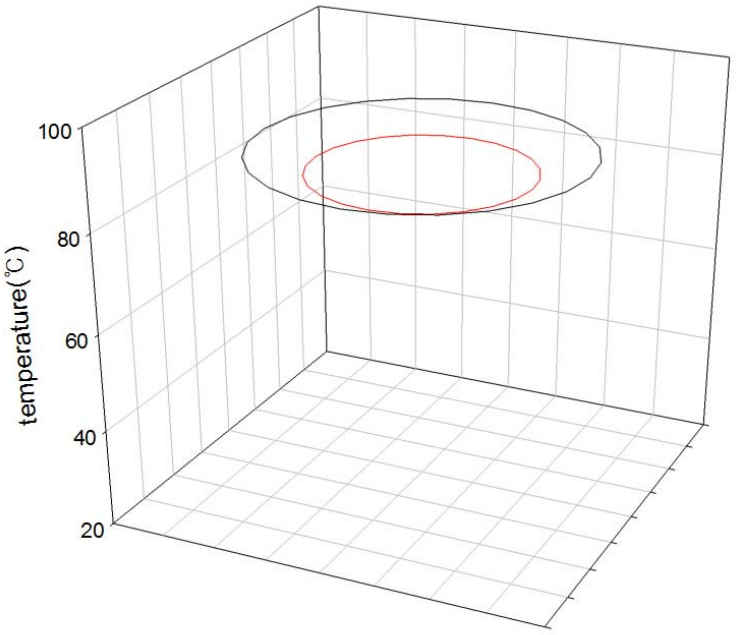
Temperature change



3 hr



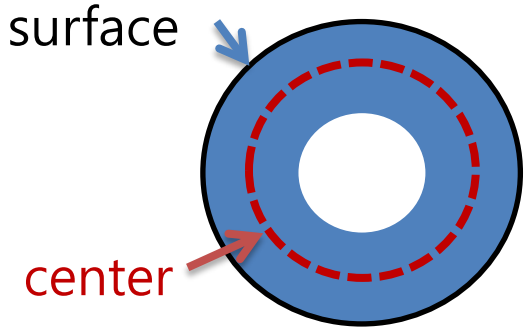
Control wood



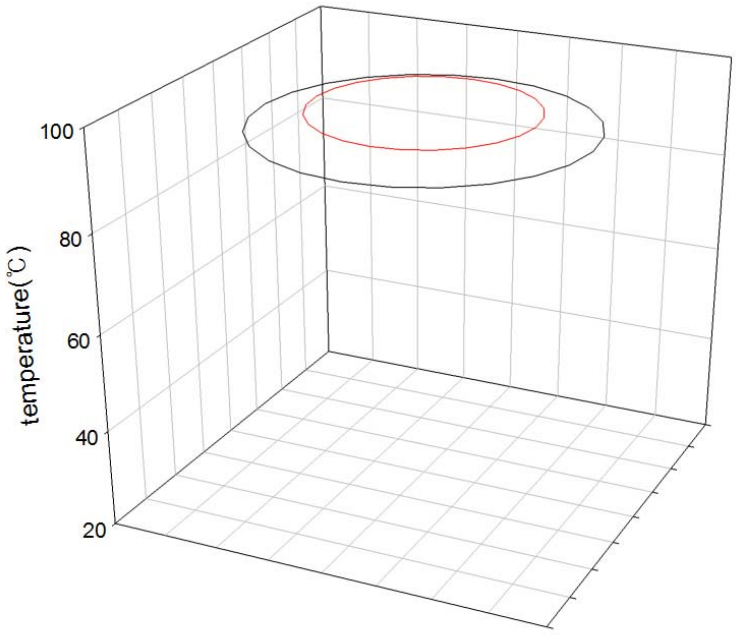
Sealing wood

Results & Discussion

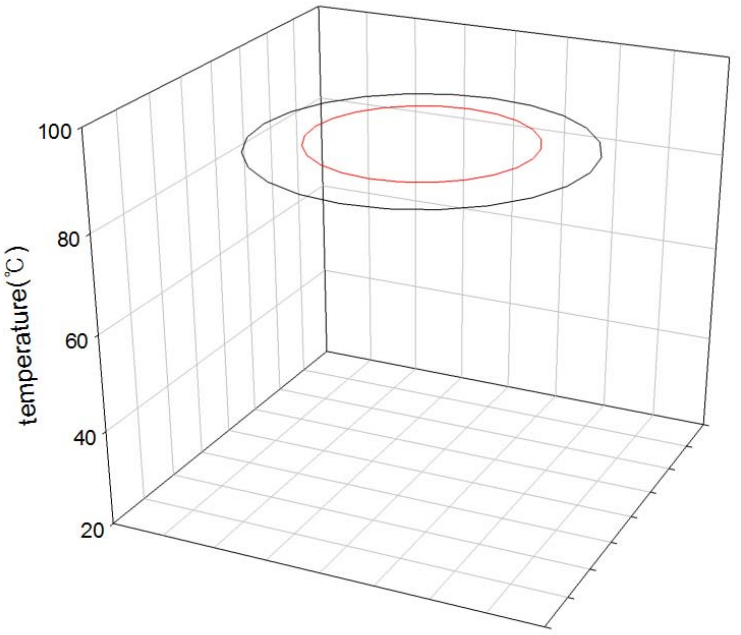
Temperature change



24 hr



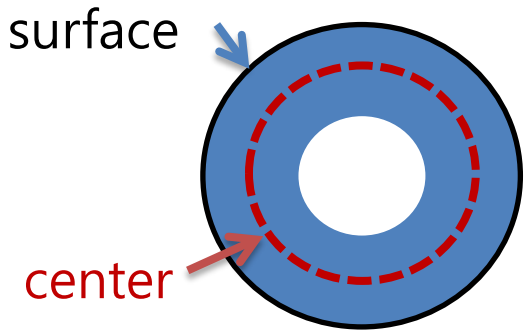
Control wood



Sealing wood

Results & Discussion

Temperature change



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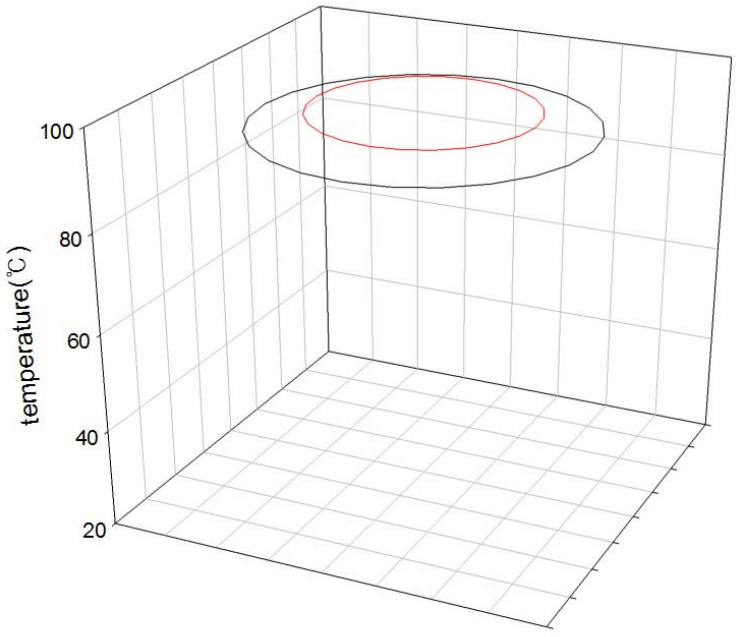
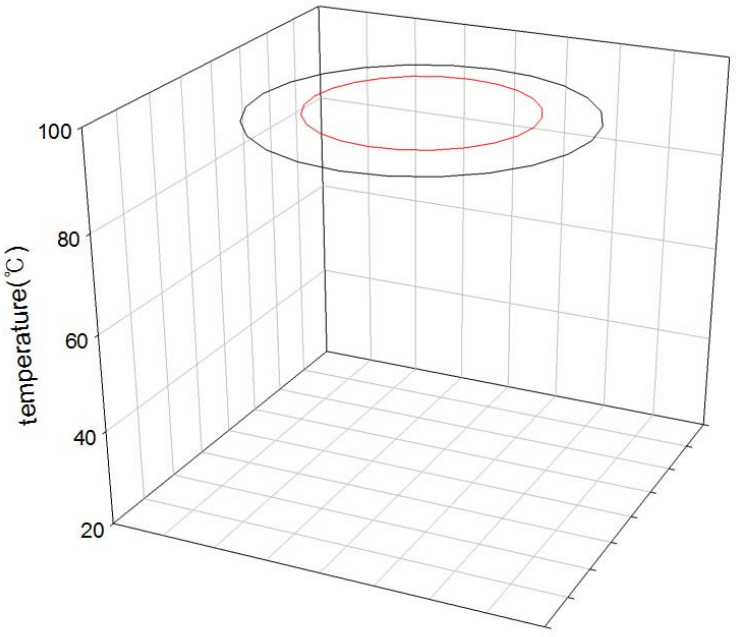


Control wood

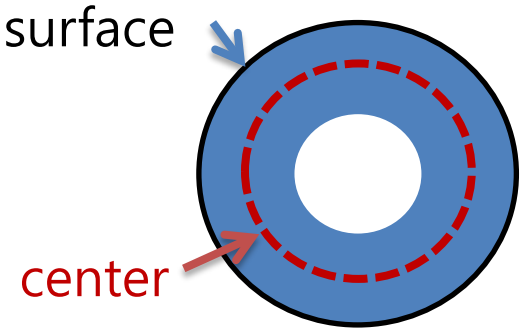


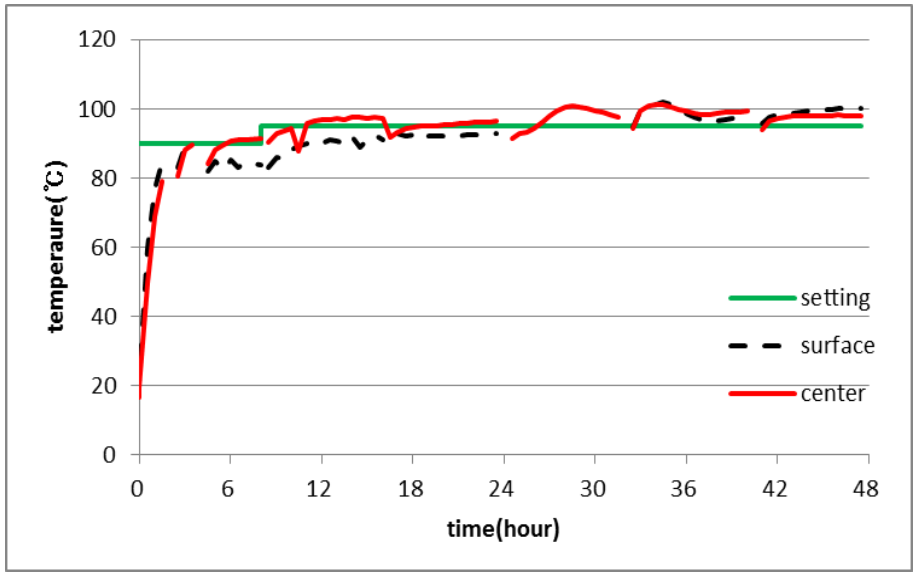
Sealing wood

Temperatures of surface and center in the sealing wood rose slower than those of control wood.

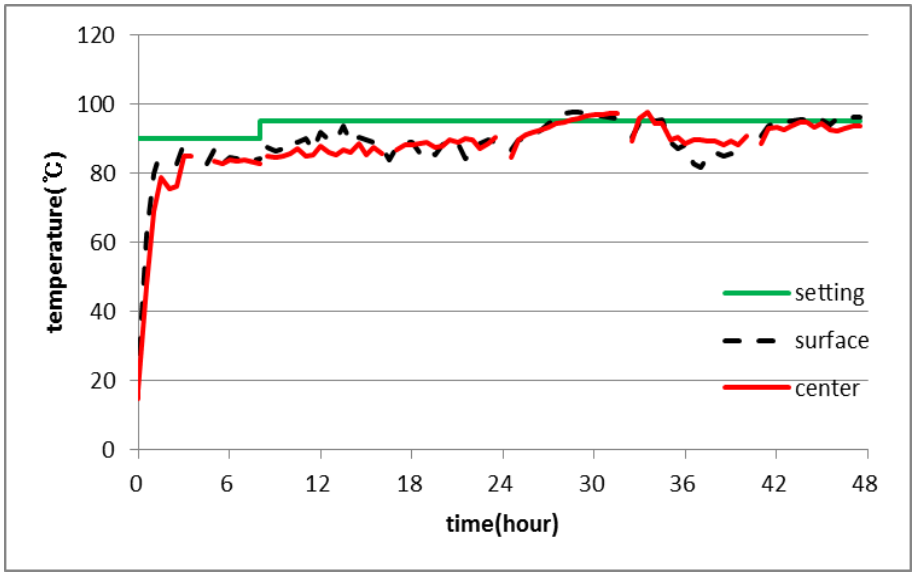
Results & Discussion

Temperature change





Control wood

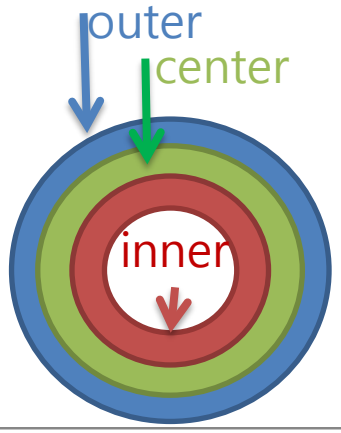


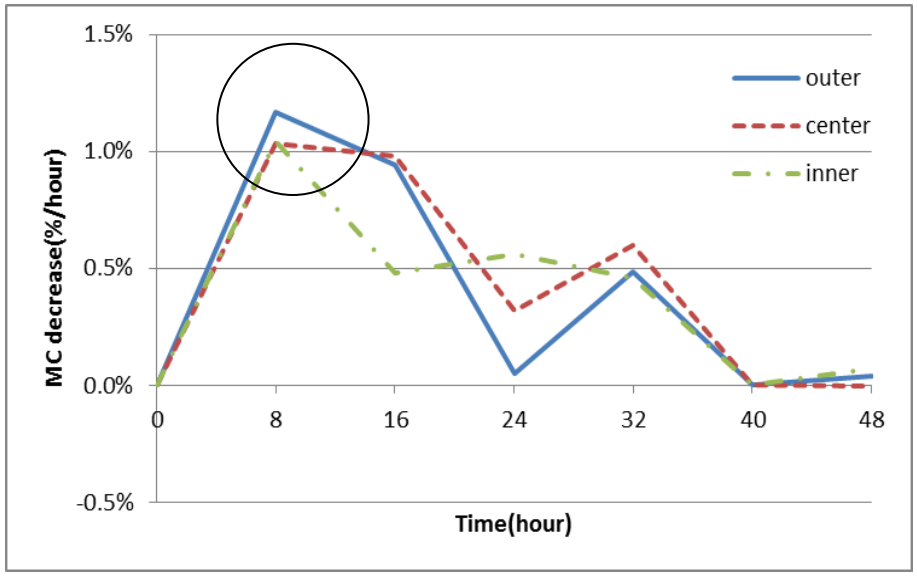
Sealing wood

Wood temperature was increased during approximately 3 hours to reach around the target setting temperature.

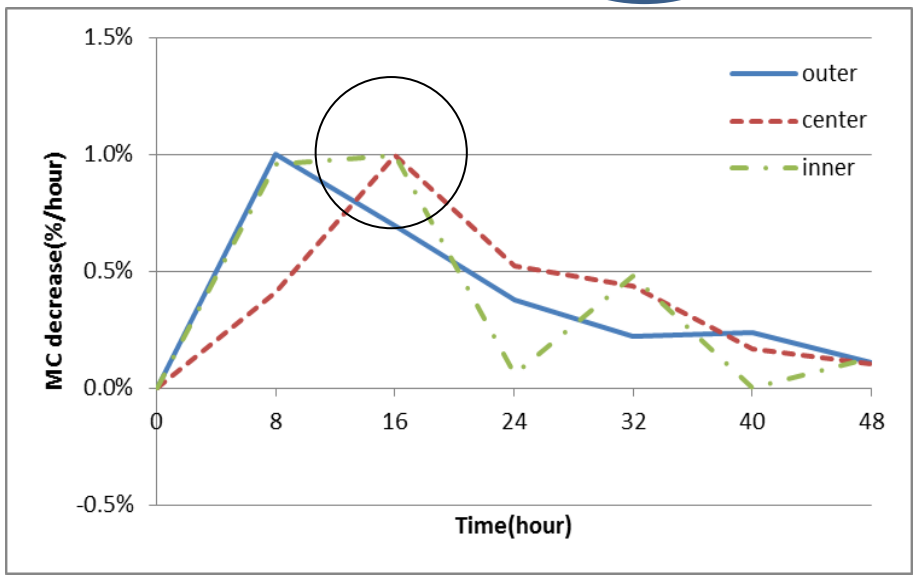
Results & Discussion

Drying rate





Control wood

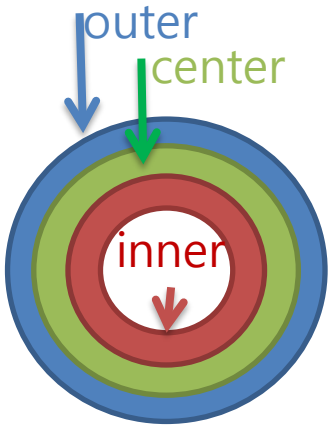


Sealing wood

Control wood : outer surface was dried rapidly
Sealing wood : drying rate of inner surface was higher than that of outer surface

Results & Discussion

MC variation



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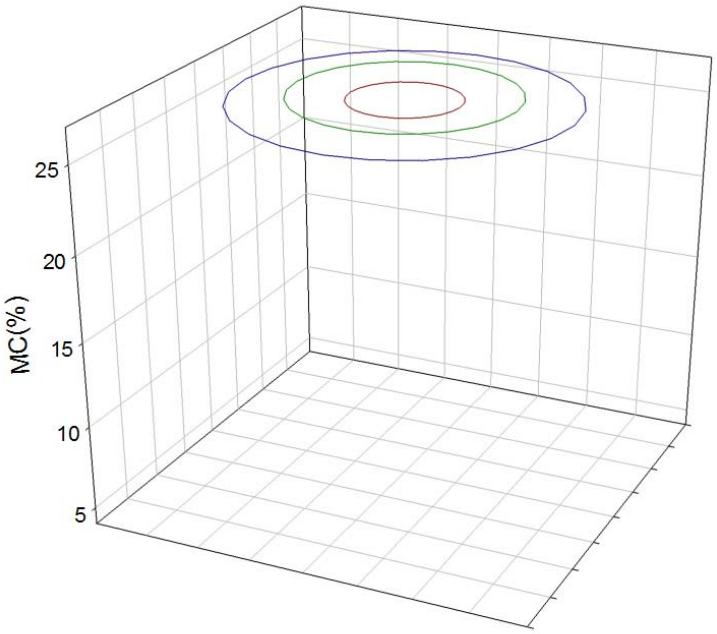
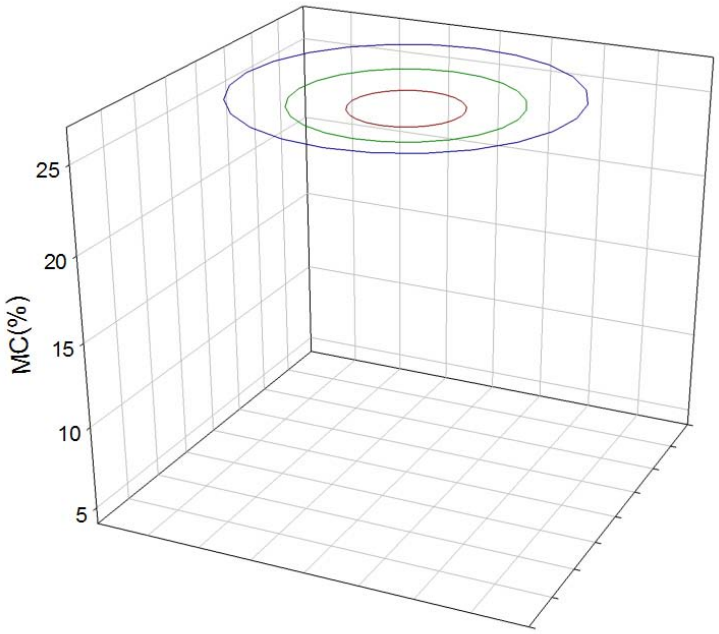


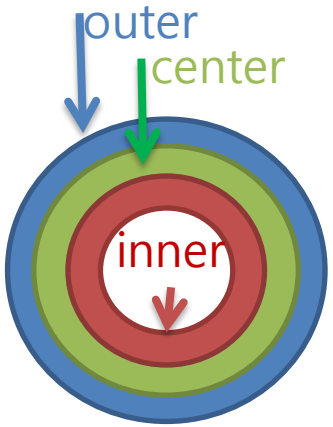
Control wood



Sealing wood

Results & Discussion

MC variation



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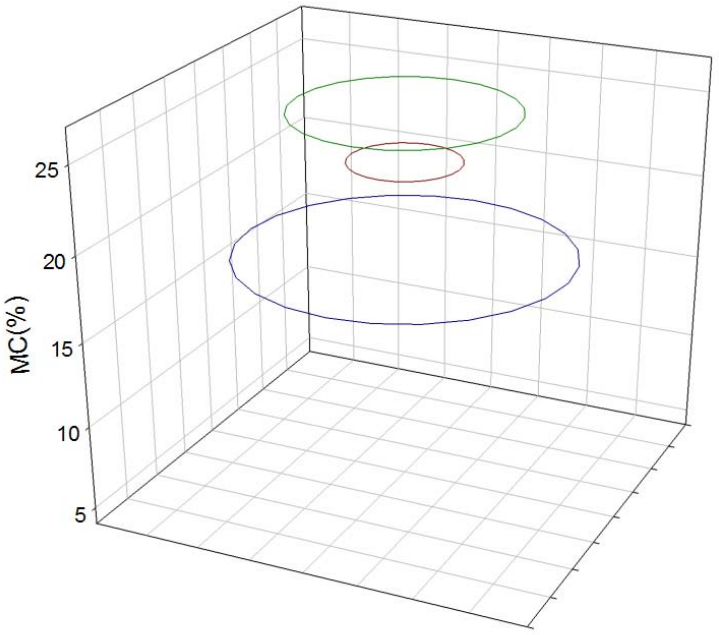
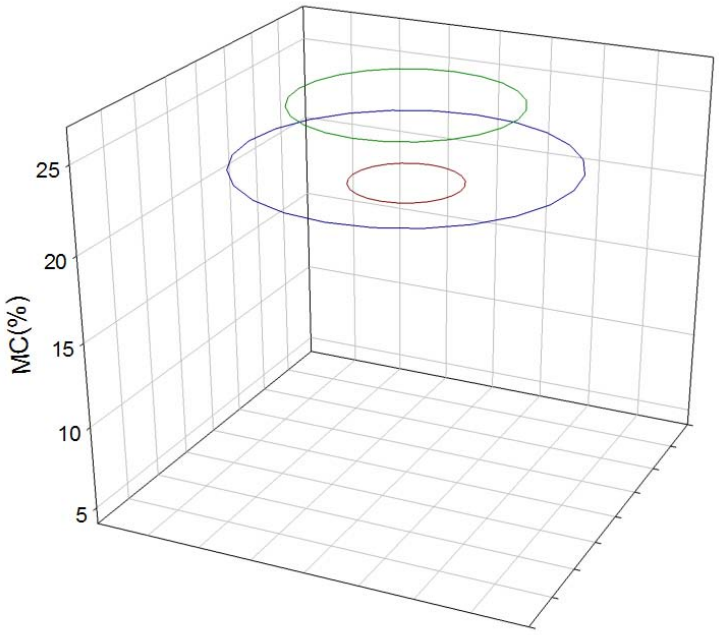


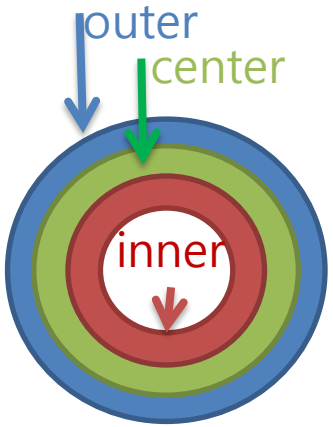
Control wood



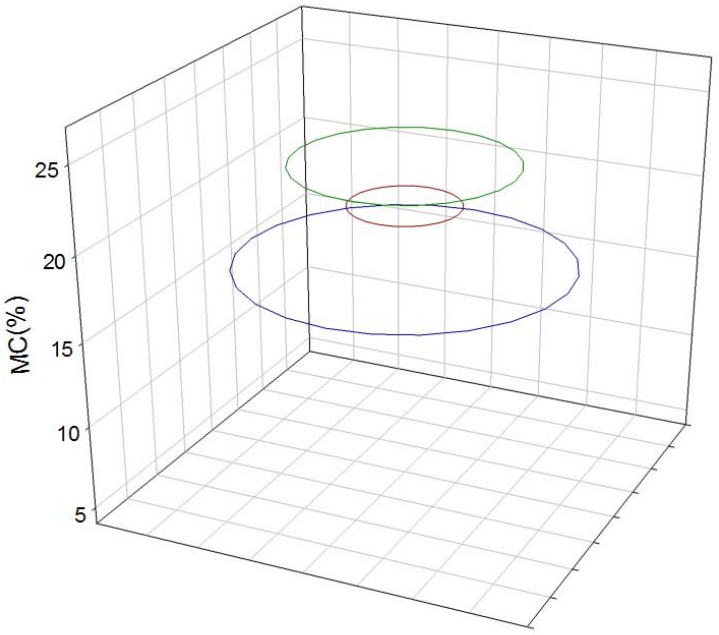
Sealing wood

Results & Discussion

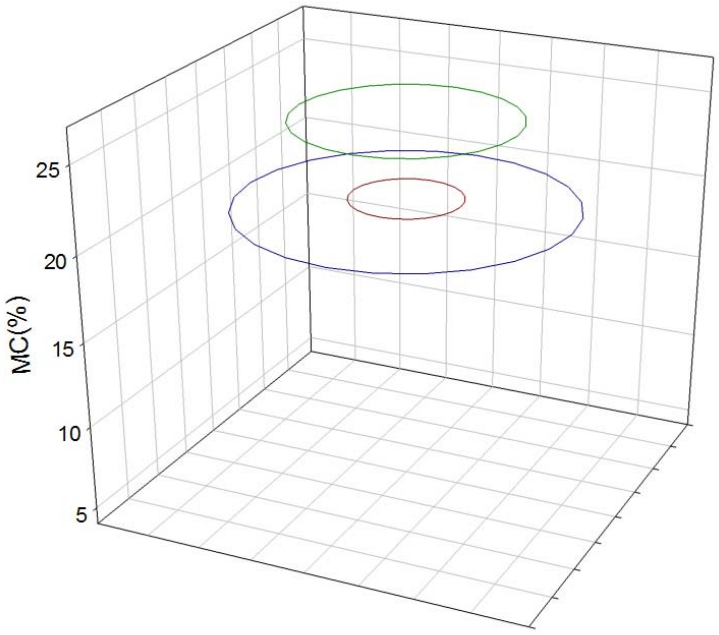
MC variation



4 hr



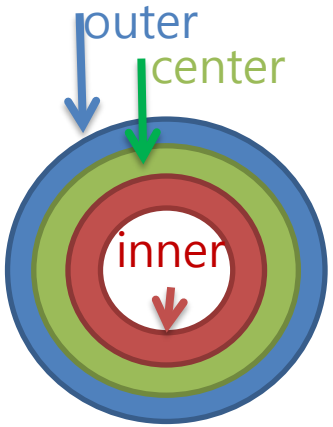
Control wood



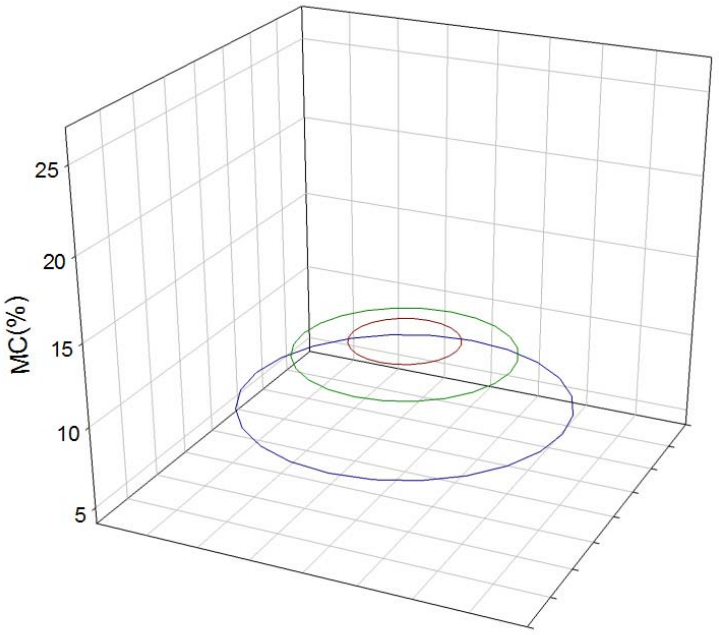
Sealing wood

Results & Discussion

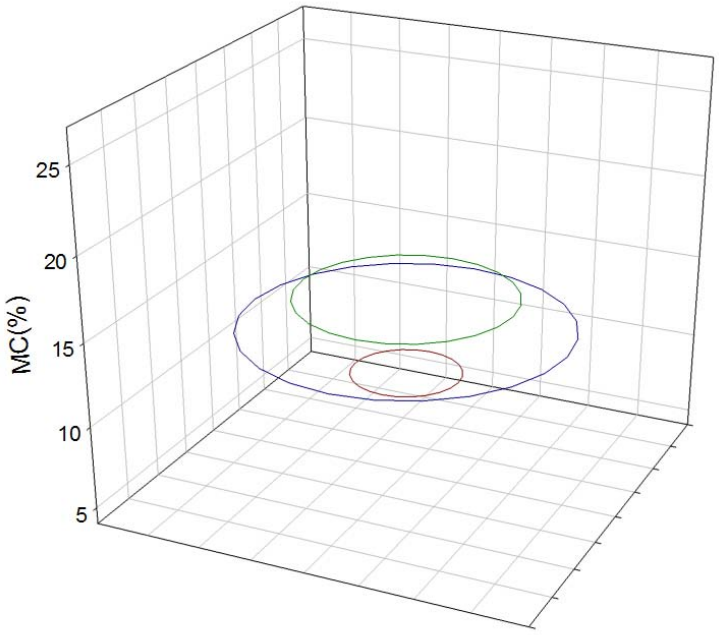
MC variation



16 hr



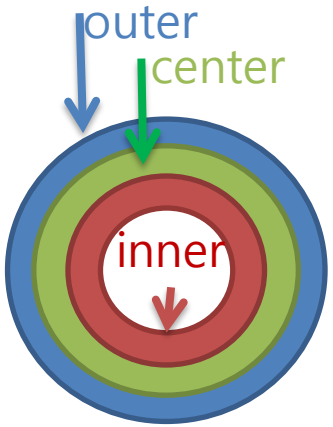
Control wood



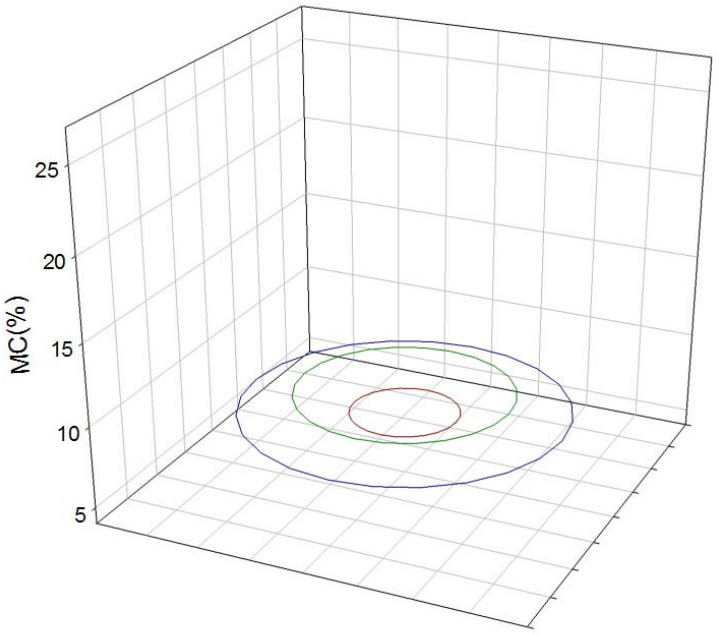
Sealing wood

Results & Discussion

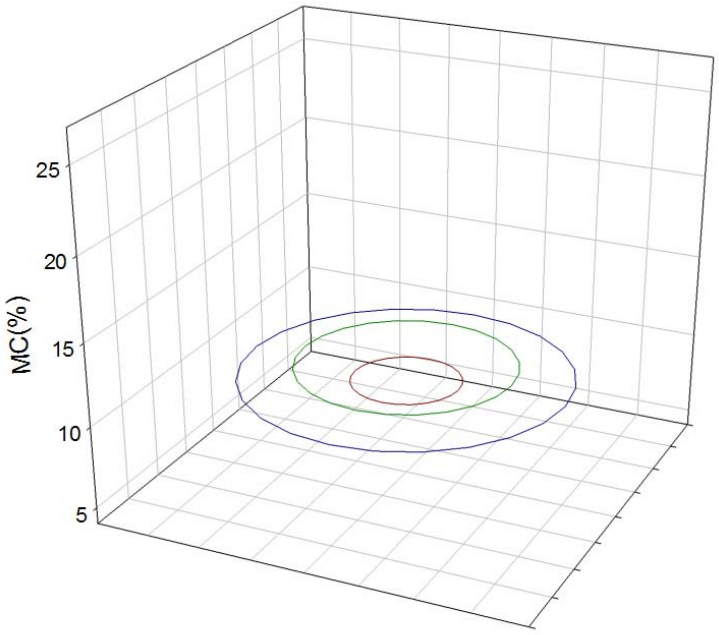
MC variation



24 hr



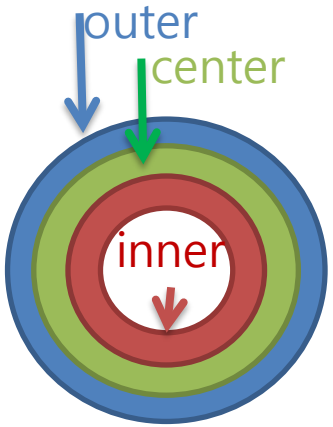
Control wood



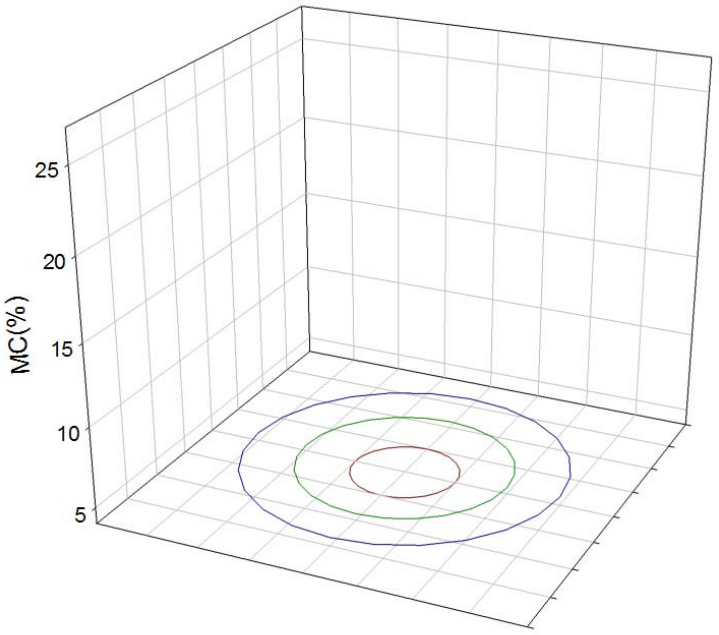
Sealing wood

Results & Discussion

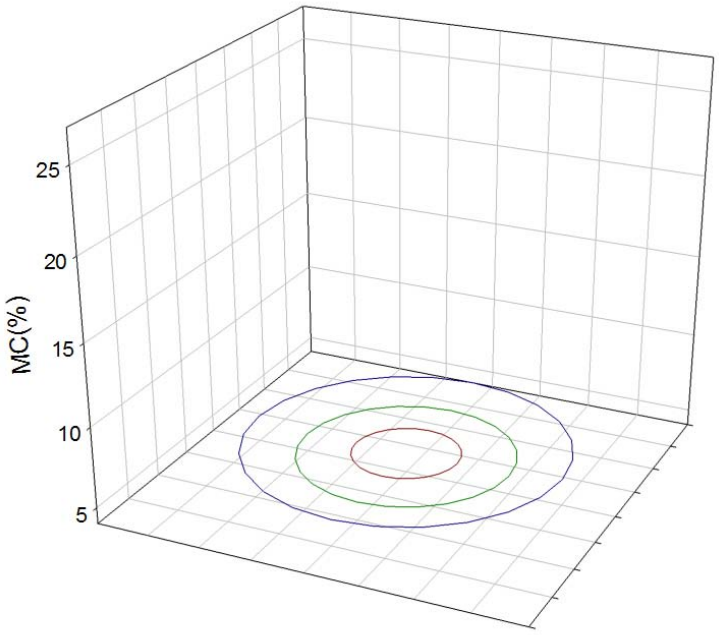
MC variation



48 hr



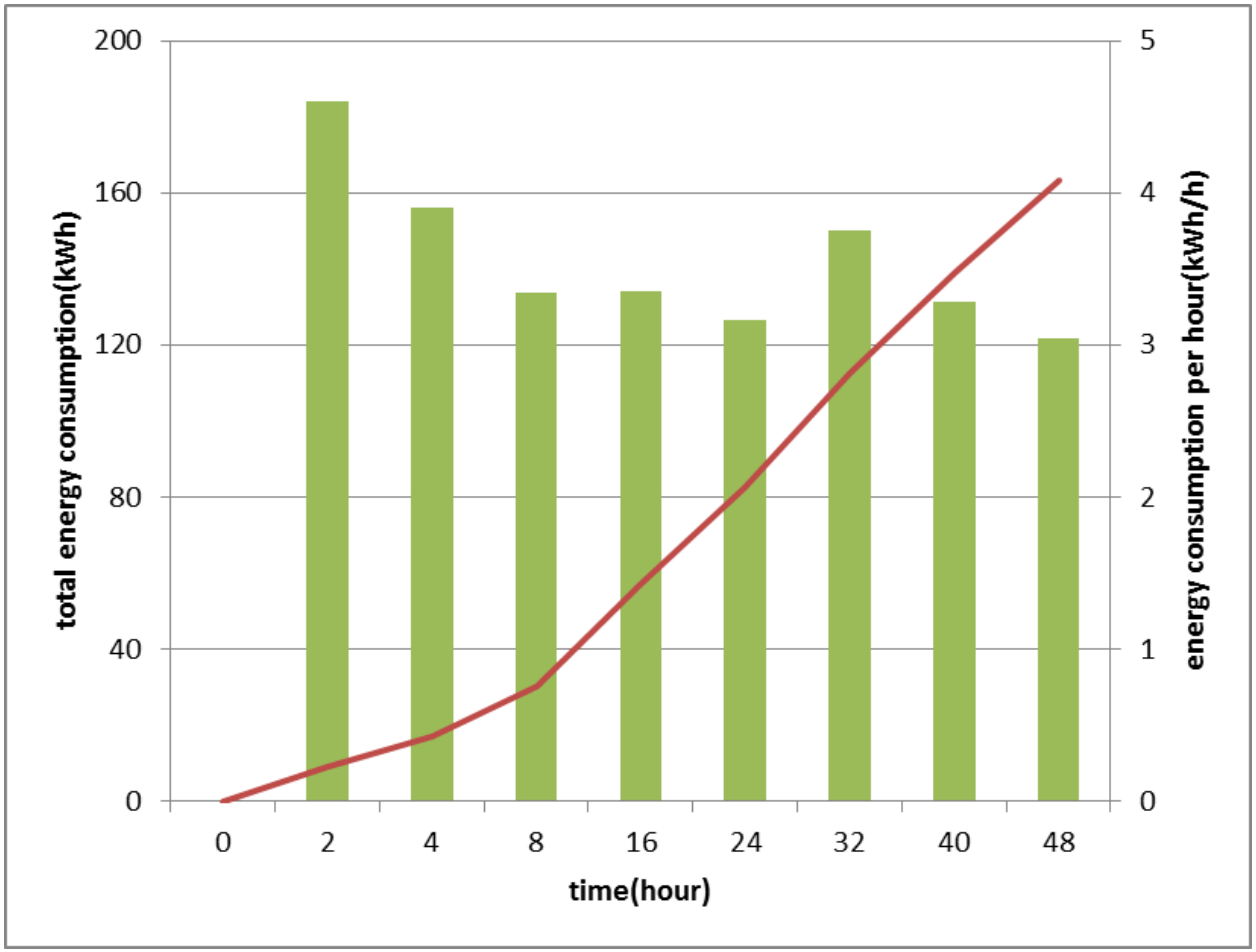
Control wood



Sealing wood

Results & Discussion

Drying energy of center-bored timber



Total energy consumption : 163.14kWh

Results & Discussion

Comparison of drying energy

outer ø140mm, inner ø80mm

Center-bored timber

30X135mm

lumber

ø140mm

Round wood

Results & Discussion

Comparison of drying defects

-surface check

No.	Length of surface check (cm)
1	8.49
2	13.15
3	9.51
4	20.08
5	5.67
6	5.14
average	10.34
S.D.	5.58

Control wood

Sealing wood

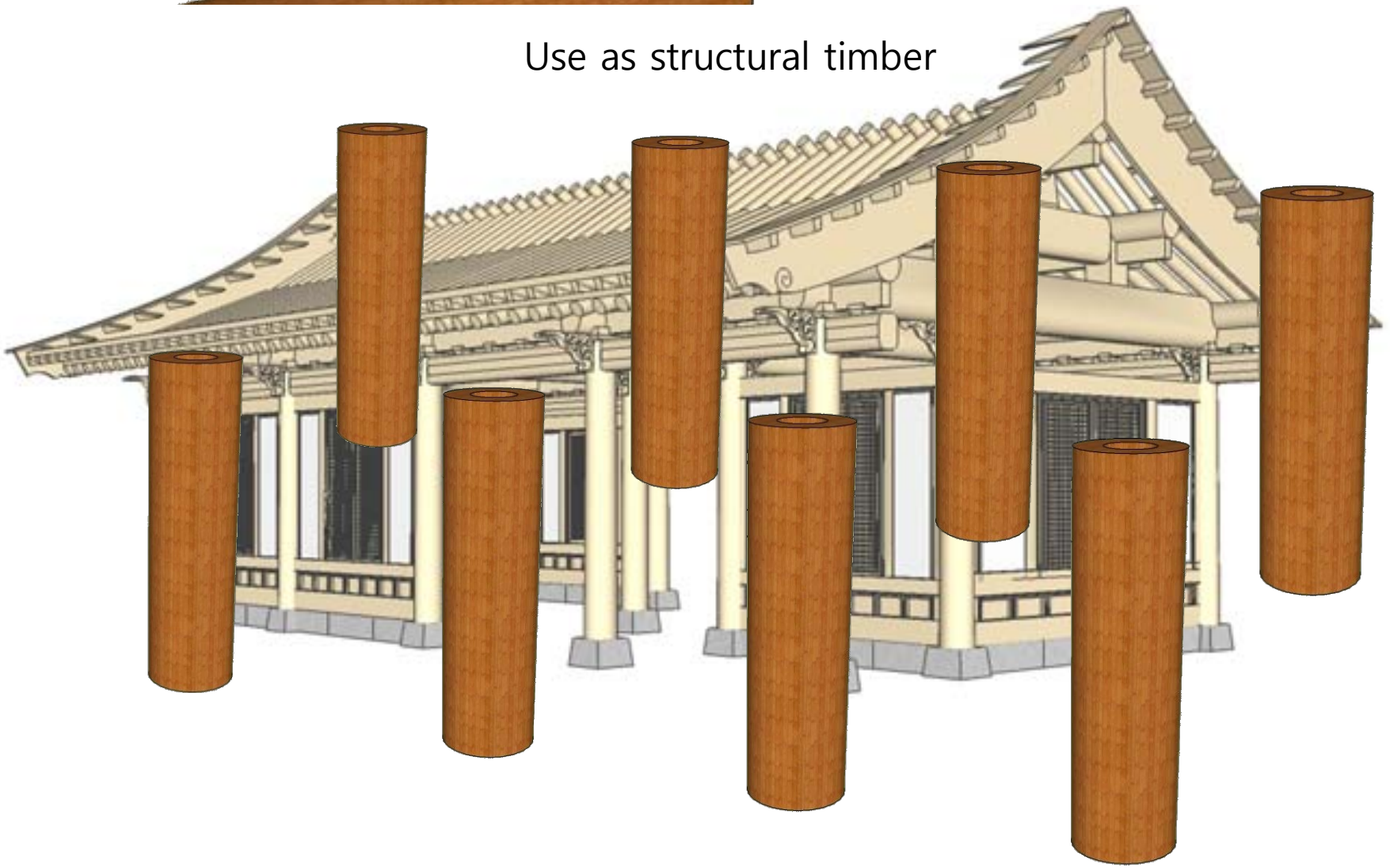
Control wood : surface checks were occurred during drying

Sealing wood : dried without drying defects

Utilization of center-bored timber

Dried center bored timber

Use as structural timber



Conclusion

1. Reduction of drying time by high temperature drying of center-bored timber
2. Preventing drying defects by sealing pitch pine center-bored timber
3. Reduction of drying energy of large cross section timber by center-boring process

Thank You !