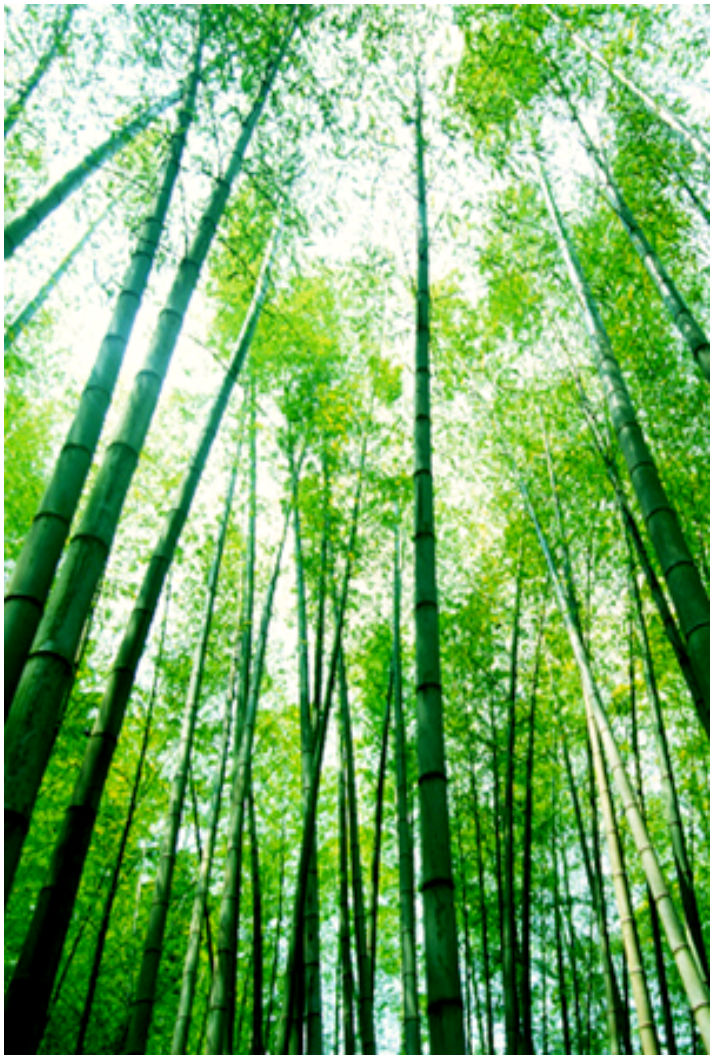
Adhesion and Bonding Performance of Laminated Bamboo Lumber made from *Dendrocalamus sericeus*

"10th World Bamboo Congress"
18-22 September2015
Damyang, South Korea

What is bamboo ?



- Perenial grass with “woody” culm
- Subfamily : *Bambusoideae*

  Family : *Poaceae*

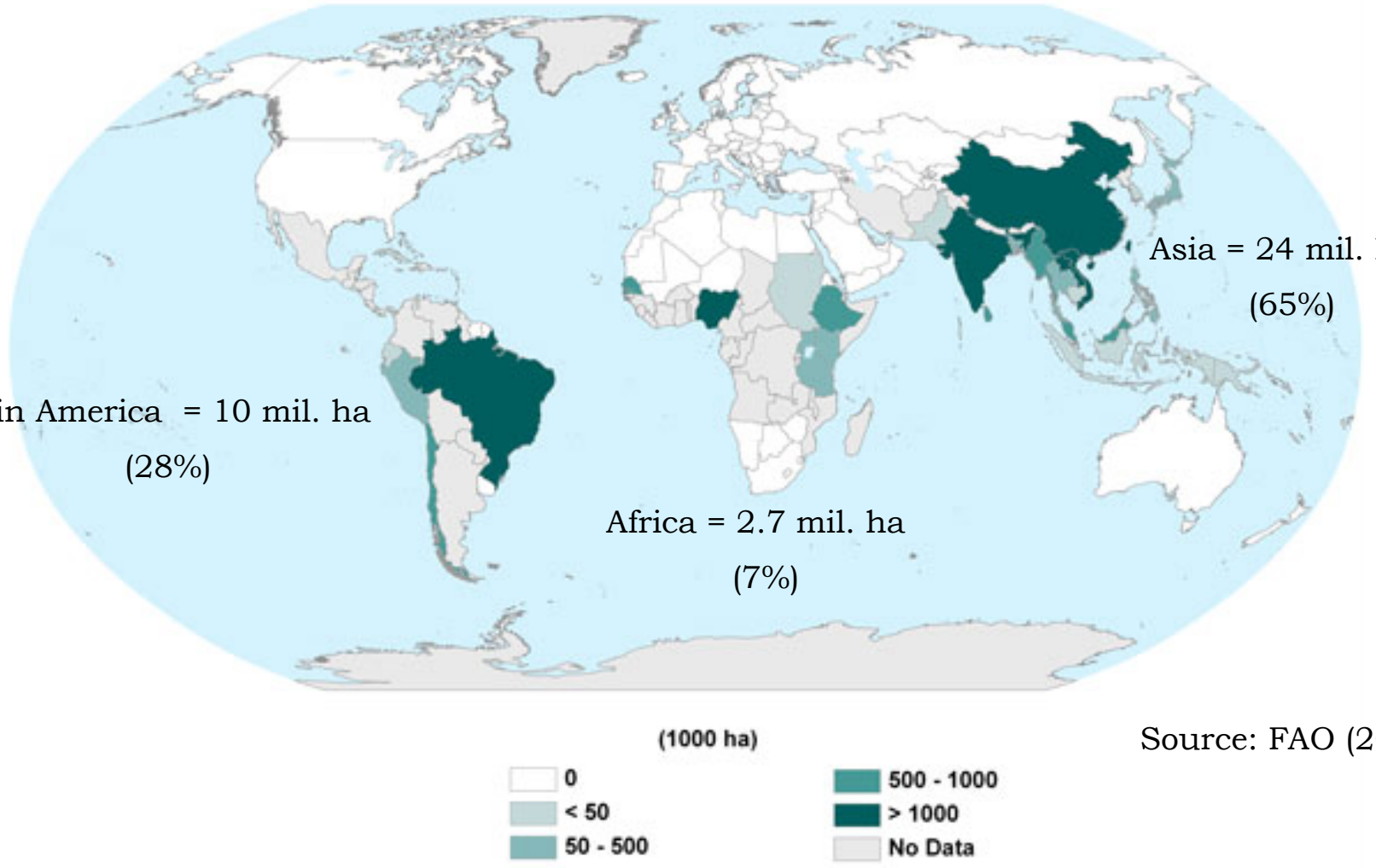
  Order : *Graminales*

  Class : *Monocotyledons*

  Subphylum : *Angiosperms*

  Phylum : *Spermayophyta*
- Over 1,200 species within 50 genera worldwide

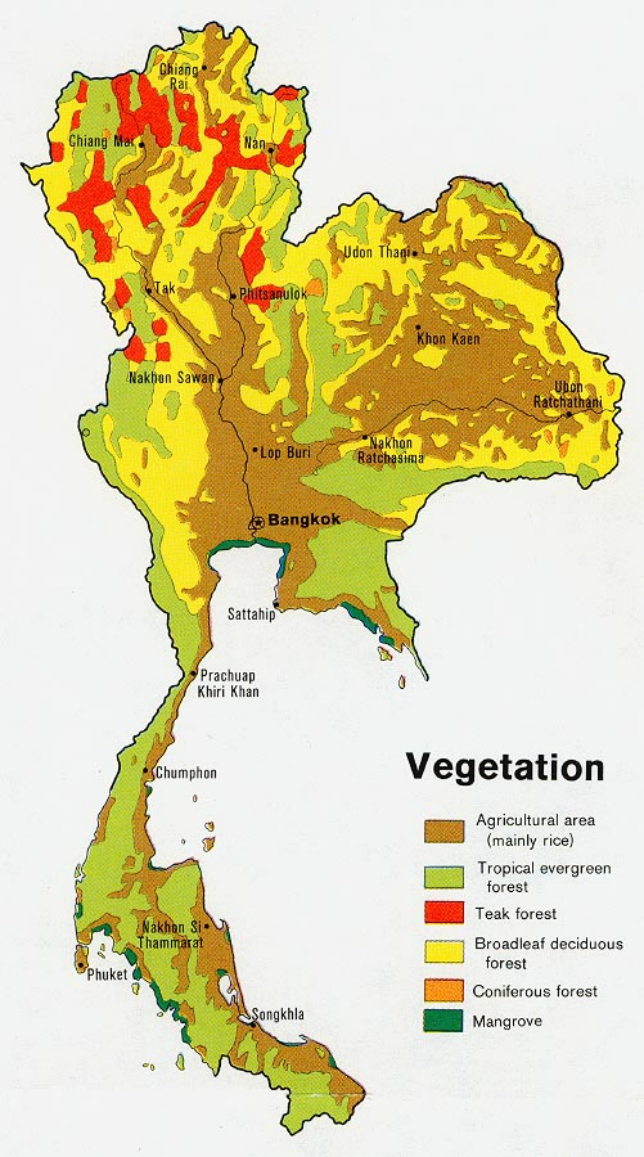
Distribution of bamboo area



Source: FAO (2011)

Total area of bamboo in worldwide: 37 million hectares

Bamboo Resources in Thailand

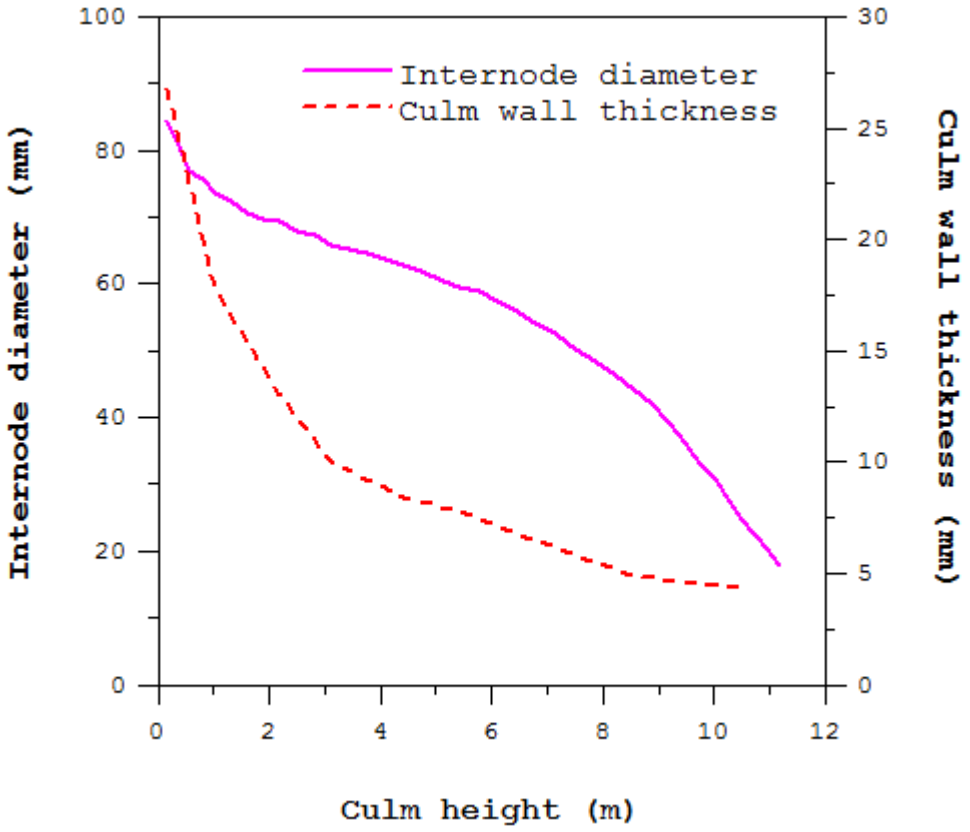


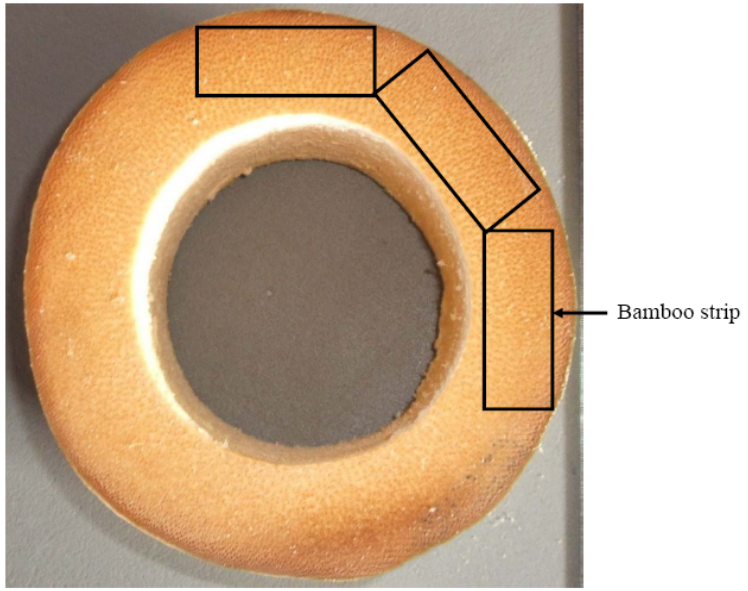
- Distributed in deciduous forests and tropical evergreen forests (in the northern and western parts)
- Total bamboo resource ≈ 260,000 ha (1.8% of the total forest area)
- There are 13 genera and 60 species of bamboo
- The main species:
  - *Bambusa* spp.
  - *Dendrocalamus* spp.

Dendrocalamus sericeus

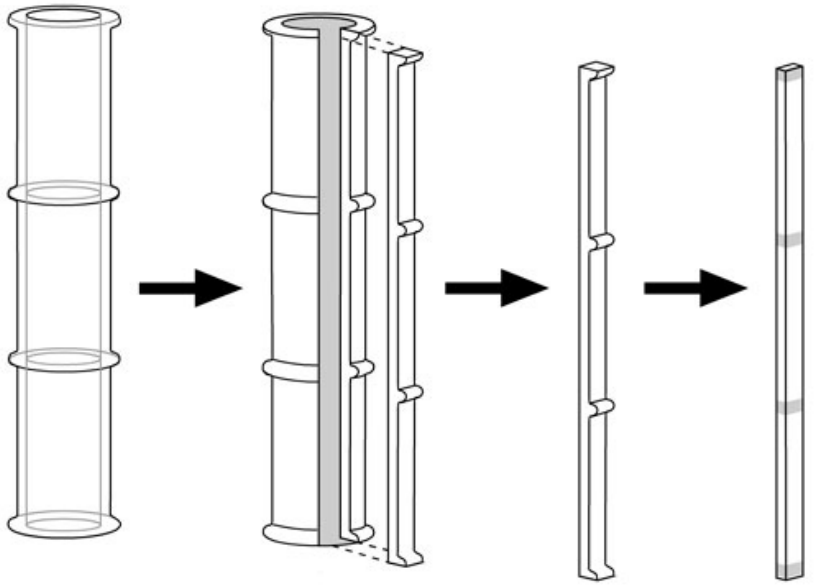
- One of clumping bamboo species.
- Very straight culms to 15 m.
- The most beautiful smooth skinned giant bamboo.
- Found in the higher altitudes of Northern Thailand.
- Uses: construction, furniture and decorative strips (bamboo matts, and interior design)

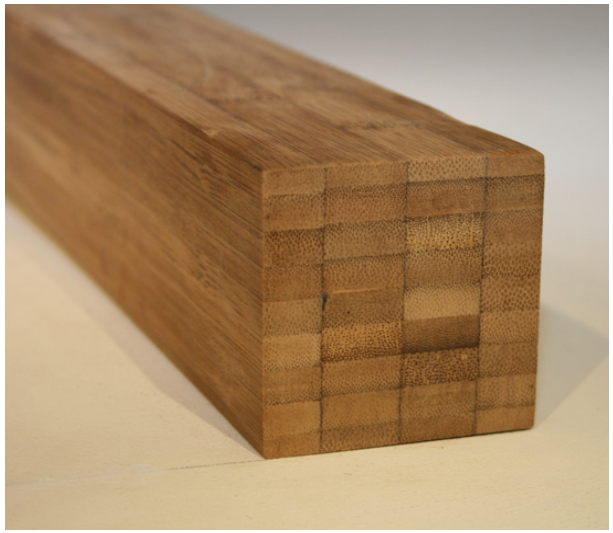
Advantage of *D. sericeus*





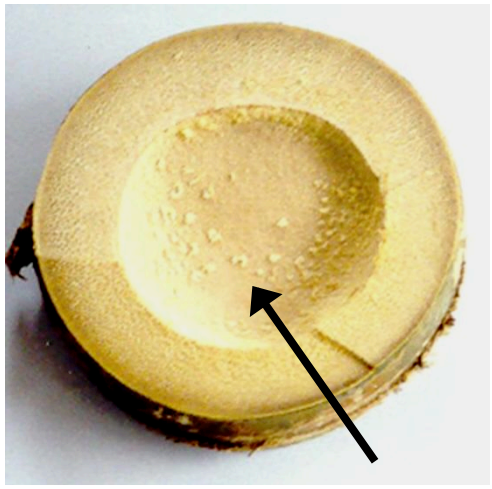
Laminated Bamboo Lumber (LBL)





- A type of structural bamboo-based composite
- Composed of several layers of bamboo strips which are placed parallel to each other bonded together with durable, moisture-resistant adhesives.
- Use: construction (as vertical columns or horizontal beams, as well as curved configuration, arched shapes), panel form for truck floor and gang planks.

Bamboo culm characteristic

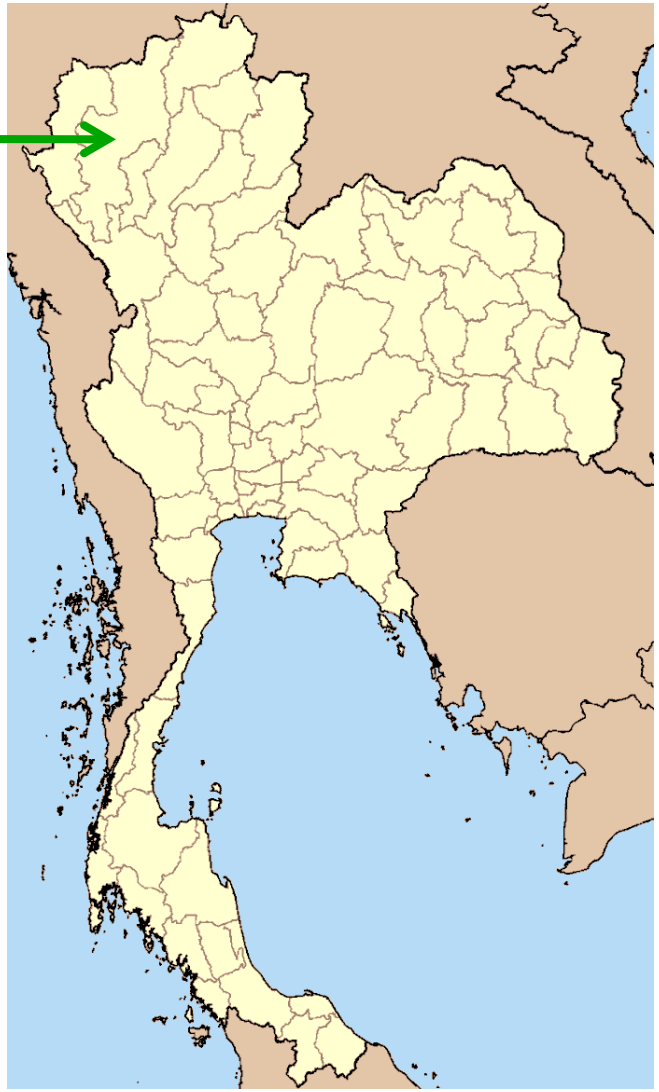


Objectives

- To investigate the surface properties of *D. sericeus*.
- To produce LBLs from *D. sericeus* bonded with MUF resin in the lab-scale regarding to the combinations of the layer structure.
- To investigate the LBL properties.

Raw material preparation

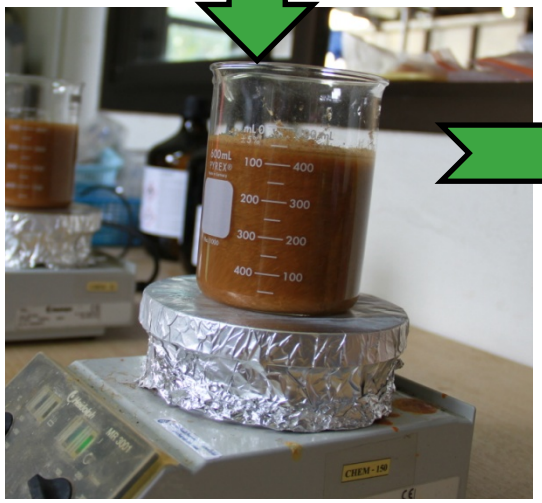
Bamboo culms (3 years old) from plantation in Chaing Mai



1st to 6h internode taken from culms at the bottom part were collected

pH value & buffer capacity investigation

Bottom part of bamboo culm



Soaked in distilled water and then stirred

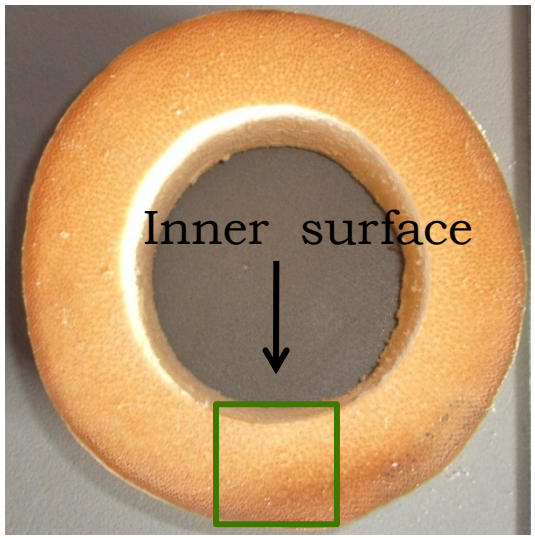
Record the pH value and buffer capacity in acid addition

Result: pH value & buffer capacity

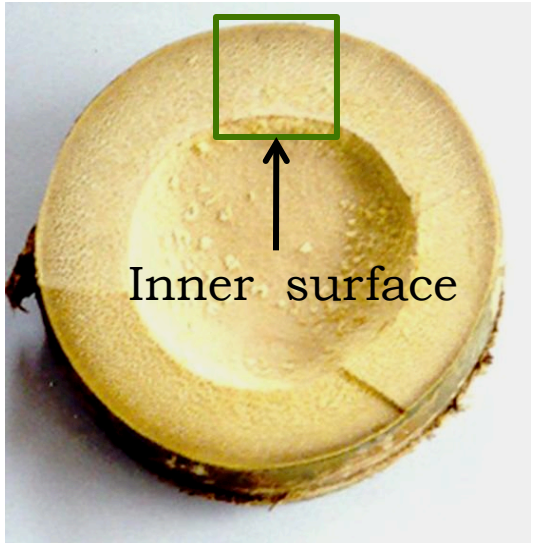
Species	pH value	Buffer capacity
Dendrocalamus sericeus	**6.1**	**0.14**
Populus spp.[1]	5.8	0.23
Pseudotsuga menziesii [1]	3.3	0.09
Tsuga canadensis [1]	5.5	0.20
Quercus alba [1]	3.5	0.10

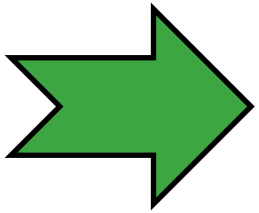
Source: [1] Graves (1985)

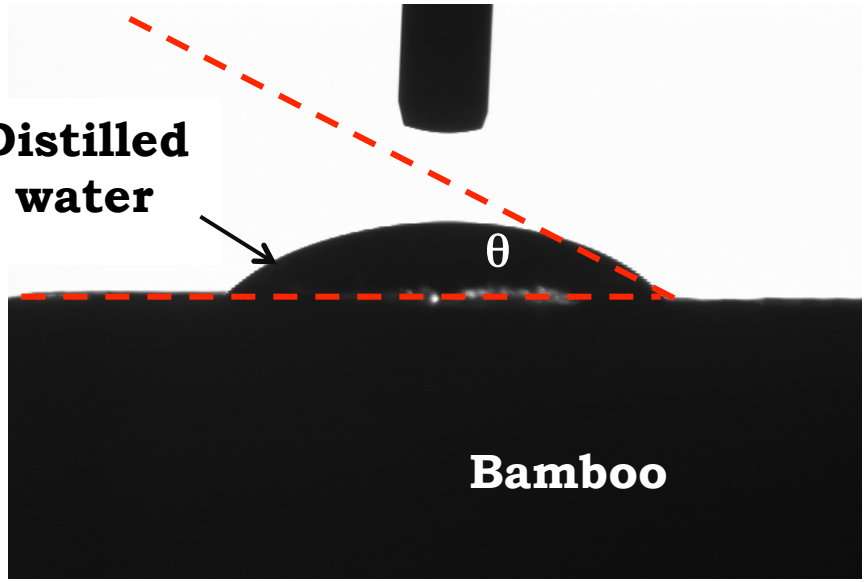
Wettability measurement



Outer surface

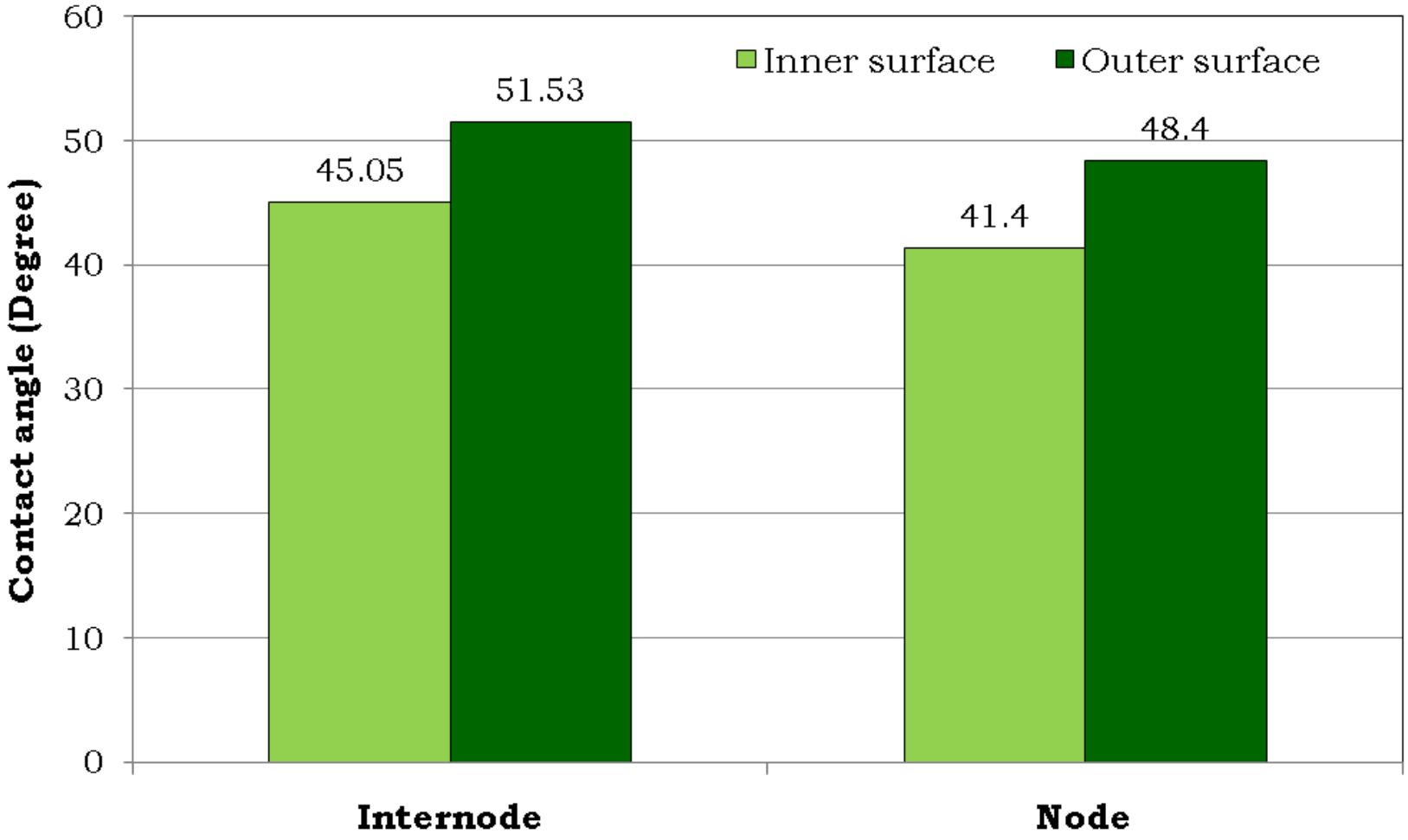




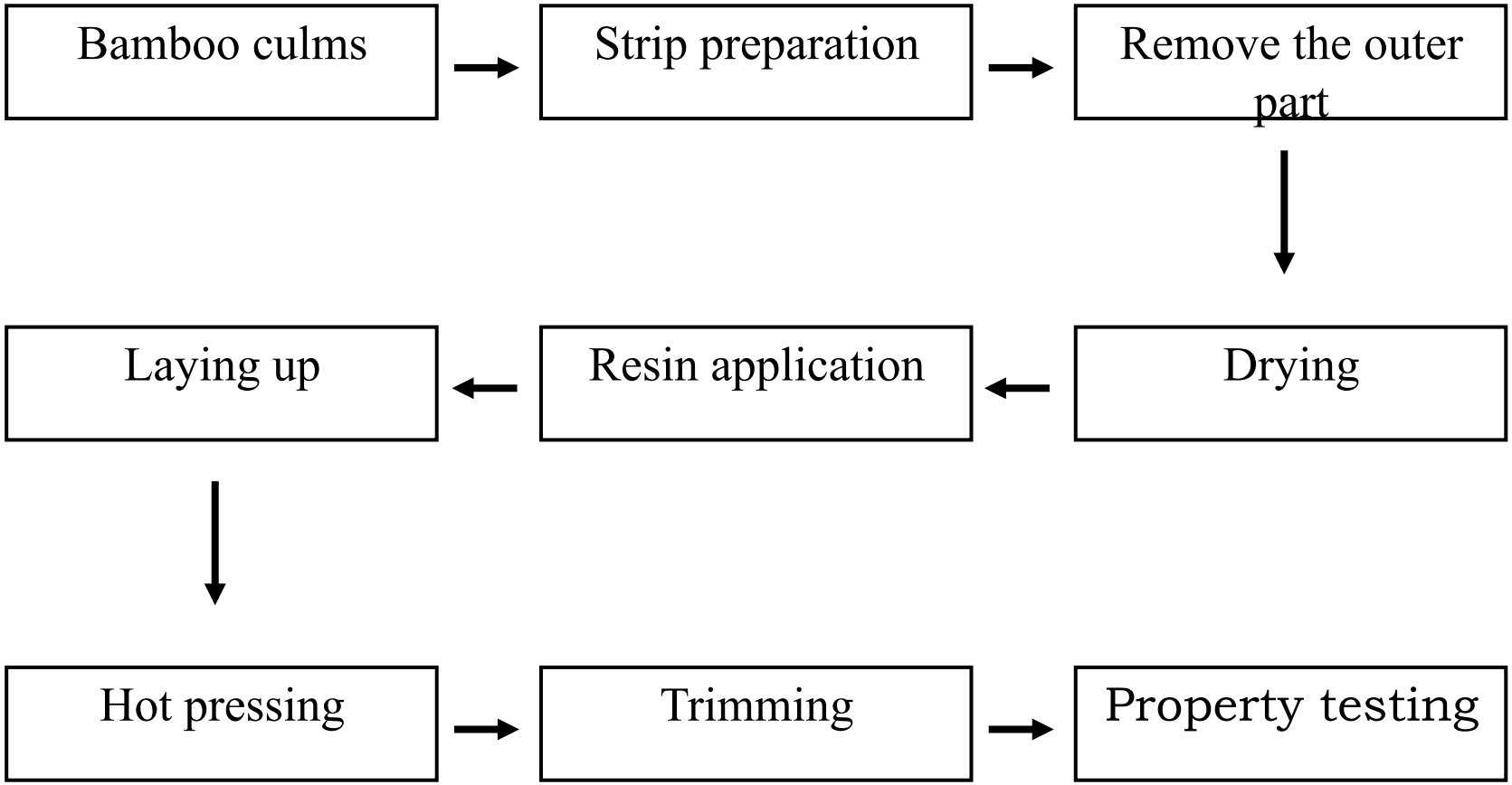


Measure the contact angle after drop the distilled water on bamboo surface

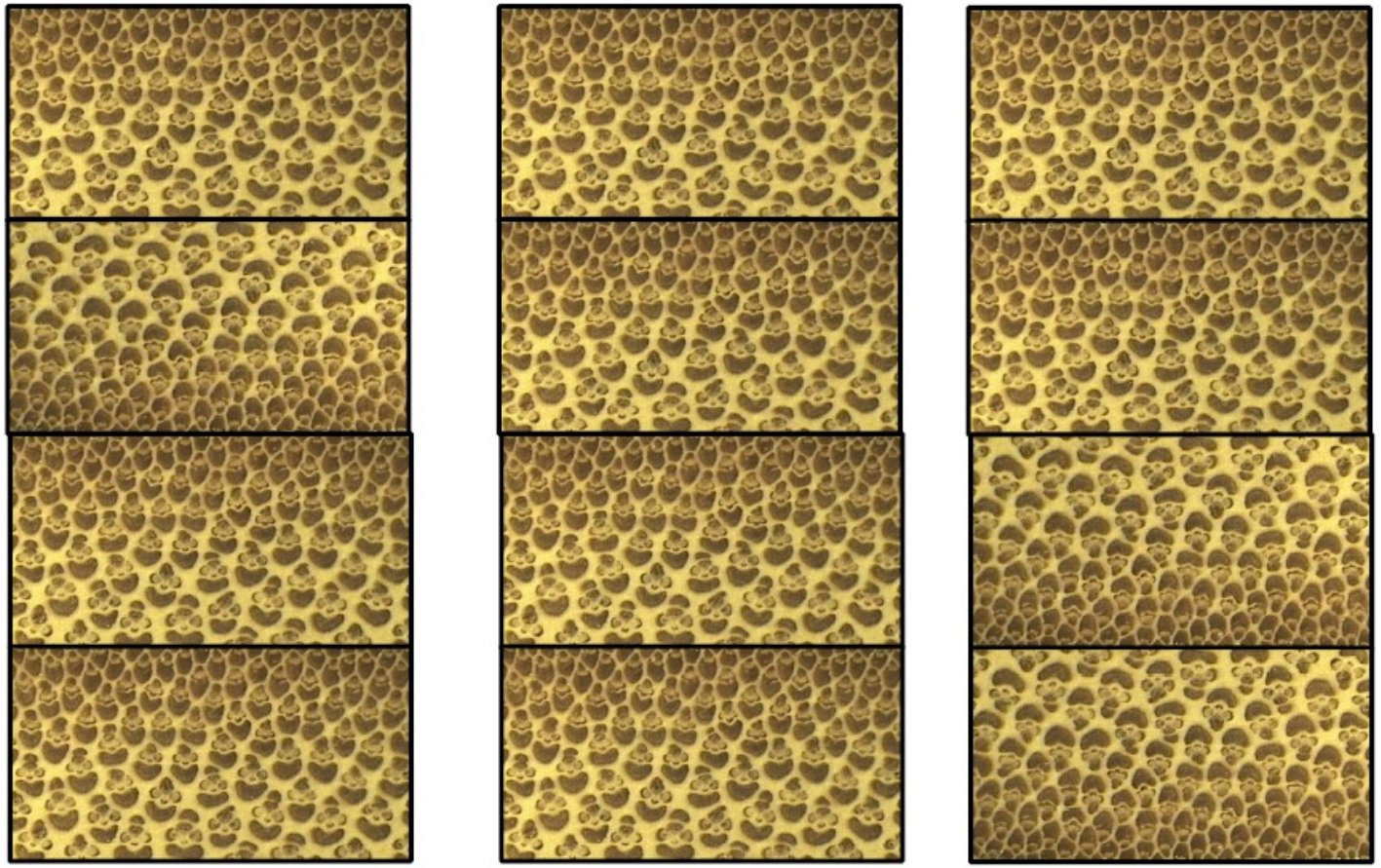
Result: Average value of contact angle



Prototype Laminated Bamboo Lumber

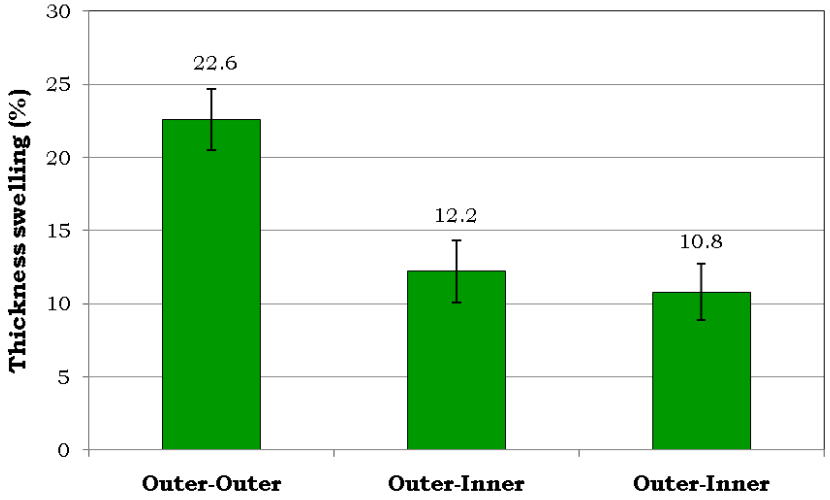


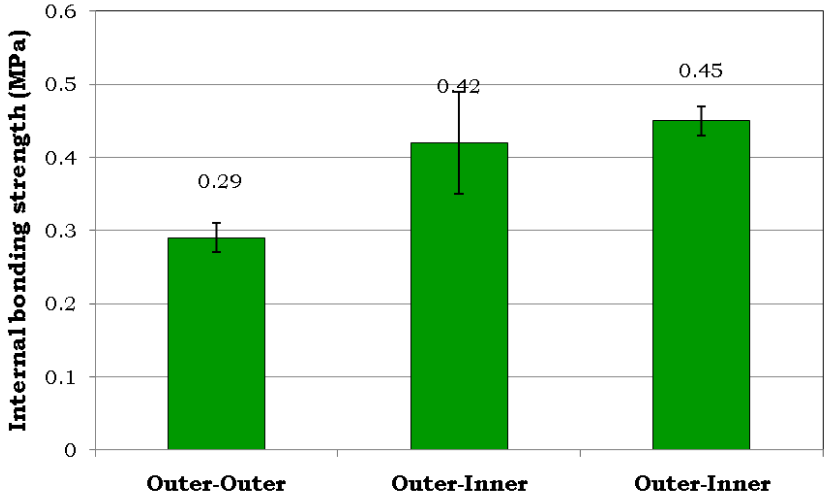
Layered structure on LBL

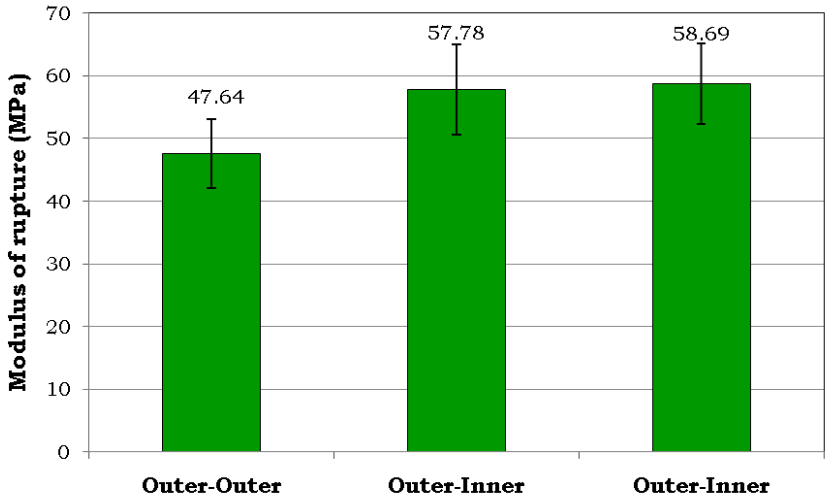


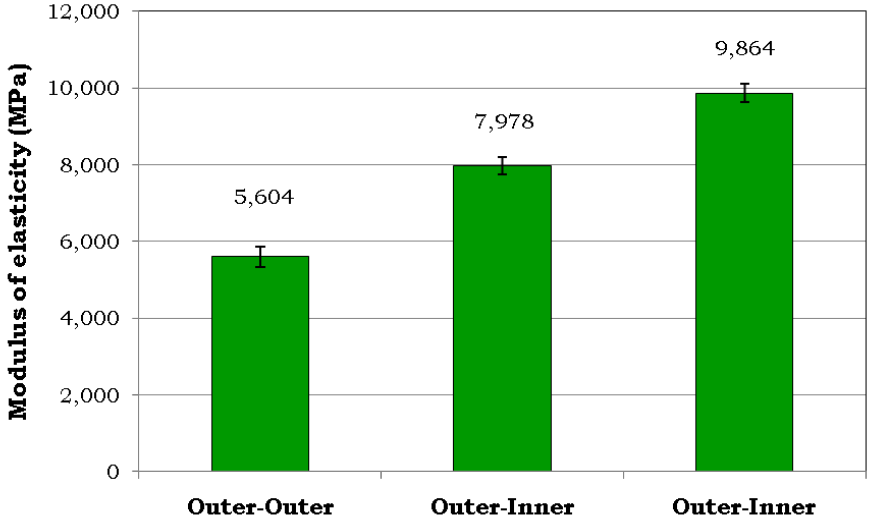
Outer-outer Outer-inner Inner-inner

Result: LBL properties









Conclusions

- *D. sericeus* has the comparable pH value and buffer capacity to other commercial wood species.
- The wettability of *D. sericeus* is quite similar to common wood species. In addition, wettability of bamboo culm outer surface is found to be lower than inner part. Moreover, the wettability of nodes was found to be higher than internodes.
- The layered structure appears to be significant variable for the properties on four-ply LBL made from *D. sericeus*.
- Based on this finding, the bamboo strips should be laid in inner-inner layer type for LBL manufacturer

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Thank You
for
Your Attention