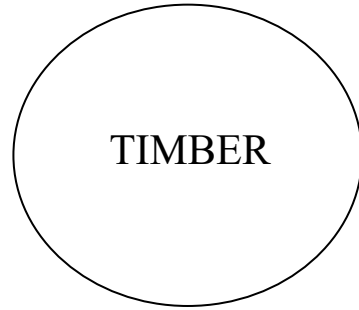


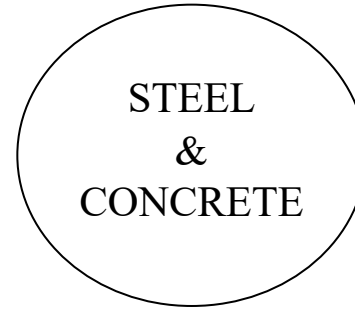
BAMBOO

- Not a tree, but a giant grass
- South America and Southeast Asia are the centers of diversity
- With 1,439 species in the world, 161 species in Indonesia (121 native)





vs



Renewable resource

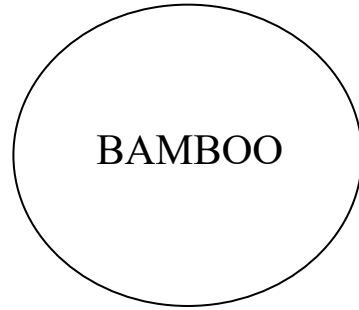
+

Lifetime, durable

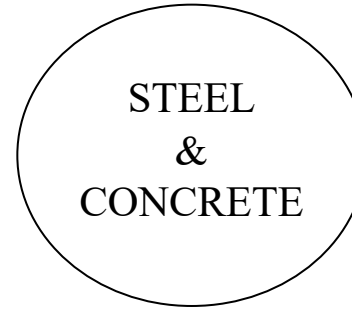
deforestation

-

Non-renewable resource
High consumed energy



vs



Renewable resource

+

Lifetime, durable

~~deforestation~~

-

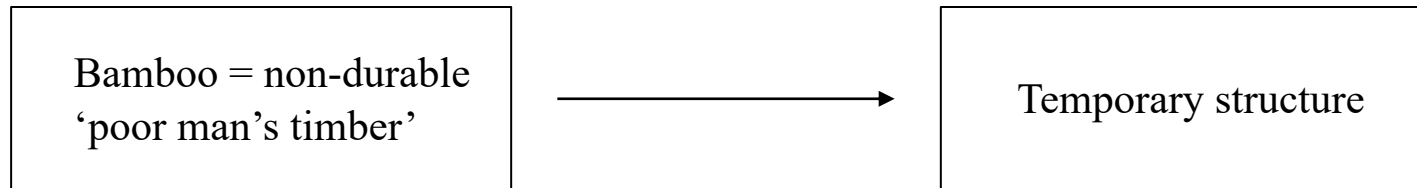
Non-renewable resource
High consumed energy

How Bamboo is Used in Indonesia

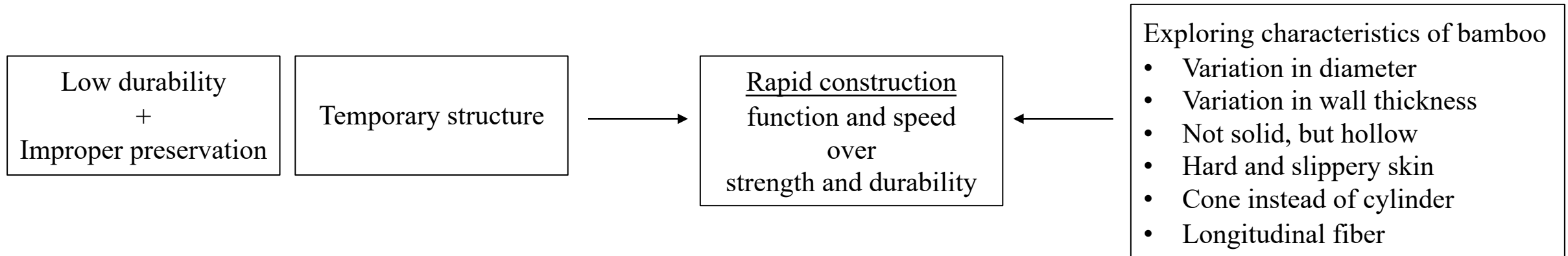


Natural durability of bamboo (Janssen, 2000) :

- 1-3 years in the open and in contact with soil
- 4-6 years under cover and free from contact with the soil
- 10-15 years under very good storage / use conditions.



Traditional and Vernacular Architecture



Simple Gazebo





Drilled Lashing Joint



- A hole is drilled all the way through the pole. A cross-pole is then secured to the upright by a lashing through the hole. Lashing on both sides of the cross-pole node prevents the bamboo poles from shifting.
- Tying lashings around any drilled hole is a good way to strengthen the joint and helps prevent bamboo poles from splitting.
- The drilled joint can also be used to connect the end of a cross-pole to an upright. For this application, the lashings should be tied above a node on the upright. Downward pressure on the cross-pole will simply tighten the bamboo lashings further as they encounter the larger diameter of the node.

This is one of the most basic principles used in bamboo construction; having the nodes work for you to prevent slippage

Pegged Socket Joint



- This joint is a pegged socket joint. A hole is drilled into an upright bamboo pole at the right size to fit a smaller cross-pole.
- The cross-pole is then fitted snugly into the socket until it touches the back wall of the upright bamboo pole.
- A hole is drilled through both pieces so that a peg can be inserted to pin the joint together.
- Lashings should be added to these bamboo joints to help prevent splitting under heavy loads.



Working with Bamboo, Basic Principles and Techniques



WRONG

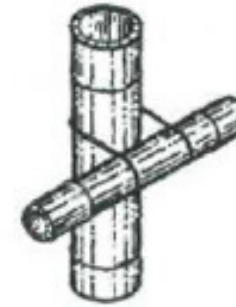


RIGHT

- Do not use green, fresh cut bamboo
- Only use mature bamboo of 4-6 years
- Do not use bamboo infected by insects
- Do not use bamboo poles with profound vertical cracks
- Use bamboo with the right diameter and wall thickness for your project
- Use appropriate cuts and joints when building with bamboo

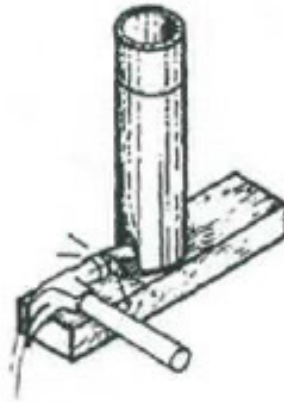


WRONG



RIGHT

- Do not use conventional wood nails in bamboo joinery, they will cause the bamboo to split. Instead use nylon, steel or vegetal cord of the appropriate diameter.



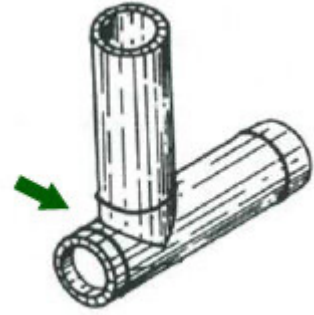
WRONG



RIGHT

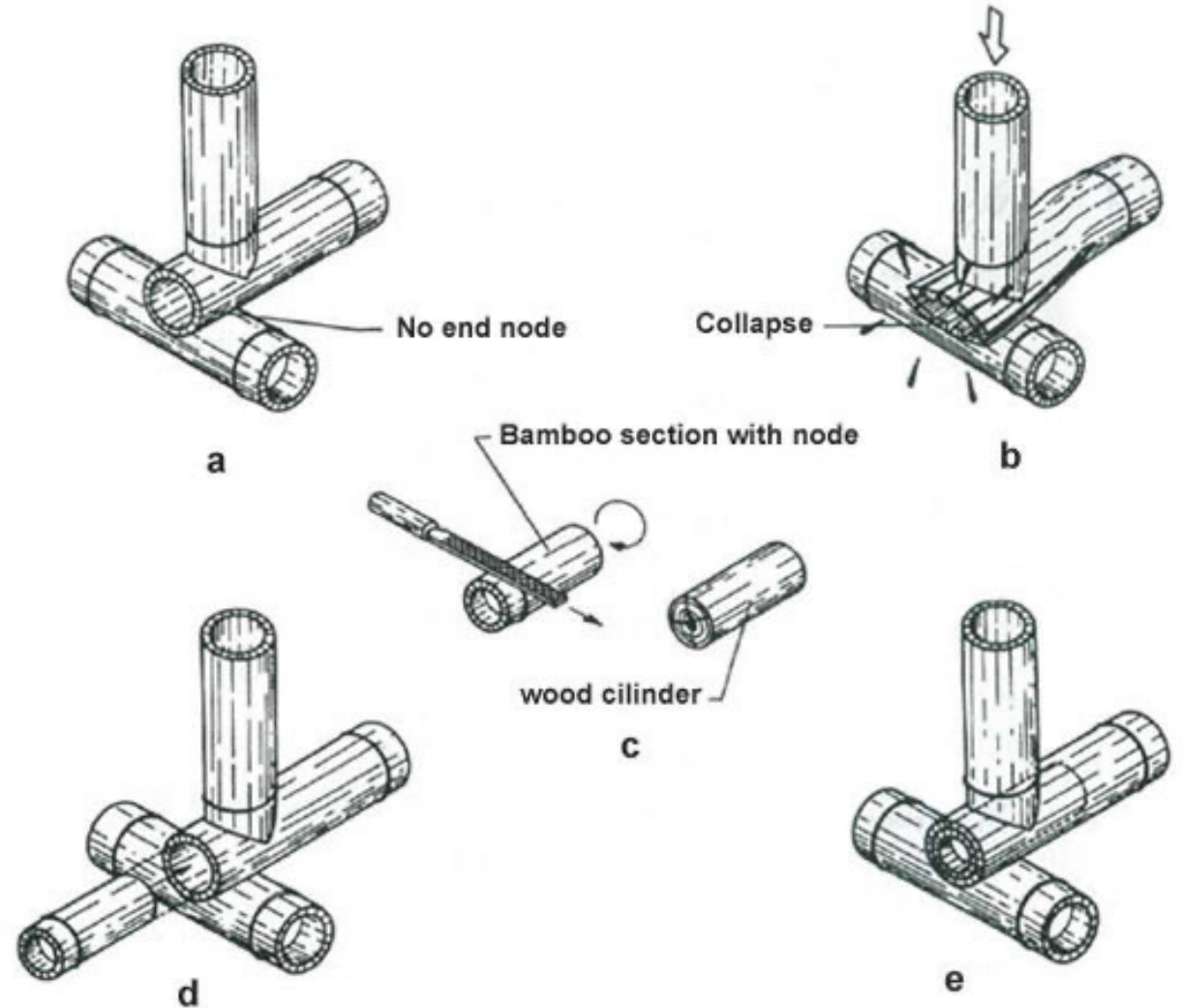
- When using bamboo as a column make sure that the lower part connecting with the surface ends with a node. If not the bamboo will splinter when struck
- When connecting bamboo poles with bolts, make sure to bolt them together in between 2 nodes, otherwise the bamboo may crush.

Bamboo Has Nodes, Use Them!



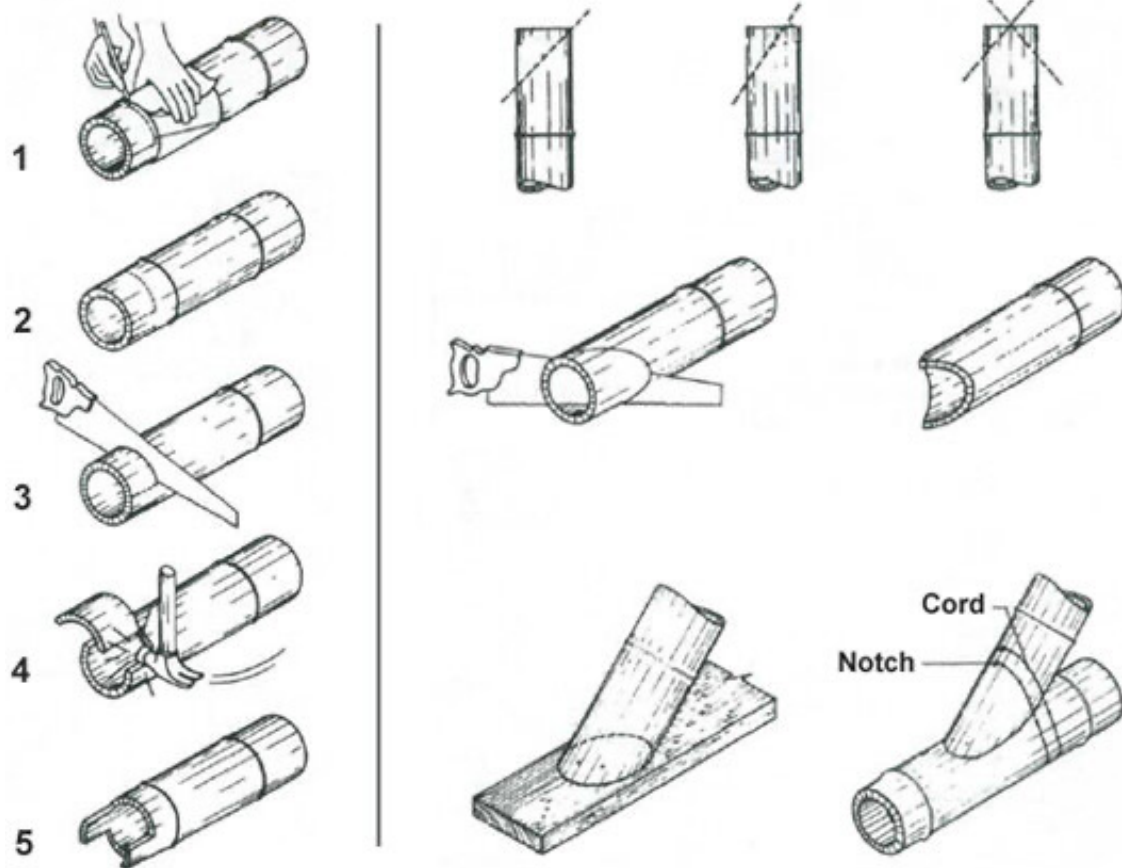
In construction, using bamboo nodes is very important. Bamboo columns or beams need to have a node at both ends (or as close as possible towards the ends), if not the pressure of a structure on the joint may crush the bamboo.

Often it isn't possible to find bamboo of the required length with both end nodes in place. When this occurs you should insert a wooden cylinder of the appropriate diameter or a fitting piece of bamboo with a node.



Bamboo Cuts

These are the most common cuts to use when making bamboo joints:



one ear

two ear

beveled

flute mouth

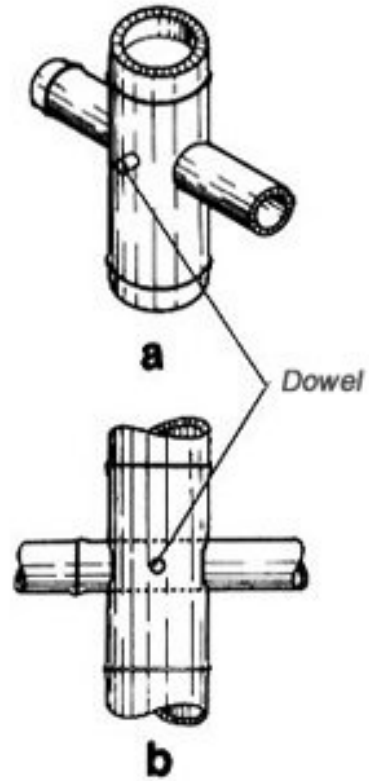
fish mouth



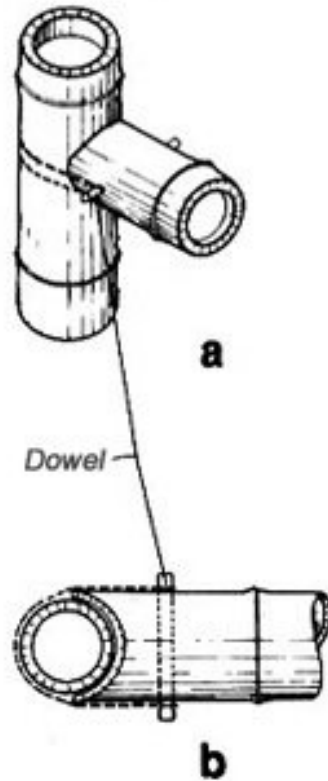
Making basic cuts in bamboo doesn't require expensive or heavy power tools, just a few traditional hand tools will work fine.



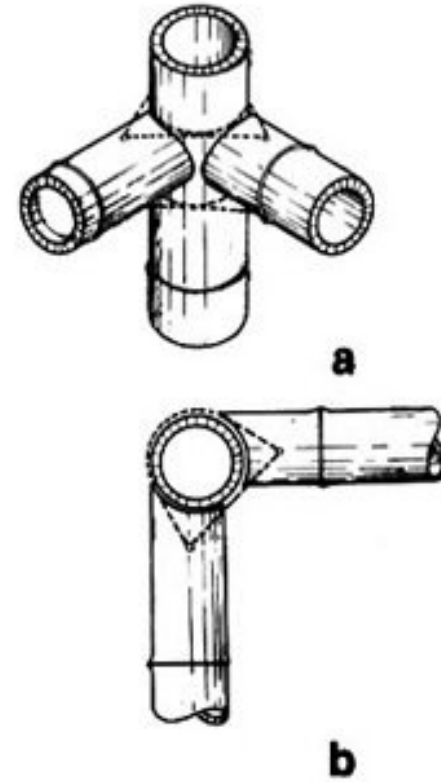
Joining and fixation of bamboo poles



Cross joint with dowel



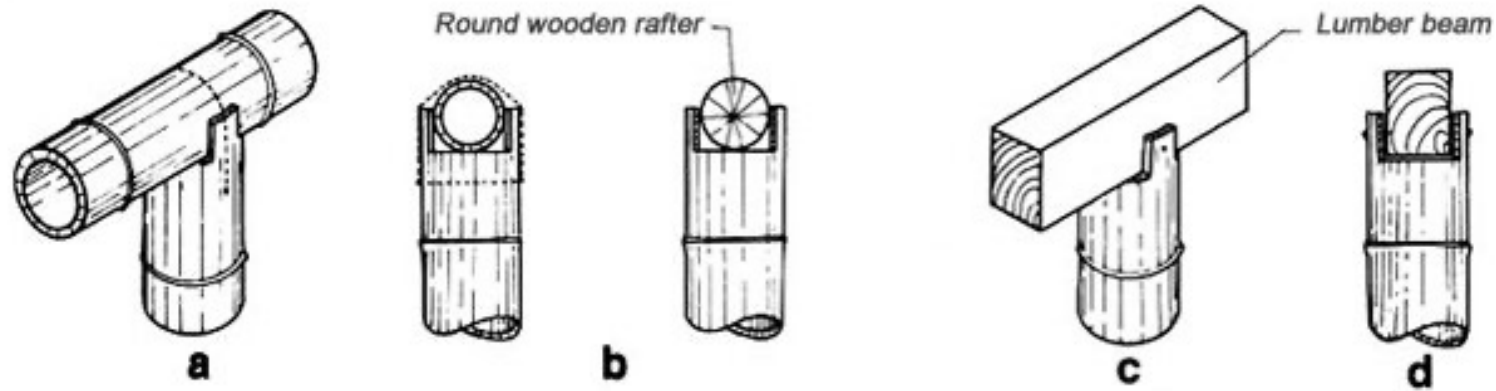
Lateral joint with dowel



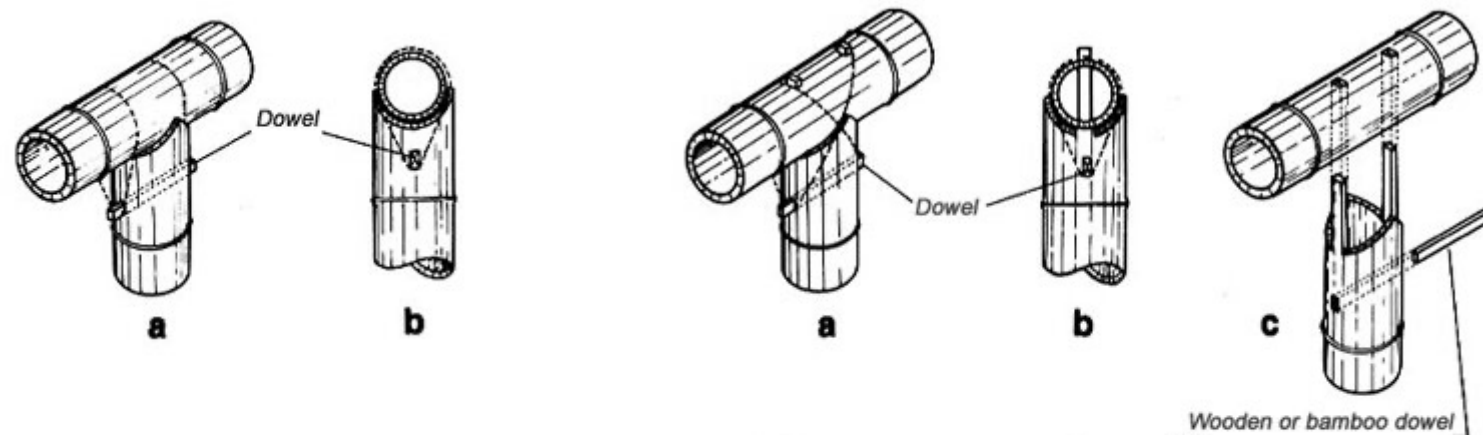
Corner joint

Joining horizontal with vertical elements

Joint with one or two ears is used to join bamboo rafters, logs or lumber.



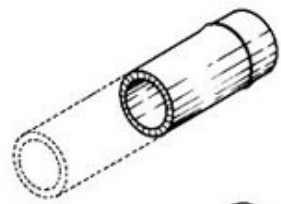
Fish mouth joint, use of dowels and anchors in bamboo joinery



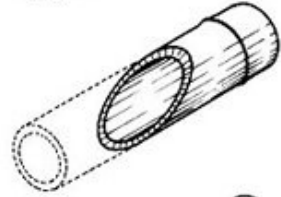
Joining bamboo with dowels and lashing. The peg should be placed in the column parallel to the rafter.

Fish mouth joint with pegs.

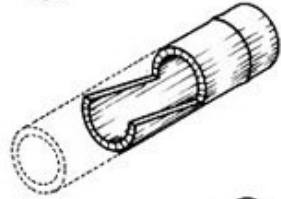
Splicing bamboo poles



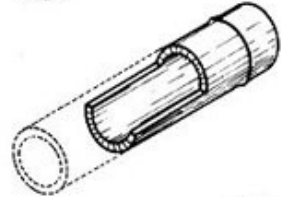
1. Top splicing.



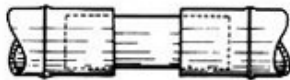
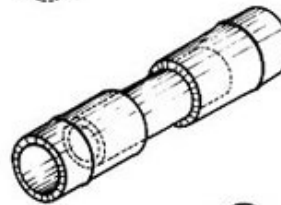
2. Bevel splicing.



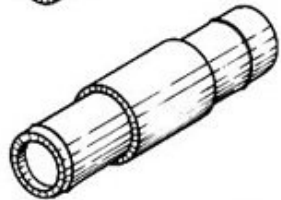
3. Ray splicing



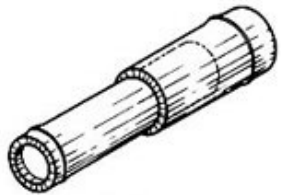
4. Half bamboo splicing.



5. Splicing with internal union.



6. Splicing with external union.



7. Telescope splicing.

Plastered bamboo construction - Bamboo as substitute for brick



Study on Colonial Plasteres Bamboo Construction in Jatiroto (1998-1999)



These houses were built in early twentieth century to accommodate Dutchmen employee in sugar factory in Jatiroto, East Java.



A few damaging house gave us solid proof of the bamboo mat as inner part of the wall.
The skeleton could only be seen from the interior.
They used mortar plaster by mixing sand with lime

Plastered Bamboo House Prototype in Pasir Impun, Bandung (1999)



Step 1 : Bamboo workshop to produce prefabricated bamboo panel including wall and window frames.



Step 2 : Land preparation and tie beam construction on site, in the same time with bamboo workshop



Step 3 : Erecting the prefabricated bamboo panel and constructing roof



Step 4 : Plastering bamboo house to become ‘permanent house’

Plastered Bamboo House Construction



Bamboo Panel Prefabrication



Roof Frame Prefabrication



Bamboo Panel Erection



Plastering the Bamboo Wall



Plastering Process and Roof Construction



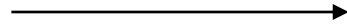
Exterior View



Interior View

While bamboo might have a reputation as a second-class building material, it can be converted into artistic products of high quality and functionality

Bamboo = non-durable
'poor man's timber'



~~Temporary structure~~



Bamboo preservation

Treatment : Borax, Boric Acid, Freemite

- soaking / deeping method (4-6days), all internodes are perforated

Bamboo preservation, by design

- Big Hat (roof) : cover from sun and rain
- High Heels (foundation) : far from soil
- Ventilation : mold free

Thank You