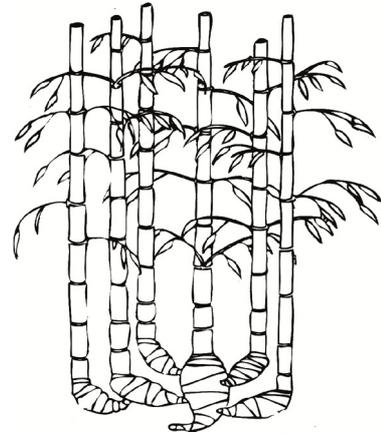


Fact Sheet 1: Bamboo

Background

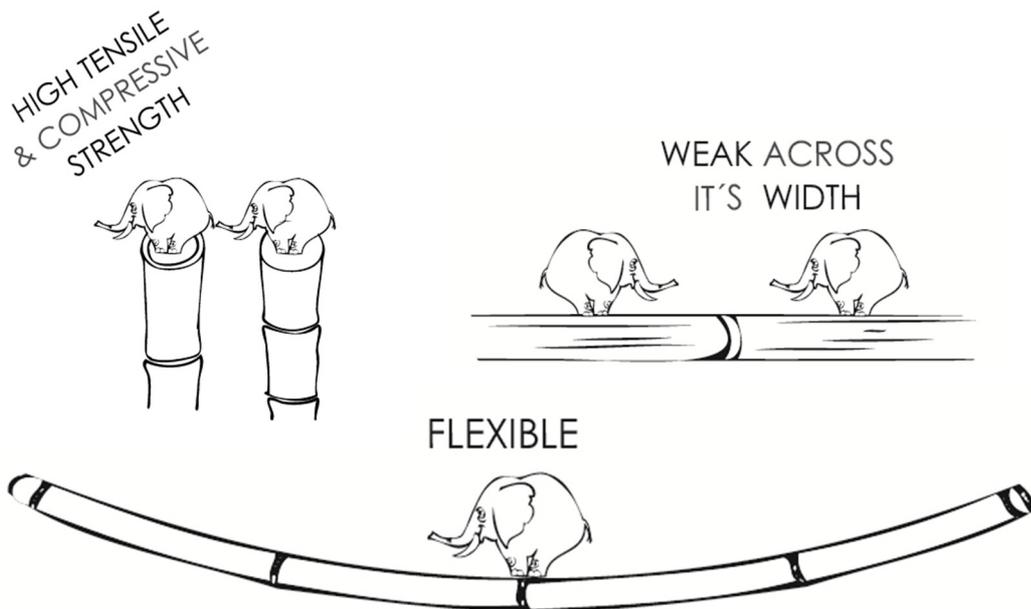
Bamboo is a form of grass that grows over much of the planet. There are thousands of varieties, they are divided broadly into two groups; clumping bamboo's that grow in distinct and separate clumps, most common in the tropics, and running bamboos that are found primarily in cooler northern climates.



There are over 200 varieties of “woody” bamboo that are used in construction, Each species has differing properties, advantages and disadvantages but also some things in common. ***It is critical to talk with local bamboo experts to know the exact characteristics of local species and how best to treat them***

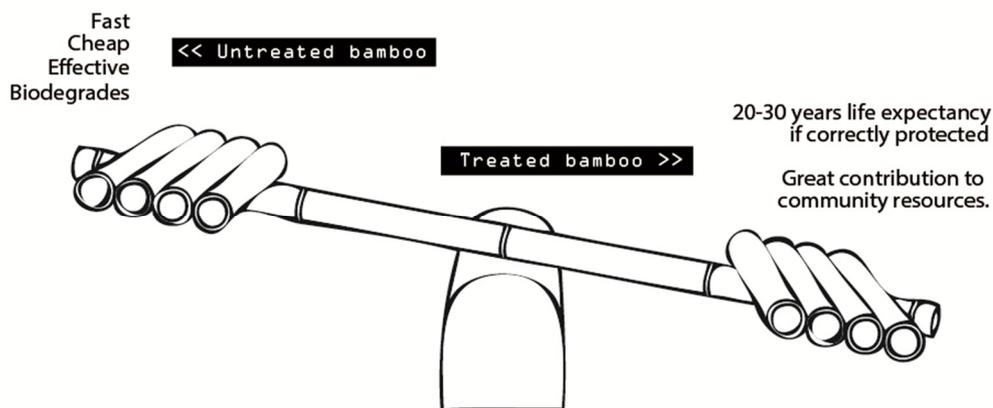
Structural Characteristics

Bamboo is very different in its properties to timber, with a much higher tensile strength along it's length (equal to mild steel) culms can handle high levels of load in tension and compression as long as supported to resist buckling and joined well. Across their width bamboo culms are strongest in compression at, or close to nodes and much weaker and easily crushed between the nodes, hence designing around nodal placement and bracing in all dimensions is critical.

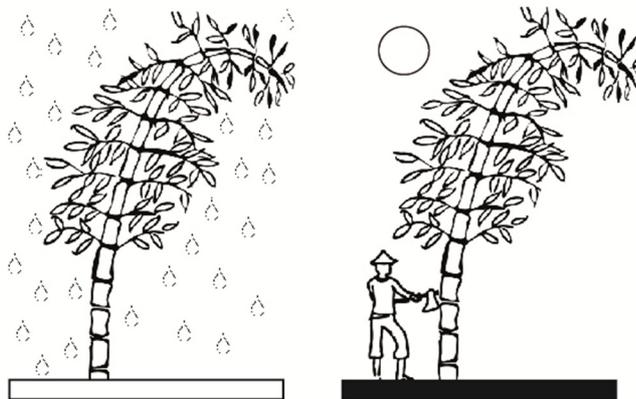


Durability and lifespan

The durability of bamboo is directly related to how well it is treated at all stages of its use, including how it is grown, harvested, dried, stored, transported, and installed. Well grown and harvested bamboo, protected from excessive rain, sun and ground contact can last for 10's of years, while poorly treated bamboo may only survive a year or two at best.



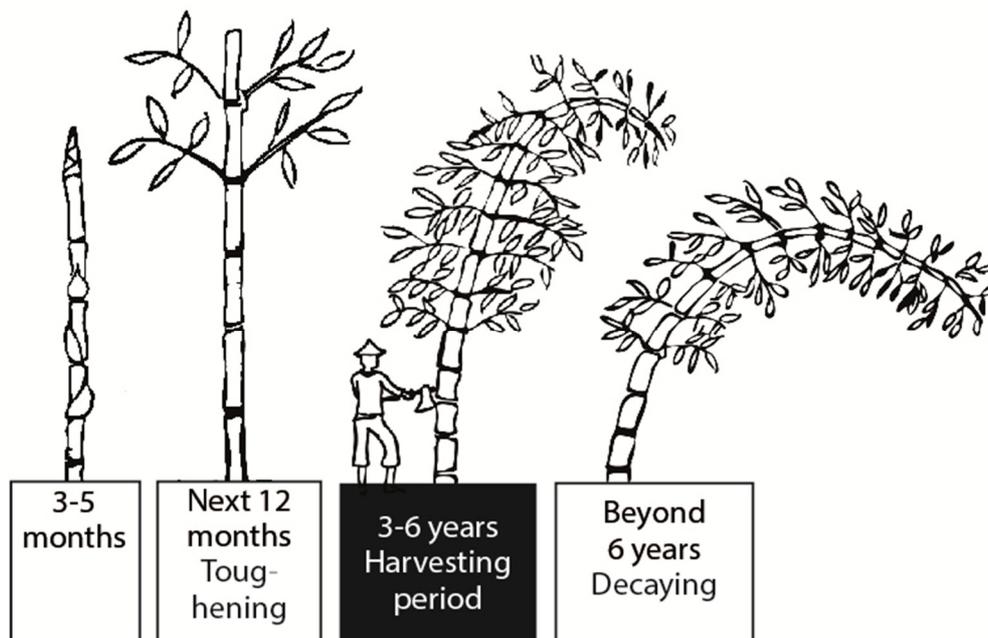
Bamboo fails most commonly through rot from excessive water contact, and attack from pests seeking out the sugars in the starch of the bamboo, harvesting when sugar levels are at their lowest, (in the early morning, during the dry season) will greatly increase durability.



The outer skin of bamboo is hard and salicaceous, unattractive to most pests, hence most pest infestation occurs at the joints and through cracks and holes. Reducing cracking through careful handling will greatly increase life expectancy as will surface treatments such as paint and oils.

Lifecycle

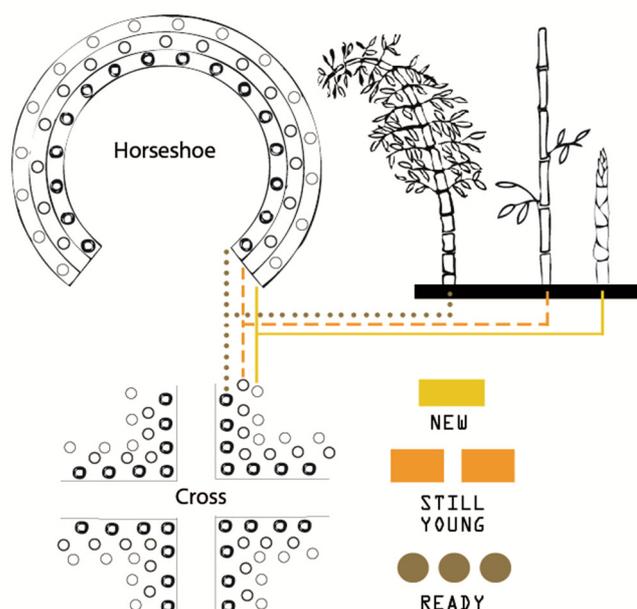
Woody Bamboo plants are most commonly cultivated from sections of a culm or rhizomes and take around 8-12 years to reach full maturity. Once mature they can be cropped by 20-30% per year for their lifespan, before finally flowering, turning to seed then dying (commonly 50-150yr cycle).



Each culm in the clump of bamboo grows to full height and width over one rainy season, sprouting leaves and branches over the first year. Over the next two years the culms toughen and dry, reaching full strength in their 3rd year at which time they are ready to harvest till around their 6-7th year, when they begin to degrade, slowly being attacked by mould, fungus, rot and insects till unusable.

Harvesting

Local communities tend to know when bamboo is ready to harvest by its colour and or the sound it makes when tapped. Young bamboo has a fresh clean green colour and has a dull tone when struck, slowly toughening to darker or yellower colours depending on the species and developing a tighter clearer tone. The surface of older bamboo's become covered in mould and they begin to loose their tone, eventually splitting, falling over and rotting.



Bamboo is an important though often undervalued community asset, to maintain this asset only harvest around 20-30% of a clump per year, trying to thin the clump evenly to allow more sunlight to enter. Overharvesting can result in dramatically reduced crops for years to come or even kill off the culm.

When harvesting, cut the bamboo neatly and evenly immediately above a node that is one or two nodes above the ground, to reduce the potential for fungus and mould to infest and degrade the plant.



Proper way of cutting bamboo.

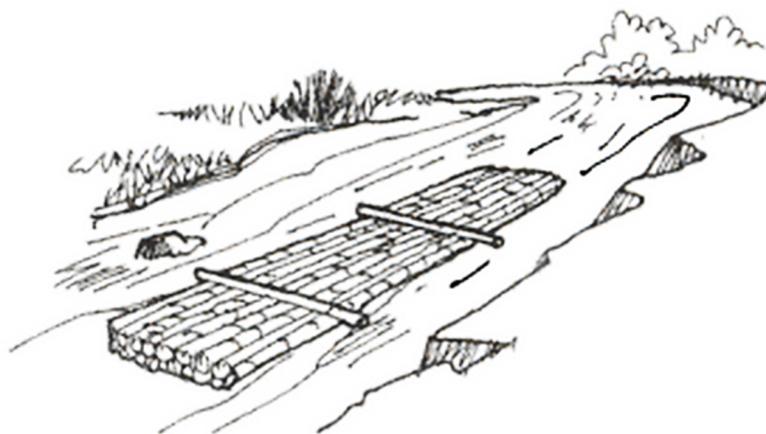


The water enters inside the culm causing fungal attack.

Past large-scale humanitarian shelter responses have been responsible for the devastation of bamboo crops, impacting heavily on food security, causing erosion, reducing wind protection and affecting livelihoods for year to come. Humanitarian shelter programs should include clear procurement guidelines and monitoring to minimise impact. Crop replanting as a livelihoods support component could be considered.

Leaching

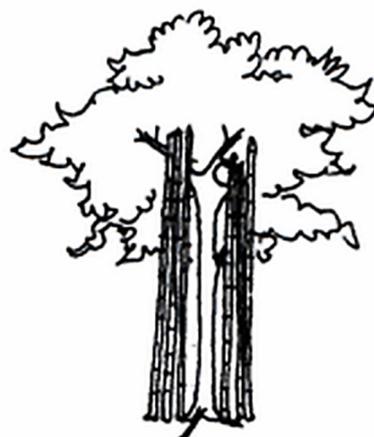
In many cultures freshly cut bamboo is soaked in rivers or streams to leach out sugars and saps to reduce pest infestation. Where time allows these local practices should be supported. Leaching should be done as soon as possible after cutting whilst vascular cells are still



open. Leaching is more effective on smaller sections of bamboo, so cut to length or split prior to leaching. Knocking a hole through the centre of each node along the length of bamboo will allow saps to wash away more rapidly. Where possible leach in flowing rather than stagnant water, placing bamboo in a flowing stream weighted down with rocks for a week or two is one common solution. If leaching, dry prior to use to avoid cracking.

Drying

Bamboo will achieve its greatest strength if dried prior to use. For best results dry evenly undercover out of direct sunlight, rotating regularly to avoid splitting from uneven drying.



Where time pressure does not allow for drying prior to use, bamboo joints should be designed to allow for shrinkage and extra bracing should be added to ensure the culms dry out straight and even in application.

Transport and storage

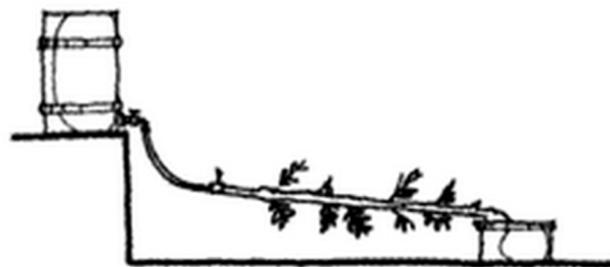
The more that bamboo is cracked and split the more quickly and easily it will become infested by pests. Bamboo culms should be loaded and underloaded by hand, not thrown from the truck. They should be stored carefully so that air can circulate around each culm and so they are protected from ground water and rain.



Treatment

Whether to treat or not treat bamboo is a common discussion in humanitarian circles. For emergency or even temporary shelters untreated bamboo is more than adequate particularly if the other steps described here to protect and value the material are undertaken. Treatment should be considered for core houses and temporary shelters that are in all likelihood likely to become permanent.

Treating bamboo does not change the need to protect and value the material at all stages of usage as most treatments are water based and will wash out of not protected from rain and ground water.



Boucherie Process

Treatment can be divided into two types; surface and penetrative.



Surface treatments such as the application of sump oil, paint, varnish or other chemicals are not as effective as penetrative treatments and require regular top up treatments. They should be applied in a diluted form to ensure as deep penetration as possible. Focus should be given to joints, ends, cracks and nodes as this is where most pest infestation will occur.

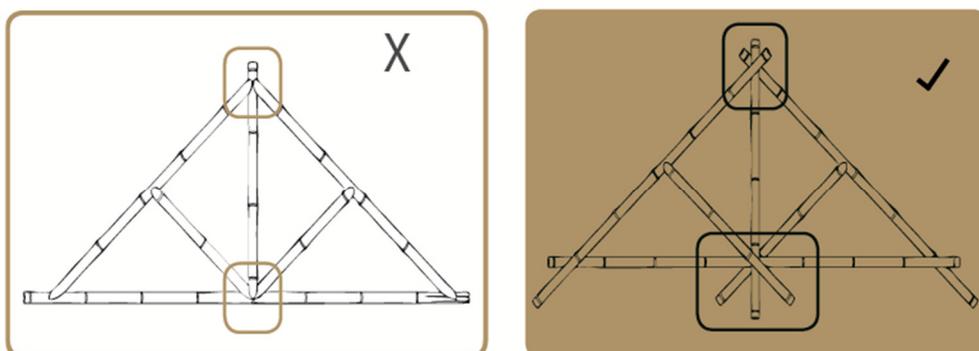
Penetrative treatments involve soaking the bamboo in a chemical long enough for the chemical to soak through the entire structure of the culm. Toxic pesticides and

preservative chemicals such as copper arsenic may be used as may pressure treatment systems. Soaking in a solution of Borax and Boracic acid is a much more common and less harmful method and is generally more suitable to the humanitarian context.

In the humanitarian context it may be better to commence distribution of non treated bamboo for emergency shelters whilst simultaneously setting up treatment systems to take over as recovery and reconstructing commences. It is common to add a dye to the treatment solution to assist communities in differentiating between treated and non treated culms. Training communities in treatment can provide valuable long term livelihoods

Design

Most structures that are designed using bamboo use it in the same way as they would timber. Although generally effective this does not account for bamboos unique characteristics, strengths and weaknesses. The major difference when designing with bamboo is ensuring good nodal placement and protecting the bamboo from weather and pests.



When working with disaster affected communities our aim should be to introduce as few technological changes as possible, focusing rather on getting communities back under cover in buildings that are built out of materials and styles that the community is familiar and comfortable with. Consultation with local communities is key when designing post disaster bamboo shelter solutions. Minor improvements in levels



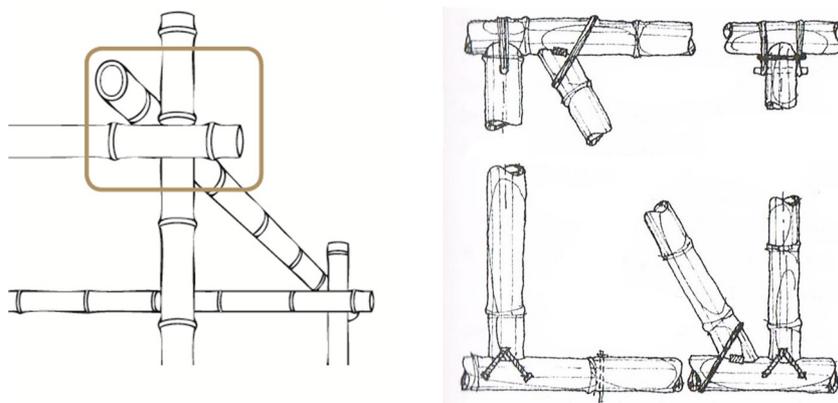
of bracing, quality of jointing and protection from weather and pests is commonly all that is required.

Jointing

Bamboo can be jointed in a wide variety of ways, nails, bolts, string, rope and wire. All can be effective when done well, most important is to use methods that communities are familiar with.

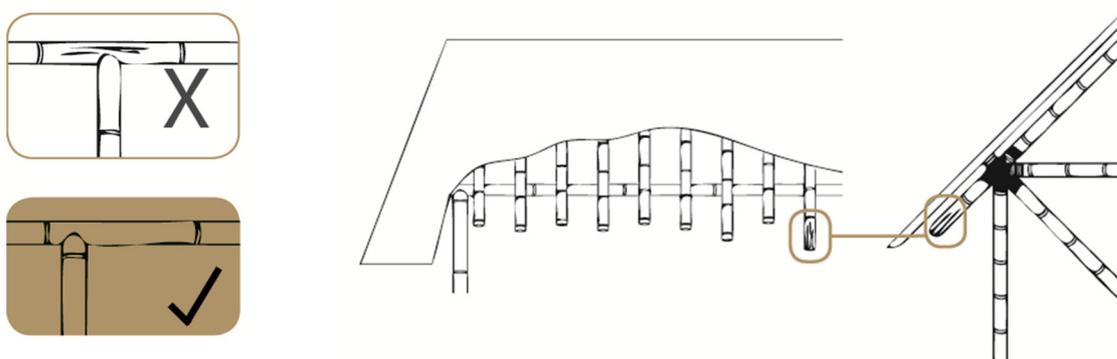
Joint bracing:

To reduce movement that could increase the stress on joints ensure they are braced in all three directions.



Nodal placement:

To ensure culms are not crushed, load bearing joints should occur within 1.5 the width of the bamboo from the node. Culms should be cut after the next node after a joint.



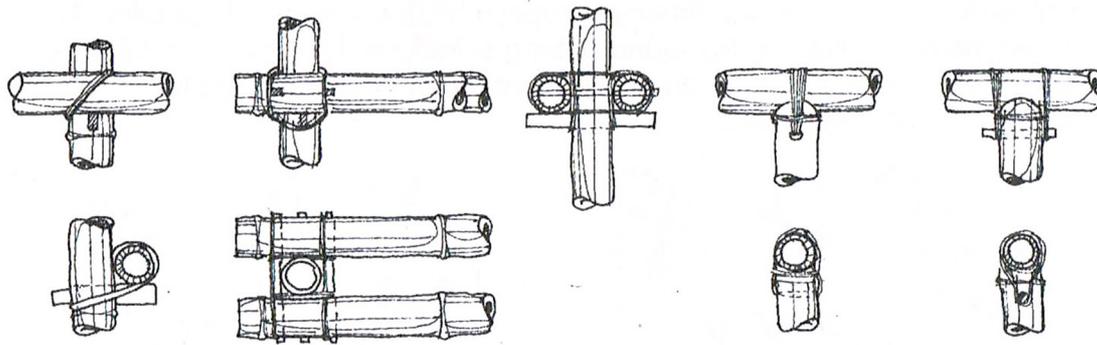
Nails:

Skew nail to ensure grip, pre drill or cut through surface skin to reduce splitting

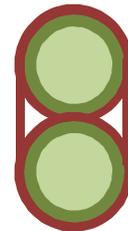


Wire and rope:

When using green bamboo design joints so wires or ropes can be tightened as the bamboo shrinks.



Tie around the bamboo in a figure 8 as well as in an 0 around the joint ensuring that the two pieces are held firmly together but also that the pressures are spread around the circumference of the culm and not simply by crushing them together



Maintenance

Bamboo structures should be regularly checked for damp, excessive sun bleaching and pest infestation, surface treatments should be applied and individual sections replaced as required

