## Why rough?

• Delamination is a common mode of failure for composite materials. Delamination results from poor bonding between layers in a composite. Roughing bamboo is a way to ensure good bonding between the natural composite of the bamboo and the artificial composite lug. One of the first bikes built by the BBS team had an unroughed down tube. It didn't work so well.

• Bamboo pulls silica out of the soil. The skin of bamboo contains a high concentration of silica, up to 10%. This silica is the same stuff you'll see on silicon cooking utensils. It is ultra non-stick. It is critical to remove this outer skin and expose the lignin underneath.

• The lignin is the matrix of the bamboo fiber composite. It is slightly porous. Exposing these pores will allow the epoxy resin to soak into the lignin, forming an ultra strong bond and integrating the natural composite bamboo tube with the artificial composite lug.

• Our roughing lengths are generally 60mm from the bamboo/foam junction, or 15mm past the end of the slotted bamboo stays. Aesthetically, it is nice to have shorter roughed areas. For our own bikes, we've started to experiment with shorter roughing distances. We will update this how to as we get a better track record. In the meantime, we encourage the 60mm rough lengths.