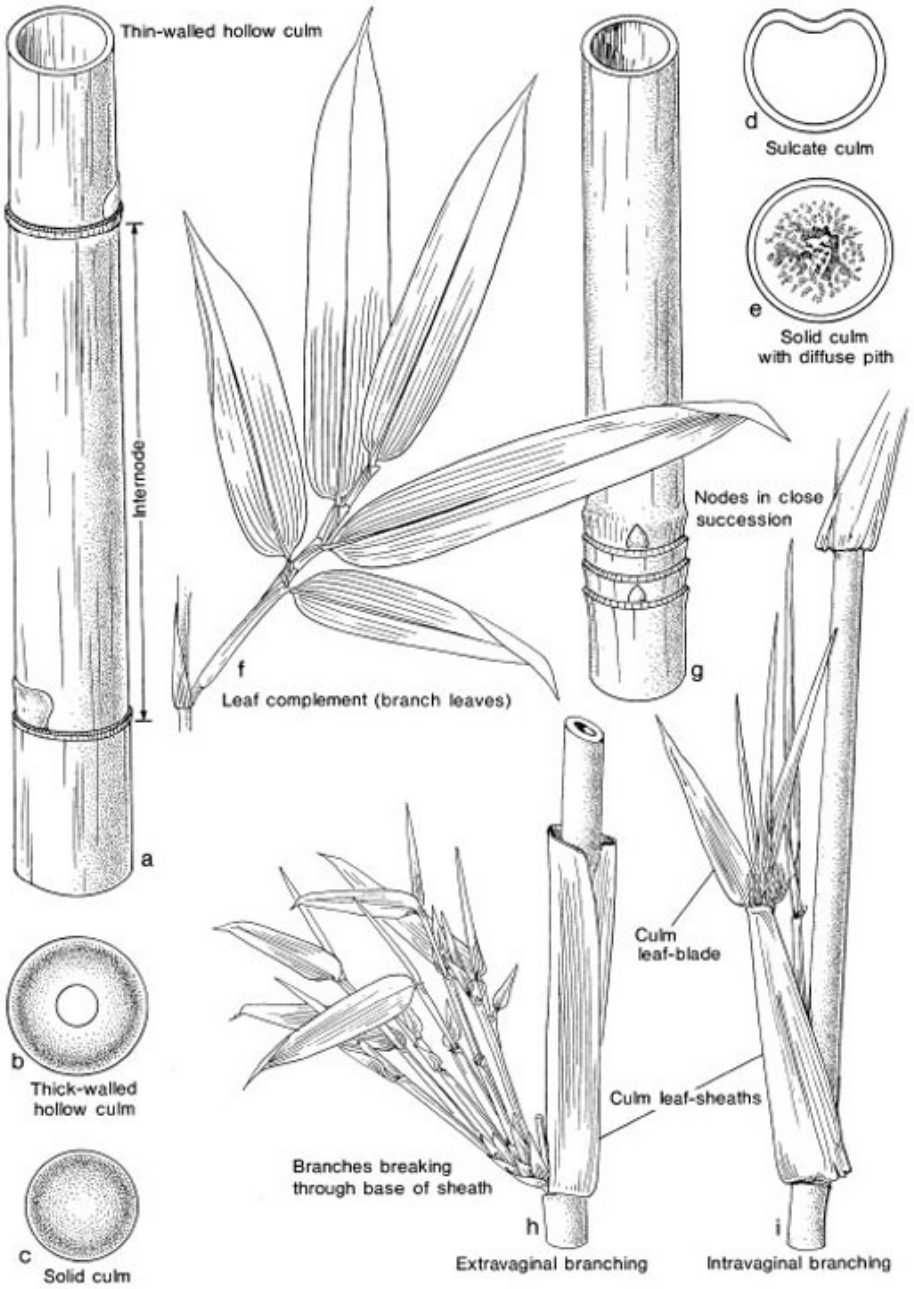
Ramón Górdova Gonzalez
Ecologies of Migration



BAMBOO STRUCTURE ASSEMBLY MANUAL

BAMBOO

Guadua amplexifolia. Also known as *"Otate"* is a bamboo specie native to America. It can be found in Mexico (mainly in Chiapas and Oaxaca), Central America, Colombia and Venezuela.

It can reach the height of 20 m and diameter of 10 cm. The bamboo stalks have thorns as most of the *Gauduas*. This specie is commonly used for construction purposes by countryside communities in Mexico.

HARVESTING

Bamboo contains a considerable amount of starch from which some parasites, fungi, and insects feed. During the dry season, the bamboo plant is acquiring and conserving nutrients to use them in the next rain season. Therefore, starch content is at its highest level at the end of dry season and that increases the chances of plague. In other words, the most recommended time to harvest bamboo is at the end of rainy season - beginning of the dry season.

The starch content in bamboo also varies with age. The starch content is lowest during the first year and highest between year 1-3. *Guadua* bamboo is considered mature and in its best moment for structural purposes between 4 and 7 years, after which they slowly start to deteriorate.

Harvesting only mature bamboo stems is also a very important part of the practice of bamboo plantation, since it will impact the sustainable development of the plantation.

Preparation

1. Select mature bamboo, 4 to 5 years old for structural elements.

2.Preferably harvest at evening, when the sap returns to the rhizomes. Always cut at least 30 cm above the soil.

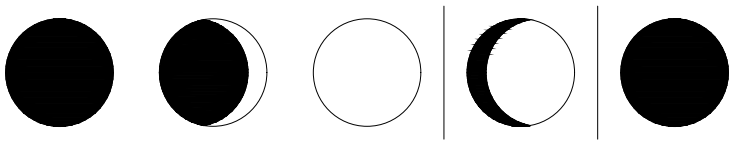
3.Add protection layers against moist, fire, insects and fungi.

4.There are different methods to dry bamboo. Among the most common are:

a. Immerse in water for a month, then let dry. This is a good method for conservation.

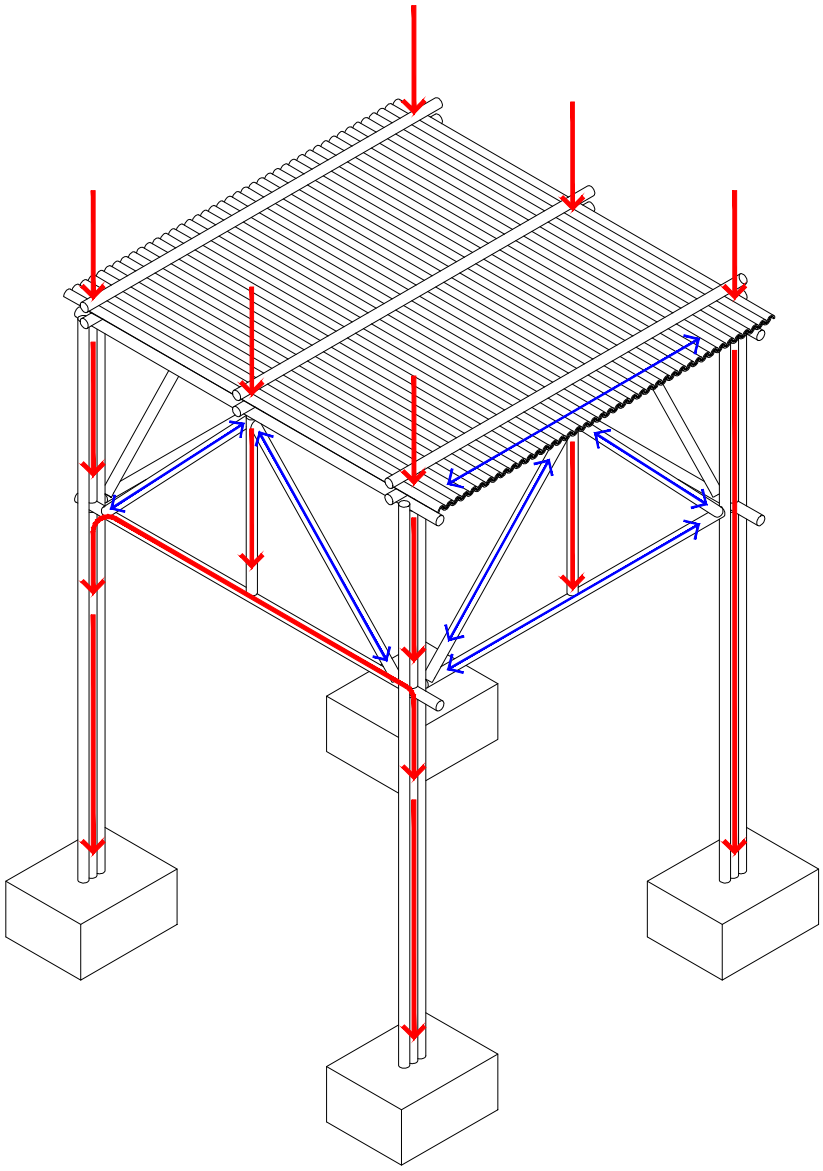
b. Apply hot air until it dries. Good to obtain straight pieces.

c. Smoked until soot the Surface of bamboo.



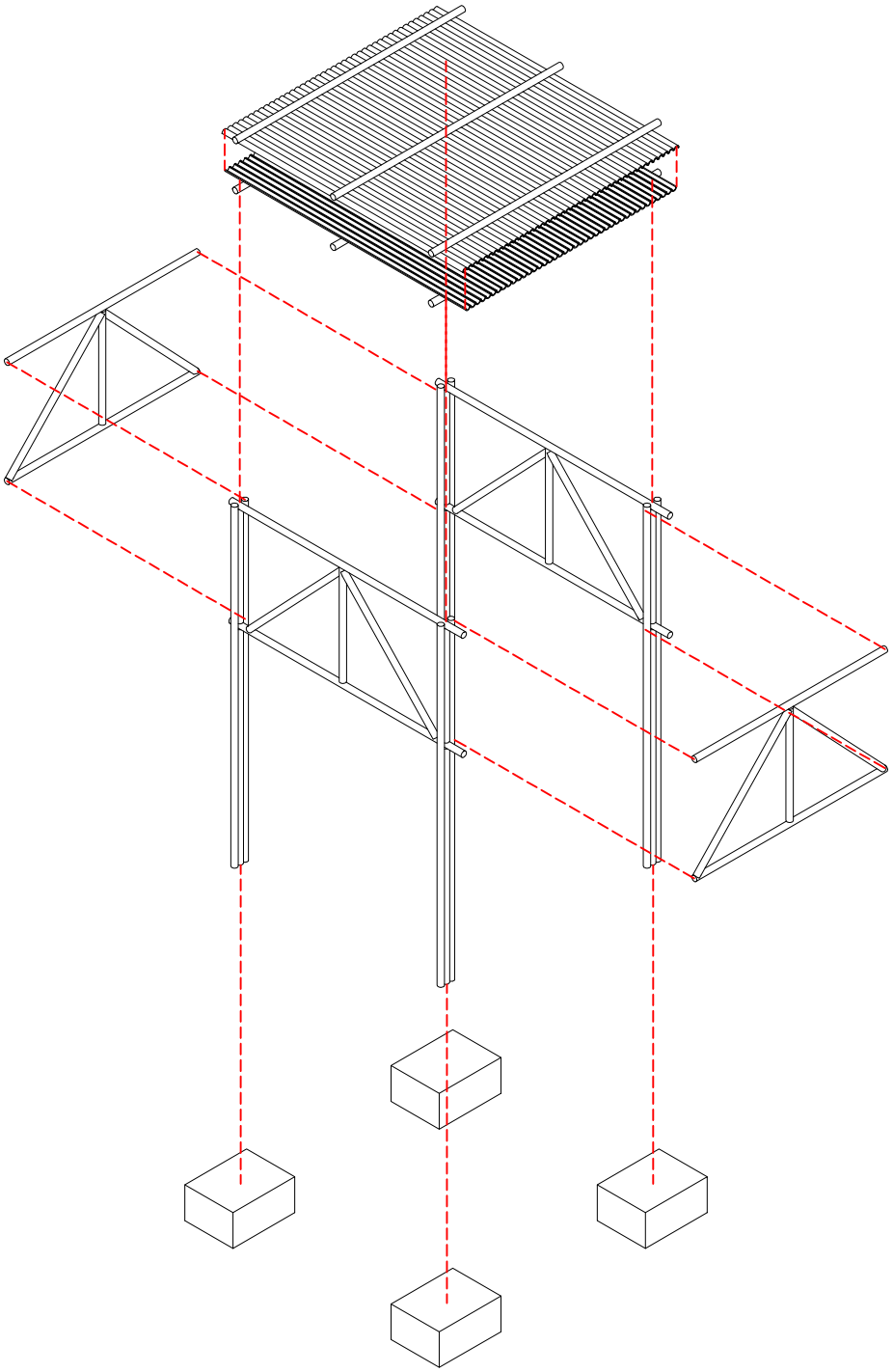
It is also advisable to harvest the bamboo during the last quarter of the lunar phase. It is during this period when the moon has less influence over the movement of liquids on earth and the gravity attraction increases, therefore the liquids do not flow so easily through the stems of the plants.

THE STRUCTURE



A typical example of the structure.

Load management.



Exploded axonometric of the structure

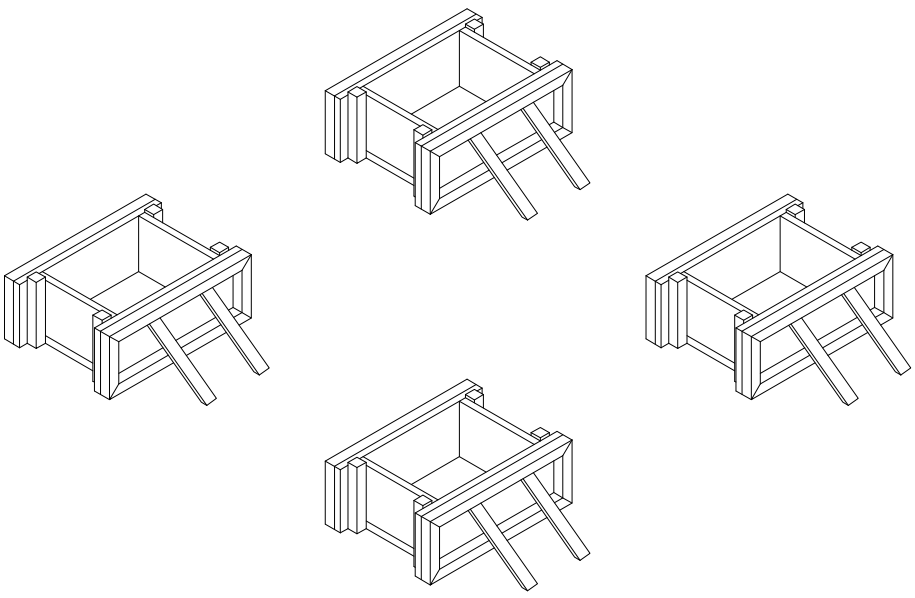
12 bamboo pieces as columns, diameter 7.5-10 cm
5x4 cross bracing pieces, diameter 5-7 cm
Matching number or longitudinally cut bamboo roofing pieces
Aproximately 300 cm^2 of concrete for foundation

ASSEMBLY

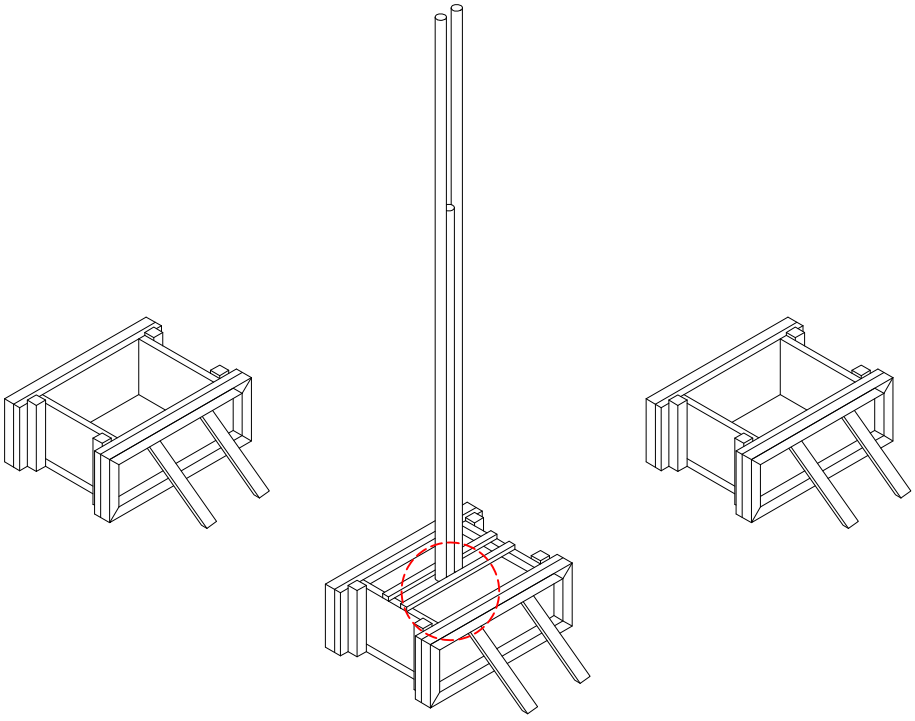
In the following pages an a step-by-step guide to assembling a typical section of the structure will be shown. In the three interventions there are slight adjustments to the structure, be it inclined roof or an added facade, but the structural principles remain the same.

The structure is symmetrical and can be continued in either direction.

1. Foundations
2. Columns and beams
3. Cross bracing
4. Roof

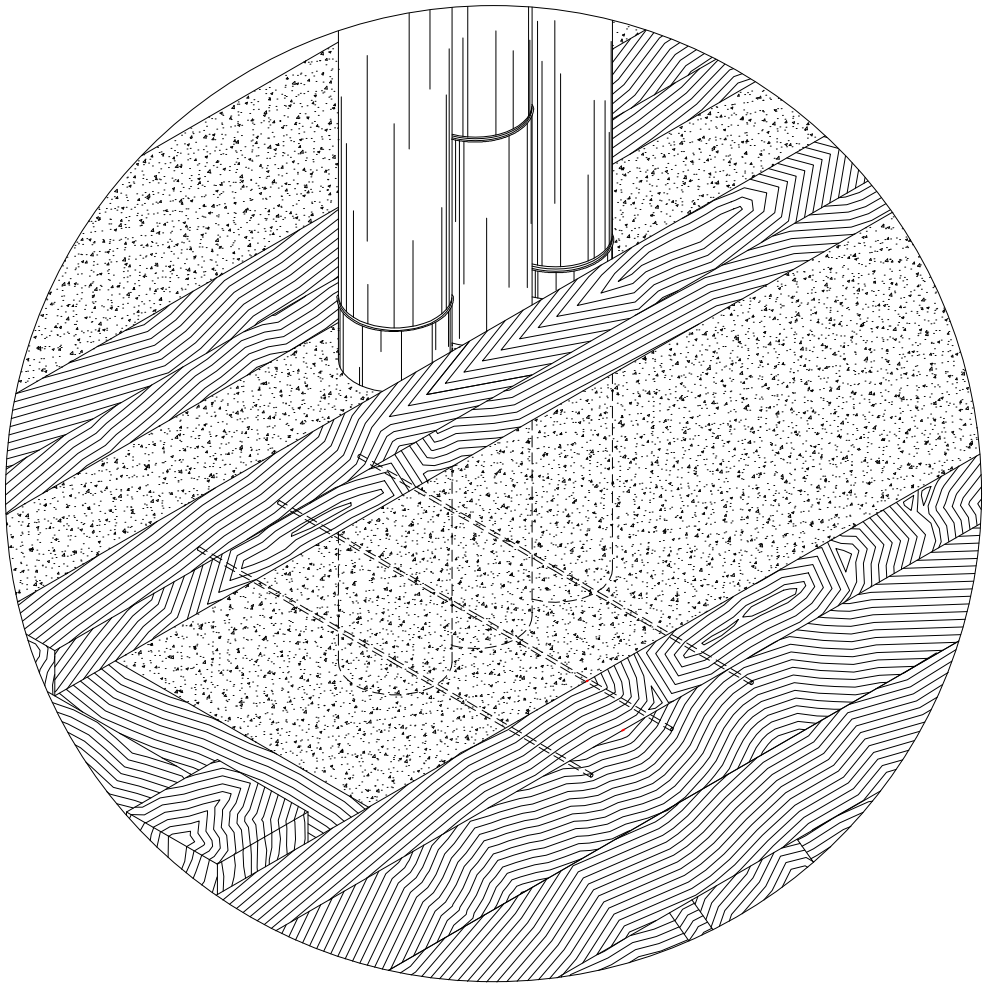


1.2 Foundation



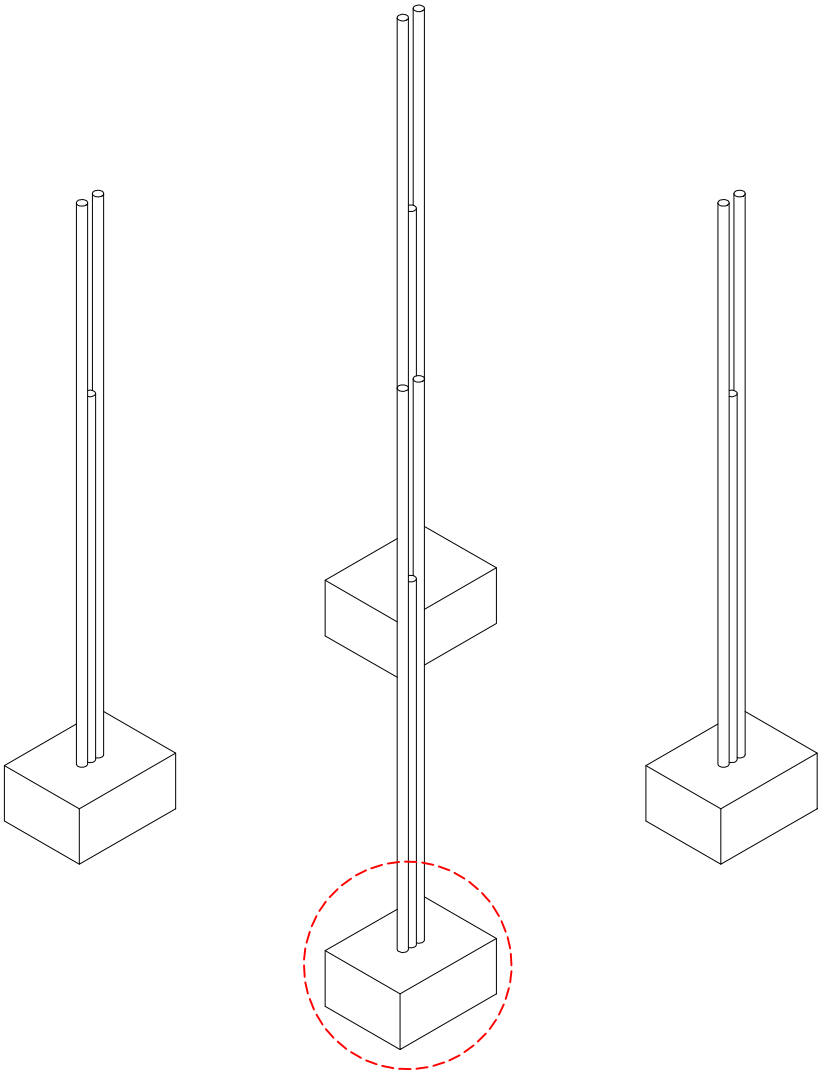
Add extra pieces of wood to secure bamboo columns in position. Use three pieces of bamboo.

Pour the concrete into the cast and let it set for 28 days approximately to dry completely.

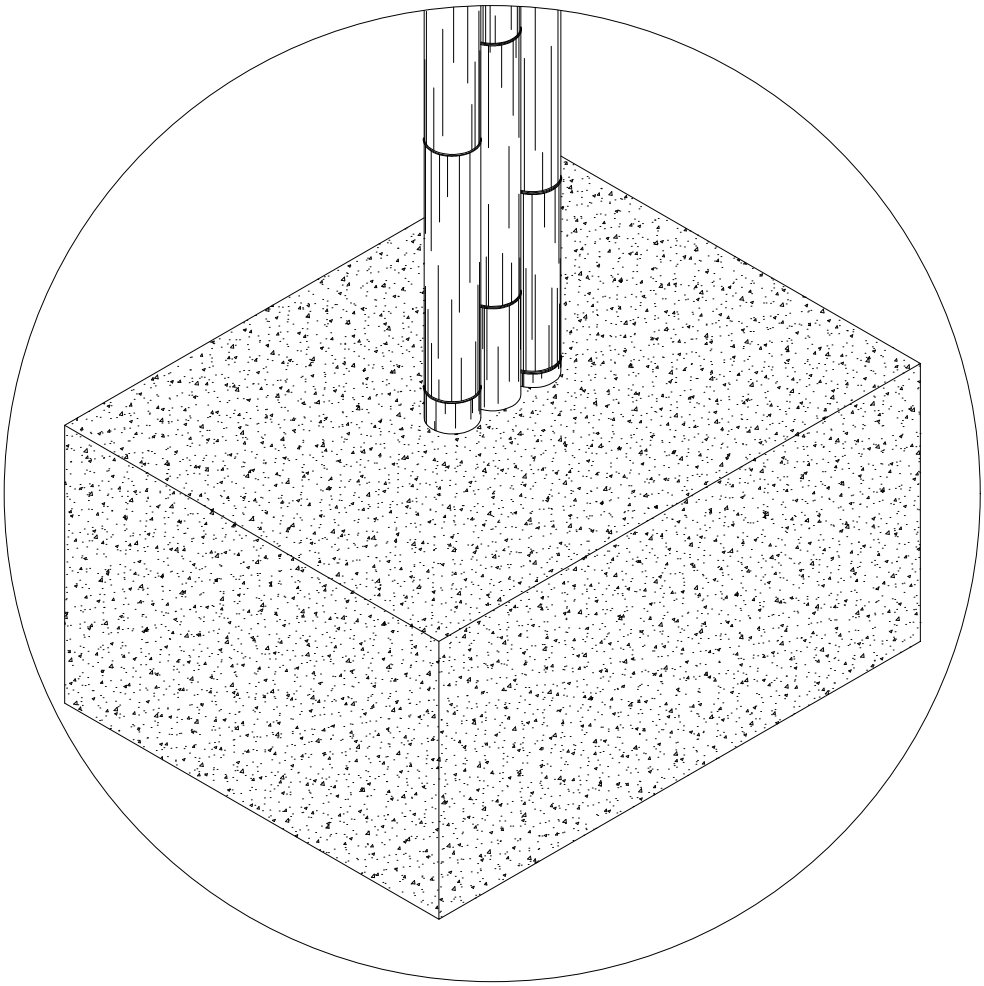


Add a steel rod through the bottom part of each bamboo element to act as an anchor.

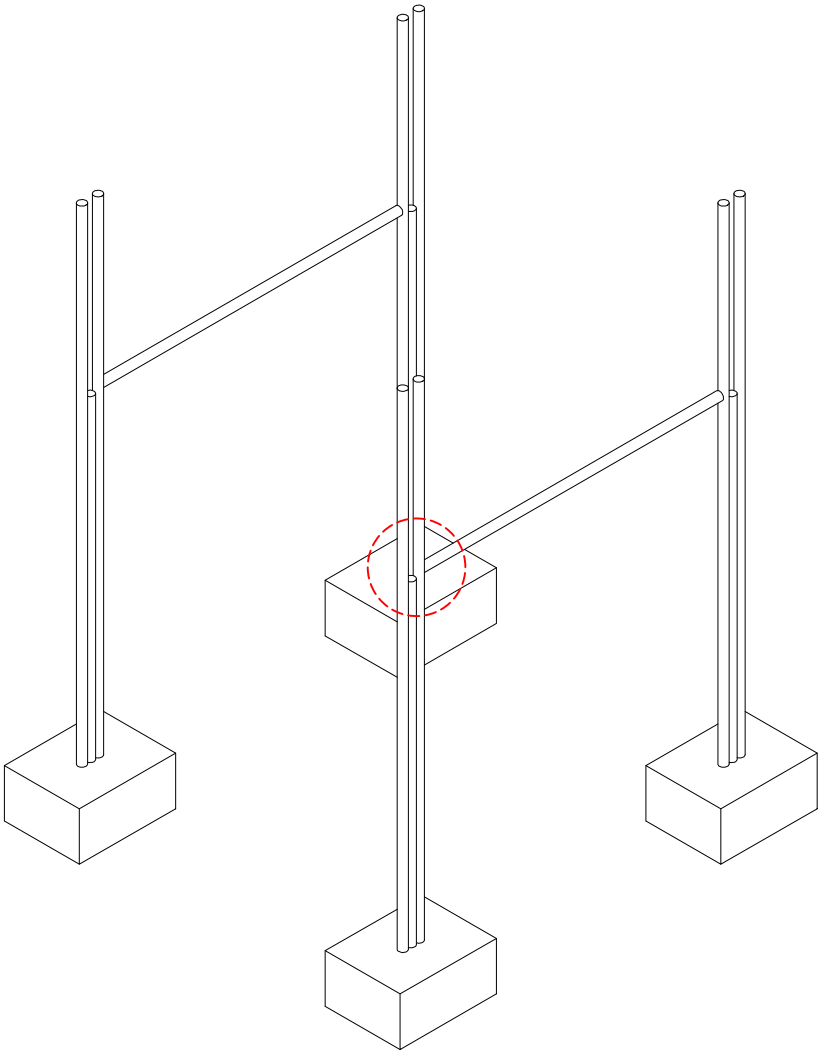
1.3. Columns and Beams



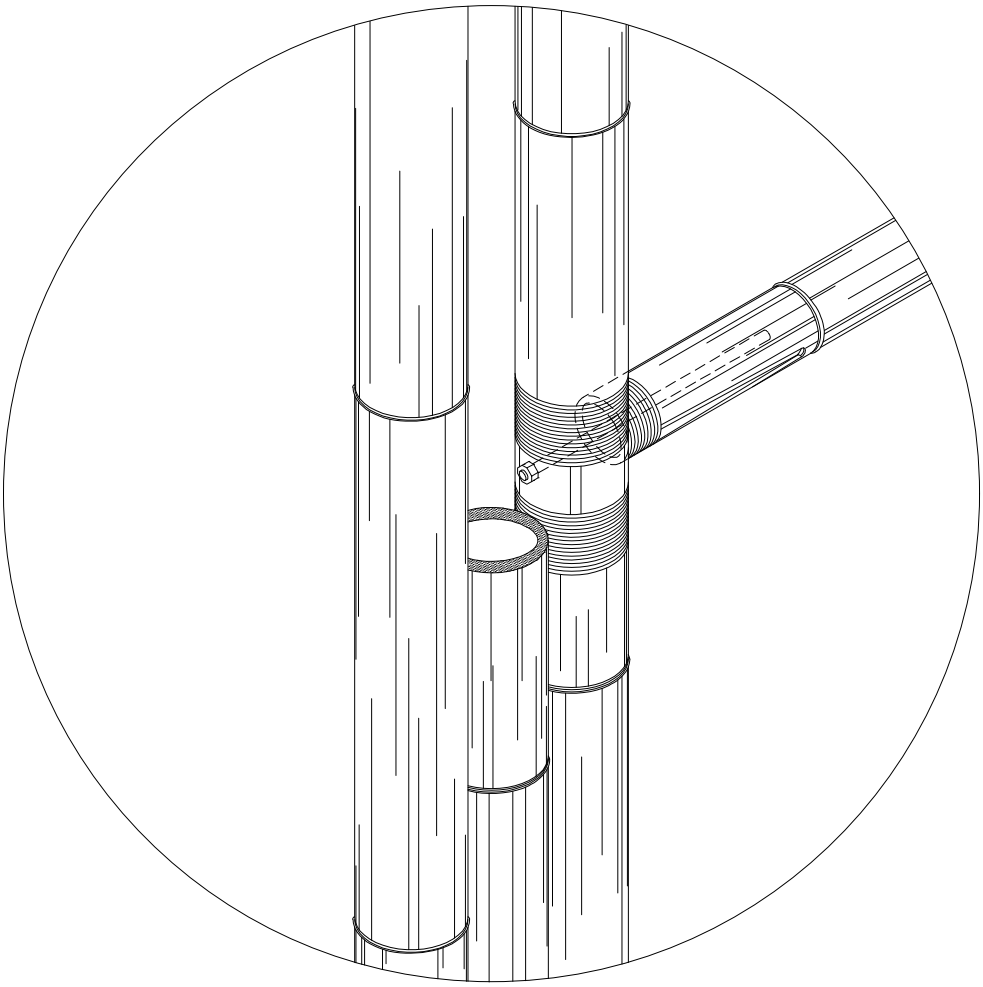
After the concrete in the foundation pads has set, remove the formwork.



1.3. Columns and Beams

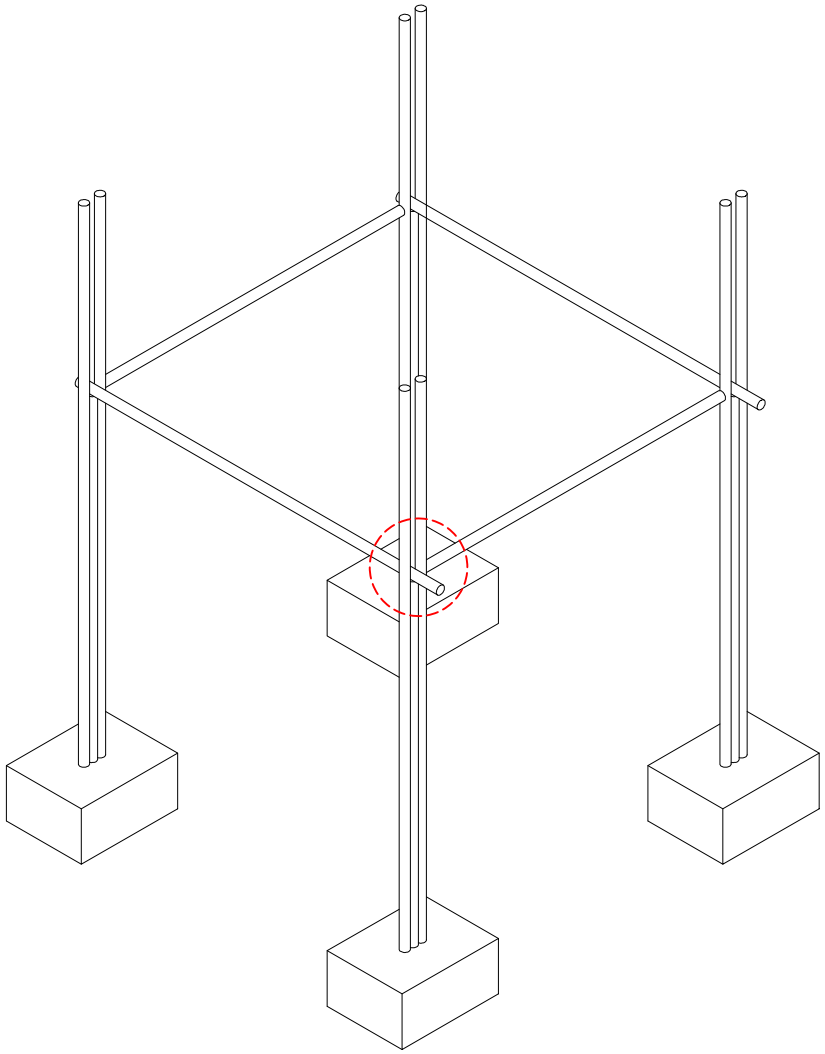


Add horizontal bamboo elements above the level of the middle bamboo piece in the column. Fix it in place with cement, steel bolt, and strong string.

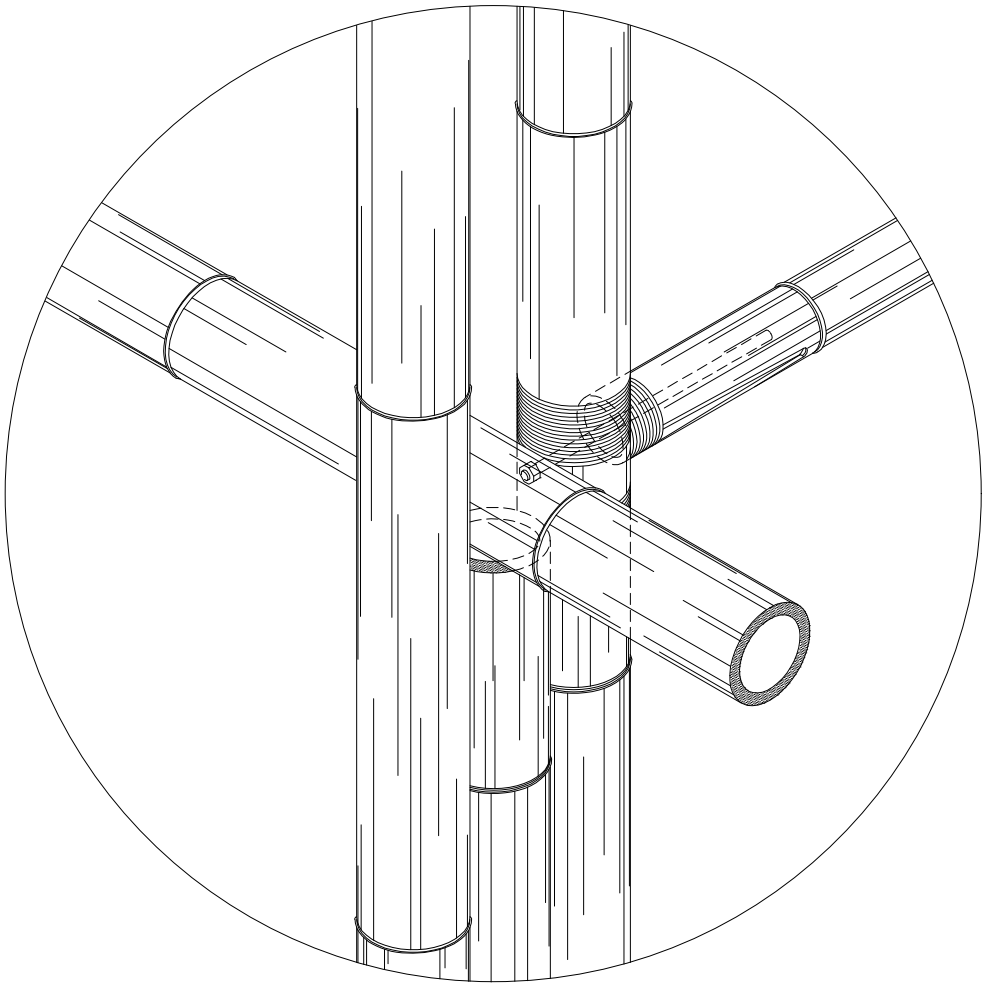


Fill the end of the bamboo element with cement at a depth of 15-20cm. Position at the appropriate level and fix to the vertical element with a steel bolt, which is sunk into the cement. For extra security add string as shown above.

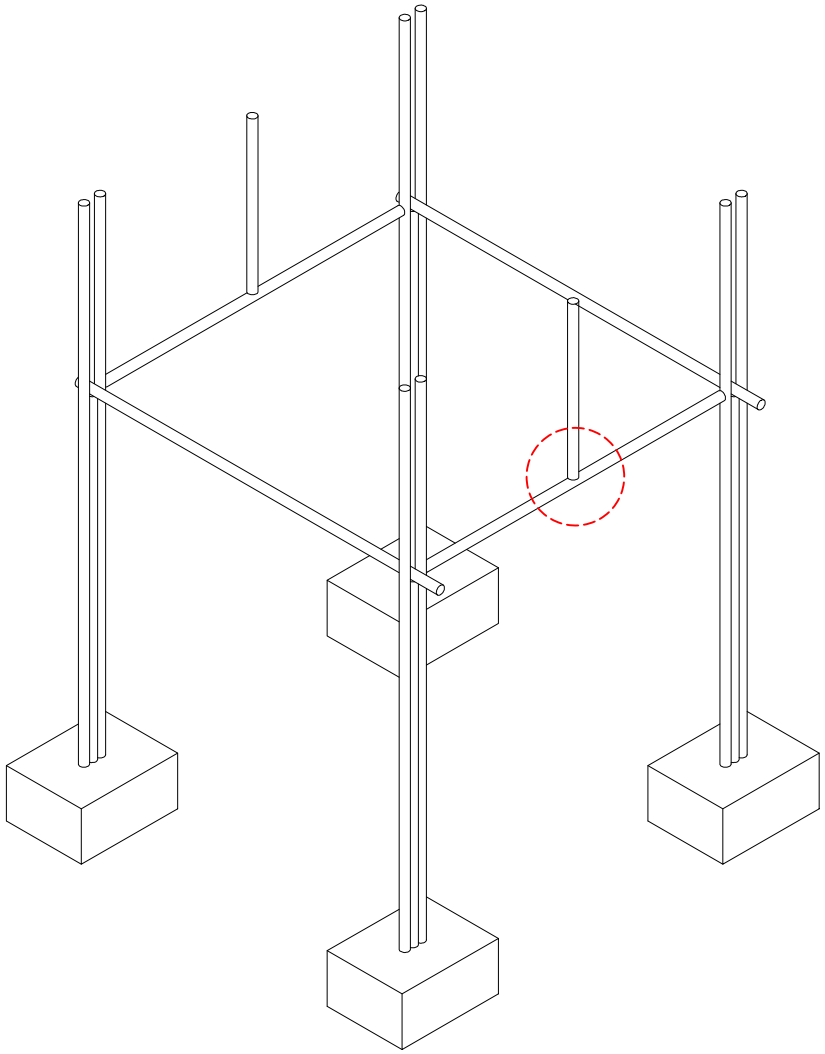
1.3. Columns and Beams

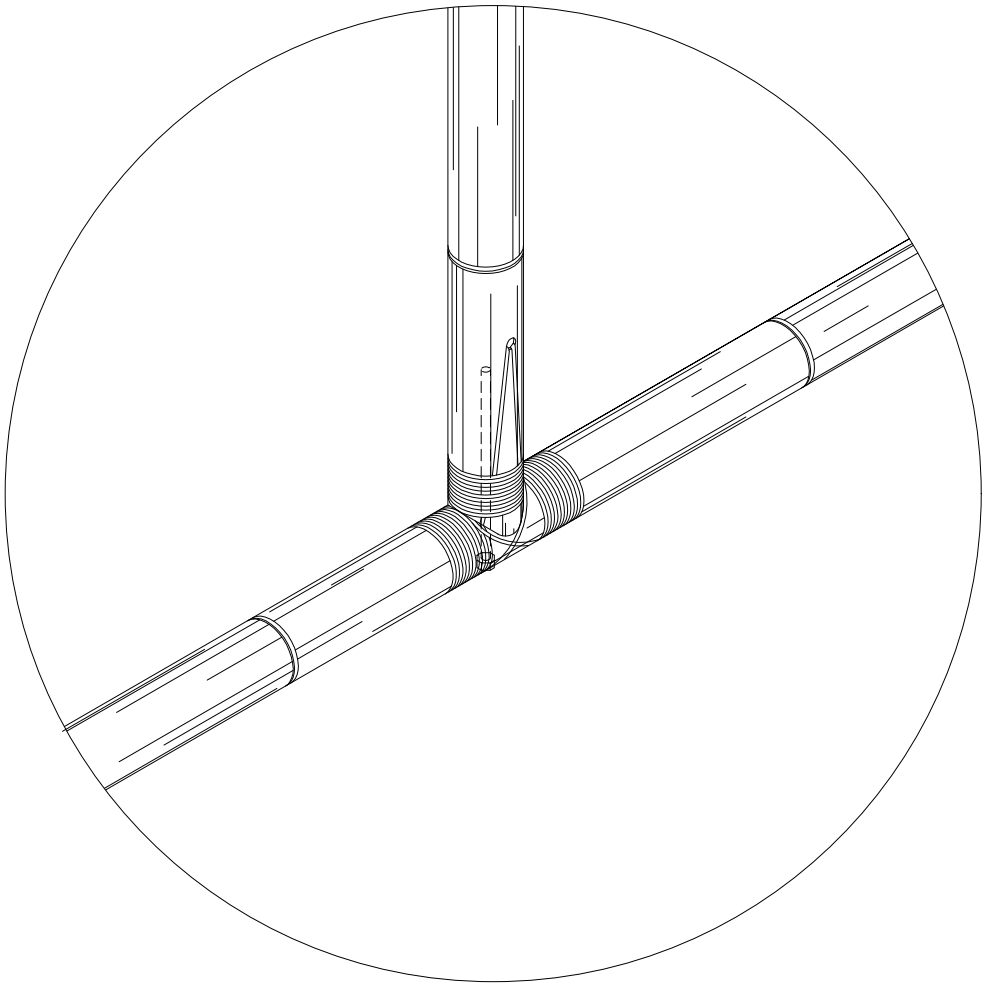


Place the next set of horizontal bamboo elements resting on the middle shorter bamboo stud.



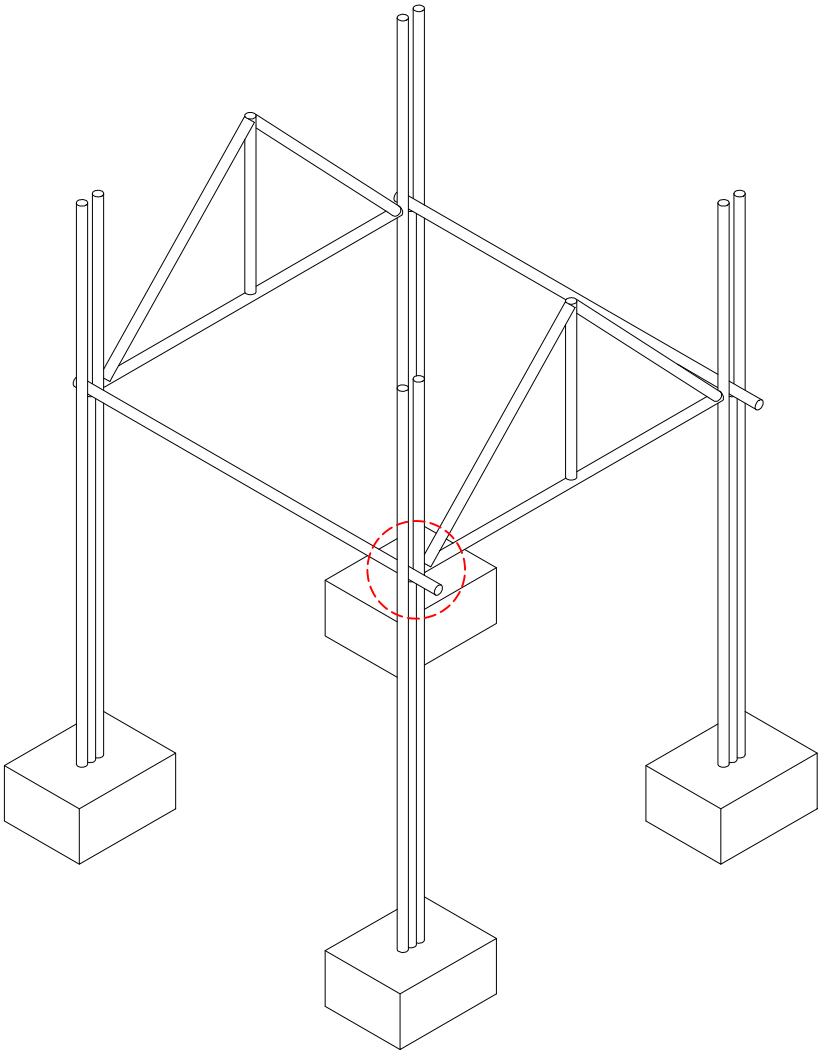
1.3. Columns and Beams



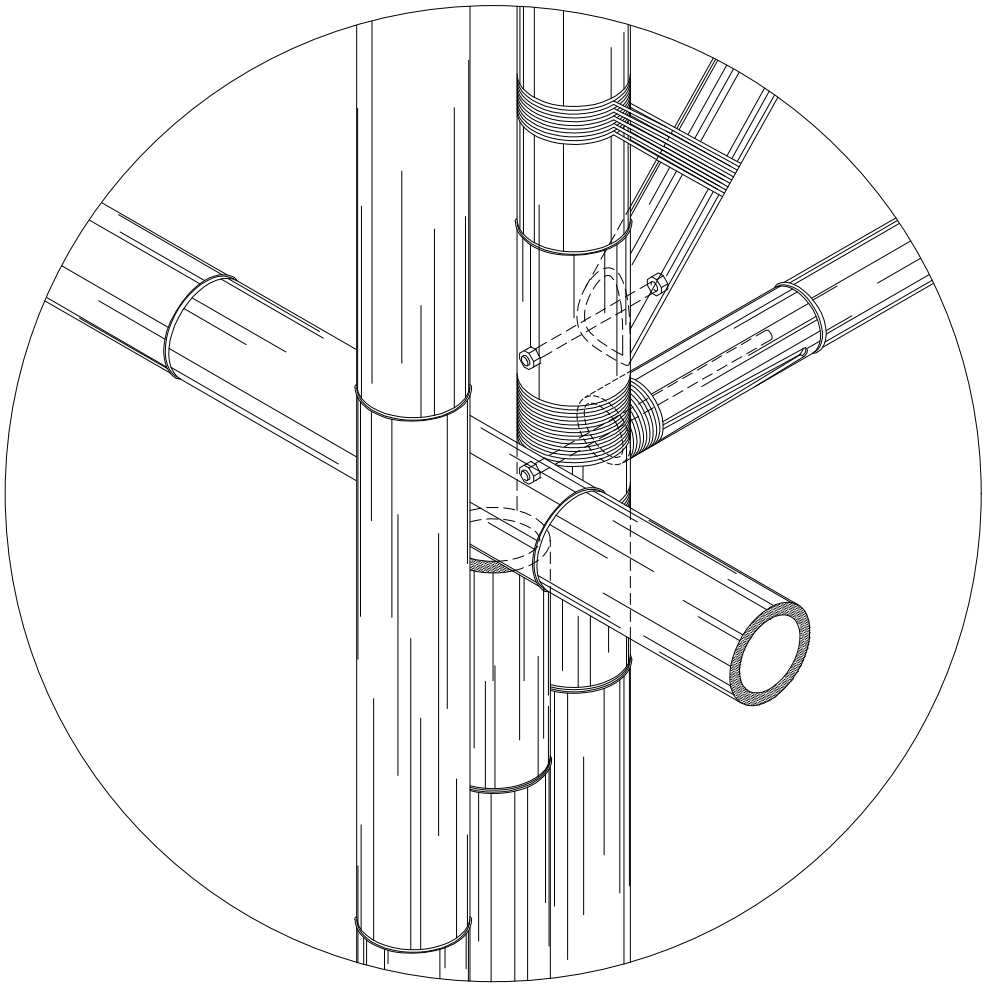


Fill the bottom part of the vertical element with 15-20cm of cement and use a steel bolt to attach it to the horizontal bamboo beam. Secure with intertwined string.

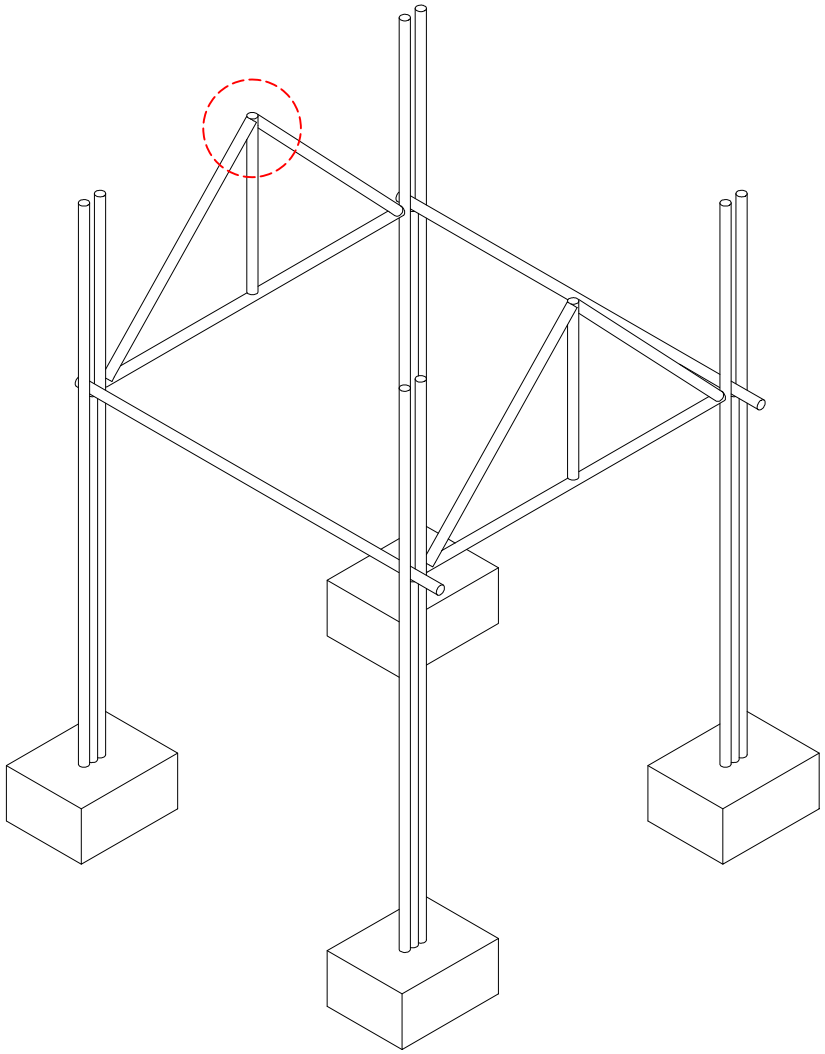
1.4. Cross bracing

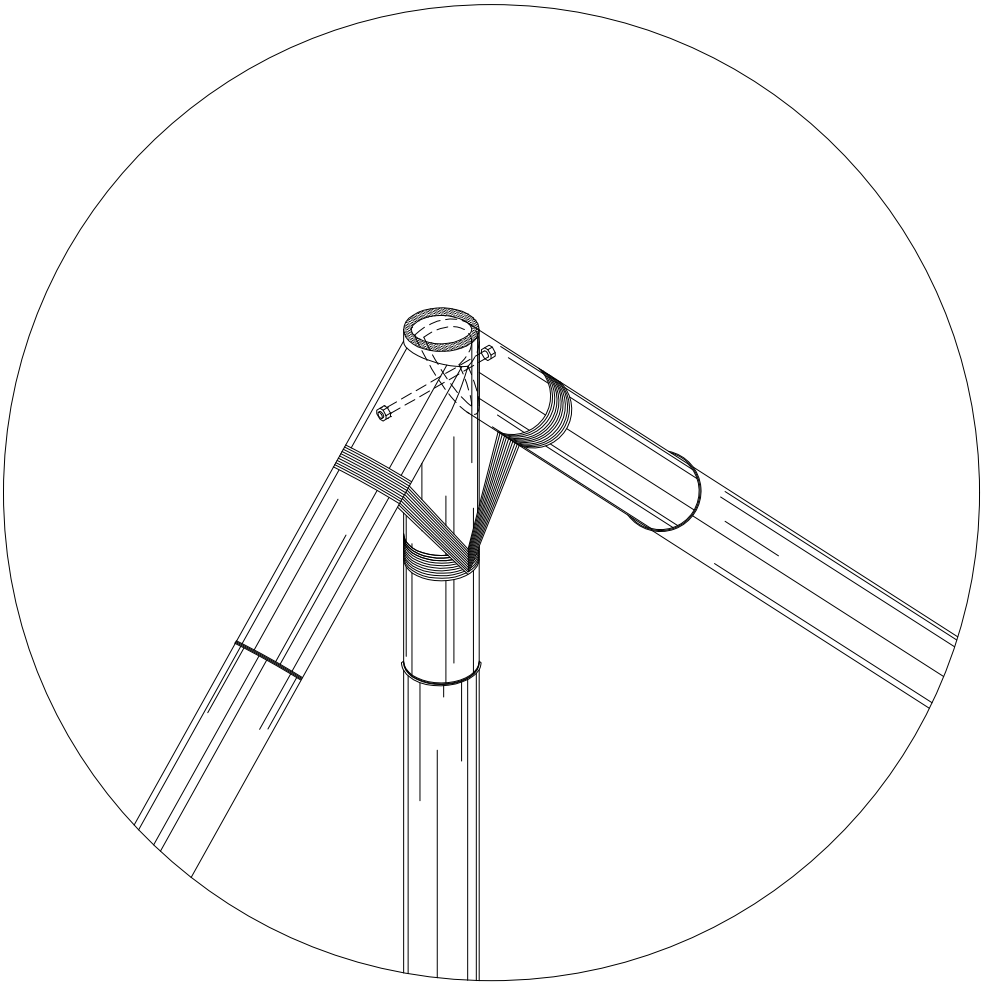


The next step is adding cross bracing bamboo truss elements. After placing the vertical elements first, attach the diagonal elements.



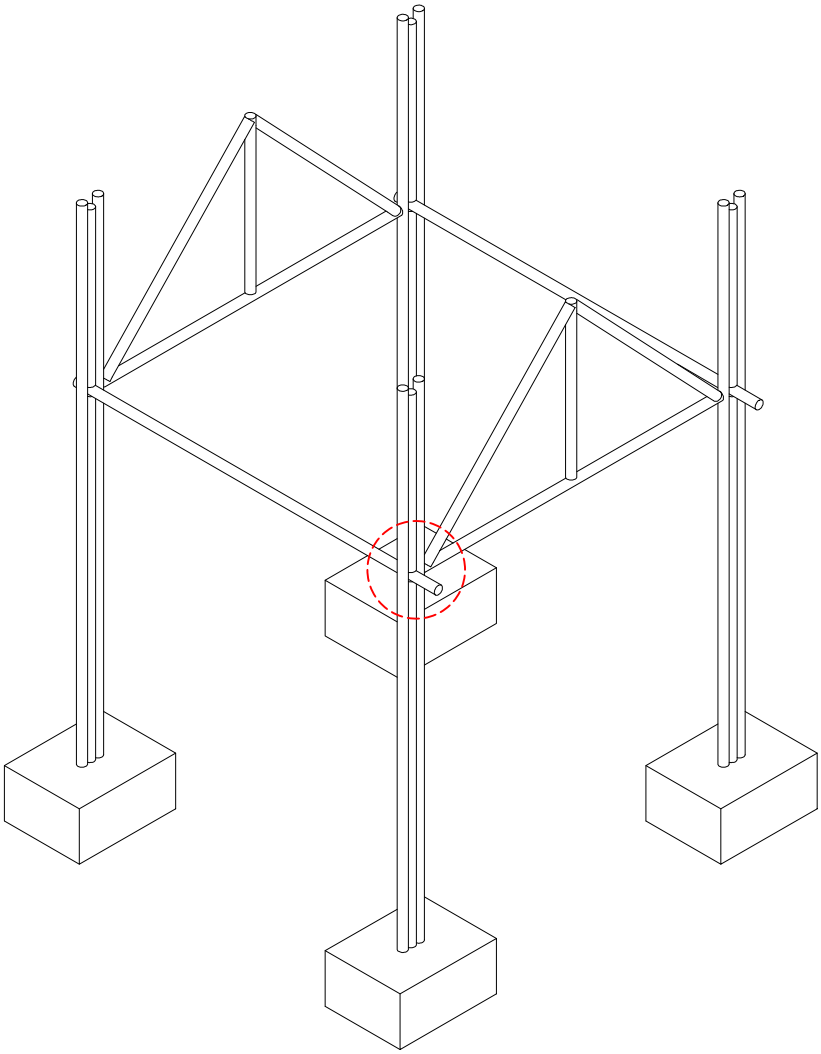
1.4. Cross bracing



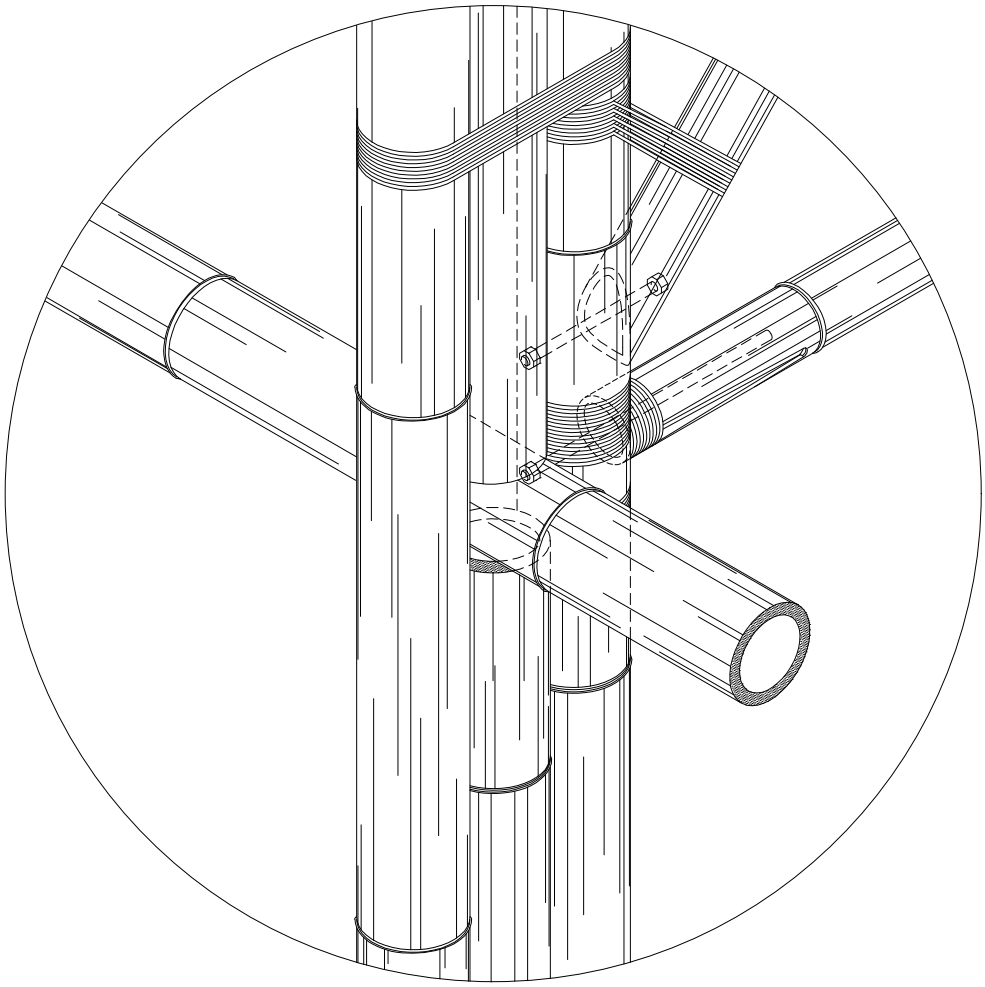


The ends of the diagonal bamboo elements need to be cut to curve around and align to the vertical element. After placing, fix both at the same time with string.

1.4. Cross bracing

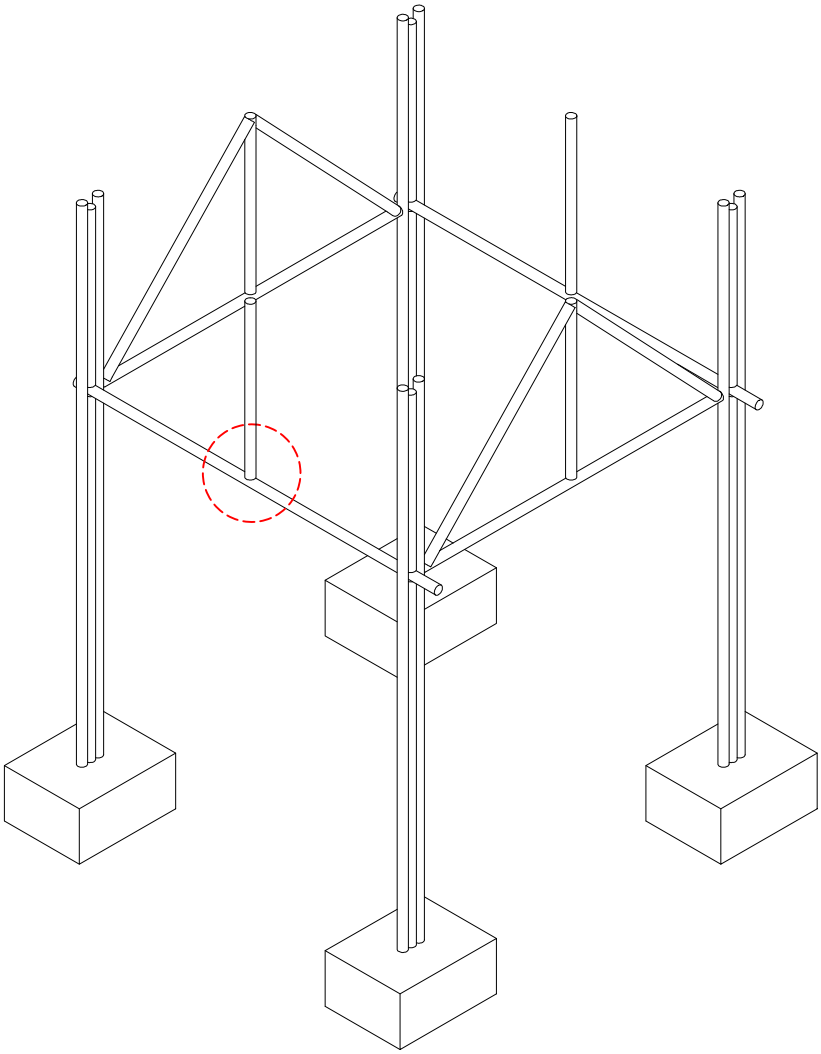


Next add the vertical bamboo elements in the middle of columns above the first line of horizontal elements. This will maintain the structural strength for the next set of horizontal elements.

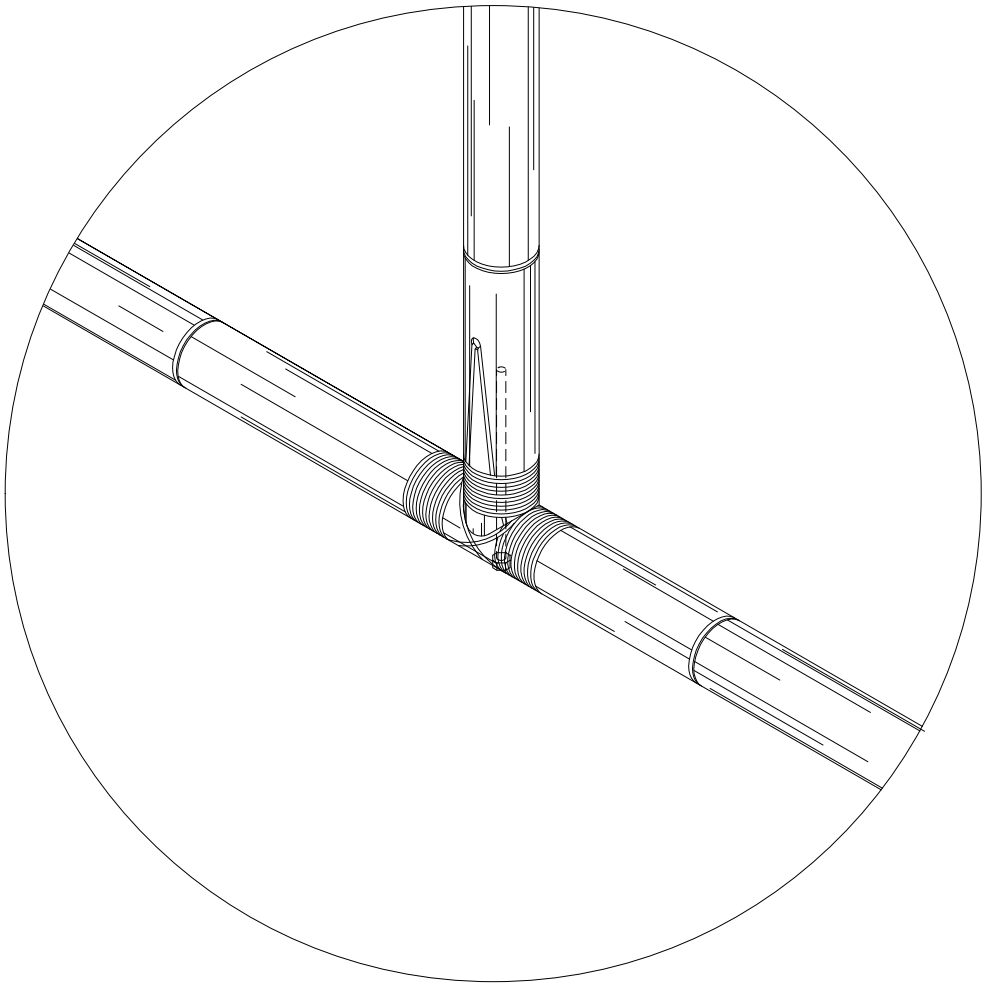


The new vertical element needs to be attached with string to the other vertical elements, as well as to the diagonal bamboo pieces.

1.4. Cross bracing

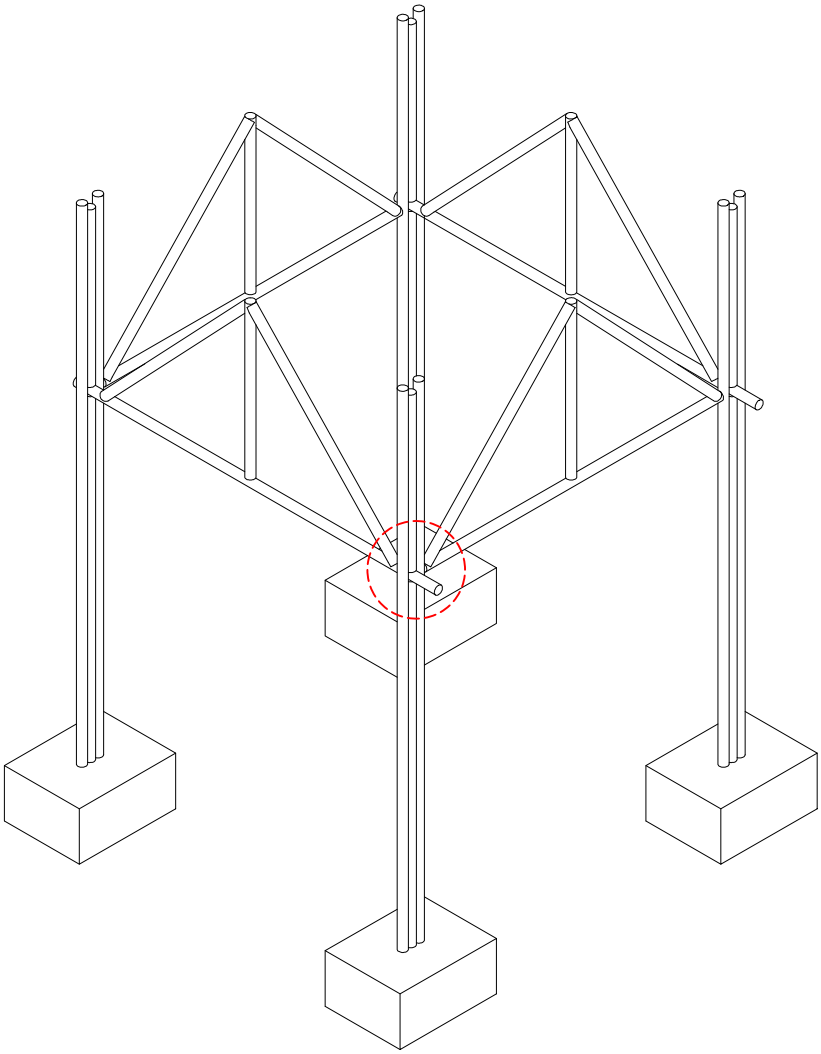


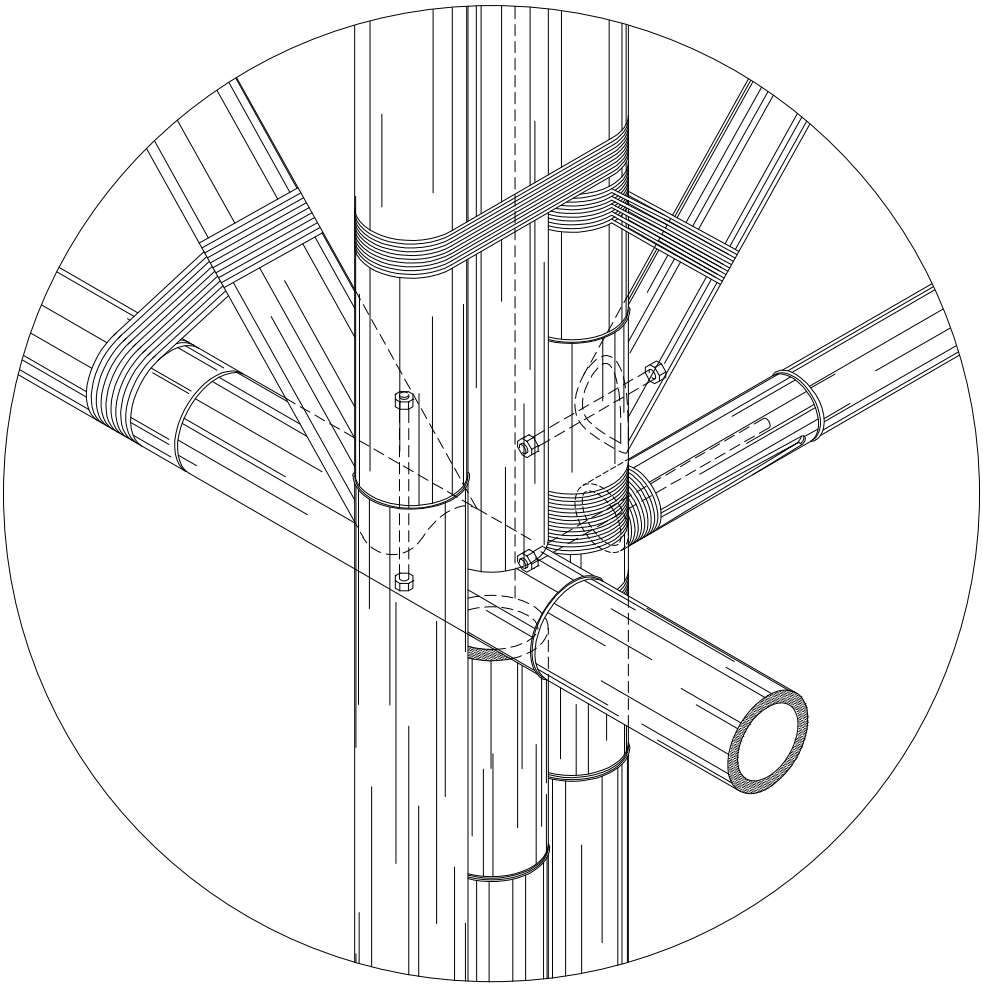
Next add the vertical bamboo elements in the middle of columns above the first line of horizontal elements. This will maintain the structural strength for the next set of horizontal elements.



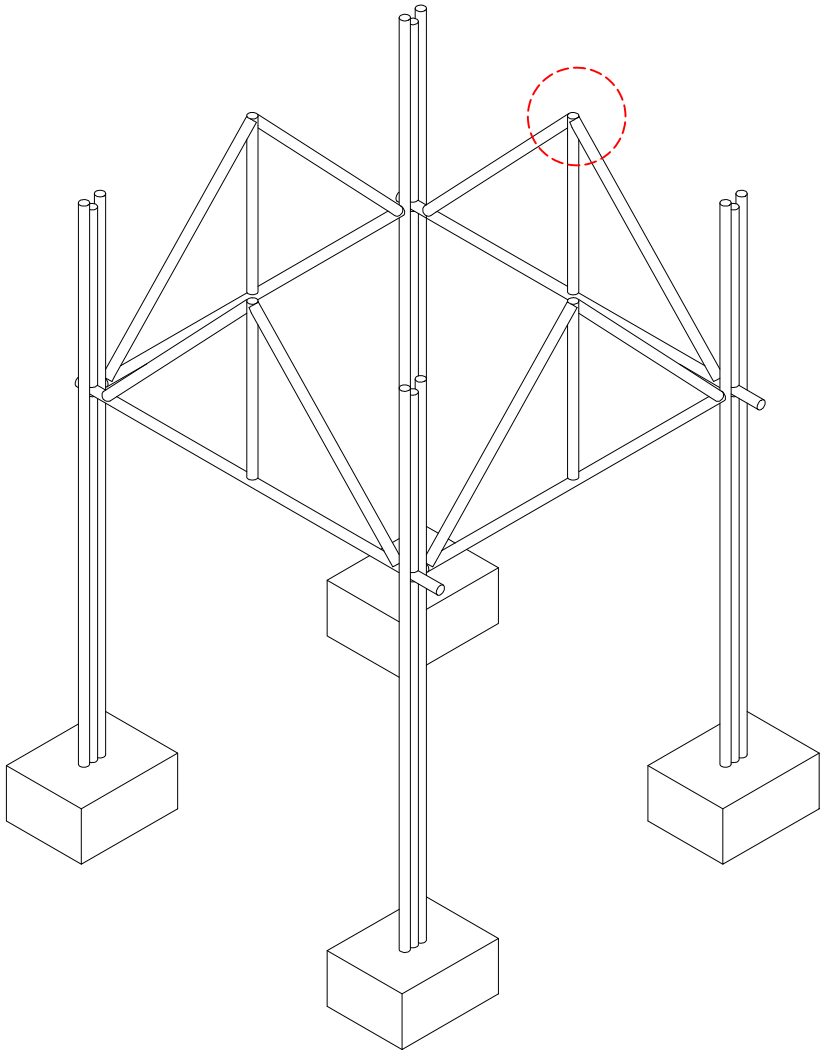
The new vertical element needs to be attached with string to the other vertical elements, as well as to the diagonal bamboo pieces.

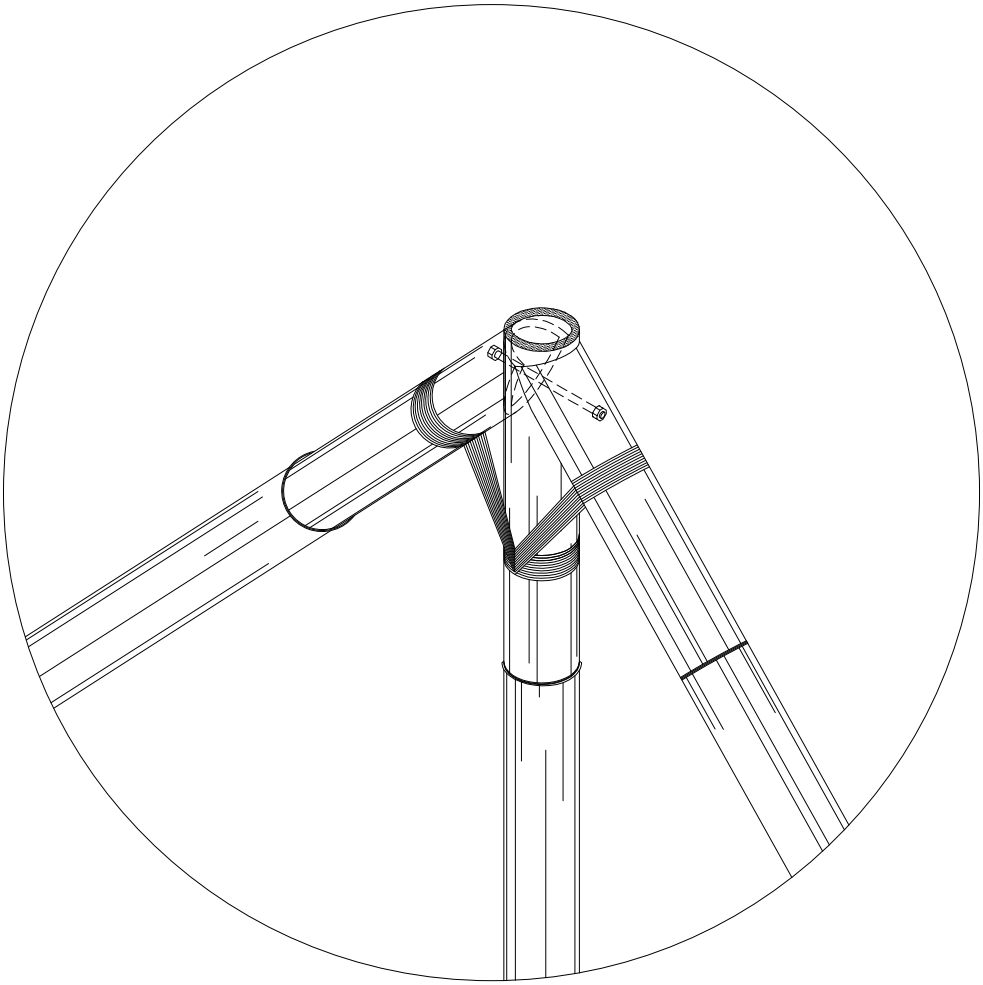
1.4. Cross bracing



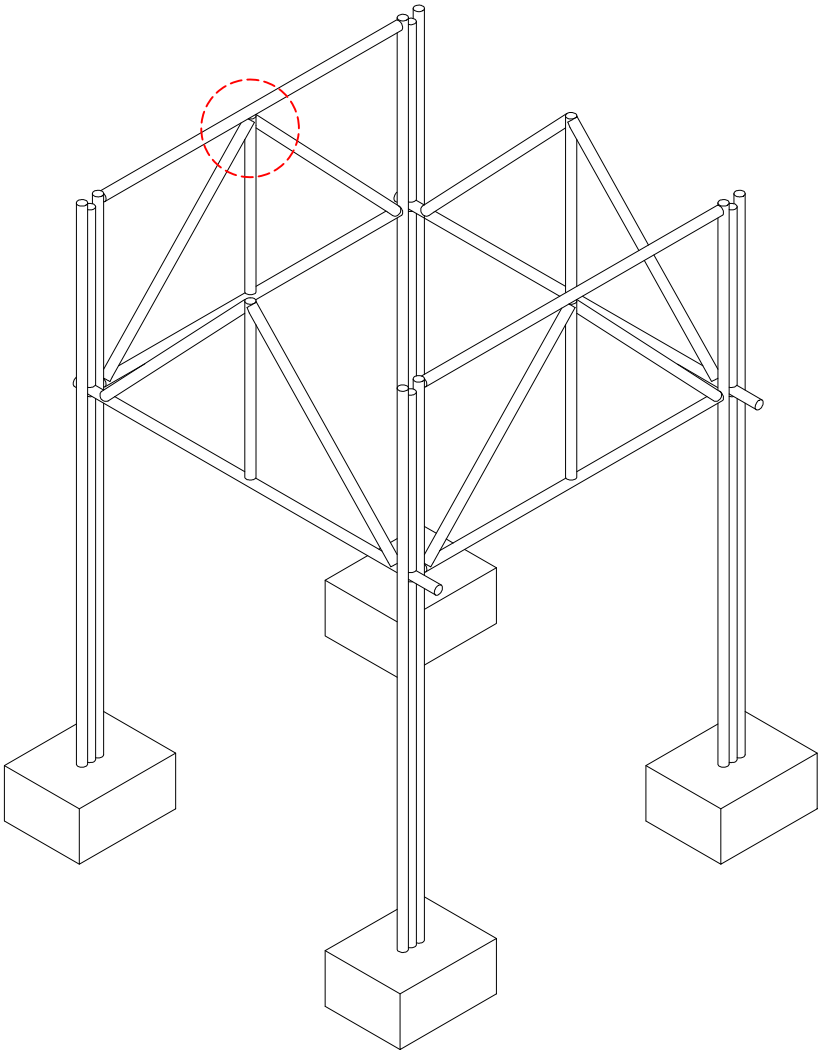


1.4. Cross bracing

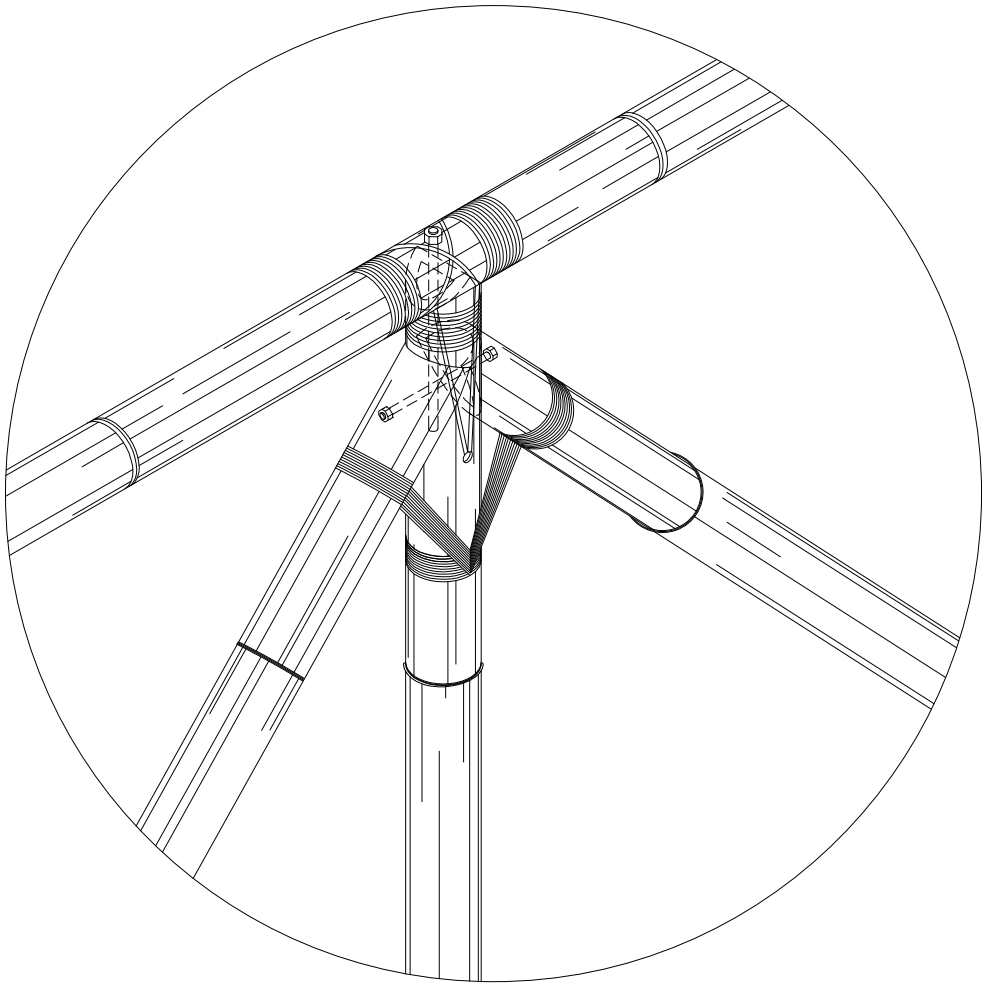




1.4. Cross bracing

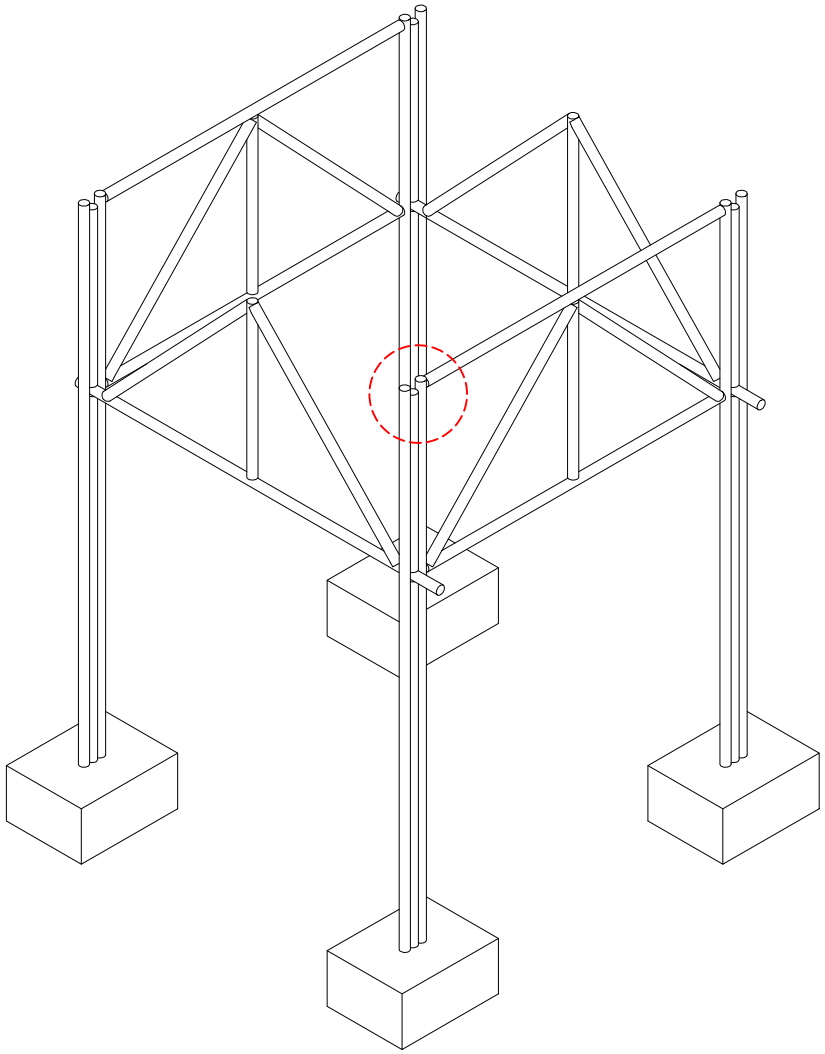


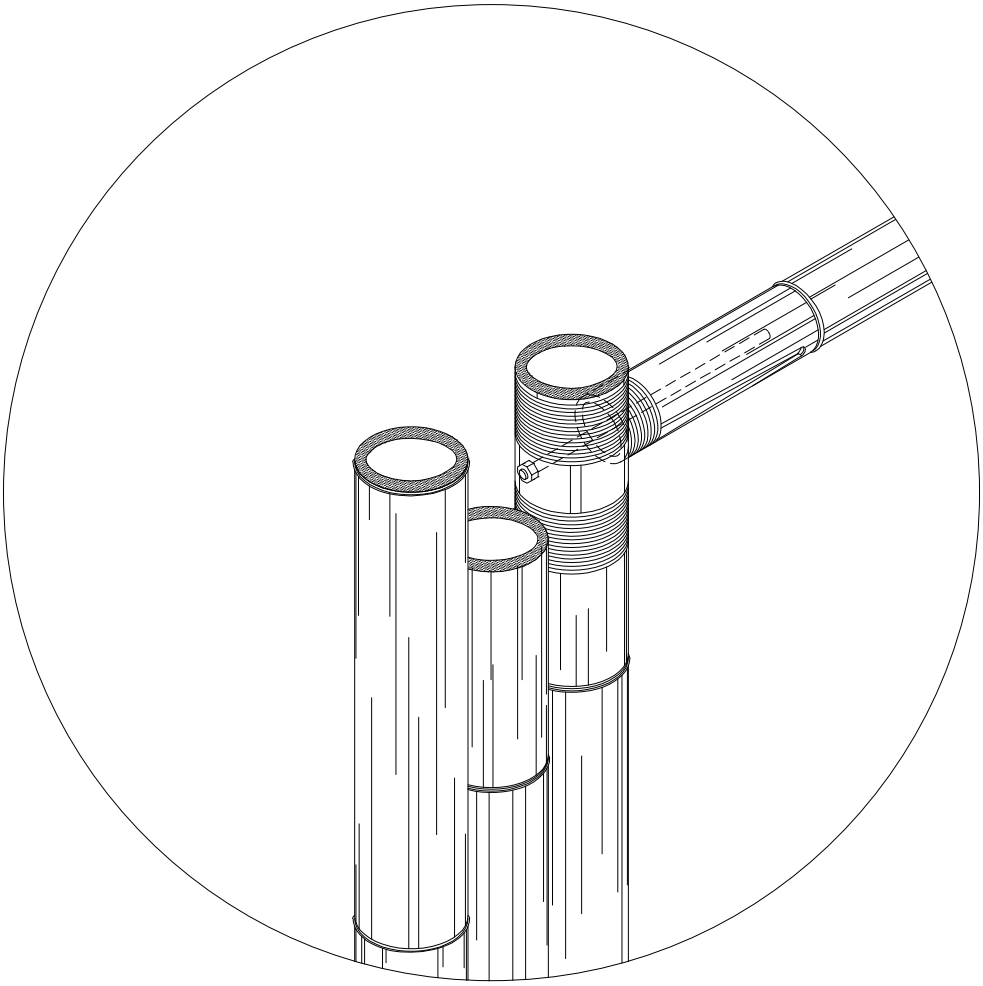
Add the top layer of horizontal bamboo elements on top of the cross bracing. Attach to the cross bracing elements in the middle, as well as to the columns at the sides in the same way as the lower set of beams.



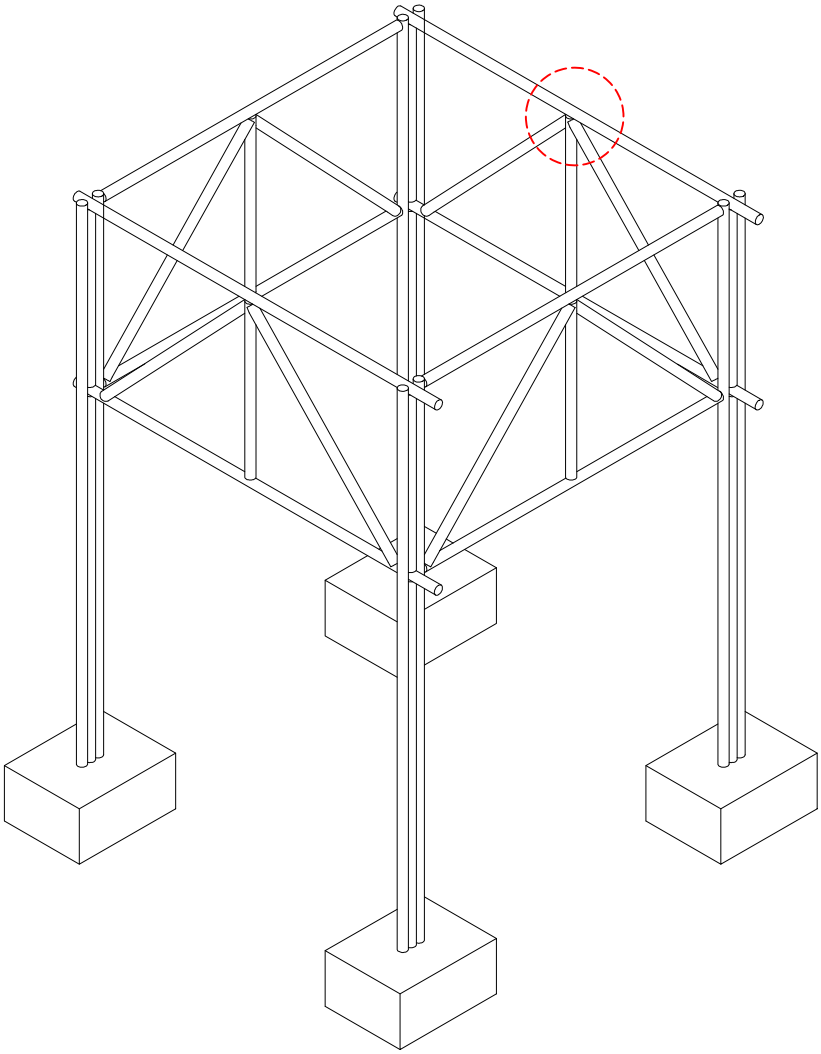
Fill the top part of the vertical bamboo element with 15-20cm of cement and use a steel bolt to attach it to the horizontal bamboo beam. Secure with intertwined string.

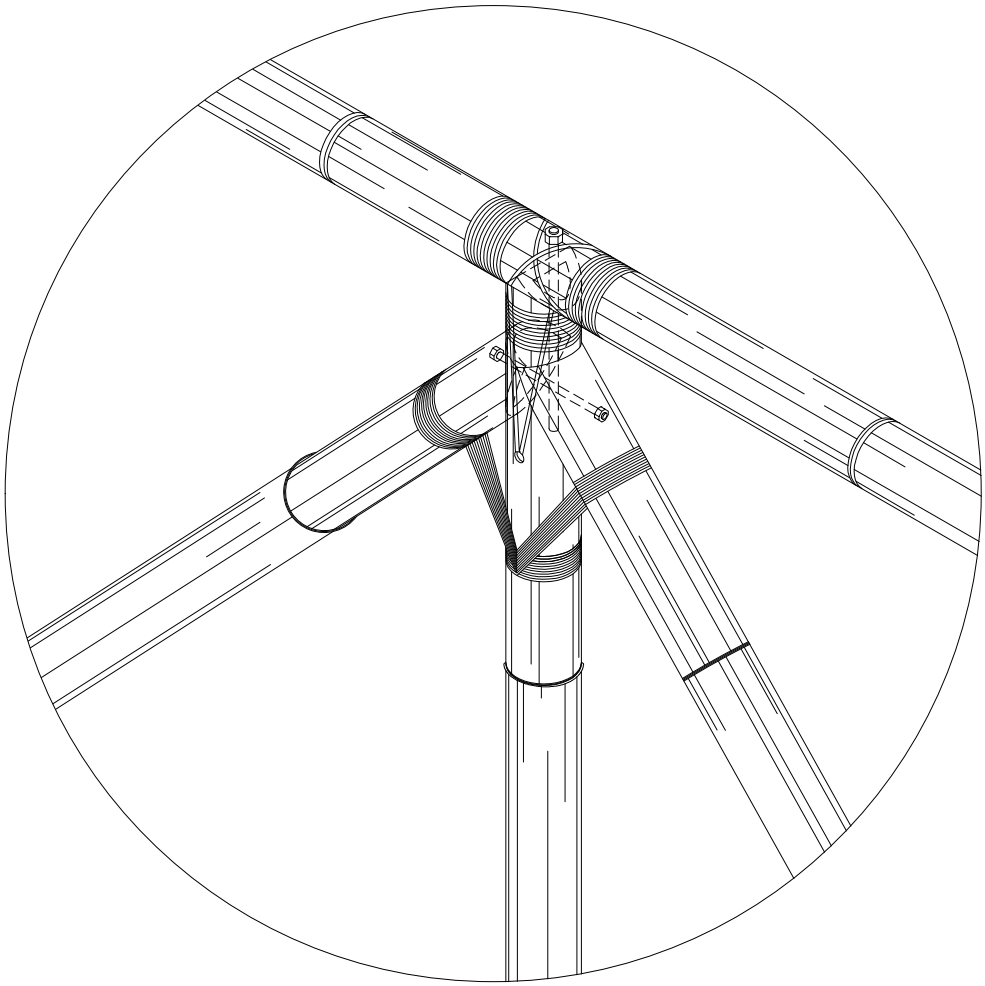
1.4. Cross bracing



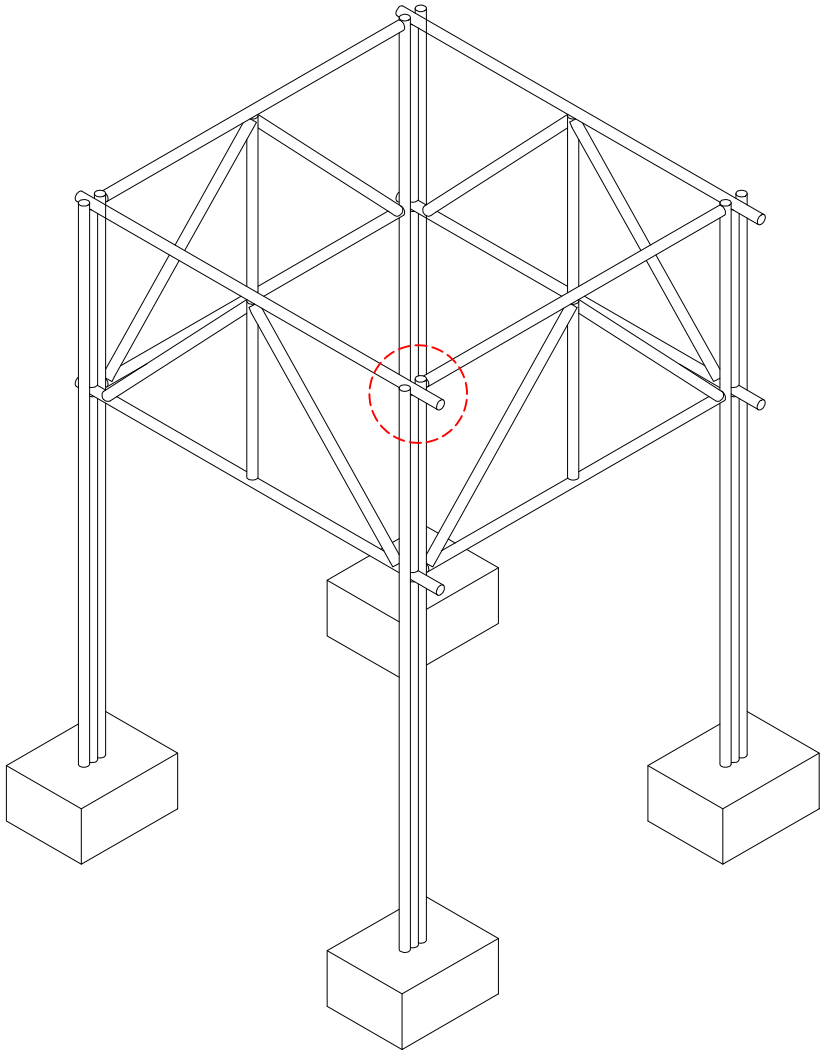


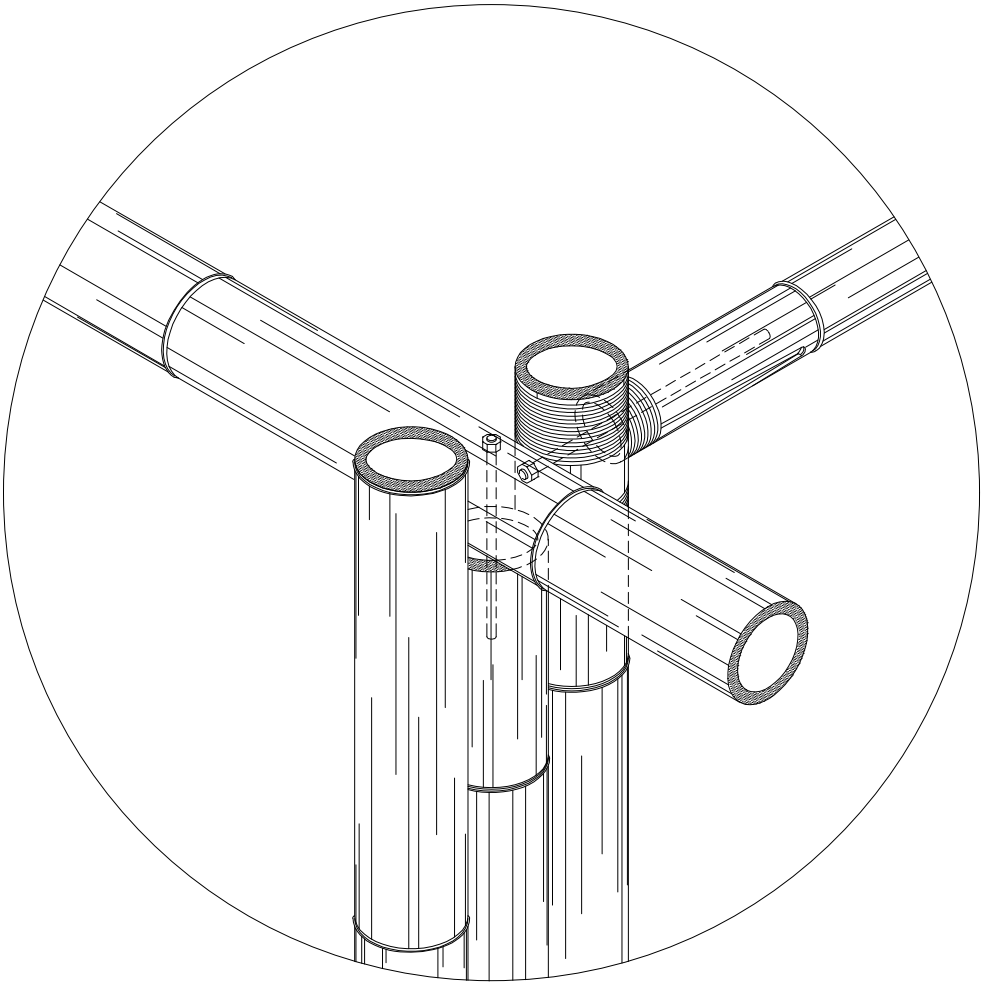
1.4. Cross bracing



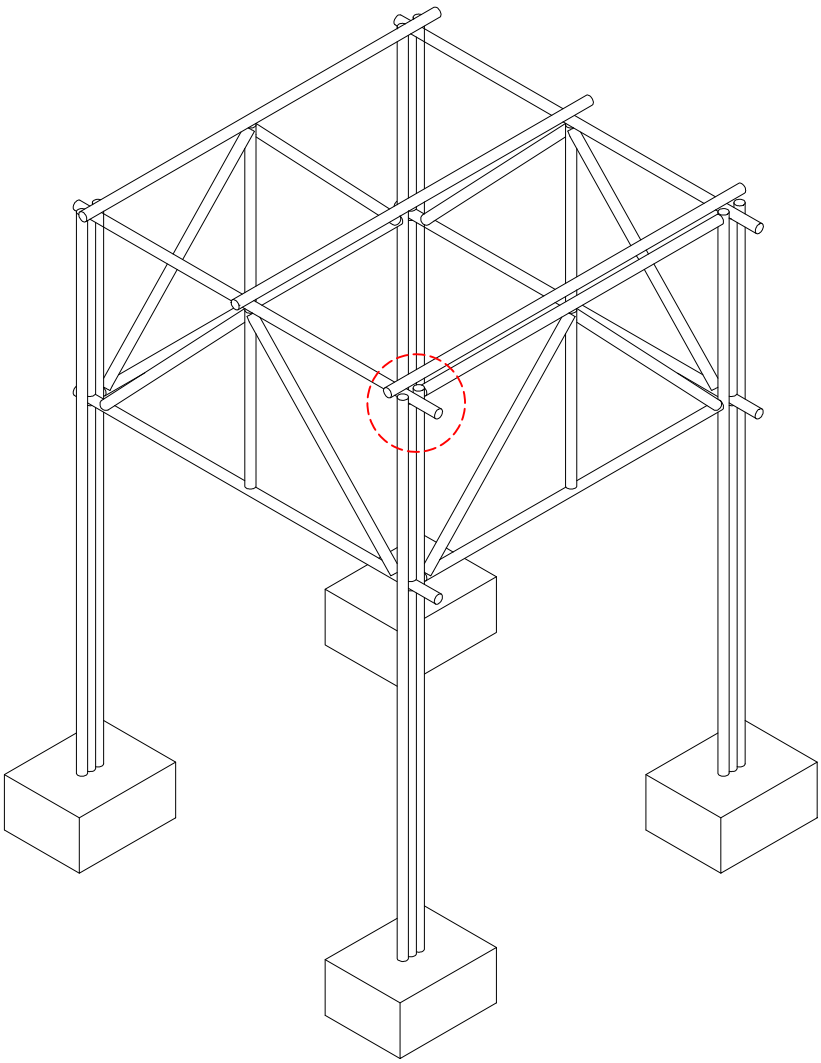


1.4. Cross bracing

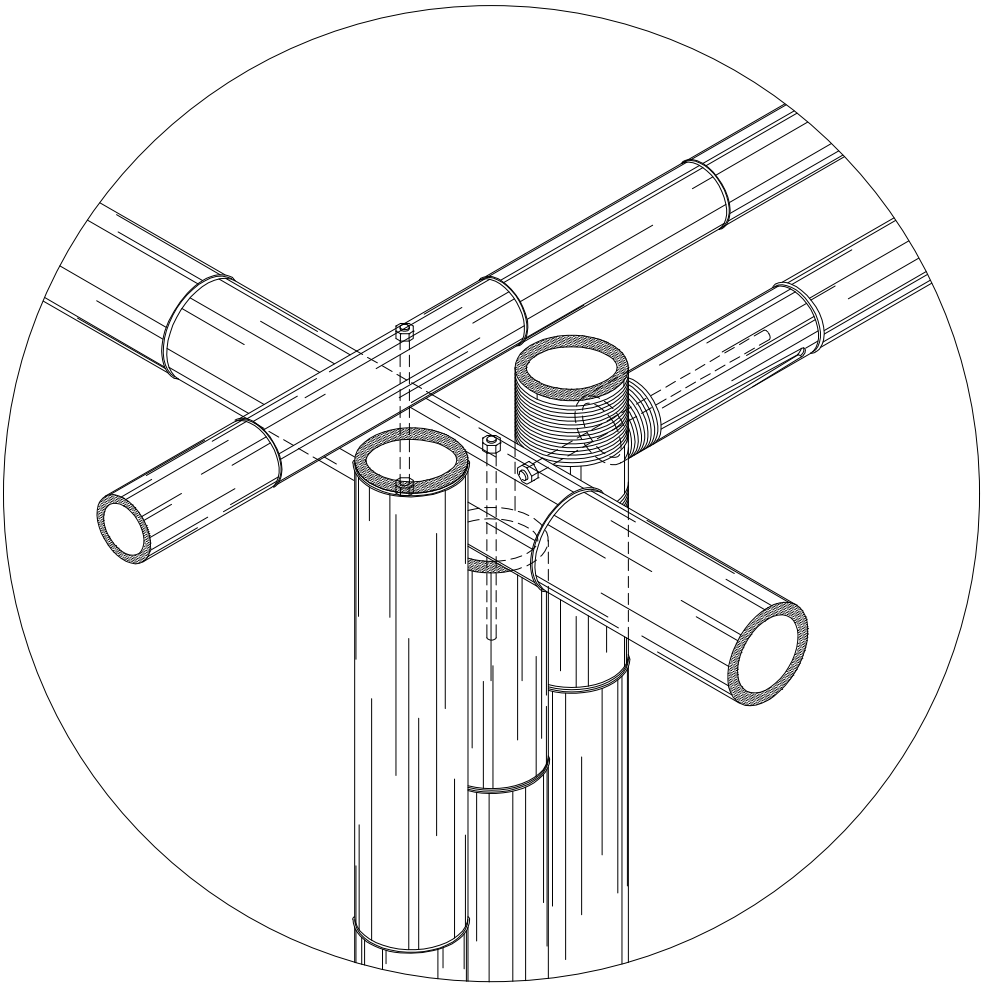




1.5.Roof construction

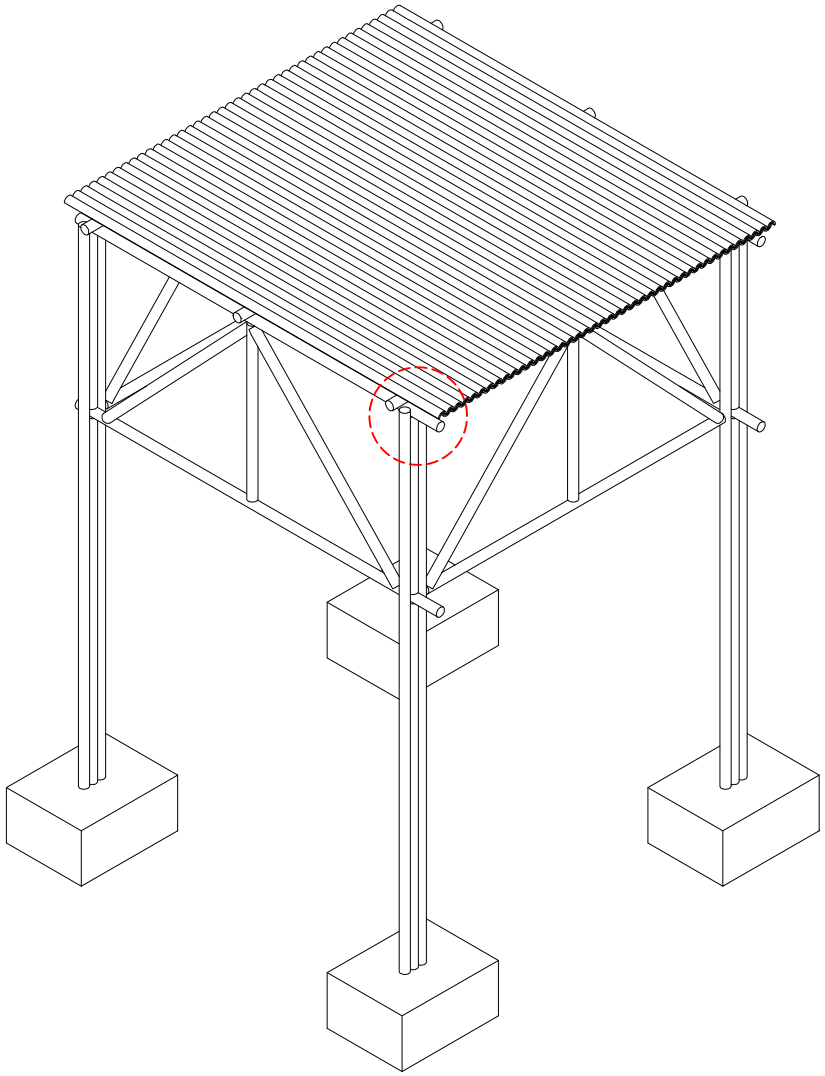


The next phase in the structure is the roof. Place three longitudinal roof beams. Attach them to the perpendicular structural beams with steel hooks.

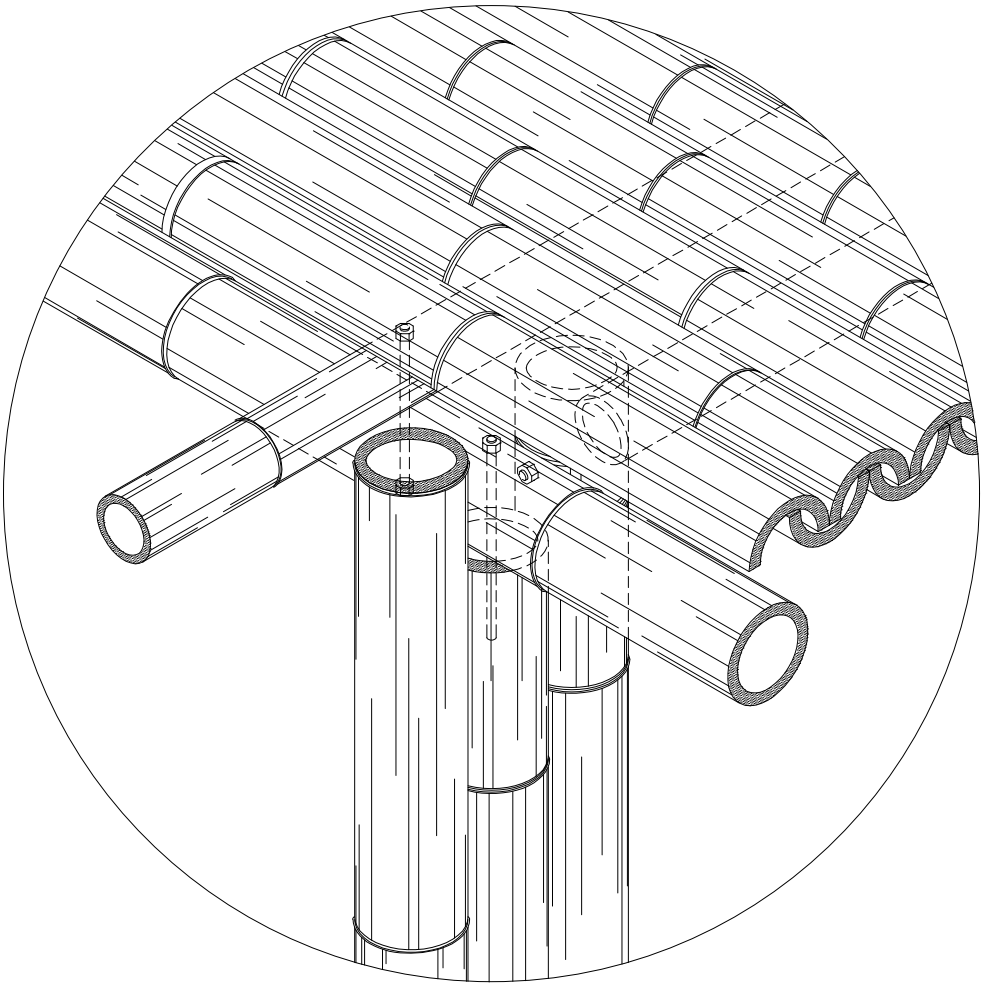


View above the placement of the roof beam and connection with a steel hook.

1.5.Roof construction

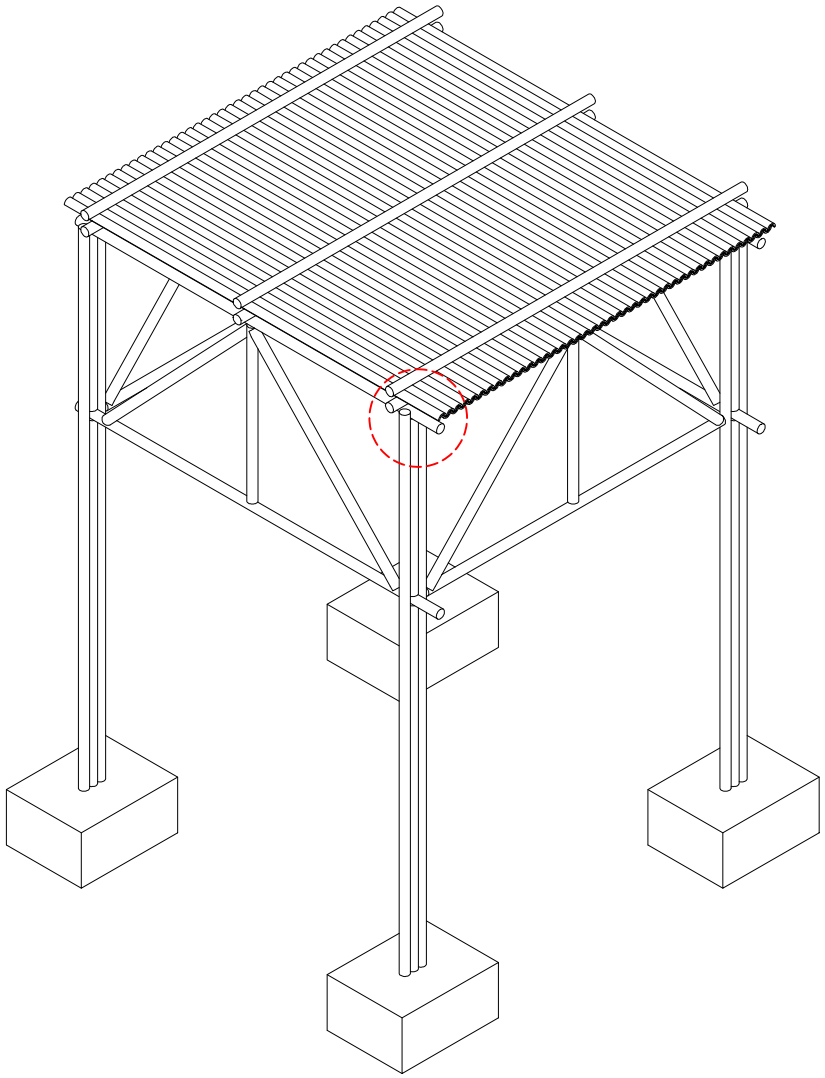


For roofing, cut a large number of bamboo pieces longitudinally in half. Place them facing upwards and downwards so that they link together.

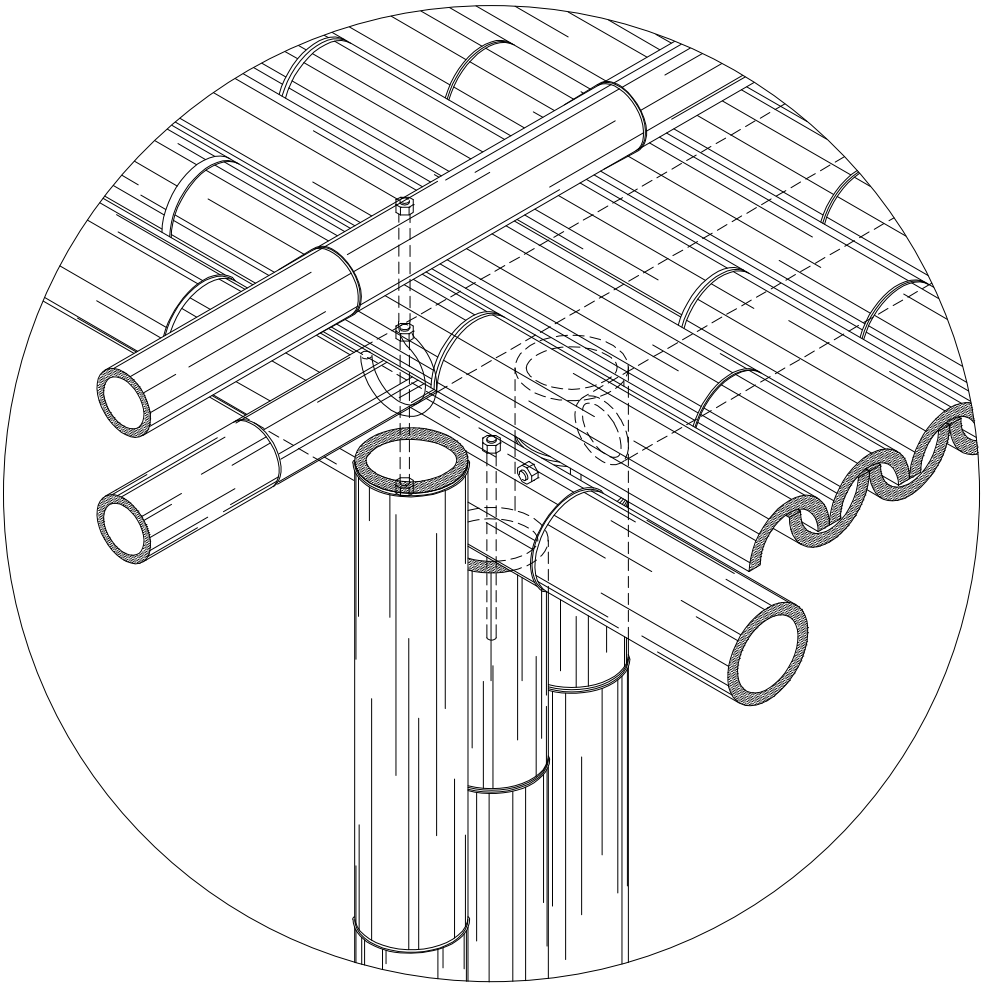


When placing the roof-cover bamboo pieces, intertwine them with string to ensure maximum stability and durability.

1.5.Roof construction



Place three roof beams perpendicularly on top of the roofing cover bamboo pieces. They need to be attached to the same hooks holding the lower beams to the rest of the structure.



The top roof beams need to be attached to the hooks in the ends and the middle, and secured with a steel bolt.