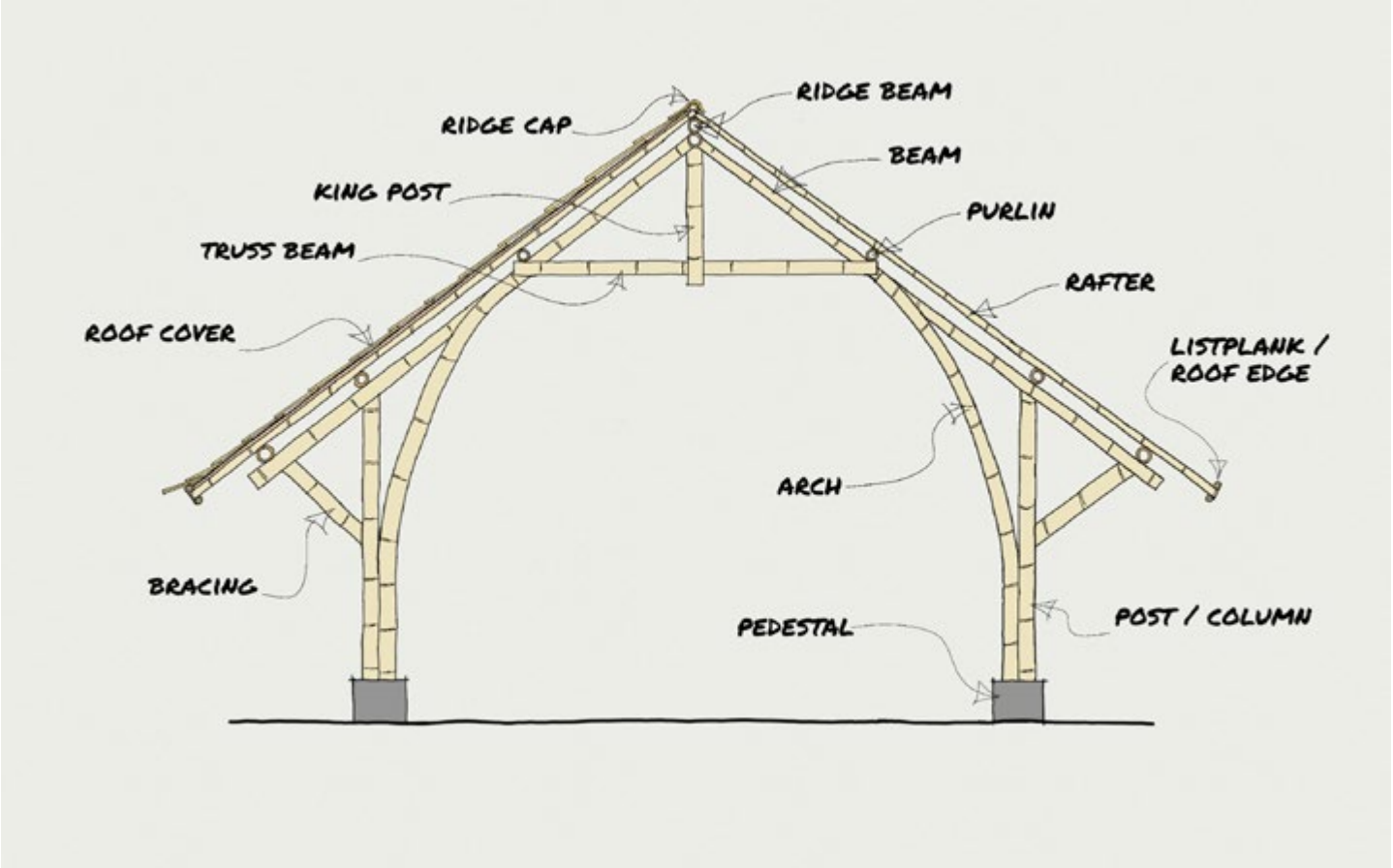
15 YEARS OF BAMBOO STORIES

MATERIALS AND FINISHES • 2024

BAMBOO CONSTRUCTION ENGINEERING

MATERIALS AND FINISHES

BAMBOO STRUCTURE VOCABULARY



Pedestal: Concrete or stone element, houses the bamboo structure and distances it from the ground;

Post/Column: Structural vertical or inclined pole, shapes the primary structure;

Arch: Curved structural pole, shapes the primary structure;

Beam: Structural pole, shapes the primary structure and support the roof;

Ridge beam: Connects all the beams and shapes the profile of the roof;

Purlin: Structural pole/bundle, straight or curved, shapes the secondary structure of the roof;

Truss beam: Structural reinforcement element;

Bracing: Structural inclined reinforcement element;

King post: Structural vertical reinforcement element;

Rafter: Supports the roof cover;

Listplank/Roof edge: Connects all the rafters together and gives an aesthetic finishing;

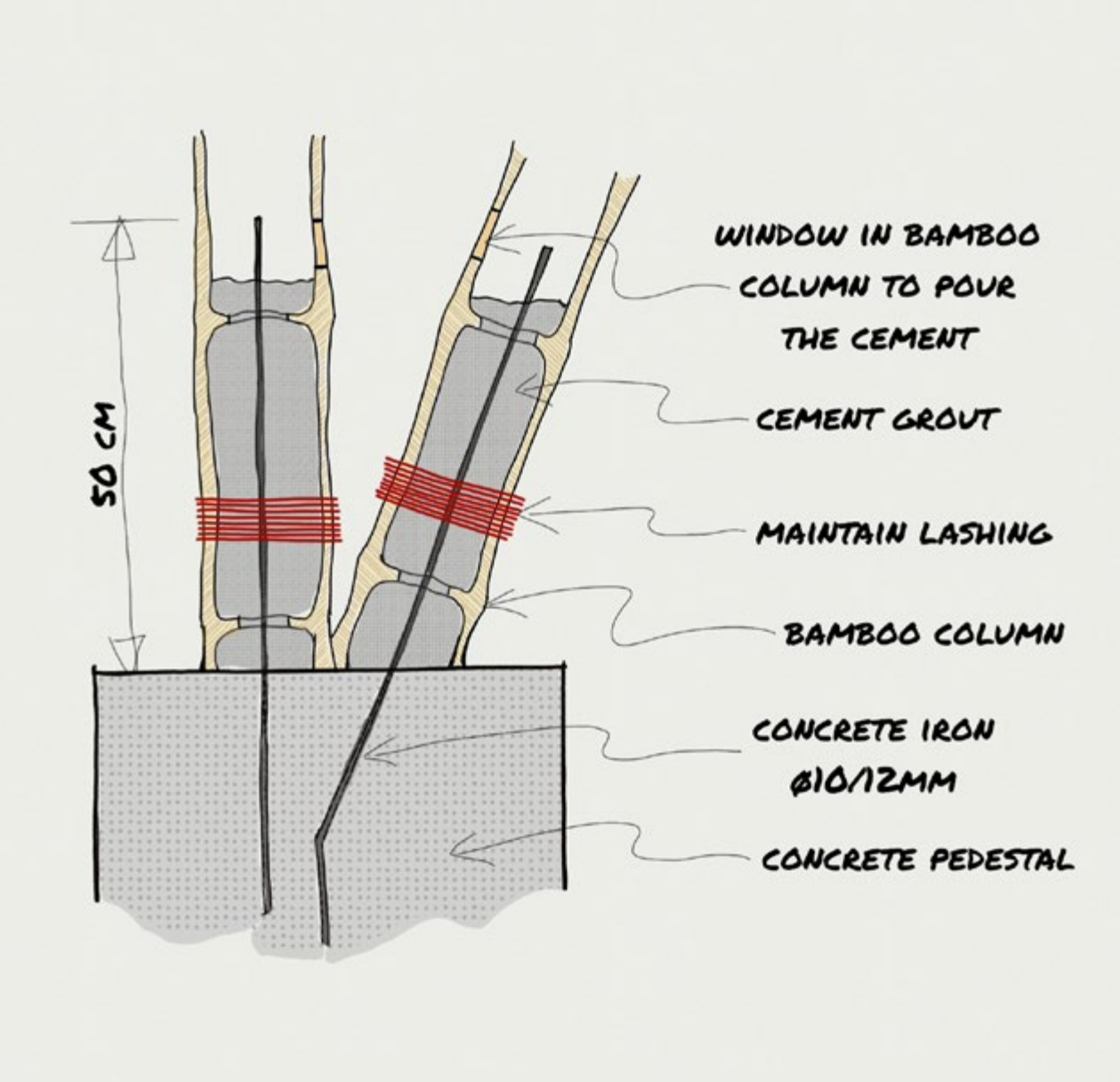
Roof cover: Waterproof layer, protects the structure and covers the building;

Ridge cap: Protects the ridge beam and ensures the waterproofing of the roof pitches.

STRUCTURE

COLUMNS & PEDESTALS

In order to prevent ground moisture through capillary and reduce the risk of exposure to rain and direct sun exposure, bamboo columns are commonly placed on pedestal. The pedestals can be done in concrete or with additional river stone on top of the foundations. A steel bar (>12mm diameter) should be stepping out of the pedestal with a minimum of 50cm free length in order to realize to bamboo anchorage.



Concrete pedestal and steel anchorage – Technical sketch detail.

COLUMNS & PEDESTALS

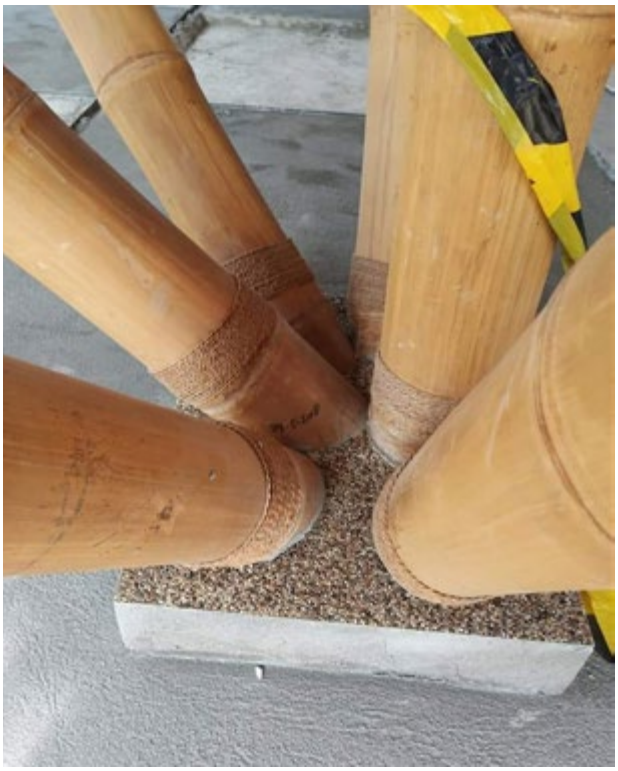
The columns for bamboo buildings are commonly done with bamboo petung (Dendrocalamus Asper) Ø 13-15 cm diameter. Black bamboo (Dendrocalamus Asper Sp.) is an alternative for original aesthetic. The roots of the bamboo can be conserved at the base of the columns for additional stiffness and aesthetic.

Bamboo petung with roots and concrete pedestal. Whales and waves, Sumbawa. 2014.

Bamboo petung with concrete pedestal. Warehouse Tripper, Batubulan, Bali. 2015.

Black bamboo petung with concrete pedestal. K Club – Tegallalang, Bali, Indonesia. 2019.

River stone pedestal, Ulaman Eco Retreat, Bali. 2020.



Resin, Mutia Garden Restaurant, Medan, Sumatra. 2018.

CENTRAL COLUMNS

For large spans and circular buildings, central bamboo column can be used. The reciprocal towers offer additional strength to the structure by reducing the length of buckling of each bamboo elements and working together in the most efficient way.

Bamboo petung with roots and concrete pedestal. Whales and waves, Sumbawa. 2014.

Bamboo petung central column. Apothecary, Joali Being, Bodufushi, Maldives, 2021.

COLUMNS VARIATIONS

To create aesthetic bamboo columns, bamboo tali Ø 6-7cm and Ø 8-10 cm can be used.

Atelier Alam School, Berawa, Bali. 2016.

Triyana Condotel, Petang, Bali. 2018.

Bamboo tali Ø 6-7cm for interior Spa. Kinput, spa – Seychelles Island. 2017.

In order to "curve" the bamboo, a "V" cut is realized on the intrados of the bamboo pole. The "V" cut size and spacing will depend of the bending required for the structure.

V-CUT

01. V-CUT TO ALLOW THE CURVE

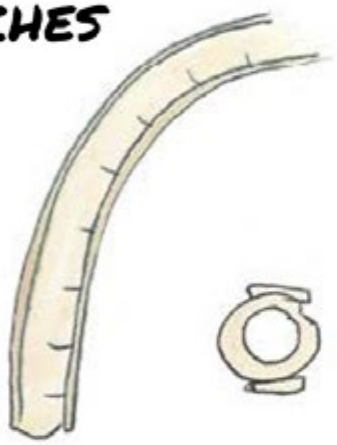
02. EPOXY TO FIT THE V-CUT

03. SPLITS TO MAINTAIN THE CURVE

04. CROSSING BAMBOO PINS

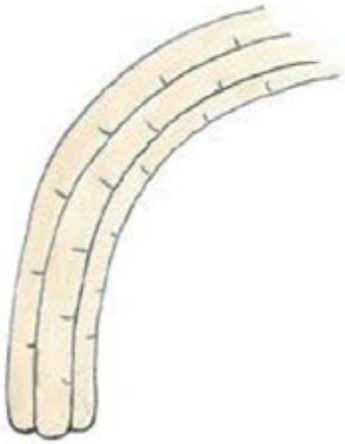
05. FIXING THE V-CUT WITH STRING

ARCHES

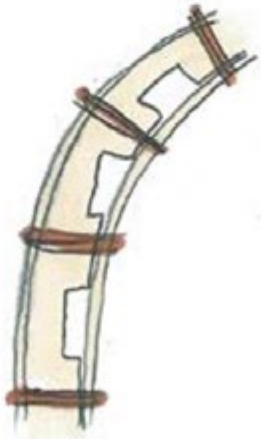


I. ROUND BAMBOO WITH V-CUT AND TWO SPLITS FOLLOWING THE CURVE

II. ROUND BAMBOO WITH V-CUT, TWO SPLITS FOLLOWING THE CURVE AND STRINGS TO REINFORCE THE V-CUT



III. SET OF THE BAMBOO WITH ALTERNATING V-CUT



IV. ROUND BAMBOO WITH CAVITIES, TWO SPLITS DEFINING THE CURVE AND STRING TO REINFORCE

BAMBOO ARCHES

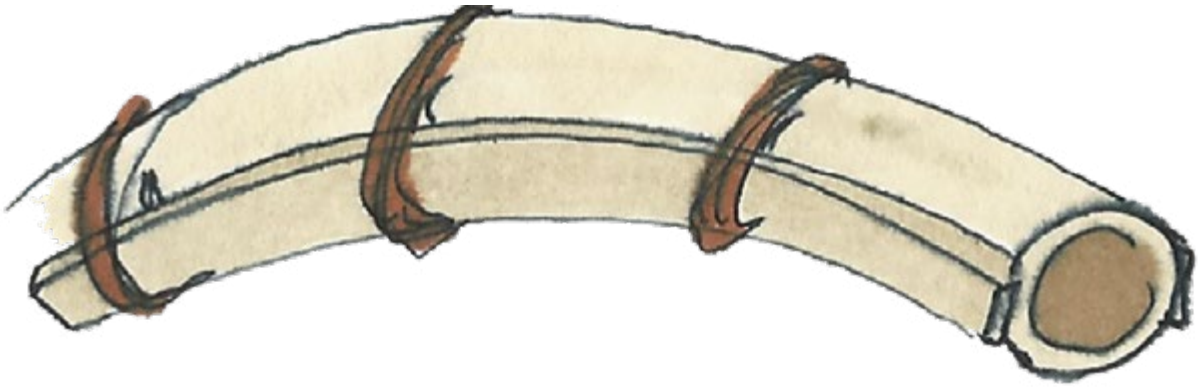
With “V” cut technique, 2 dimensional arches can be realized.

Arches with bamboo petung – Seven Chakra, Yoga – Kerobokan, Bali. 2019.

Round Bamboo arches and beams – Bochu Villa – Sidemen, Bali, Indonesia. 2021.

ROOF STRUCTURE

BEAMS - ROUND BAMBOO Ø 8-10CM & Ø 10-13CM



Bamboo beam with "V' cut technique – principle sketch.

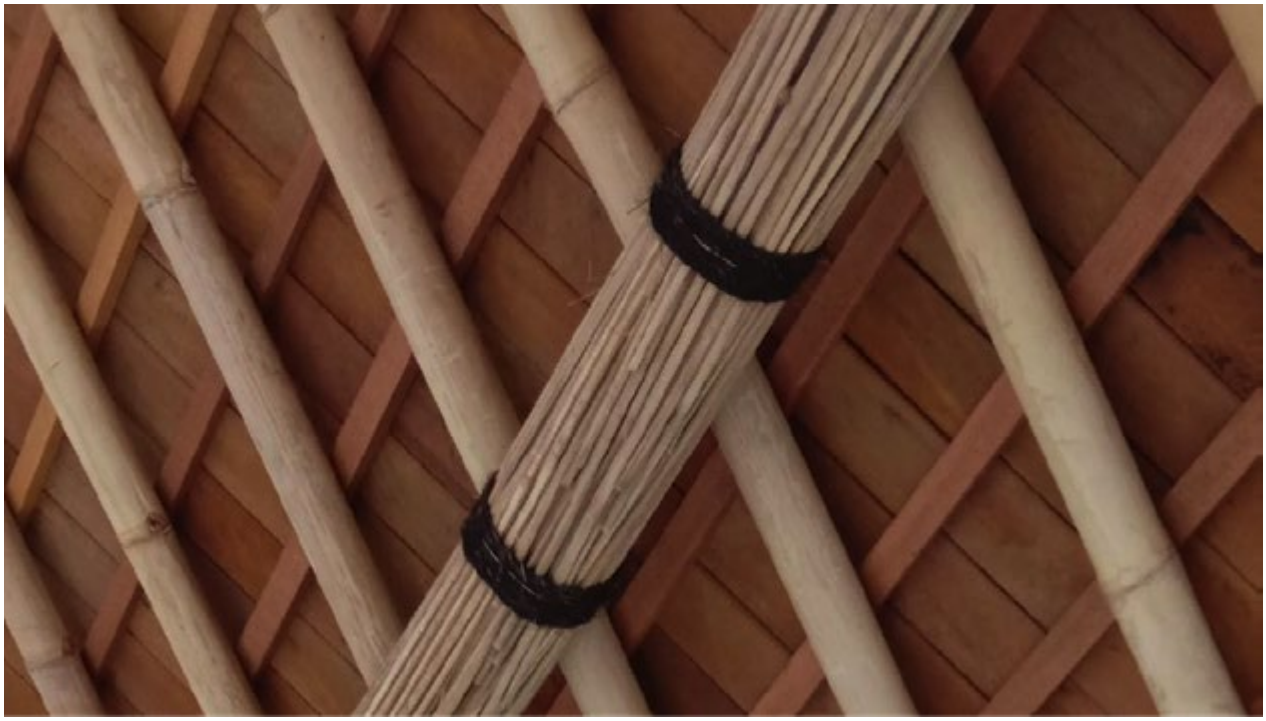
Arches with bamboo tali – Seven Chakra, Yoga – Kerobokan, Bali. 2019.

BEAMS - BAMBOO LIDI

In order to realize 3D curved structures, bamboo lidi made out of bamboo strips connected together in bundles are used, integrating additional bamboo splits inside the beam for additional stiffness and allow a better connection with main beams and columns. The diameter of the bamboo lidi beam will depend of the loads applied on the structure and would be sized consequently.

Detail bamboo lidi beam with inside bamboo split to connect with main beams and columns.

Sketch bamboo lidi.



Bamboo lidi beam supporting the rafters and the roof. RASLI villa, Ubud, 2020.

BEAMS - BAMBOO SPLIT

For 2D curved Beams we can use bamboo split with epoxy. The dimensions of the bamboo split beam will depend of the loads applied on the structure and would be sized consequently. The splits are pinned together with inclined bamboo pins and tight together by metal steel wire and rope.

Split beam during construction – Tea House, Ubud, Bali. 2020.

RAFTERS - ROUND BAMBOO Ø 6-7CM

Round bamboo tali (Gigantochloa Apus) of Ø 6-7cm for the rafters offer a particular well adapted solution to realize the roof structure. The bamboo rafters are placed on top of the roof beams, over the roof area in order to install the roof cover. The space between rafters will depend of the roof cover chosen generally 25 to 40cm. (cf Roofing Solutions).

Rafters bamboo tali Ø 6-7 cm. Ekommunity Farmstay & Yoga – Munduk, Bali. 2018.

Rafters bamboo tali Ø 6-7 cm. Mutia Garden Restaurant - Medan,Sumatra. 2019.

RAFTERS - CROSSED SPLIT

The bend of the crossed split rafters allow to follow the organic shape of the roof, conferring an original and aesthetic rendering. White washed finishing can be apply to reinforce the contrast with the roof material. The crossed installation adds stiffness to the roof structure working as a gridshell membrane.

Rafter bamboo split. Ulaman Eco Retreat. Kabakaba, Bali. 2020.

Rafter bamboo splits. K Club ubud – Lobby. Tegallalang, Bali. 2019.

RAFTERS - RANDOM SPLITS

In order to give an original look for the ceiling, the rafters can be installed randomly. Using black pelupuh would reinforce the ceiling contrast. For random rafters, more material would be needed than straight rafters, however, the rafter size can be reduce to add some lightness to the roof structure.

Rafter bamboo splits. K Club ubud – Lobby. Tegallalang, Bali. 2019.

ROOF EDGE - LISPLANK

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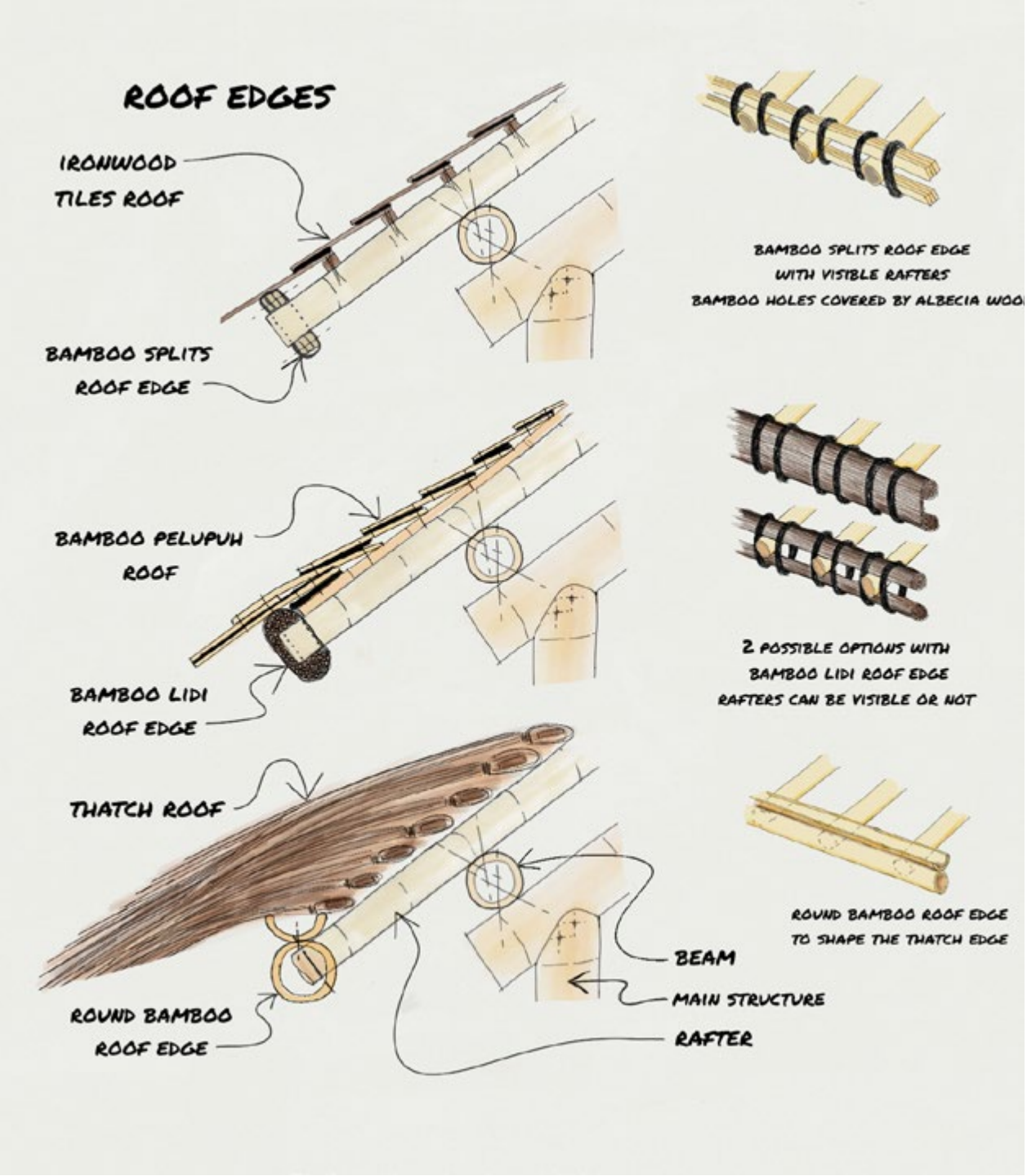
ROOF EDGES
IRONWOOD TILES ROOF
BAMBOO SPLITS ROOF EDGE
BAMBOO SPLITS ROOF EDGE WITH VISIBLE RAFTERS
BAMBOO HOLES COVERED BY ALBECIA WOO
BAMBOO PELUPUH ROOF
BAMBOO LIDI ROOF EDGE
2 POSSIBLE OPTIONS WITH BAMBOO LIDI ROOF EDGE
RAFTERS CAN BE VISIBLE OR NOT
THATCH ROOF
ROUND BAMBOO ROOF EDGE
ROUND BAMBOO ROOF EDGE TO SHAPE THE THATCH EDGE
BEAM
MAIN STRUCTURE
RAFTER

SPLITS BAMBOO

The roof edge with split bamboo can be applied for straight or 2D curves shapes by placing 3 splits under the rafters and 3 splits on top of it. Splits bamboo for roof edge brings stiffness to the roof by connecting all rafters together through an aesthetic finishing.

Alang alang roof and split roof edge - Eco Symbiosis, Survival Ecotourism - Anambas, Indonesia. 2018

BAMBOO LIDI

Bamboo lidi is an alternative to splits bamboo which allows 3D curved roof edge.

Bamboo lidi roof edge – Kaba kaba, Bali. 2019.

Bamboo lidi roof edge – K Club lobby – Tegallalang, Bali. 2019.

ROUND BAMBOO Ø 8-10CM

Round bamboo will close all the holes of the bamboo for the rafters. Its round appearance confers a smooth rendering. This element can be applied for straight or 2D curves roof overhang.

Alang alang roof edge with round bamboo – Mutia Garden Restaurant – Medan, Indonesia. 2019.

Alang alang roof edge with round bamboo - Villa Nangka, Gili Air, Indonesia. 2019.

ROOF EDGE COVER

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STRAIGHT PELUPUH

For an additional protection against the rain projection and finished aesthetic, the roof edge can be cover with straight bamboo pelupuh.

Ulaman Eco Retreat, Kaba kaba, Bali. 2020.

Seven Chakra, Spa – Kerobokan, Bali. 2019.

Ulaman Eco Retreat, Kaba kaba, Bali. 2020.

ROUND PELUPUH

In order to have an aesthetic finishing and drive the rain water to the back of the roof, a side cover roof edge in pelupuh can be added. With a bamboo split and extra waterproofing it protects the roof edge.

Nusava Eco resort – Nusa Penida, Bali. 2020.

TATCH (ALANG-ALANG)

When installing a thatch roof, we can add an extra layer of thatch bundle on the side to hide the bamboo sticks on which the thatch is attached which confers a homogeneous finishing and rendering.

Bale Pod – Asali Bali, Bali. 2021.

Bale Pod – Asali Bali, Bali. 2021.

RIDGE BEAM COVER - PEMUBUG

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PEMUBUG THATCH (ALANG-ALANG) & KLAKAT

In order to protect the ridge beam from leaking, we cover the roofing with an extra waterproofing layer. These protection present different options regarding the type of roof we are using. For alang alang roofing, an extra layer of bamboo split can be installing to protect the roof against strong winds.

Joali Being, Yoga Shala – Bodufushi – Maldives. 2021

In order to protect the ridge beam from leaking, we cover the roofing with an extra waterproofing protection. This protection present different options regarding the type of roof we are using.

Logal Eco Stay, Restaurant – Candidasa, Bali. 2021.

PEMUBUG - PELUPUH

In order to protect the ridge beam from leaking, we cover the roofing with an extra waterproofing protection. This protection present different options regarding the type of roof we are using.

Tea House – Ubud, Bali. 2021.

TILES

In order to protect the ridge beam from leaking, we cover the roofing with an extra waterproofing protection. This protection present different options regarding the type of roof we are using.

Main Building & BaleApi, Meditation Center – Sangketan, Bali. 2019.

CEILING AND CLADDING

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BAMBOO PANCING Ø 3 CM

Bamboo cladding can be done with round bamboo from diameter 2 - 7cm. Wider the bamboo, the fastest it will be for installation, bringing down the final cost.

Bamboo Cladding Ø 2-3cm with lasure dove finishing - Bali, 2018.

Sample bamboo cladding Ø 2-3cm before finishing - Bali, 2019.

BAMBOO TALI Ø 6-7 CM

For a faster installation and reduce cost, we can use bamboo with diameter 6-7cm as the pictures bellow of the project we built in Republic of Congo in 2017.

Bamboo ceiling Ø 6-7cm - Republic of Congo, 2017.

BLACK BAMBOO Ø 6-7 CM

In order to confer a classy and cozy atmosphere to the interior design, black bamboo can be used for interiors, partition walls, ceiling or decorations. The bamboos are naturally colored from chocolate tones to dark black aspects; a lawyer of natural finishing on top of it will exacerbate the natural colors.

Black bamboo cladding. Sunsri House of Jewelry - Batubulan, Bali, Indonesia. 2018.

Black bamboo cladding. Ulaman Retreat – Kaba Kaba, Bali, Indonesia. 2020.

PELUPUH – OPEN BAMBOO

Pelupuh is a natural material use traditionally in all Indonesia for roofing, cladding and flooring. To do so we use the top part of the bamboo petung, contributing to the valorization of the whole bamboo pole. Pelupuh walls are the most economic solution, most recommended to maximize logistic for remote areas projects and natural rendering. The simple pelupuh should be double with plywood or other material for partition walls.

Bamboo pelupuh, interior bamboo skin on traditional cladding – Bali, Indonesia

RASLI Villa – Ubud, Bali, Indonesia. 2020

ROPES - TALI

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TALI IJUK - BLACK COCONUT STRING

The traditional Ijuk is used in Indonesia for the most resistance in exposed environment and weather conditions. Its natural black color offers a nice contrast with yellow bamboo.

Tali Ijuk – Office, Ekommunity – Munduk, Bali. 2018.

Tali bamboo – woven bamboo string

Tali bamboo made out of bamboo fibers fit perfectly with bamboo structure for a homogeneous rendering. It is strong and resistant on shaded areas.

Mutia Garden, Restaurant - Medan, Sumatra, Indonesia. 2018.

TALI MENDONG – WOVEN MENDONG STRING

Tali mendong which is made out of a water plant is a natural material used traditionally to tie bamboo structure and craftship. It has the best balance for durability, reduced price and natural rendering for bamboo projects.

Alam Atelier School - Berawa, Bali, Indonesia. 2016.

TALI RATTAN - RATTAN ROPE

Tali rattan is natural and sustainable resource with fit perfectly with interior design, precise finishes and furniture.

Ulaman Eco Retreat – Kaba Kaba, Bali, Indonesia. 2019

COVER STEEL BAR & COVER HOLE

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COVER STEEL BAR – BAMBOO PETUNG

For large diameters steels bars we can use the skin of bamboo petung to hide the steel bars.

Cover of the steel bars with bamboo petung - Tegallalang - Bamboo Lobby. Bali, 2019.

Cover of the steel bars with bamboo caps – Yoga Shala, Joali Being, Bodufushi, Maldives, 2021.

COVER BAMBOO HOLE

To prevent insect and animals to get into the bamboo structure, we can use albecia wood to close the bamboo holes for an aesthetic and natural rendering.

Cover holes with albecia wood (closed and not closed)- K Club – Tegallalang, Bali. 2019.

Cover holes with albecia wood before finishing -Restaurant – Candidasa, Bali. 2021.

ELECTRIC INSTALLATION

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ELECTRIC INSTALLATION

For a perfect integration of the electric plugs, we can integrate bamboo opening to pass the electric cables inside the bamboo columns.

Electric installation sample.

Tripper Nature, Atrium – Batubulan, Bali, Indonesia. 2017.

Meditation center, Sangketan, Bali. 2020.

The Nyx, Coconest –Tampaksiring, Bali, Indonesia. 2020.

BAMBOO RAILING

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BAMBOO DURI

For a natural railing and finishing, the bamboo slices made out of the species of bamboo call bamboo duri with natural tight internodes. The top part railing should be at a minimum of 1,03m height.

Ekommunity Farmstay& Yoga, Dormitory - Munduk, Bali, Indonesia. 2018

Babcock Villa – Ubud, Bali, Indonesia. 2020

BAMBOO STAIRS

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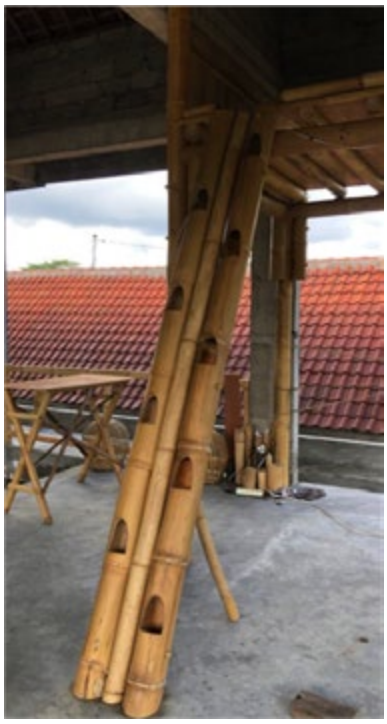
BAMBOO STAIRS

For a complete bamboo set, bamboo stairs fit well with the building. The steps are 15-20cm height and can be cover with wood, bamboo splits or bamboo planks.

Ulaman Eco Retreat – KabaKaba, Bali, Indonesia. 2020

Bamboo stairs & wood steps.Villa Nangka – Gili Air, Bali. 2020.



The Nyx, Mezzanine – Tampaksiring, Bali. 2020.

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