Bamboo in European construction industry

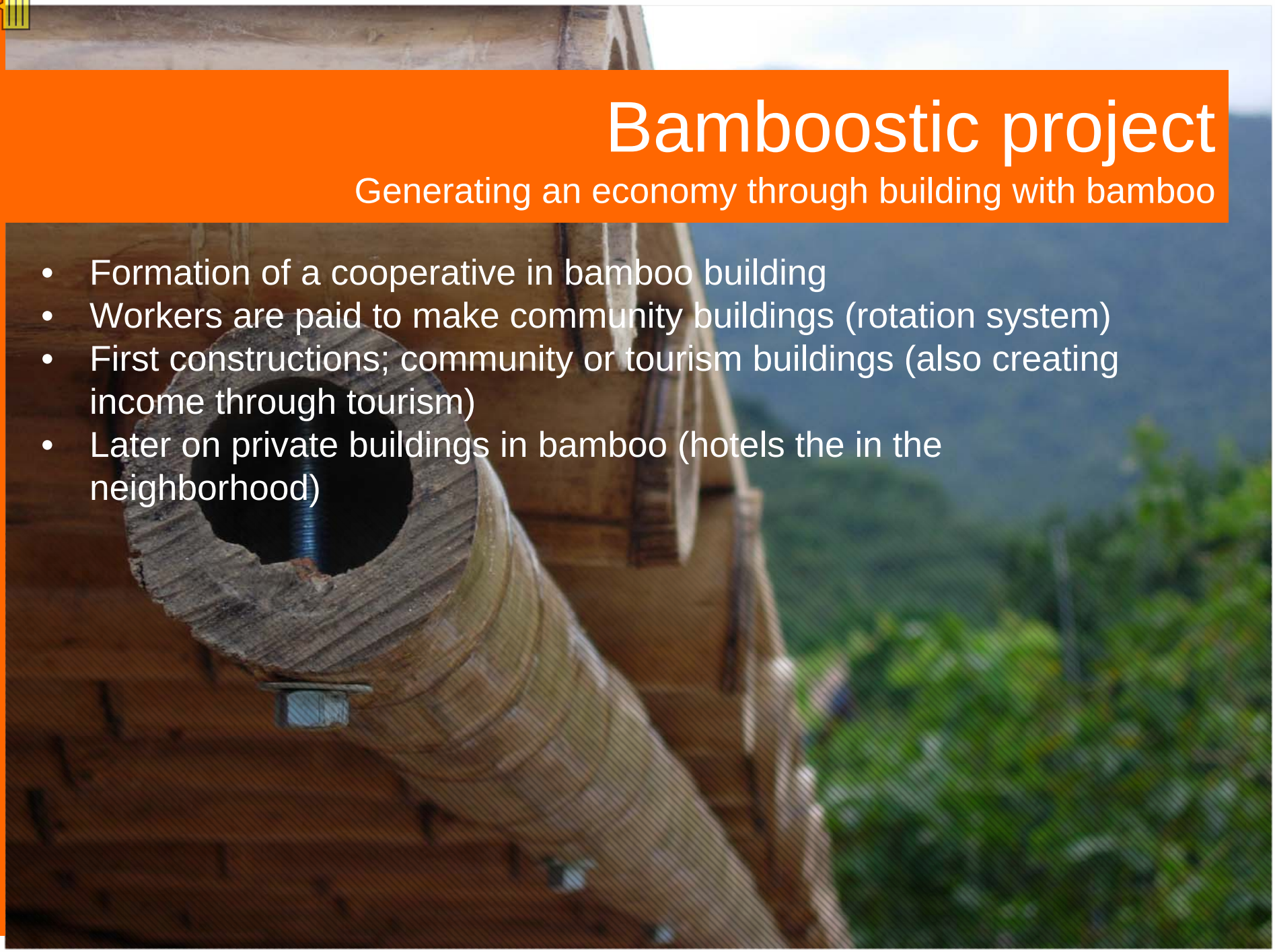
The foundation of CRU! Architects in Belgium started with

Bamboostic

A collaboration between PUC-Rio University (professor K. Ghavami) and VZW Bamboostic

Bamboostic project

Generating an economy through building with bamboo



- Formation of a cooperative in bamboo building
- Workers are paid to make community buildings (rotation system)
- First constructions; community or tourism buildings (also creating income through tourism)
- Later on private buildings in bamboo (hotels the in the neighborhood)

Realised Projects

the first construction = bridgemaking to community

Several smaller tourism buildings

Problem = tatched roof + overhang

Tourist information stand – entrance of Camburi


Community Centre
with class rooms, library, venue, kitchen and toilets

Design of the community building :

- Protection of bamboo against sun and rain:
  - roof overhang
  - 50 cm above ground level – stone basis
- Ventilation; danger of wind shadows; axis towards main wind
- Comprehensible design + easy to duplicate
- Importance of good examples for acceptance

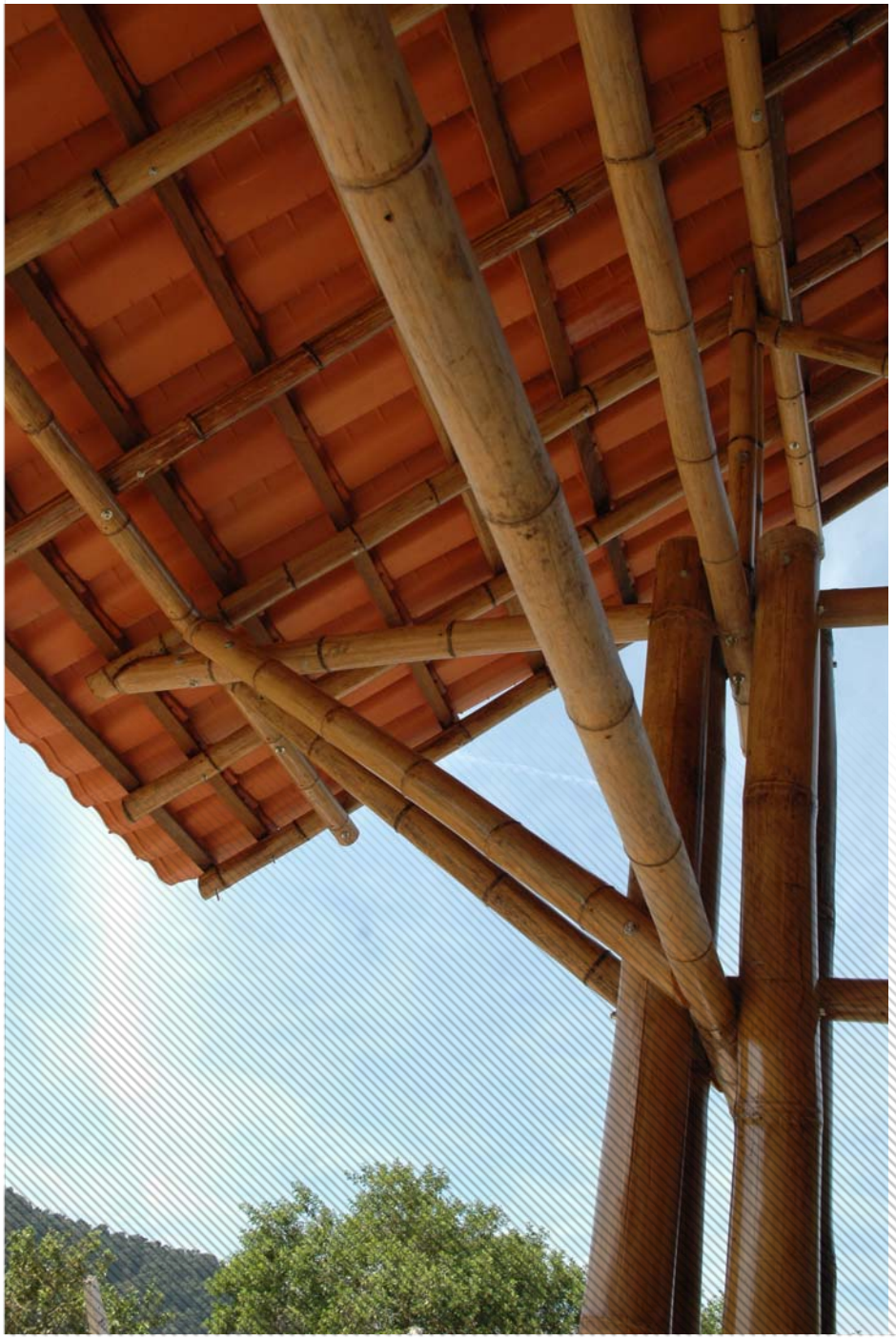
Used techniques; bamboo, taipa, adobe bricks, river stones, green roof, plastic bottle walls, etc

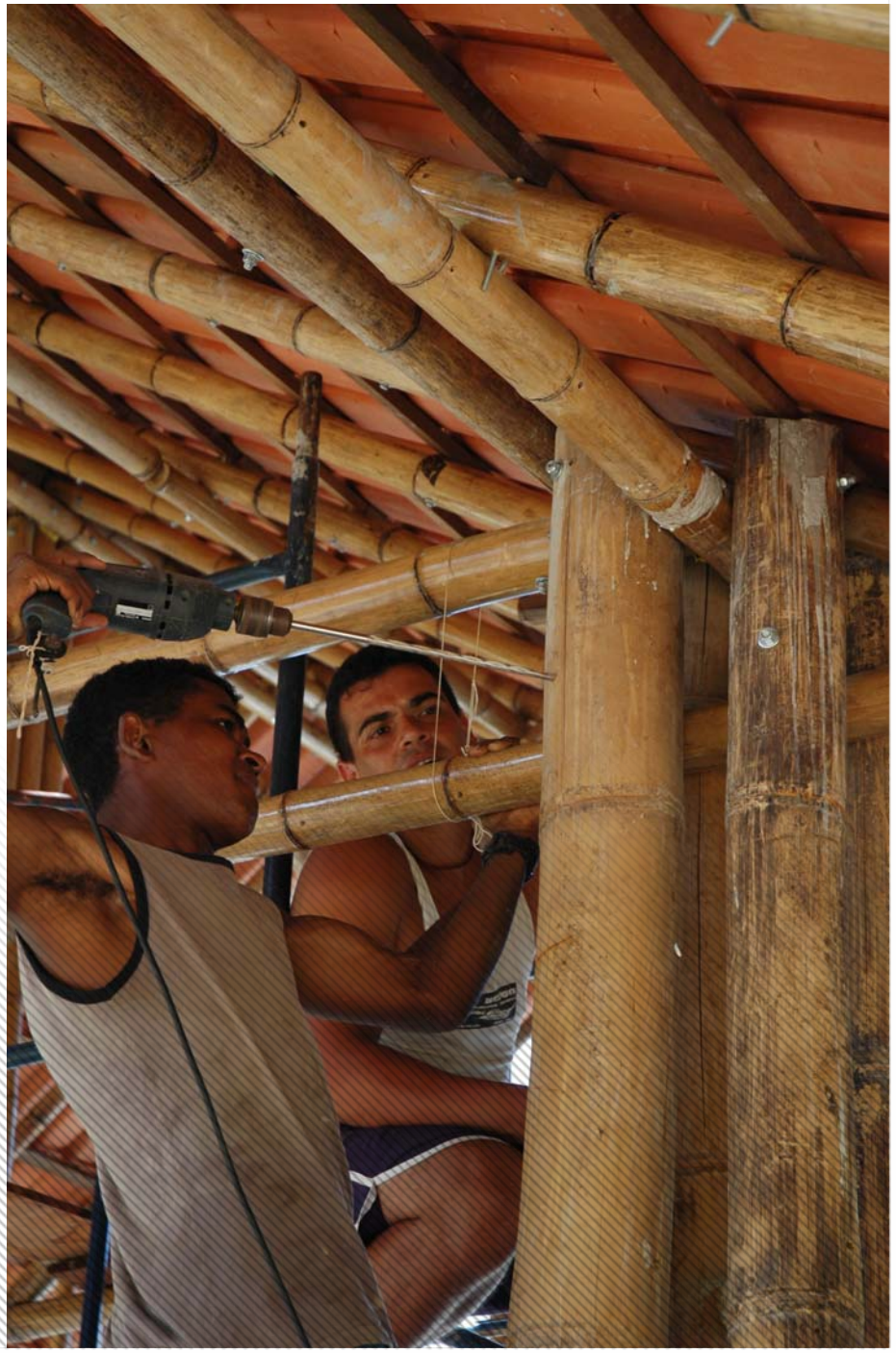
Cutting bamboo: time and photosynthesis

Drying bamboo: construction and shade

Treatment through immersion

Training of jointing techniques (fish mouth)





Putting the (prefabricated) trusses
Protection against the sun

Compressed earth blocks

Rammed earth walls


CENTRO COMUNITÁRIO DE CAMBURY

CRU! Architects

Ghent - Belgium

2006 Back in Belgium

- Clean globalized => not related to local identity-architecture
- Energy = ecology?
- Is passive dangerous and a-social? New building > 30km from work?
- Conventional materials and technologies; contributing to energy saving and ecology in the 21st Century?

Why isn´t bamboo used in Europe

- Lack of knowledge, trust and good examples
  image of poor man´s timber – technical solutions not very known

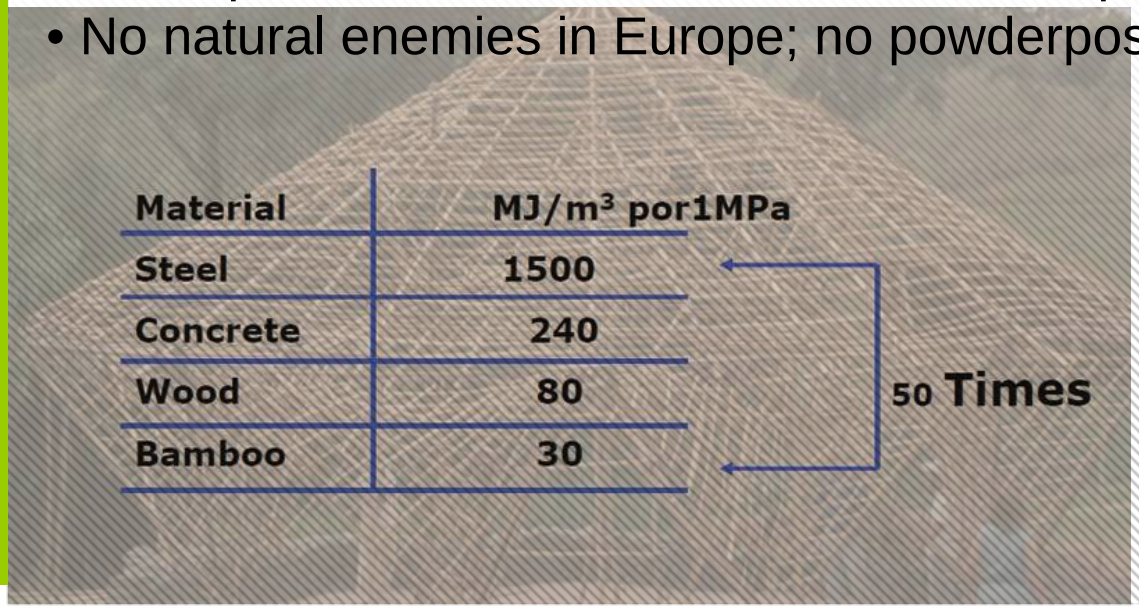
•Lack of good construction codes

Since 2003 international iso-norms for mecanical properties – Jules Jansen, K. Ghavami ea collaboration Kaho St Lieven

- Lack of dimensional stability – variable material
  Requires originality of the designer, letting go of fixed design methods and knowledge of common connection techniques

Why using bamboo in Europe

- Moso is already imported for decades (decoration etc) and available
- Question of transport; compare it to its ecological equivalent
  - most wood is Canadian or Scandinavian (Oregon or Douglas) which is equally as far but to the north – most building materials are imported
  - a tree grows in 30 years versus bamboo in 4 to 7 years
- Energy spend to produce 1 m^3/Mpa of bamboo is 50x less than that of steel (K.Ghavami) !
- Tensile strength (N/mm^2); of bamboo almost equal to that of steel!
- In the production of 1 ton steel 2 ton $C0^2$ is produced; bamboo absorbs CO^2
- No natural enemies in Europe; no powderpost beetle-less funghi



How to apply bamboo in Europe

- Safety! no lashings but use high tec techniques (steel+concrete)
- Make a variable material straight – longeron, ridge and wall plate

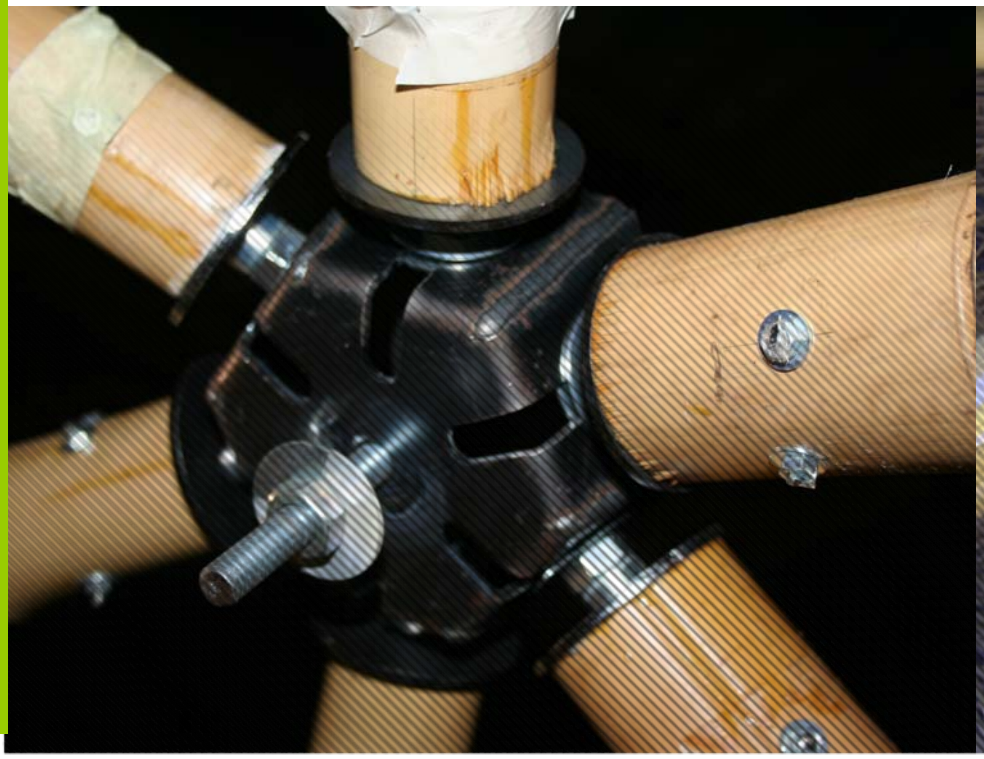
- Give attention for dry air (at least 40% humidity in the air- winter!)
- Calculation now is possible

- Prefabricate; use rafters like iron or wood, use scaffolding
- Make a logical and copyable design – no hippie architecture

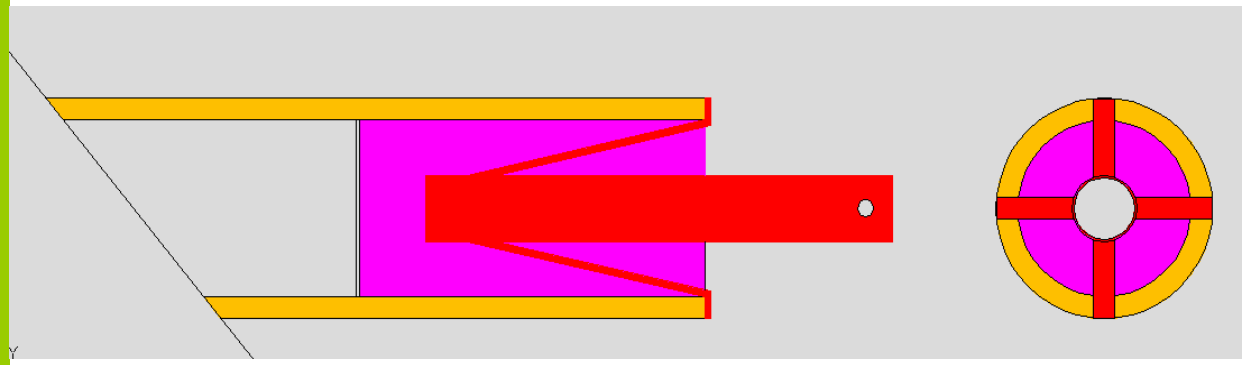
- Don´t mention it to your city service urban planning

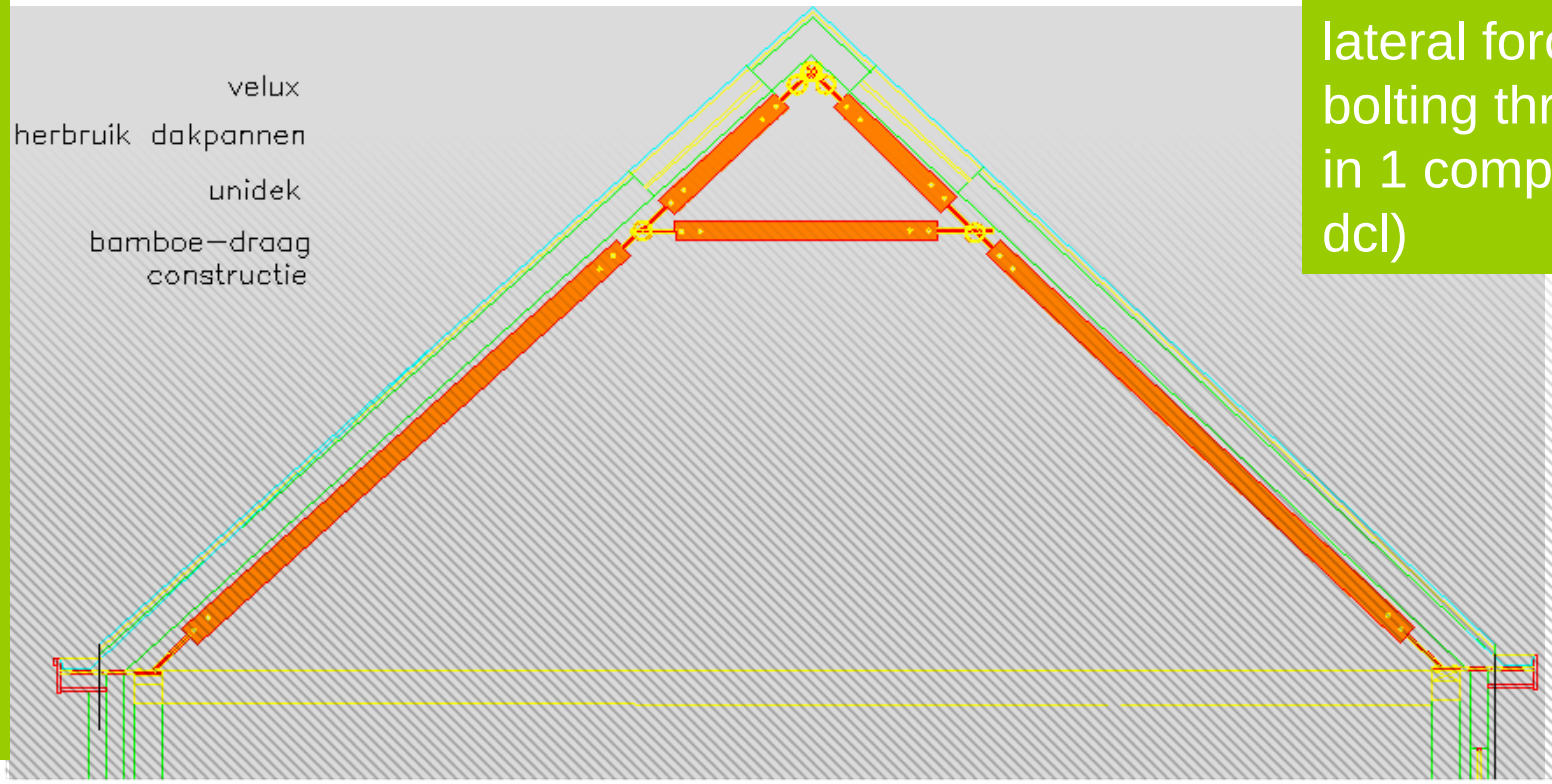
Various connection techniques

- Lashing or bamboo pins are dangerous when not perfectly executed, not secure enough for European context
- Fish mouth technique; requires a perfect ‘mouth` = labour intensive
- Multiple bamboo connected to each other by the merho-node = expensive method but good



The used technique





- The used technique was developed in Colombia by Hidalgo en Velez;
- The ends with metal couplers, concrete or plastic bottles.
- Cross connections with wire rods; size M12
- Protection against lateral forces when bolting through concrete in 1 compartment (=<2 dcl)

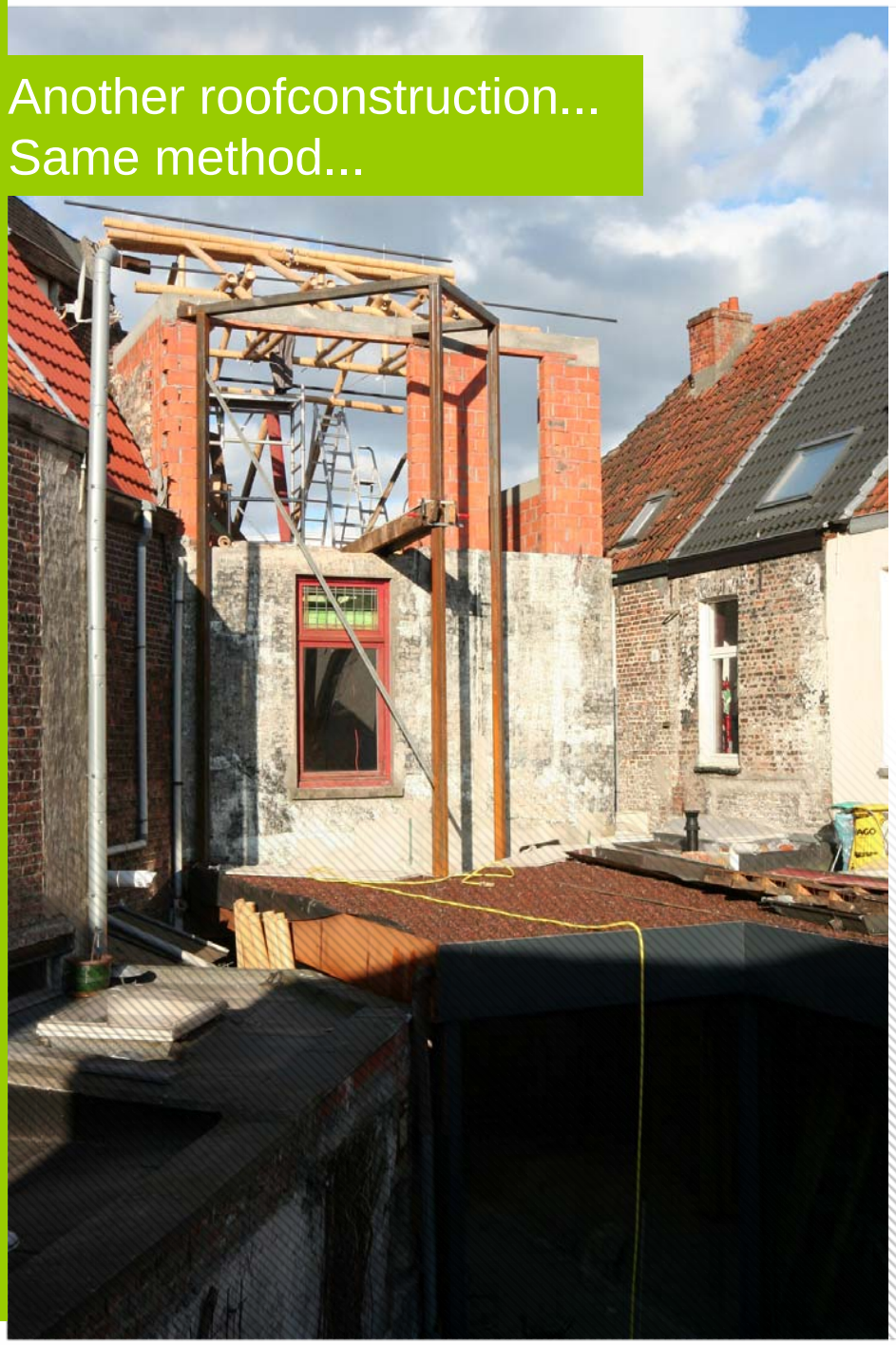
Eliminate variability of bamboo through metal ridge and longeron

Prefabrication; make the design copyable and prefabricate as much as possible on the floor + fill up connections with concrete

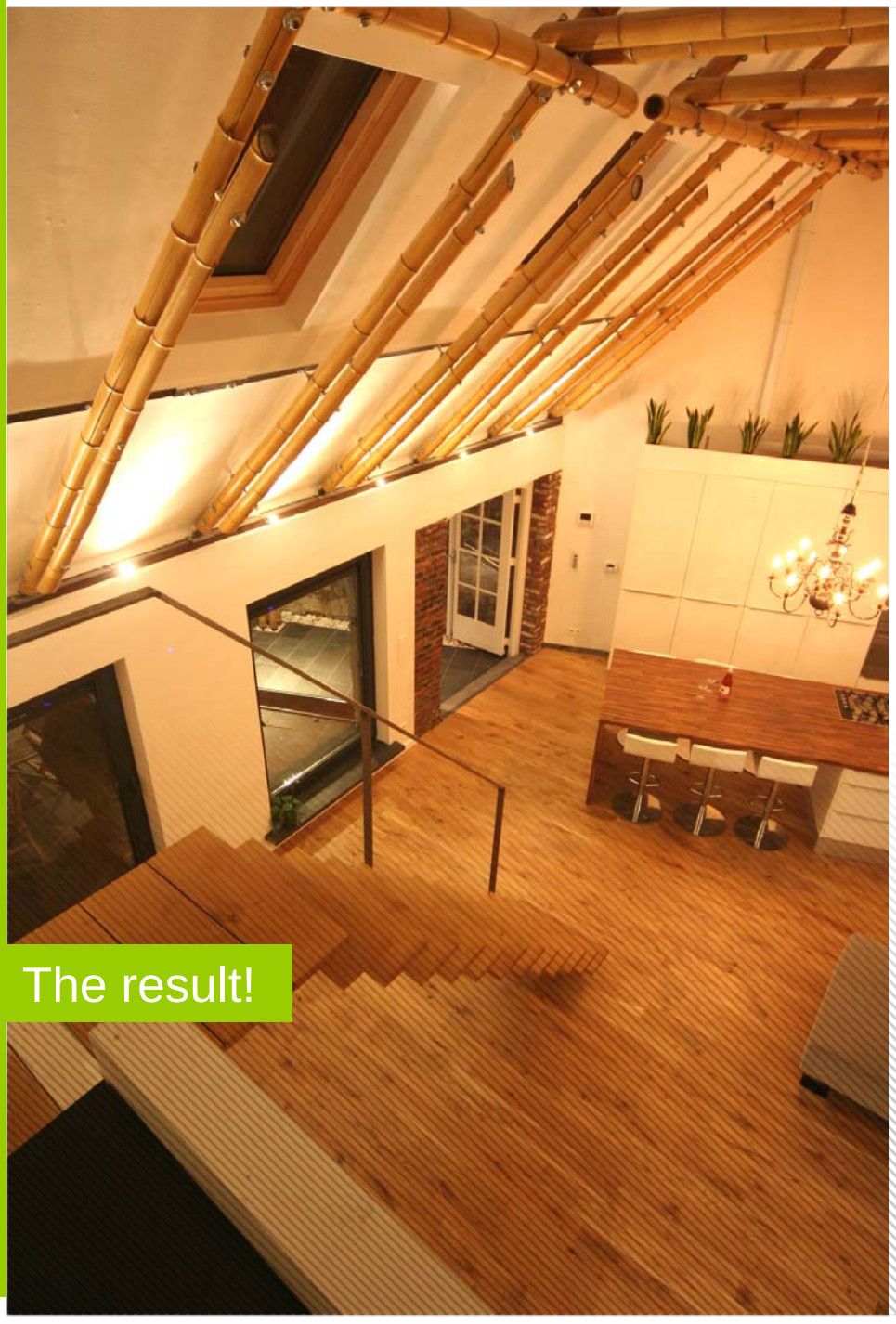
- Cross connect bamboos
- Put three bamboos on top (can´t weaken the bamboo with to many connections coming on to one single bamboo – therefore three bamboos

Sandwichpanels with isolation (= standard material + easy for finishing off rest of the roof construction). Variability is gone

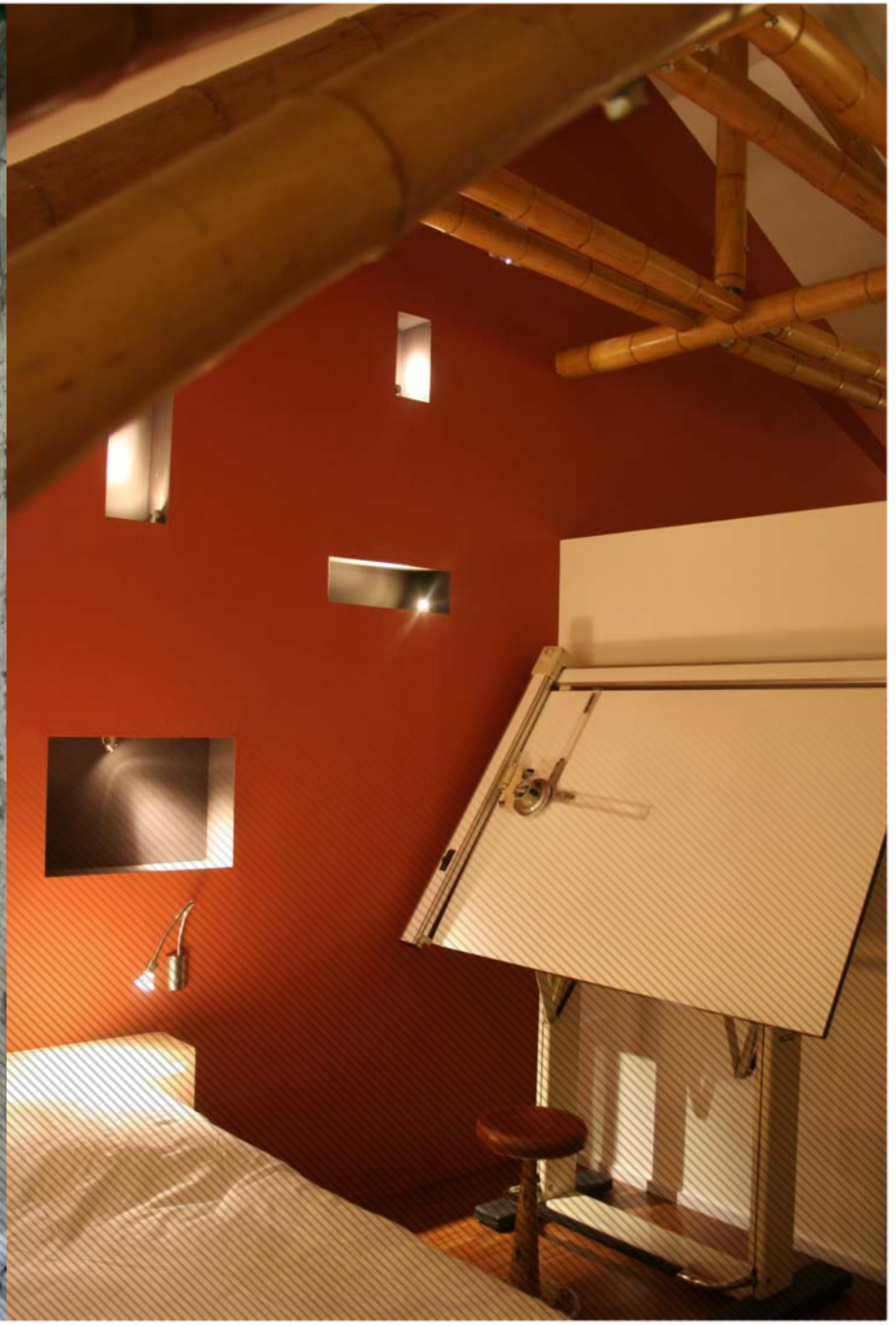
Another roofconstruction...
Same method...



Scaffolding and tempory support

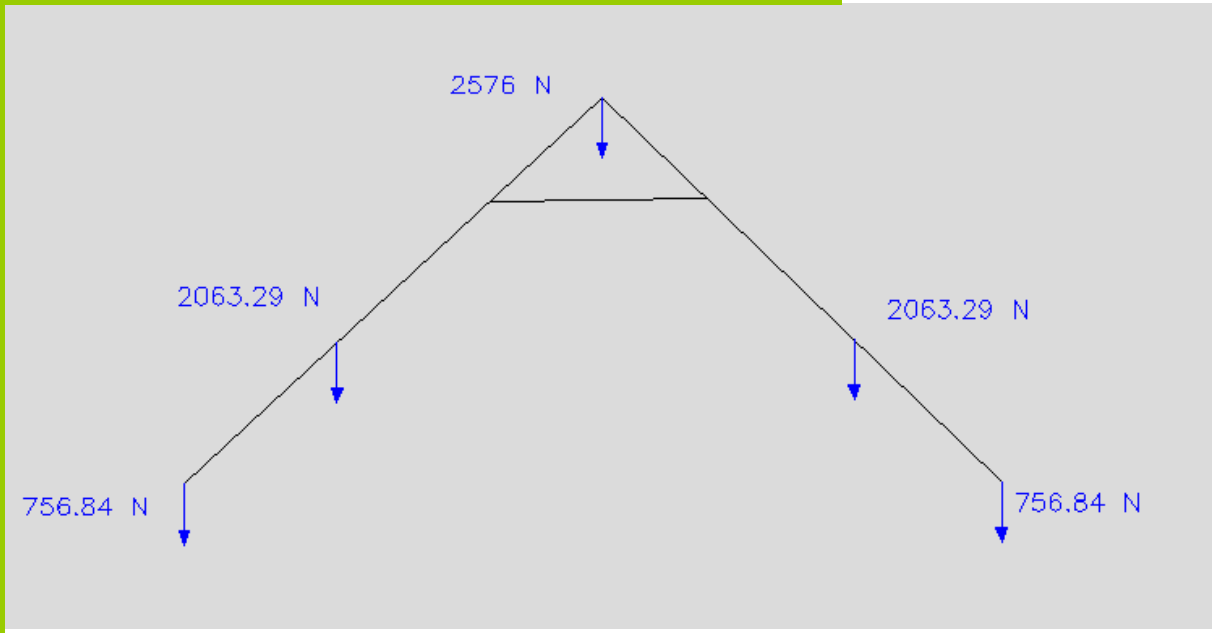


The result!

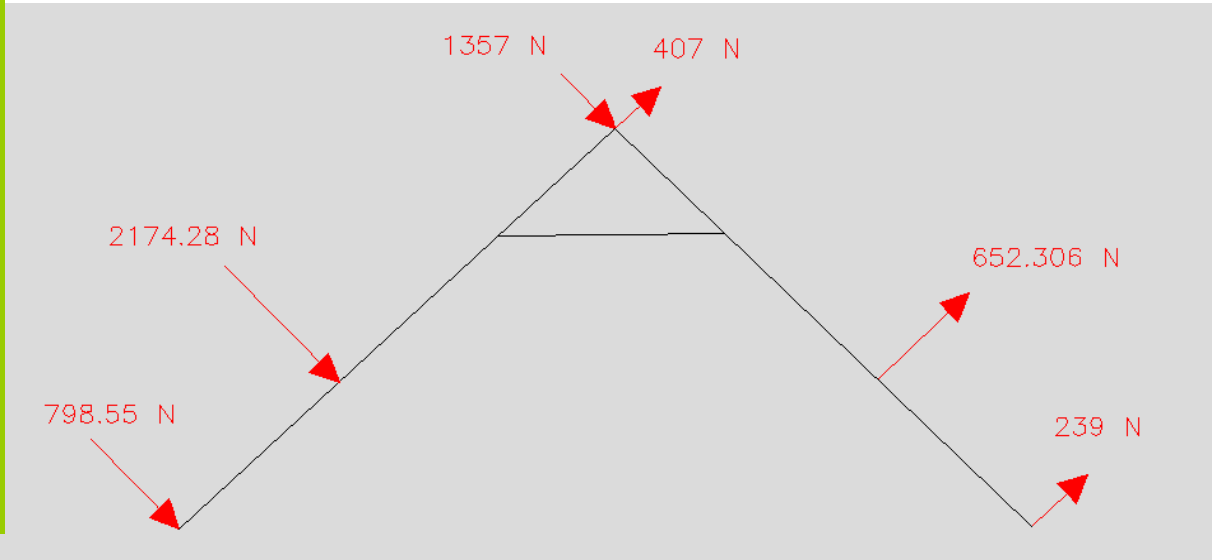


Improvements ?

Evaluation and optimalisation of bamboo roof construction
Thesis by Sander Cordeel
2009 – 2010
Kaho St Lieven in Ghent



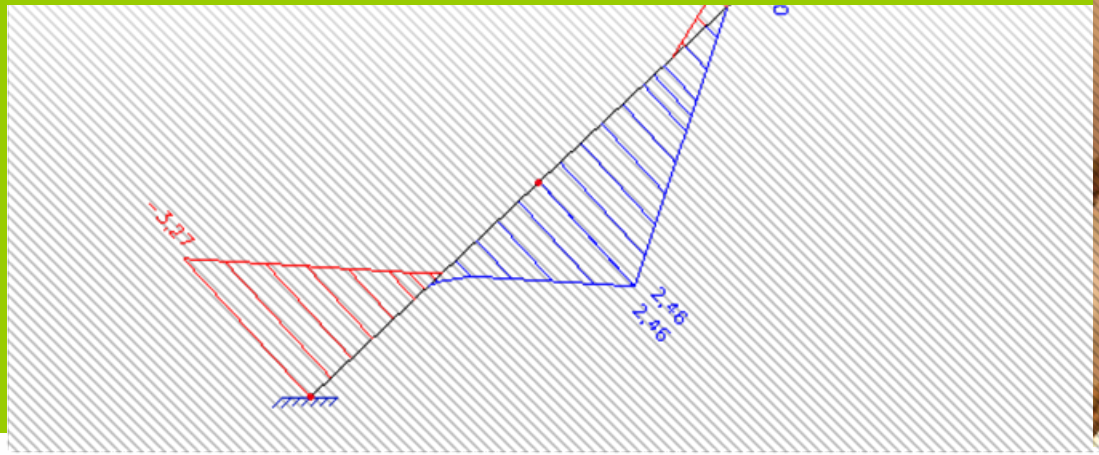
Permanent loads

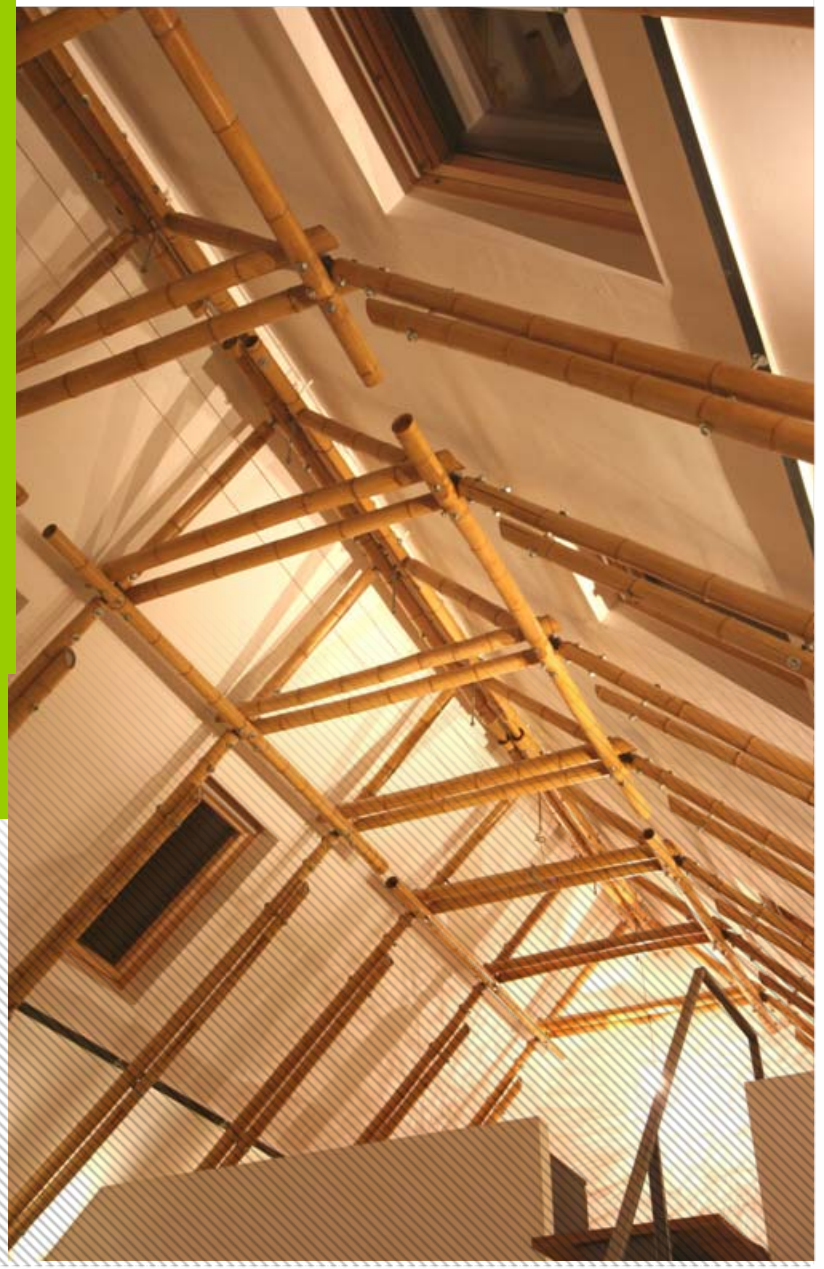


Wind loads

Conclusions

- The load the bamboo can bear = 6x higher
- Improvements could be made in the design
  - fixation of the connection with metal foot and bamboo end is too rigid: a hinge would resolve the moment
  - chance of buckling of bamboo was high, therefore a secondairy bamboo was foreseen -> different design could solve this as well
- Put span tapes or polymers were bamboo cracked





Collaboration with academical world

* PUC- Rio; professor Ghavami – first and longest collaboration
* Kaho ST. Lieven – afd; bouwkundig ingenieur; 4 thesissen (last=CRU! roof)
* Kaho ST. Lieven – 2012 – 2 thesis; on LCA, codes en norms + calculation
* RUG burg. Ing. Architect; 1 thesis treehut
* VUB burg. Ing. Architect; 1 thesis Britt Christiaens; opvolging Bamboostic
* Artesis Antwerpen afd. Bouwkundig ingenieur; 1 thesis bamboe in noodh.
* Universiteit Antwerpen – Johan Gielis
* St Lucas Brussel architecture – exchange to Brasil Kaat Vandevelde
* Howest Kortrijk industrial design – exchange to Brasil Benoit Verbeke