



The development of
"Conventional" American building elements
made from bamboo

INBAR

International Workshop on Prefabricated Housing from Bamboo Based Board

Nov. 23-26, 2005

What approach justifies development of bamboo based construction materials for the US market?

- Why bamboo.....its marketing factors
- Improvement of raw bamboo features
- Construction elements produced by using (sustainable) technologies
- The introduction of improved designs to create functional products
- Is there a market for these materials ?
- What is a competitive price range for them

Bamboo construction materials in the USA ?

The conventional (western) building tradition creates a Grid-lock by:

- design customs (architects)
- building codes (officials and legislation)
- the building industry
(manufacturers, suppliers and contractors)



Introducing new products is a challenge.

To overcome this problem one can use certain aspects to convince parties to change their preferences:

- aesthetics
- practical
- sustainable
- price

Aesthetics



Sustainability

Sustainable development is the most vibrant and powerful force to impact the building design and construction field in more than a decade. (www.usgbc.org dec 2004).

LEED

- Rapidly renewable (within 10 yrs)
- Low-Emitting materials (VOC's)
- Certification
(FSC ---- BambooPlantation Steward Council?)

Low-emitting materials

- Low or Formaldehyde free
- Cost competitive
- Soybean based
 - Purebond of Columbia Forest products

New 'conventional' bamboo elements

Concerns:

What 'western' bamboo products are already available

Which common building materials of the USA construction market could be replicated in bamboo based products

Which improvements can be made to create new elements for the US market.

The market potential and target prices of conventional building products

Influencing the market potential on a different level are sustainability, aesthetics and social concerns

Basic bamboo materials

- Bamboo plywood



Basic bamboo materials

- Flooring



www.ltlarchitects.com

photo: Michael Moran

Basic bamboo materials

- Bamboo Mat Board



Basic bamboo materials

- Corrugated Mat Board



Dimensional lumber replacement



Dimensional lumber replacement

Nominal sizes	Actual sizes	Size in MM
2x2	1-1/2x1-1/2	38x38
2x3	1-1/2x2-1/2	38x63
2x4	1-1/2x3-1/2	38x89
2x6	1-1/2x5-1/2	38x140
2x8	1-1/2x7-1/4	38x184
2x10	1-1/2x9-1/4	38x235
2x12	1-1/2x11-1/4	38x286
4x4	3-1/2x3-1/2	89x89
4x6	3-1/2x5-1/2	89x140
6x6	5-1/2x5-1/2	140x140

Solid Bamboo Studs

Properties of Pine wood

- Cheap
- Not perfectly straight
- Fast construction
 - Nailed with compression guns, cut with electrical chops saws

Solid bamboo stud (SBS)

- Straight
- Nailing might split material
- Costs
- Hidden in wall

Issues

- Density of pine wood is around 530 kg/m³ (34 lbs/cf),
- SBS is heavier at 600 kg/m³ (38 lbs/cf) (P.van der Lugt, 2003).

Price indicator:

Green Douglas Fir Std&Btr 2x4 R/L (Portland) per stud \$1.48-\$1.58

Product not likely to be successful

U-shaped Bamboo studs

Steel-studs

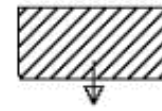
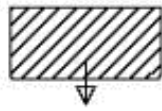
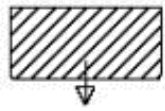
- weigh 60% less than wood
- Easy to carry on construction site
- No sawdust when cutting
- No drilling for conduit
- Bends easily

Price: similar to wood - per 2x4 stud \$1.48-\$1.58

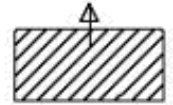
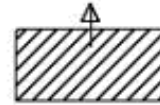
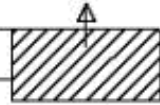
U-shaped bamboo studs

- Formed bamboo mat board pressed into U shape

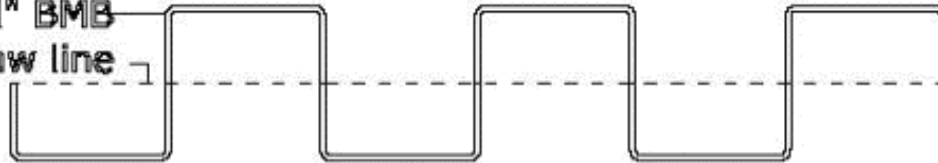




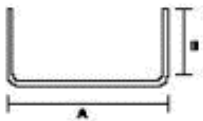
Bamboo mat 3 mm
 Radius (3-5 mm)
 Press forms

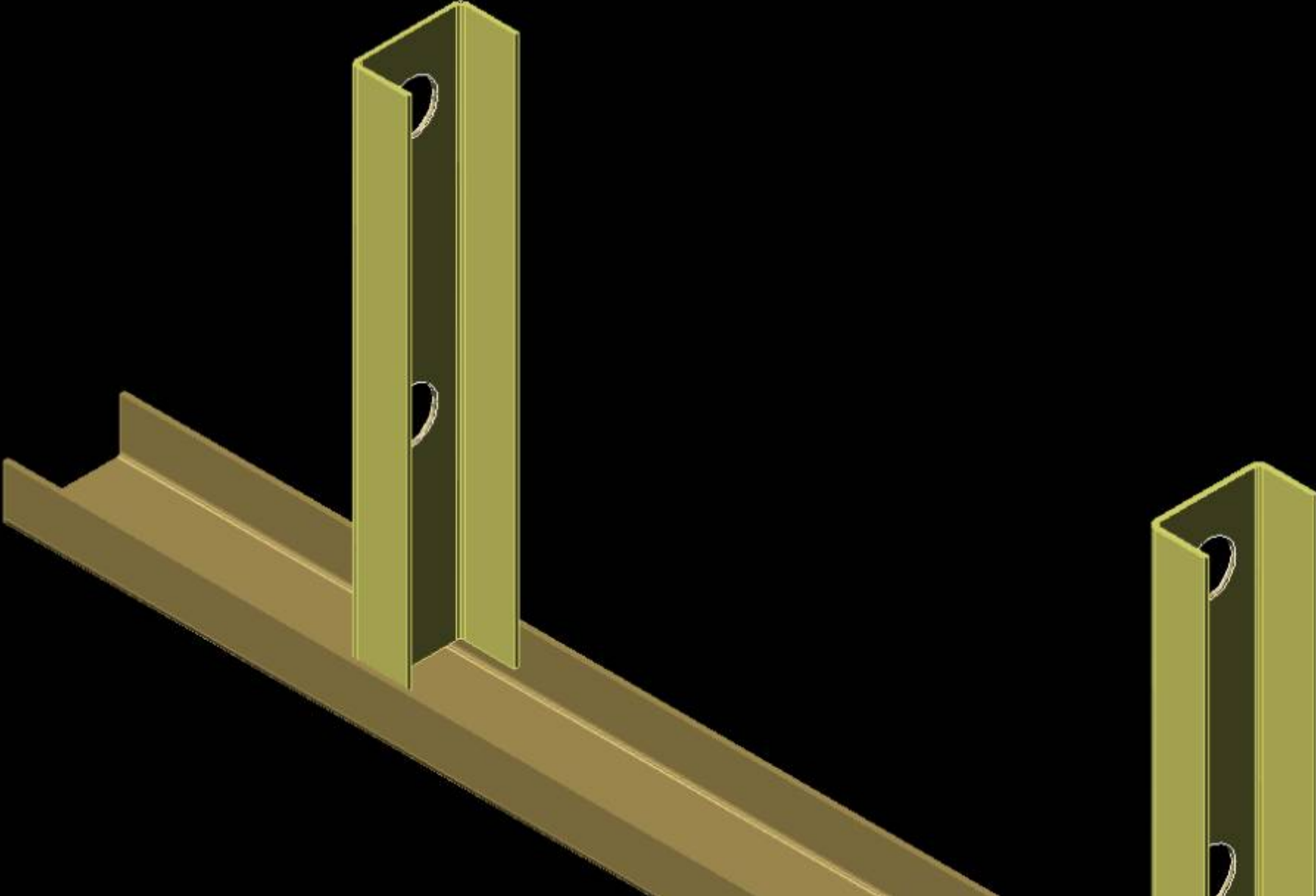


Half product
 square "corrugated" BMB
 Saw line

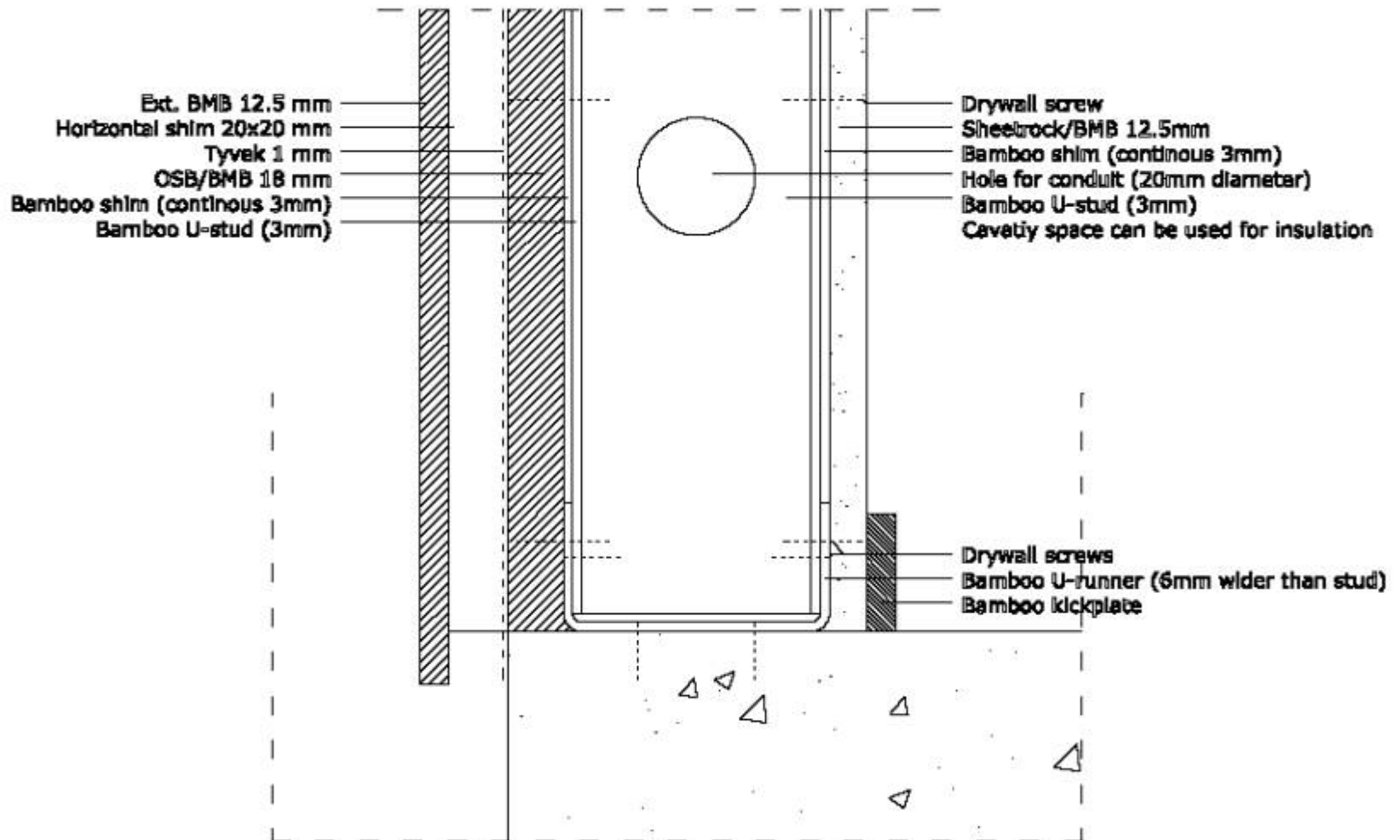


End product
 X studs (A by B)





Details



Engineered wooden products

Glu-lam beams (Solid bamboo)

- Visual
- Cost can be aesthetically justified
- Heavy

Price: sight quality
around \$400/m³ to \$425m³



Engineered wooden products

I-joist

- Efficient
- Long spans
- Light

Material

- BMB flanges
- Solid or BMB or glu-lam wood

Price

southern Californian I-joist (11-7/8”),
\$ 0.95 cents per LF (\$3 /m³)



Engineered wooden products

Exterior panels

- BMB
- UF resins
- Not aesthetically attractive per se

Concern

- Lifespan

Price

12-15mm OSB - \$200-\$400 /m³

BMB quoted at \$500 /m³



Engineered wooden products

Interior panels

- Bamboo plywood
- Veneer
- Bamboo MDF with veneer

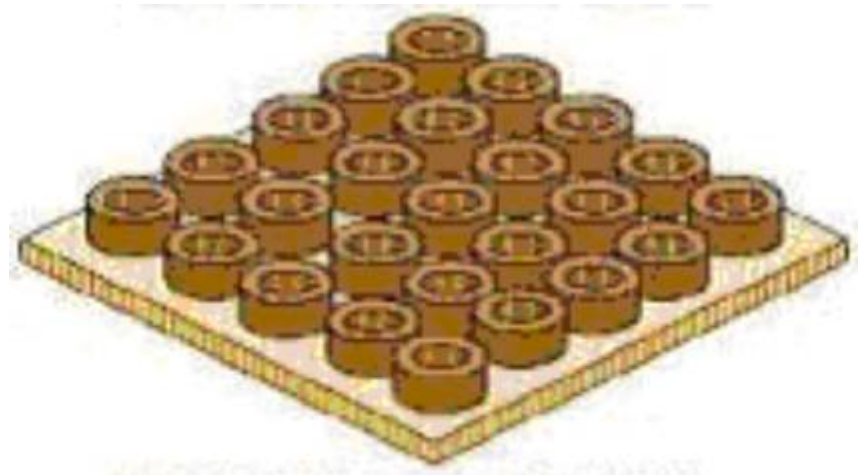
Price

- 3/4 “ sanded Western exterior Plywood \$750-900 /m³
- 3/4 “ MDF \$360 /m³
- Bamboo currently 750 /m³ – 3000 /m³

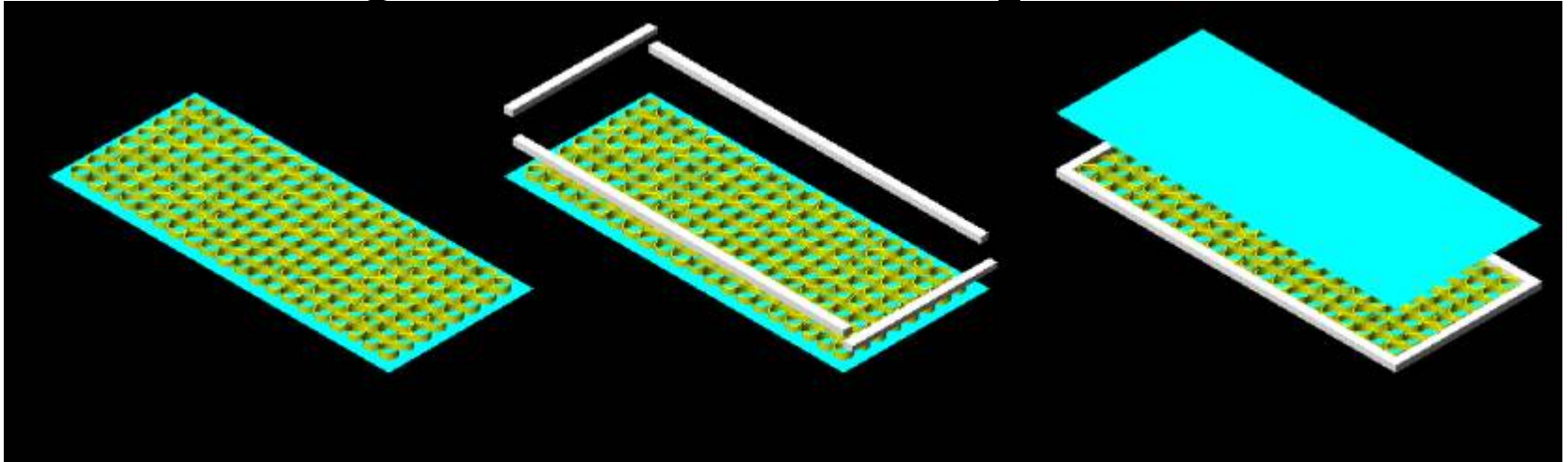
Engineered wooden products

Bamboo sandwich panel

- Light weight
- Durable
- Uses for higher part of Culm



Engineered wooden products



Doors (Bamboo sandwich panel)

- Light weight, Efficient
- Durable
- Pine wood for perimeter ?

Price

- Laun faced (inexpensive door): \$40
- Solid wood door: \$250

Additional hurdles

the building codes to be met/ the costs of testing and Life cycle assessments