

CLT

Cross Laminated Timber
or
Consumes Lots of Timber

...a challenging perspective on whether we should be using our only renewable construction material with more care – focusing on value engineering, design efficiency and lessons to be learnt from the steel and concrete industries.

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Content

- Is solid a problem?
- CLT structural efficiency
- Steel & Concrete
- Options for CLT
- Conclusions

“The best friend of man is the tree. When we use the tree respectfully and economically, we have one of the greatest resources on the earth”

Frank Lloyd Wright

Is solid a problem?

No – our forests are growing faster than we harvest

In the EU we only harvest about two thirds of annual growth.

Nearly 200 million m³ of wood is added to our forests each year.

Is solid a problem?

No – our forests are growing faster than we harvest

Yes – we can build more with less timber using stud

A CLT building uses about 0.30m^3 of timber for every m^2 of floor area provided.

A timber stud and cassette building uses about 0.15m^3 of timber for every m^2 of floor area provided.

Is solid a problem?

No – our forests are growing faster than we harvest

Yes – we can build more with less timber using stud

No – enhanced robustness, fire and acoustic performance

...but how do we put a value to this?

Is solid a problem?

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No – enhanced robustness, fire and acoustic performance

Yes – it is an imported product

Subject to fluctuations in the exchange rate.

A CLT contract does not benefit the community that places it.

Is solid a problem?

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No – enhanced robustness, fire and acoustic performance

Yes – it is an imported product

No – it locks up significant CO₂

For every m² of building constructed from CLT approximately 250kgCO₂ is stored.

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Yes – it is an imported product

No – it locks up significant CO₂

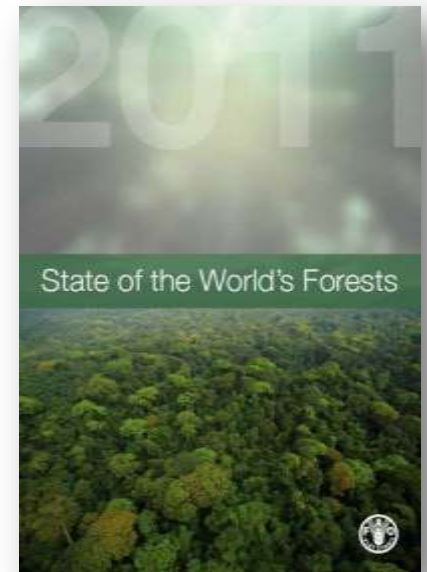
Yes – it costs more than the competition

<i>Steel frame</i>	<i>£190/m²</i>
<i>Concrete frame</i>	<i>£190/m²</i>
<i>CLT frame</i>	<i>£240/m²</i>

Is solid a problem?

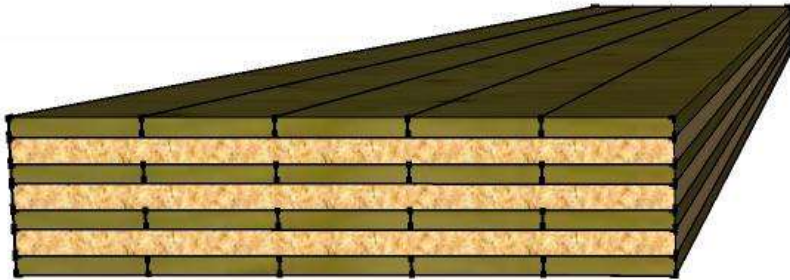
Wood Stocks & Use

- EU27 stocks
 - *22.5 billion m³ total stocks*
 - *660 million m³ annual growth*
 - *420 million m³ annual felling*
- EU27 sawnwood use
 - *UK - 0.14 m³ per capita*
 - *Germany - 0.20 m³ per capita*
 - *Finland - 0.80 m³ per capita*



Is solid a problem?

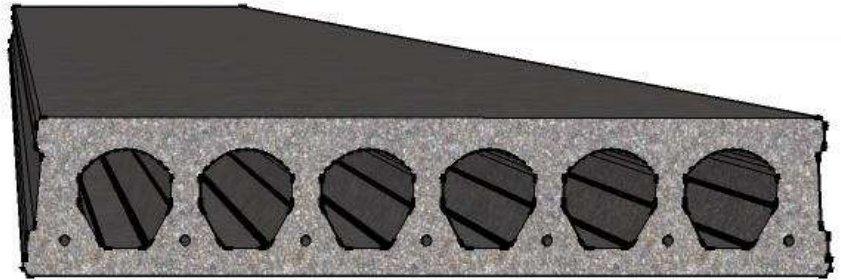
CLT floor plank versus pre-stressed hollow core plank



100kg/m²

span to depth 30

£110/m²



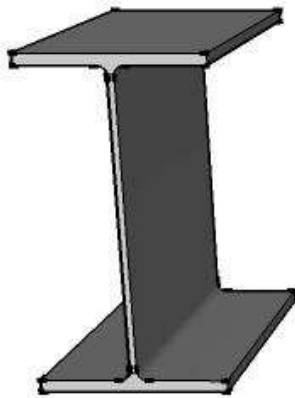
300kg/m²

span to depth 40

£40/m²

Is solid a problem?

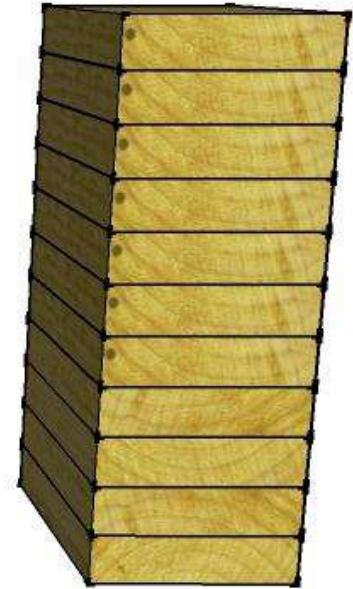
Beams of equivalent structural performance



50kg
75kgECO2
£65



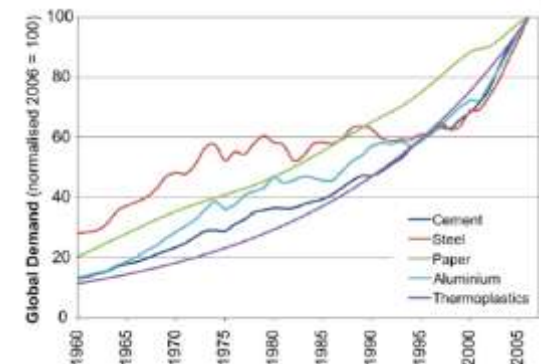
300kg
65kgECO2
£65



50kg
20kgECO2 (80kgSCO2)
£85

Is solid a problem?

- Doubling of materials demand by 2050
 - *Due to increase in population and wealth*
- Existing industrial processes already efficient
 - *Predicts maximum 50% emissions savings still to be made (through processes and recycling)*
- Culture of ‘..substitution of more material for less labour..’

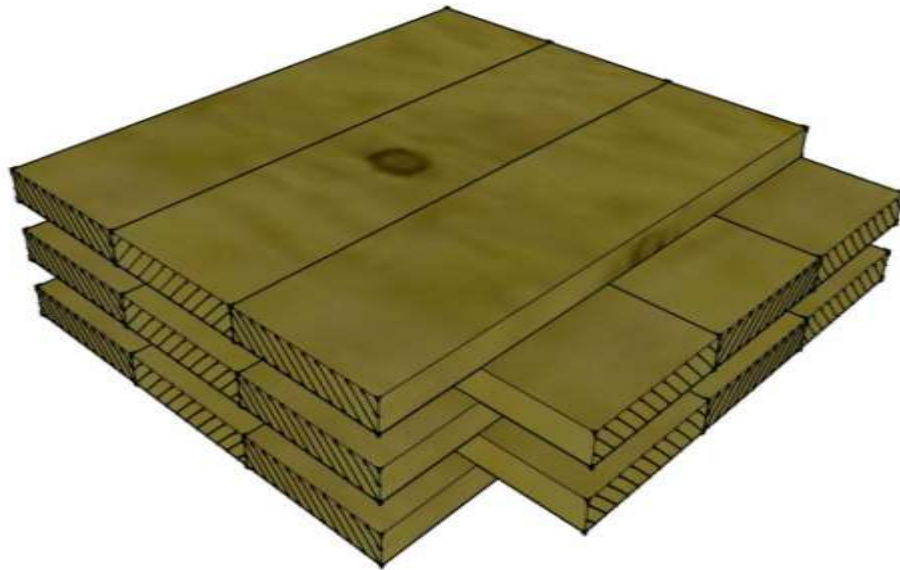


Ref: 'Materials and the Environment' Mike Ashby

CLT structural efficiency

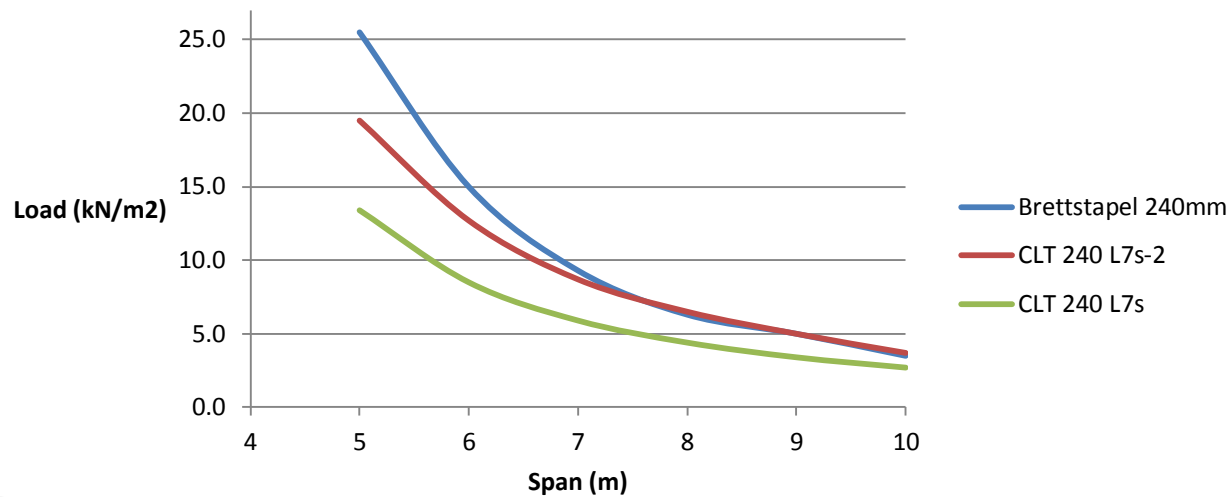
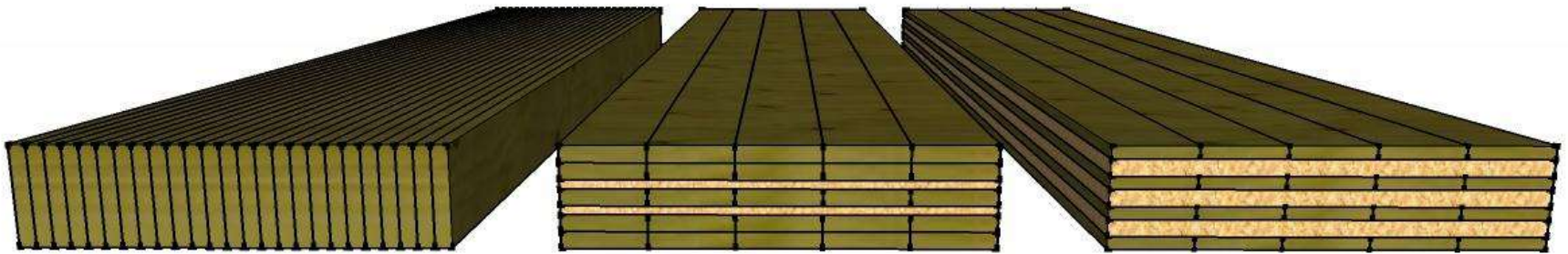
How efficient is CLT compared to 'solid timber'?

...how much does cross lamination affect structural performance



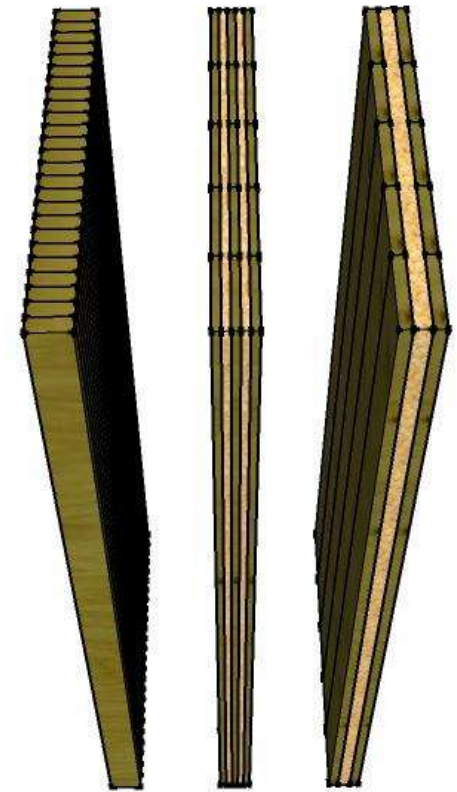
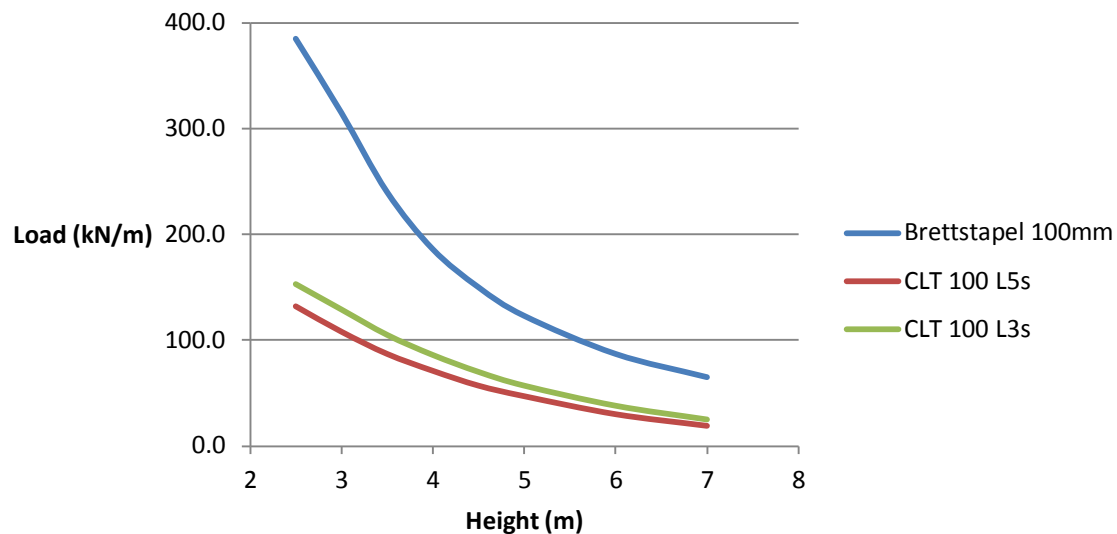
CLT structural efficiency

CLT versus Brettstapel - Floors



CLT structural efficiency

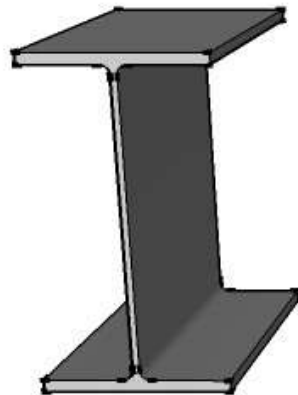
CLT versus Brettstapel - Walls



Steel & Concrete

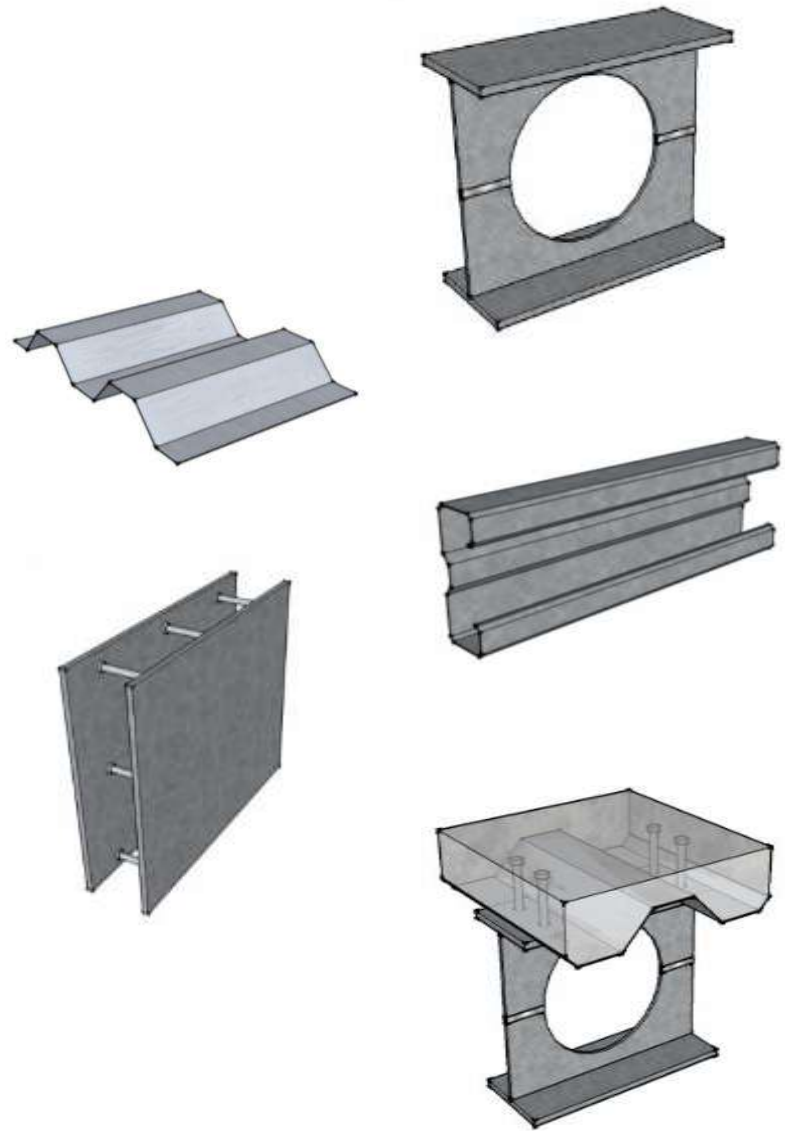
What have the competition been doing to increase efficiency?

...and what are they planning



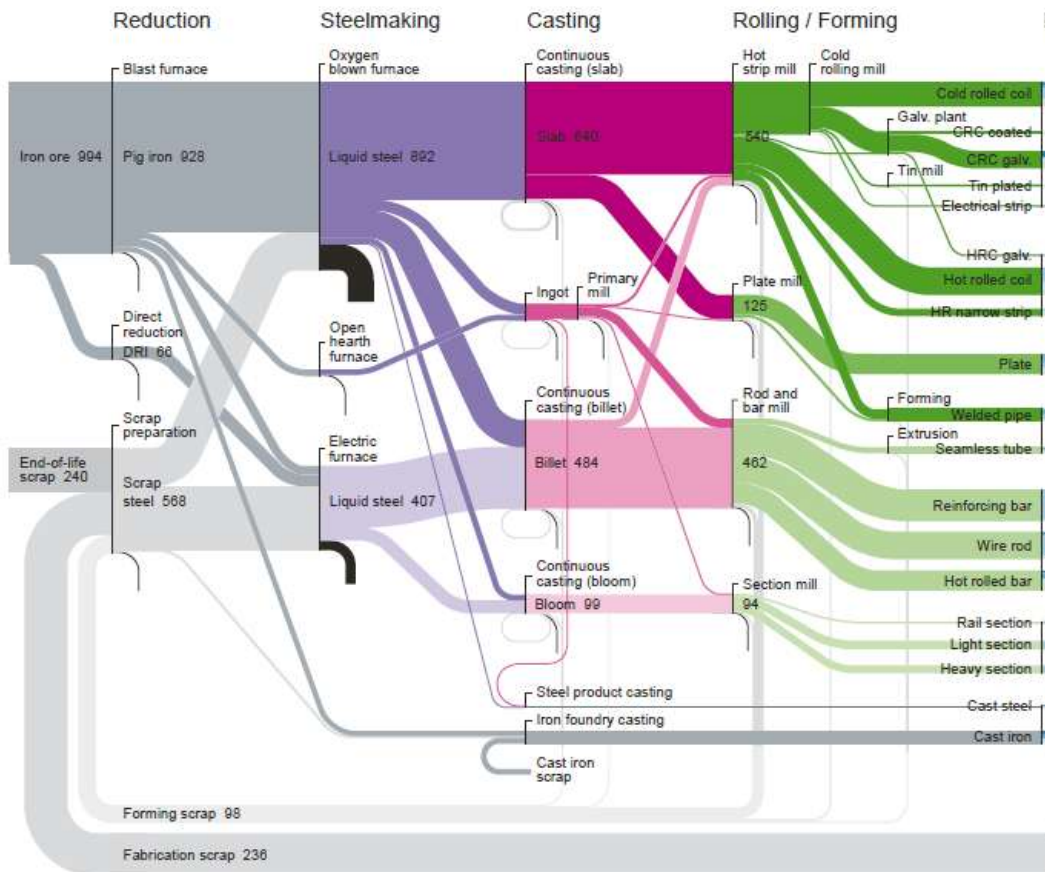
Steel

- Cellform beams
- Decking
- Cold formed sections
- Fastwall
- Composite action



Steel

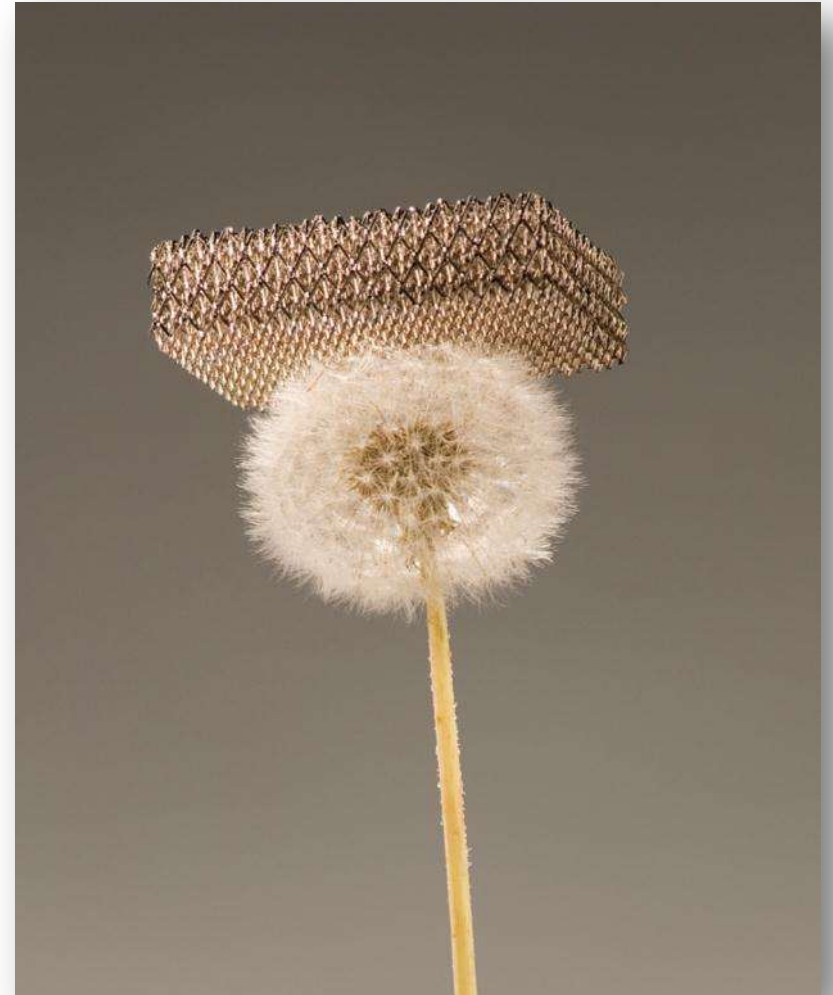
- Re-cycling rates



In the Olympic Stadium, 2,500 tonnes of pipeline steel is being reused in the roof truss structure, welded to 15m lengths from 12m stock. (Image: London 2012)

Steel

- Steel honeycomb
 - *A lattice of interconnected tubes*
 - *0.9kg/m³*
 - *Nearly 500x lighter than softwood*



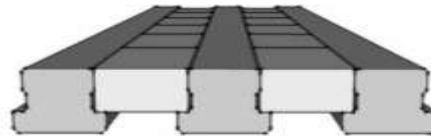
Concrete

- Rib slab



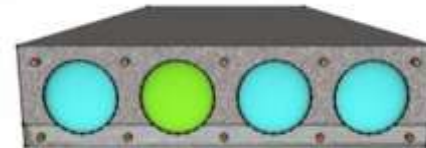
-30%

- Beam and block



-40%

- Cobiax



-30%

- Pre-stress



-50%

*Change in concrete
compared to solid slab*

Concrete

- UHPC
 - *Ultra high performance concrete*
 - *High strength fibre reinforced*
 - *Cement, silica fume, fine sand and water reducer*
 - *Compressive strengths up to 200MPa*
 - *Flexural strength up to 50MPa*



Concrete

- Carbon negative concrete
 - *Uses magnesium silicates in leau of cement*
 - *Process could absorb more CO2 than it produces during manufacture*
 - *UK venture Novacem acquired by Calix in 2012*

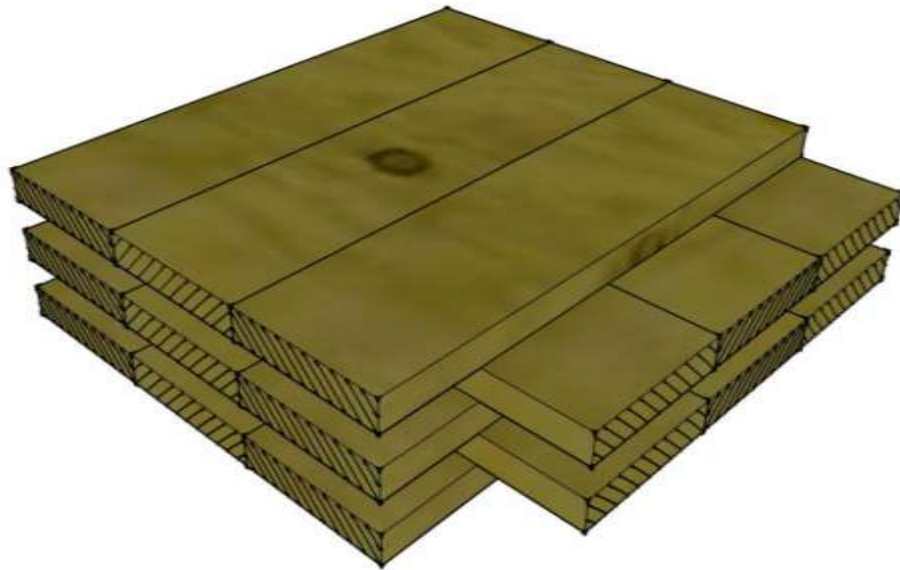


CLT options

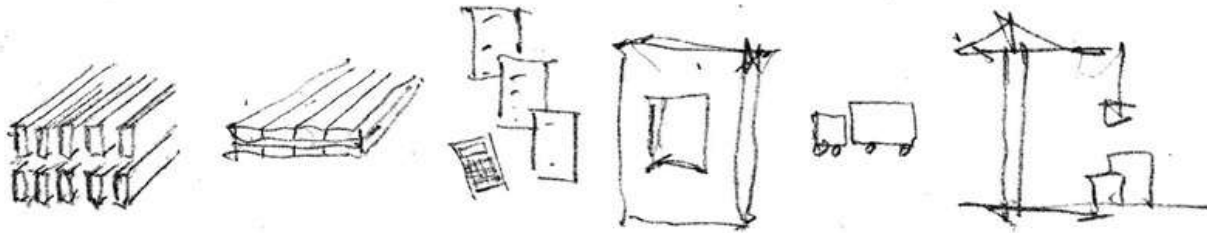
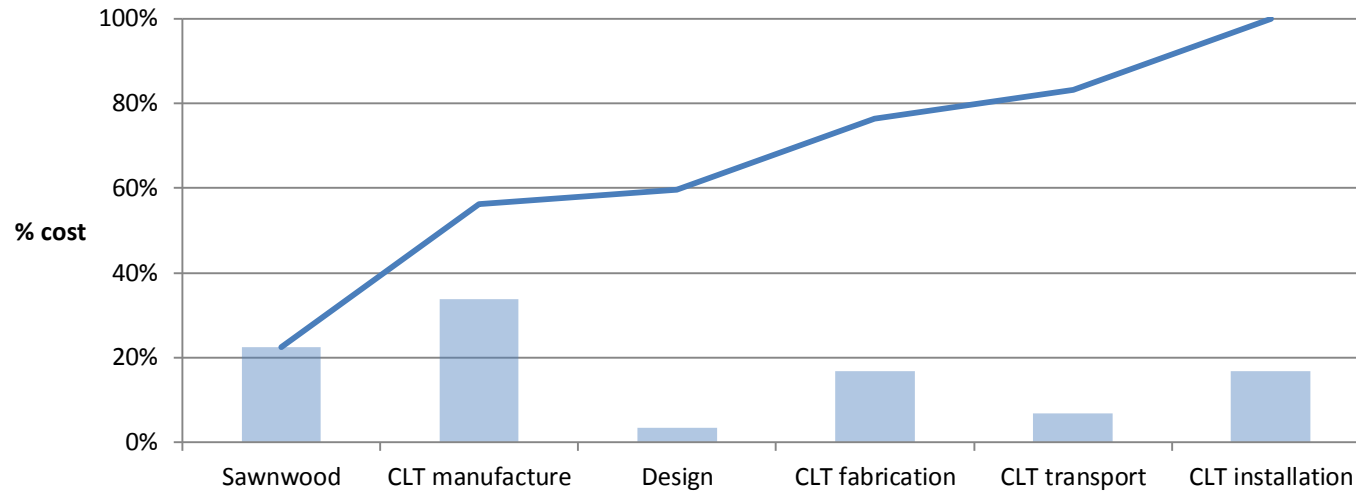
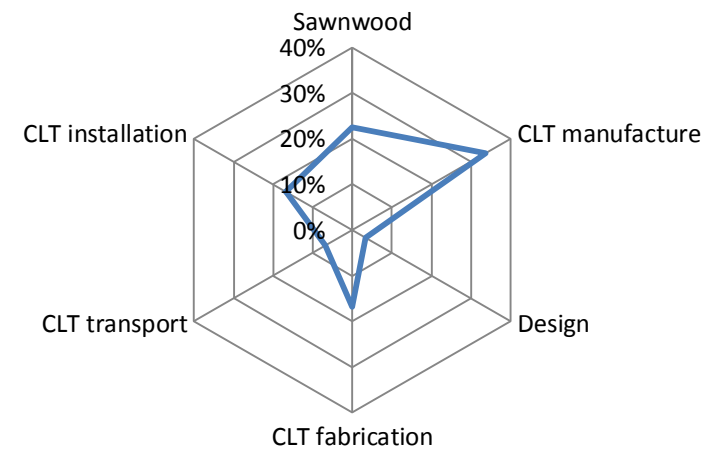
Can we make CLT more efficient?

...can we break the culture of 'substitution of more material for less labour'

...or is cost king



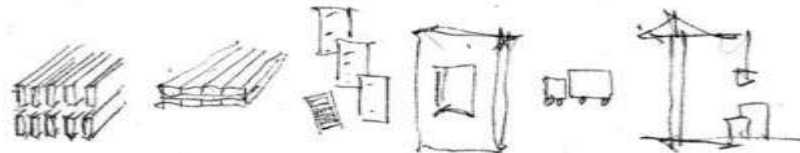
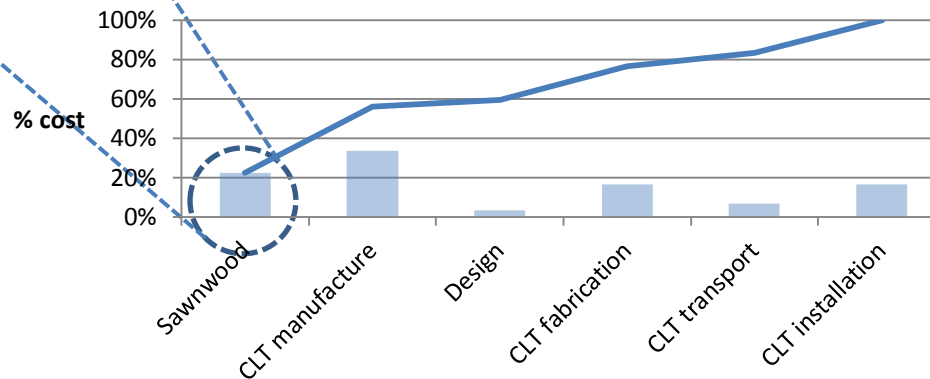
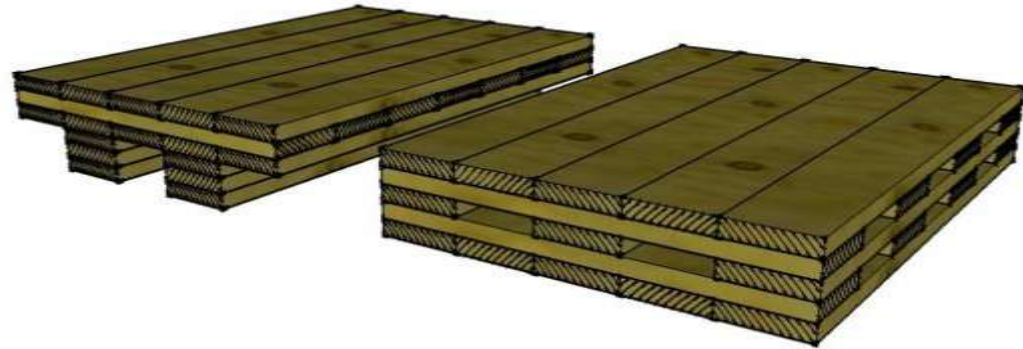
CLT options



CLT options

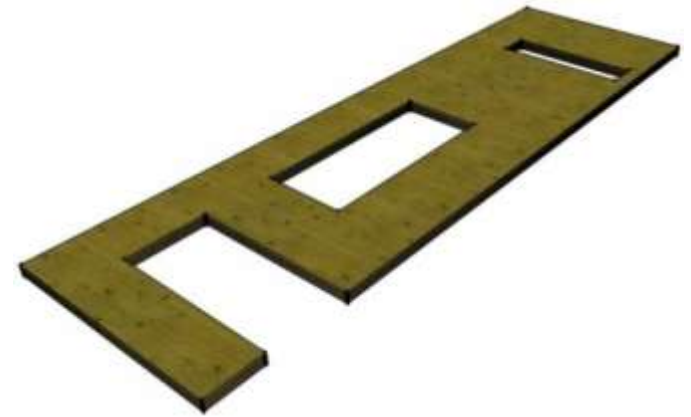
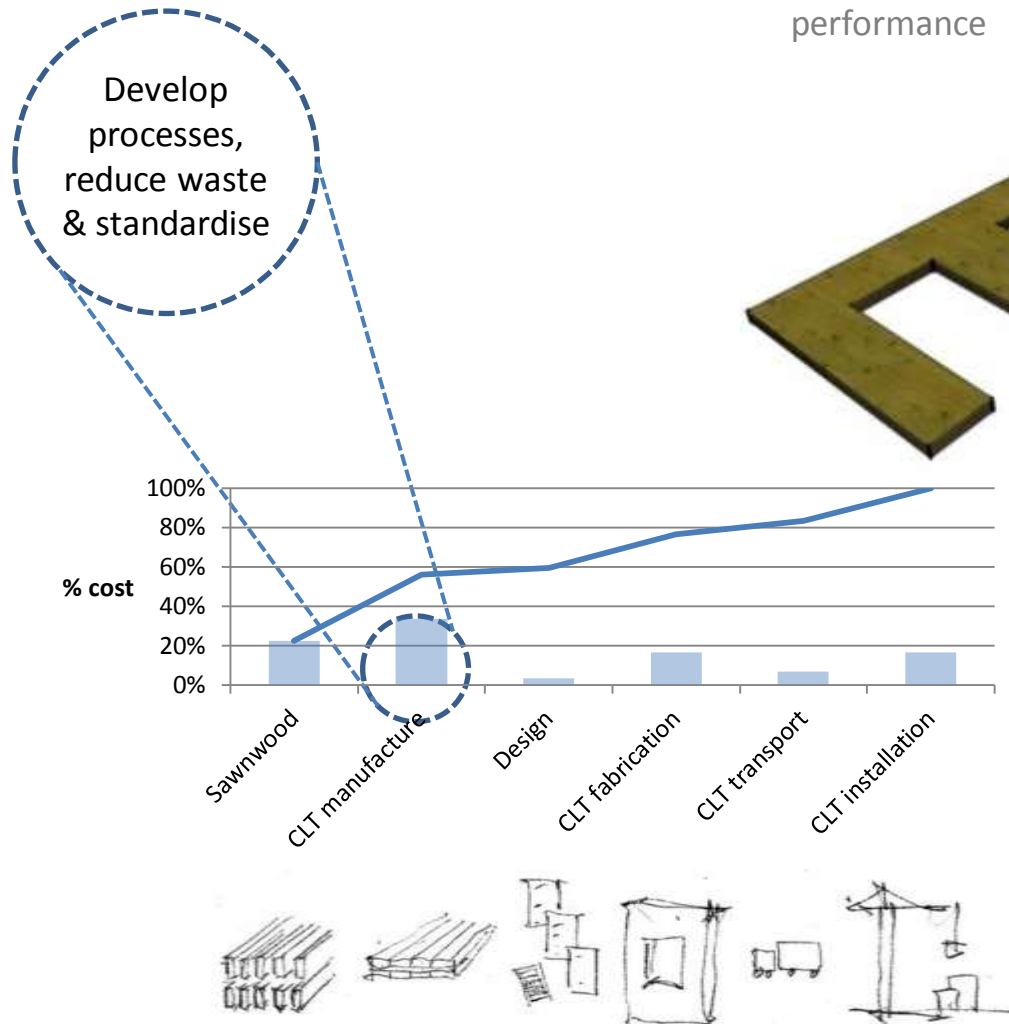
- Challenging solid
- Use part voided or rib CLT
- Increase depth to combat vibration/deflection

Develop CLT product to use 20% less timber



CLT options

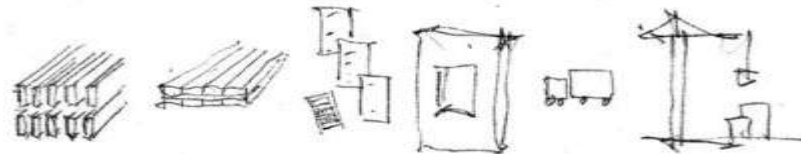
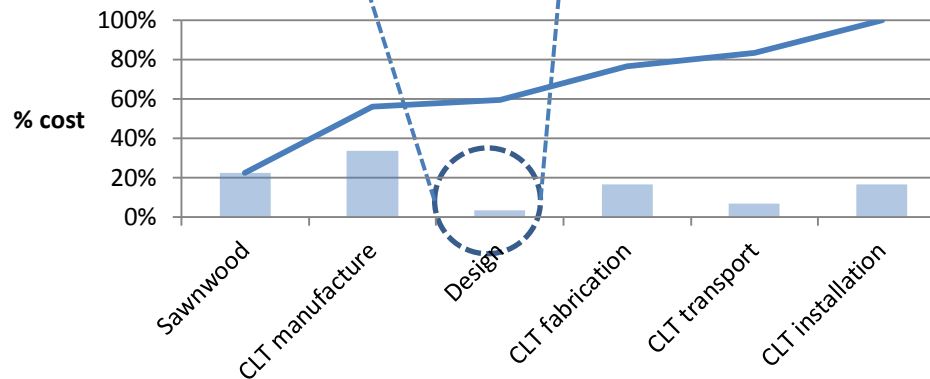
- Pre-form openings and bespoke shapes during pressing to reduce fabrication
- Standard panel thicknesses and performance



CLT options

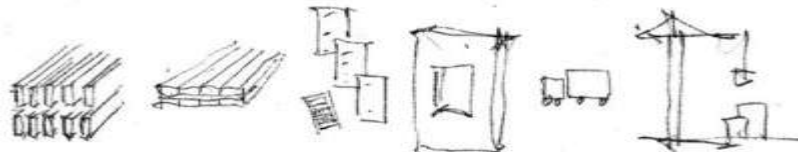
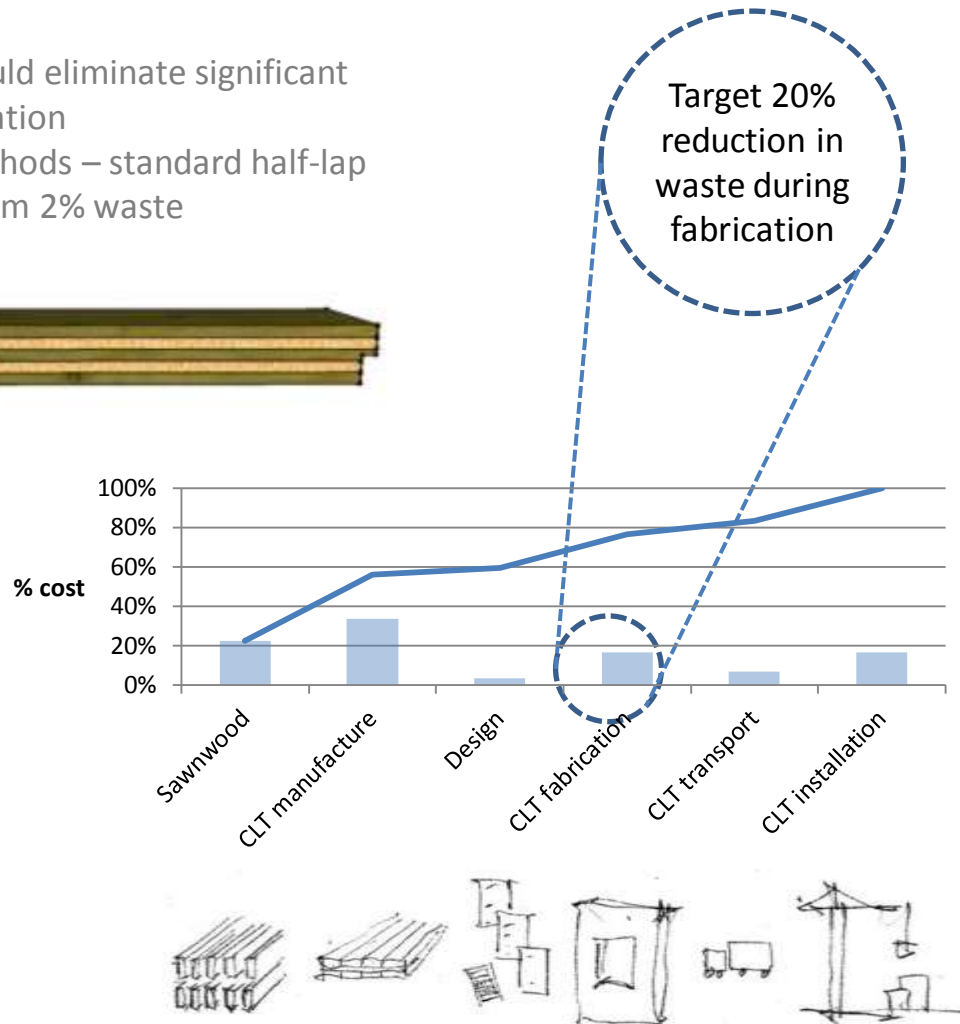
- Produces design codes (vibration)
- Mainstream multi-product software (incl. connections)
- Efficient CLT designs require educated designers
- Spend time honing designs

Codify,
software,
educate and
invest time

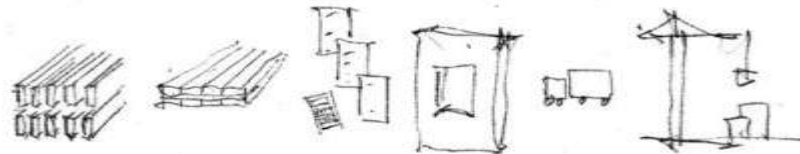
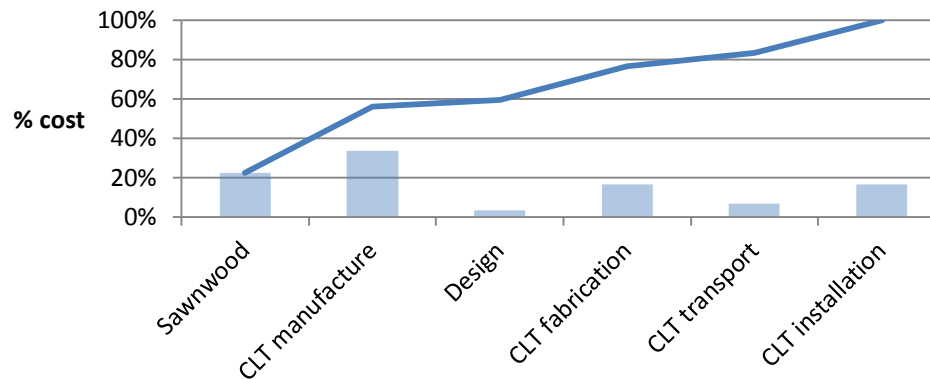
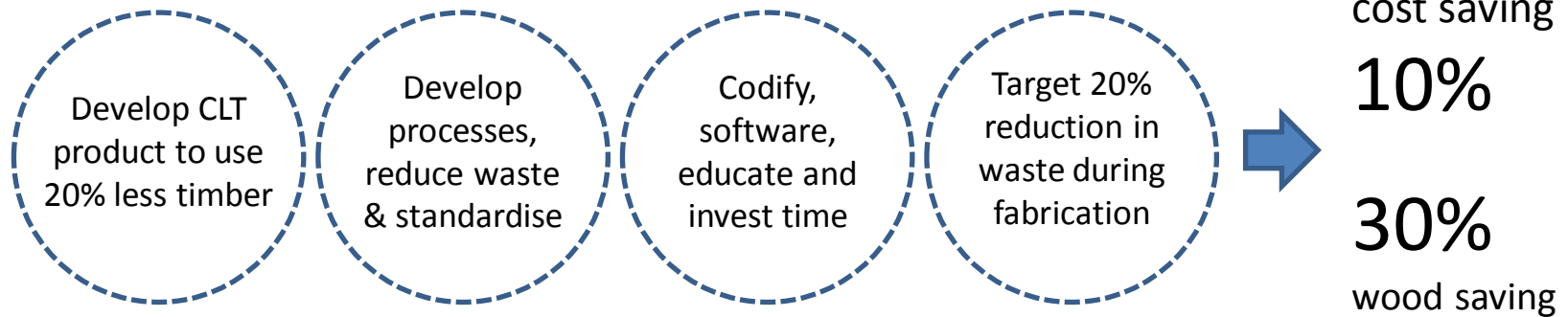


CLT options

- Previous acts should eliminate significant waste during fabrication
- Review jointing methods – standard half-lap joint results minimum 2% waste



CLT options



Conclusion

- Design for CLT
 - *A CLT sympathetic building could reduce volume and wastage*
- Standardisation required
 - *Of panel sizes and performance*
- Design and BIM software required
 - *For both panels and connections*
- Research needed
 - *Vibration performance and spread of flame*
- CLT product needs to evolve
 - *Concrete and steel is!*