Mass Timber Applications

using innovative connection systems

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Solemar - Therme

Bad Dürrheim 1987

Toscana - Therme

Bad Orb 2010

Evolution in timber

!

production …

1 level

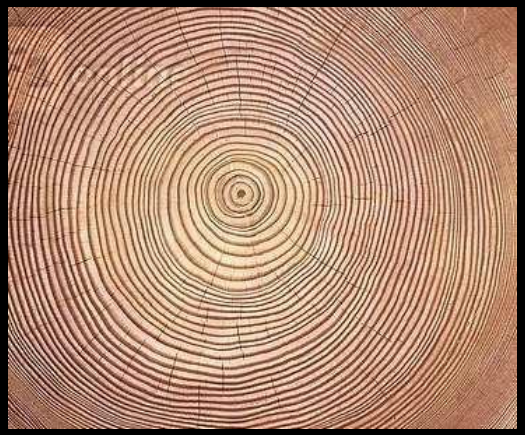
assembly…

9 levels

Evolution in geometry

sticks… to plates…

Performance



fire

Cost

1 $/kg

500 $/cbm

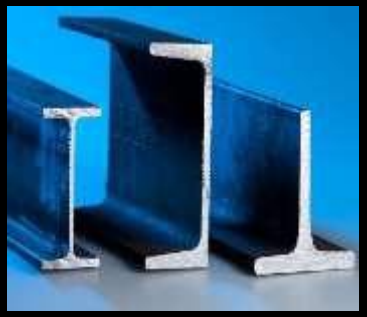
8.000 $/cbm

100 $/cbm

450 $/cbm

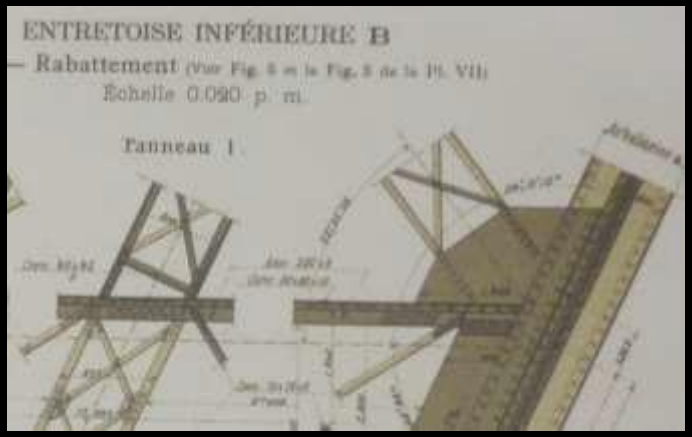
Composite Systems

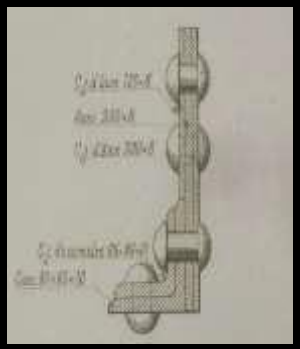
…the challenge is the connections!



Structures

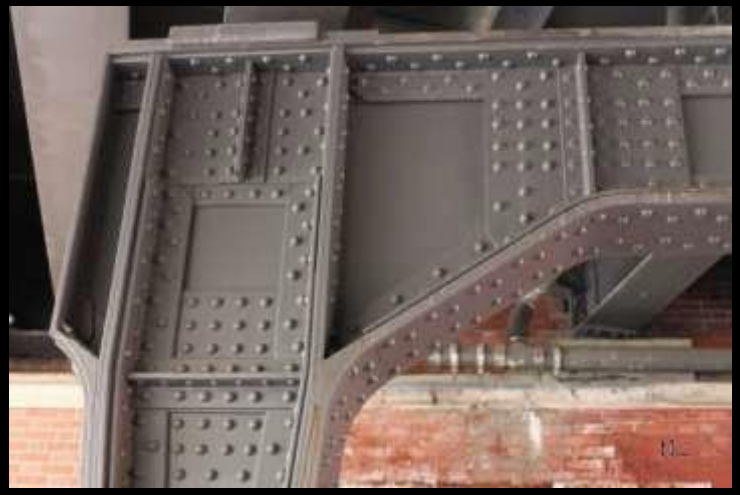
…depend on connections

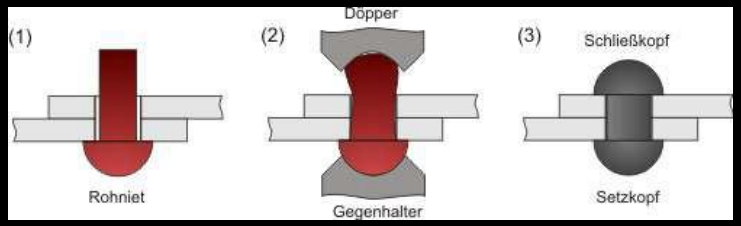




Rivets

…the beginning



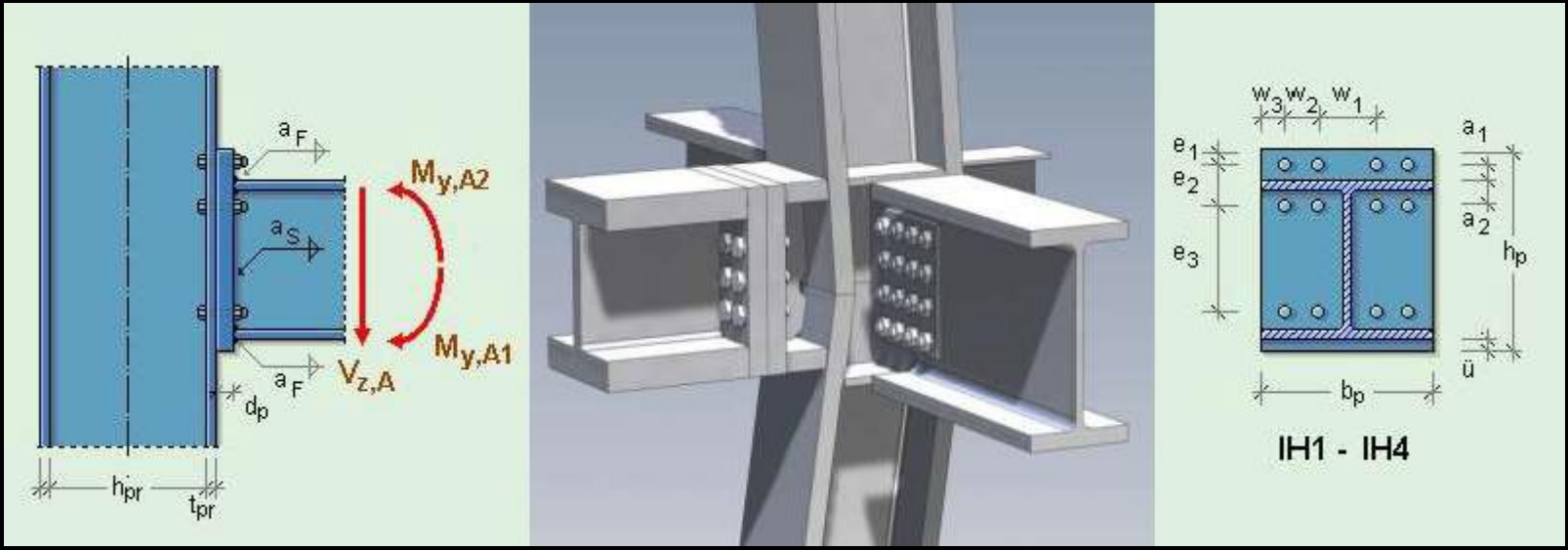


Welding

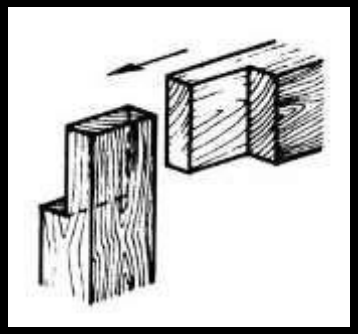
…the revolution

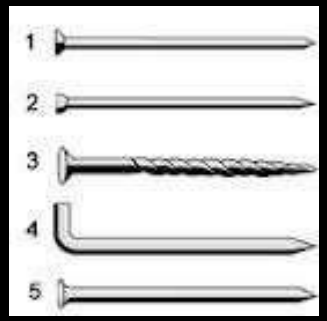
Welding + bolts

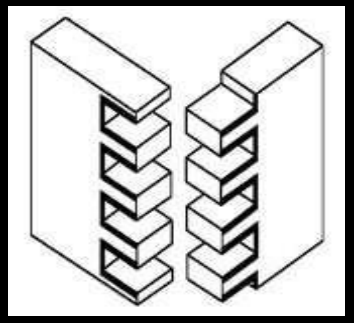
…the solution

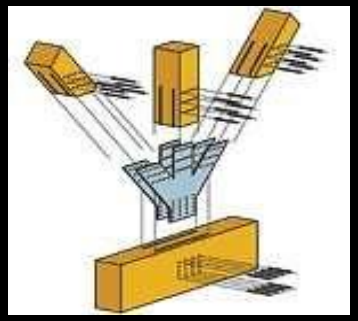


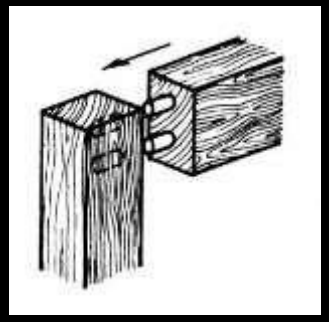
Connections in timber design

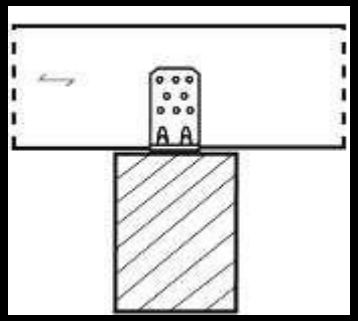












Linked

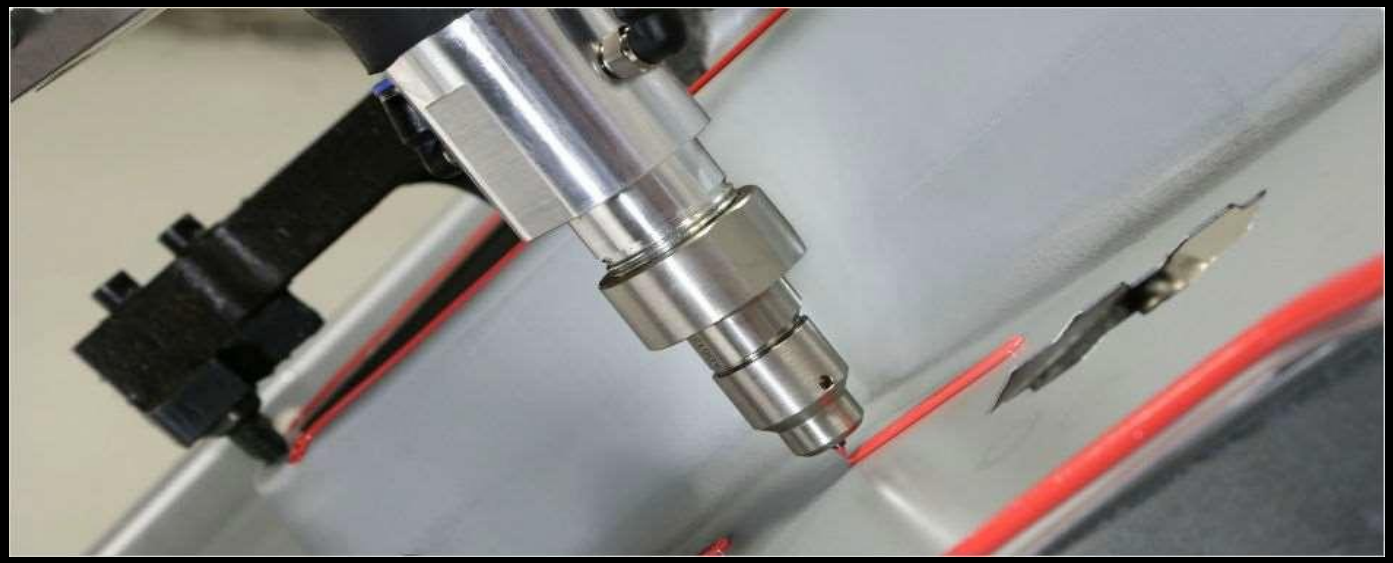
Nails

Bolts

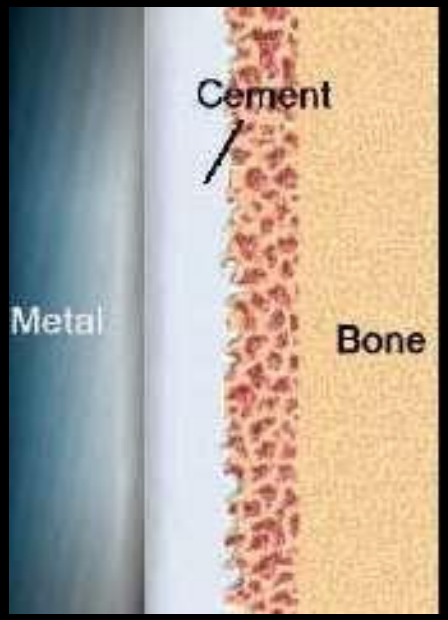
Pins

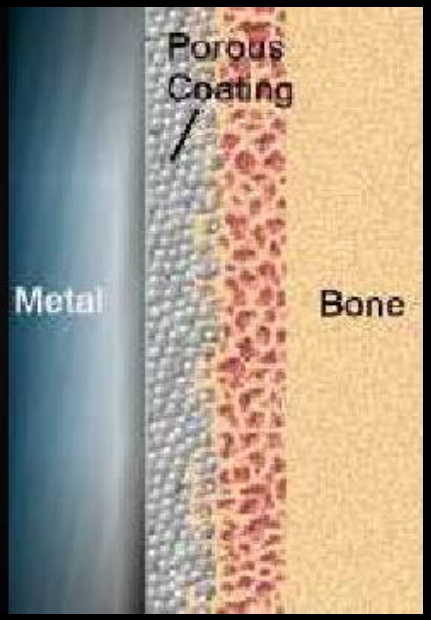
… adhesive action

Adhesive connections in automotive

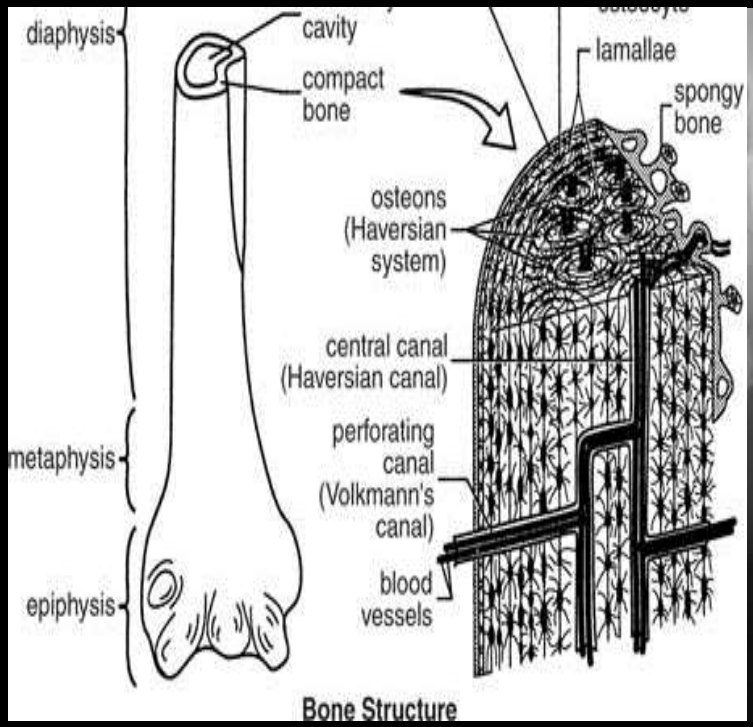


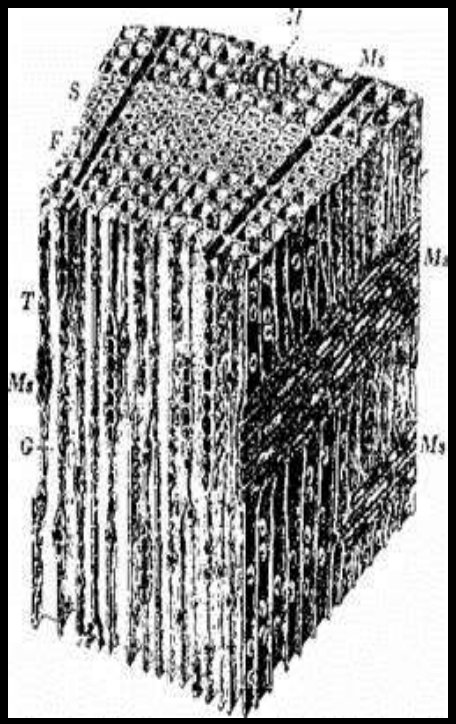
Adhesive connections in medicine





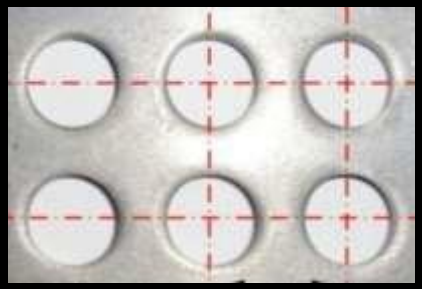
Think out of the Box !





Adhesive connections

wood
- sustainable
- light
- free geometries

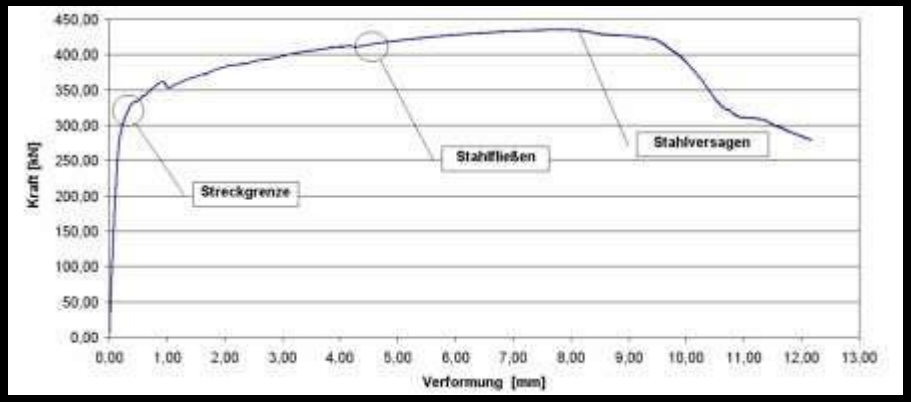


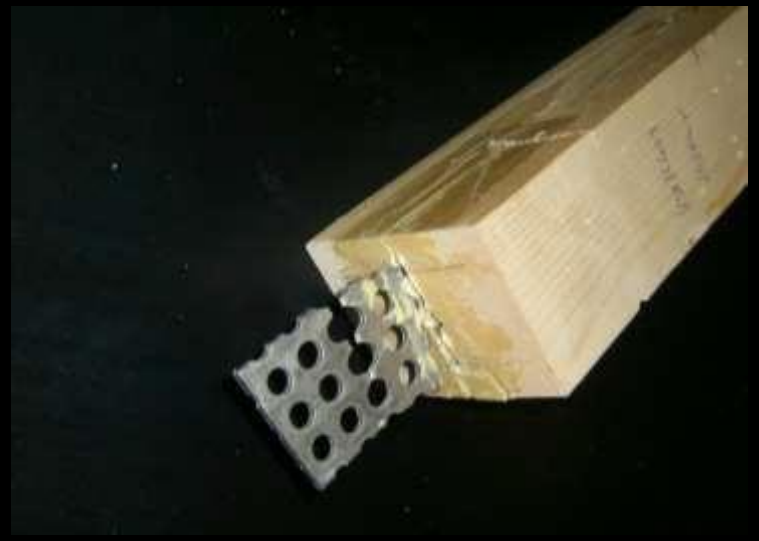
steel
- ductil
- isotropical
- easy to design

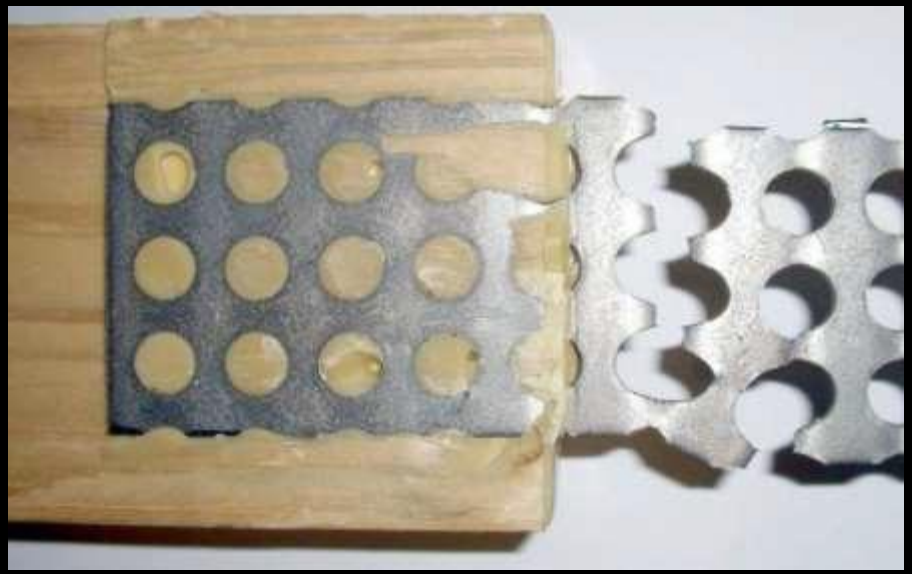
adhesive
- gap filling
- fast curing
- environmental friendly

Adhesive connections

. . . with ductile behaviour







Design criteria

steel failure

adhesive failure

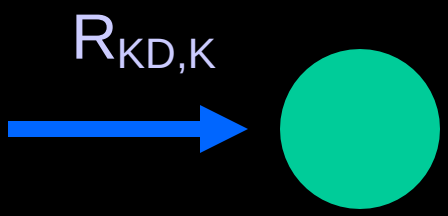
wood failure

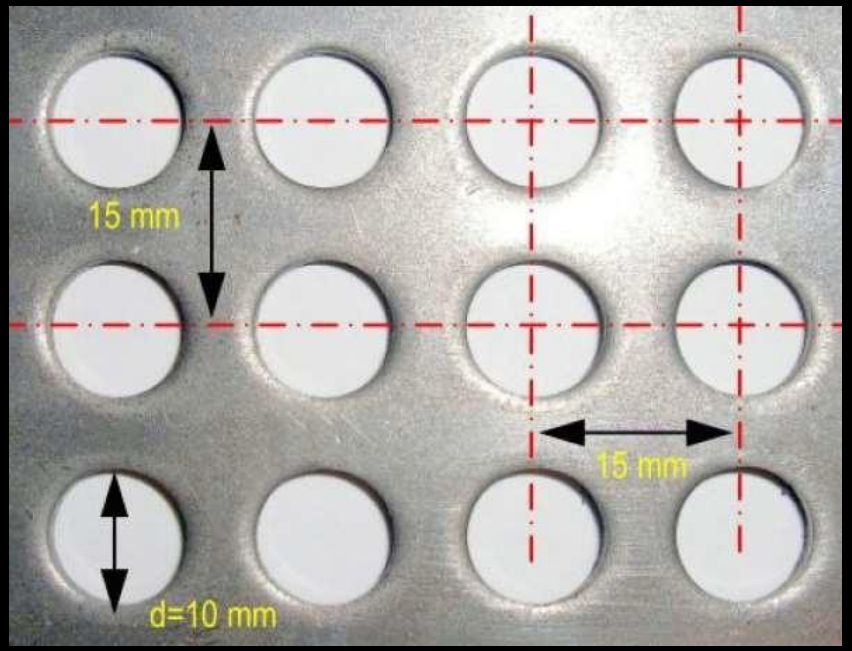
…design in steel, build in wood!

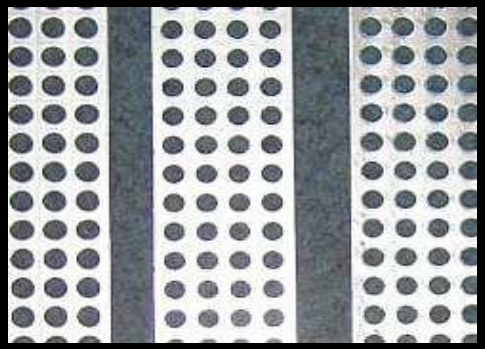
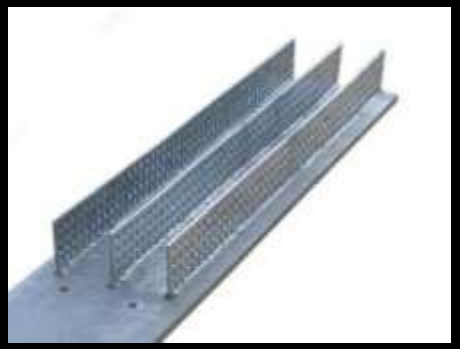
design criteria

$R_{KD,K}$ = 800 N per dowel

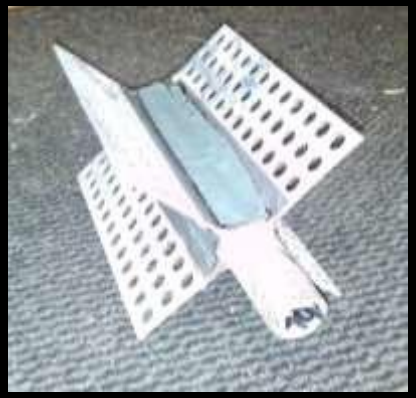
K_{ser} = 7400 N/mm per dowel





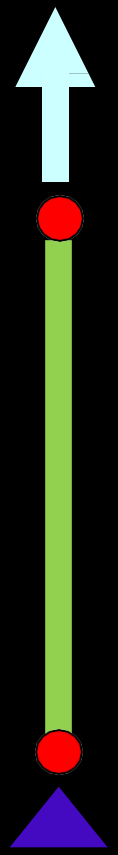





Topics

Time……Cost……Performance…..

End grain connections „hsk-pipe“



Adhesive Connection

…steel design with timber

implant

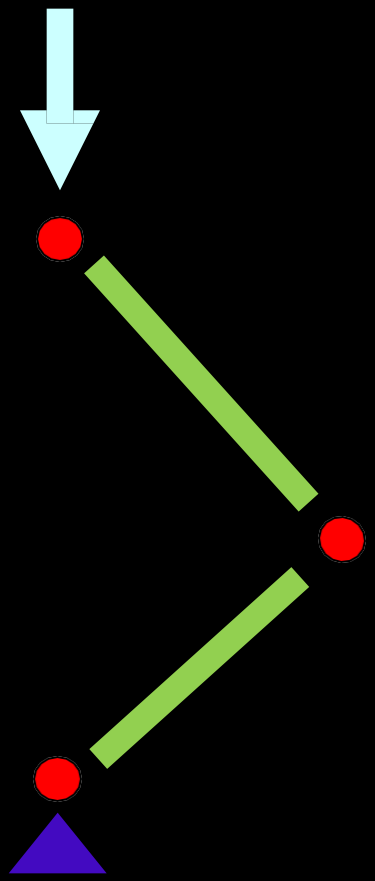
Soccer Ball

… 82 feet / 25 m diameter

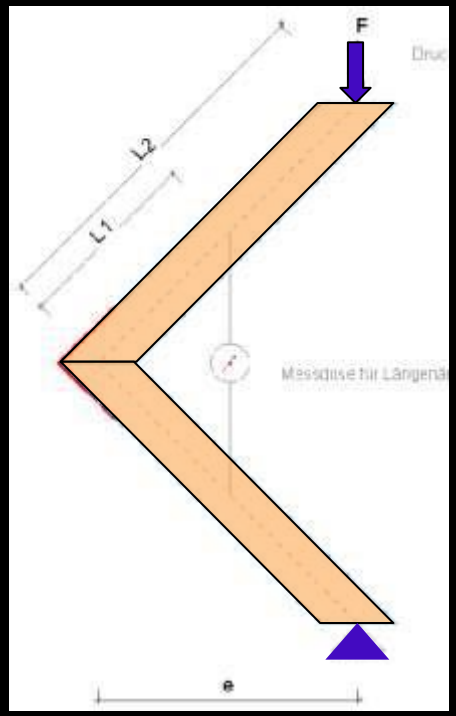
Topics

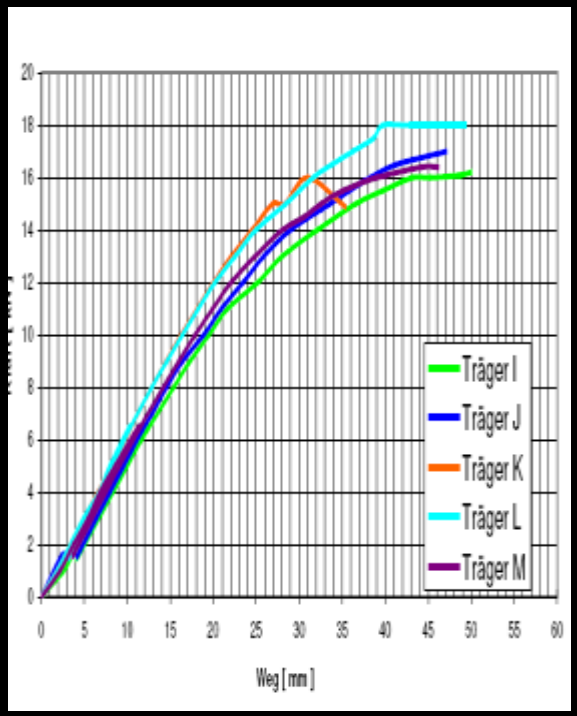
Time……Cost……Performance…..

Moment rigid connections



Testing … moment rigit frame



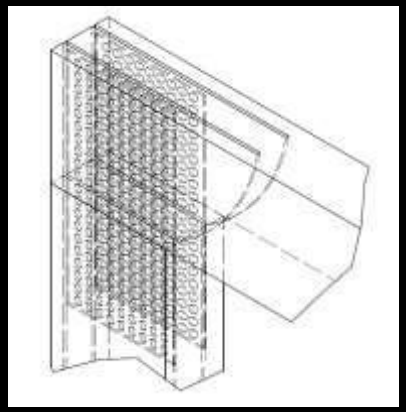


Bathon Bike Shack

girder 3/5,5 in (L= 10 feet)
column 1,6/8,7 in (H= 8 feet)

Fotos: Bathon

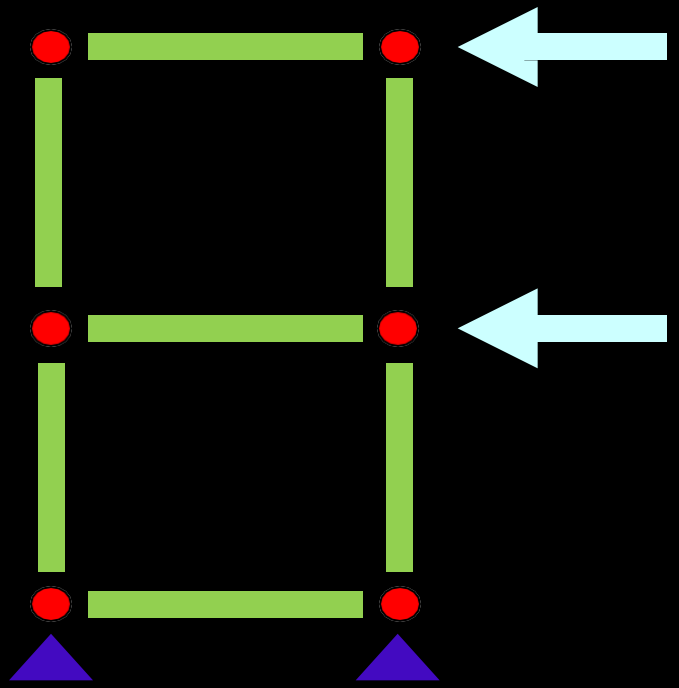
Decathlon 2010 Madrid „Ikaros“



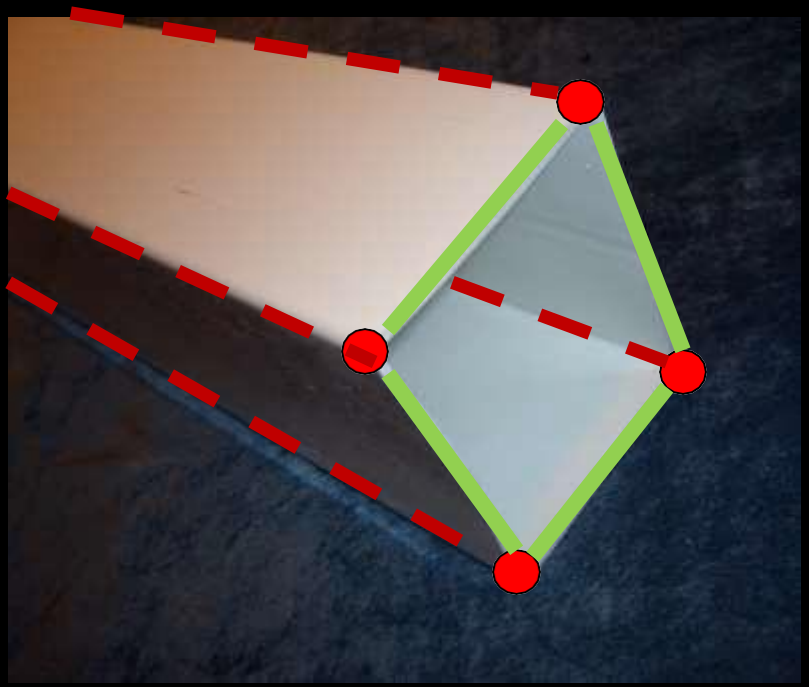
Topics

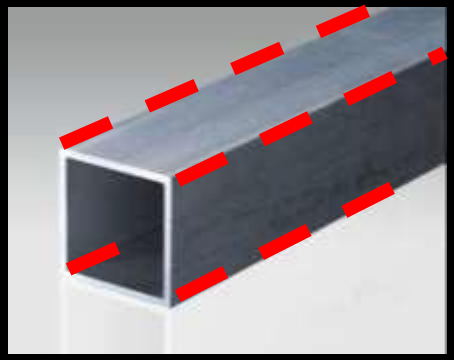
Time……Cost……Performance…..

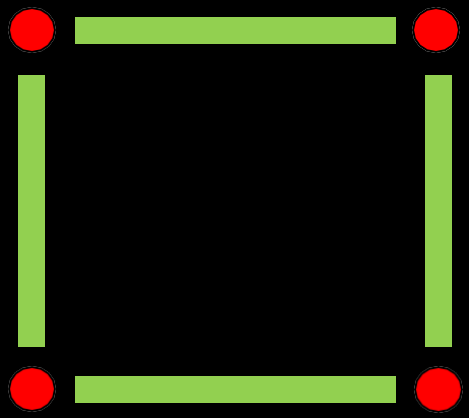
Moment rigid connections



Rigid clt pipe

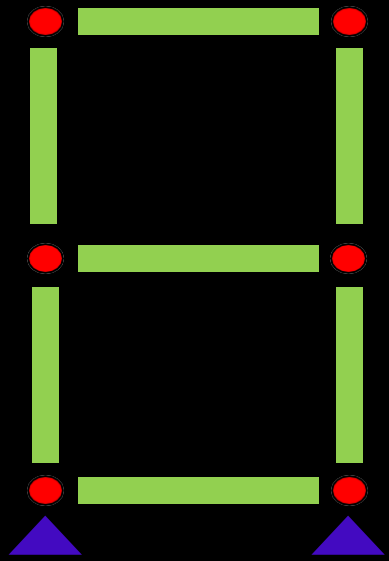




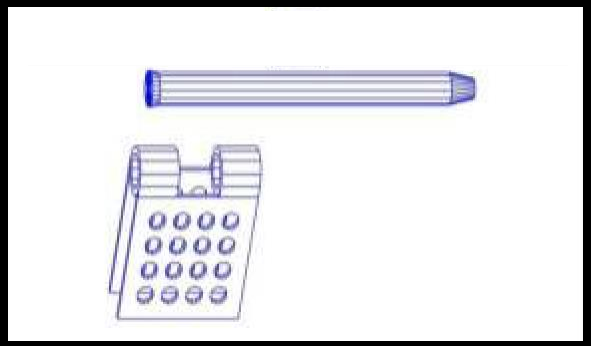


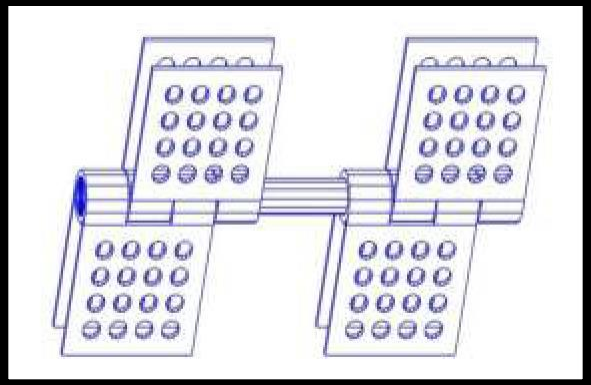
Moment rigit connection

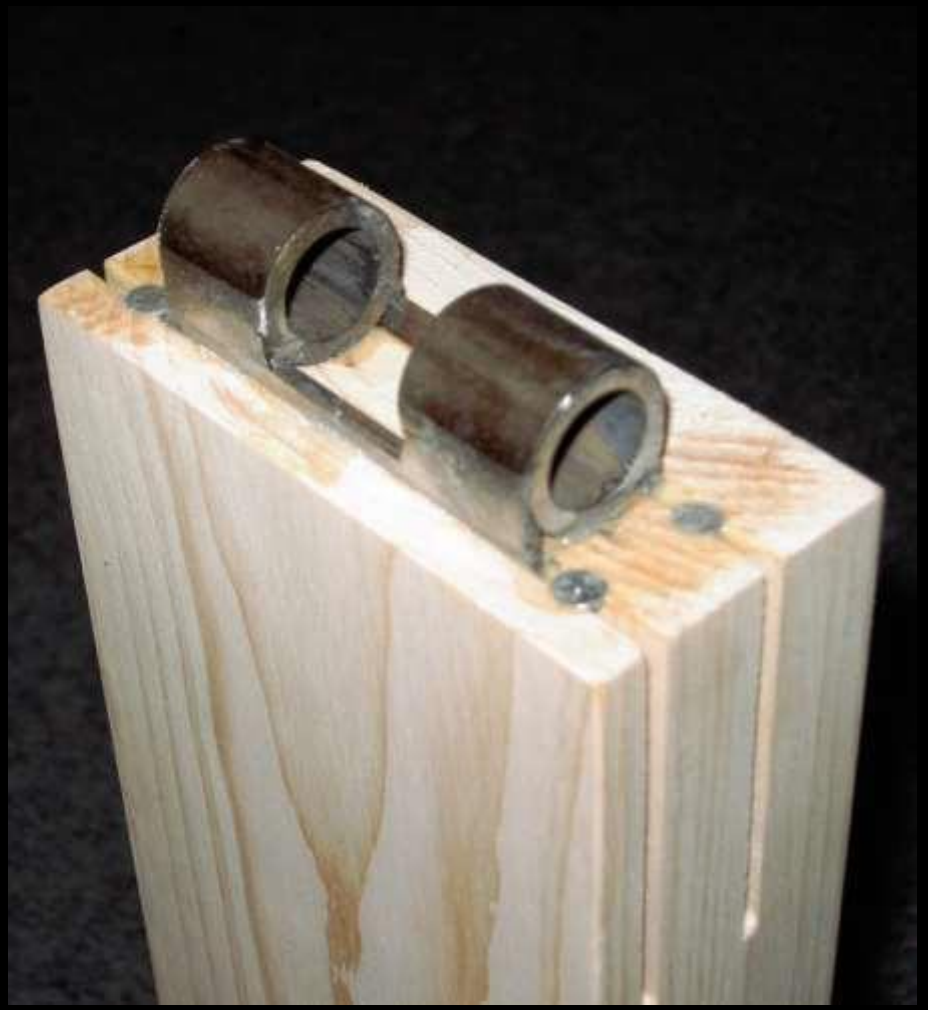
… allows a free few of the „CLT“ home



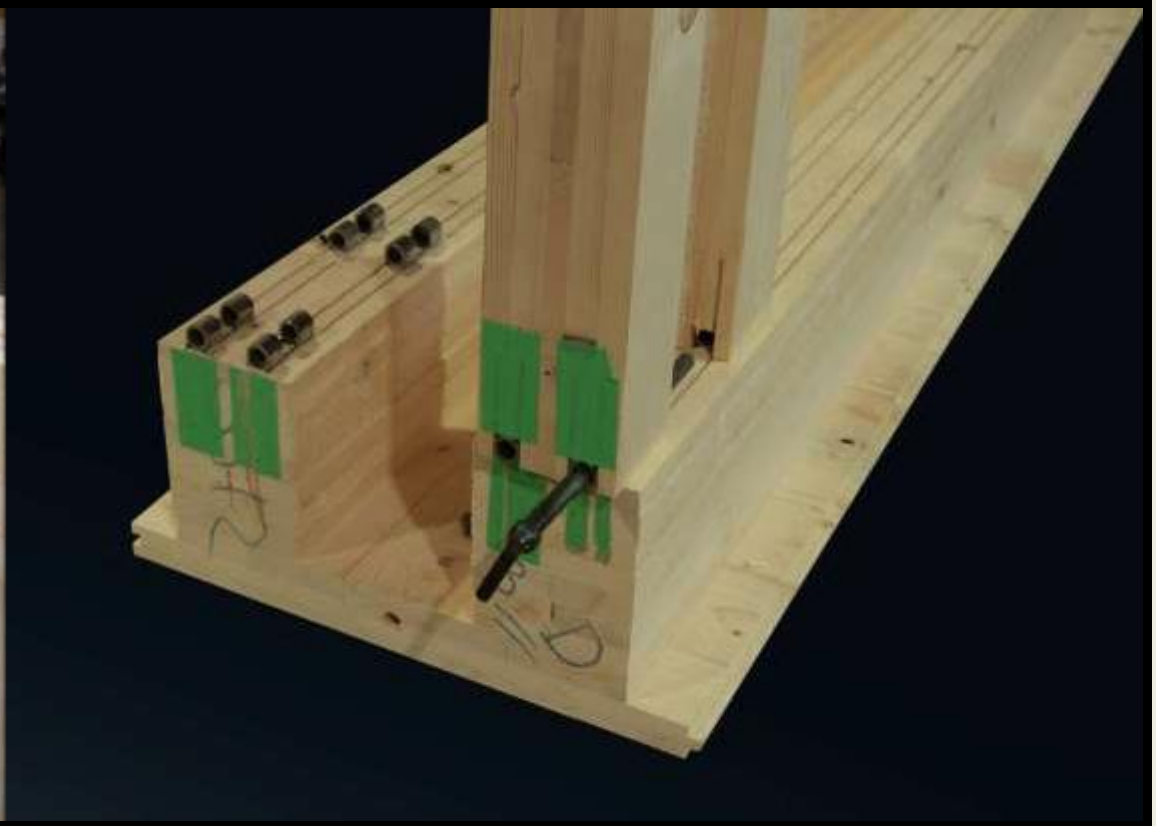
Adhesive / pin connection







Moment rigid connection



Moment rigid frame

…steel connection with timber members

Mass Timber

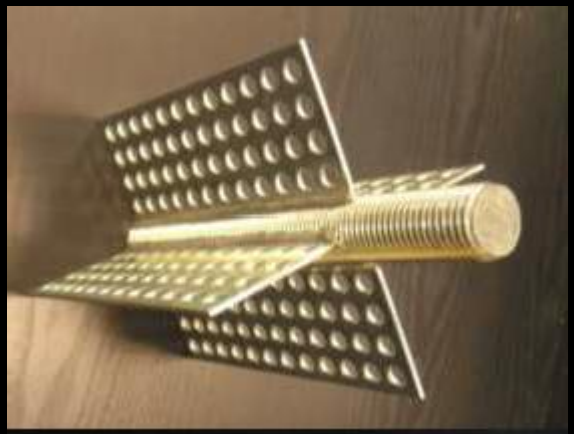
…using steel coupling

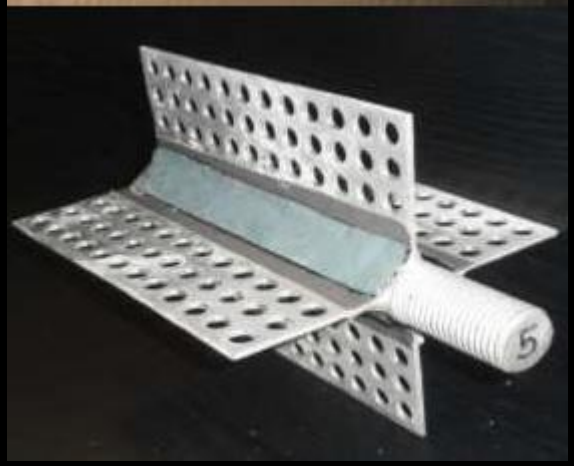
Topics

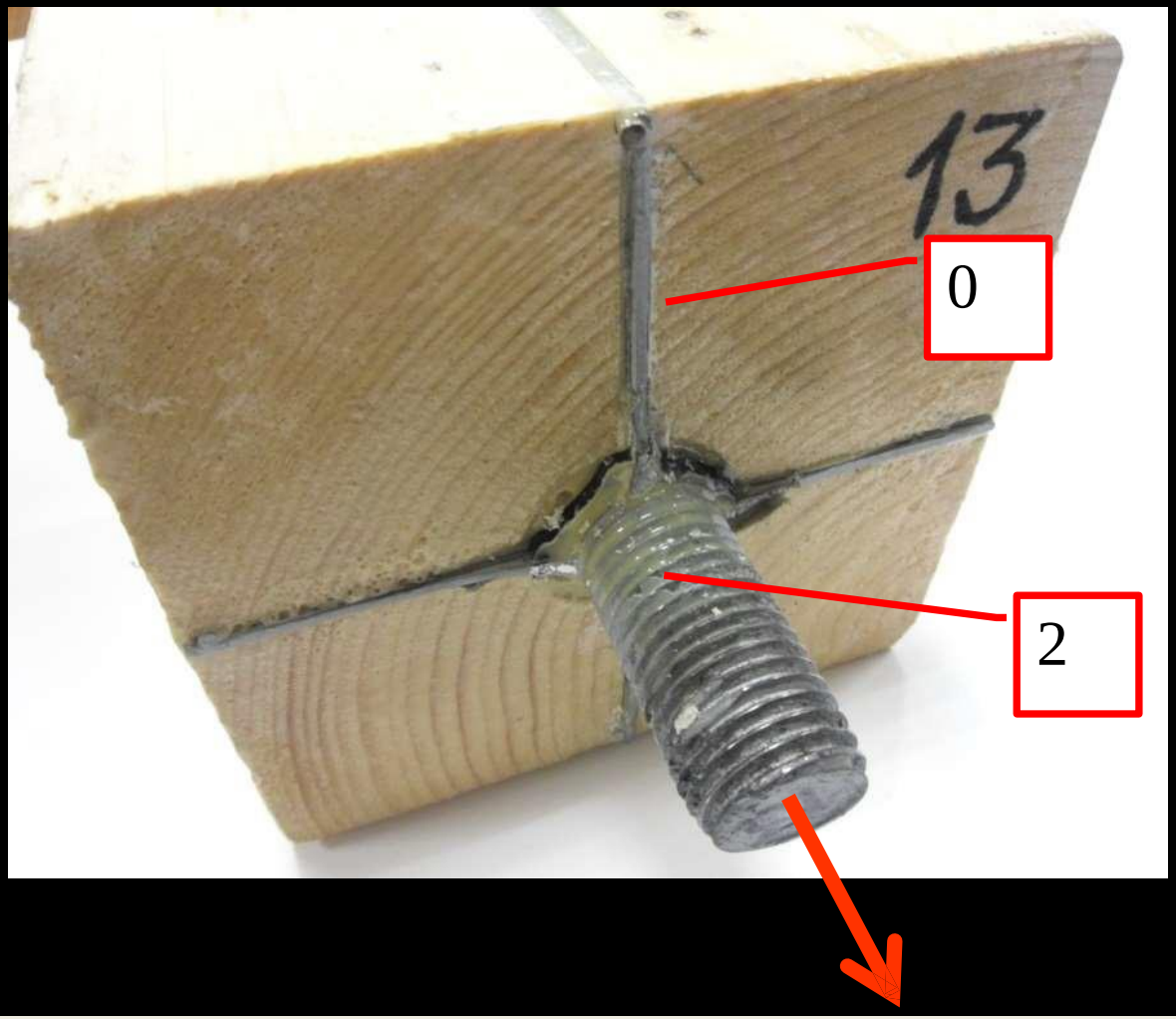
Time……Cost……Performance…..

End grain connections „hsk-rod“

High ductility!

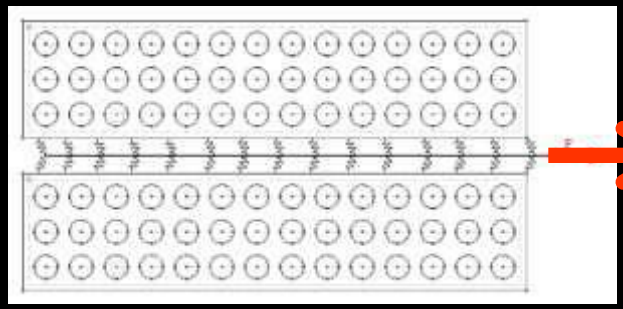


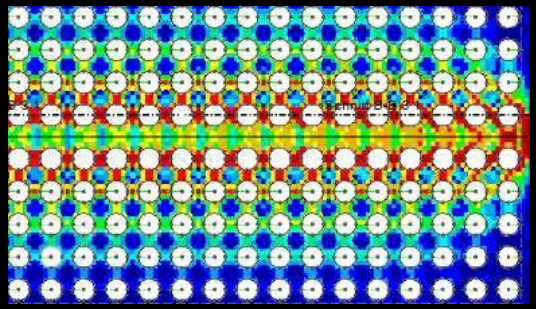




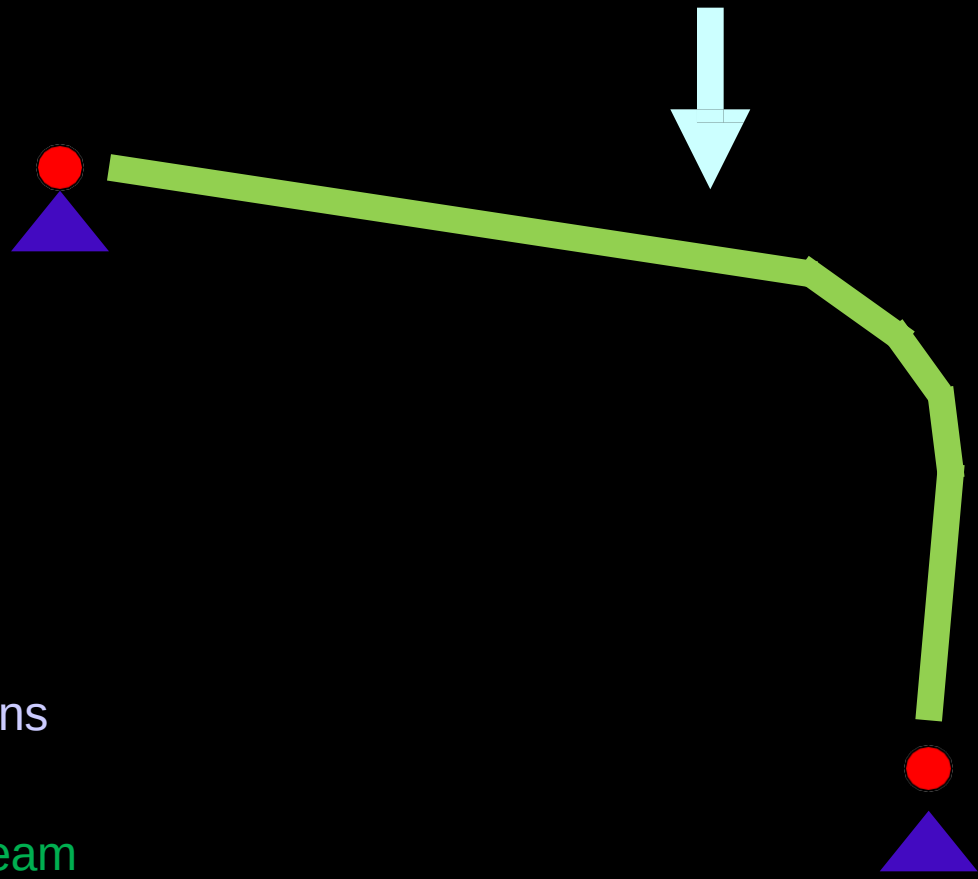
High ductility

…allows for pre-stressing!





Topics



Moment rigid connections

… on a „curved“ CLT beam

UBCO Wellness and Fitness Centre

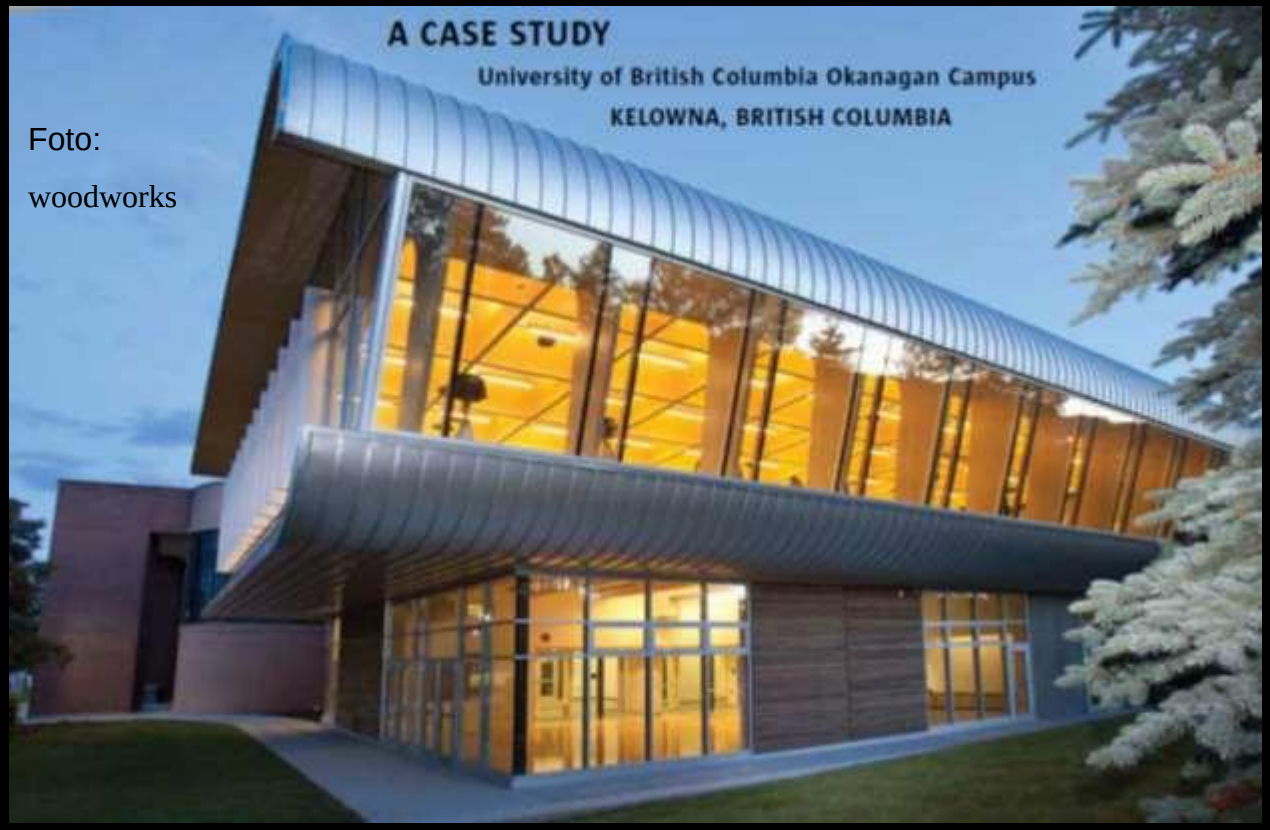


Foto:

woodworks

... *hbv-system* and *hsk-system* provide the performance criteria!

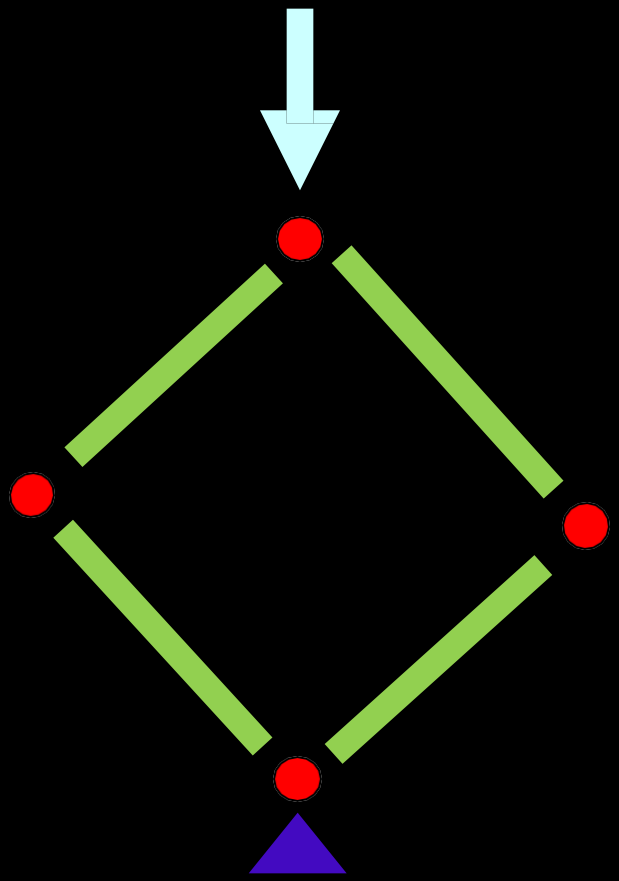
Fitness building at UBC

... first CLT moment rigit frame using *hsk-system*

Topics

Time……Cost……Performance…..

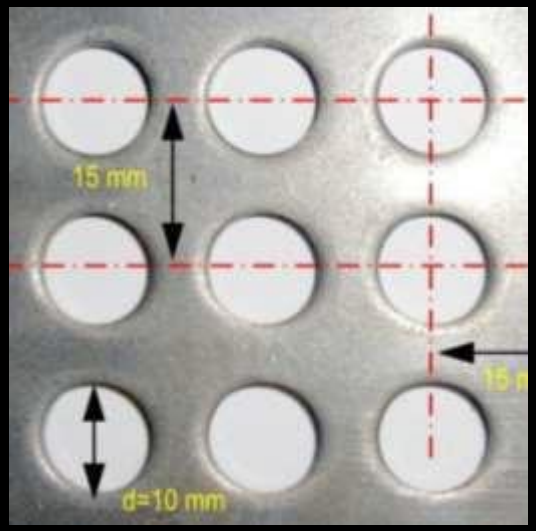
Moment rigid connections



Rigid adhesive connection

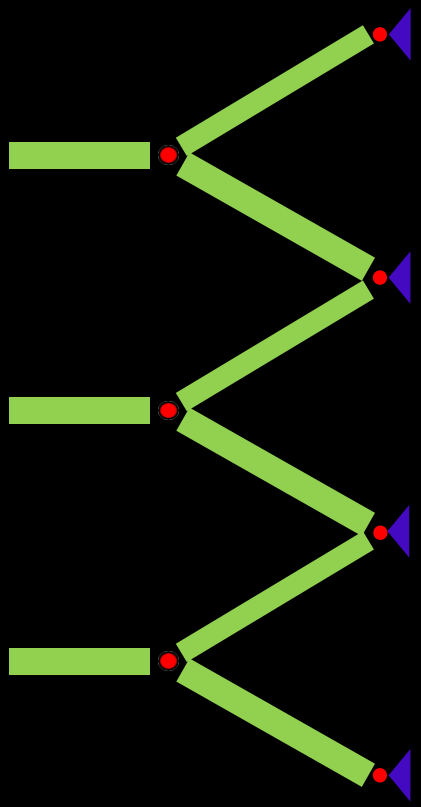
…steel design with timber

Stiff and ductile connection system

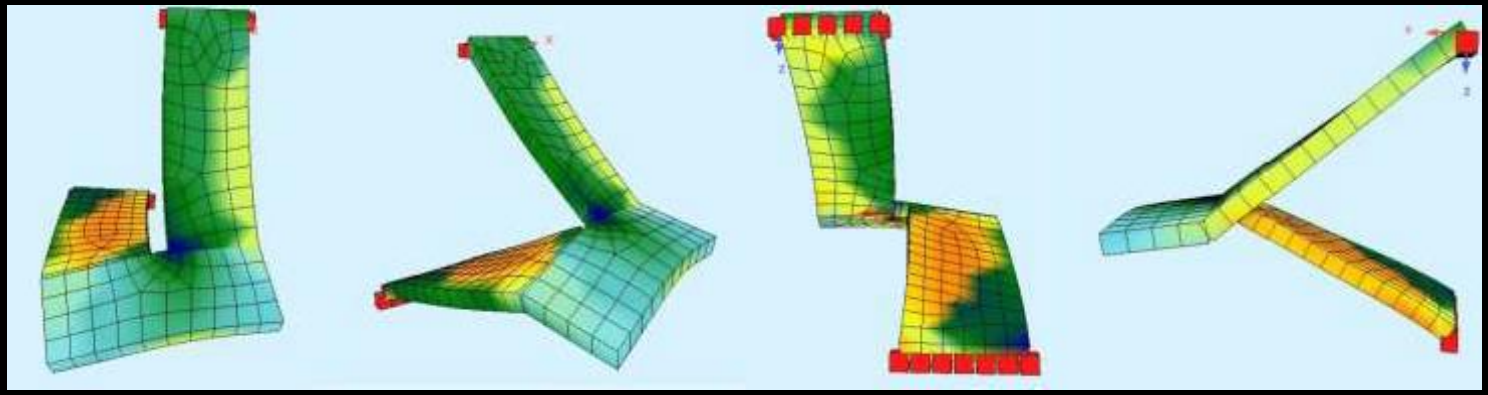


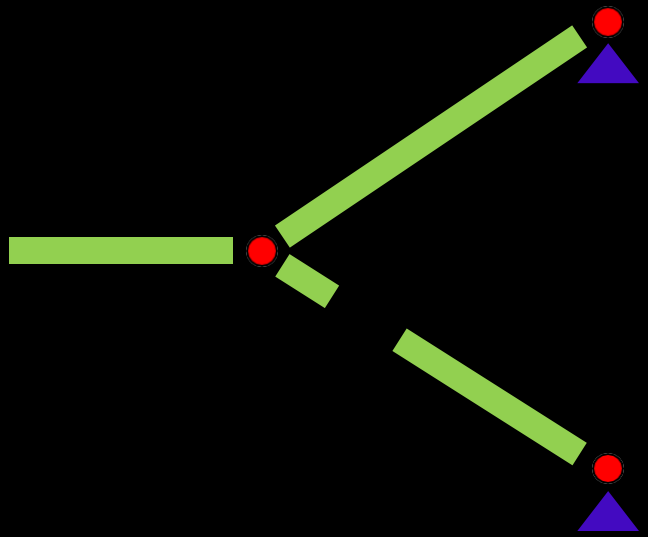
Flying stairs

… the idea is simple!

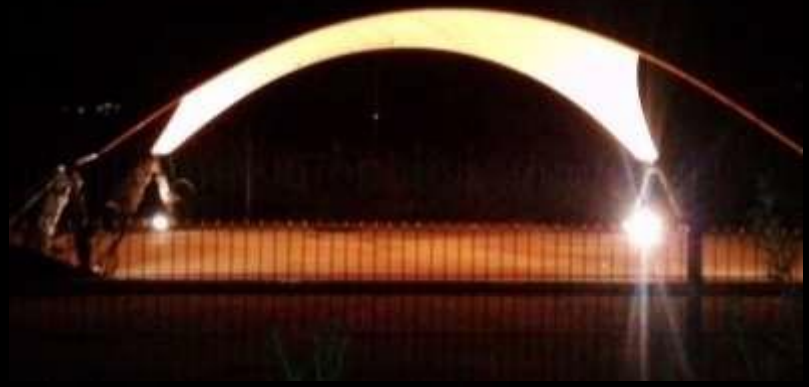


… but how do you do it ?





Stuttgart SmartShell



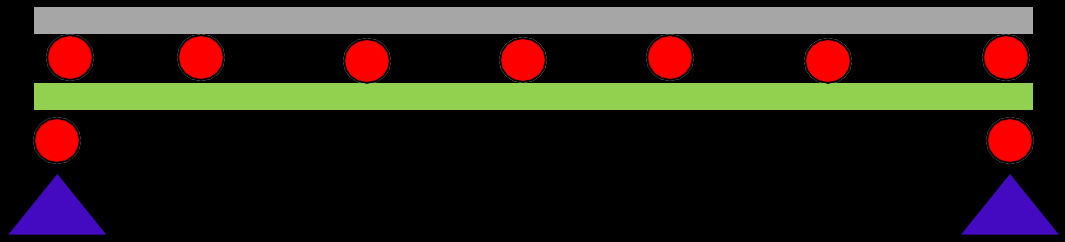
Stuttgart SmartShell

stainless steel

Topics

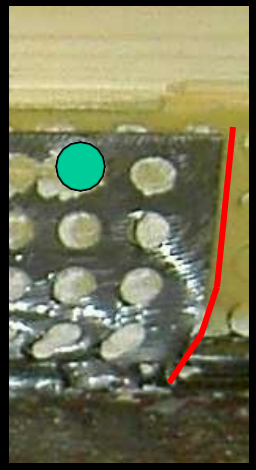
Time……Cost……Performance…..

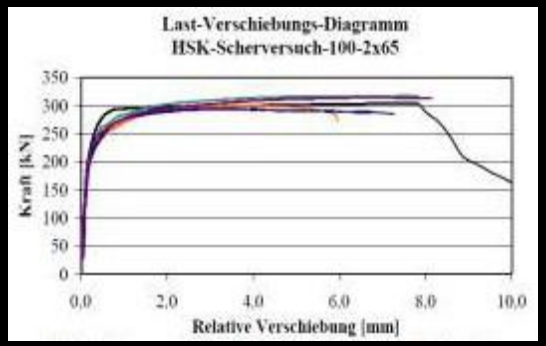
wood – wood - composite system

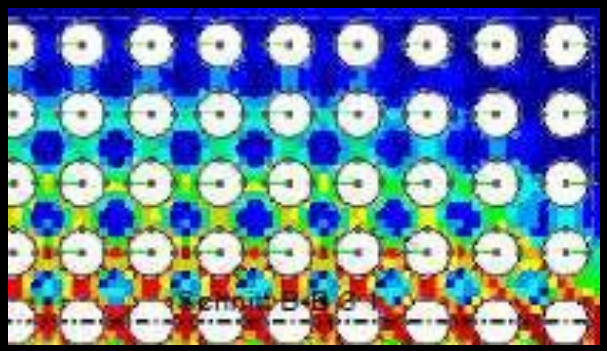


Shear test

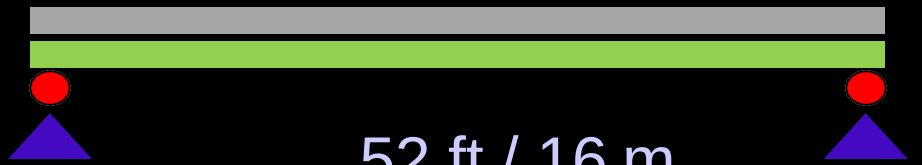
… stiff and ductile





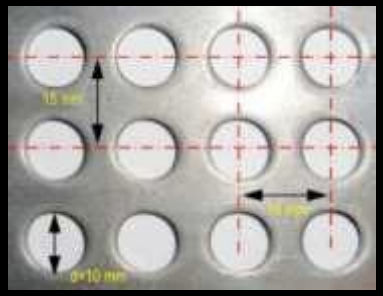


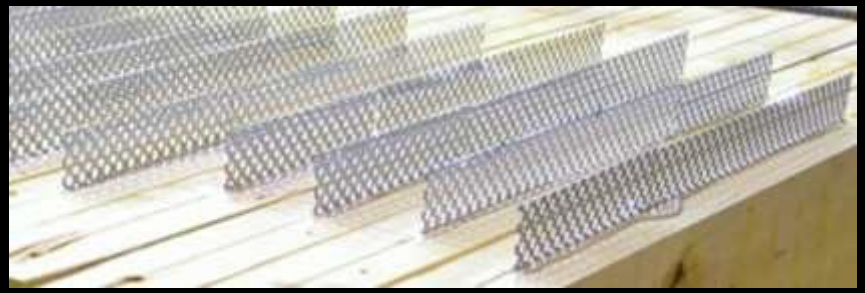
Hybrid roof „box“ element

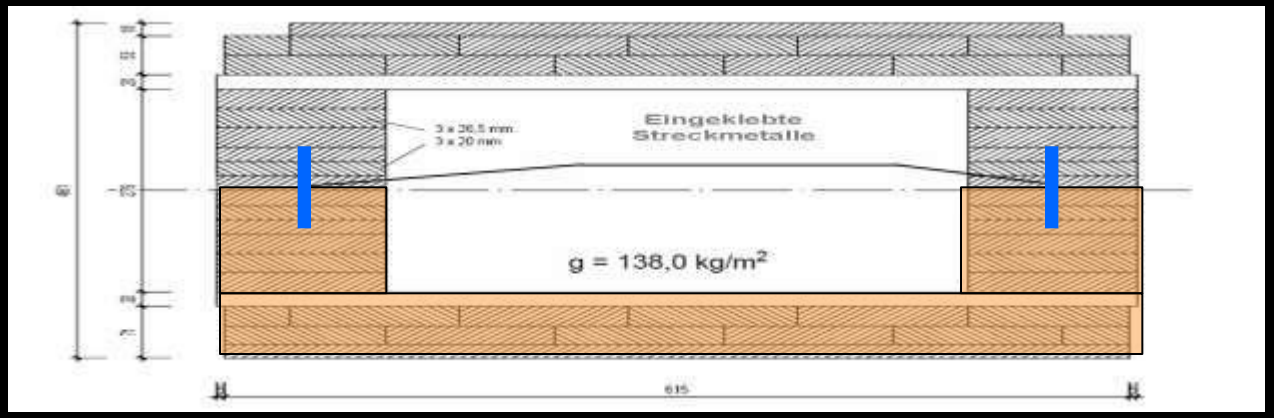


Hybrid roof „box“ element

… allows for cambering







52 ft

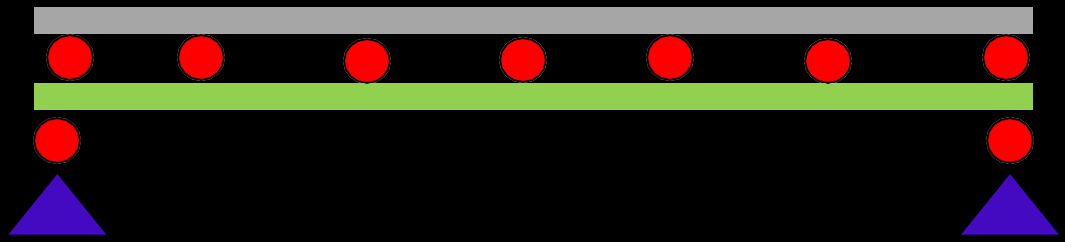
16 m

Span !!

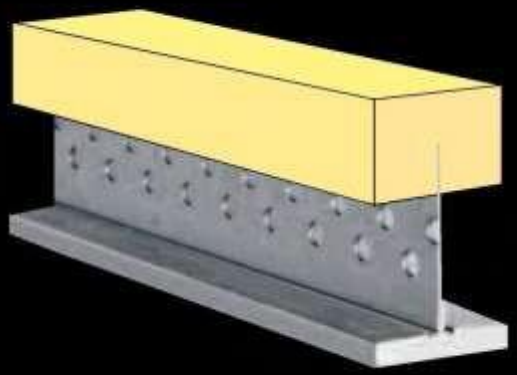
Topics

Time……Cost……Performance…..

wood – steel - composite system



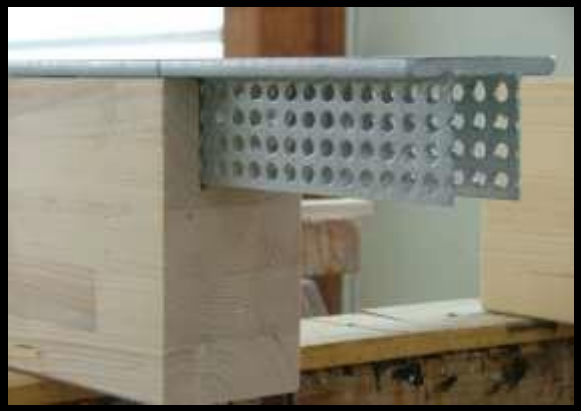
Carbon balanced system (CBS)!

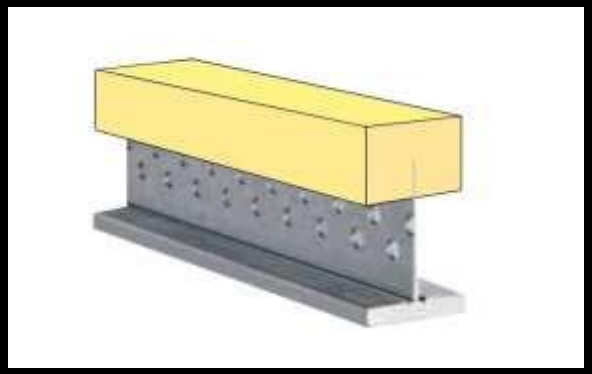


wood	ca. 1 kg
steel	ca. 1 kg

Hybrid-Building-Component

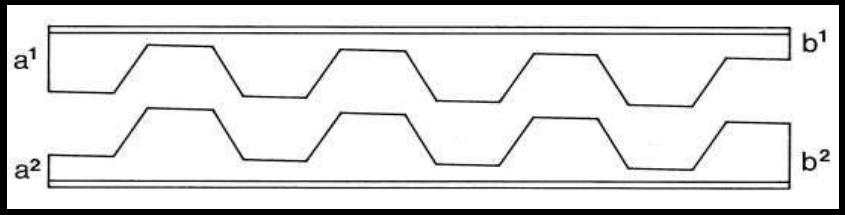
CO2 Neutral

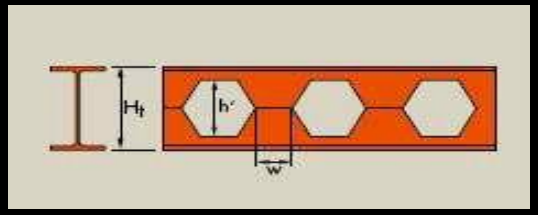


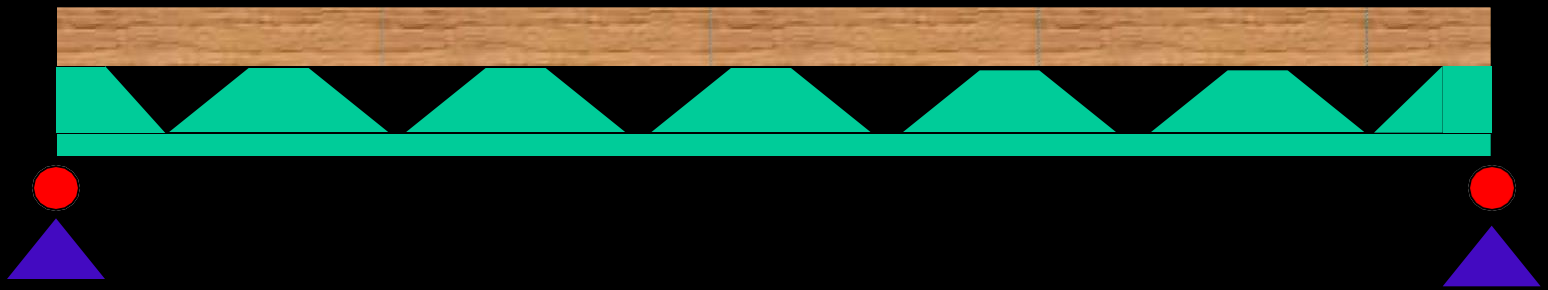


Web girder

… Carbon balanced system (CBS)!







The idea is old, but how does it work on a bigger scale !?

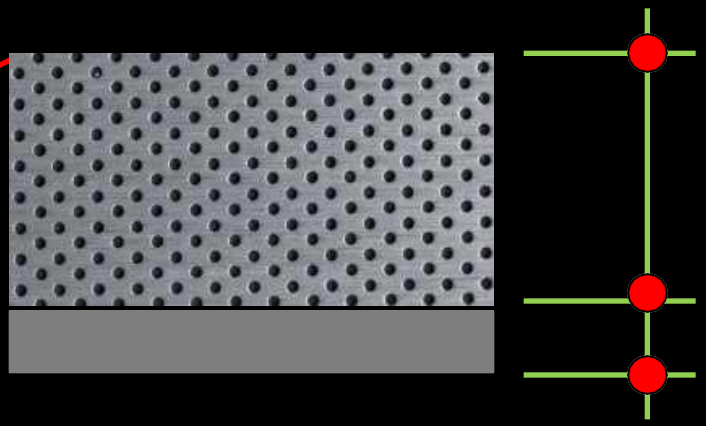
~ 1700

~ 2012

TimberTower

… small ideas allow for big things

Tower 328 feet / 100 m



Mass Timber Panels

Connetions detail at the base

… wood-steel to concrete

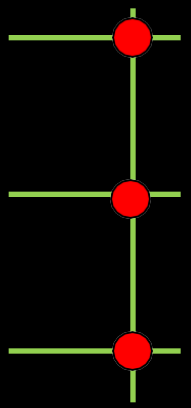
Connecting the base elements with the foundation

inside

outside

TimberTower

… small ideas allow for big things



Connection

180 mm

into each element

HSK-System

… application of the adhesive

TimberTower

30 stories ?

100 m

equell

to

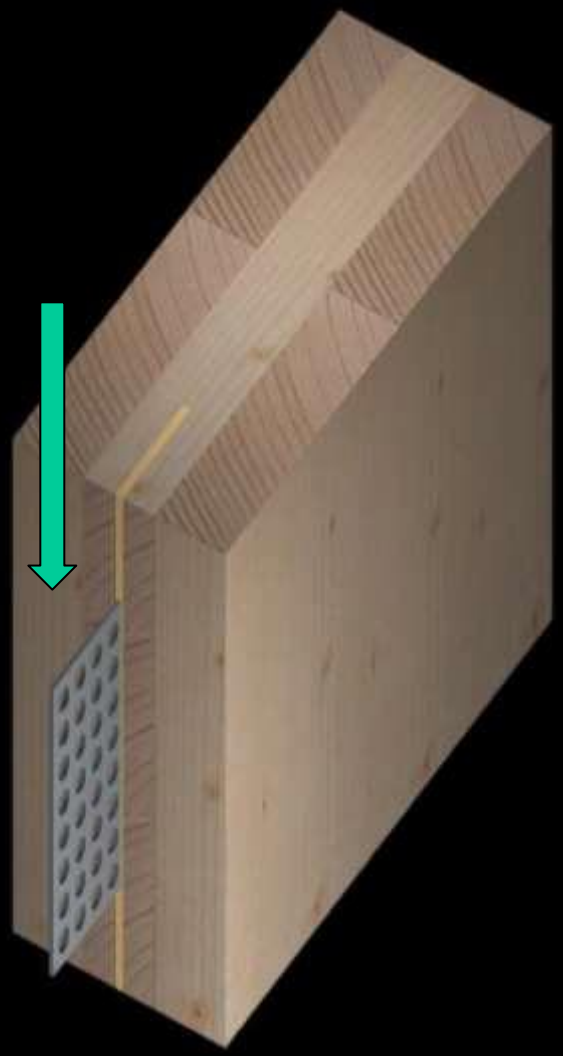
30 stories

Performance

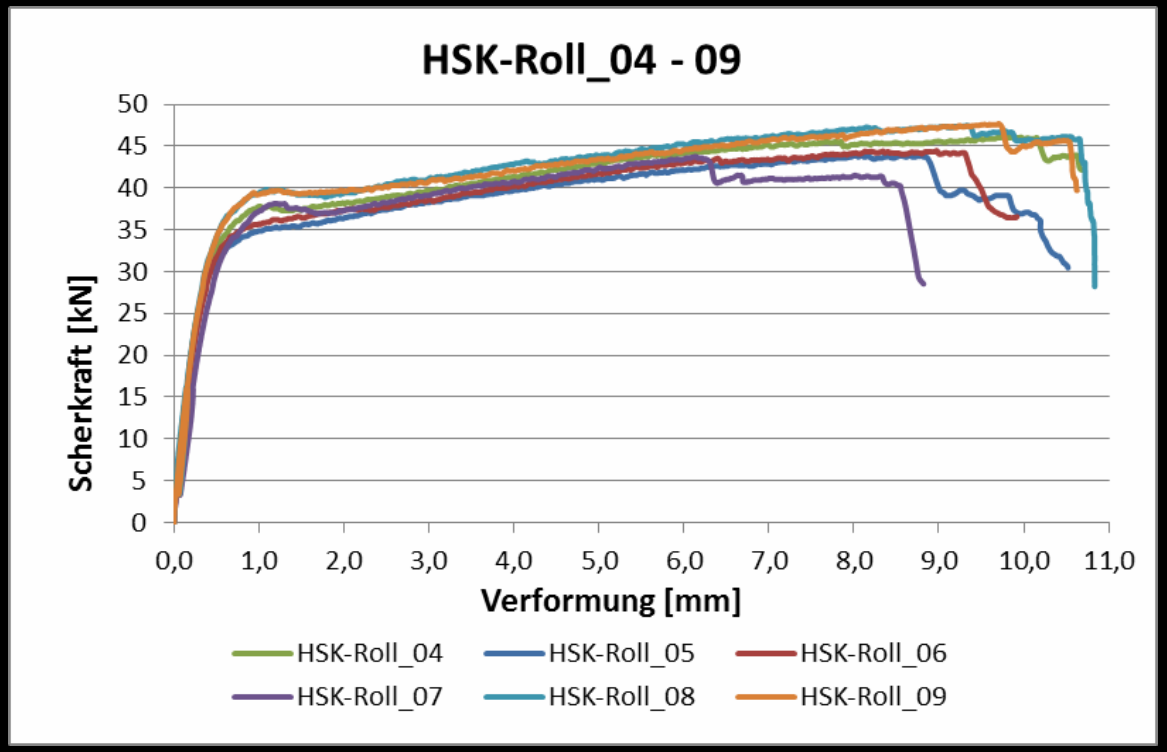
seismic

Test set-up

„end grain connection“

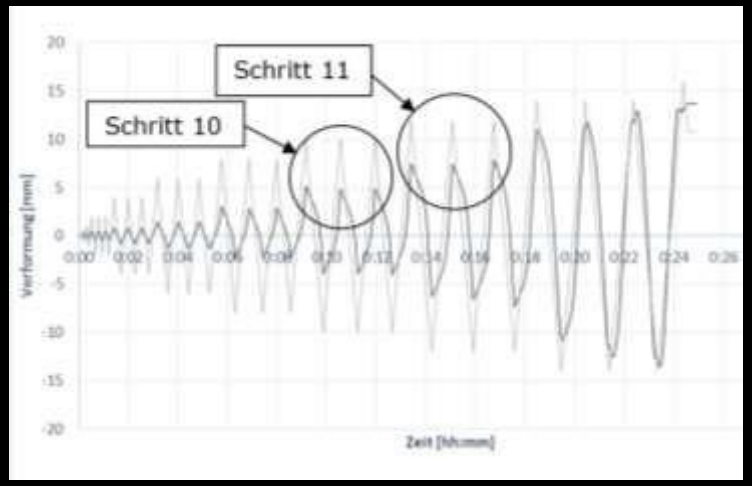


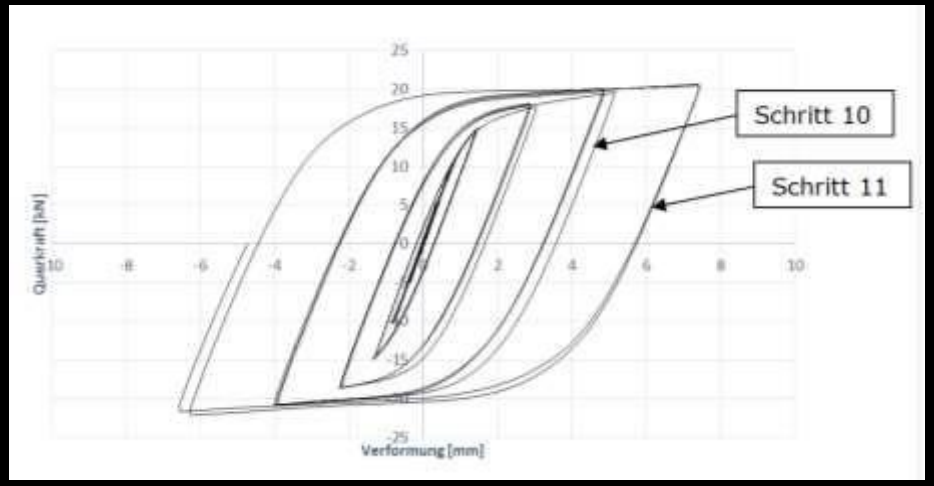
Load – Displacement Curves



Result

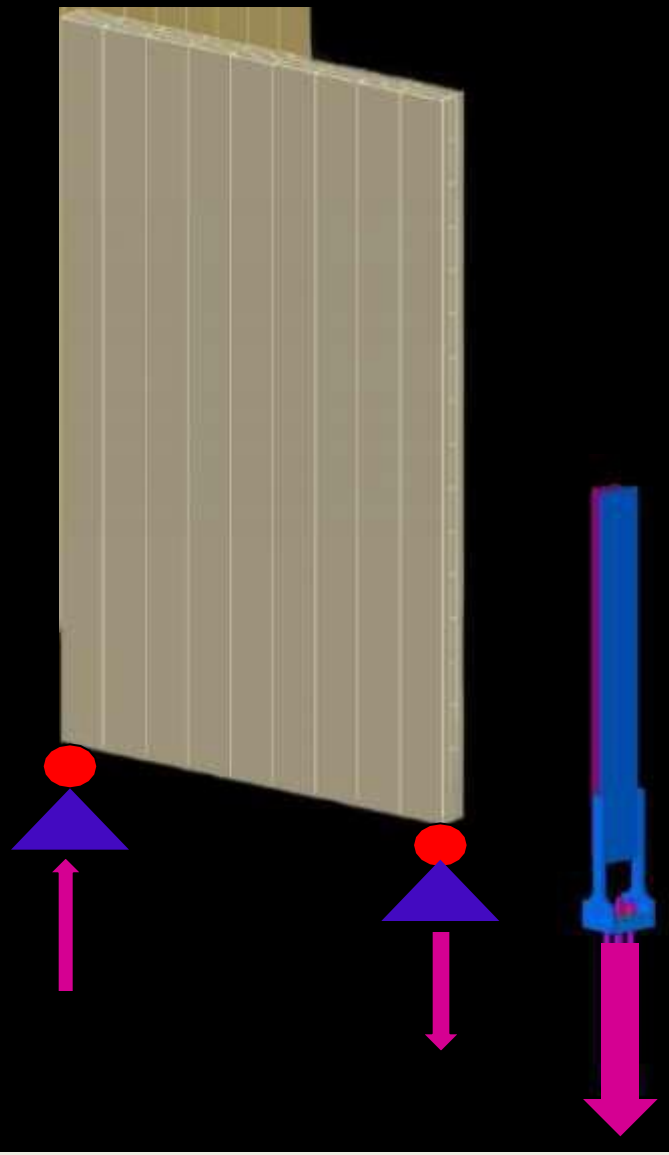
Seismic testing





Failure Mechanism

WIDC Prince George, BC



Thank you very much for your interest !

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leander@bathon.net