

USING REINFORCED GLT LATHS FOR CONSTRUCTING GRID SHELLS WITHOUT SUPPORTS

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HISTORY

- Most common grid-shell technology (Mannheim Multihalle 1974)
- Connection of laths with finger joints
- Later the connection of grids with node clamps



- Huge amount of scaffolding details and construction jacks need to be use (Downland Gridshell 2002)



- Forming the grid-shell shape



Is it possible to model and construct grid-shells cheaper?

IDEA

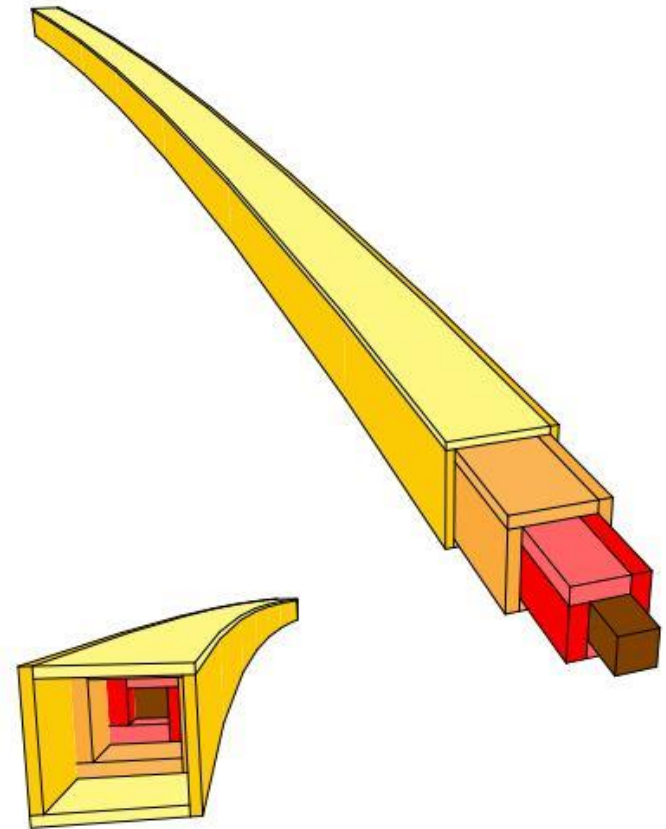
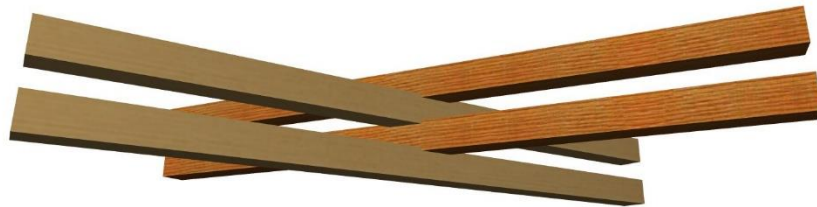


- Making a willow basket

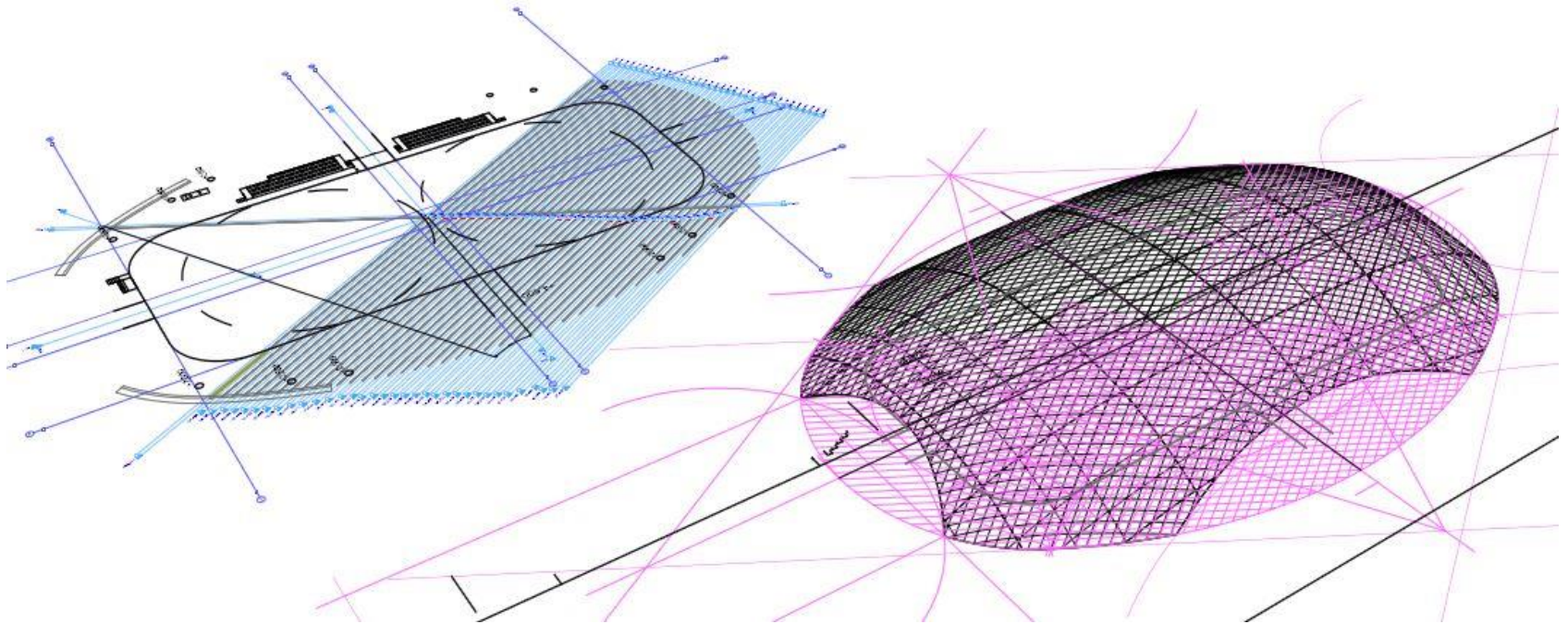


Does it possible without „infinitely“ long laths?

- YES, it is...
...if we use a special longitudinal joint with mortise on one and tenon on another end
- ...if we use self-locking carpentry joints between layers of laths with help of torsional forces

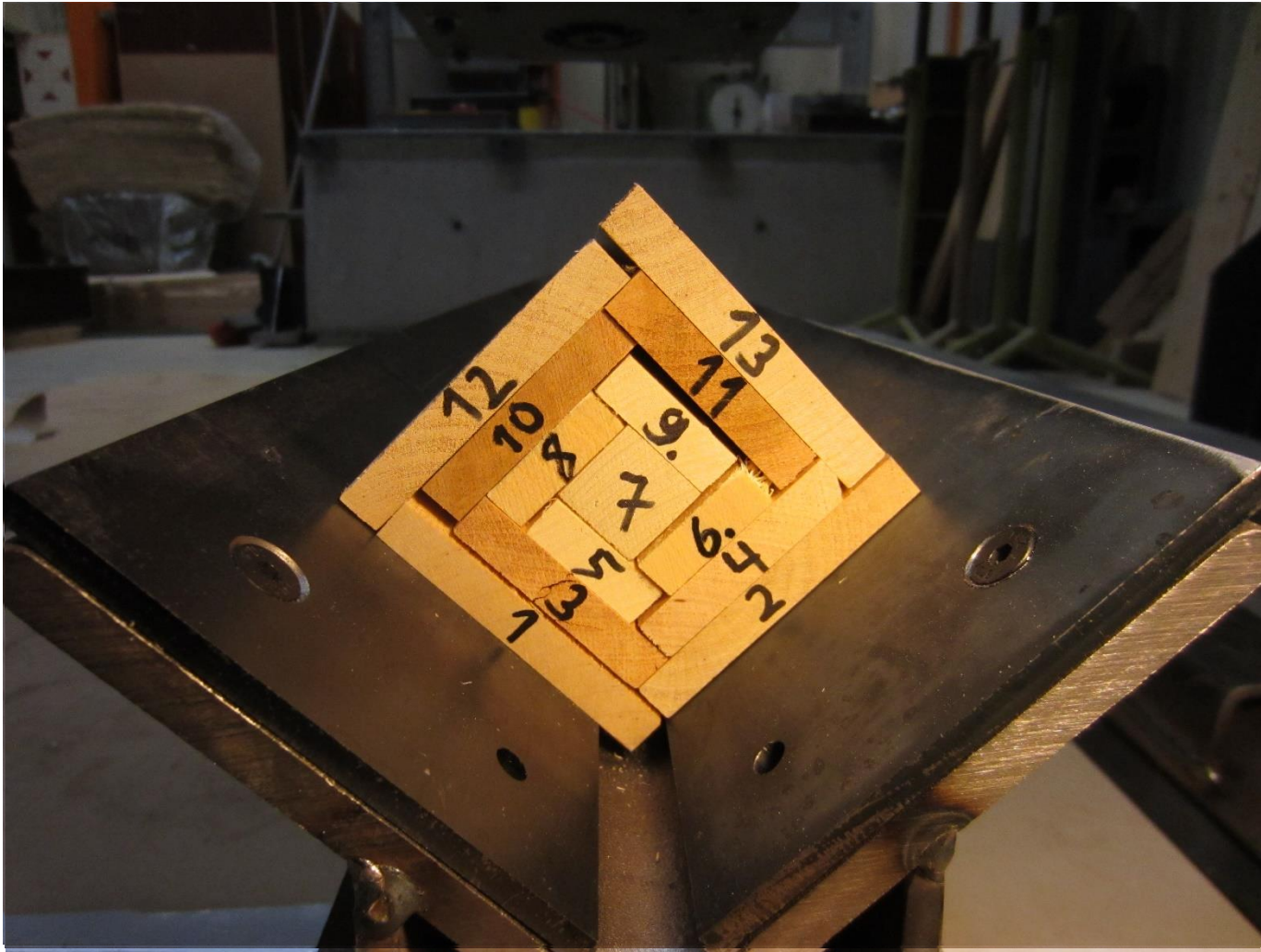


Sample of modelling grid-shell structure

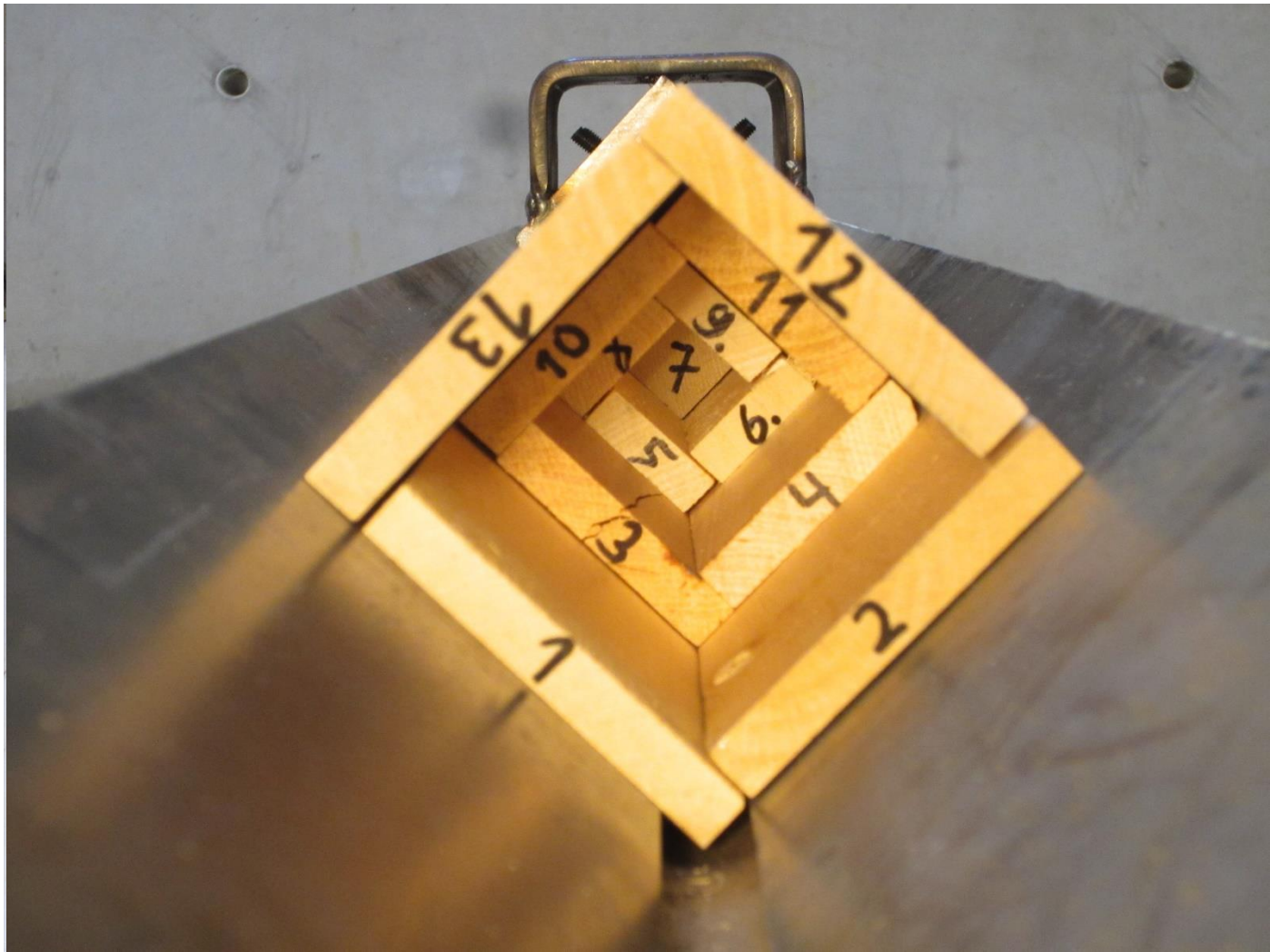


- Riding ground

Gluing the lamellas of different species of wood



Forming the tenon and the mortise



SPECIMEN

Specimen 80x80x1400 mm				
Specimen NR 1 (V_03_KK1)				
Layers (starting from middle)	NR 1	NR 2	NR 3	NR 4
Material	Oak	Aspen	Birch	Oak
Cross section (mm)	20x20	10x30	10x50	10x70
Length (mm)	1400	1400	1400	1400
Amount for one Specimen (pcs)	1	4	4	4
Specimen NR 2 (V_03_KK2)				
Layers (starting from middle)	NR 1	NR 2	NR 3	NR 4
Material	Oak	Alder	Oak	Ash
Cross section (mm)	20x20	10x30	10x50	10x70
Length (mm)	1400	1400	1400	1400
Amount for one Specimen (pcs)	1	4	4	4
Specimen NR 3 (V_03_KK3)				
Layers (starting from middle)	NR 1	NR 2	NR 3	NR 4
Material	Ash	Aspen	Birch	Ash
Cross section (mm)	20x20	10x30	10x50	10x70
Length (mm)	1400	1400	1400	1400
Amount for one Specimen (pcs)	1	4	4	4



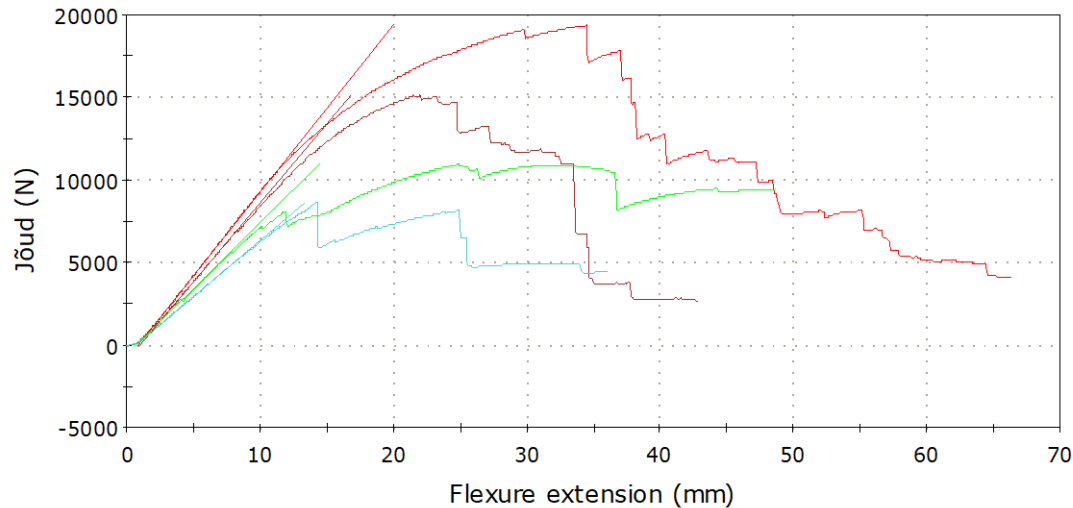
BENDING TESTS



- Bending test; INSTRON 3369

Specimen as Reference model

Painde katse



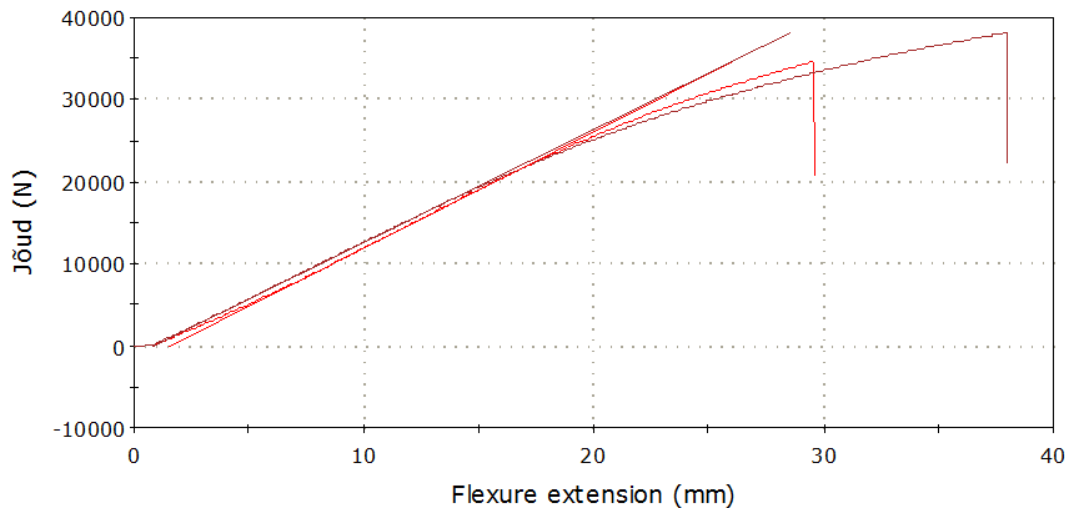
RESULTS

Spruce 80x80mm;
diagonally

Mean failure load
(of 3) 15,15kN

Specimen NR 3

Painde katse



Ash+aspen+birch+
ash 80x80mm;
diagonally

Mean failure load
36,40kN

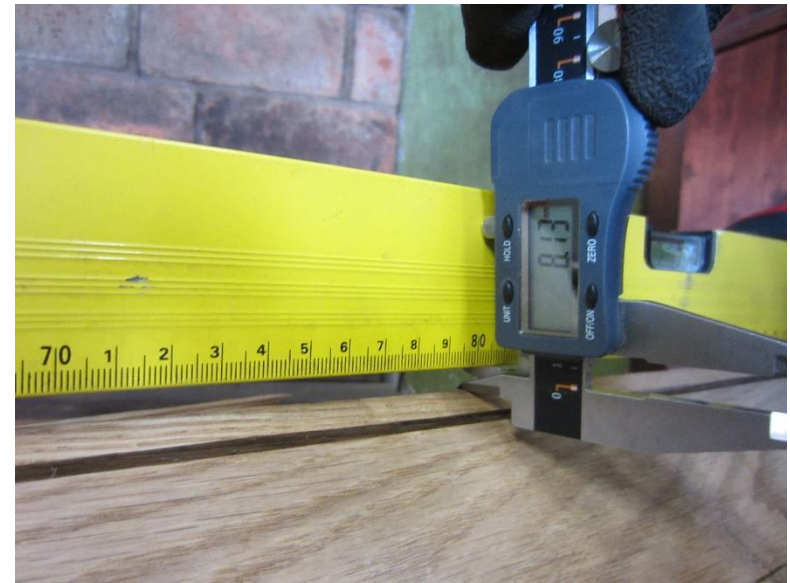
Final results

Specimen as Reference model					Mean failure load [kN]
Material	Spruce				15,15
Specimen 80x80x1400 mm					
Specimen NR 1 (V_03_KK1)					
Layers (starting from middle)	NR 1	NR 2	NR 3	NR 4	
Material	Oak	Aspen	Birch	Oak	24,24
Specimen NR 2 (V_03_KK2)					
Layers (starting from middle)	NR 1	NR 2	NR 3	NR 4	
Material	Oak	Alder	Oak	Ash	34,53
Specimen NR 3 (V_03_KK3)					
Layers (starting from middle)	NR 1	NR 2	NR 3	NR 4	
Material	Ash	Aspen	Birch	Ash	36,40

Specimen NR 1



- Mode of failure



- Plastic deformation
8,13mm of total 37mm

CONCLUSIONS

- Plastic deformation of laths with concentrically glued lamellas is very small
- Pre-stressing during mounting gives to the structure flexural stiffness
- Bending strength is good enough to avoid shear blocks between the laths
- Doubled layers of laths started from the edges with self-locking carpentry joints enable to mount the structure without or minimum supports

**THANK YOU FOR YOUR
ATTENTION!**

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