Herstellung konstruktiver Formholzprofile aus Pappelholz

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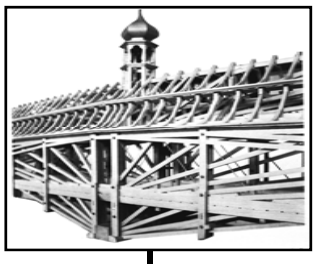
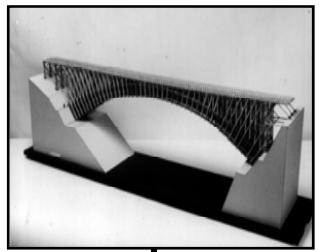
Konstruktionsentwicklung

Schaffhausen



U. Grubenmann

Brücke



T. S. Brown

Spruce Goose

H. Hugues

Expo Dach

J. Natterer, T. Herzog

?

1750 **1850** **1950** **2000** **2020**

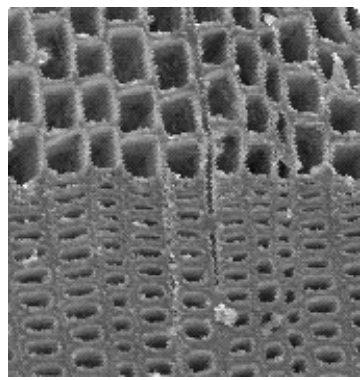
Sägen **+ Analysis** **+ Kleben** **+ Numerik** **+ ?**

Technologische Basis and Methoden

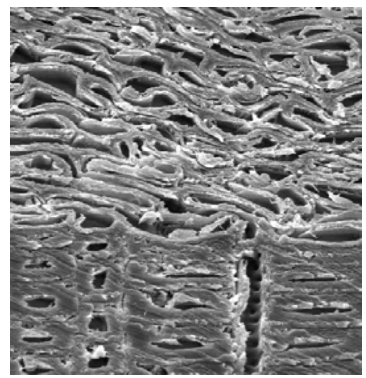
Herstellung von Pressholz

- Temperatur: 140 - 160°C
- Druck: 10 - 15 N / mm^2
- Zeit: 1 min / mm
- Fichte

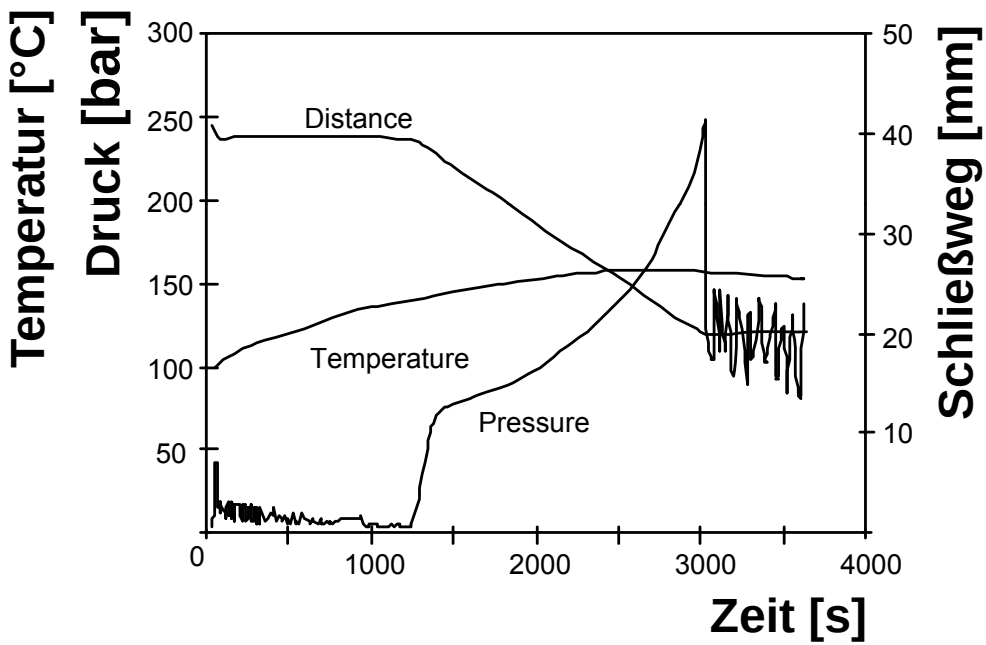
Etagenheizpresse



Fichte, 0% ...



50% verdichtet



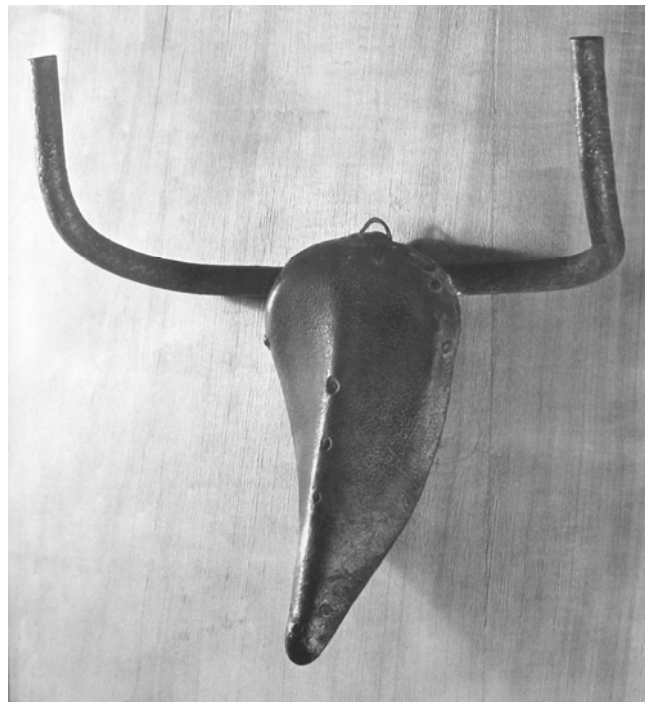
a)

b)

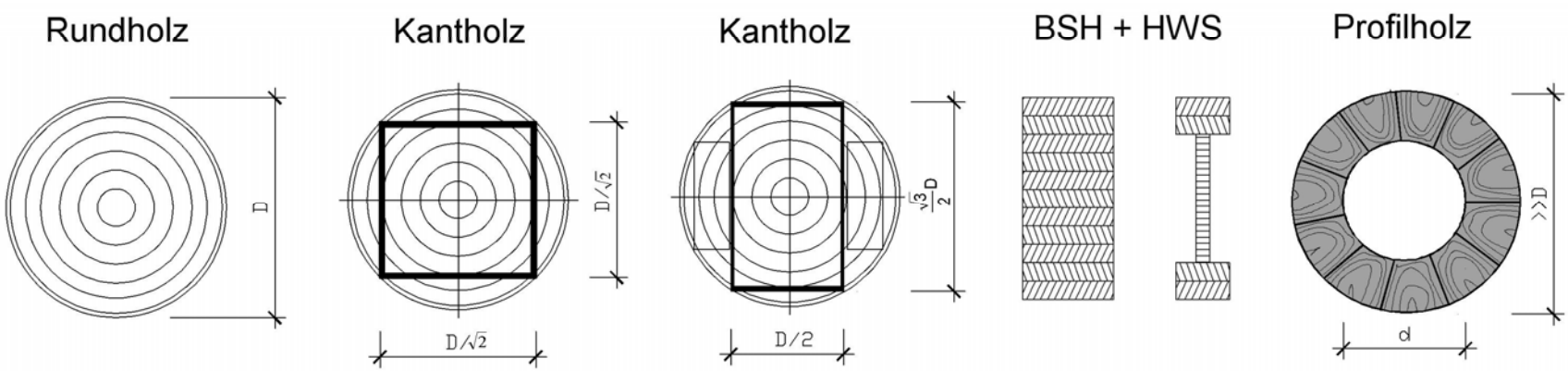
c)

Sich selbst zur sparsamen Verwendung von Materialien zu zwingen, ist eine Art von Beschränkung, die das Schöpferische freisetzt.

Pablo Picasso



Rohholzausbeute in der Holzverarbeitung



$\frac{A}{A_{max}} =$	1	0,64	0,55	0,5	≈ 1
$\frac{\overline{EI}}{EI_o} =$	1	0,42	0,55	. . .	> 2

Dreißig Speichen treffen sich in der Nabe:

Auf dem Nichts daran beruht des Wagens Wirksamkeit.

Durch Tonkneten macht man Gefäße:

Auf dem Nichts darin beruht des Gefäßes Brauchbarkeit.

Durch Aushöhlen von Türen und Fenstern macht man Häuser:

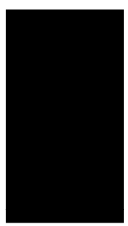
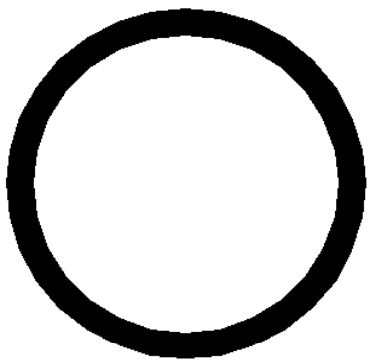
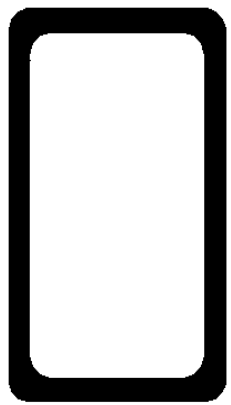
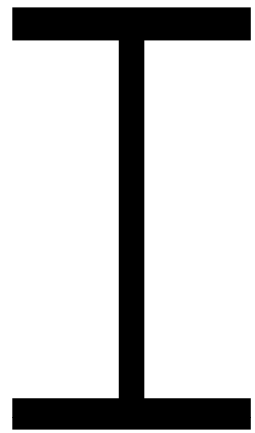
Auf ihrem Nichts beruht des Hauses Brauchbarkeit.

Darum: Das Seiende ist zwar nützlich,

Das Nichts ist das Wirksame.

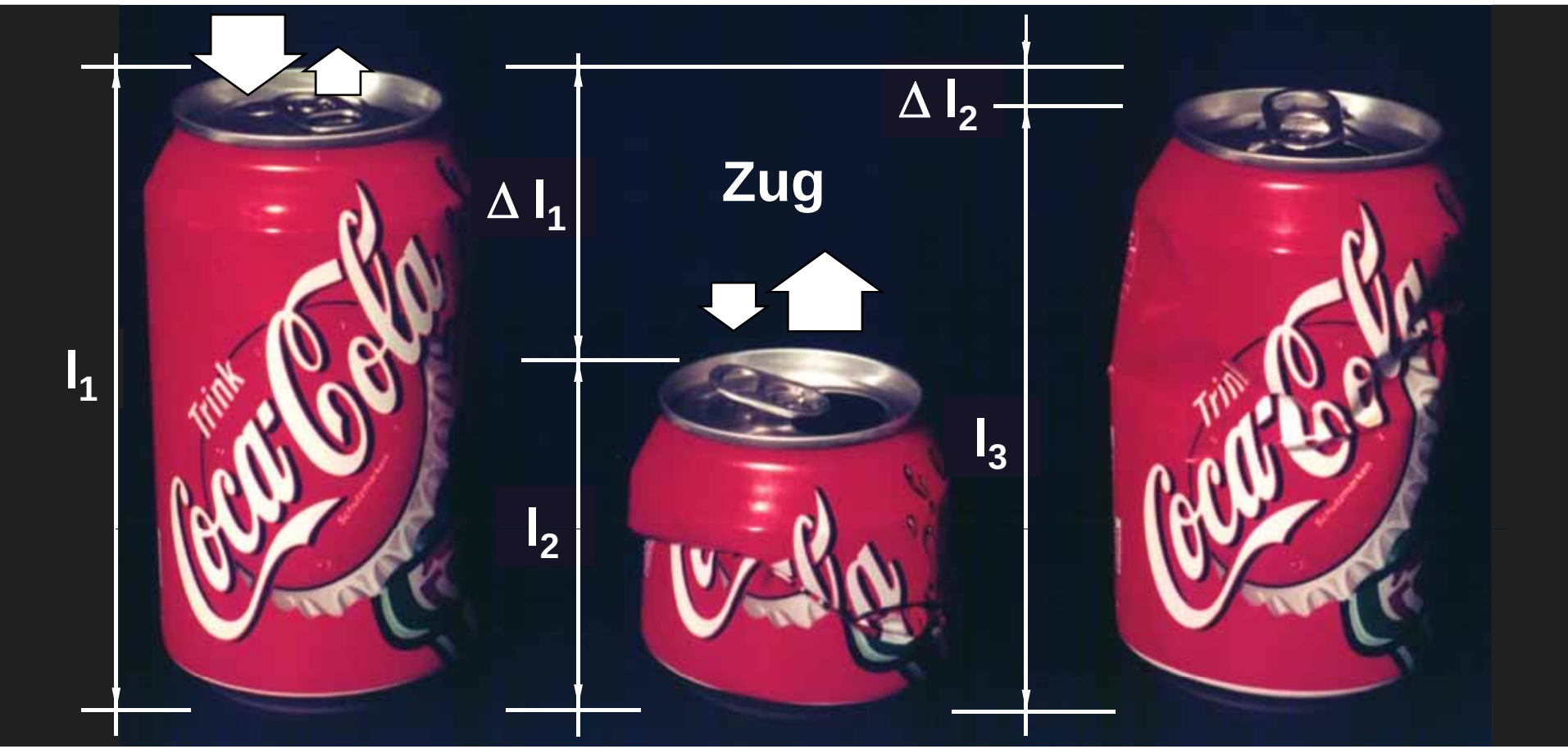
Laotse, Tao Te King

Vergleich - Flächenmomente

Voll	Rohr	Rechteck	I - Profil
			
100 %	375 %	550 %	740 %

A = const

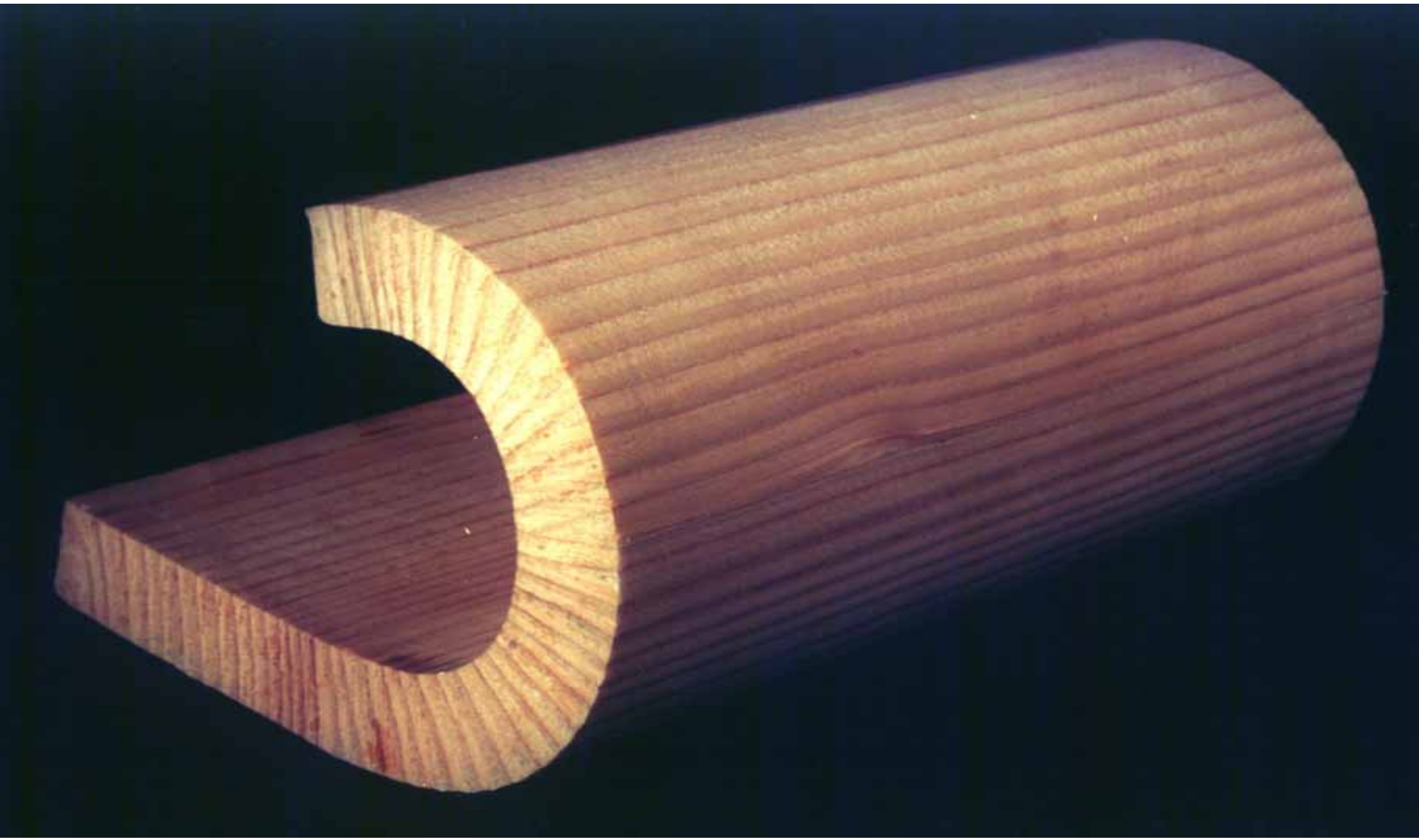
Druck



$$\varepsilon_{c,90} = \frac{\Delta l_1}{l_1} \cdot 100 \approx 50\,\%$$

$$\varepsilon_{t,90} = \frac{\Delta l_1 - \Delta l_2}{l_2} \cdot 100 \approx 100\,\%$$


Verdichtungsrichtung



Herstellung von Formholzrohren

1. Beschicken

2. Schließen

3. Pressen

a) uniaxialer Druck

b) Biaxialer Druck

Agro-Wood: Plantagen auf LW-Flächen

Pappel (Methau/Sa) 11/05

Ungarn, 8/06

Weide, nach 3 Jahren

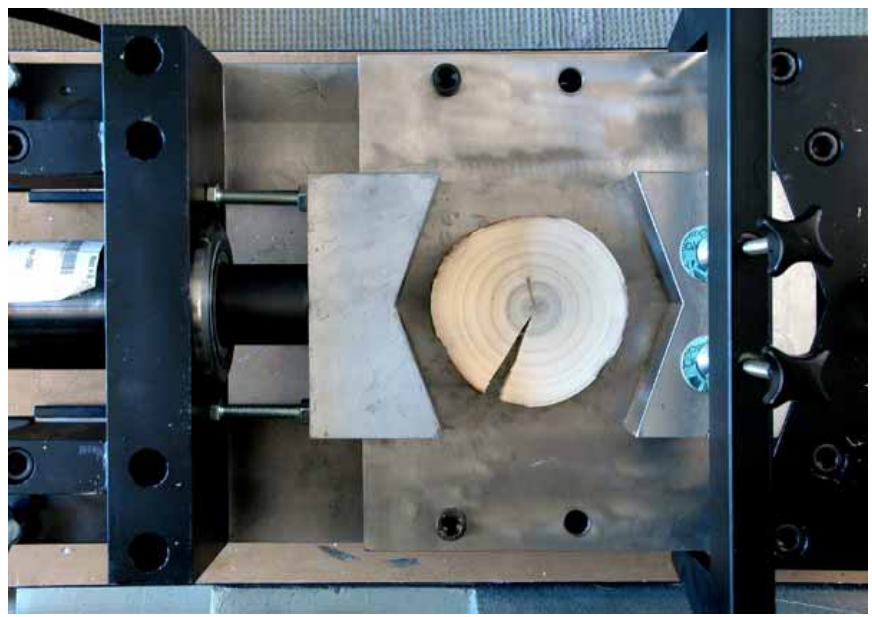
Foto: A. Bemmann

AGROWOOD – Schnellwüchsige Pappel und auf LW Flächen

Alter: 10 Jahre
Durchmesser: 10 ... 18 cm
Dlchte: 300..350 kg/m3

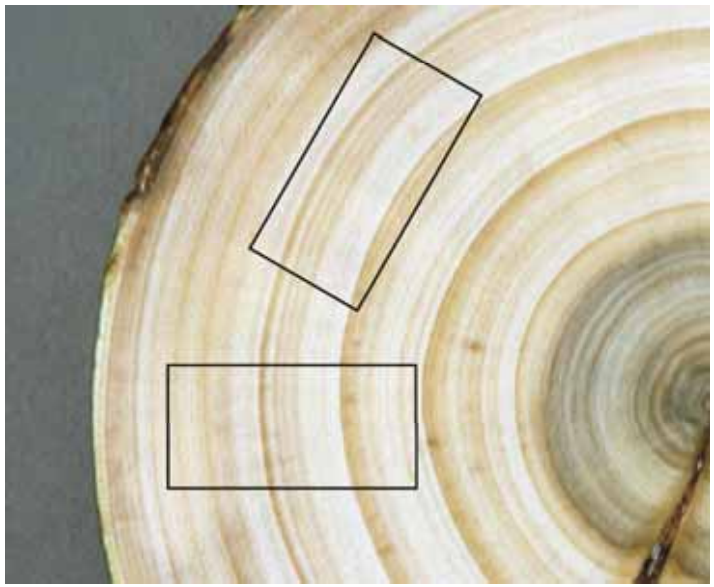
Pappel aus Plantagenanbau

Agro-Wood: Pressversuche an Pappel



Versuchspresse mit Pappelscheibe

Specimen Geometry



length: 40mm

width: 40mm

height: 20mm

Direction of compression:

- **radial...**
- **tangential...to the grain**

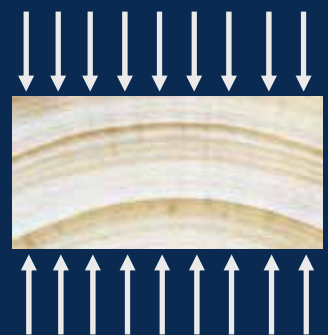
Testing Regime:

wood moisture: 7% and 70%

temperature: 120°C

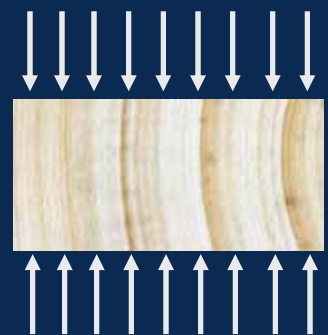
Richtung der Verdichtung

radial:



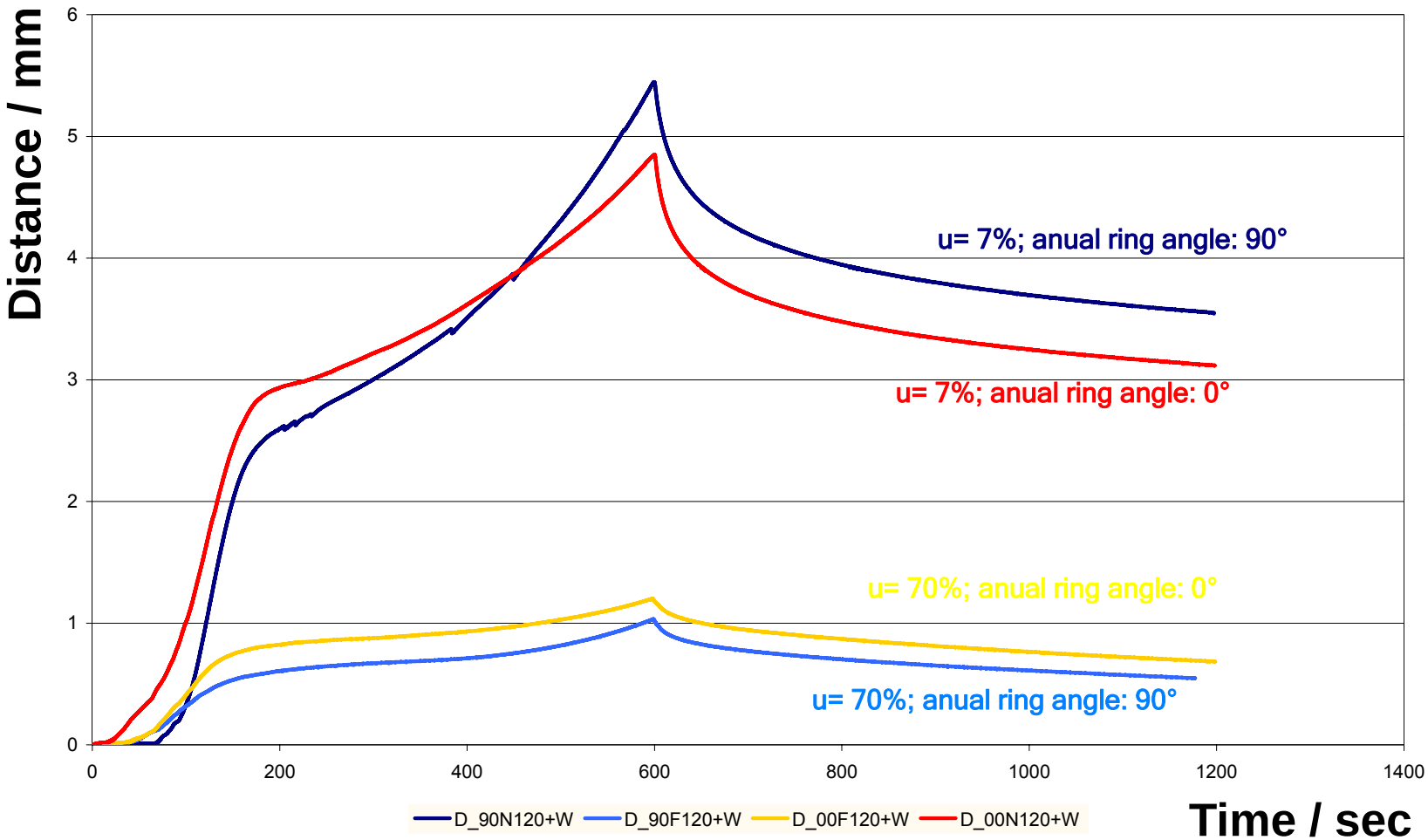
0°

tangential:

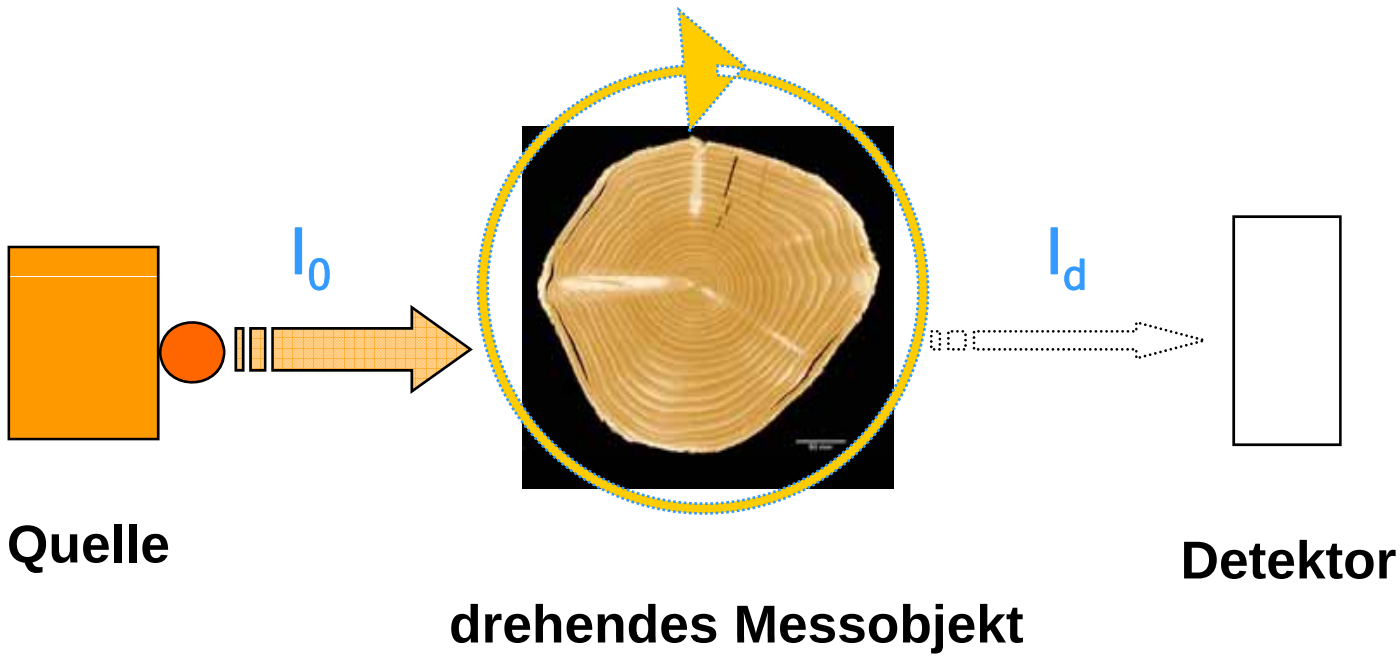


90°

Pressversuch - Ergebnisse



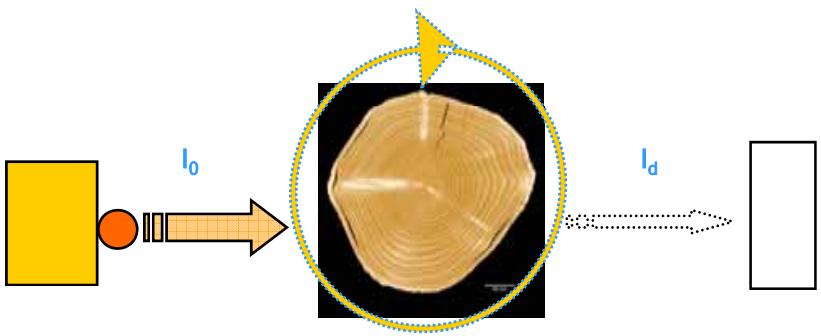
Agro-Wood: Messung des Dichteprofils



Prinzip der Röntgen-Tomographie

J. Schreiber 2007

Agro-Wood: Versuchsaufbau und Auswertung



$$I_d = I_0 \, e^{(-\mu \, d)}$$

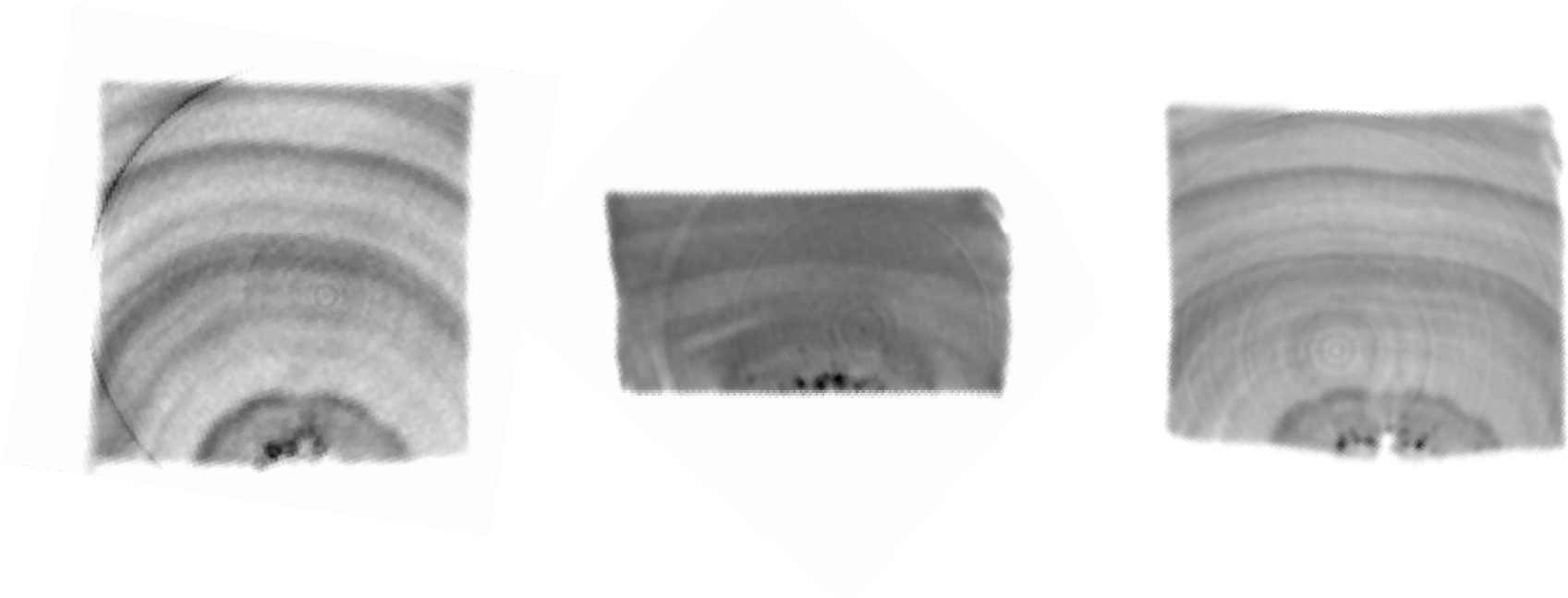
$$\mu = -\frac{1}{d} \log \left(\frac{I_d}{I_0} \right)$$

I_d ... radiation intensity with object
I_0 ... radiation intensity without object
μ ... material-dependent attenuation coefficient
ρ ... density (kg/m^3)
μ / ρ ... mass attenuation coefficient

$$\rho = \frac{-\frac{1}{d} \log \left(\frac{I_d}{I_0} \right)}{\frac{\mu}{\rho}}$$

J. Schreiber 2007

Agro-Wood: CT Aufnahmen



Pappel **50% verdichtet** **nach Rückformung**

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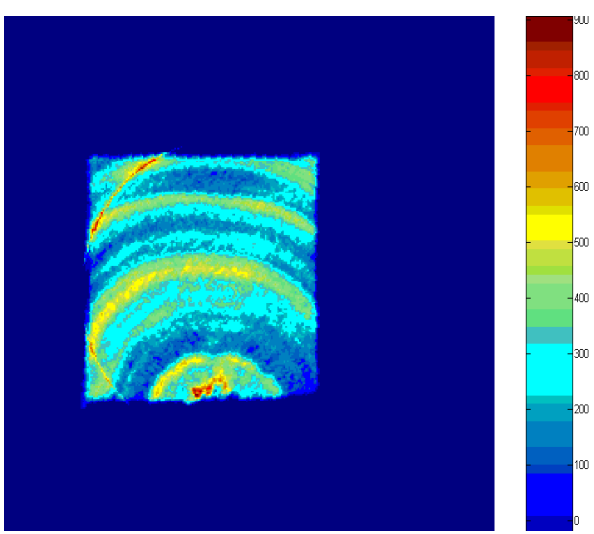
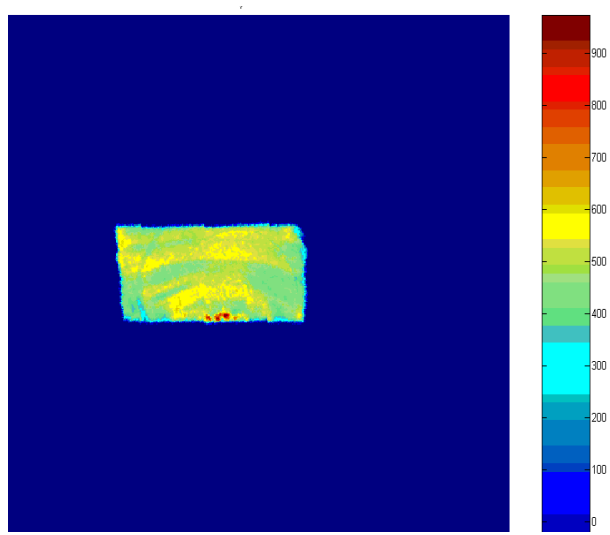
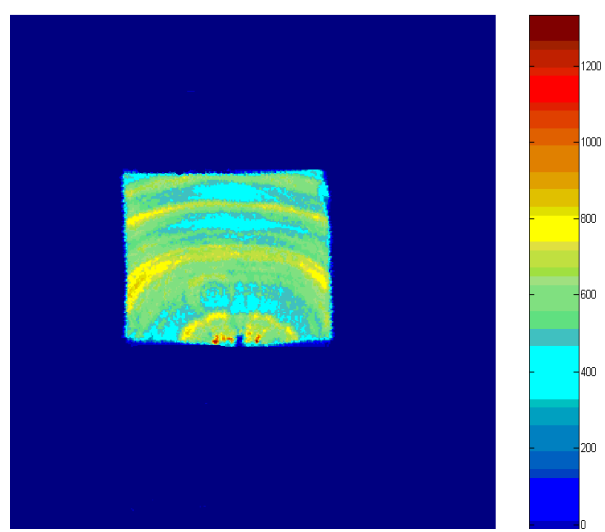
Agro-Wood: Dichteprofile



Pappel

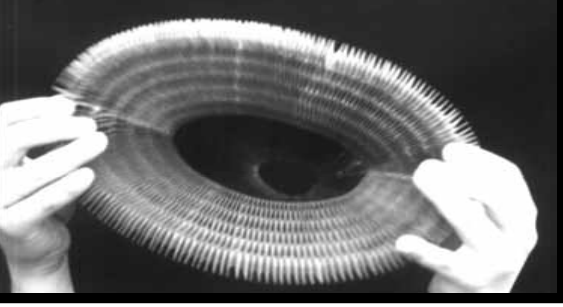


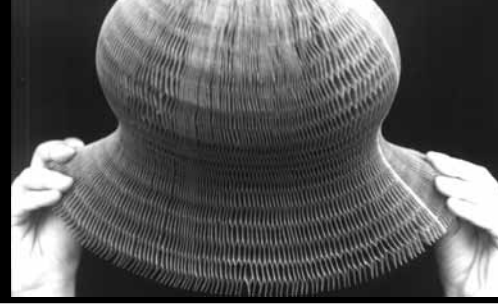
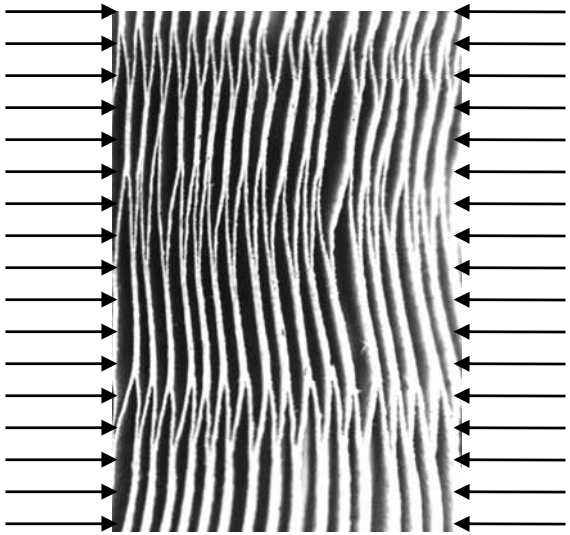
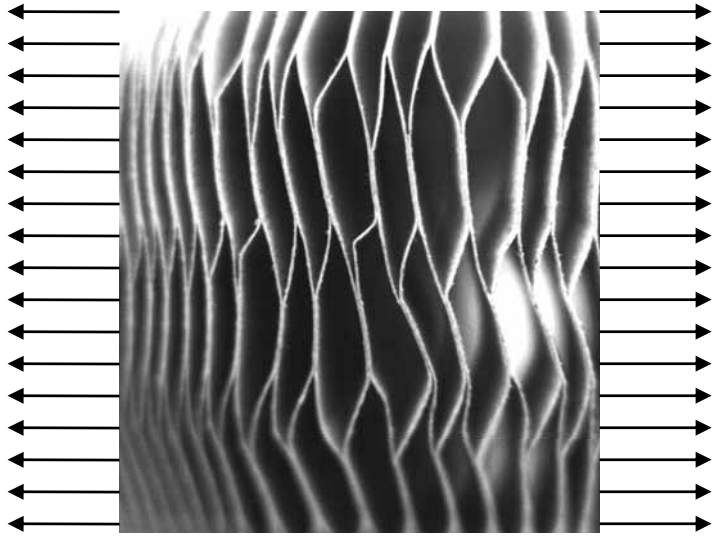
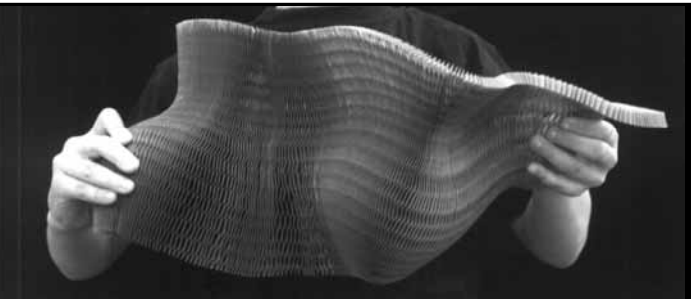
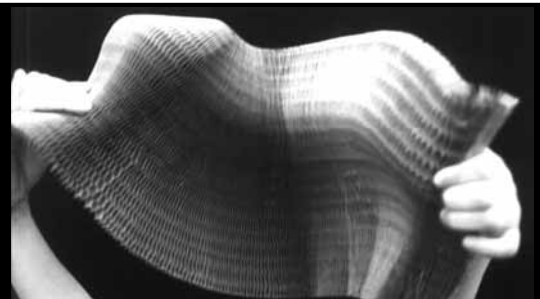
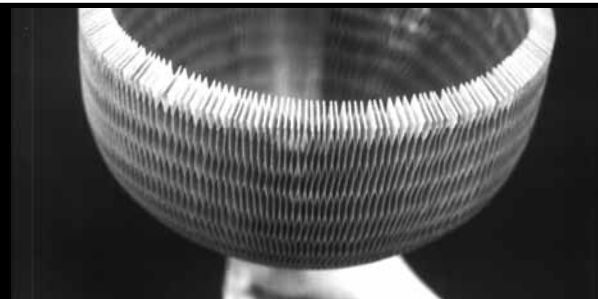
50% verdichtet



nach Rückformung

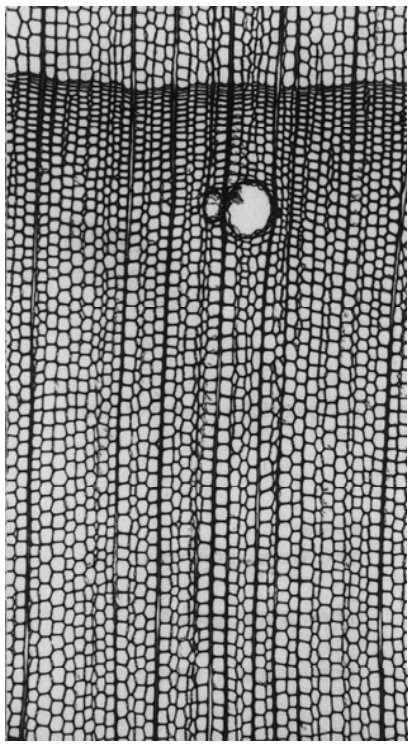
J. Schreiber 2007



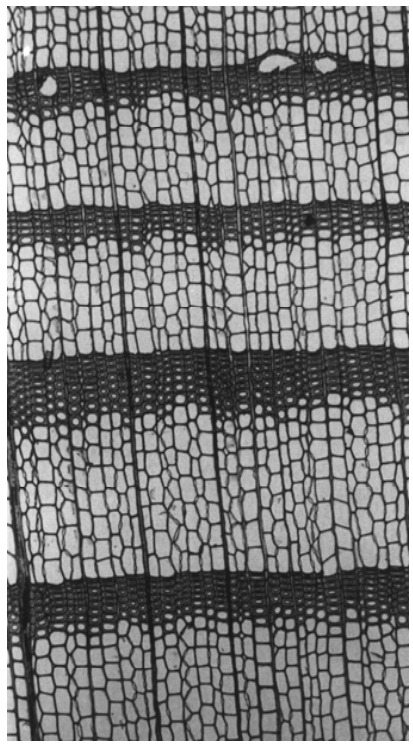







Anatomie heimischer Holzarten

Nadelholz 40x

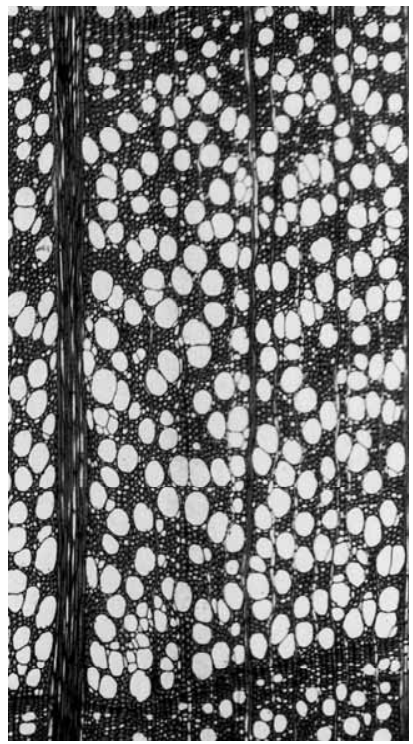


Picea abies

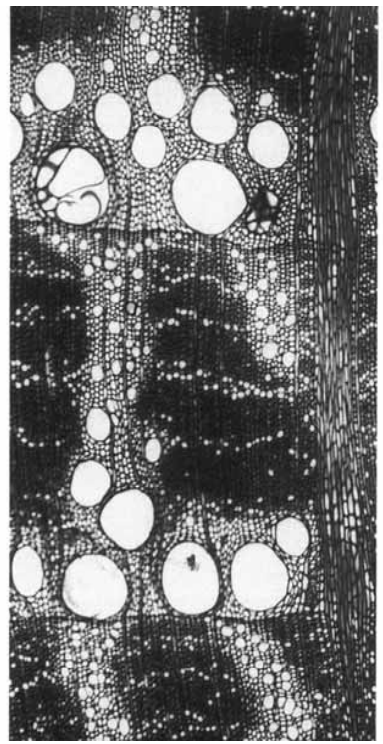


Larix decidua Miller

Laubholz 40x



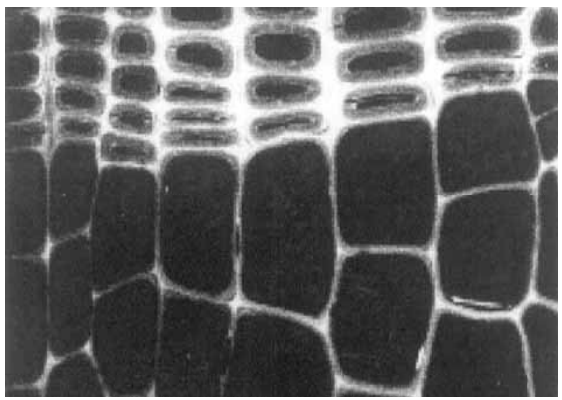
Fagus sylvatica L.

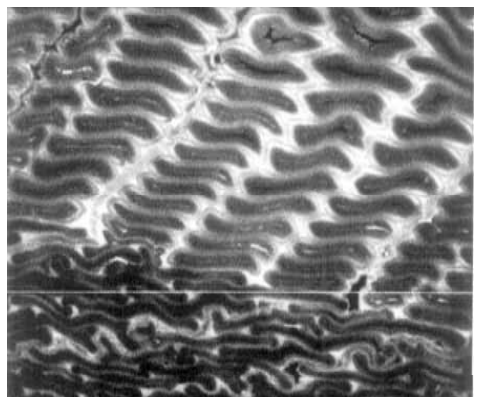


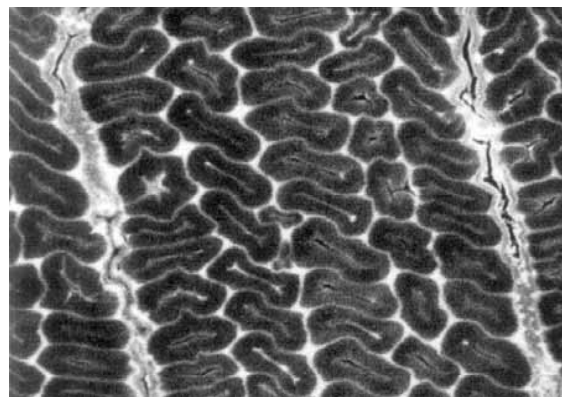
Quercus rubor L.

F. H. Schweingruber, Anatomie europäischer Holzarten, 1990

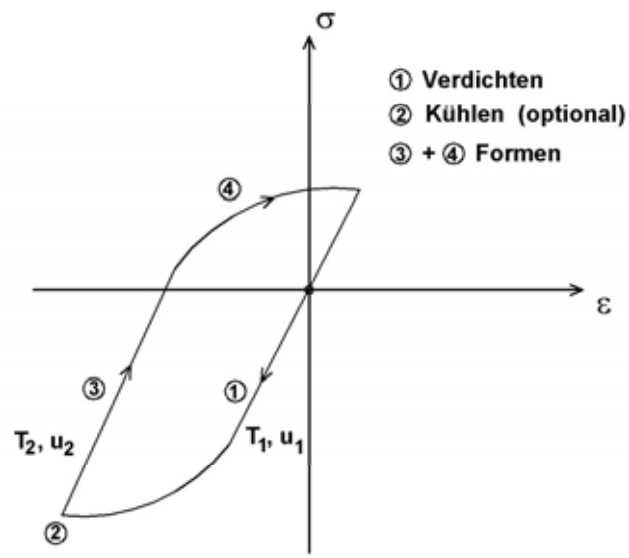
THM - Faltvorgänge des Zellgefüges

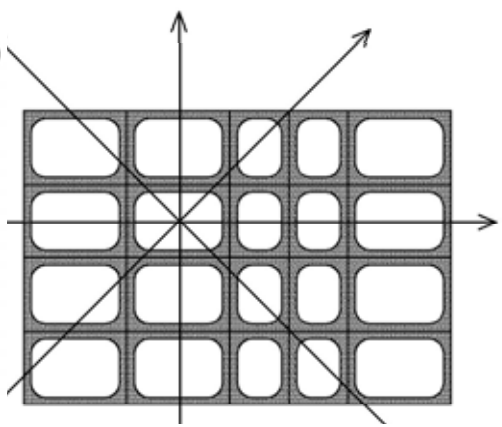




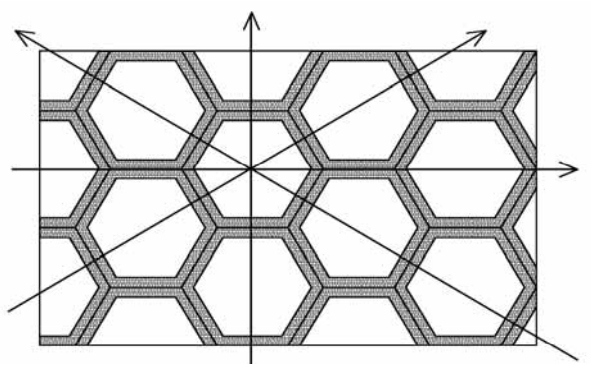


P. Navi, F. Girardet, 2000



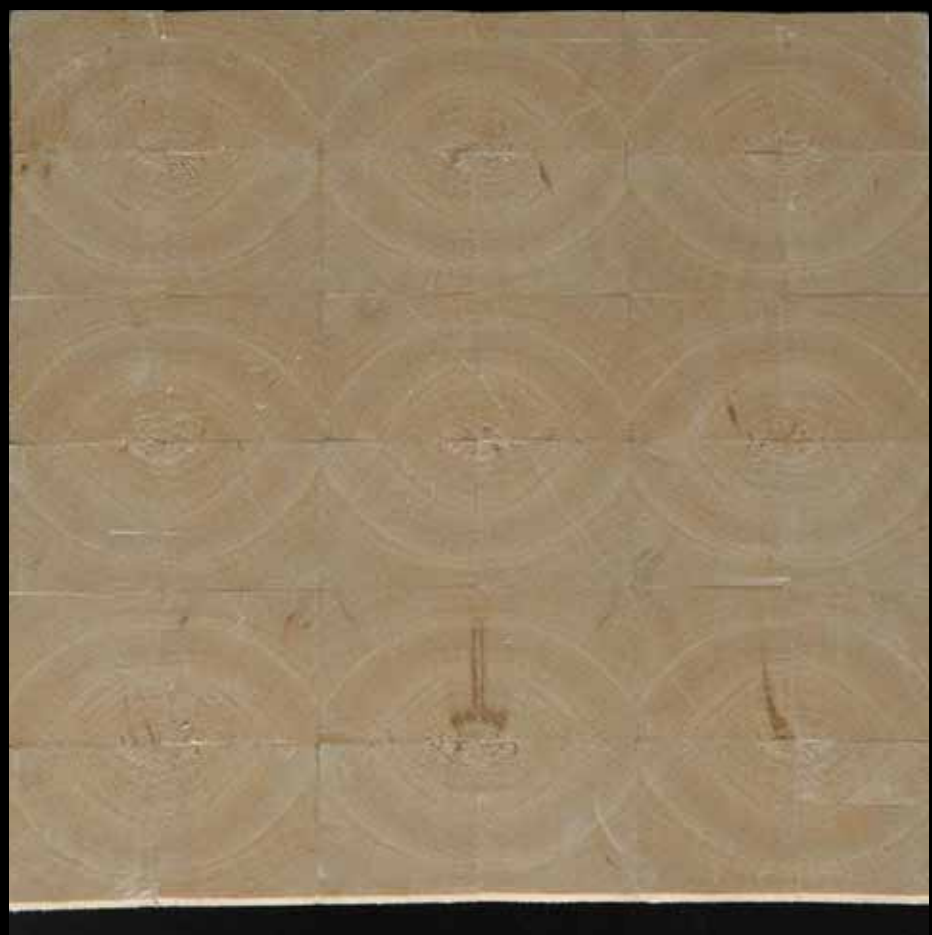


Rechteckstruktur



Wabenstruktur

Biaxial gestauchte Hirnholzplatte



Sphärisch geformte Hirnholzplatte

Hirnholz Pappel, klarlackiert

mit Matronamaserfurnier


Vielen Dank