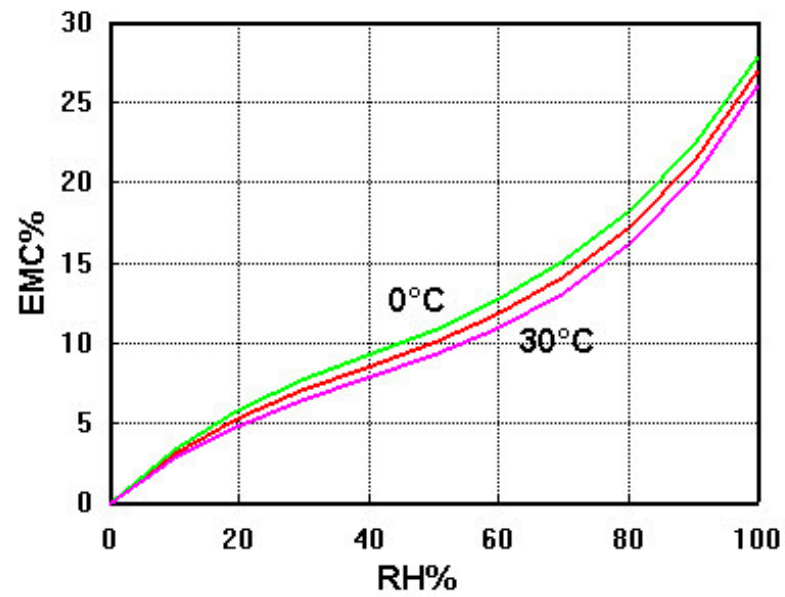
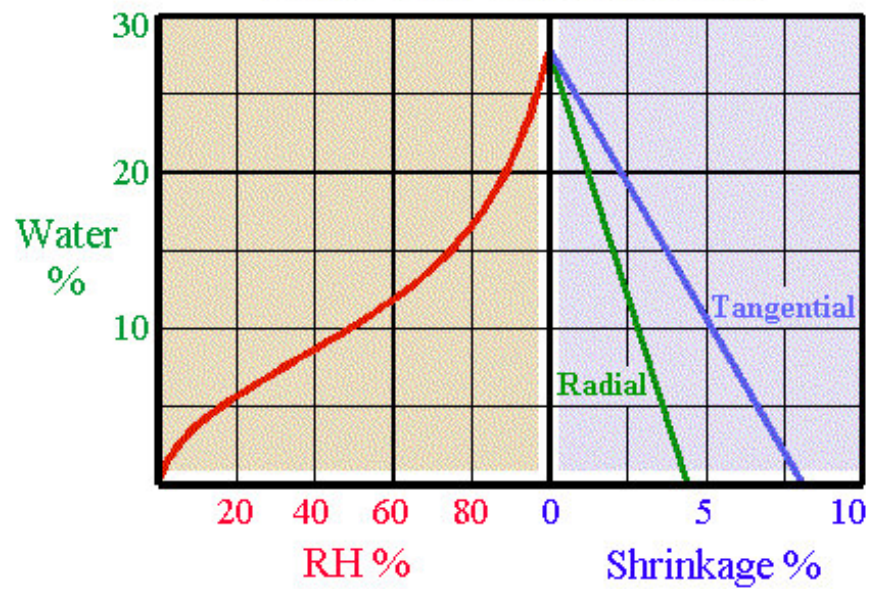


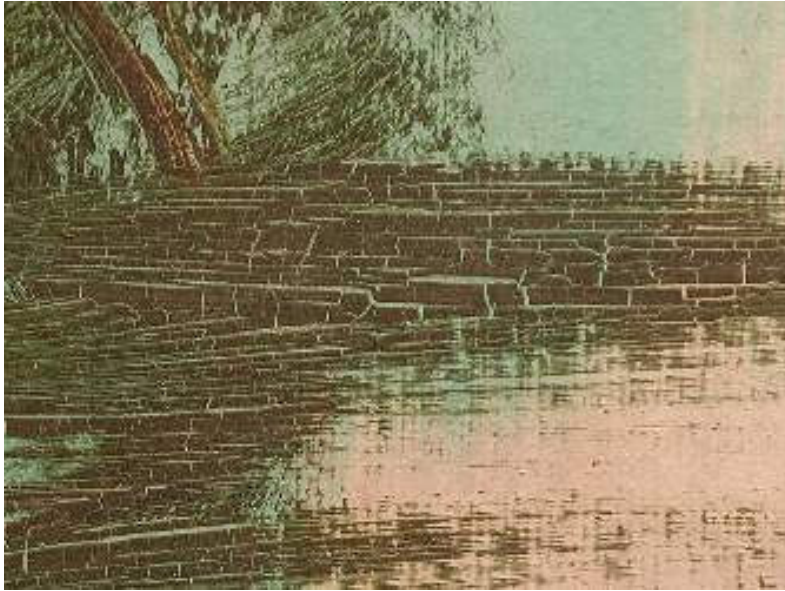
Variazioni dimensionali



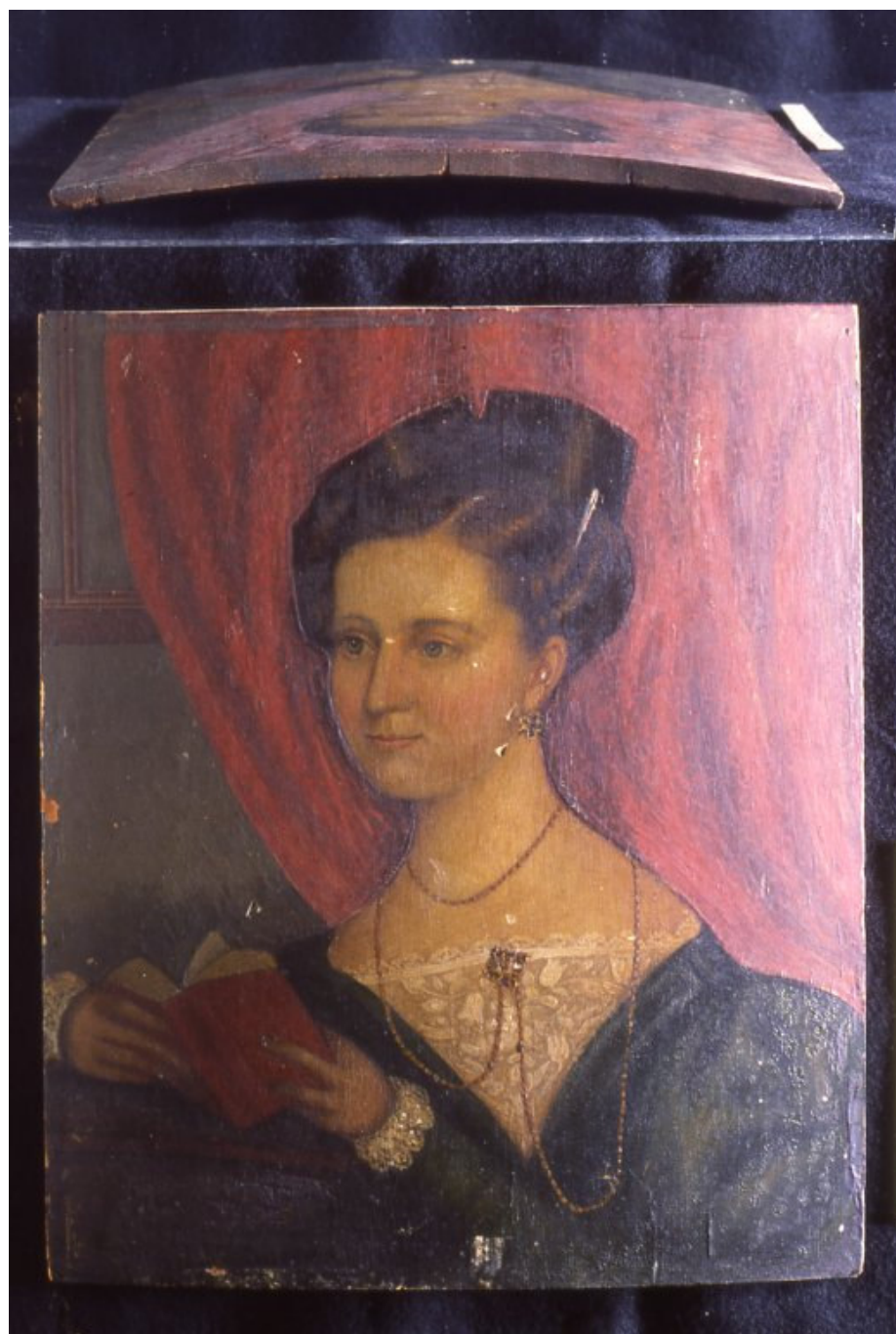


Wood: water content and size

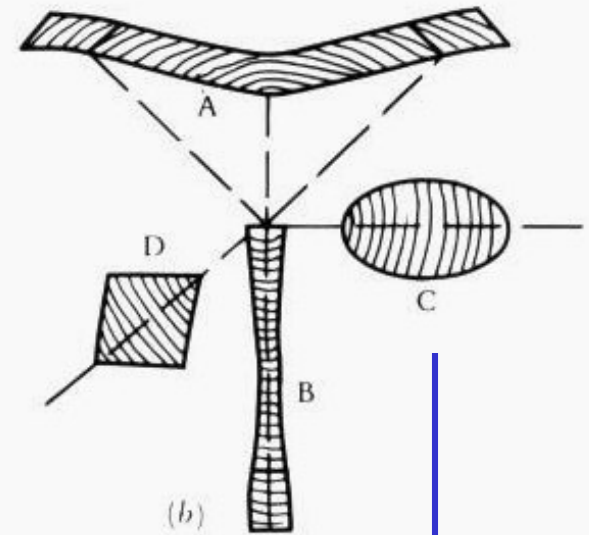
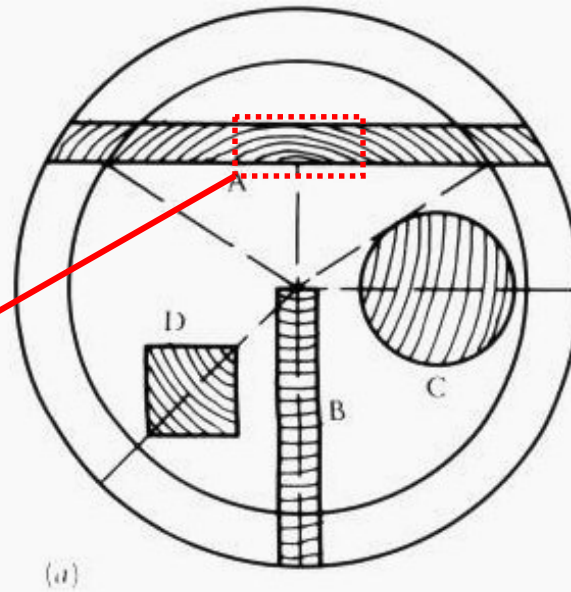








Anisotropic drying of timber after Tiemann⁸⁵. (a) the cross-section of a tree trunk with the inner circle indicating the extent of the heart wood. Because radial contraction is less than tangential, pieces A, B, C and D dry as shown in (b)



legno

analogie:
avorio



analogie:
pergamena

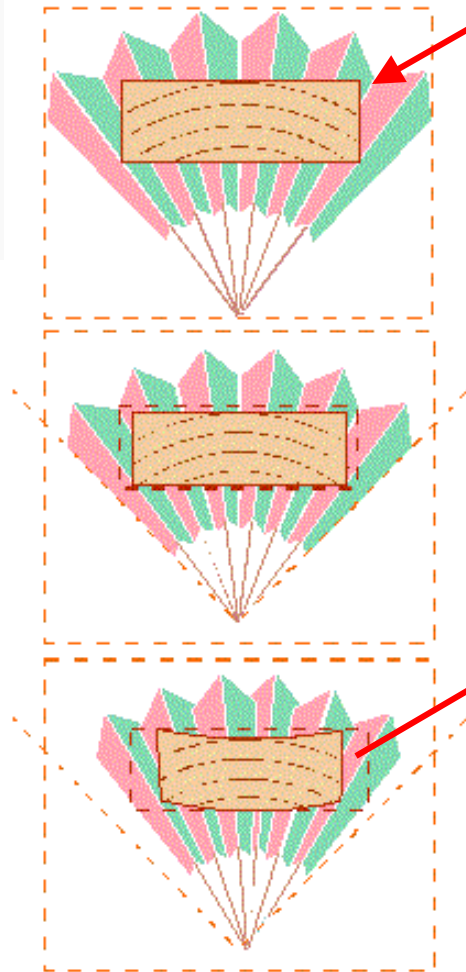
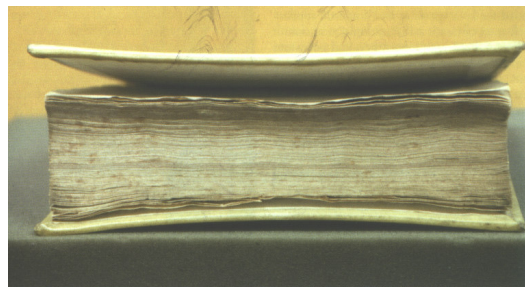


TABLE 33. Wood and Climate

<i>Climate</i>	<i>Examples</i>	<i>Moisture content</i>
<i>Desert</i>	{ Inland north Africa. Arabia Dry south-west U.S.A. }	6%
<i>Cool temperate</i> (rain all seasons, severe winter)	{ North-eastern U.S.A. Inland Europe Central Iran }	8%
<i>Steppe</i>	{ Hyderabad, Pakistan Inland south Africa }	8–10%
<i>Warm temperate:</i>		
Rain all seasons, cool summer	{ U.K., France }	10%
Rain all seasons, hot summer with dry season (winter or summer)	{ South-eastern U.S.A. Spain, Italy North-eastern Iran North-central India }	10–12%
<i>Tropical:</i>		
With dry season	{ South-central India }	14%
Rain all seasons	{ South coastal India Malaysia, Indonesia }	15–18%

Notes

Generally recommended moisture contents for modern furniture and interior decorative wood.

NB. These figures have been compiled from a variety of sources which do not always agree, and so they can only be regarded as approximate. They are *not* made for museums. Since winter heating levels have risen greatly in the present century, the moisture contents quoted for cold climates are too low for antiquities.

TABLE 34. Dimensional Change in Wood

Per cent dimensional change for a 10% RH change in the middle of the range.
(Figures are for 50 to 60% RH.)

	<i>Tangential (%)</i>	<i>Radial (%)</i>
Mahogany (<i>Khaya</i> spp)	0.45	0.30
Chestnut (<i>Castanea sativa</i>)	0.50	0.35
Walnut (<i>Juglans regia</i>)	0.50	0.40
Scots pine (<i>Pinus sylvestris</i>)	0.50	0.40
Poplar (<i>Populus canadensis</i>)	0.60	0.30
Oak (<i>Quercus robur</i>)	0.70	0.40
Birch (<i>Betula pubescens</i>)	0.85	0.65
Beech (<i>Fagus sylvatica</i>)	0.90	0.60

Notes

(Expansion along the grain for a 10% RH change might be about 0.03%).

These figures must be read as very approximate since dimensional change depends on the manner in which the wood has been dried, and also on where in the tree the wood is taken from. They are estimated from shrinkage from the green condition⁸⁵ taking into account the average moisture/RH relation (Stevens²⁷⁶).

Variazione dimensionale:
(o *igroespansione relativa*)

$$\varepsilon_h = \frac{\Delta L}{L_0}$$

Per un ampio intervallo di valori, la dipendenza di ε_h da ΔU_{CA} è approssimativamente lineare, con un coefficiente di proporzionalità β detto *igroespansività*

$$\varepsilon_h = \frac{\Delta L}{L_0} = \beta \Delta U_{CA}$$



Igroespansività

$$\beta = \frac{\Delta L / L_0}{\Delta U_{CA}}$$

NOTE

1. L_0 è la lunghezza al valore centrale di ΔU_{CA}

2. Unità di misura $\{\epsilon_h\} = \%$ $\{\beta\} = 1$

3. Analogia tra *termoespansione* e *igroespansione*
$$\Delta L = \alpha L_0 \Delta T \qquad \Delta L = \beta L_0 \Delta U_{CA}$$

Talvolta la variazione dimensionale, invece che al contenuto d'acqua (caratteristico del materiale) è messa direttamente in relazione all'umidità relativa (caratteristica dell'ambiente)

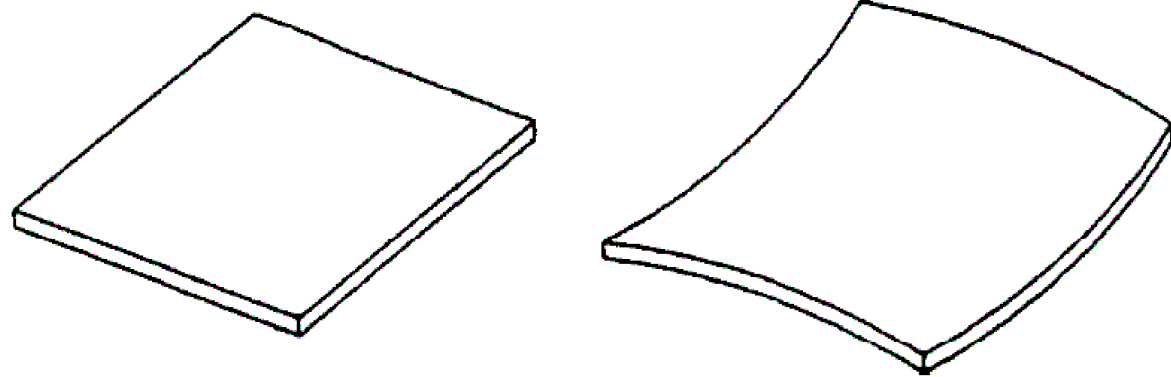
$$\varepsilon_h = \frac{\Delta L}{L_0} = X \Delta UR \quad \longrightarrow \quad X = \frac{\Delta L / L_0}{\Delta UR}$$

- L_0 è la lunghezza al valore centrale di ΔUR
- In realtà, nella relazione che lega ε_h alle variazioni di UR si riflette la non linearità e l'isteresi che caratterizzano la dipendenza funzionale di U_{CA} dall'umidità relativa (diagramma *EMC*) e la “igroespansività X per ΔUR ” risulta meglio definita localmente da

$$X = \frac{1}{L_0} \frac{dL}{dUR}$$

carta

Moisture induced paper swelling



Fibra

variazione dimensionale

espansione delle fibre di cellulosa
a T_{amb} per $UR=0\% \rightarrow 100\%$
 $\rightarrow \Delta U_{CA}=20\%$

$$(\epsilon_h)^*_{\parallel} = (\Delta\lambda/\lambda_0)_{\parallel} = 1\%$$

$$(\epsilon_h)^*_{\perp} = (\Delta\lambda/\lambda_0)_{\perp} = 20\%$$

Foglio

variazione dimensionale igroespansività

corrispondente espansione del
foglio a T_{amb} per $UR=0\% \rightarrow 100\%$
 $\rightarrow \Delta U_{CA}=20\%$

$$(\epsilon_h)_{\parallel} = (\Delta L/L_0)_{\parallel} = 0.6\%$$

$$(\epsilon_h)_{\perp} = (\Delta L/L_0)_{\perp} = 3.0\%$$

$$\beta_{\parallel} = 0.02 \rightarrow 0.03$$

$$\beta_{\perp} = 0.1 \rightarrow 0.15$$