Wood as a Construction Material

Matthew White for Carl Mills

PubWood Project

Erasmus+

PUB-WOOD

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Wood

What we will cover

- Growing and Structure
- Fire performance
- Grading
- Recycling

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Growing

- Most commercially available timber in the UK is grown in plantations – timber is “farmed” like any other crop
- Timber can be classified as either hardwood or softwood
- Not all softwoods are soft
- Not all hardwoods are hard

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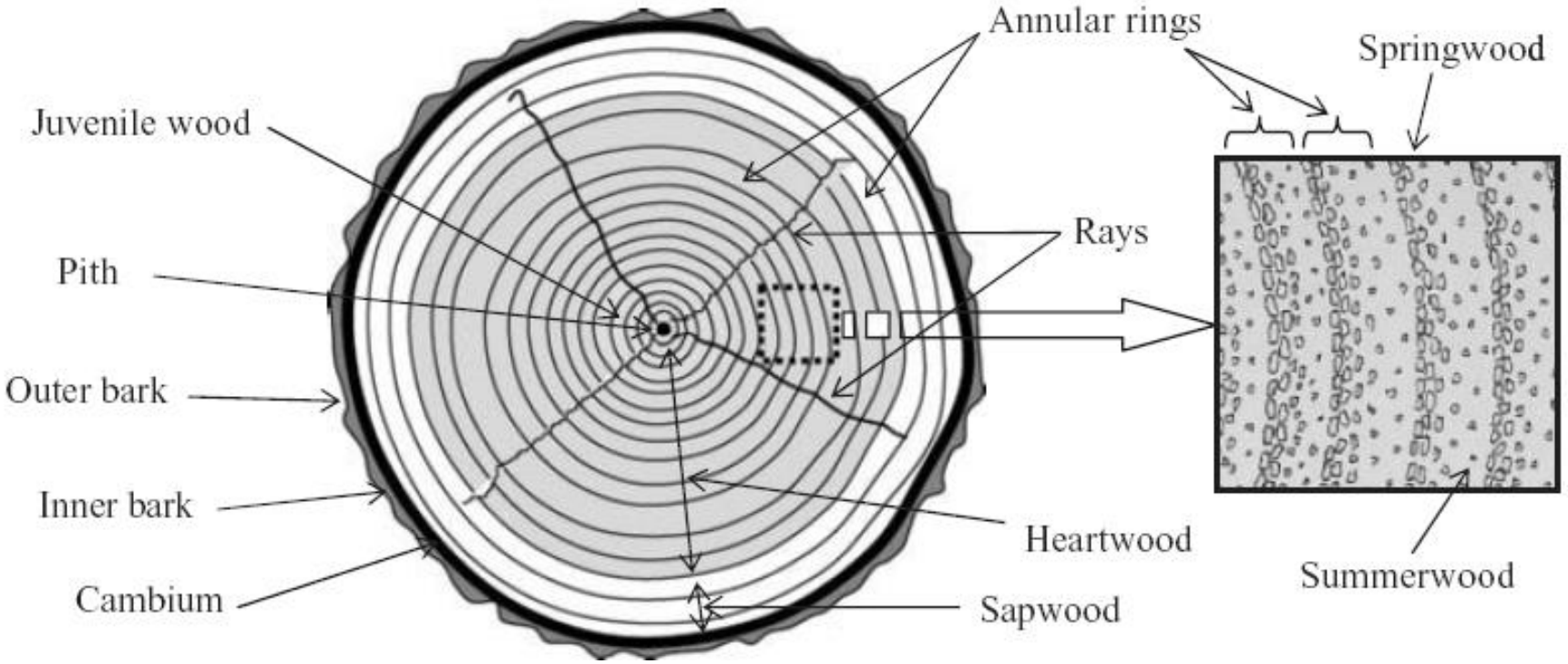
Cross-section of a tree trunk



Source: J. Porteous & A. Kermani *Structural Timber Design to Eurocode 5*

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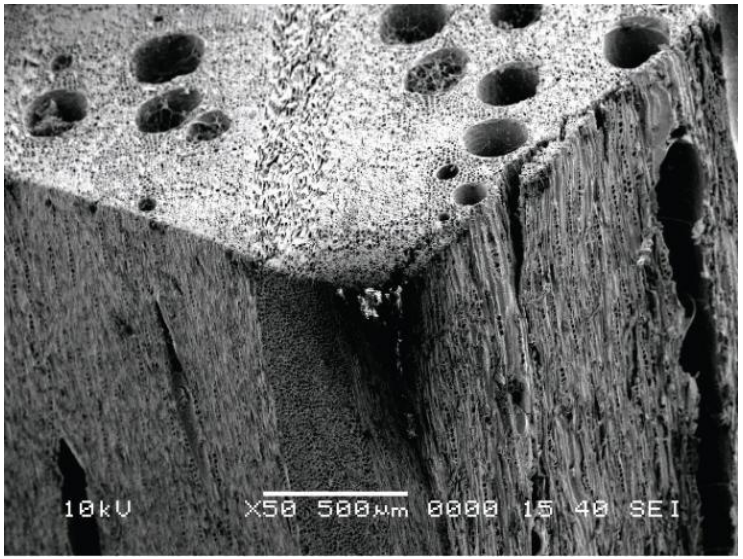
Hardwood

- Usually broad-leafed
- Mostly *deciduous* in temperate and boreal climates,
- Mostly *evergreens* in the tropics and subtropics
- A lot more diverse than softwood (100x)
- More complex at microscopic level
- Examples: Oak, Chestnut, Teak, Balsa, Greenheart
- Some species are very durable



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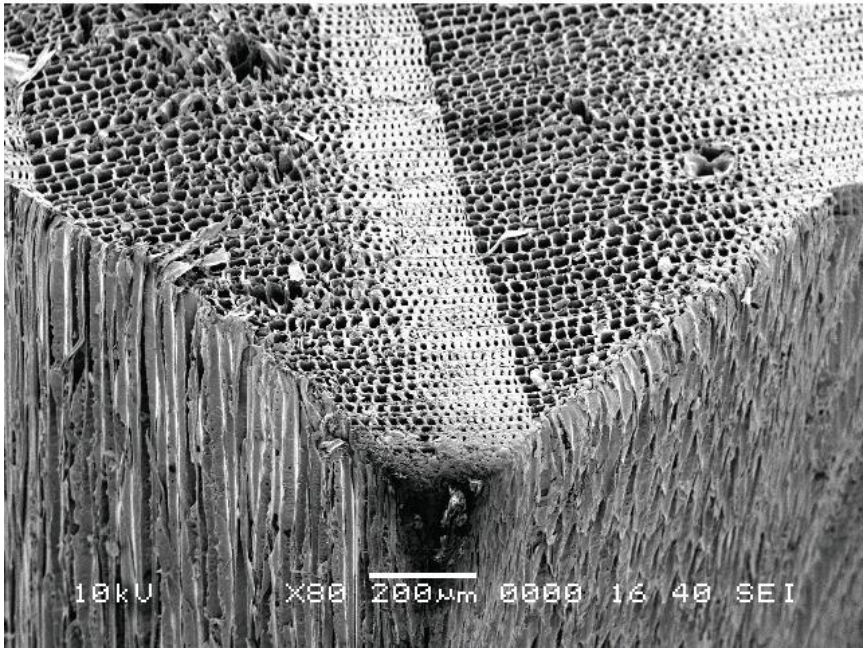
Softwood

- Primarily from coniferous trees
- Mostly evergreens
- Constitute the bulk of forestry trade
- Examples: Spruce, Yew, Firs, Pines, Larch
- Some hardwoods are not very strong e.g. Balsa
- Some softwoods are very strong e.g. Yew
- But at equal density hardwoods are stronger



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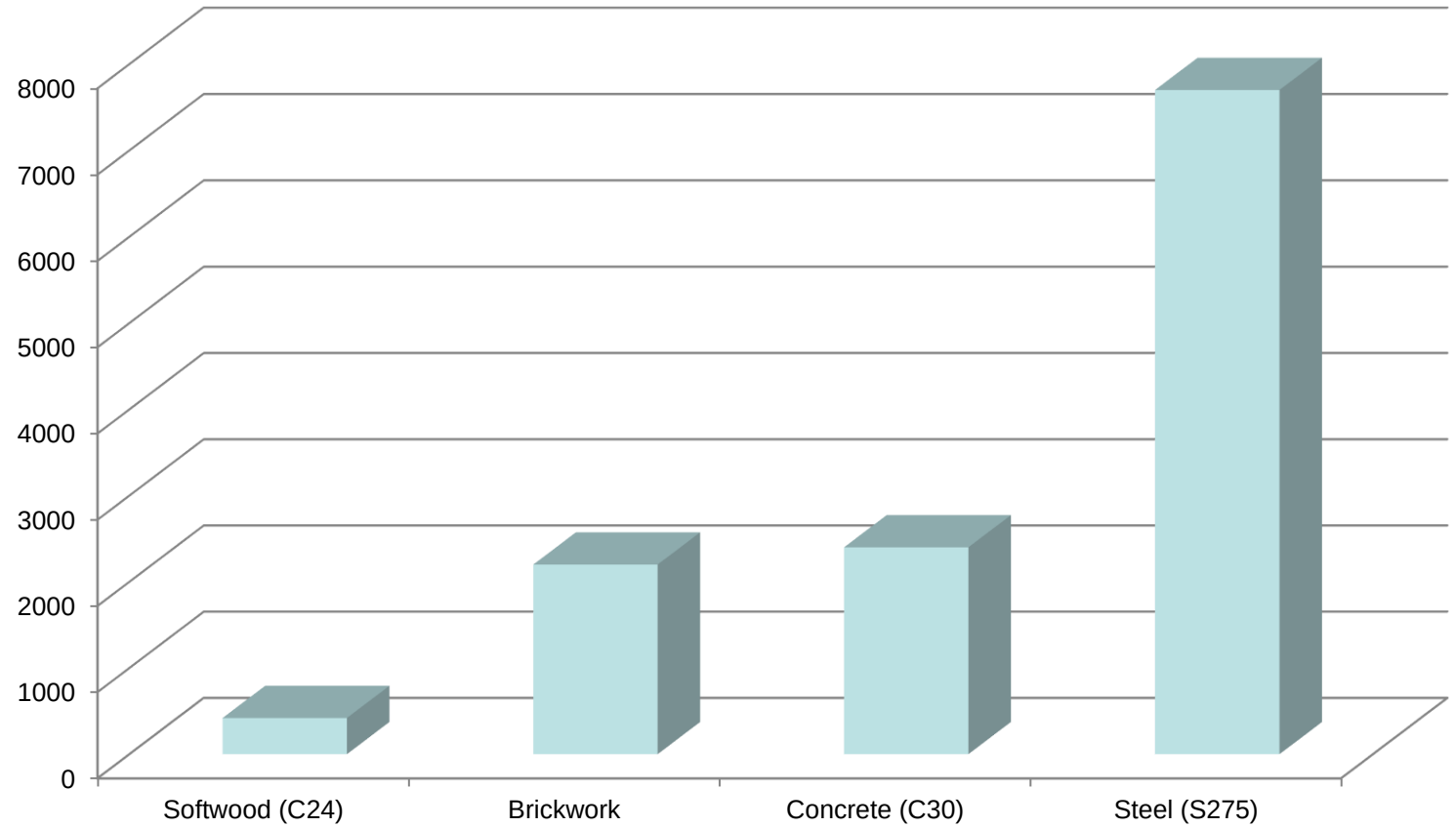
Density


Density - kg/m3
8000
7000
6000
5000
4000
3000
2000
1000
0
Softwood (C24)
Brickwork
Concrete (C30)
Steel (S275)

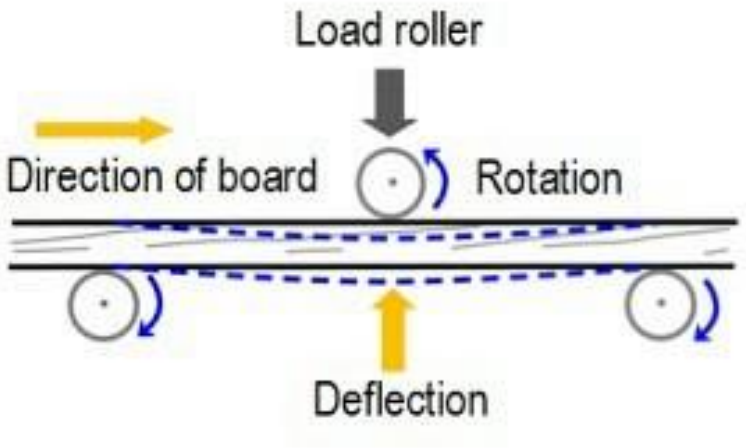
Fire

- Timber is combustible
- Timber is not readily ignited (surface temps >400°C without flame and >300°C in the presence of a flame
- Timber burns at a slow predictable rate (charring rate).
- Timber is a poor conductor of heat: no damage by thermal expansion
- Timber at the heart of the section is unaffected.
- Loss of strength results as a loss of cross-section.
- Combustibility depends on surface/volume-ratio (many small pieces burn faster than one large section)
- Combustibility depends on density
- Timber spreads flame

Behaviour in Fire

Timber grading

- Most construction timber is strength graded
- This is done mechanically



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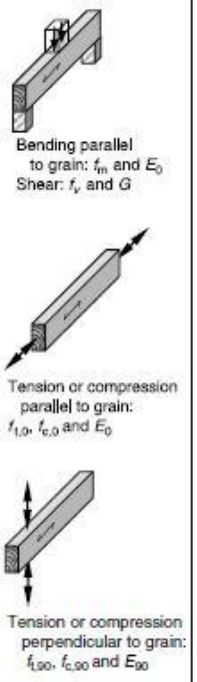
Timber grades

	Strength class	Characteristic strength properties (N/mm²)						Stiffness properties (kN/mm²)				Density (kg/m³)	
		Bending	Tension 0	Tension 90	Compression 0	Compression 90	Shear	Mean modulus of elasticity 0	5% modulus of elasticity 0	Mean modulus of elasticity 90	Mean shear modulus	Density	Mean density
		($f_{m,k}$)	($f_{t,0,k}$)	($f_{t,90,k}$)	($f_{c,0,k}$)	($f_{c,90,k}$)	($f_{v,k}$)	($E_{0,mean}$)	($E_{0.05}$)	($E_{90,mean}$)	(G_{mean})	(ρ_k)	(ρ_{mean})
Softwood and poplar species	C14	14	8	0.4	16	2.0	3.0	7.0	4.7	0.23	0.44	290	350
	C16	16	10	0.4	17	2.2	3.2	8.0	5.4	0.27	0.50	310	370
	C18	18	11	0.4	18	2.2	3.4	9.0	6.0	0.30	0.56	320	380
	C20	20	12	0.4	19	2.3	3.6	9.5	6.4	0.32	0.59	330	390
	C22	22	13	0.4	20	2.4	3.8	10.0	6.7	0.33	0.63	340	410
	C24	24	14	0.4	21	2.5	4.0	11.0	7.4	0.37	0.69	350	420
	C27	27	16	0.4	22	2.6	4.0	11.5	7.7	0.38	0.72	370	450
	C30	30	18	0.4	23	2.7	4.0	12.0	8.0	0.40	0.75	380	460
	C35	35	21	0.4	25	2.8	4.0	13.0	8.7	0.43	0.81	400	480
	C40	40	24	0.4	26	2.9	4.0	14.0	9.4	0.47	0.88	420	500
	C45	45	27	0.4	27	3.1	4.0	15.0	10.0	0.50	0.94	440	520
	C50	50	30	0.4	29	3.2	4.0	16.0	10.7	0.53	1.00	460	550
Hardwood species	D18	18	11	0.6	18	7.5	3.4	9.5	8.0	0.63	0.59	475	570
	D24	24	14	0.6	21	7.8	4.0	10.0	8.5	0.67	0.62	485	580
	D30	30	18	0.6	23	8.0	4.0	11.0	9.2	0.73	0.69	530	640
	D35	35	21	0.6	25	8.1	4.0	12.0	10.1	0.80	0.75	540	650
	D40	40	24	0.6	26	8.3	4.0	13.0	10.9	0.86	0.81	550	660
	D50	50	30	0.6	29	9.3	4.0	14.0	11.8	0.93	0.88	620	750
	D60	60	36	0.6	32	10.5	4.5	17.0	14.3	1.13	1.06	700	840
	D70	70	42	0.6	34	13.5	5.0	20.0	16.8	1.33	1.25	900	080



Subscripts used are: 0, direction parallel to grain; 90, direction perpendicular to grain; m, bending; t, tension; c, compression; v, shear; k, characteristic.

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Durability

- Wood as a natural resource is destined to biodegrade
- Therefore it has limited durability
- Species have different natural
- Appropriate design and maintenance can make timber structures last for centuries.
- Preservation can increase the useful life of timber
- NB. Some species are easier to treat than others.
- Durability by design – detailing that keeps timber dry, drained and ventilated

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Durability

- Ensure timber is kept drained and well ventilated.

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Timber Buildings

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Timber recycling

- Timber can be recycled
- Recycled timber products include
  - OSB board
  - Chipboard
  - Wood fuel

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Any Questions?

Thank you for listening

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