Green Kerfing for Improvements in Drying and Future Utilization

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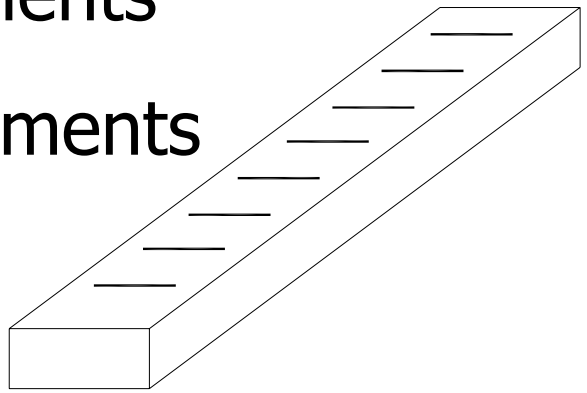
What's the problem?

- **Unsatisfactory drying**
  - Pieces inadequately dried
  - Pieces that are over-dried
- **Too much warp**
  - Crook, Bow and Twist
  - How crook is sometimes "corrected"
    - ✓ The cross-cutting approach
    - ✓ The hand-held planer approach
    - ✓ The "remove and replace" approach

- **Economic cost**
  - 600 million Euros lost to warp
  - Importance of straightness to builders
  - Solid lumber lost to alternatives of higher cost and energy requirements
- **Customer satisfaction**
  - Contractors wary of solid lumber
  - Do-it-yourselfers unhappiness
  - The mold problem
  - Improved preservative treatments?

Is there any solution?

- **Taking advantage of parallel- to-grain moisture movement**
  - End-grain drying is rapid
  - However, small area available
- **Possible warp benefits?**
  - Based on alteration of MC gradients
  - Breaking parallel grain into segments

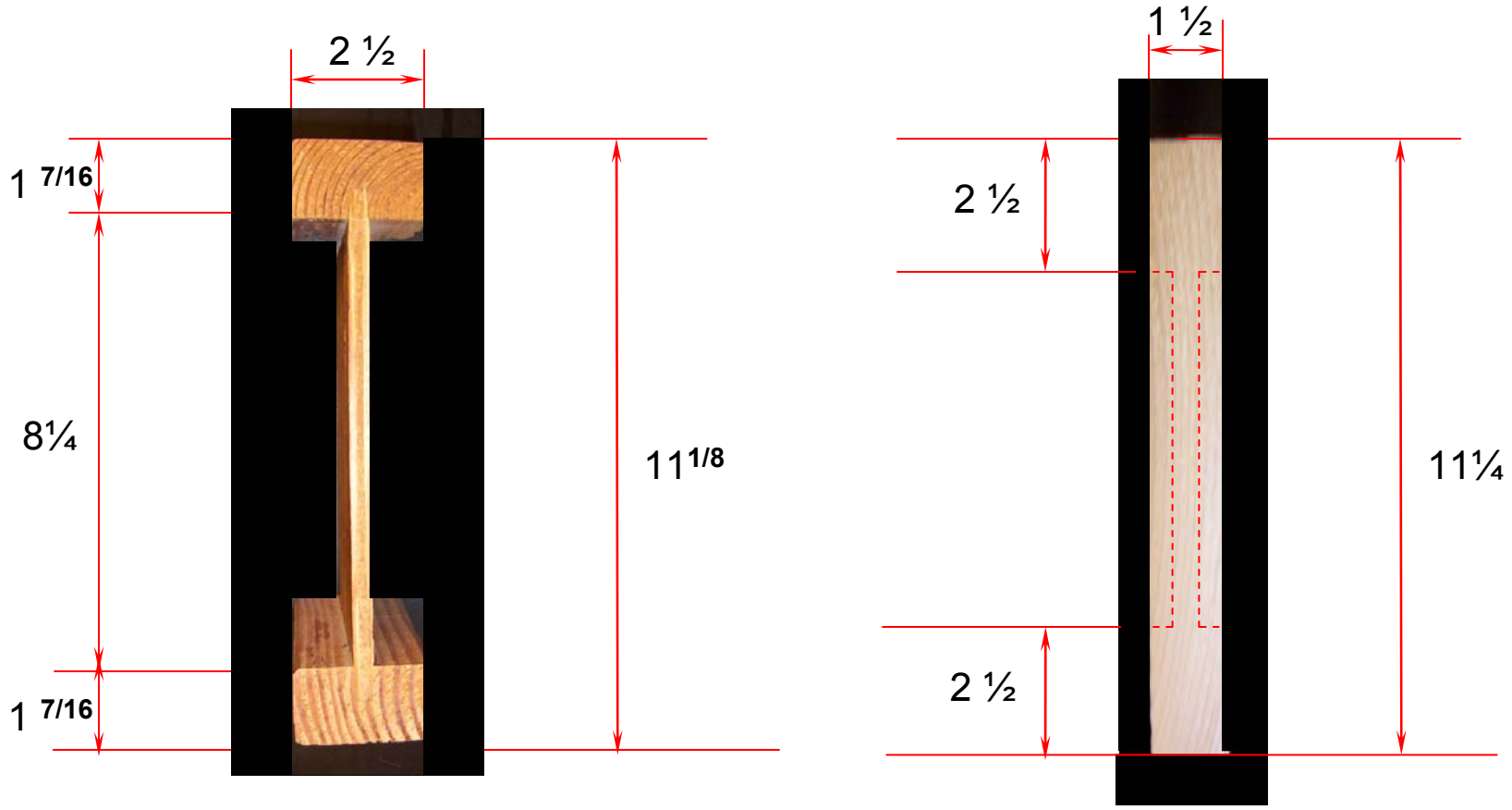


Our approach

- **Creating end grain**
  - Saw kerfs perpendicular-to-grain on wide surfaces

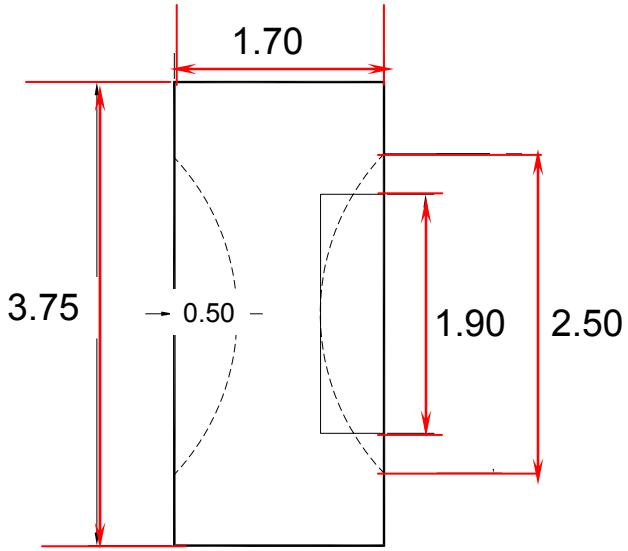
The magic of the I-joist

- The I-joist and the 2 by 12 have equal I values
- If kerfed as shown, the I value is 90% of that for the solid cross section. $I_k \div I_s = 0.90$



I value for a green 2 by 4

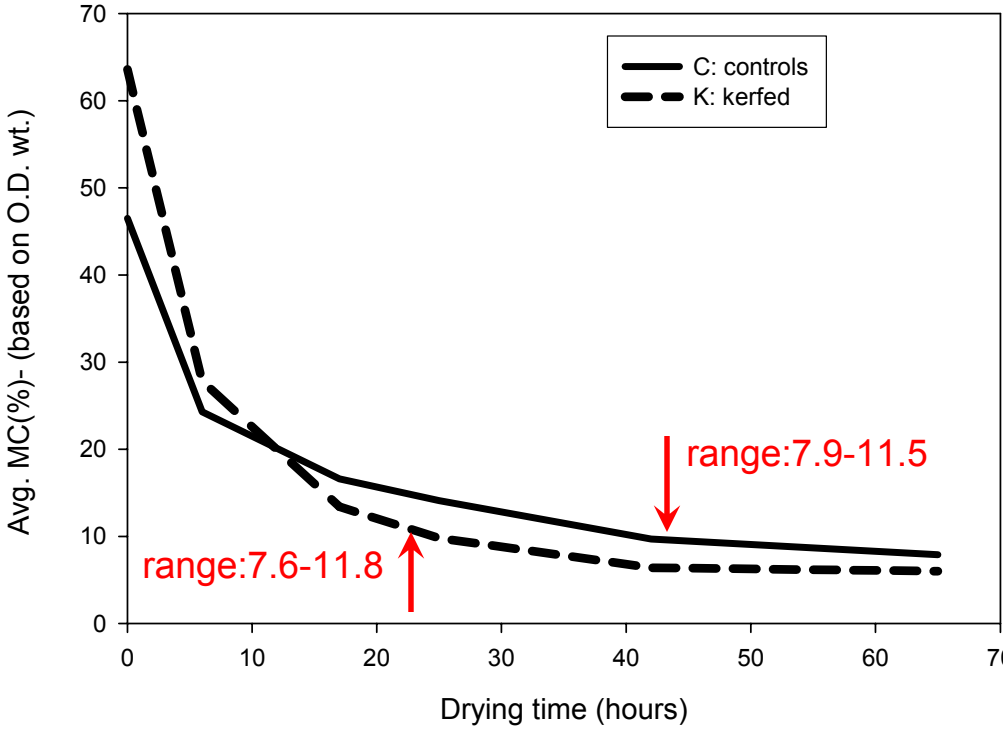
- The sketch illustrates the effect of kerfing in the green condition on the I value of the nominal 2 by 4.
- The ratio of I_k to I_s is 0.92.
- The small reduction in I value, especially in the context of stud grade, is a small price to pay for the possible improved drying.




POLICE STATION
TOILET STOLEN
COPS HAVE NOTHING
TO GO ON

Some drying results

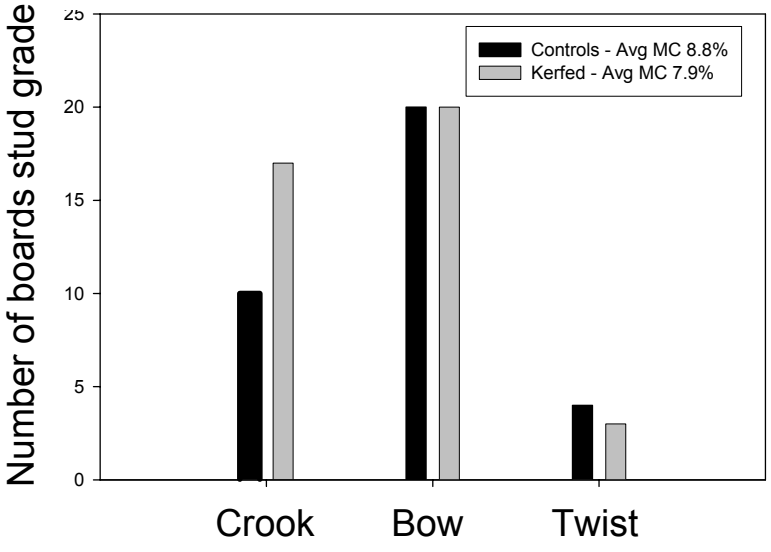
- 40 boards-20 controls and 20 kerfed-100” long.
- Dried at 190°F dbt, 174°F wbt and 800 fpm.
- 16 full-length kiln samples-8 of each treatment.

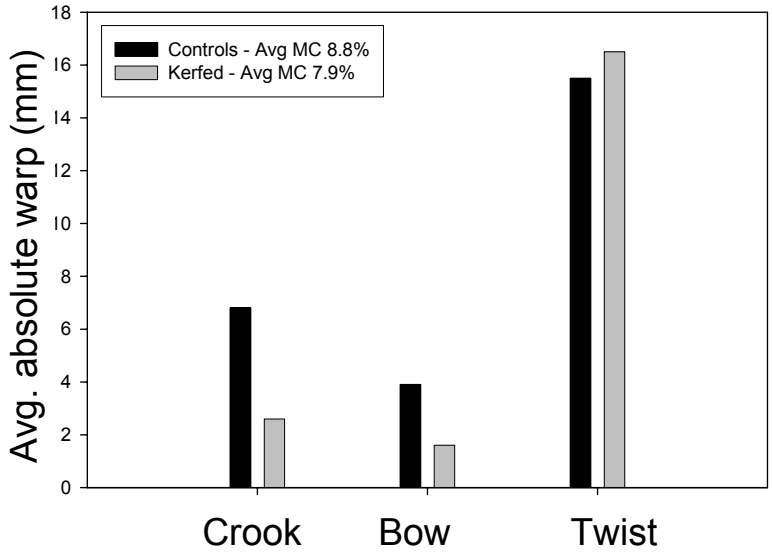


- 10% average MC for the kerfed in 22 hours but for controls 41hours
- At 10% average MC the ranges were comparable

Some warp results

- Warp data: MC's of~8% for kerfed, 9% for controls
  - Crook and bow reduced over 50% by kerfing.
  - Twist, in the absence of restraint, severe for both.
  - Stud grade recovery, based on crook much higher for kerfed.





Strength values in bending

- Testing after 50-day "equalization" and in accordance with ASTM-D 1037-99.
  - Mean Peak load for kerfed 95% of control's.
  - Mean MOE 15% higher for kerfed.
  - Peak load mean deflection for kerfed 75% of that for controls.

Data from edgewise bending, 82" clear span & concentrated load at mid-span

		Peak Load (lb)	Load at PL (lb)	Deflec. at PL (in)	Deflec at Peak Load (in)	MOR (ksi)	Stress at PL (ksi)	MOE (ksi)
20 K	Mean	708.6	334.9	0.75	1.61	4.7	2.2	949
	Range	143-1295	119-557	0.41-1.21	0.70-2.94	0.9-8.7	0.8-3.7	427-1381
20 C	Mean	744.6	353.5	0.92	2.16	4.9	2.4	8.23
	Range	409-1228	166-732	0.53-1.56	1.74-3.64	2.7-8.2	1.1-4.9	503-1200

Table 4-11 Wood Handbook, 1987

Table 4–11—*Approximate middle trend effects of moisture content on mechanical properties of clear wood at about 20 °C*

Property	Relative change in property from 12 percent moisture content	
	At 6 percent moisture content	At 20 percent moisture content
	Percent	
Modulus of elasticity parallel to the grain	+9	−13
Modulus of elasticity perpendicular to the grain	+20	−23
Shear modulus	+20	−20
Bending strength	+30	−25
Tensile strength parallel to the grain	+8	−15
Compressive strength parallel to the grain	+35	−35
Shear strength parallel to the grain	+18	−18
Tensile strength perpendicular to the grain	+12	−20
Compressive strength perpendicular to the grain at the proportional limit	+30	−30

Wood as an Engineering Material. USDA Forest Products Lab. Agr. Hdbk. 72

Some MC and SG data

- Kerfing improved average, shell and core, and range of MC. Mean SG for kerfed 96% of that for controls. If due to a real effect, it suggests less shrinkage for kerfed boards.

Percent MC and SG immediately after strength testing

	Avg.MC by meter [1]	Avg. MC by OD	Avg. shell MC by OD	Range of shell MC	Avg. core MC by OD	Range of core MC's	Avg. SG [2]	Range of SG
Kerfed	9.0	9.7	9.0	8.2-9.5	9.9	9.2-10.6	0.39	0.35-0.47
Controls	9.7	10.2	9.7	9.2-10.6	10.5	9.5-11.7	0.41	0.35-0.52

[1] Obtained by resistance type meter just prior to strength testing

[2] Based on ovendry weight and ovendry volume

Conclusions

- Kerfing of 6” spacing reduced drying time to 10% average MC by over 45%.
- The kerfing reduced the absolute amounts of crook and bow by over 50%.
- Stud grade recovery, based on crook was 50% for controls and 85% for kerfed.
- Twist, in the unrestrained drying, was not reduced by kerfing.
- Lower and more uniform final MCs yielded higher MOE for kerfed boards.
- Warp reductions by kerfing were permanent.

Thanks for listening!

Any questions?

US Patent Pending