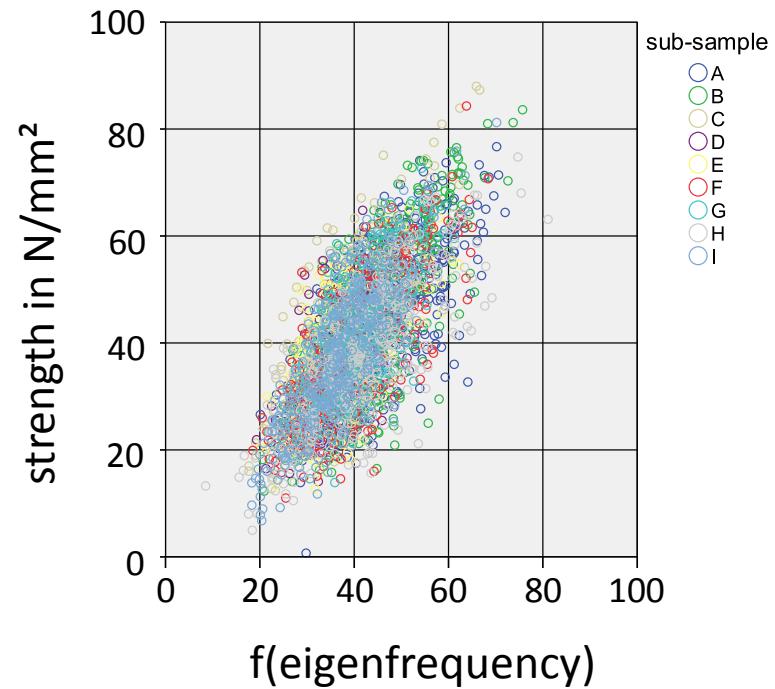
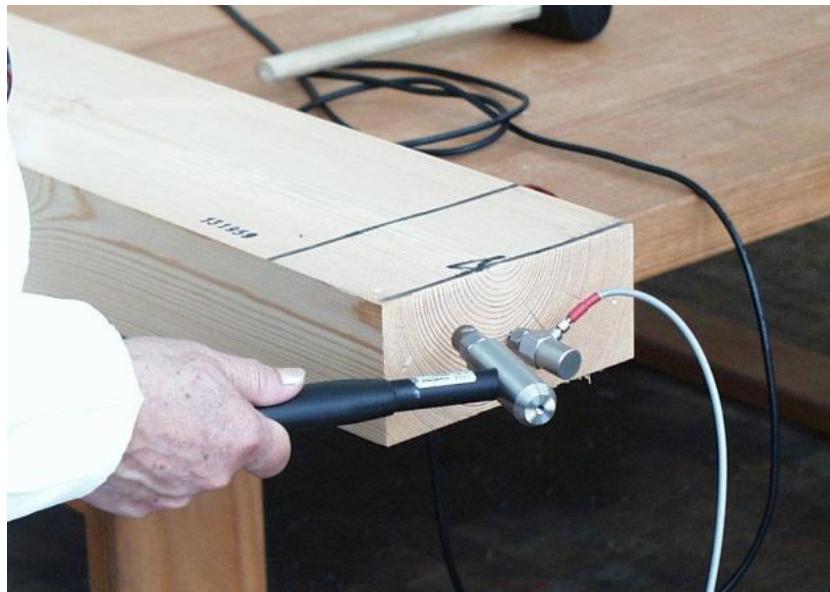
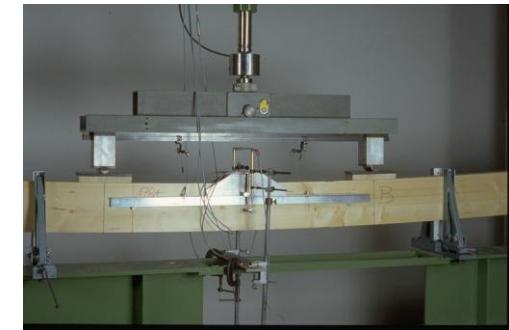
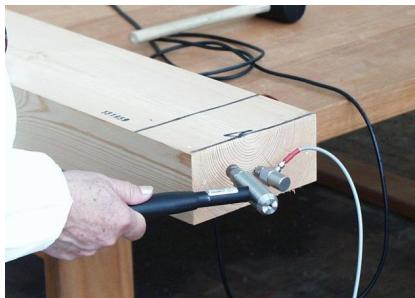


Influence of local strength determining defects on grading machine settings based on dynamic measurements

Andreas Rais
Peter Stapel
Jan-Willem G. van de Kuilen

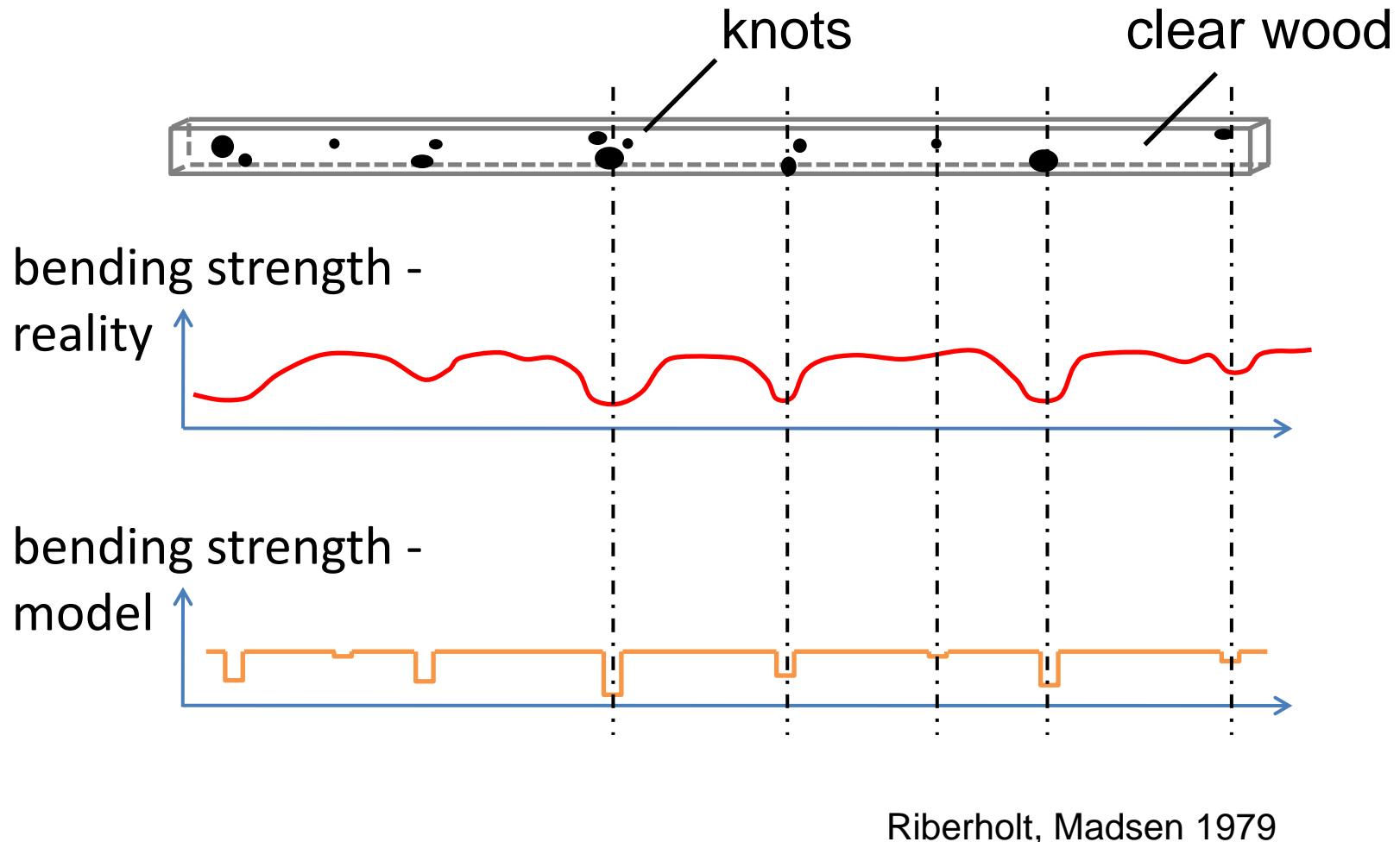
Sopron, Hungary, September 15th 2011





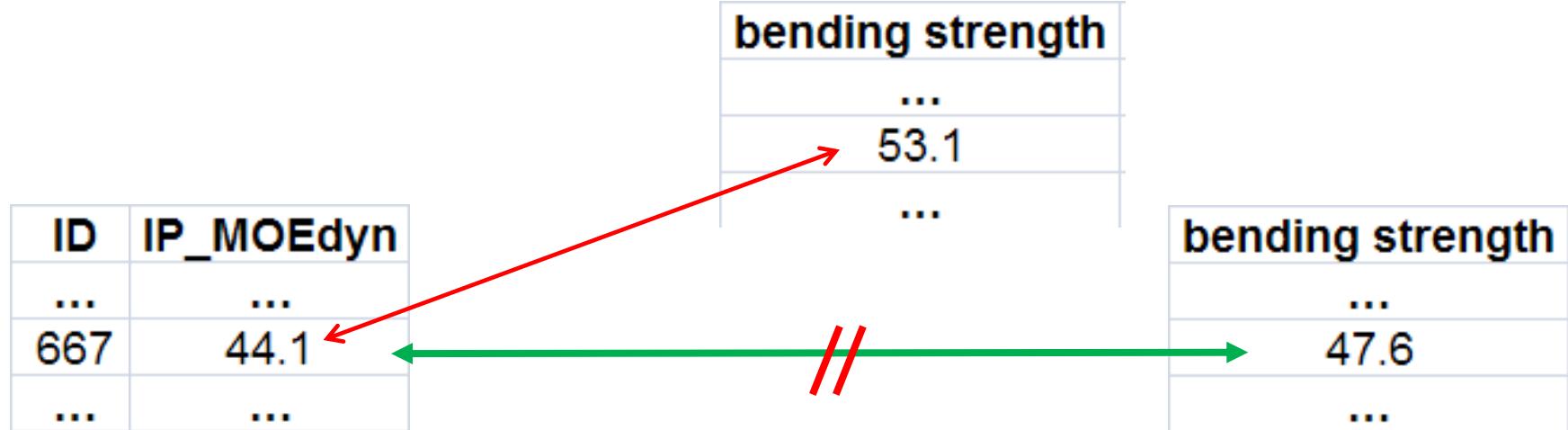
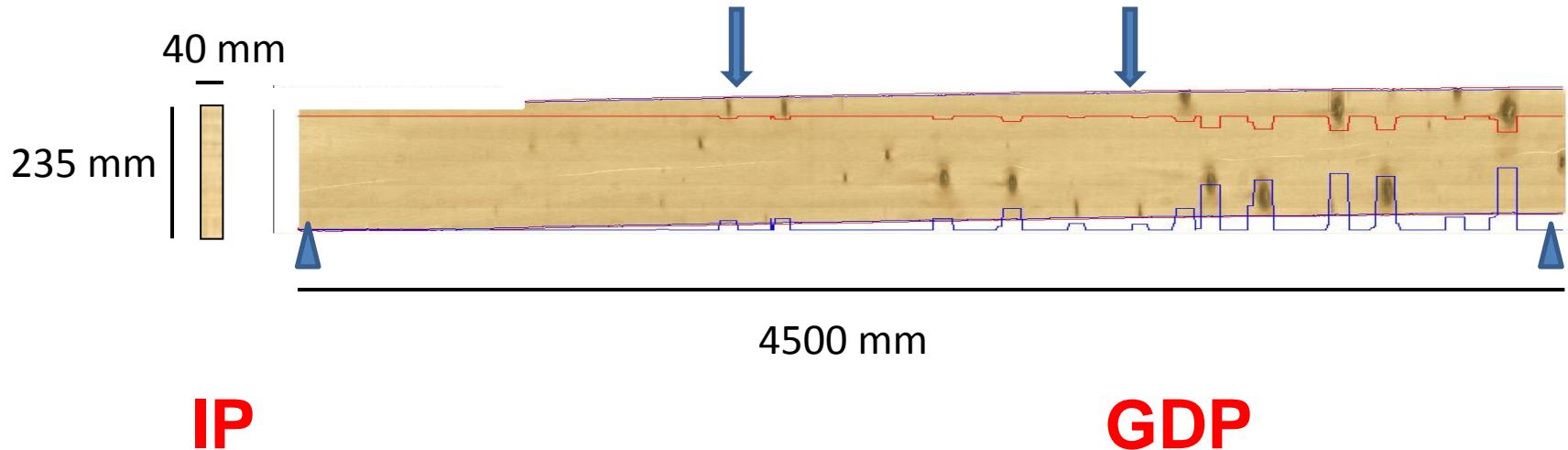
IP ← → GDP
is combined with

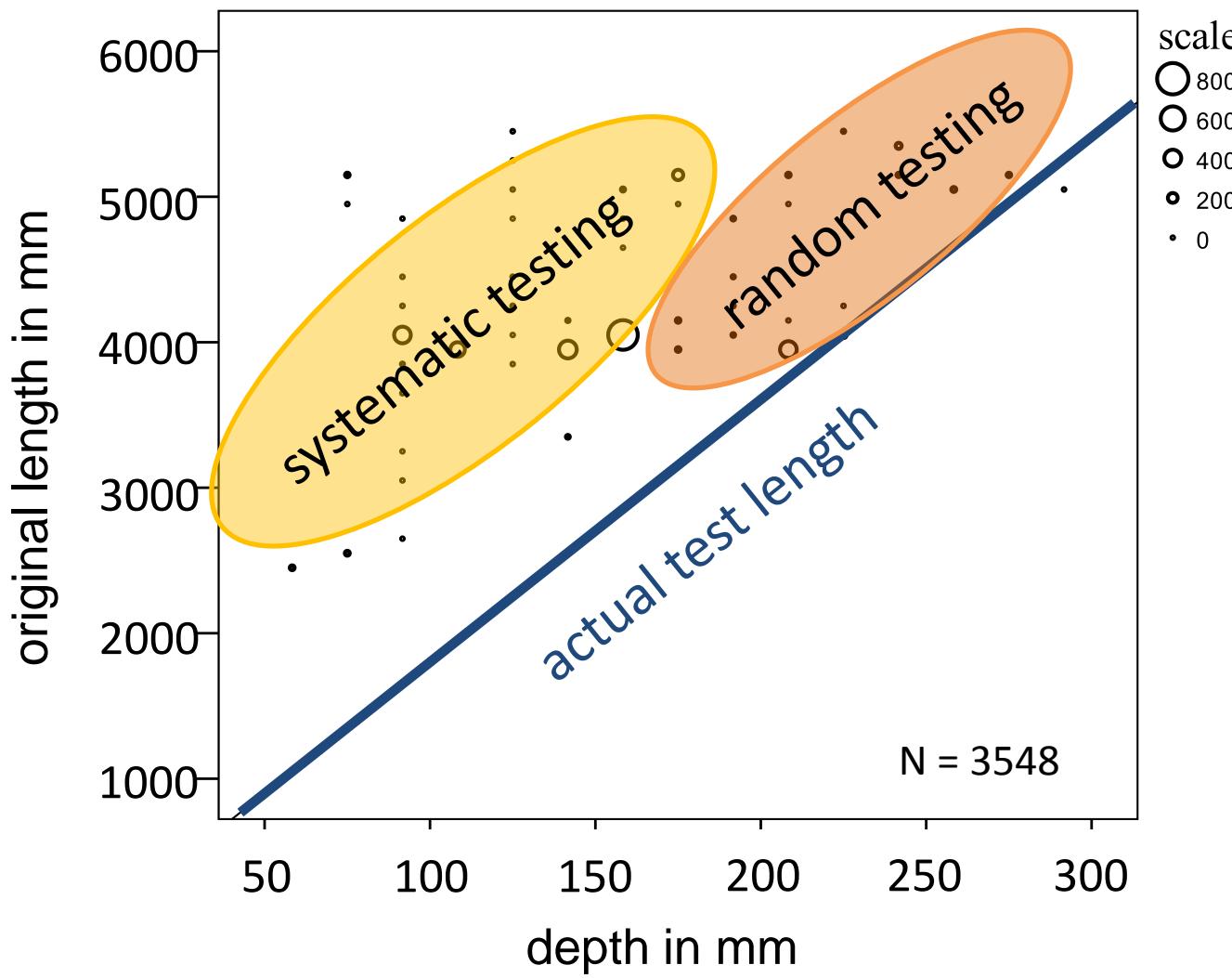
ID	IP_f	bending strength	static MOE	density
...
...
3200	25.7	23.0	7100	332
3403	35.9	50.3	10600	449
3533	45.4	42.0	11000	459
5142	56.8	38.1	13500	517
6238	56.7	69.0	15900	512



EN 384

“...a **critical section** shall be selected in each piece of timber. This section is the position at which failure is expected to occur, based on a **visual examination** and **any other information** such as measurements from a strength grading machine ...”





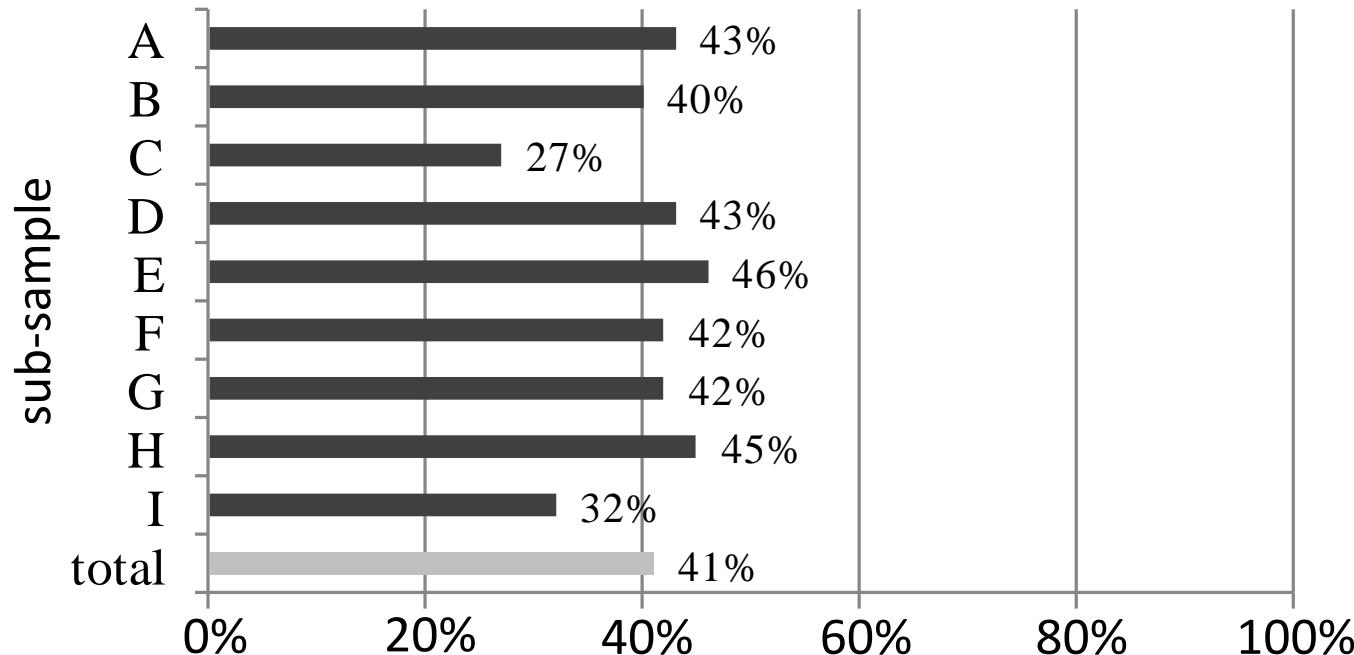
Objectives

1. How often is the section with the largest, local defect tested in a bending test?

2. How does a grading machine based on dynamic measurements benefit, if the weakest section is not tested?

sub-sample	region	n	Simulated MoR middle		Simulated MoR entire		MoE		P	
			mean in N/mm ²	cov in %	mean in N/mm ²	cov in %	mean in kN/mm ²	cov in %	mean in kg/m ³	cov in %
A	Slovenia	637	42.7	29.5	41.3	30.7	11.2	19.8	444	9.8
B	Slovenia	489	43.3	31.1	41.7	32.0	11.2	21.3	448	10.0
C	Sweden	210	40.1	31.6	38.3	34.1	10.8	21.5	435	11.9
D	Romania	203	37.7	27.7	36.3	28.9	9.7	16.8	391	8.2
E	Slovakia Ukraine	304	36.1	35.1	34.8	36.4	10.0	19.1	396	10.1
F	Poland	433	39.0	31.0	37.6	32.5	10.8	20.4	440	10.8
G	Luxembourg Belgium	471	40.0	28.9	38.5	29.9	10.9	15.5	436	9.2
H	Austria Czech Republic	416	38.0	37.0	36.7	38.0	10.8	24.1	438	12.4
I	Germany	385	39.1	32.3	37.2	34.9	10.8	21.5	440	12.2
Total sample		3548	40.0	32.0	38.5	33.3	10.8	20.7	434	11.3

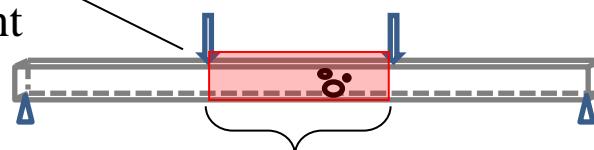
Weakest section/largest knot



boards, where **largest knot** was tested

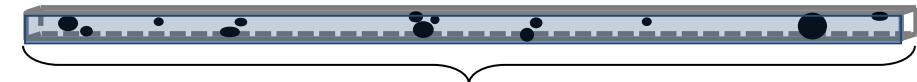
=> More than half of the boards was not tested at the weakest section!

inner
load
point



middle, tested section

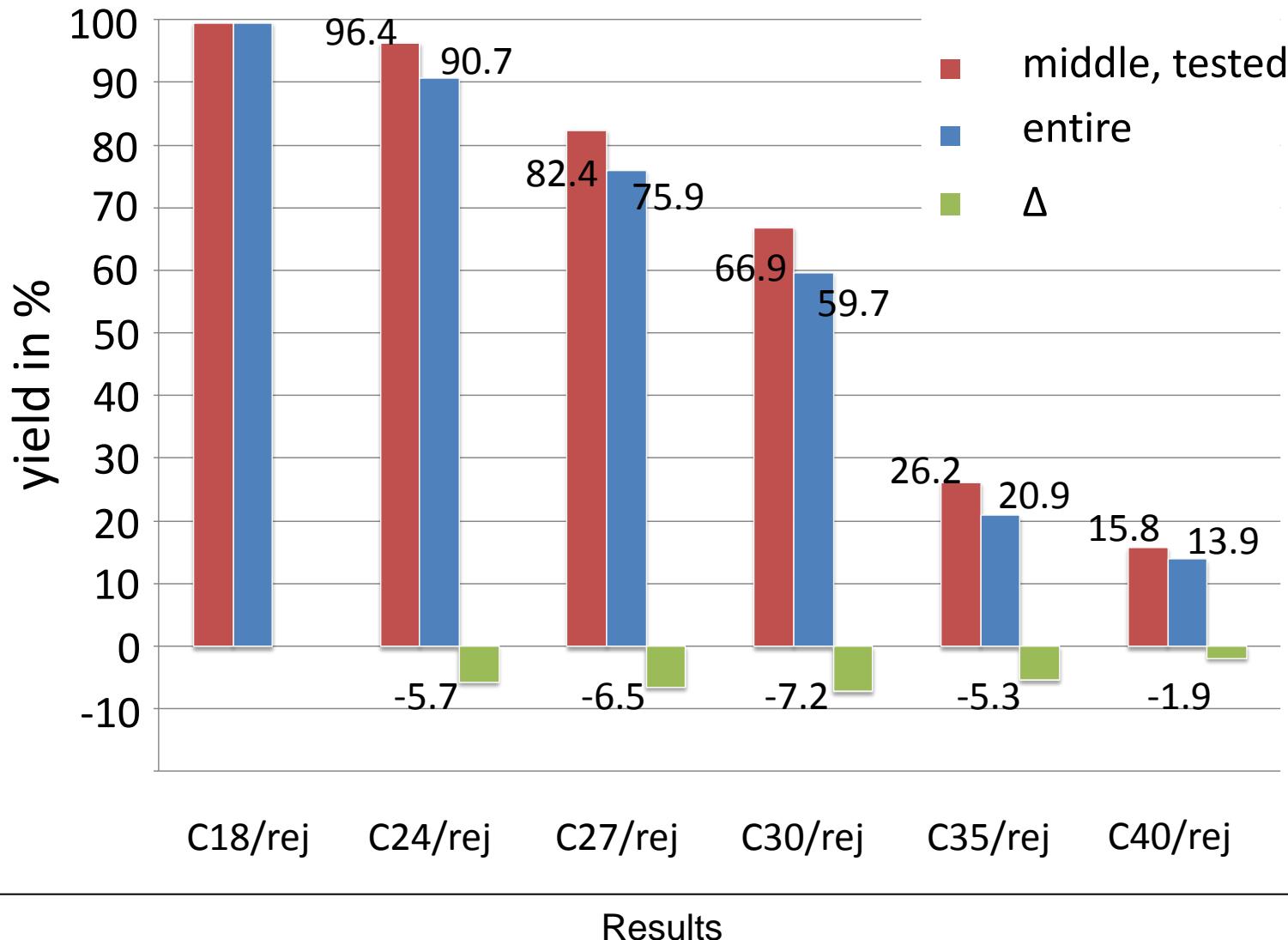
Settings



entire board

	middle section [N/mm ²]	entire board [N/mm ²]	ratio
C18 / rej	19.8	19.8	1.00
C24 / rej	25.2	28.7	1.14
C27 / rej	31.7	33.8	1.07
C30 / rej	35.9	37.4	1.04
C35 / rej	45.6	47.4	1.04
C40 / rej	49.5	50.4	1.02

Yield



Conclusion

- Derivation of settings is a very sensitive point.
- Eigenfrequency or dynamic modulus of elasticity are not able to detect local defects (only a average property).
- It is not always possible to locate the weakest section between the inner load points in a bending test. The lowest strength is not measured.
- Consequently, settings are too low, yields are too high.

