



**Optimising
machine strength grading
with three indicating properties**

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Introduction

- EN 14081-2 / Initial type testing
- Strength class requirements: Strength, MOE, density
- Grading machine: One or more indicating properties (IPs)
- Settings: Lower limits for IPs satisfying the strength class requirements
- How can we find “good” settings?

Material

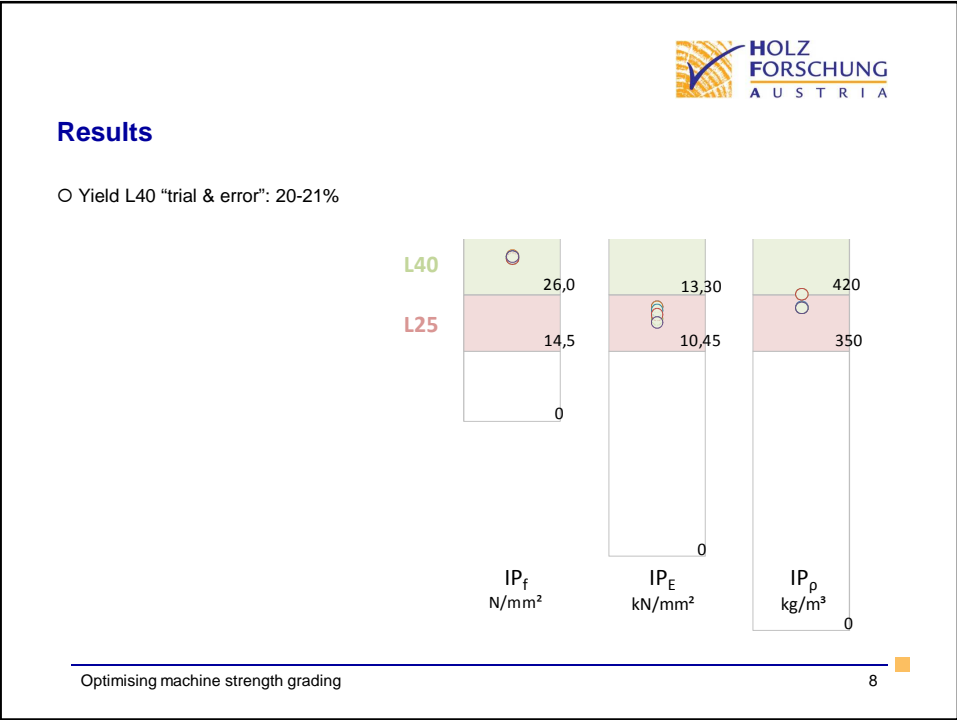
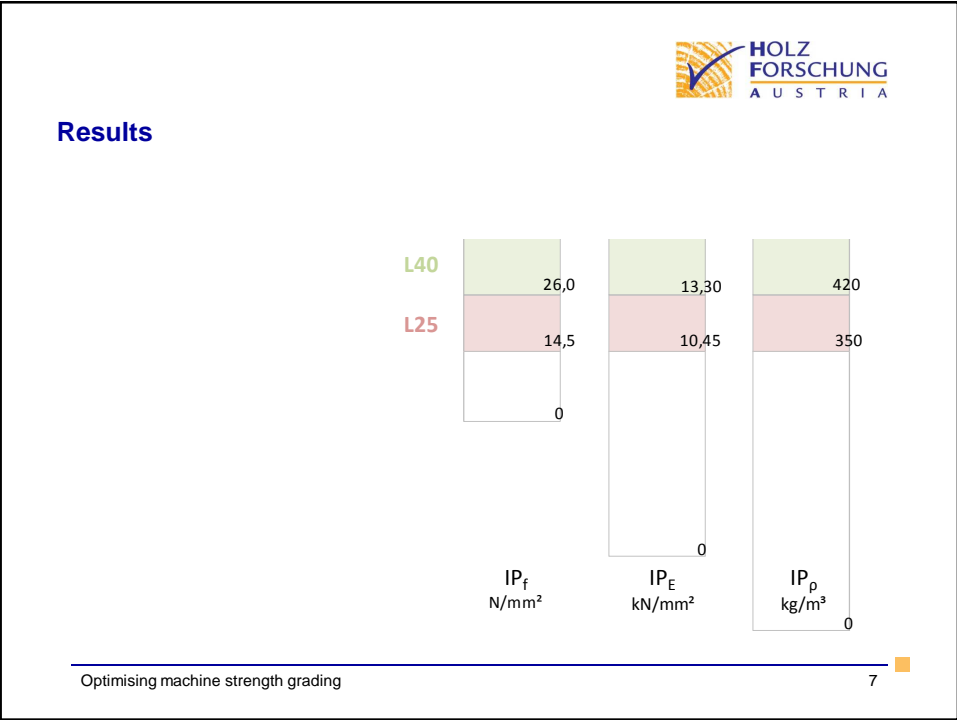
- 1162 boards of European spruce graded with GoldenEye 706 data provided by MiCROTEC
- Three IPs: IP_f , IP_E , IP_ρ
- Tested in tension (EN 384, EN 408)
 - Tension strength
 - Modulus of elasticity
 - Density

Methods

- Grade combination L40 / L25 / reject
- Settings determined by two methods
 - “advanced method” 
 - “trial and error method” 
- Comparison of these settings
 - Yield 
 - Adaptation to the dataset

The “trial and error method”

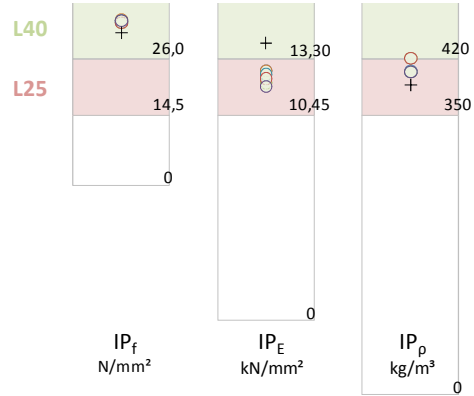
- Each setting is determined in such a way that the respective characteristic value is achieved
- Order of determination of settings becomes relevant:
 - $IP_f - IP_E - IP_\rho$ - $IP_f - IP_\rho - IP_E$
 - $IP_E - IP_f - IP_\rho$ - $IP_E - IP_\rho - IP_f$
 - $IP_\rho - IP_f - IP_E$ - $IP_\rho - IP_E - IP_f$
- Six setting combinations, six different yields



Results

○ Yield L40 "trial & error": 20-21%

+ Yield L40 "advanced": 18%



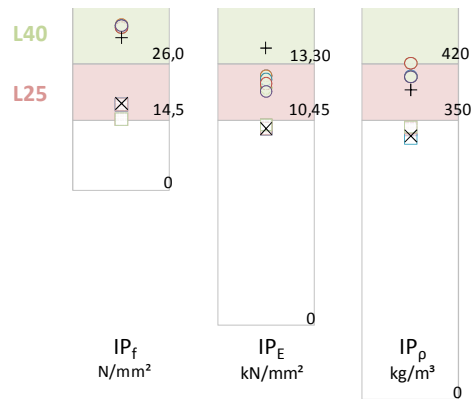
Results

○ Yield L40 "trial & error": 20-21%

+ Yield L40 "advanced": 18%

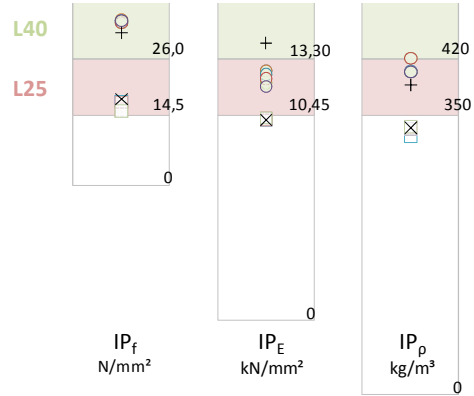
□ Yield L25 "trial & error": 54-56%

X Yield L25 "advanced": 56%

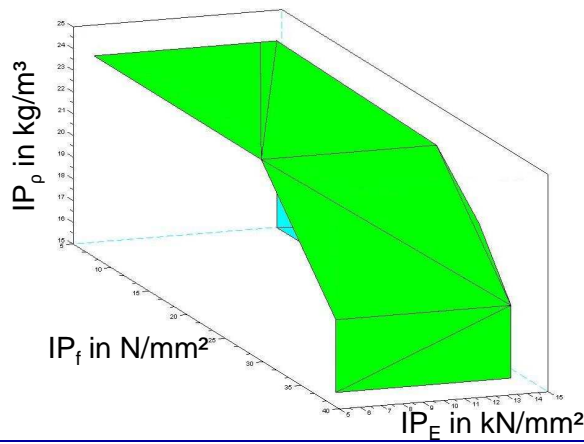


Results

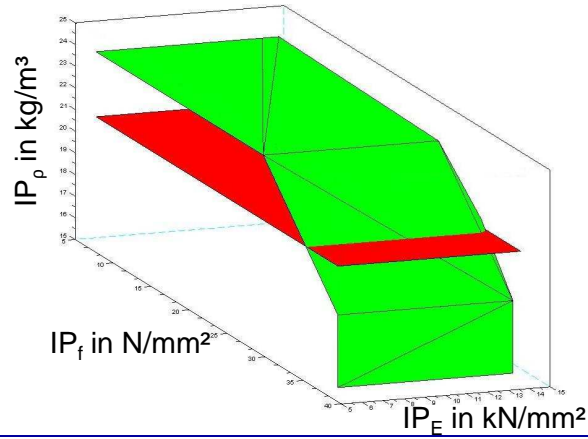
- Yield L40 "trial & error": 20-21%
- + Yield L40 "advanced": 18%
- Yield L25 "trial & error": 48-49%
- X Yield L25 "advanced": 49%



Results: convex hull

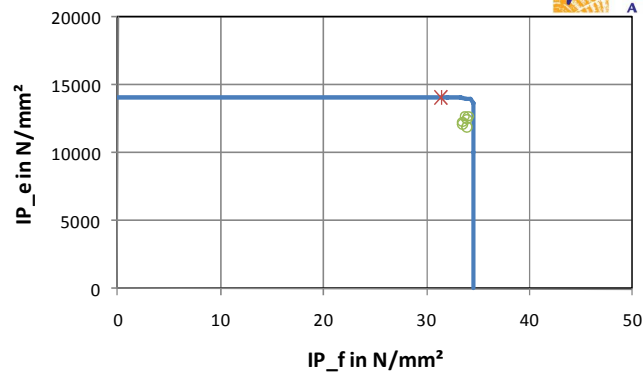


Results: convex hull



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Results – adaptation to the dataset (L40)

Space of all possible setting combinations with IP_ρ set to 421 kg/m³

- * Setting combination found by "advanced method"
- Setting combinations found by "trial and error method"



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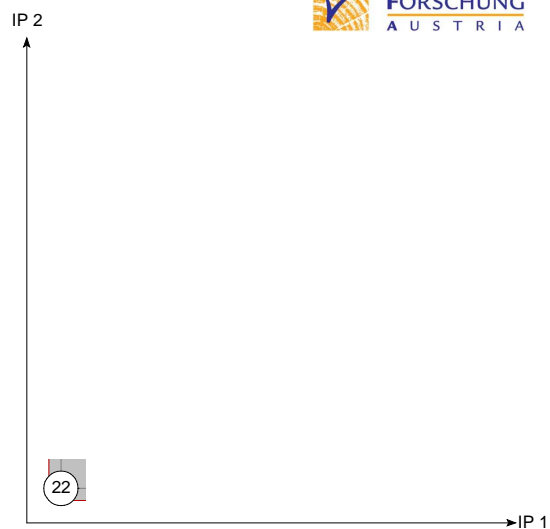
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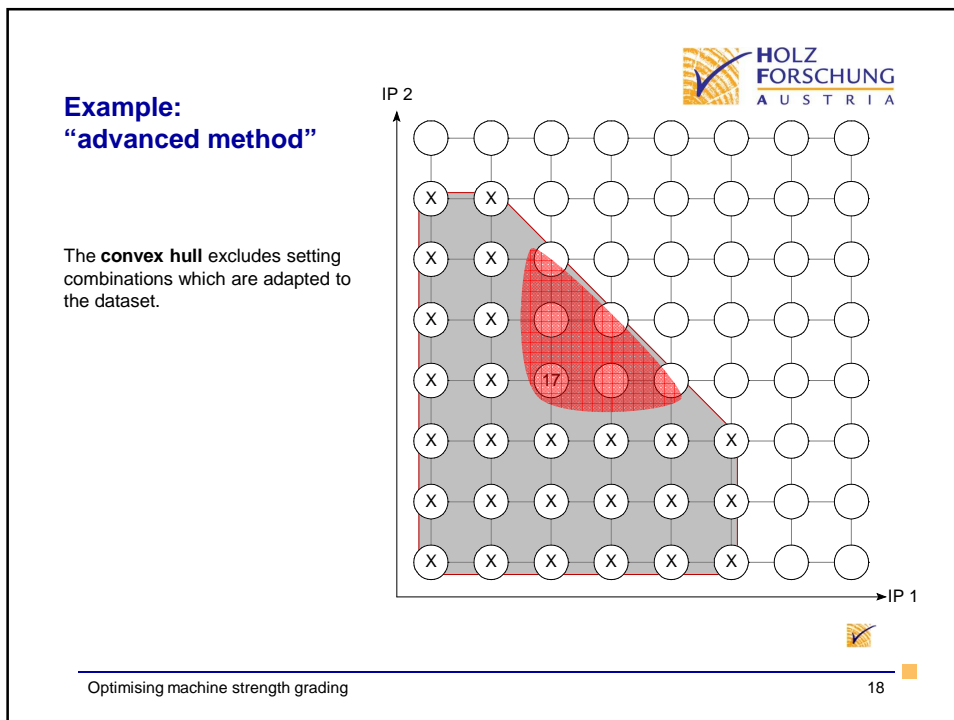
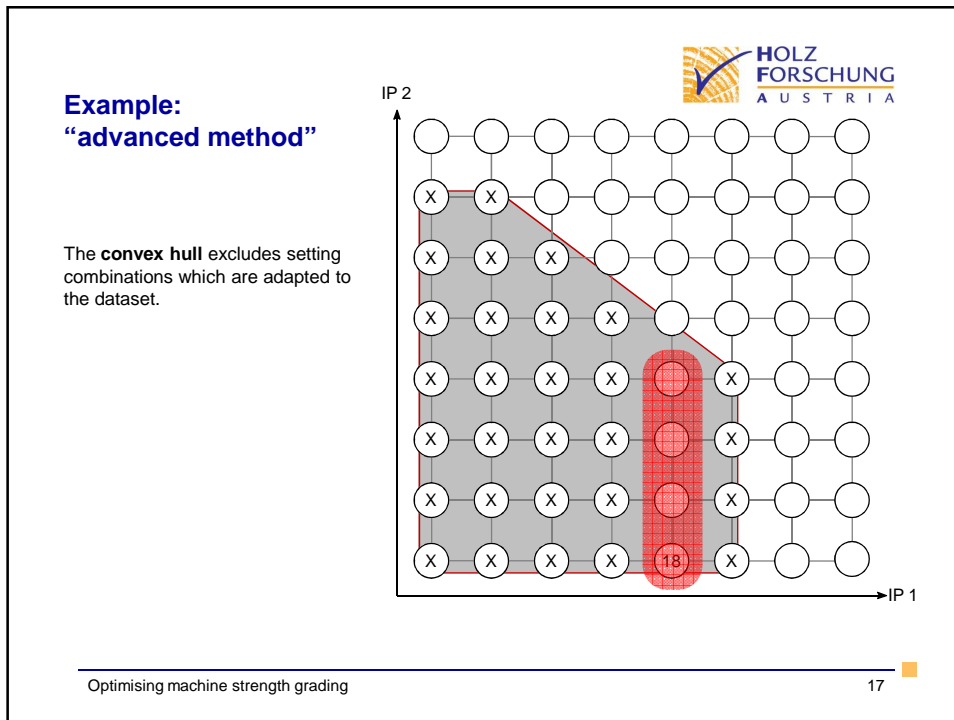
Conclusion

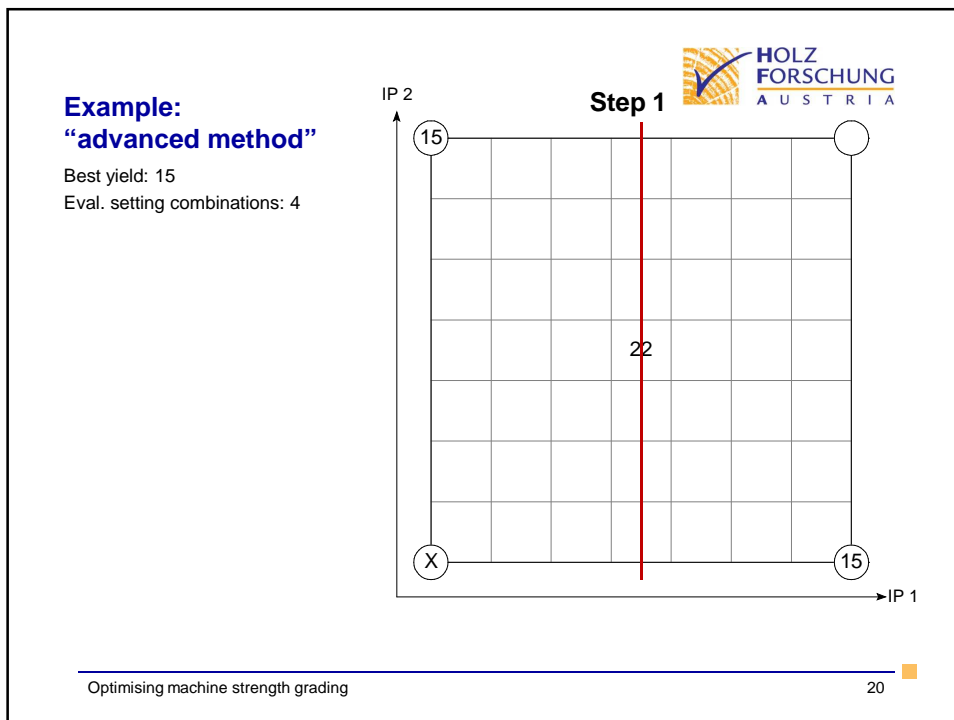
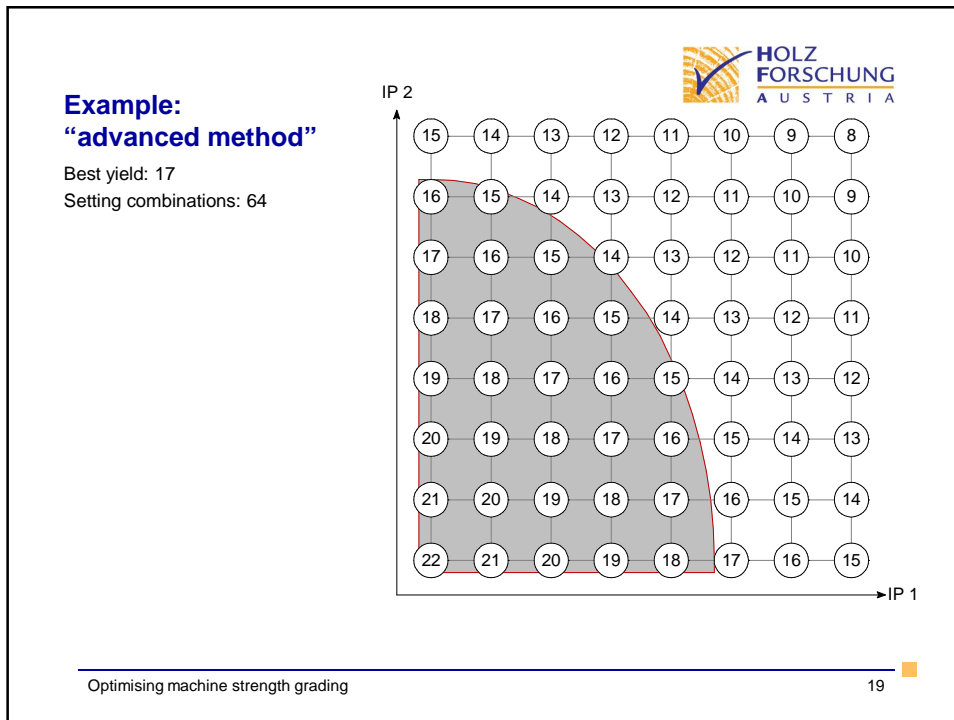
- Many ways to determine settings
- What are “good” settings?
- The “advanced method”
 - helps to decide whether settings are “good”
 - tries to determine settings which are not adapted to the data

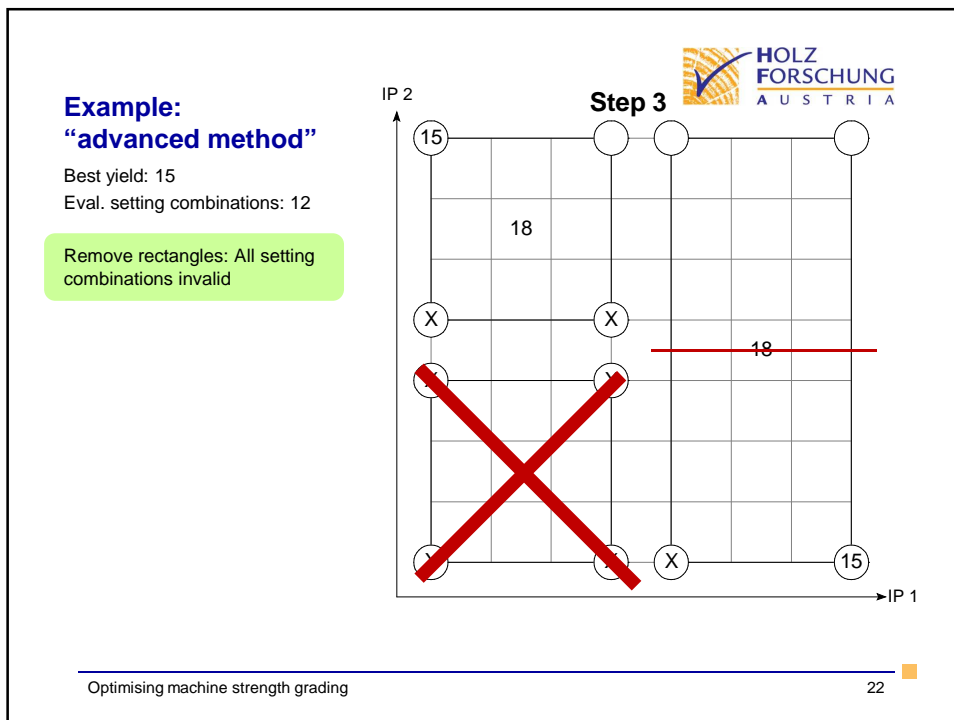
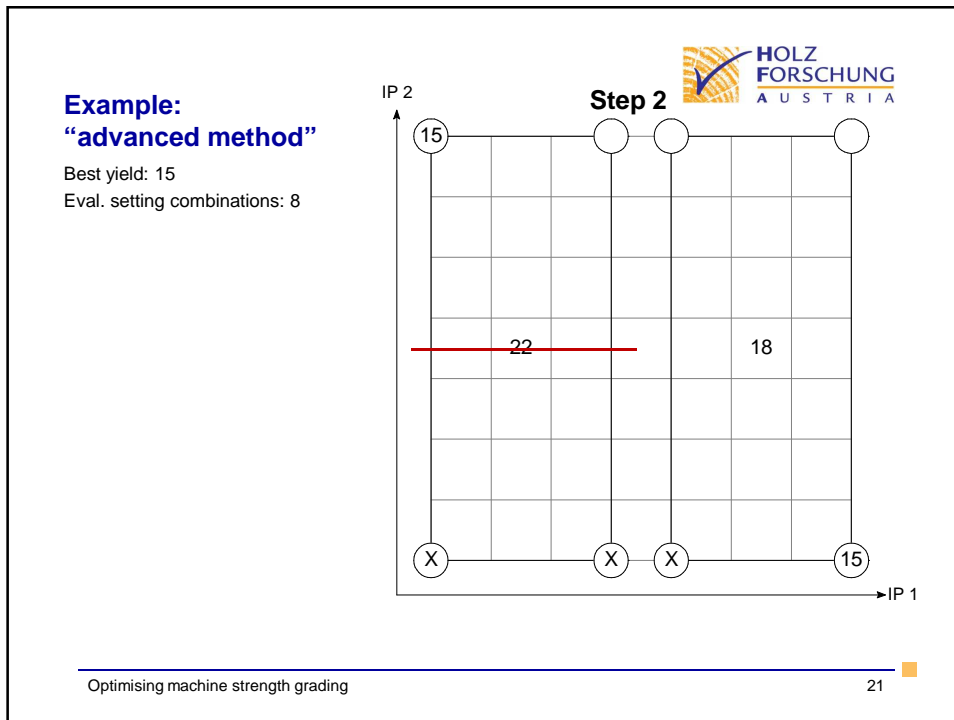
Example: “advanced method”

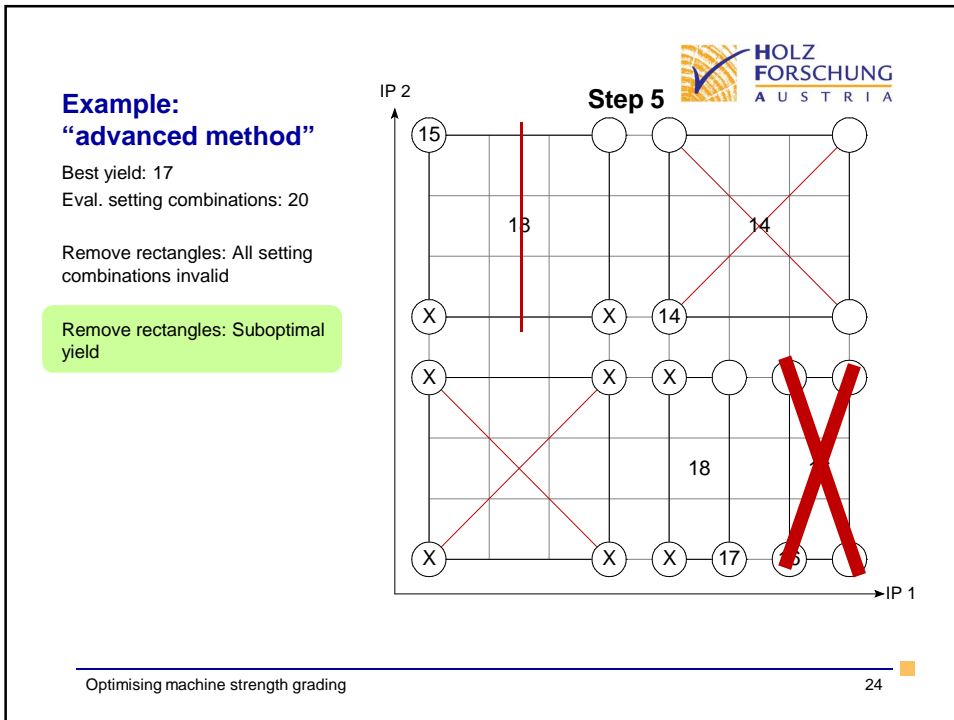
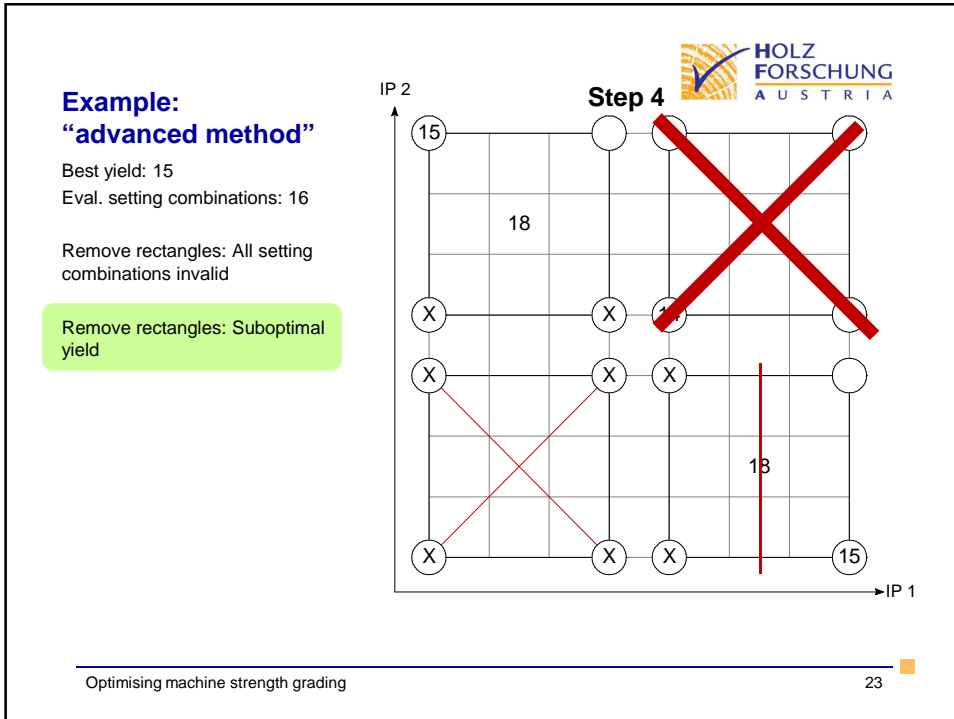
Best yield: 17
Setting combinations: 64

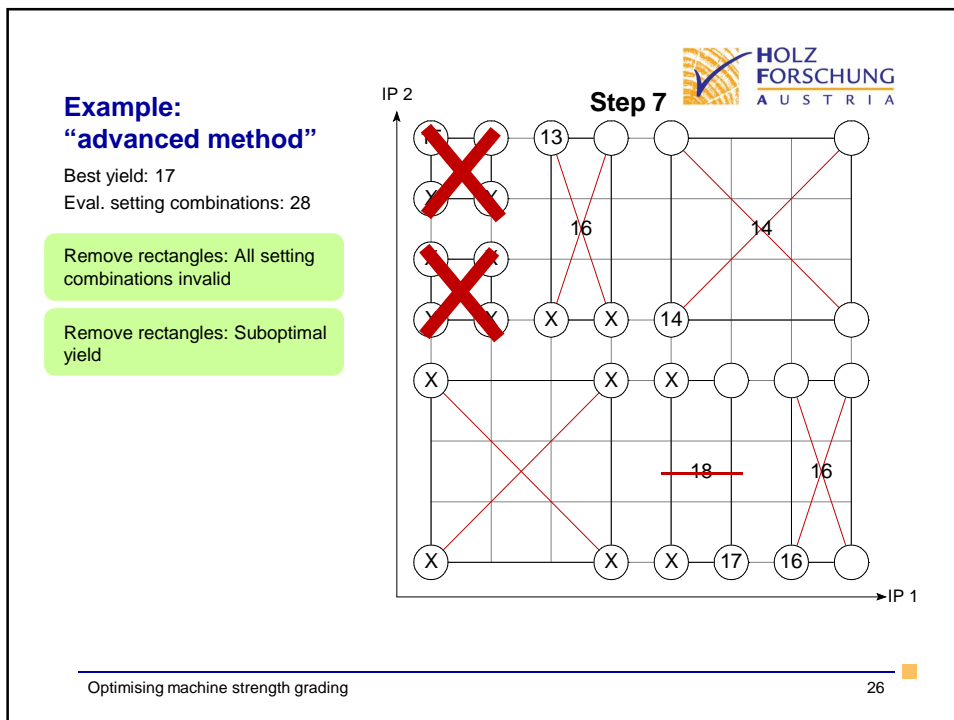
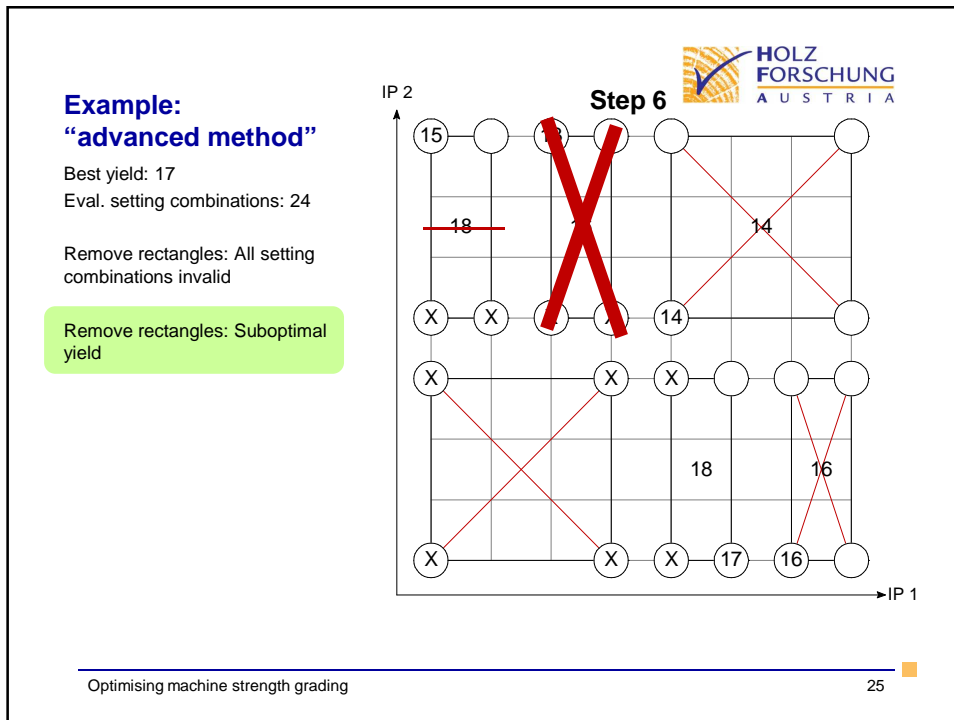












**Example:
“advanced method”**

Best yield: 17
Eval. setting combinations: 32

Remove rectangles: All setting combinations invalid

Remove rectangles: Suboptimal yield

