Machine strength grading with a flexibility in use and application
Contents:

- Activities of woodworking companies Netherlands
- Strength grading machines
- Derivation of settings for grading
- Flexible grading in practice
- Conclusions
- Comments to EN 14081
Activities of woodworking companies

Some figures:

• Netherlands:
  • Number of large timber trading companies: 288
    • Import of sawn timber:
      • Softwood: 1,928,000 m³
      • Hardwood: 502,000 m³
  • number of sawmills > 25,000 m³ / year: 5
Activities of woodworking companies

Some figures:

- Sweden:
  - number of sawmill companies member of the federation: 150?
  - production sawn timber: 18,000,000 m³?
Activities of woodworking companies

• processing in large sawmills:

  - sawing
  - Drying
    - Drying chambers > 500 m³
  - grading
    - Laminating
  - trading

• Mainly softwood, small number of species
• Large amount standardised material
Activities of woodworking companies

- processing for (Dutch) Timber Trader:

- batches with small number of beams
- different species (hard- and softwood), different sizes
- no automated production lines
Activities of woodworking companies

- Large sawmills:
  - automated processing lines for sawing and drying
  - Mainly softwood, small number of species
  - large amount standardised material

- (Dutch) Timber trader:
  - no automated production lines, contract sawing and drying
  - different species, different sizes, small batches

- Small sawmill: ?
Strength grading machines

• EN 14081: written with in-line machines in mind
• Number of grading machines Europe: approx. 150:
  • in-line machines at large sawmills with production lines where these can easily be incorporated:
    • Microtec
    • Dynagrade
    • Computermatic
    • ....
Strength grading machines

• The largest amount (80% ?) of companies in the woodworking industry have no infrastructure for in-line machines.

• There is a demand for flexibility in grading machines for companies with:
  • no automated production lines
  • different species, different sizes, small batches
Strength grading machines

- Development of Brookhuis Micro-Electronics: Timber Grader MTG, a hand grading device: based on stress wave measurements, accepted for EN 14081-4 for Northern and Middle European spruce. For flexible use in woodworking companies.
Derivation of settings for grading:

- Parameters for derivation of grading settings:
  1. botanical species
  2. growth areas

- Settings depend on:
  1. the quality of the model
  2. a representative distribution of growth areas

Possibilities:
Derivation of settings for grading:

The world’s forests: origin of species used
Derivation of settings for grading:

- Number of species used for structural uses in Europe:
  - Softwoods: 5 (?) (mainly spruce and pine)
  - (tropical) Hardwoods in the Netherlands: 30 and more to come (also due to the FSC).

- Characteristics of tropical hardwoods:
  - Hard to identify in practice
  - Changing quality.
  - Tropical hardwoods have little visual distinctions
Derivation of settings for grading:

- Structural hardwoods in the Netherlands
Derivation of settings for grading:

- **Case 1: Combining growth areas and hardwood species.**

  At TNO and TU Delft there has been research on hardwood timber for more than 40 years, with azobé (lophira alata) as the most important species.

  The research goal was to determine if machine grading for tropical hardwoods is possible and economical.

  More than 20 species were tested:
  - non-destructive
    - natural eigenfrequency (longitudinal)
    - density
    - visual (growth features)
  - destructive (EN 408)
    - minimum of 40 beams to allow strength class assignment
Derivation of settings for grading:

Research results:

- For individual wood species not always clear relationships between MoE and MOR were found.

- When all beams were regarded as ‘one’ population hardwood good correlations between MoE and MOR were found.
Derivation of settings for grading:

- When tropical hardwood regarded as ‘one’ population non-destructive measurements (density and MoE$_{\text{dynamic}}$) give good correlations for the strength.

• Growth area: South-America + Africa

• Species: 20 tropical hardwood species with little visual distinctions
Flexible grading in practice

- Grading set-up: Timber trader with no automated production lines.

- Grading material: South-American hardwood species, different sizes, small batches

Hardwood grading models incorporated in the Timber Grader MTG.
Flexible grading in practice

Species A
Species B
Population of tropical hardwood timber
Excluded for machine grading by visual override.
Beams to be machine graded (form a population that is easy to determine)
Individual species as population are hard to determine (by anatomical features)
Flexible grading in practice

Species A
Species B

Population of tropical hardwood timber

Excluded for machine grading by visual override.
Flexible grading in practice

Species A

Species B

Population of tropical hardwood timber

Beams to be machine graded
Flexible grading in practice

Species A

Species B

Population of tropical hardwood timber

Grading results

Species A

Species B

Grading results rej rej rej rej

D40 D50 D40 D50

D50 D60 D60 D50

D60 D70 D30 D60

D30 D40 D40
Flexible grading in practice

D Class according to EN 338

D50

D70
Flexible grading in practice

Case 2: Combining growth areas Middle and Northern Europe and species spruce.

Settings derived for the Timber Grader MTG accepted to be listed in EN 14081-4: Middle and Northern European spruce.

- Settings were derived for spruce for Timber Grader MTG because of market demand for flexible grading for softwoods.
- Deriving settings for restricted growth areas (like only Northern European spruce) can give higher yields.
Conclusions

- Flexibility in grading machines;
  - In-line grading machines are suited for companies with automated processing lines.
  - For the majority of companies (timber traders, small sawmills) more flexible machine grading solutions are demanded.

- Flexibility in grading applications:
  - combining growth areas and species combinations can make machine grading possible for species brought the market in small amounts.
Comments to EN 14081

• Machine installation check:
  • What is the goal: the machine in the company must give the same results as the master machine for which the settings were derived?
  • Is this achieved by the present requirements?