

Nondestructive methods

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Methods for inspection and diagnosis – nondestructive methods



Inspection and measurement of timber's properties through nondestructive techniques.

Easy to perform with reduced subjectivity, however with qualitative results.

Traditional techniques

“Knocking” on wood

Removal of a splinter



Moisture content measurement

- Moisture content profile



Electric resistance

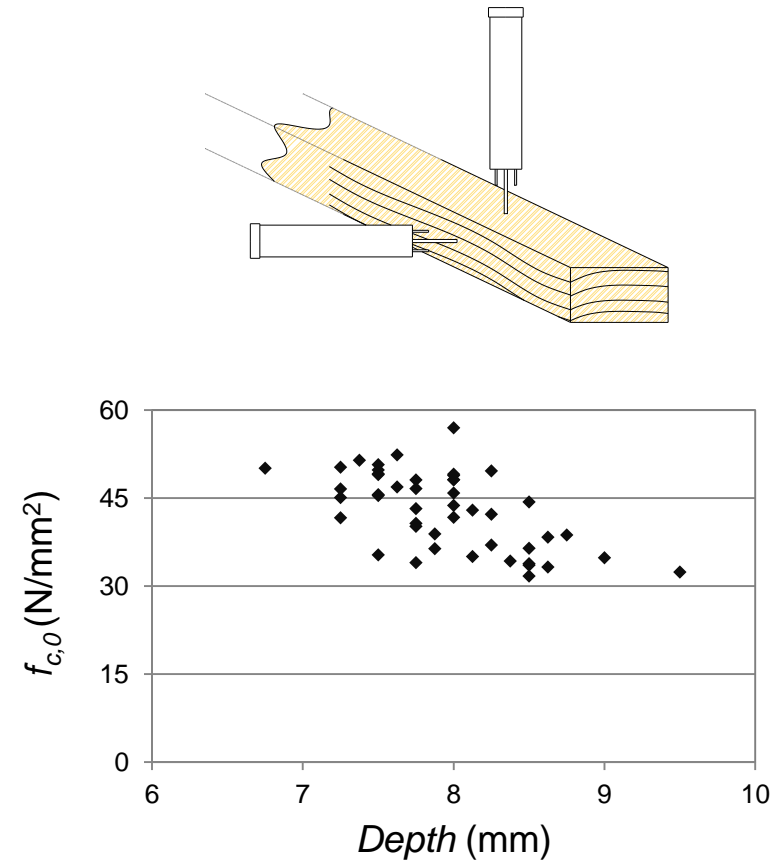


Electric capacitance

Impact penetration tests

- Model **Pilodyn®**.

Depth of penetration



Impact penetration tests

- **Decayed sections** may be assessed along the whole **perimeter**, for sections with different percentages of **sapwood** and **heartwood**.
- **Multilayer stratified cross section** may be considered for the different segments of an element regarding the **decay level found in visual inspection**.

- - - mean impact penetration limit



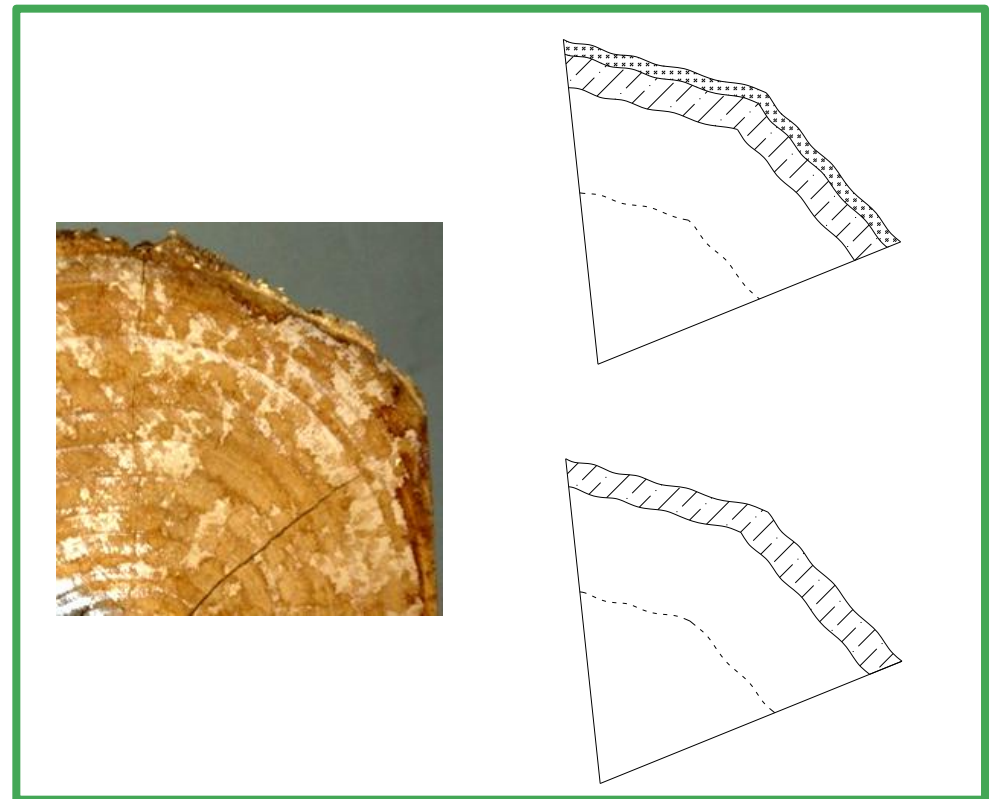
external decayed layer



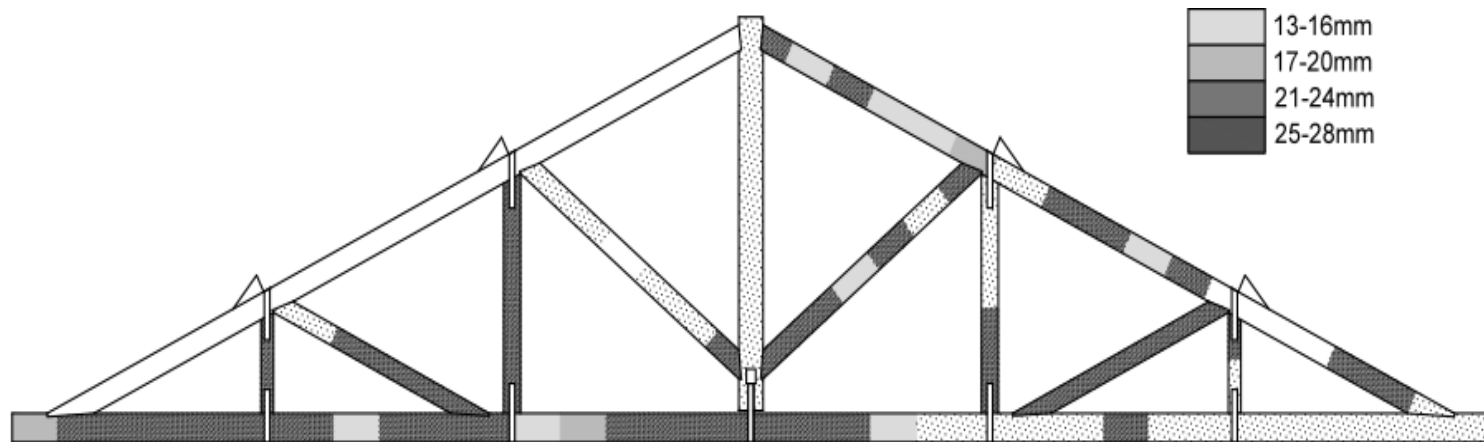
lower resistant transition wood



undecayed wood



Impact penetration tests



Level of decay – comparative analysis between sections

Drilling resistance tests

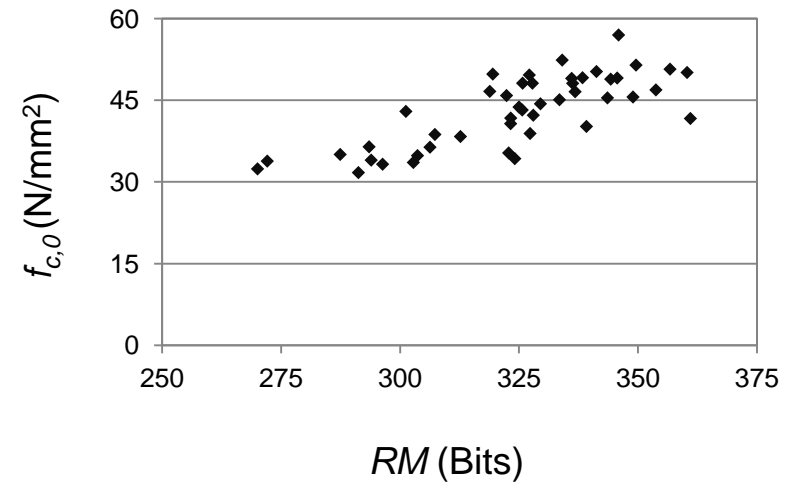
- Model Resistograph®.

$$RM = \frac{\int_0^h Area}{h}$$

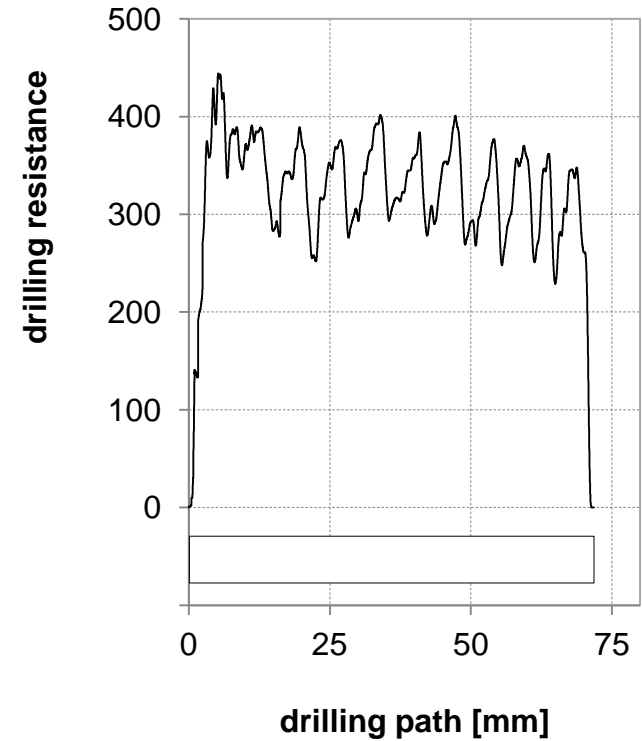
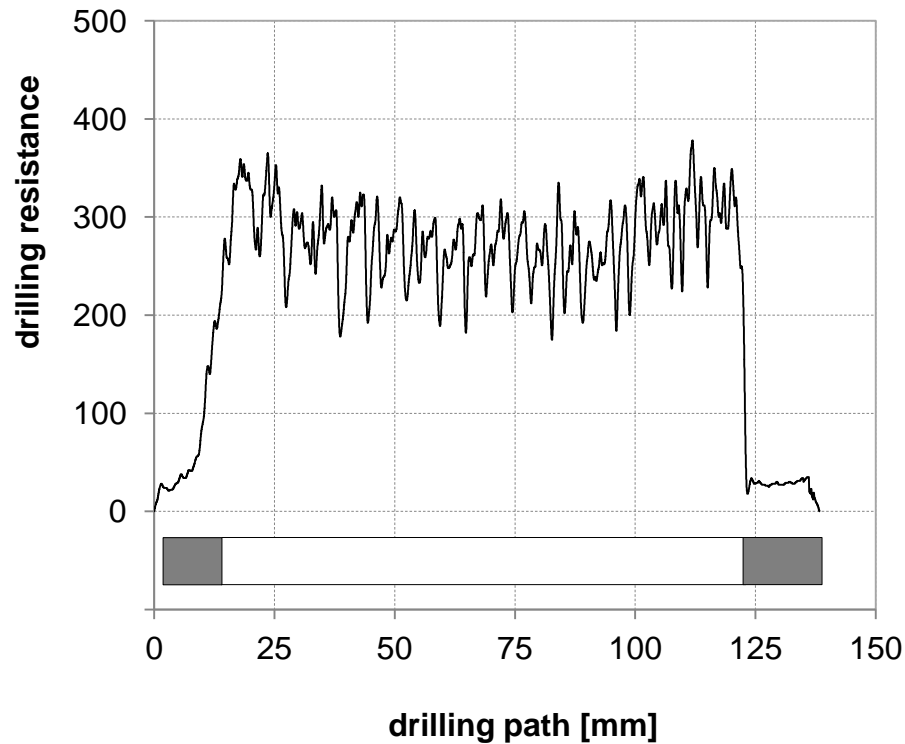
RM → resistographic measure (Bits)

Area → area of the diagram

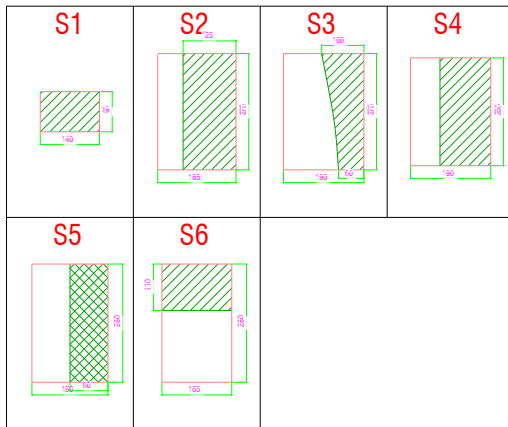
h → height of the test specimen



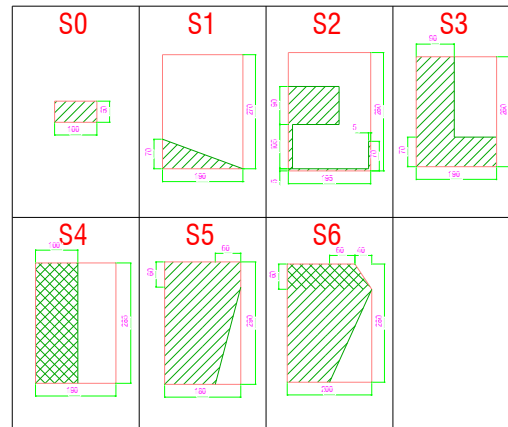
Drilling resistance tests







Perna 1.1



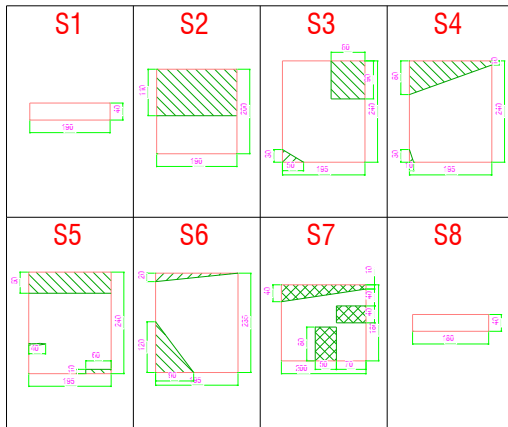
Perna 1.2



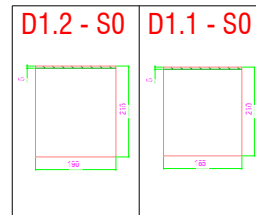
-  Degradação provocada por Fungos (apodrecimento)
-  Degradação provocada por Insectos Xilófagos (caruncho)
-  Degradação provocada por Fungos e Insectos Xilófagos
-  Ocorrência de Fendas



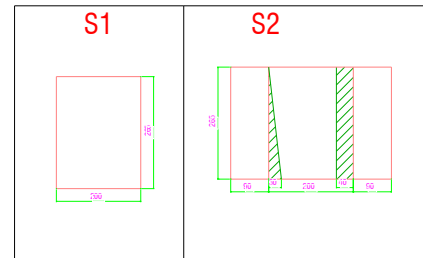
Linha 1



Diagonais

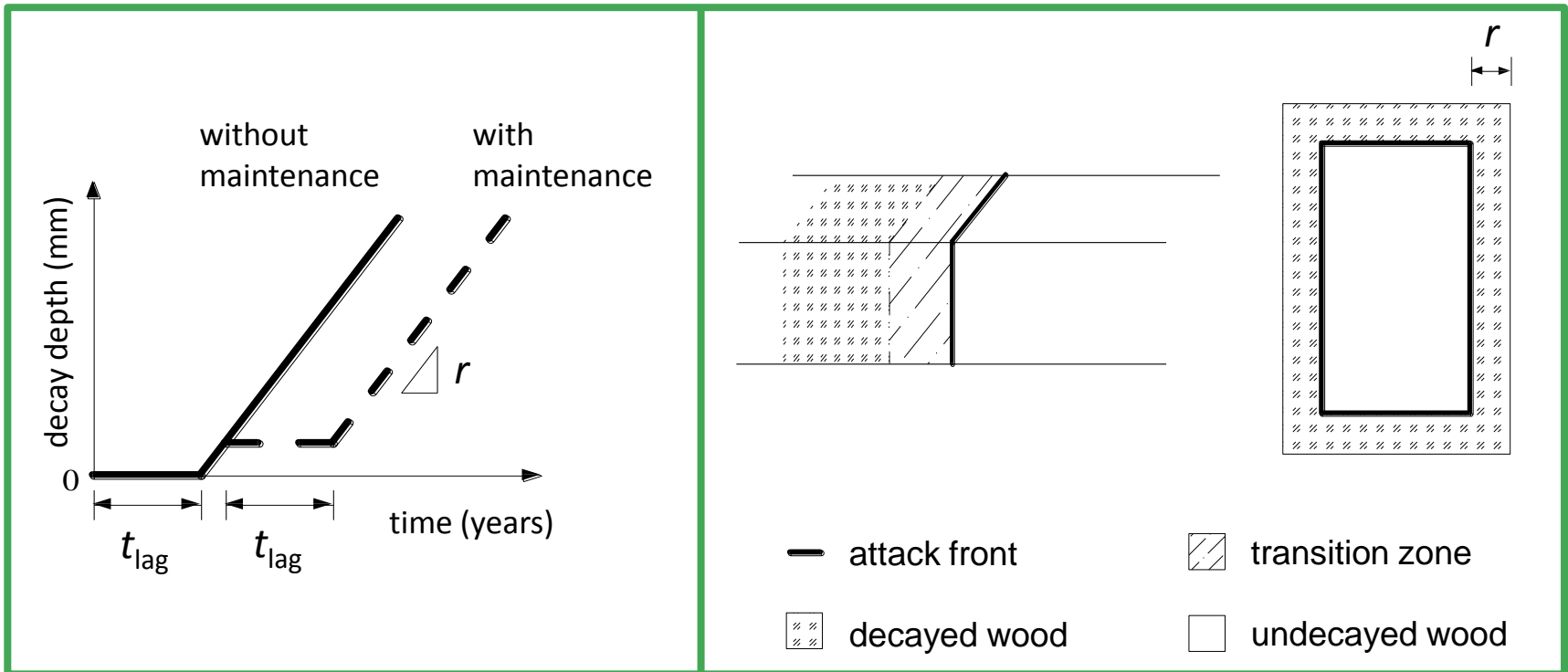


Montante



Decay modeling parameters

- Biparametric deterioration model: $r \rightarrow$ annual penetration ratio
 $t_{lag} \rightarrow$ initial propagation period of the deterioration phenomenon



Ultrasounds

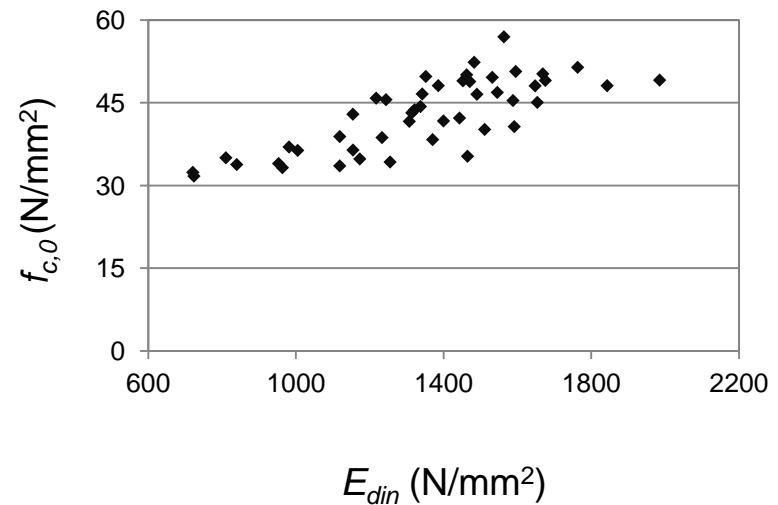
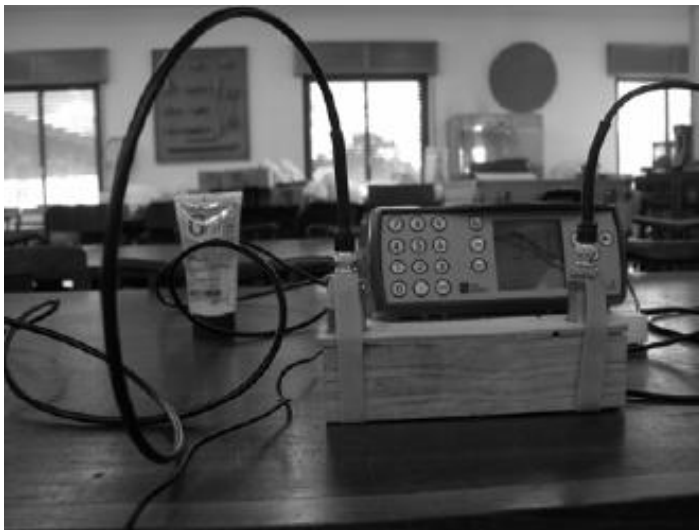
- Data and correlations obtained by **Ultrasound** testing.

$$E_{din} = V^2 \rho$$

E_{din} → (elasto)dynamic modulus of elasticity (N/mm²)

V → propagation velocity of the longitudinal stress waves (m/s)

ρ → density of the specimens (kg/m³)



Other tests

Thermography

Tomography

Boroscopy

X-ray

Microscopical analysis



Other tests – destructive tests



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**Thank you for
your attention!!**

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