Characteristics of "resonance wood" as viewed by violin makers or by wood scientists: Part 2 – Characterisation and correlations of structural and mechanical properties

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« CHARACTERISTICS OF “RESONANCE WOOD” AS VIEWED BY VIOLIN MAKERS OR BY WOOD SCIENTISTS: PART 2 – CHARACTERISATION AND CORRELATIONS OF STRUCTURAL AND MECHANICAL PROPERTIES »

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1. Introduction

The objective of this study is to improve the understanding of the interactions between physical-mechanical properties of resonance wood, their natural variability, and the actual expertise of violin makers in the selection and qualification of their raw material.

2. Visual and vibrational features of spruce

Material and Methods

- Spruce (Picea abies [L.] Karst)
- 10 Violas and 14 violin soundboard, Quality grades “Excellent” and “Master grade”
- 72 samples in R radial direction (120 × 2.5 × 12mm, R × T × L) and 177 samples in L longitudinal direction (12 × 2.5 × 150mm, R × T × L).

Measurement of physical and vibrational properties and the acoustical indexes of the specimens

- Specific modulus of elasticity E'ρ
- Damping coefficient / internal friction tanδ
- Characteristic impedance z = \sqrt{E'ρ}
- Ratio of radiation R = \frac{E'}{E'ρ}
- Acoustic conversion Efficiency ACE = R / tanδ

3. To go further: How in progress

3.1. Correlations between visual characteristics of spruce wood and its properties

High variability within and between specimens (a single specimen may not be representative of the properties of the entire board).

- Wood properties: variability and correlations

<table>
<thead>
<tr>
<th>Property</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>0.78</td>
<td>0.55</td>
</tr>
<tr>
<td>EL/ρ</td>
<td>0.86</td>
<td>0.65</td>
</tr>
<tr>
<td>ER/ρ</td>
<td>0.69</td>
<td>0.55</td>
</tr>
<tr>
<td>tanδR</td>
<td>0.74</td>
<td>0.55</td>
</tr>
<tr>
<td>zL</td>
<td>0.51</td>
<td>0.84</td>
</tr>
<tr>
<td>RL</td>
<td>0.28</td>
<td>0.58</td>
</tr>
</tbody>
</table>

4. Conclusion and perspectives

This study shows the peculiarity of spruce “resonance wood” in regards to classical softwoods. Empirical choice by violin makers, based on perceptual criteria that can be visual, physic-mechanical, auditory, are relevant to the acoustic properties measured.

- Perspectives
  - To construct a model to evaluate the properties of a full violin plate from sampling fabrication offsets.
  - To analyze microstructural features of resonance wood in regards to visual characteristics and wood properties.
  - To enlarge the study to “fiddleback” maple.

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