

VALIDATION OF A FINITE ELEMENT MODEL OF MARIMBA BARS

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ANNOTATION

Marimba is a musical instrument of the idiophones category. Idiophones are percussion instruments. The mechanism of sound producing of these percussion instruments is based on natural vibrations of single bars. The vibrations are fundamental for the marimba tuning, sound quality optimization and assessment of alternatives materials. The modal analysis is a powerful tool to describe and analyze the complex vibration behavior by the natural frequencies and mode shapes. Therefore, the models reached by modal analysis need to be validated to make them reliable and useful. The validation employs the Experimental Modal Analysis (EMA).

MATERIAL AND METHOD

The employed wood species are listed in table 1. For each species are used 45 samples of dimensions of 300x15x5 mm³. The *free-free support* method (fig. 1) is used to achieve the frequency domain of the samples' vibration.

Trade name	Scientific name	Region of origin
maple	<i>Acer</i> spp.	Czech Republic
beech	<i>Fagus sylvatica</i> L.	Czech Republic
hornbeam	<i>Carpinus betulus</i> L.	Czech Republic

Table.1. Trade name, scientific name and the origin of the employed wood species in this project.

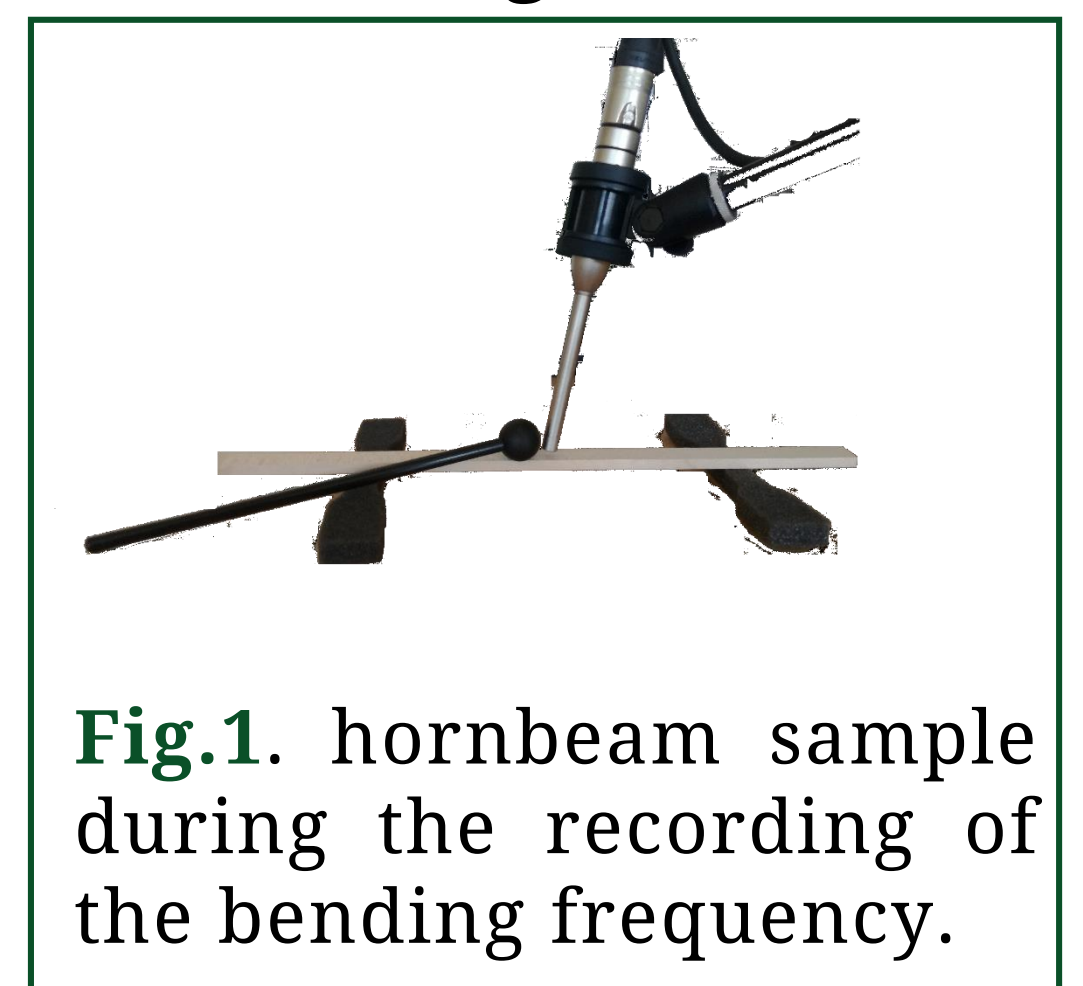


Fig.1. hornbeam sample during the recording of the bending frequency.

ANSYS is the software used for the analytical test; the material models are based on the Hearmon literature data (1948): Poisson ratio, Elastic moduli and Shear moduli. Others material data, such as E modulus and G modulus, are developed from comparison of own data and the Hearmon literature. To collect the experimental data, four accelerometers, a dewetron data logger, and the Dewesoft software are employed.

RESULTS

The table 2 shows the average of the 45 samples' frequencies' values: the first three picks of frequency visible from the frequency domain. The first pick refers to the first bending mode, then the second bending and the third pick to the torsion mode.

	beech	maple	hornbeam
1st fr (Hz)	278.9	280.9	274.6
2nd fr (Hz)	765.8	769.9	743.40
3rd fr (Hz)	1484	1493	1444

Table 2. Average of the firsts three frequency picks measured by the free- free support method.



Fig.1. First bending mode of the beech wood made by ANSYS R19.2. The referred frequency value is 236.8 Hz, (material model from Hearmon, 1948)

CONCLUSIONS

Currently, the modal parameter as the frequency reached by the modal analysis shows slightly different values than the one from the free- free support method. This behavior is enhanced in the case of the beech samples, where the Hearmon data are employed. The EMA will be achieved in the near future.

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