NON-DESTRUCTIVE
MATERIALS CHARACTERIZATION

APPLICATION NOTE

Orthotropic elastic properties with the Resonalyser

In contrast to isotropic materials, orthotropic materials are a subset of anisotropic materials becasuse their properties change when measured from different directions. Composite materials like long-, short- or particle reinforced plastics and metals and Wood products (particle, multiplex boards, …) can generally be considered as orthotropic materials.

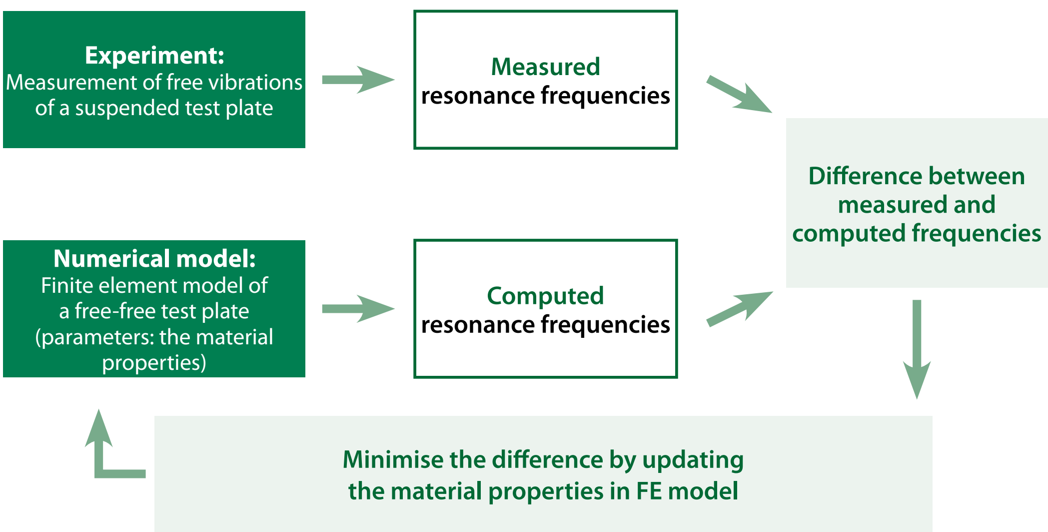
The elastic properties of orthotropic materials can be described by 4 engineering constants:

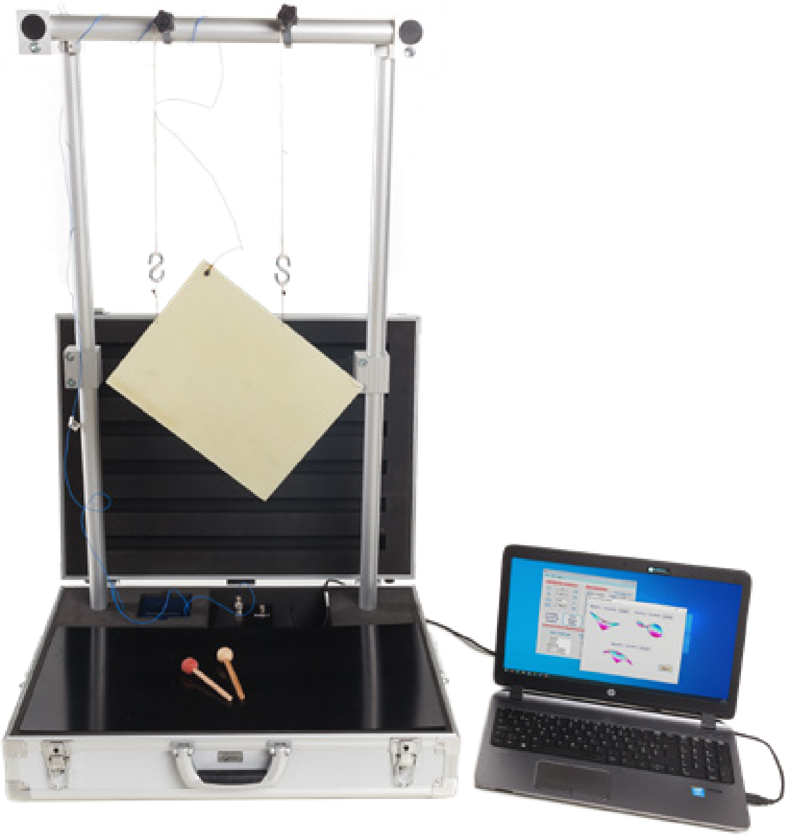
- Young's modulus E_1
- Young's modulus E_2
- Poisson's ratio ν_{12}
- In-plane shear modulus G_{12}

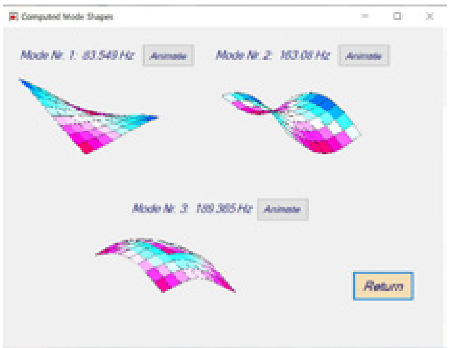
Theory background:

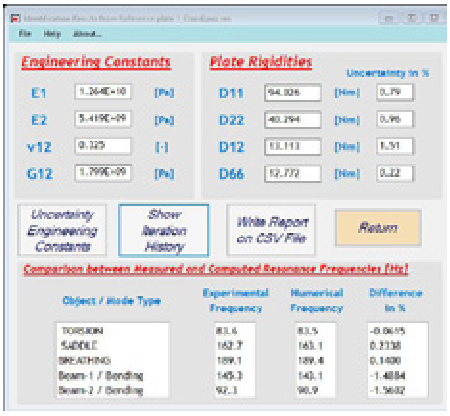
IET combined with an inverse method for measuring orthotropic elastic properties

The Resonalyser procedure is based on the inverse method to measure the resonance frequencies of test plates by IET and to compare these measurements with computed values by accurate finite element models. The engineering constants in the finite element models are tuned in such a way that the computed vibration behavior matches the measured vibration behavior as close as possible. This method is fast and yields very accurate results.









Benefits of the Resonalyser

1. Companies or research institutes having tensile benches for testing materials

Tests on tensile benches must be executed by highly skillful and trained operators in order to obtain reliable results. The test specimens are often equipped with **strain gauges** for recording the strain as a function of the applied force.

First, **the engineering constants** are identified in a non-destructive way with the Resonalyser procedure. Afterwards, the tensile bench can measure **failure strengths** without needing to fix strain gauges, hence saving time and costs.

The **combination** "Resonalyser – tensile bench" yields all important mechanical material properties necessary for engineering analysis of products and structures in an economical way.

2. Engineers needing engineering constants for finite element simulation models

Simulation models for mechanical properties of arbitrary products or structures require the input of the material engineering constants. Finite element models need material properties averaged over the element areas. The Resonalyser procedure yields **averaged values** over the test plate area and delivers hence suitable "finite element friendly" results.

3. Companies producing sheet materials

Companies producing plastics, metals, ceramics, foams, … need constant testing of new compositions and **quality control**. With the Resonalyser procedure, hundreds of tests can be performed every day. The procedure is fast, simple and accurate and needs no highly trained operators.

4. Universities and technical educational institutes

The resonalyser instrument is very robust and affordable and allows laboratory experiments for students to increase their skills and understanding of dynamics, modal analysis, data acquisition, finite elements, inverse methods, etc. Results on engineering constants can be used for mechanical simulation exercises and can be compared with similar results of other available experimental measurement techniques.

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