

Principles of Modal Tuning – Course Content

Session 1: Modes of Vibration and Frequency Response Curves

What is a "mode of vibration"? Explanation, pictures
Visualising modes of vibration, Chladni patterns (demo)
Correlation of modes of vibration to frequency response curves (FRC)
FRC defines how a guitar sounds (mostly!)
Measuring FRC. Demo on a few guitars
Examples of FRCs of generic guitar families (flamenco/classical/steel string etc) and how they differ.
Distinguishing features and modes of the different guitar types

Session 2: What controls mode frequencies and why are “good” frequencies “good”?

Introduction to Simple Harmonic Motion
Spring/mass systems
Response curve for a simple driven oscillator
Mechanical Admittance/Impedance
Coupling of components; coupled vibrations
Selecting target mode frequencies
Selecting the spread of mode frequencies

Session 3: Requirements of a guitar as a static and dynamic structure

Static requirements:

2 degrees of bridge rotation
Rotational stiffness measurement (demo)
Static stiffness design (EI for the soundboard)
Historic analysis of EI for a range of instruments

Dynamic Requirements

Hearmon's formula for orthotropic plates
Properties that need to be measured
Principles of properties measurement and tuning techniques

Session 4: Material Properties and Guitar Design

Wood selection: Using the wood you have rather than the wood you'd like
Static testing of wood properties + demo
Dynamic testing of wood properties (demo)
Requirements of the test blank (flatness, smoothness, shape)
Q testing (Discussion)
Back bracing schemes
Top Bracing schemes

Session 5: Moving from “as built” to “to design”

Efficient guitars - only move a resonance if its giving a problem
Principles of resonance shifting - adding/subtracting mass/stiffness. How to influence one mode and not another
Placing the main top resonance
Placing the main air resonance
Variables: Bridge mass, edge thinning, back plate, side masses, hole size

Session 6: Open session

More depth on anything the participants want to look at
(This is frequently the most valuable session for students)

