

The major free back modes in Cypress and Rosewood

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This study starts with the measured and observed frequency response of two guitar backs in early stages of production. These are little more than sheets of wood cut to the shape of a guitar. The thickness and weight of each is given below. Photos illustrate the patterns.

Traditional Spanish nylon/gut string guitar design dictates 3 transverse braces to stabilize the back. The exact placement of these braces differs somewhat from maker to maker. In this study I show the location of the natural node lines on Cypress and Rosewood backs. I've drawn 3 equally spaced transverse lines across the cypress back to give an indication of where the natural nodes align themselves in each of the three modes.



Monopole - The two node lines align with the outer two lines as drawn in this photo of a cypress back plate. This mode manifests at the following frequencies and thicknesses in this cypress example.

3.0mm/185g – 70Hz

2.5mm/154g – 59Hz



Long dipole - The center node line aligns with the center drawn line.

This mode manifests at the following frequencies and thicknesses.

3.0mm/185g – 188Hz

2.5mm/154g – 158Hz



Long tripole - Each node line is between the drawn lines.

This mode manifests at the following frequencies and thicknesses.

3.0mm/185g – 360Hz

2.5mm/154g – 304Hz



Long 4-pole - Each node line is between the drawn lines. This mode manifests at the following frequencies and thicknesses.

3.0mm/185g – not done

2.5mm/154g – 501Hz



Long 5-pole - Each node line is between the drawn lines. This mode manifests at the following frequencies and thicknesses.

3.0mm/185g – not done

2.5mm/154g – 742Hz

The Rosewood back in this example has a long/cross grain stiffness ratio that is less than the cypress back shown above. As a result, the node lines are not as straight as those manifested by the cypress back plate. To those unfamiliar with Chladni patterns, these may appear to be completely different patterns, but they are the same. Also, note that due to the different material used for the cypress (ground pepper) and rosewood (sawdust), round piles of material on the rosewood indicate the most active areas that are not similarly presented on the cypress tests.

The monopole is not pictured for rosewood. It is very similar to that shown in the cypress photo. This mode manifests at the following frequencies and thicknesses in the rosewood example.

3.0mm/319g – 62Hz

2.5mm/256g – 51Hz

2.0mm/200g – 41Hz



The Long dipole pattern in Rosewood:

3.0mm/319g – 188Hz

2.5mm/256g – 155Hz

2.0mm/200g – 116Hz

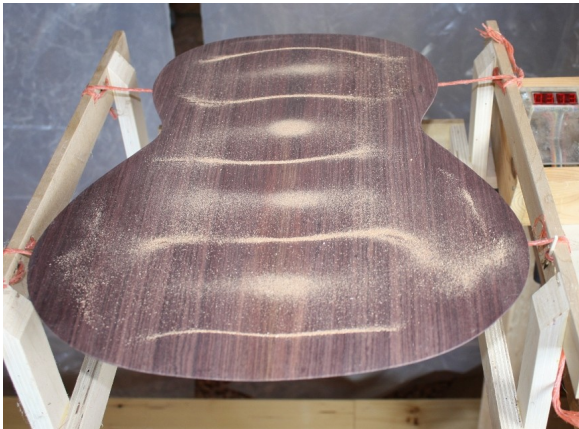


The Long tripole in Rosewood:

3.0mm/319g – 356Hz

2.5mm/256g – 292Hz

2.0mm/200g – 226Hz



Long 4-pole in Rosewood:

2.0mm/200g - 373Hz



Long 5-pole in Rosewood:

2.0mm/200g - 549Hz

A summary chart follows. Note the ratios of the modes to each other. Given how different the woods are, these ratios are remarkably consistent.

Weight	Wood/thickness	long poles as observed (free)					ratio 1 – 2	ratio 2 – 3	Ratio 3 – 4	Ratio 4 – 5
		1	2	3	4	5				
185g	Cypress 2.9mm	70	188	360			2.69	1.91		
154g	Cypress 2.5mm	59	158	304	501	742	2.68	1.92	1.65	1.48
309g	EIRW 3.0mm	62	188	356			3.03	1.89		
256g	EIRW 2.5mm	51	155	292			3.04	1.88		
200g	EIRW 2.0mm	41	116	226	373	549	2.83	1.95	1.65	1.47

As a picture is worth a thousand numbers in a table, the following graph shows graphically how the thickness of the wood correlates to the frequencies at which the various modes appear. The thicker the wood, the steeper the curve. Even though the two woods differ considerably in stiffness along and across the grain, the curves are virtually identical.

