Illustration by Mike Avitabile

Will the support mechanism have any effect on FRFs? Does bungie cord vs. fishing line make any difference?
It really depends - Let's discuss this.

Well, we have discussed the effects of the test set up before. But maybe we need to shed a little more light on this.

For your specific problem, there was some concern as to whether or not the damping may be affected by the way the structure is supported – for instance, whether we use an elastic cord or maybe fishing wire as suggested. In order to see what kind of an effect this may have, let's test a simple structure and see what effects may result from several different mechanisms to support the structure for modal testing.

For this test, we used a simple plate that was basically hung horizontally from the four corners of the plate using long flexible elastics (rubber bands) and nylon cord (fishing wire) in one set of tests. But then in a second set of tests, the plate was hung vertically and only supported from two corners in a pendulum type fashion. In all cases, the plate response was measured with an accelerometer that was fixed on the plate for all testing and an impact excitation was used to provide the input to measure the frequency response function.

As far as signal processing parameters are concerned, care was taken to assure that the time sample was long enough so that the response signal was essentially zero by the end of the time sample; this then ensured that the FFT was not affected by leakage and no weighting function (windows) were applied to the measurement.

The plate along with several different support configurations are shown in Figure 1. The impact hammer and accelerometer are also shown for reference. Rather than discuss the results for each of the individual tests performed, the results will be discussed for all four tests conducted.

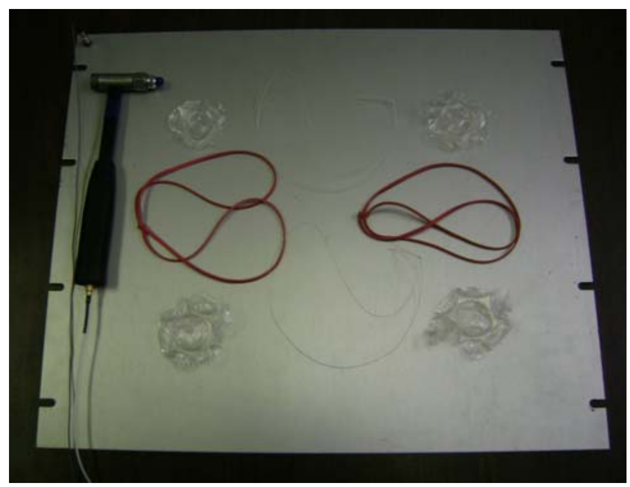


Figure 1- Plate with elastic cord and fishing wire
(as well as some bubble wrap pieces for other testing)

Figure 2 shows an overlay of the measured frequency response functions as well as the results of the frequency and damping obtained from the rational fraction polynomial curvefit (using the MEscope software). Only the first five modes were considered

At first glance, it is very obvious that there is some difference between the four different frequency response functions obtained from the four different tests performed.

In the case of the plate testing performed with the plate hung in a vertical orientation (in a pendulous configuration), there seems to be little difference in the measured frequency response functions; the blue frequency response function is with the elastic rubber bands and the green frequency response function is with the fishing line.

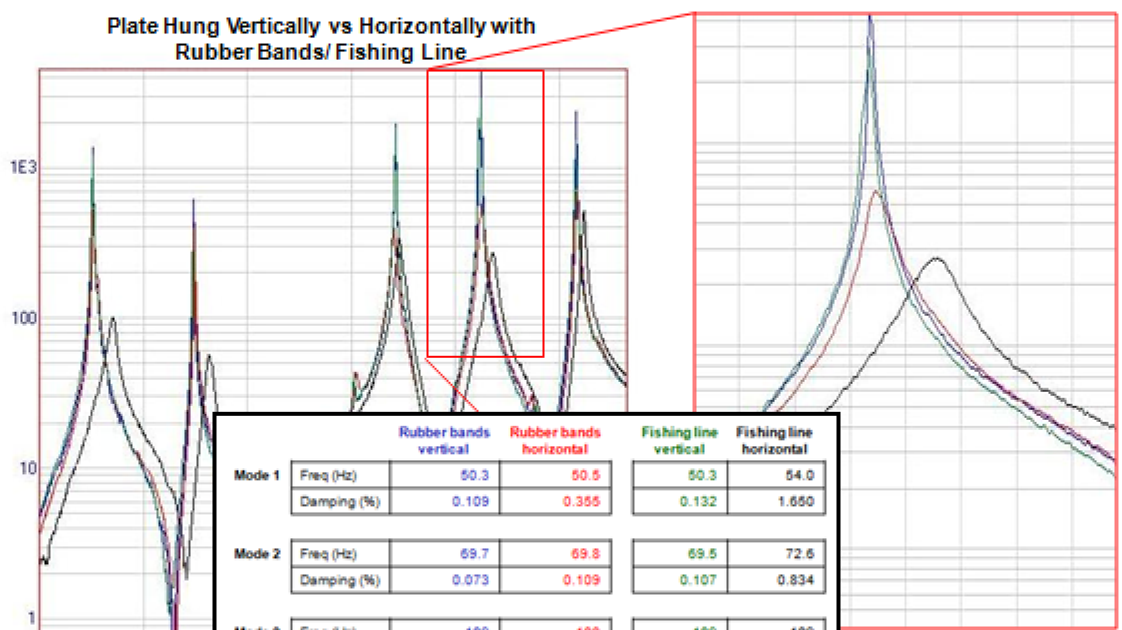
The frequency values are very similar for these two tests and the damping values are also similar but do show some differences. For this configuration, the results are not exactly the same but reasonably close to the same values (at least for the purposes of what is being presented here).

Now when the plate is supported horizontally, a different situation exists. For the elastic rubber band supports (red), the frequencies are very similar but the damping values are somewhat different with the values appearing to be higher than those for the vertically hung plate.

And then when looking at the fishing line with the plate hung horizontally (black), there is a very clear increase in the natural frequency for all the modes investigated. The damping values are also higher than any other configuration investigated.

So from these very simple, quick tests that were run, there is definitely a difference in the resulting frequency response functions and extracted parameters depending on how the test is set up.

I hope this explanation helps you to understand that the test set up can have a dramtic effect on some of the critical parameters of interest typically obtained from a modal test. If you have any other questions about modal analysis, just ask me.



		Rubber bands vertical	Rubber bands horizontal	Fishing line vertical	Fishing line horizontal
Mode 1	Freq (Hz)	50.3	50.5	50.3	54.0
	Damping (%)	0.109	0.355	0.132	1.650
Mode 2	Freq (Hz)	69.7	69.8	69.5	72.6
	Damping (%)	0.073	0.109	0.107	0.834
Mode 3	Freq (Hz)	109	108	109	109
	Damping (%)	0.081	0.435	0.095	0.554
Mode 4	Freq (Hz)	125	125	125	127
	Damping (%)	0.035	0.328	0.077	0.677
Mode 5	Freq (Hz)	143	143	143	145
	Damping (%)	0.045	0.182	0.088	0.227

Figure 2 – Comparison of FRFs for two different test set ups with two different support mechanisms along with frequency and damping extracted from the measured frequency response functions