MODAL SPACE - IN OUR OWN LITTLE WORLD by Pete Avitabile

Illustration by Mike Avitabile

Is there any effect in impact testing when hitting harder or softer with the different tips? This needs some discussion.

Well there can definitely be some significant effects depending on which tips you are using and how hard you are hitting the structure. Actually with imact testing, you really need to have the hammer do the work. This is not like driving nails in a wood framing operation. What I mean by this is that the hammer is held in your hand and your wrist is used like a pin joint as you swing the hammer. I have seen some people perform impact tests and they are swinging the hammer excessively which is not really the way to do this. (And I have seen some hammer tips that look like they have been through a nuclear detonantion they are so damaged.)

From what I have seen, there are many different hammer tips that are often supplied with the hammer kits commercially available. In particular, I want to concentrate on a few tips that I have seen that have significantly different force spectrums during various impacts with increasing levels of force applied to a structure. These tips need to be used with caution. The air capsule and the plastic cap on top of the hard plastic tip will be compared to the hard plastic tip to show some overlooked effects of these tips when used with different force levels.

In all cases, I will impact a very large, massive, steel block and I will keep the applied force level to a softer level, a medium level and a harder level of force applied to the block. In the first case, the air capsule will be evaluated, then the plastic cap on top of the hard plastic tips followed by the hard plastic tip. The results of these impacts (time pulse and input spectrum) are shown in the attached figure.

Air Capsule – This tip shows a dramatic change in the time pulse and resulting force spectrum depending on force level applied. Notice that the frequency spectrum excited with an attenuation of 20 dB changes significantly (and the hardest hit excites a much wider range overall). So that if you are performing an impact test and every hit for an average has a different level of force, the spectrum excited by that impact is significantly different each time. This could have a significant effect in the coherence in the higher frequency ranges.

Plastic Cap on Top of Hard Plastic Tip – This tip can also exhibit the same type of behavior in many cases. For this particular test, the plastic cover was slightly longer than the hard plastic tip so that there was effectively a small air pocket included. Again depending on the level of excitation applied there may be a significantly different input force spectrum/frequency range excited.

Hard Plastic Tip – Notice that this tip shows relatively little variation in the spectrum force characteristics over the frequency spectrum excited. There is same small variation but relative to the previous two tips, it is relatively small. So the frequency range excited with this tip will be relatively constant even with relatively different impact levels applied.

This effect is very important when testing structures where the frequency range to be excited is critical. For the first two tips, the frequency range excited is very dependent on the level of excitation used for the test. Care must be exercised to assure that a fairly consistent force strike is applied with every impact, for every average, for every measurement. This is not so easy to do all the time. So use care when using some of those special impact tips as part of your impact hammer kit.

I hope this explanation helps you to understand that you need to be very careful when performing impact tests. If you have any other questions about modal analysis, just ask me.