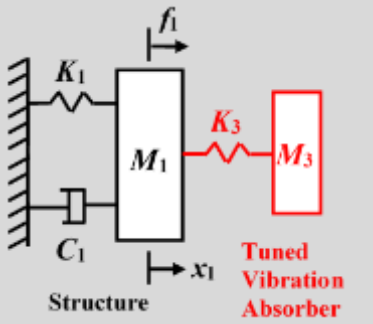
Vibration/Noise Absorption in an Airplane using Tuned Vibration Absorbers

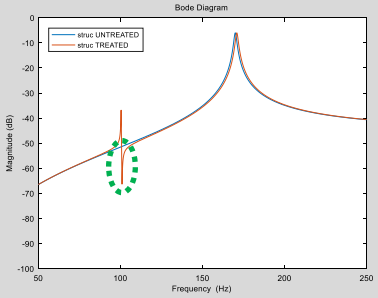
The airframes of some airplanes are equipped with a number of tuned vibration absorbers tuned the propeller blade passage frequency, to cancel out the noise and vibration and keep the cabin quiet and comfortable.

A number of the DVAs in a private airplane were removed from the airframe, disassembled and their leaf springs refurbished. Following the re-assembly of DVAs with their refurbished leaf springs, they were re-installed at their corresponding locations. DEICON re-tuned these tuned vibration absorbers to their target frequency of 102 Hz by changing their stiffness, via modifying the active length of their corresponding leaf springs in an iterative manner. After each slight change in active length, the acceleration/force frequency response function of the structure at the location where the dynamic absorber was installed, were measured. This iterative process continued until the tuning frequency got within 0.2% of the target frequency.

A *tuned vibration absorber*, also known as *dynamic vibration absorber* (DVA), is a spring mass system appended to a structure to absorb its vibration at a certain frequency. At its natural frequency, also called the tuning frequency, the DVA vibrates out of phase with the vibration of the structure. The outcome of this phenomenon is the absorption of vibration of the structure at that frequency.

The frequency response functions of a structure without and with a DVA are shown in the adjacent figure. The tuning frequency of DVA is the frequency corresponding to the notch, circled in green.





Accurate tuning resulted in absorption of the vibration of the airframe, at the intended offending frequency. The image of Figure 1 shows a technician changing the active length of the leaf springs of a DVA by repositioning its mass blocks.

A measured frequency response function of the airframe, following the re-tuning of the DVAs, is presented in Figure A-2. The frequency of the notch shown on the frequency response function (circled in green) is the tuning frequency of the DVA which matches the target frequency of 102 Hz.

Figure 1 A technician adjusting the active length of the leaf spring of one of the DVAs, by repositioning its mass blocks

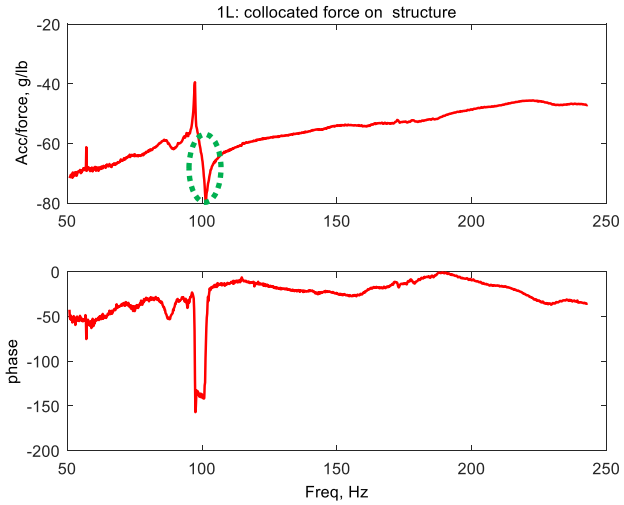


Figure 2 Frequency response function of the structure equipped with the re-tuned DVA