

Vibration Analysis for the Violin with or without Bass-bar

Yoshio Kurosawa ^{1,a}

¹ Faculty of Science and Technology, Teikyo University, 1-1 Toyosatodai,
Utsunomiya City 320-8551, Japan

^a<ykurosawa@mps.teikyo-u.ac.jp>

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Abstract. In this research, it examined how the existence or non-existence of the bass-bar of the violin changed vibration and sound. The bass-bar is the part to support the pressure of the bridge which is in the reverse side of the top plate by. It measures a vibration measurement and sound by the existence or non-existence of the bass-bar, using marketed violin manufacturing kit this research and installing the top plate in the musical instrument next, installing in the vibration measurement by the hammer excitation by the existence or non-existence of the bass-bar first only with the top plate and it introduces vibration modes and results of comparing transfer functions.

1. Introduction

The strings such as the violin are often manufactured by the scent of the workman and being empirical in the past and it is often adjusted. The authors are studying what sound (the vibration) they become if they change the structure and the shape of the violin, the thickness, the material of the board and also for the board in which part of the musical instrument it is easy to influence a sound, doing an experiment and the computation of the finite-element method. It examined a lot of research of the strings was done but how the existence or non-existence of the bass-bar (Fig. 1) changed vibration-a sound in [1] this research. The bass-bar is the part to support the pressure of the bridge which is in the reverse side of the top plate by.

This time, the vibration measurement result which used vibration analysis soft ME' scope VES is shown. It does a vibration measurement by the existence or non-existence of the bass-bar, using marketed violin manufacturing kit (HOSCO violin kit V-KIT-1) and installing a top plate in the musical instrument next, installing in the vibration measurement by the hammer with the bass-bar or without the bass-bar first only with the top plate and it introduces a result of comparing the transfer function of the vibration modes and the sound.

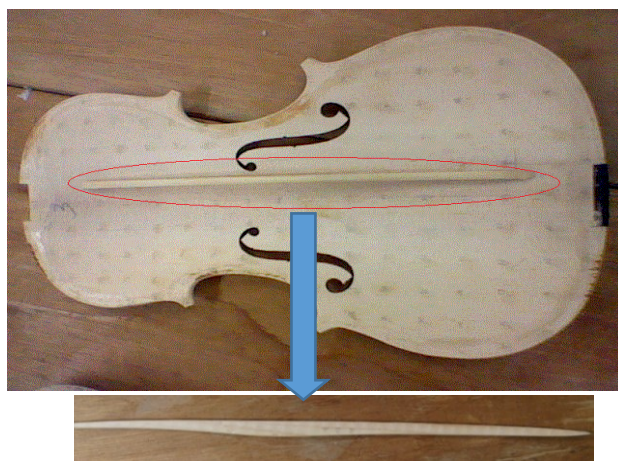


Fig. 1. Bass bar on the top plate of the violin

2. Experimental Results

2.1 Comparison of with or without Bass-bar on the top plate

The vibration entered the top plate with the excitation receptacle (4809 which is made from B&K) from the reverse side in the bridge mounting point. It measured 156 transfer functions in the 20 mm interval with the laser doppler vibrometer (VMS-100 which is made from NEOARK). Fig. 2. is experimental setup. Fig. 3 shows the results of comparison for frequency response function [unit is m/s/N] for 42 points near the top plate. In figure, the green lines are without the bass-bar, and the black lines are with the bass-bar. I know that the replying level falls by installing the bass-bar and that the resonant frequency is rising from the graph.



Fig. 2 Experimental setup of the top plate

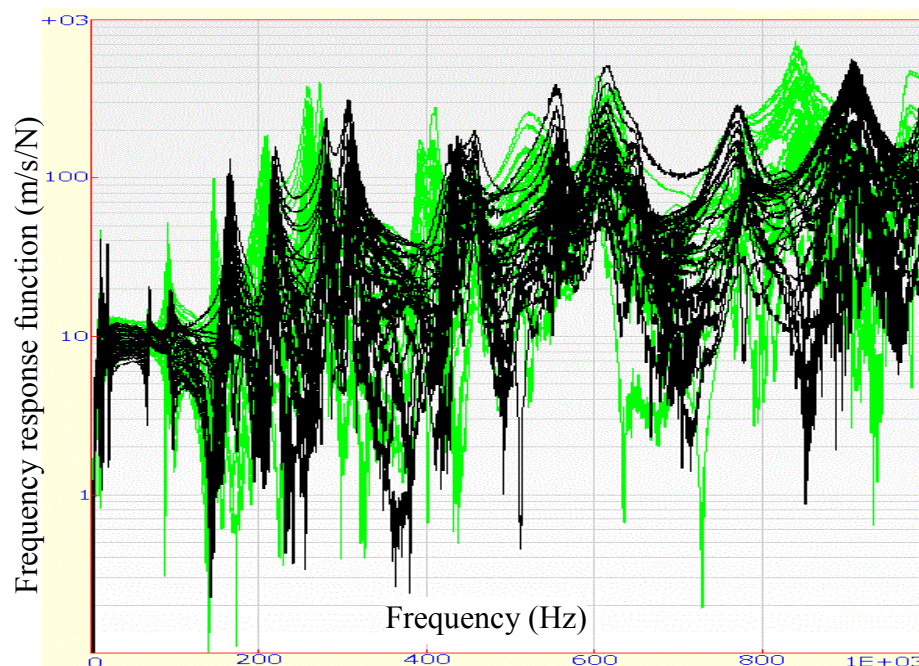


Fig. 3 Experimental results of frequency response function

Fig. 4 shows results of identifying vibration modes from the frequency response function. In figures, a is with the bass-bar, and b is without the bass-bar. It is a part with the amplitude of vibration which is big, being greenly partial. It is a part with the amplitude of vibration which is small in the blue place. As for either, the natural frequency was 460 Hz but the difference appeared in the vibration mode shape.

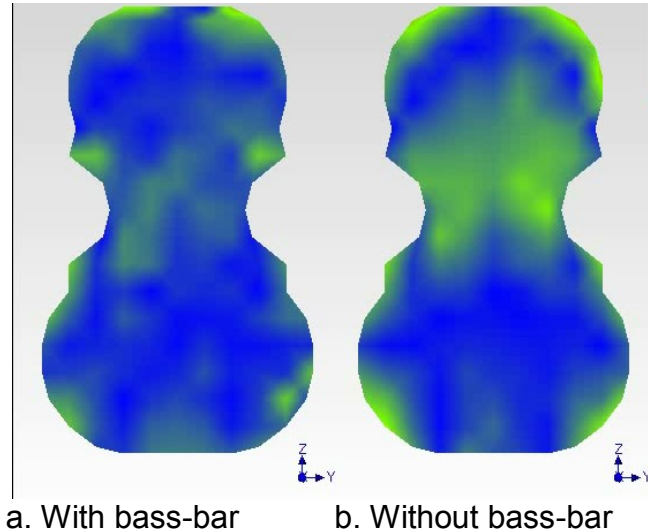


Fig. 4 Vibration mode (460Hz) of top plate

2.2 Comparison with or without the bass-bar when installing the top plate

It glued together the top plate with the glue at the violin in the condition to have installed a bass-bar and the condition not to install, and it compared vibration modes. Fig. 5. is experimental setup of violin. It did a center in the upper end of the bridge by the excitation with the excitation hammer. In the about 20 mm interval, it measured 352 points frequency response functions using accelerometers in the top plate - the stave - the back plate and it sought vibration modes. It used very thin fishing lines for the fixation of the musical instrument. Fig. 6. is comparison of the vibration mode with or without the bass-bar. I know that it becomes vibration modes with the big vibration area of the board by installing a bass-bar when comparing vibration modes at the near frequency. Incidentally, it measured the vibration of the back boxing, too.

There was little vibration mode in the change but as for the peak value of the transfer function, the one which has a bass-bar more was rather big. It thinks that this became it was easy for the vibration to spread through the back boxing and that the mode damping became small. Also, the influence of the gluing of the glue, too, is thought of. I want to make a problem in the future.

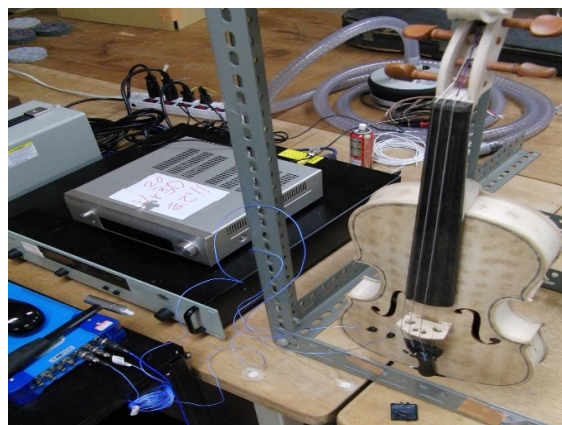
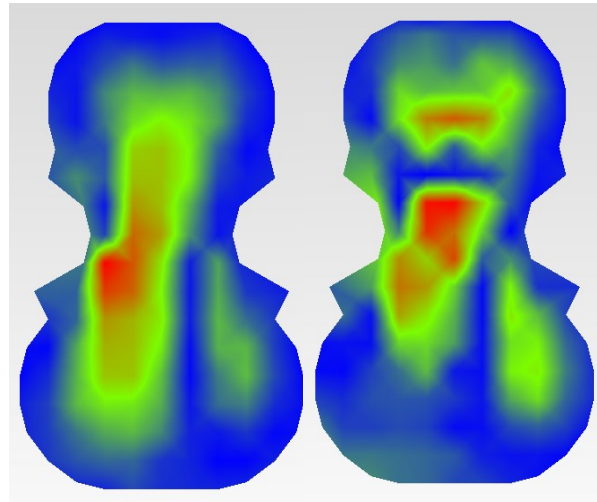


Fig. 5 Experimental setup of violin



a. With bass-bar (470Hz) b. Without bass-bar (457Hz)

Fig. 6 Vibration mode of top plate

2.3 Comparison of the sound with or without the bass-bar

It compared the sound with or without the bass-bar. Fig. 5. is experimental setup of violin. It played A line by the bow. In that case, it measured a sound pressure level with the microphone 550 mm above the upper end of the bridge. Also, it measured the vibration velocity of the bridge in that case using the laser doppler vibrometer. The frequency response function (unit is dB/m/s) which divided a sound pressure level by the vibration velocity of the bridge is shown to Fig. 8. It was possible to confirm that the transfer function (it is that it is easy to become to the sound) was changing roughly from the figure. It got a feeling that the sound became rather easy to make in the feelings and that the timbre, too, changed into the stiffer one.

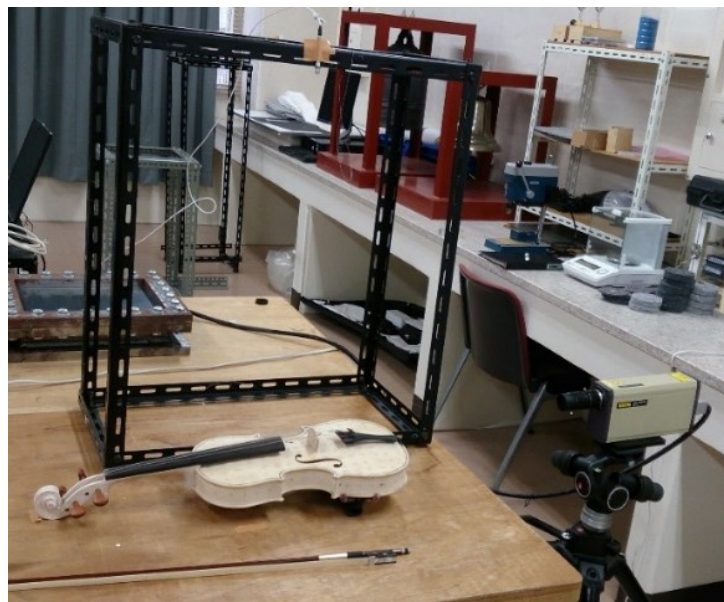


Fig. 7 Experimental setup of sound and vibration

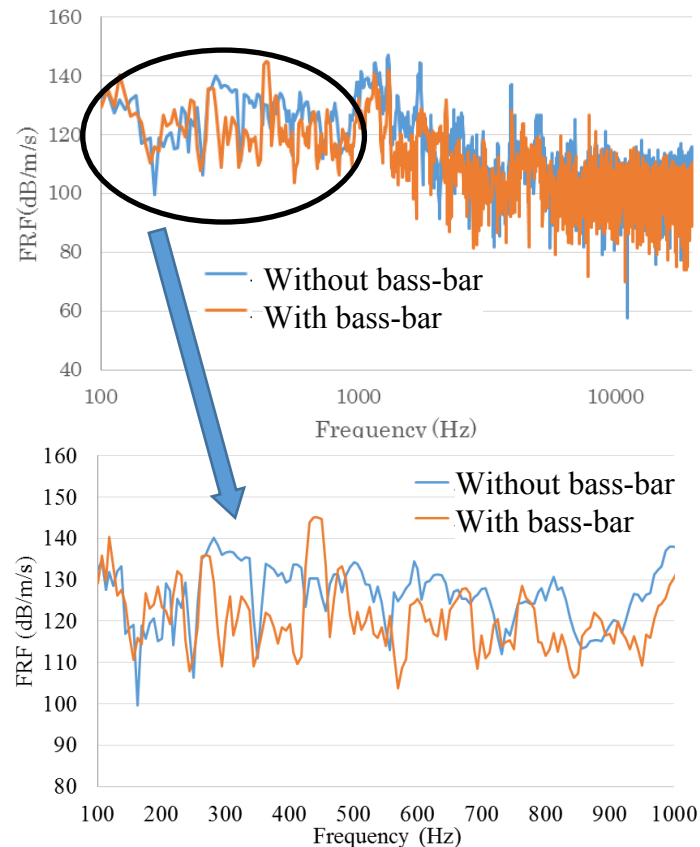


Fig. 8 Experimental results of sound / vibration

3. Conclusion

The bass-bar was the structural member to support the pressure of the bridge by but it was possible to confirm that it had an influence on the vibration of the front plate of the violin and the timbre, too. Later, it plans to do the shape reviewing [2][3] which used a finite-element method.

References

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