

Evaluation of effect of added mass of air on measuring method of membrane stress using sound wave

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One of the most important issues in keeping membrane structures in good condition is to maintain the proper tension distribution over the membrane. However, it is not easy to determine the real stress level in the membrane quantitatively after completion of the structures. Fluttering by strong wind or ponding caused by rain water may cause severe damage to the membrane structure itself. Therefore, it is very important to know the magnitude of existing stress in membrane structures for their maintenance and management.

The authors proposed a new method to measure membrane stresses in two different directions separately using white noise sound waves instead of measuring the membrane stresses directly. The new method makes use of the resonance phenomenon of the membrane which is induced by sound excitation given through an audio speaker, where the effect of surrounding air on the vibrating membrane cannot be overlooked in order to assure high measurement precision.

In this paper, an evaluation scheme for the added mass of membrane for the effect of air on a vibrating membrane is discussed. It is confirmed that the proposed measurement scheme can be used as a tool for scientifically and quantitatively determining the membrane stress, since measurement accuracy can be achieved only with proper consideration of the added mass of membrane.