Aeroelstic Wind Tunnel Tests on 2D Membrane Structure

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ABSTRACT

Membrane structures are characterized by their lightweight and flexibility, which makes them rather sensitive to wind. In this paper, the flow-induced deformation of a membrane in a flow with a pressure gradient is studied. The investigation focuses on the deformation of a 2D membrane roofs. An series of wind tunnel test on flexible models was performed to investigate the aeroelastic behavior of 2D membrane structures. Laser displacement meters were used to measure the time-history displacement of roofs.

Random decrement technique and load response correlation method were adopted separately to identify some modal parameters, which are aerodynamic damping and added mass. Their variation with wind speed, exposure, structural stiffness and vibration mode shape were analyzed especially, and the mechanics of wind-structure interaction were discussed.

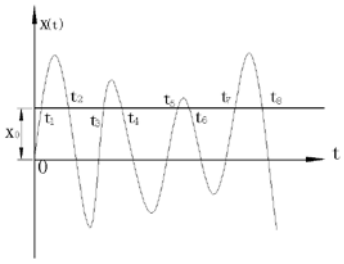

Fig. 1 The random decrement technique

Fig. 2 wind tunnel test model

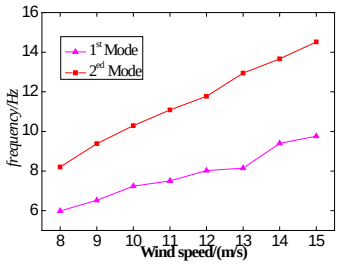

Fig. 3 The frequency of the response

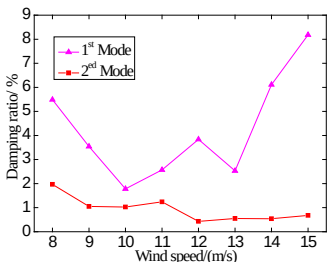

Fig.4 Damping ratio of the response

The frequency of the response increased with the wind speed, because the tension of the membrane increased with the wind speed. The damping ratios of the first mode are bigger than that of the second mode, and the damping ratio of the first mode decreased at low wind speed and increased at high wind speed. But those of the second mode keep decreasing with the increase of the wind speed.

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