Abstract Submitted
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Procedure to the collapse of the Tacoma Narrows Bridge[1] WOOJIN KIM, HAECHEON CHOI, Seoul National University — The Tacoma Narrows Bridge (TNB) was collapsed in 1940 at the wind speed (U) of 18m/s corresponding to Re = 3000000 based on the height (H=2.4m) of the deck. The deck was lifted by two cables with 110 hangers and each cable was suspended by two towers. The deck experienced a vertical vibration with the spanwise wavelengths (l) of 1/4 and 1/4.5 of the deck length (L) and the non-dimensional frequency of St = fH/U = 0.08, followed by a torsional vibration with l = L and St = 0.027. We investigate the procedure before the collapse of the TNB using numerical simulation with fluid-structure interaction. We consider Re = 300 and 1000 because the non-dimensional frequency of vortex shedding is not much changed by the change in the Reynolds number due to a fixed separation point at the leading edge of the deck. A nonlinear model for a suspension bridge (Arioli Gazzola, 2017) is used for the motion of the TNB. Initially, two-dimensional vortex shedding is generated with a weak vibration of the deck. Then, the deck oscillates vertically with l = L/4.5 and St = 0.09, together with three-dimensional vortical structures behind the deck. Finally, the deck oscillates torsionally with l = L and St = 0.033. These predicted vibrations of the TNB are in good agreements with those occurred in 1940.

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