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O B A V I J E S T

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General linear aeroelastic stability and post linear behavior of bridges and cross sections in wind flow

ABSTRACT: Dynamic wind effects on long bridges are frequently analyzed using a double degree of freedom (DDOF) model working with heave and torsional response components of a respective cross-section. The wind-structure interaction based on the energy extraction from the flow leads to the formation of the non-conservative and gyroscopic self-excited forces. The lowest critical state of slender systems can be investigated using double degree of freedom linear models of neutral type with aero-elastic forces treated as constants. This approach is working well on the theoretical level, but it shows number of shortcomings due to neglect of time dependency. Thus the approach using flutter derivatives or indicial functions has been introduced in the past. However, these two groups of models have been developing separately and it seems they are also isolated until now. The paper puts all three approaches together on one common basis and tries to establish linkage of them avoiding the time/frequency duality. The stability limits are analyzed by means of the generalized Routh-Hurwitz approach and Lienard theorem. The practical examples are shown.

Moreover, the wind tunnel analysis of a double-degree-of-freedom system represented by sectional girders is carried out. Besides an evaluation of the aero-elastic coefficients, the analysis is focused on the influence of the natural frequencies ratio on the initiation of unstable vibration, which can be of practical interest. On the phenomenological level, the article also discusses experimentally ascertained response regimes, with an emphasis on their stability character. The attention is paid to the effect in the response described by the ”hysteresis” loop together with the separation curves determining the stability boundaries. The influence of initial disturbance on the stability is examined. Two types of cross-sections were investigated: (i) rectangular one with the aspect ratio 1:5, and, (ii) bridge-like cross-section with comparable principal dimensions. For both types of cross-sections, the limits of the stability are significantly affected by an intentionally introduced initial disturbance. This holds especially with regard to the rectangular profile where the separation curves create very narrow sub-domains between a stable and an unstable response, while the bridge-like cross-section demonstrates much stable behavior.

Pozivaju se studenti, apsolventi i svi zainteresirani da prisustvuju predavanju, koje će se održati u predavaoni br. 2 Geofizičkog odsjeka PMF-a, Horvatovac 95, Zagreb. Studentima 2. godine diplomskog sveučilišnog studija fizika - geofizika je prisustvovanje predavanjima u sklopu Geofizičkog seminara obavezno.