8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

POSTBUCKLING BEHAVIORS OF STEEL TRUSSES UNDER MECHANICAL AND THERMAL LOADS

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Key Words: *Critical temperature, critical load, fire, post-buckling, temperature, truss, yielding.*

ABSTRACT

Temperature rise may lead to strength degradation and stiffness deterioration of structures under fire conditions. The purpose of this paper is to theoretically study the thermal effect on the post-buckling behavior of an elastic or elastoplastic two-member truss, based on the large-deformation elasticity considerations. Two kinds of loadings are considered, i.e., trusses under constant temperature but increasing loads, and trusses under constant loads but rising temperature. For the case with constant temperature, the critical load of an elastic truss will be greatly reduced if the effect of yielding is taken into account. Moreover, yielding of material can cause the truss to bifurcate from the original elastic path. For the case with constant loads, a critical temperature that occurs as the limit point of the temperature- deflection curve can always be found. Besides, the presence of yielding can drastically reduce the critical temperature of an elastic truss, causing it to collapse in an abrupt manner. The solutions presented herein can be used as the benchmarks for calibration of the accuracy of general finite element procedures in analyzing structures under fire conditions.

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