LONG-TERM STABILITY OF THIN STRUCTURAL MEMBERS SUBJECTED TO CREEP DEFORMATIONS

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In the past decades, new technological developments have intensified the demand for lightweight thin flexible structures. Such structures play an increasingly important role in many applications, particularly, in the fields of energy, construction, transportation, aviation and space exploration.

However, the service life of thin structures is often terminated due to various complications arising from the problem of long-term structural instability. Such complications amount to the development of creep buckling deformations that typically culminate in catastrophic failures. In view of the complexity and serious implications of the problem, any measurable effort to extend the lifetime of thin-walled structures requires the development of innovative design strategies involving the inclusion of materials as an important design variable.

This paper presents a unified approach to the creep buckling analysis and the analysis of structure-base interaction problems involving thin composite structures such as laminated beam-columns and plates. The mechanical properties of the structures are defined in terms of the linear hereditary viscoelasticity coupled with the concept of thermorheologically simple material behavior. The problems are solved by means of the quasi-elastic solution method. Both linear and nonlinear buckling analyses are presented.

The obtained solutions afford a consistent examination of the time-dependent critical conditions and post-buckling characteristics of the structural members under consideration. An assessment of the useful life of viscoelastic structures subjected to creep buckling is provided based on the critical time concept. This approach is discussed vis-à-vis the concept of the critical load which is usually considered to be the major factor in for elastic structures.

Keywords: creep buckling, viscoelasticity