NONLINEAR FINITE ELEMENT MODELING AND CHARACTERIZATION OF GUYED TOWERS UNDER SEVERE LOADING

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ABSTRACT

Guyed towers have been widely employed in the telecommunication industry. This study thus intends to improve the understanding and analysis of guyed towers that undergoes not only large deformation, but also large strain. Impulsive loads are potential threat to the safety of guyed towers besides wind load, earthquake, and ice storm. This research explores the area using an already developed P-I diagram method and nonlinear finite element modeling to provide an efficient and effective way for structural integrity evaluation for guyed towers.

The mechanical characteristics of basic components of guyed towers are investigated first. Because guyed towers with large defection also have large strain in some parts, material nonlinearity is introduced by improving the existing FEM codes for trusses and cables. It is found that the improved methodology can well predict the performance of structures and tremendous difference exists between elastic analysis and inelastic analysis. Under seismic loading condition, inelasticity in material can help dissipate the inputted seismic energy and reduce the intensity of structural response.

To evaluate the guyed tower's safety under impulsive loads, relative P-I formulas have been derived based on existing transverse velocity profiles of rigid plastic beams under impulsive loads. The impact of boundary condition and load types on the response is investigated. It is found under certain conditions only one failure mode is possible. But shear failure and bending failure can coexist under very severe impulsive loads. Most guyed towers are expected to survive light or medium impulsive loads due to their high redundancy and small loading area.