Damage detection for UHPFRC communication tower based on frequency data and particle swarm optimization

ABSTRACT

Advances in the telecommunication and broadcasting sectors have increased the need for networking equipment of communication towers. Slender structures, such as towers, are sensitive to dynamic loads, such as vibration forces. Therefore, the stability and reliability performance of towers can be maintained effectively through the prompt detection, localization, and quantification of structural damages by obtaining the dynamic frequency response of towers. However, frequency analysis for damaged structures requires long computational procedures and is difficult to perform because of the damages in real structures, particularly in towers. Therefore, this study proposed a correlation factor that can identify the relationship between frequencies under healthy and damaged conditions of ultra high performance fiber-reinforced concrete (UHPFRC) communication towers using particle swarm optimization. The finite element method was implemented to simulate three UHPFRC communication towers, and an experimental test was conducted to validate and verify the developed correlation factor.

Keyword: Communication towers; Ultrahigh performance concrete (UHPC); Dynamic nonlinear analysis; Frequency response; Correlation factor; Finite element method; Particle swarm optimization (PSO)