ABSTRACT

A study is concerned with the dynamic behavior and characteristics of a group of towers and a dome surrounded by a group of a tower acted upon by wind forces. The study also presents the static approach for evaluating the approximate response of these groups. Tandem, side-by-side and in addition to staggered arrangements of the towers are studied. The dynamic wind forces are represented by a harmonic sine pulse. The towers are modelled by assemblies of two and three dimensional conventional stick model while the dome shell is modelled by flat shell elements covering side arches of central angle less than or equal 22.5° . Finally, ring beams are modelled by brick elements.

Both the equivalent static and the dynamic response analysis are carried out using the facilities available by MSC/NASTRAN software, for which, a detailed formulation of stiffness and mass matrices of element type is highlighted in the study.

The resulting responses as predicted by the equivalent static approach are compared to that obtained by previous theoretical and experimental work including wind tunnels.

The free and forced vibration analysis of single towers, group of towers with different arrangements and domes are studied through ten numerical case studies and also compared with the available previous work. Results have shown that:

Staggered arrangement can give higher response than that predicted by other arrangements. The lift forces if used alone in the in-plane direction of wind result in higher response than used the lift and drag forces together. Difficulty of the occurrence of lock-in condition for a dome is due to complicated of the three dimensional flow. Many of local modes may be estimated for a dome and they have no contribution to global response in case of dynamic analysis.

Recommendations for future work are also presented to allow for continuous scope of research