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Basic Modal Displacements (BMD) for Optimizing the Buildings Subjected to Earthquakes

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Abstract : In structural optimizations through meta-heuristic algorithms, analyses of structures are performed for many times. For this reason, performing the analyses in a time saving way is precious. The importance of the point is more accentuated in time-history analyses which take much time. To this aim, peak picking methods also known as spectrum analyses are generally utilized. However, such methods do not have the required accuracy either done by square root of sum of squares (SRSS) or complete quadratic combination (CQC) rules. The paper presents an efficient technique for evaluating the dynamic responses during the optimization process with high speed and accuracy. In the method, first by using a static equivalent of the earthquake, an initial design is obtained. Then, the displacements in the modal coordinates are achieved. The displacements are herein called basic modal displacements (MBD). For each new design of the structure, the responses can be derived by well scaling each of the MBD along the time and amplitude and superposing them together using the corresponding modal matrices. To illustrate the efficiency of the method, an optimization problems is studied. The results show that the proposed approach is a suitable replacement for the conventional time history and spectrum analyses in such problems.

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