



Sensitivity Analysis based Optimal Seismic Design of Tall Buildings under Story Drift and Base Shear Constraints

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Abstract

Earthquake actions for tall buildings are significant due to great building height and huge building mass, thus numerous tall buildings are controlled by earthquake actions. Inadequate lateral stiffness may cause excessive damage to non-structural components, thus story drift limitations under earthquake actions are specified in Chinese Code. Chinese code also specifies minimum base shear limits under earthquake actions to ensure the minimum shear force resisting capacity. A sensitivity analysis method for story drift and base shear constraints is derived in this study based on response spectrum method. The optimal strategy of optimal design problem with double constraints is established. Then cost effective structural design can be achieved by reasonably distributing materials among the various components. A real 468-meter tall building project is employed to illustrate the applicability and effectiveness of the optimal seismic design method under story drift and base shear constraints.

Keywords: sensitivity analysis; optimal seismic design; tall building; story drift constraint; base shear constraint.

1 Introduction

Optimal resizing technique is attracting increasing interest in the building industry, especially in the design of tall buildings. Optimal resizing technique includes objectives, constraints, and design variables. Objective function is minimized (or maximized) during optimization. Objectives can be weight, structural cost, or seismic energy. Constraint functions are the criteria that the system has to satisfy for each feasible design.

Constraints include stress, drift, base shear, etc. Design variables generally are member sizes in optimal resizing technique.

There are two methods to optimize cross-sectional dimensions of structural members. One is automatic structural optimization method. The optimization problem is first explicitly defined. Optimization algorithm such as Mathematical Programming (MP) and Optimality Criteria (OC) is developed to solve the optimization. By automatically resizing members, objective can be