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# Comparing the Results of Frames Optimization under Stress and Displacement Constraints with Frames Optimization under Frequency Constraint

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**Abstract**

Optimization is the foundation of all scientific and daily activities. As we know, the purpose of optimum design in engineering is choosing the best design among all acceptable designs. In this study the optimal design of a ten-story frame under the stress and displacement constraints based on the AISC-ASD specifications and Iranian code of practice for seismic resistant design of buildings is performed. And the results are compared with results obtained from the optimal design of that frame under the frequency constraints of the frame. The chosen frequency constraints are the frequency of the first three modes of the frame that is optimized under the stress and displacement constraints. To perform the optimization the particle swarm optimization algorithm (PSO) is used. Finite element analysis software ANSYS for modeling and analysis of the structures and also mathematical software MATLAB for optimization process are used.

**Key words: Optimization, steel frame, stress and displacement constraints, frequency constraints, Particle Swarm Optimization Algorithm.**

## 1. INTRODUCTION

Optimization in civil engineering is finding a plan to construct in compliance with the technical principles, regulations and standards. The purpose of optimization is achieving minimum structural weight and decreasing the operating costs. The importance of designing the structures with minimum weight for the first time was considered by the aerospace industry in the design of aircraft structures. In other industries related to building engineering systems, costs may primarily be important. Determining a design which includes the minimum weight, is achieved by optimization algorithm, In which the structural weight is selected as the objective function. Along with satisfying the imposed requirements and constraints, it makes the weight minimum. Here in this study, optimal design of a ten story steel frame under the stress and displacement constraints is performed based on the AISC-ASD(1989) [2] specifications and Iranian Code of Practice for Seismic Resistant Design of Buildings [1] which is similar to UBC97 [5] code of practice, has been considered as the design code. And the results of optimal design of the frame under the stress and displacement constraint are compared with the results obtained from the optimal design of that frame under frequency constraints. The selected Frequency constraints are the first three frequency modes of the frame that is optimized under the stress and displacement constraints.

## 2. THE MATHEMATICAL MODEL OF OPTIMIZATION PROBLEM

### 2.1. OBJECTIVE FUNCTION

The automated design of steel frames may be mathematically formulated in the form of a standard optimization problem that consists of an objective function and a set of constraints. Among various options