OPTIMAL PERFORMANCE-BASED DESIGN OF STEEL BRACED FRAMES BY PSO AND FA METAHEURISTICS

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Design for seismic resistance is one of the most important tasks in the field of civil engineering. The seismic resistance design process has been undergoing a critical reappraisal in recent years, with the emphasis changing from *strength* to *performance*. In fact, the number of parameters which can affect the performance of a structure is usually large. In the sequel, recognizing that the current design is the best solution or still there is room for finding cost-efficient solutions is a difficult task. In the face of increase in price of materials, finding cost-efficient structural designs, with improved performance, is one of the major concerns in the field of structural engineering. In order to achieve this purpose, structural optimization methodologies have been developed during the last decades. The performance-based design of steel structures in the framework of structural optimization is a topic of growing interest (Gholizadeh and Kamyab, 2014; Kaveh et al., 2012; Fragiadakis and Lagaros, 2011). In the performance-based seismic design approach, nonlinear analysis procedures are efficiently employed to evaluate the seismic response of structures.

Structural optimization algorithms can be effectively used for replacing the traditional performance-based design (PBD) process with an automatic advanced procedure for structural seismic design. In this case, pushover analysis can be incorporated in a structural optimization strategy to evaluate the structural performance at the various performance levels. In this study, two well-known metaheuristics particle swarm optimization (PSO) and firefly algorithm (FA) are employed to achive optimization task in the framework of PBD of steel braced frames. In order to illustrate the efficiency of the proposed methodology, two three and nine story planner steel braced frame structures, shown in Figures 1 and 2, respectively, are optimized for various performance levels using PSO and FA metaheuristics and the results are compared in Tables 1 and 2 respectively for three and nine story steel braced frames. The numerical results reveal that the FA possesses better performance compared with the PSO.

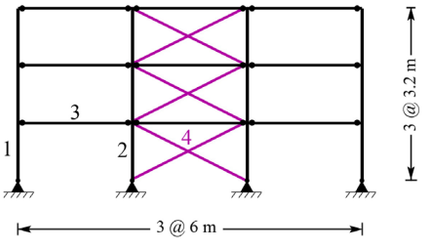

Figure 1. Three story steel braced frame

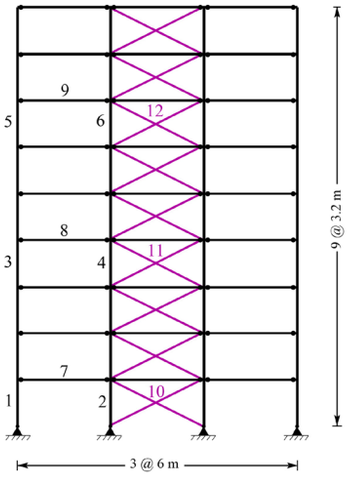

Figure 2. Nine story steel braced frame

Table 1. Optimization results for three story braced frame

Group No.	FA	PSO
1	W8X31	W16X36
2	W24X76	W24X76
3	W10X22	W10X22
4	W14X61	W8X67
Weight (Kip)	28.727	30.475

Table 2. Optimization results for nine story braced frame

Group No.	FA	PSO
1	W8X35	W8X35
2	W40X235	W27X194
3	W8X31	W8X31
4	W33X118	W30X116
5	W24X55	W24X55
6	W21X48	W21X44
7	W10X22	W10X22
8	W8X28	W10X22
9	W8X28	W8X28
10	W21X83	W8X67
11	W24X55	W14X48
12	W12X30	W12X30
Weight (Kip)	95.9	88.5

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