OPTIMAL SEISMIC DESIGN OF STEEL MOMENT RESISTING FRAMES

Hassan MOGHADDAM
Professor, Sharif University of Technology, Tehran, Iran
Moghadam@sharif.edu

Seyed Mojtaba HOSSEINI GELEKOLAI
PhD Student, Sharif University of Technology, Tehran, Iran
Hosseinigelekolai@gmail.com

Keywords: Seismic Design, Optimal, Uniform Deformation Theory, Steel Moment Resisting Frames

This paper proposes an effective method to optimize the distribution of sections of steel moment frames under earthquake. For optimization the uniform deformation theory is used. In order to demonstrate the efficiency of the method, the optimal distribution of sections for 5 and 10 story frames are obtained respectively. In order to eliminate the sensitivity of the optimal solutions to discrete sections, contiguous sections fitted between Eshtal sections were used since the structure get close enough to its optimal state. In this study, steel moment resisting frames have been optimized subjected to 5 natural earthquakes and one Artificial Earthquake (average of other 5 natural earthquakes).

The results show that the optimized frame designed by this method not only show better performance in earthquake but also, has less weight than the original structures which designed in accordance with ASCE standard. Structural weight reductions reach up to 50% weight of structure which lead to less expenditure on the construction cost.

Table 1. Characteristics of ground motions used in this study

EQ. #	Earthquake	Record/ Component	Station	Magnitude (Ms)	PGA (g)	PGV (cm/s)	PGD (cm)
a	Duzce, Turkey 1999	DUZCE/ DZC270	Duzce	7.3	0.535	83.5	51.59
b	Imperial Valley 1979	IMPVALL/ HE04140	955 El Centro Array #4	6.9	0.485	37.4	20.23
c	Loma Prieta 1989	LOMAP/ G03000	47381 Gilroy Array #3	7.1	0.555	35.7	8.21
d	Cape Mendocino 1992	CAPEMEND/ PET090	89156 Petrolia	7.1	0.662	89.7	29.55
e	Northridge 1994	NORTHR/ NWH360	24279 Newhall - Fire Sta	6.7	0.59	97.2	38.05

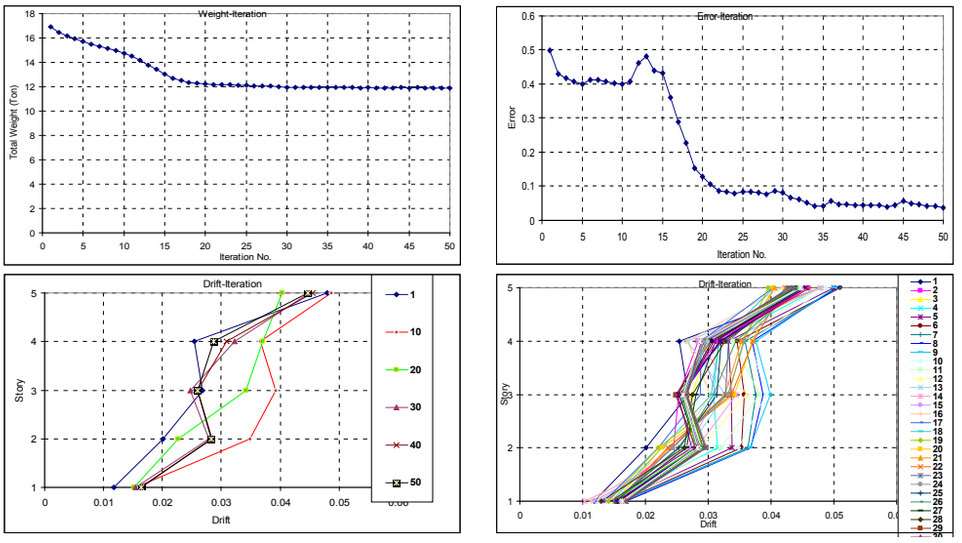

Figure 1. Optimization results of 5 story frame for earthquake a, top left: reduction of weight versus iteration number, top right: error from standard limitation versus iteration number, bottom left: inter story drift of frames in each 10 iteration, bottom right: inter story drift of frames in each iteration

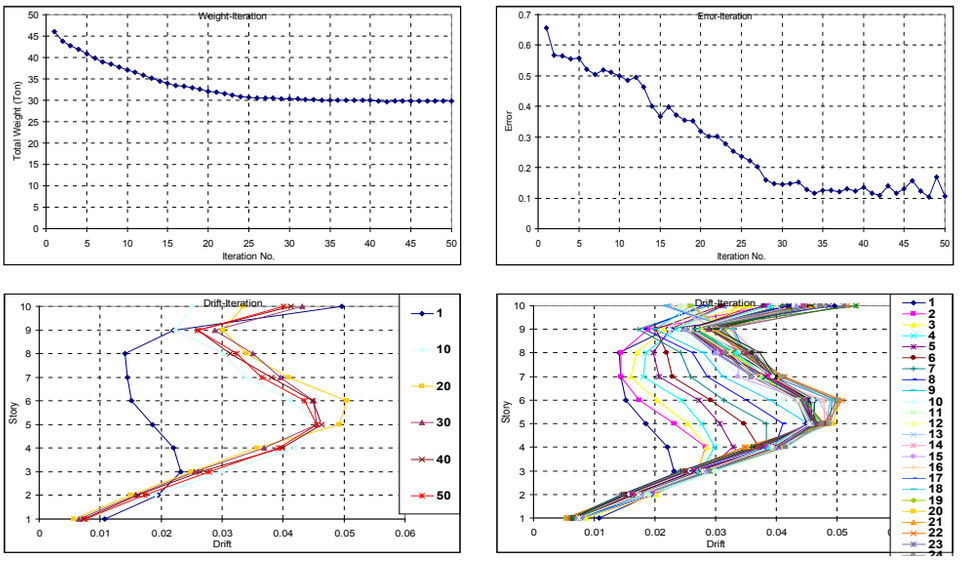

Figure 2. Optimization results of 10 story frame for earthquake a, top left: reduction of weight versus iteration number, top right: error from standard limitation versus iteration number, bottom left: inter story drift of frames in each 10 iteration, bottom right: inter story drift of frames in each iteration

REFERENCES

Hajirasouliha I and Moghaddam H (2009) New lateral force distribution for seismic design of structures, *Journal of Structural Engineering,* ASCE 135:8, 906-915

Karami Mohammadi R, El Naggar MH and Moghaddam H (2004) Optimum strength distribution for seismic resistant shear-buildings, *International Journal of Solids and Structures*, 41:22-23, 6597-6612

Moghaddam H, Hosseinigelekolai SM, Hajirasouliha I and Tajalli F (2012) Evaluation of Various Proposed Lateral Load Patterns for Seismic Design of Steel Moment Resisting Frames, *15th World Conference on Earthquake Engineering*, Lisbon, Portugal

Moghaddam H (1996) Earthquake Engineering (1st Edition), RTRC, Tehran, Iran

Moghaddam H and Hajirasouliha I (2006) Toward more rational criteria for determination of design earthquake forces, *International Journal of Solids and Structures,* 43(9): 2631-2645

Moghaddam H and Hajirasouliha I (2008) Optimum strength distribution for seismic design of tall buildings, *The Structural Design of Tall and Special Buildings,* 17(2): 331-349