Damage Assessment of Reinforced Concrete multi-storeyed Buildings

Pritam Hait[1*], Arjun Sil[1], Satyabrata Choudhury[1]
[1] *National Institute of Technology Silchar, Silchar, India*
** e-mail: corresponding author-pritamhait15@gmail.com*

Introduction

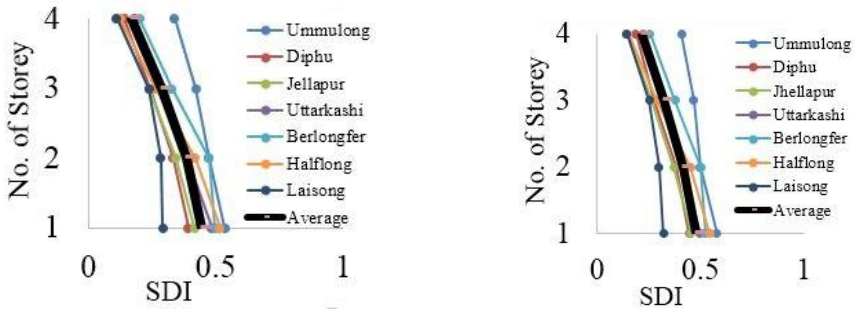
According to earthquake history, the North-East India and Himalayan region are the most seismic prone zone in India. In this seismic zone (zone-V) many seismic events occurred in the past and will happen in the future. Numerous structures have been damaged and life has been deceased due to falling of structures which are vulnerable for a seismic event. Therefore a seismic investigation is essential in this region to determine storey wise damage index under the site-specific ground motion. Structural damage has been quantified by several researchers in past decades such as for a reinforced concrete component, the damage was determined considering the combined effect of deformation and cyclic loading effect [1-2]. Further, DI was evaluated in terms of single or a combination of multiple demand parameters such as maximum deformation, modal parameters, dissipated hysteretic energy, inter-story drift, modal strain energy and initial to final resistance capacity of structures [3-6]. In this context, a comprehensive review has been done by the authors [7-8] to find out the limitation of work in this area. In that overview, it was suggested that a zonal basis [9] seismic damage evaluation is essential for a complete reliable damage assessment of structure that can be used in the future as design guidelines. Therefore in this study storey wise damage index and global damage index have been evaluated for 4, 8 and 12 storey SMRF buildings in seismic zone V in India.

Materials and Methods

There are several damage assessment methods are available among them Park-Ang [1-2] method is the preferred choice by the researchers as this method includes both deformation and energy effect and applicable on steel, RC, timber structure. This is why authors have adopted this method for storey wise damage assessment of the buildings. To perform the study a typical plan of 4, 8 and 12 storey reinforced concrete (RC) SMRF building have been considered. RCC design and seismic design were performed as per IS: 456-2000 and IS: 1893 2016. Capacity design principle i.e. all columns are stronger than beams by 1.4 times was followed in this design as per IS: 13920-2016. Non-linear time history (NLTHA) was performed in SAP2000 both x and y directions to obtain the best structural response. The buildings were analyzed under seven real earthquake ground motions converting into SCGM by Kumar software.

Results and Concluding Remarks

In this investigation, it was observed that ground storey experiences maximum damage and top storey experiences minimum damage for all buildings. Therefore ground storey should be strong enough to withstand the building in its position. It was also observed that ground storey DI (SDI) is higher than GDI therefore, ground storey DI should be considered as separate damage indicator than that of GDI.



(a) *(b)*

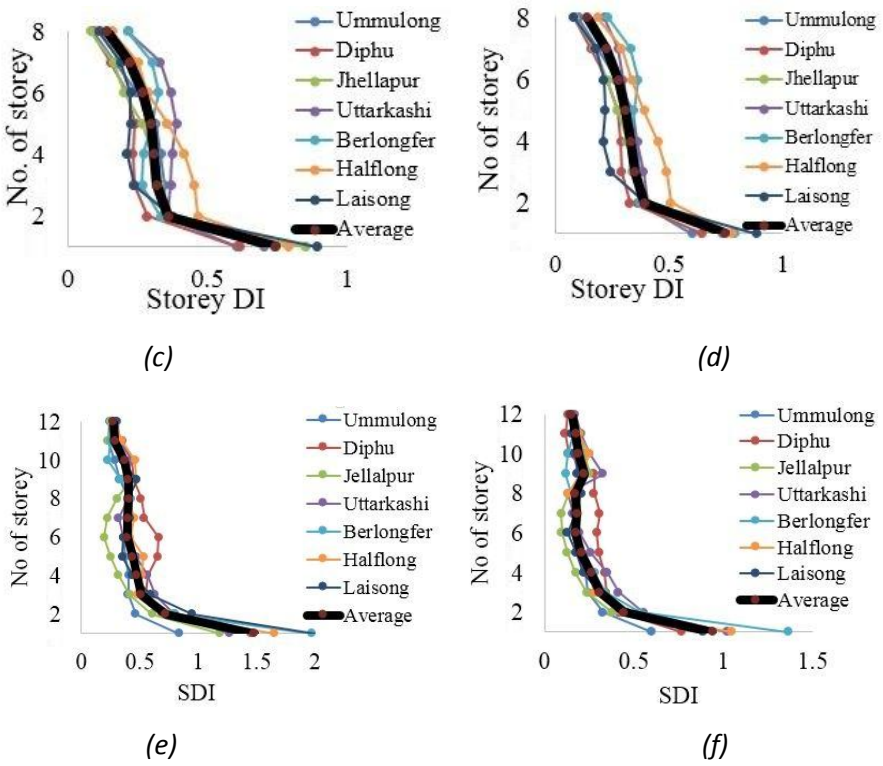


Figure 1: Storey wise damage index of all buildings (a) 4 storey in X dir. (b) 4 storey in Y dir. (c) 8 storey in X dir. (d) 8 storey in Y dir. (e) 12 storey in X dir. (f) 12 storey in Y dir.

Storey wise damage index of all buildings in both directions were shown in figure 1. Structural damage concentration has been observed in the lower storey due to the excessive moment in the beams.

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Journal article example:

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