THE EFFECTS OF NEAR-FIELD AND FAR-FIELD MULTIPLE EARTHQUAKES ON SINGLE STORY RC FRAMES

Ali Reza MANAFPOUR
Assistant Professor, Urmia University, Urmia, Iran
a.manafpour@urmia.ac.ir

Parisa KAMRANI MOGHADDAM
PhD Student, Urmia University, Urmia, Iran
p.kamrani@urmia.ac.ir

Keywords: Fragility Curves, Multiple Earthquakes, Incremental Dynamic Analysis

ABSTRACT

Most of the structures situated in seismic regions experience several earthquakes during their lifetime. The majority of research studies in earthquake engineering field consider the effects of a separate earthquake on an intact structure i.e. without any initial seismic capacity deterioration. This consideration might have been justified based on the low probability of occurring two ground motions of significant effects in the lifetime of the structure, or based on the assumption that there would be sufficient time to assess and repair the structure after the first event. However, based on recent experiences, the issue of a structure to be subjected to consecutive earthquakes is real and therefore requires adequate attention. These earthquakes may be considered as from the same seismic source commonly known as foreshocks, main shocks and aftershocks, or from nearby sources affecting similar regions.

It is now well known that the seismic ground motions recorded within the near-fault region of an earthquake are qualitatively quite different from the far fault seismic ground motions. Therefore, this paper aims to investigate the effects of multiple near-field and far-field earthquakes on a SDOF system using IDA. In order to evaluate frame's behaviour under these seismic situations, the systems are considered to have a spectrum of various dynamic properties and hysteresis stiffness and strength degrading characteristics.

It is concluded that multiple near field seismic excitations may result different lateral transient and permanent deformations as compared with far field ground motions. It is also shown that the extent of these differences depends on the structural dynamic characteristics which are sensitive to ground motion frequency contents. This suggests that multiple near field and far field earthquakes would require different seismic considerations within the design procedure. Recommendations are provided on the threshold of seismic excitations as a seismic hazard level to be considered.

INTRODUCTION

Most of the structures situated in seismic regions experience several earthquakes during their lifetime. Seismic resistant design traditionally has focused on structures under single isolated design earthquake. In fact they do not consider the effects of damage accumulation during possible previous events.This was to some extent due to the complexity of seismic behaviour and the limitations in technical and computational knowledge to understand and deal with the considerable uncertainties in structural behaviour under even one single seismic event. Lack of sufficient actual data was led to accept the assumption that there would be sufficient time to assess and upgrade the structure before the next significant event.

Reinforced concrete structures due to stiffness and strength deterioration in their structural materials are more vulnerable to multiple earthquake excitations compared with steel frame structures. The damage accumulation deteriorates the stiffness and strength of structural systems in a manner that can alter their dynamic characteristics and hence their response if subjected to subsequent earthquakes. This response