



# Site Specific Design Response Spectra for Bandar-e-Anzali Area

Behrooz Alizadeh<sup>1</sup>, Saeid Pourzeynali<sup>2</sup>, Reza Jamshidi Chenari<sup>3</sup>

1- Master of Sc., Department of Civil Eng., The University of Guilan

2- Associate Prof., Department of Civil Eng., The University of Guilan

3- Assistant Prof., Department of Civil Eng., The University of Guilan

alizadeh.fe87@yahoo.com

pourzeynali@guilan.ac.ir

jamshidi\_reza@guilan.ac.ir

## Abstract

Bandar-e-Anzali city, an area of 275 square kilometers and a population exceeding 150,000, is located in Guilan province in the north part of Iran. Since this area is located among many active faults, therefore it is one of the active regions of the Iran zone, seismologically. The main aim of this paper is estimation of specific design response spectra for different levels of seismicity active within the city's surrounding area. In this paper, after the removal of aftershocks and foreshocks by time and place windows method, first the Poisson behavior of the remaining earthquakes is studied, and then the seismicity parameters of this region is obtained for seismic hazard analysis. Finally, the site specific design response spectra related to horizontal and vertical coefficients of ground acceleration for this city and its suburbs have been obtained.

**Keywords:** Hazard response spectrum, Seismicity parameters, specific design response spectra, Bandar-e-Anzali area.

## 1. INTRODUCTION

Bandar-e-Anzali is located in geographic range of 49.22-49.36° north longitude and 37.20-37.26° east latitude; in the Sefidrood delta and western domain of Alborz Mountain, with an area of 275 square kilometers. In terms of topography, this city is placed on a smooth and extremely low height region that does not exceed 4 meters. Also, the Anzali city is placed nearly 23 meters below the surface of waters of the world [1]. Due to the remarkable region's population, and existing important structures such as jetties of Anzali, seismicity studies of the area could be crucial. Considering the severe historical and instrumental earthquakes in the region including Manjil-Rudbar great earthquake in 1990, the probability of the earthquakes occurrence with high intensity in the region is expected.

The main objective of this paper is to estimate the specific design response spectra for different levels of seismicity active for Bandar-e-Anzali area. For this purpose, the latest statues of the major faults in the area [2-7]; the reported historical earthquakes [8]; and the registered instrumental earthquakes by the end of 2010 A. D. [4, 9, and 10] within a radius of 200 km from the center of the city have been collected and studied. In the present study, after removal of aftershocks and foreshocks by using time and place windows method [13], first the Poisson behavior of the occurrence of the remaining earthquakes is studied, then by calculating the frequency of earthquakes using probabilistic seismic hazard analysis relationships of Kijko 2000 computer program [12, 13], seismicity parameters of the region for seismic hazard analysis is obtained. Finally, the specific design response spectra for Bandar-e-Anzali and its suburbs have been obtained.

## 2. SEISMICITY OF BANDAR-E-ANZALI AREA

In the point of seismotectonics view, Iran area can be divided into four states [2]: strip folded-driven Zagros, Makran region in southeast of Iran, the Central Iranian plateau, and Alborz Mountains, among which the last state is discussed in the present study. In terms of seismicity, existing of multiple faults in the Alborz region has led to the identification of one of the most seismotectonic regions of Iran with high seismic hazard. The Guilan province which includes the Bandar-e-Anzali city also, is located in this most seismotectonic region.

More than 24 major and minor faults have been identified in surrounding area of the Guilan [2-9]. By considering various factors including the proximity to Bandar-e-Anzali and fault's seismicity background, 16