Difficulties on Earthquake Design due to Standards Limits on an Extensive Offshore Bridge, Sheikh Jaber Al-Ahmad Al-Sabah Causeway in Kuwait

Aurélie Vivier, Georges Mauris, Mohamed Akraa, Serge Montens

Systra Consulting and Engineering, Paris, France

Contact: avivier@systra.com

Abstract

Subiyah project design was implemented with long discussions due to standards limits. With 36 km of viaducts, all decisions had a significant impact on quantities and then on cost.

Project is based on 2.5 and 3.0 m monopiles and standards design requirements are not adapted for such diameters. Moreover, some additional project requirements, not addressed in most of the codes, made also the design more complex (service earthquake and imposed strength reduction factor). All those parameters led to complex discussions on earthquake design: R factor value, capacity design, seismic detailing, P-D effect, asynchroneous motion, seismic design of bearings.

The aim of this article is then to present all the previous inconsistencies of project standards for non-typical structures, all related discussions, and the numerous comparisons that have been done with Eurocode to explain and/or solve the problems.

Keywords: Earthquake design, R factor, overcapacity and detailing, P-Delta, asynchroneous motion, bearings, AASHTO, Eurocode

1 Introduction

For the design of Sheikh Jaber Al-Ahmad Al-Sabah Causeway project in Kuwait, the AASHTO LRFD 2007 [2] is the project standard. Due to many difficulties in application of the standard regards to particularities of the conception and design requirements, many discussions and comparisons to Eurocodes have been done and are presented in this article.

Typical structures of the project are 6*60 m and 8*40 m concrete box girder spans with connection to on monopiles with elastomeric bearings.

Two earthquake levels were considered for design, based on client requirements: a Service Earthquake and an Extreme Event Earthquake.

1.1 Seismic context

At the Extreme Event with no collapse requirement, PGA is 0.14g. At the Service Limit State with no damage requirement, PGA is 0.08g. The bridge was classified as Essential and the soil was classified as Profile Type IV (soft clay) or Type II (dense sand). The vertical motion was taken as 2/3 of the horizontal one. Seismic levels are presented in Figure 1.

https://doi.org/10.2749/nantes.2018.s23-47
Distributed by structurae