Special Issue on

SPECIAL PROBLEMS IN BRIDGE ENGINEERING

Editors

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PREFACE

In the last years bridge engineering has undergone a remarkable expansion and increase in complexity due to advances in scientific knowledge about materials, structural and soil behavior, and in computing techniques available to cater for refined theories. Consequently bridge engineering today covers several fields of science and requires a multidisciplinary analysis and design approach involving materials, structural, geotechnical, wind and earthquake engineering. A proper appreciation of the state-of-the-art in bridge engineering requires an in-depth understanding of advanced and special problems regarding analysis and design, construction and rehabilitation of both cable supported, girder and arch bridges.

This special issue aims at analyzing some relevant aspects in bridge analysis for several bridge typologies, addressing some questions of structural analysis and highlighting new understanding in the load and structural modeling, experimental characterization and seismic aspects, including soil-structure interaction. Eleven peer-reviewed papers are included in this special issue. Three papers concerning design and erection aspects, three papers focused on seismic aspects, two papers regarding structural analysis and modeling, one paper focused on wind load modeling, one paper concerning structural performance assessment of an ancient arch bridge and one paper on shake table experimental study.

In their paper titled “Effects of Secondary Torsion in Curved Prestressed Concrete Bridges Built by Incremental Launching Method”, Arici and Granata propose an analysis of the construction stages of concrete curved incrementally launched bridges taking into account the effects of secondary torsion. Two different cases are examined and by both one launching the whole box section and one without the upper slab (U-shaped section). Results show that in the case of the whole box section a high provisional prestressing is needed and the launching tools are very demanding, whereas in the case of the partial section temporary piers are required leading to a reduction of the launching tools and of provisional prestressing.

Baratta et al., in their paper titled “On the Effect of Lightening the Solid Fill in an Ancient Masonry Bridge”, develop a study of a historical masonry arch bridge.The paper proposes a methodological approach to examine the global behaviour of masonry vaulted bridges. More precisely, an existing ancient masonry arch bridge, i.e. the Devil’s bridge on the Sele river in the Campania

Region of Italy, is studied, which is integrally composed by masonry blocks, both in its structural and non-structural components. A preliminary simplified analysis, based on the application of Limit Analysis results for No Tension Material Structures, is developed to capture a reasonable positioning of variable loads corresponding to collapse mechanisms of the bridge. Then, a 2D & 3D FE model of the structure is developed to evaluate the global behaviour of the masonry bridge, focusing attention to the interaction of the arch-fill.

In their paper "Influence of soil-structure interaction modeling on the response of seismically isolated bridges", Papathanasiou *et al.* non-linear time history analyses are carried out to investigate the effects of soil-structure interaction on the behavior of seismically isolated bridges. Two kinds of bridge structures are considered, the first one with short stiff pier and the second one with flexible tall piers, with piled foundations. Both far-field and near-fault seismic motions are analyzed. The numerical model adopts stick models for both bridge typologies and a bilinear hysteretic behavior for the isolation system, while the surrounding soil is taken as homogeneous, while the foundation-soil interaction is taken into account through lateral and rocking systems consisting of springs, dashpots and so-called "gyromasses". Results provide a better understanding of the soil-structure interaction problem from the engineering's point of view.

Recupero et al., in their paper "Structural Analysis of Cable-Stayed Structures in the Construction Sequence of Bridges Built by Cantilevering", propose a methodology of analysis for construction sequences of cable-stayed structures both for cable-stayed bridges and arch bridges, where partial elastic schemes which follow the actual construction sequence are incorporated in the analysis. The proposed Partial Elastic Scheme Method, is based on the analysis of multiple simple elastic schemes of partial structures representing the construction stages of the structure, where a suitable final geometry is obtained through the control of deformations from the first stage to the last one, which corresponds to the service life configuration. Moreover, internal forces are contemporary checked, and cable forces are obtained by using stay stressing adjustment technique.

One of the editors, D. Bruno, joins F. Greco and P. Lonetti as coauthor of the paper titled "Influence of Cable Failure Mechanisms on the dynamic Behavior of Cable Stayed Bridges", where the influence on the cable-stayed bridge behavior due to accidental breakages in the cable system is investigated. The structural model is based on a refined description of the bridge, which involves bridge constituents and external loads. A geometric nonlinear formulation is used, in which the effects of local vibrations in the stays and large

displacements in girder and pylons are taken into account. Moreover, damage effects are incorporated in the analysis by using an accurate description of the release effects produced by the cable-breakage processes.

Raftoyiannis and Michaltsos in their paper "Dynamics of an Arch Bridge Under Moving Loads - A Mathematical Model" investigate the behavior of an arch bridge under moving loads using an analytical approach to model the dynamical structural problem. Both the cases of continuous and discontinuous deck are considered showing the influence of moving loads on the state of stress and deformation of the bridge.

In their paper titled "Shake Table Studies of a Precast Bridge Pier with Advanced Materials", Sarira Motaref et al. develop an experimental and analytical investigation on the seismic performance of precast columns with advanced materials, focusing the analysis on the connection details and construction methods which are appropriate for accelerated bridge construction in high seismic zones.

Cairo et al., in their paper "Seismic Wave Effects on the Dynamic Response of Bridge Foundations", investigate the dynamical behavior of a bridge pier excited by polarized shear harmonic waves simulating seismic loading, taking also into account soil-structure interaction. The proposed analysis can be considered of great interest for bridges, usually characterized by deep and large foundations and whose dynamic response can be influenced by the local site conditions, the geo-mechanical properties of the soil, the kind of the seismic waves. The dynamical response of the bridge foundation and of the superstructure is analytically determined by considering different wave patterns and assuming that the soil can be modelled as a linear elastic halfspace. Specifically, the peak response of the superstructure is determined as a function of the compliance of the soil, the slenderness of the superstructure and the dimensions of the foundation.

In their paper titled "Composite Steel Concrete Bridges Using Sinusoidal Corrugated Steel Web Beams", Cammarata et al. describe some problems occurring in the design of road bridges using welding sinusoidal corrugated steel web beams. The behavior of steel girders, loaded by its own weight and by the weight of the r.c. plate, is examined accounting for viscous and shrinkage effects.

Kladis *et al.* in their paper "Bridge subjected to surface fault rupture, Part I: Numerical Investigation" proposes a numerical analysis of the effects of surface fault ruptures on the behavior of bridges built near them by adopting a model taking into account all the elements of bridge system simultaneously, (soil, foundation and bridge superstructure). The objective of the paper is to assess the

efficacy of the kinematic constraints adopted in the literature to take into account for the bridge superstructure in a decoupled way, thus avoiding a simultaneous analysis of the entire bridge system. To this end a plain strain FE model of the soil-foundation-bridge is developed adopting an elastoplastic Mohr-Coulomb with strain softening constitutive model for the soil, linear elastic beam elements for pier and deck, special contact elements for the soil-footing interface. The fault offset, on the other hand, is simulated as a monotonically increasing displacement.

Vairo, in his paper “Modeling Wind Loads on Long-Span Bridges”, gives a critical review of the wind load modeling in long span bridges and proposes a unified consistent approach on the basis of the classical thin airfoil model results and of a generalized quasi-steady wind-loading description.

We hope that these papers will stimulate further research and at the same time they will be uptaken in engineering practice.

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