

Design Optimization of Road Continuous Girder Bridges

Antonio GRIMALDI

Full Professor
University of Rome Tor
Vergata, Roma, Italy
a.grimaldi@ing.uniroma2.it

Antonio Grimaldi, born 1945, received his civil engineering degree from the Univ. of Naples. He is Professor at the University of Rome Tor Vergata. His main area of research is structural analysis

Roberta GRIMALDI

PHD
Progin Spa. Engineering
Consulting Company.
Roma, Italy
r.grimaldi@progin.it

Roberta Grimaldi, born 1974, received his architecture degree from the Univ. of Naples, and his PHD in structural engineering from the Univ. of Rome 'La Sapienza'

Raimondo LUCIANO

Full Professor
University of Cassino,
Cassino, Italy
luciano@unicas.it

Raimondo Luciano, born 1965, received his civil engineering degree from the Univ. of Naples. He is Professor at the University of Cassino. His main area of research is structural analysis

Summary

The paper investigates the optimizing criteria for most common structural bridges typologies, with respect of some relevant aspects as the behaviour under static and seismic actions; minimization of overall construction costs; flexibility of the choice of the number and the size of spans in a certain fixed range in relation to the geological and morphological constraints, structural durability and maintenance costs; aesthetic optimization and minimization of the environmental impact. Examples of optimization of prestressed concrete and composite steel - concrete girder bridges are illustrated, which take into account aspects and parameters outlined above.

Keywords: bridges and viaducts, optimization, safety, durability, costs, prestressed concrete, concrete-steel girder.

1. Introduction

In Italy, the actual trend in road bridges design mainly relies on the choice of continuous girders, with variable spans between 30 and 80 meters. Precast or cast in-situ prestressed concrete, alternatively composite steel-concrete girders are mainly used. The choice of the structural scheme and of the design solutions has to comply with optimization criteria accounting for a number of aspects such as structural efficiency, life-cycle costs and aesthetic features. Recent revision of the Italian structural code established performance standards, adjusting safety and durability requirements in line with European codes, and updating the seismic action level and design rules.

The structural analysis of bridges, developed in line with the previous design rules, requires detailed computations, both for the girders and for the piers and foundations.

The design criteria must take into account of the optimization of bridges both from the structural and aesthetical point view. The structural optimization can be developed by analyzing independently the super-structures (girders) and the sub-structures (piers and foundations).

In order to improve the structural performances of concrete girder it is necessary to take into account the following aspects:

- choice of construction materials, i.e. the characteristics of concrete in terms of durability, strength and costs.
- Detailed evaluation of the stresses and strains in the structure by using numerical techniques such as non-linear finite elements in order to take into account precisely the effects of shrinkage and creep of concrete and the differences in material properties, and, consequently, to optimize the dimensions of concrete girder and the amount of reinforcing steel.