Modernisation and widening interventions of bridge structures on the Adriatic highway in Italy

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Summary

After the realization of the "Variante di Valico", a new alignment aimed to double the A1 Milan-Naples highway in the Appenninic zone, the most important work currently under construction in Italy consists of the modernization of the Adriatic highway (A14 Bologna-Bari-Taranto), aimed to enlarge the highway carriageway by inserting the third traffic lane. Focusing the attention on the bridge structures only, the paper shows the most representative interventions realized to widen the existing bridges and viaducts, as well as to adequate the safety level to the most stringent requirements imposed by the actual Italian code.

Keywords: Bridge, Rehabilitation, Seismic Retrofitting, FRP materials.

1. Introduction

The oldest Italian highways were built in the Sixties and nowadays are inadequate to meet the actual functional and safety standards anymore. In order to answer to the continuously increasing demands due to higher volume of traffic flow, and to comply with the recent more stringent regulations, Autostrade per l'Italia, the main National transportation agency, and SPEA Ingegneria Europea, its design company, have been involved in designing upgrading and widening interventions of the most part of the national highway network [1].

This paper describes some of the most representative widening and rehabilitation interventions of bridge structures on the Italian Adriatic highway, which are currently under completion.

2. Widening and seismic retrofitting of existing bridges

Bridge widening interventions generally consist of an enlargement of both superstructure and bents in continuity with the existing parts [2]. The proportions of the new structural elements are chosen to comply with the geometric characteristics and mechanical properties of the old ones so to reproduce a similar flexural stiffness and to assure an as uniform as possible structural behaviour.

Since any widening intervention usually leads to a modification of the working state of the existing structures, in order to correctly calibrate both the characteristics of new elements and the strengthening/retrofitting interventions of the existing parts, an assessment analysis has to be carried out in order to investigate any structural deficiencies of the old parts due to less stringent requirements imposed at the original time of design and construction of the bridge under examination. In case of assessment under seismic condition, a non-linear pushover analysis has been generally carried out [3].

In general, to design seismic retrofitting interventions, two alternative approaches can be adopted. The first approach acts on the seismic demand by reducing the induced forces by means of base isolation or seismic protective systems. The second approach, instead, influences the structural

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capacity by intervening on specific structural members. In this latter case, a typical retrofit strategy consists of increasing the strength and/or the stiffness, or upgrading the mechanical properties of the structure [4]. Another efficient, even though counterintuitive, retrofit strategy consists of a rational weakening of selected structural members. In fact, by using this strategy, the seismic demand can be reduced and the inelastic mechanism can be changed according to capacity design principles in order to avoid non-ductile failure modes[5].

In the paper, some of the most representative cases of retrofitted bridge structures by using the above mentioned retrofitting techniques, acting at both the seismic demand and capacity level, have been presented. In particular, in the first case, which consists of a geometrically irregular bridge, an inadequate level of deformation ductility in plastic hinge regions of the piers has needed the use of fiber reinforced polymer wrapping [6]. In the second case, the deficiency of the foundation in resisting bending moment due to an over-dimensioning of the pier cross-section has been solved by a rational weakening of the pier base so to favour a ductile mechanism of collapse instead of the fragile collapse of the foundation [7]. In the last case, the unsuitability of the abutments in contrasting seismic horizontal forces has been solved by providing a system of passive anchors [8].

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