Optimising selection of critical bridge components - the bearings and expansion joints of the Viaducto Puerto de Santa Maria

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Summary

The highways serving the town of El Puerto de Santa Maria on Spain's southern coast were recently extended and improved, with the work including the construction of an elegant new highway viaduct. That proper attention was paid, not only to aesthetics but also to ensuring functionality, durability and value for money, can be seen in relation to the structure's critical mechanical components - its bearings and expansion joints. The care that went into the selection of these components is demonstrated by the fact that a single solution was not chosen to satisfy either the bearing or expansion joint needs of all locations. In fact, two types of bearing (spherical and elastomeric), and two types of expansion joint (modular and finger) were selected for use on the same structure – a rather uncommon degree of diversity. The resulting benefits are described, demonstrating the importance of attention to detail in this part of a bridge's design and construction.

Keywords: bridge; bearings; expansion joints; selection; installation; replacement; optimisation.

1. Introduction

The town of El Puerto de Santa Maria, on Spain's south coast close to the strait of Gibraltar, has a distinguished history, having been the launching point for Columbus' second voyage to America – a proud heritage which should be reflected in modern developments. A recent infrastructure project in the town demonstrates how design and construction work can be carried out to achieve a result that is not only attractive but also optimises functionality, durability and cost-effectiveness. The Viaducto Puerto de Santa Maria (Figures 1 and 2) is a new highway viaduct connecting to the region's A-4 and A-491 highways. The structure's designers and constructors showed an appreciation of the importance of careful selection of key components – in particular in relation to the mechanical components such as bearings and expansion joints which are far less robust than the main structure but subjected to tremendous fatigue loading and service movements during a lifetime of several decades. Rather than selecting a single type of bearing to satisfy the deck bearing needs at all locations, and a single type of expansion joint for both ends of the bridge, a mix of types was applied, as described below.

2. The structure's design

The viaduct has a total length of 440m, with 14 spans of approximately 30m each – the deck being supported by 13 intermediate piers and the abutments at each end. The deck's "fixed point" is at its mid-length, so the greatest movements experienced by the deck are at its abutments. The viaduct has a prominent horizontal curve at its centre, resulting in the need to facilitate transverse movements at each pier as the deck expands and contracts due to thermal effects.

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