Pedestrian Bridges Combining Stainless Steel and Glass-Fiber Reinforced Polymers as Structural Members

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Summary

The paper reports on the design and specific details of two similar footbridges in Zumaia (Bask country, Spain) and Medellín (Colombia). These two bridges are probably some of if not the firsts to combine the new construction materials stainless steel and fiber-reinforced composites, both as structural members, in a medium span pedestrian structure.

The bridges consist each of two main longitudinal single-span girders, creating open sections over 28.0 m and 25.2 m, and decks with clear widths of 5.0 m and 3.0 m, respectively. The longitudinal girders are made of Vierendeel trusses in stainless steel and with variable heights of approx. 1.1 m to 1.4 m, combined with glass-fiber reinforced polymers (GFRP) as structural webs of the trusses. The Vierendeel trusses have stiff bottom chords with hollow sections, stiff posts with Pi-sections – with slightly variable spacing for the larger bridge – and very slender top chords with a stiffened stainless steel plate. The bridge deck of the larger bridge is made of transverse GFRP I-girders of 300 mm height, with a spacing of 1.0 m, and longitudinal standard light deck planks of 40 mm height. The transverse girders of the smaller bridge are welded from stainless steel plates to I-sections of 165 mm height with a spacing of 1.5 m, while the same deck planks are provided.

The paper comments on the design peculiarities of the very light structures, such as the modeling of structural details for static and dynamic investigations, buckling analysis of the top chords, ultimate limit and serviceability limit state considerations and design concepts.

Keywords: new materials, stainless steel, GFRP, design procedure, dynamics, structural modeling, buckling analysis, blind rivets.

1. Introduction

Both new footbridges – designed by Pedelta – intend to provide new inputs to urban development, although in very different surroundings. The new Zumaia footbridge spans over a side-channel of the river Narrondo in the city centre of Zumaia in the province of Gipuzkoa (Baskque country, Spain). The bridge provides an additional pedestrian crossing of the channel in resident areas between two existing road bridges, which are located approx. 750 m from each other.

The new Juan Bobo footbridge in Medellín (Colombia), on the other hand, lies in the heart of the 'comunas' (ghettos) and connects highly populated areas. This new footbridge shall provide a sign that the social situation is changing in the area. Since the local government can not provide the funding for the bridge, the enterprises 'Outokumpu' (Finland) [1] and 'Fiberline' (Denmark) [2] could be convinced to sponsor the structural materials for the construction as well as specialized work such as welding of stainless steel. The rest of the works shall be executed by indigenous companies in order to locally anchor the works.

To choose stainless steel as the main structural material has quite different motivation: for the Zumaia footbridge the vicinity to the sea is the main reason, as already applied for a road bridge in Spain [3]; for the Juan Bobo footbridge in Medellín, however, it is the excellent durability intending a practically maintenance-free service life, also see [3].