

LICENTIATE THESIS

Preliminary Design and Analysis of a Pedestrian FRP Bridge Deck

PATRICE GODONOU

Department of Civil and Mining Engineering
Division of Structural Engineering

Abstract

The interest for Fiber Reinforced Polymers (FRP) as an alternative building material is constantly increasing within the building construction sector worldwide. In order to allow for a commercial breakthrough of FRP based building structures, it is necessary to develop design methods that can readily be adopted by bridge engineers. To do so, we need to combine the design philosophy from the bridge engineering sector with the design practices specific to the FRP industry. One of the purposes of this study is to initialize the combination of the two design philosophies.

FRP materials as a material group and their most common manufacturing processes are described followed by examples of applications of FRP in civil infrastructures (section 2). The bridge design methodology and terminology, the Partial Safety method and the Swedish Bridge Design Code BRO94 are introduced (Section 3)

A survey of existing FRP bridges around the world is carried out and is followed by the presentation of some cases studies (Section 4). The mechanics of structural components made of FRP, the sandwich beam model and the composite action of concrete and FRP are described (Section 5).

The conceptual design of the whole bridge system and the development of a concept for the deck cross-section are carried out (Section 6). The preliminary design and analysis of the bridge deck, based on the methodology of BRO94 and the design practices particular to FRP structures and sandwich beam construction are presented (Section 7). Design proposals for the remaining structural components such as the columns, the wearing surface and the guardrails are suggested (Section 8).

Keywords: Structural Bridge Design, Fiber Reinforced Polymer, FRP bridge survey, Sandwich bridge decks,

Sammanfattning

Intresset för fiberkompositer som ett alternativt byggmaterial har ökat konstant under de senaste åren inom byggbranschen världen över. För att göra ett kommersiellt genomslag möjligt för fiberkompositer är det nödvändigt att utveckla en dimensioneringsteknik som dagens brokonstruktörer snabbt kan ta till sig. Detta kan göras genom att förena den dimensioneringsmetodik som är typiskt för brokonstruktion med de dimensioneringsprinciper som används inom fiberkompositbranschen. Arbetet som presenteras i denna rapport är ett första steg i den riktningen.

Fiberkompositer som materialgrupp presenteras i sektion 2 tillsammans med en beskrivning av tillhörande tillverkningsmetoder. I sektion 2 presenteras även vissa tillämpningar av fiberkompositer inom infrastrukturen. Brokonstruktionens terminologi, partialkoefficientmetoden samt den svenska bronormen BRO94 beskrivs i sektion 3.

En kartläggning av befintliga fiberkompositbroar världen runt görs i sektion 4 följd av fallstudie över några fiberkompositbroar. Fiberkompositers mekanik och dimensionering av sandwichkonstruktioner beskrivs under sektion 5.

Konceptutvecklingsarbetet för hela bron och i synnerhet för brodäcket, presenteras i sektion 6. Fördimensionering av brodäcket, som görs med BRO94 i åtanke redovisas i sektion 7. Ett konceptförslag till dimensionering av de återstående bärande delarna såsom pelare och räcken ges i sektion 8.

Nyckelord: fiberkompositer, kartläggning av fiberkompositbroar, konceptutveckling av broar, dimensionering av sandwichbrodäck, styvhetsstyrd dimensionering.

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