Leadership in Sustainable Infrastructure
Leadership en Infrastructures Durables

Case Study

Vancouver, Canada
May 31 – June 3, 2017/ *Mai 31 – Juin 3, 2017*

THE USE OF ORTHOTROPIC STEEL DECK FOR SHORT SPAN MOVABLE BRIDGES

Lévesque, Éric[1, 4], Ampleman, Maxime[2] and Raff, Brian[3]
[1,2] Canam-Bridges, Canada
[3] Canam-Bridges, United States
[4] eric.levesque@groupecanam.com

1 PROJECTS OVERVIEW

1.1 Introduction

The superstructures of the Hastings swing bridge (2016) and the Kingston Mills swing bridge (2017), two small bridges in Ontario, have recently been replaced and rehabilitated. The Hastings swing bridge is located in the Village of Hastings, Ontario, Canada. The structure is a 2,200 square foot (204 square meter) swing bridge. Canam-Bridges replaced its 83.8 foot (25.6 meters) long by 26.7 foot (8.2 meters) wide superstructure (deck + main stringers + superstructure frame).

The Kingston Mills swing bridge is located in Kingston, Ontario, Canada. The general contractor replaced the deck superstructure in 2017 and also rehabilitated some existing elements. The structure is a 1,440 square foot (134 square meters) swing bridge with a length of 55.9 foot (17.0 meters) and a width of 25.7 foot (7.8 meters). Both movable bridges are owned by Parks Canada.

1.2 Challenges

For the two bridges, the main challenges were similar. First, the weight of the new bridge superstructure and deck had to be low enough for the existing mechanical and electrical elements in the substructure to support its movement. Second, the demolition and reconstruction of the bridge had to be completed quickly during winter in order to avoid disturbing the navigation season.

2 INNOVATION

2.1 Orthotropic steel deck (OSD)

Both projects asked for an orthotropic steel deck (Figure 1) solution due to its light weight; a very competitive option for movable spans when compared to conventional deck systems. The Canadian Highway Bridge Design Code CAN/CSA S6-14 suggests that a solid deck of lightweight construction in movable spans be considered in order to improve traction, reduce noise and protect the infrastructure and superstructure of movable bridges.

An orthotropic steel deck is shop-fabricated under a rigorous quality-assurance and quality control program, offering a service life beyond 75 years. With easily defined geometry, an orthotropic steel deck can offer increased moments of inertia, more effectively and efficiently controlling deflections. OSD also allows the

owner to only shop-apply a thin antiskid (and asphalt if desired) wearing surface, allowing for an even quicker installation on the jobsite.

Figure 1: Typical orthotropic steel deck section

2.2 Particulars of the projects

The final design and optimization of the OSD for both projects was the contractor's responsibility. The engineers designed the structure in accordance with the latest standards while also respecting the maximum weight imposed by the project specifications.

Also, for the Hastings swing bridge, the designer specified that the OSD and the superstructure must be pre-assembled in the shop. Because the steel fabricator secured both contracts for the supply of the OSD and superstructure, this continuity greatly simplified the process.

As the new superstructure and the new decks were erected on the existing substructures and rotating supports, the weight of the new element had to be adjusted accordingly.

The demolition and reconstruction of the movable structure provided another interesting challenge as it had to be done during winter. Fabricating the OSD in the shop shortens the construction time on site and allows the project team to meet the specification's schedule requirements.

2.3 Design/Fabrication

Decks of both projects are non-composite; loads are carried out by the floorbeams to the twin-girder system superstructures. However, the design of the two decks was not identical. An asphalt layer was to be applied on the wearing surface of the Hastings swing bridge, a longitudinal bolted joint to connect the two deck panels was used in order to ease and accelerate the erection. On the other hand, the Kingston Mills swing bridge used a welded longitudinal joint with permanent backing bar as a thin antiskid wearing surface was desired.

3 LESSONS LEARNED

Key points to the success of these projects can be summarized as follow:

A. Final design and optimization of the OSD was performed by the contractor;
B. Steel fabricator had experience with OSD in order to avoid fabrication and erection difficulties.
C. Fully bolted deck splices to minimize the erection schedule during winter season.

Also, for the Hasting swing bridge, fabrication of the OSD and superstructure have been done in the same plant in order to facilitate the pre-assembly in the shop and to have an OSD that fit in the superstructure "as built".