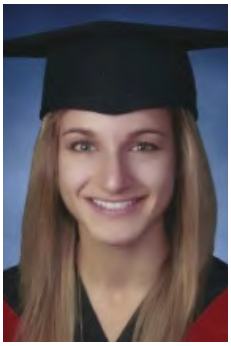
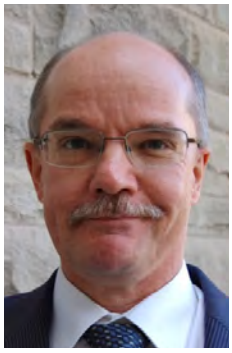
Built-up Wrought-Iron Compression Member with Missing Stitch Rivets

Caitlin MANCUSO
Undergraduate Student
Western University
London, ON, Canada
cmancus2@uwo.ca



Caitlin Mancuso, born 1992, will be earning this year a B.E.Sc. from Western University with a focus on Civil & Structural engineering. She will be returning to Western University in the fall in pursuit of a M.E.Sc.

F. Michael BARTLETT
Professor
Western University
London, ON, Canada
f.m.bartlett@uwo.ca



Michael Bartlett, born 1957, earned civil engineering degrees from Queen's University (B.Sc.), the University of Waterloo (M.A.Sc.) and the University of Alberta (Ph.D.). His research interests include the evaluation and rehabilitation of bridges.

Summary

London Canada's Blackfriars Bridge, fabricated by the Wrought Iron Bridge Company of Canton Ohio, has been in service since 1875. The parabolic top chord of this tied-arch through-truss structure is built-up using seven shapes interconnected by stitch rivets. Recent inspections indicated extensive stitch rivet failures, raising concerns that the fully composite action of the member has been compromised, with its constituent shapes in danger of separating. The bridge was temporarily closed to both vehicular and pedestrian traffic to facilitate emergency repairs. This paper investigates the loss of compressive capacity of the built-up compression chord due to missing stitch rivets, including preliminary calculation of the effect of the missing rivets in accordance with the provisions of Canadian steel design standards for built-up members.

Keywords: wrought-iron; built-up compression members.

1. Introduction

London Canada's Blackfriars Bridge, shown in Fig. 1 as originally constructed, is a surviving example of the elegant and efficient bowstring arch-truss form. It was fabricated and erected in 1875 by the Wrought Iron Bridge Company (WIBC) of Canton Ohio, and has the greatest span of any surviving WIBC bowstring arch-truss in Canada and the United States. The arch-truss is structurally efficient because its compression chord is parabolic in elevation and is restrained at its ends by a horizontal tension tie. A uniformly distributed load across the entire bridge span causes the force in the tie and the horizontal component of the force in the chord to be constant along the entire length of the bridge, and so permits shapes with uniform cross section to be used for these members over the full length of the bridge. The centre panels of Blackfriars Bridge also feature a novel double-panel web diagonal arrangement that was patented in the United States in 1876, i.e., a year after the bridge was built [1].

The Blackfriars Bridge compression chord features a built-up riveted plate-channel-and-column cross section, shown in Fig. 2, that was patented by WIBC founder David Hammond and his colleagues in 1873 [2]. The section is approximately 460 mm wide by 310 mm deep, and consists of a 6.3 mm-thick middle plate, four column quarter-segments supplied by the Phoenix Iron Company, and two channel shapes. These seven components are connected by 13 mm-diameter stitch rivets, spaced at 100 mm: these can be classified as "A" rivets that connect the channel flange to the quarter-column shape or "B" rivets that connect the quarter-column shape to the middle plate as shown.

https://doi.org/10.2749/222137814814067329