Lions Gate Suspension Bridge Tower Joints Renewal

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Abstract

A unique collaborative approach was utilised for the renewal of this important component of the bridge. It was a combination of input from the engineer, contractor, material specialist, manufacture and the owner that enabled a process of renewal which was innovative, constructible, utilised new materials and maintainable. An important consideration was to establish the causes for the observed early deterioration of components. A small scale model of the joint in particular was constructed out of wood and based on the 3-D FEM analyses that were carried out on the bridge, for failure mode analysis. Solutions were developed in a joint effort of all parties involved, leading to a novel approach for the restoration of the existing structural component. The installation was time sensitive and took place without any interruption of traffic

Keywords: modular expansion joint, modelling, wind load, wear, restoration, repair, bearing, spring, elastomer, polyurethane.

1 Introduction

The Lions Gate Bridge represents an iconic landmark of Vancouver, bridging the first narrows of the Burrard Inlet from North Vancouver to Stanley Park. The suspension bridge was opened to the public in 1938. Several upgrades and maintenance projects have been implemented since then. One of the last major changes in 2000 and 2001 included the replacement of the deck superstructure, the widening of the traffic lanes, and the exchange of the main bearings and the joints between the spans.

2 Description of the joint

The modular expansion joint was designed and manufactured by Watson Bowman ACME. The movements of the structure, mainly due to wind load, thermal expansion and contraction, and due to traffic loads, are significant for this suspension bridge. The design of the joint had to take into account these loads and movements, as well as requirements for ease of inspection, maintenance and service life of minimum 50 years.

2.1 Functionality of the design

Two identically constructed expansion joints connect the spans of the bridge at each of the main towers. Based on the loads and movements, each of the joints has to compensate an opening of up to 1415 millimetres. This is accomplished by nine centre beams which create gaps for ten rubber seals with a maximum opening of 80 millimetres each. (Figure 1).

The centre beams rest on support bars which connect two spans of the bridge, and are held by elastomeric springs and bearings. Stainless steel slide plates welded to the support bars, and PTFE bonded to the springs and bearings enable the support bars to freely slide while the gaps between the spans open and close. Centre beams and support bars are welded together at connection points which form a web structure that provides the required flexibility to the joint.

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