



The Influence of Concrete Filling on the Fatigue Behaviour of Tubular Steel Bridge Joints

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Abstract

Concrete filled steel tubular (CFST) elements are a new technique which recently became very popular in bridge constructions due to the many advantages. The main advantage of these bridges is their aesthetical and elegant design in combination with a high strength and ductility. Moreover this technique allows fast and economical construction methods. Despite of the increasing use and interest in this technique the technological know-how and insight is rather limited. Currently no design codes are available yet and the knowledge about the fatigue behaviour is very limited. In this paper the fatigue behaviour of concrete filled T-joints is investigated using a numerical model and focusing on the hot spot stresses. Next the results of the final model were compared with an unfilled model and a model with steel diaphragms. From these results it is clear that the concrete filling improves the fatigue strength of the nodes under the condition of a perfect filling method.

Keywords: concrete filled steel tubular elements, bridges, fatigue, T-joints, finite element modelling, design codes.

1 Introduction

As structures with circular hollow sections provide very slender and aesthetical pleasing designs, the use of such structural systems in bridge constructions is increasing. Moreover, in recent years a new technique has been developed in which the main steel tubes are filled with concrete. These concrete filled steel tubular (CFST) elements provide additional strength and stiffness to the system and are very advantageous for civil engineering applications. From practical experience it is observed that CFST bridges have many structural and practical advantages which made this bridge type very cost-effective and popular. In China the CFST technique has been widely used during the past 25-years for the construction of large span arch bridges. More than

300 composite CFST arch bridges have been constructed in China so far ([1] - [2]).

Despite of the increased use and interest in CFST bridge structures the research and knowledge about the structural behaviour is still very limited compared to other bridge types. For instance, currently no design codes are available and aspects such as the fatigue strength are not investigated thoroughly yet. One could even say that the research about the CFST bridges cannot keep up with the practical applications [3]. In this paper an investigation is performed on the fatigue strength of the concrete filled nodes of these bridge types. The fatigue strength of the concrete-filled joints is examined based on the hot spot stresses which are determined by numerical calculations.