Fatigue Damage Assessment of Stay Cables for Light Rail Transit Bridges

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Abstract

The use of cable stayed structures for long span bridges gained popularity in the late 20th century with the development of advanced construction materials and equipment, and advancement of sophisticated structural design and modelling capabilities. There are many light rail transit (LRT) cable-stayed bridges in use today. Due to the repetitive cycling loading from passage of similar trains, the potential risk of fatigue-induced damage to stay cables is significantly higher for LRT bridges than roadway bridges. As LRT bridges carry heavier trains and provide increased levels of service, the fatigue induced damage to stay cables and its impact on the remaining service life has been frequently raised by transit authorities. This paper presents a recent study completed on assessing fatigue induced damage to stay cable for a LRT bridge including numerical analysis, processing of historic and future train data, and field investigation of the bridge's response.

Keywords: cables; concrete; bridges; fatigue; assessment / repair; dynamic effects / vibrations.

1 Introduction

For any type of bridge structure the intended use and actual vehicular loading changes over time. During the design process assumptions are made as to the future use and expected growth in demand. Particularly with cable-stayed LRT bridges, as train technology advances and passenger demands grow, heavier train loading and more frequent services result in increased fatigue-induced stresses that may exceed initial assumptions made by the designer. As part of on-going bridge asset management programs it is important that transit authorities review and assess the impact of any significant changes made to train loading configurations and service frequency on the fatigue life of the stay cables and, if necessary, identify potential timelines for intervention including reprograming of train timetables to reduce or eliminate simultaneously train passage over the affected cable-stayed bridge, or in the worst case, replacement of the stay cables that have reached their anticipated fatigue life.

This paper presents a recent study completed on assessing fatigue-induced damage to stay cables for an in-service 616 m long LRT Bridge (e.g. 138 m, 340 m, 138 m) with two concrete pylons supported on piles, built between 1987 and 1989, carrying two tracks on a post-tensioned precast concrete deck supported by 120 semi-parallel 7

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