Practical Guidance for Design of Steel Truss Footbridges

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Abstract

Due to their slender, versatile and lightweight nature, steel footbridges are generally susceptible to vibration particularly in lateral direction if the span is greater than 30m. A common human psychology is that structural movement or vibration causes the pedestrian to become anxious about the safety of the structure and even to the extent of refusing to use it. There is a significant gap in the literature available for bridge designers on this comfort criteria. Current international codes do not provide clear and comprehensive guidance on how the performance for serviceability limit state should be assessed.

In this paper, the comfort criteria limits stated by some international design codes along with the design approaches to satisfy the comfort criteria requirements are compared with a case study. Also, best practices of designing steel footbridges covering the aspects of configuration, buildability, maintenance and selection of bearing are presented.

Keywords: Footbridges, comfort criteria, frequency, dynamic analysis, acceleration, buildability, bearings, maintenance

1 Introduction

1.1 Steel as Truss Choice

Among the structural forms, steel offers economic and attractive form of construction which suits all the requirements necessitated for a footbridge. Steel truss superstructures are generally the preferred option for footbridges due to their slender and lightweight nature. For medium spans ranging from 30m to 80m, they are extremely versatile and provide economical solutions. Steel can be melted and reshaped at the end of structural life, making it a sustainable choice. With modern paints and sealing techniques, the maintenance required for a steel truss footbridge with steel hollow sections is very low. The steel truss type footbridges are generally either through or half-through construction. The truss type of structures also makes it easier to achieve the clearance requirements.

Depending on the span, the entire steel superstructure can be prefabricated, lifted, and erected, with or without intermediate support. Along with ease and speed of construction, this also reduces the risk of pollution and debris on site. Usually, the truss footbridges are supported on bearings with provisions for future maintenance.

1.2 Importance of Vibration and Natural Frequency

The economics of modern design and construction dictates that the structural design be efficient in terms of material volume. This has increasingly led to slender and flexible structures with associated liveliness in vibration. The critical condition to be avoided is a coincidence of average walking rate with natural frequency. The increased likelihood of