Re-use of wind turbine steel towers for pedestrian bridges

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Abstract

Steel towers used for wind turbines are being decommissioned after relatively short service lives of around 25 years. This abbreviated lifespan is partially due to fatigue loading, although the steel itself may still be safe for normal loads. FORSBERGS and Dissing+Weitling Architecture are investigating the potential for reusing these towers as the primary structure for pedestrian bridges. The focus of these investigations lies in the structural design of a new bridge, constrained by the existing geometry of the steel tower. One approach involves longitudinally splitting a tower into two half-pipe structures that could serve as bridge spans. This study encompasses an assessment of the CO2 aspect, comparing the overall carbon footprint resulting from a conventional decommissioning of a steel tower with that of repurposing it for a bridge. The proposed concept could potentially apply to narrow pedestrian or bicycle bridges, or utilise side-by-side half-pipes for multipurpose use.

Keywords: steel towers; wind turbines; pedestrian bridges; architecture.

1 Introduction

The design of a steel bridge should adhere to specified standards, such as Eurocode 3 [1]. Similarly, fabrication and construction must comply with applicable standards, like EN 1090-2 [2]. Whether constructing a new steel bridge or repurposing steel from a wind turbine tower, the design and construction requirements remain largely consistent.

Over 25 years of supporting a wind turbine, the steel structure has largely exhausted its dedicated fatigue life. However, in the case of a pedestrian bridge with minimal design loads throughout its lifespan, fatigue considerations will not govern the design. While the steel structure might be considered worn out for use in a wind turbine, it remains virtually new for a pedestrian bridge.

The imposed geometric constraints could potentially result in an aesthetically displeasing appearance of the bridge, a concern addressed within this article. A recommended practice for structural engineers is to optimize structures based on specific constraints. Developing a structure to serve multiple purposes seldomly results in an excellent technical solution. Figures 1 and 2 depict the possibility of using a portion of the wind turbine tower by slicing it, resulting in shallow end sections while maintaining a full middle section. Several other purposes and ideas are briefly outlined here.

The debate over the carbon footprint of producing one ton of steel construction persists. As per [3], the global average in 2021 stands at 1.9 tons of CO2 emissions per ton of crude steel. For simplicity, an additional 0.2 tons are considered for cutting, bending, welding, transportation, and installation.

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