

Experimental Study on Prefabricated Parallel Wire Strands for Main Cables in Suspension Bridges

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Summary

This paper discusses the mechanical behaviour of parallel wire strands with high performance steel wires, which have the tensile strength of 1960MPa grade, as a major component of the main cables in suspension bridges. Required items for performance and quality of parallel wire strands are suggested based on the established references. Proposed performance indexes include the elastic modulus, elongation at failure and pull-out lengths as well as the failure load of strands. Four specimens of parallel wire strands with their length of 4.5m are prepared by hand-made works. Ultimate tensile strength tests are carried out for the specimens in order to analyze the mechanical behaviour of high performance parallel wire strands. The test results demonstrate that the properties of test specimens are satisfied with performance indexes specified in this paper. The high performance parallel wire strands are acceptable for application in main cables of suspension bridges.

Keywords: Parallel wire strand; PPWS; Cable; Suspension bridge.

1. Introduction

Suspension bridge is inherently very flexible structure in that the main cables supported by stiff towers just lift the stiffened girders with hanger cables. Since the effect of the permanent loads rather than the live loads increases as the span length increases for this type of bridges [1], the use of high strength material, which can reduce the self-weight of bridges, is one of the important technical issues. In particular, it is possible that the use of high strength main cables can greatly reduce the self-weight of the whole bridge system in suspension bridges.

In this paper, mechanical behaviours of prefabricated parallel wire strands with high strength steel wires, which have the tensile strength of 1960MPa, are investigated by some experimental works in order to confirm the performance and applicability of this newly developed product. The performance indexes are specified by comparing previously established standards for ordinary steel wires. The tensile tests are carried out and required indexes such as the tensile strength, elastic modulus, elongation and pull-out length are checked for the test specimens.

2. Main cables in suspension bridges

2.1 Construction method

In recent years, parallel wire strands are generally used for main cables of long-span suspension bridges. In suspension bridges, construction method of main cables can be classified into air-spun method (AS) and pre-fabricated parallel wire strand method (PPWS) [2]. In AS method, corrosion-proof steel wires are directly erected into a strand by aerial spinning devices in the construction site and the fundamental unit of construction is focused on individual wires. In PPWS method, however, a hexagonal shaped strand is pre-fabricated with specified numbers of steel wires in the factory and