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Structural and Physical Aspects of Construction Engineering

Development of Corrosion Processes on Weathering Railway Bridge

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Abstract

This article presents the development of corrosion products and results of experimental atmospheric corrosion test on bearing structures of weathering steel railway bridge in Prague-Motol. This bridge structure is a part of long-term research project focused on development of corrosion processes at different structural elements of supporting structures. Measurements of corrosion losses and average thicknesses of corrosion products are carried out on selected surfaces of weathering steel structures. The article presents results of corrosion tests after one and three years of exposure of corrosion specimens. The results indicate a high degree of correlation dependence between measured average thickness of corrosion products and corrosion losses.

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Keywords: weathering steel; bridges; steel structures; patina; corrosion; atmospheric corrosion tests

1. Introduction

The weathering steel is a special low-alloyed steel with low content of chrome, copper, nickel, phosphor and other alloying elements. The basic specific property of the weathering steel is the ability to create a protective patina layer on its surface in favourable environment. The protective layer called patina slows down the corrosion rate. The structural weathering steel is used for more than 50 years to implement a different kind of outdoor support construction without any corrosion protection both worldwide (USA, Germany, Japan, South Korea, France, Switzerland and other) and in the Czech Republic [1-4]. The first weathering steel was patented in the USA at 1933. The first bridges from weathering steel were built in Michigan and New Jersey in 1964 [5]. In Europe the weathering steel started to be used for construction since the end of 1960s (trademarks Corten, Patinax, Coraldur, Intradur, Resista, Indaten).

The weathering steel was first used in the Czech Republic to design testing structures in the seventies in the last century and quickly asserted themselves for construction of houses, lattice transmission towers and mainly

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for a number of major bridges. In the Czech Republic the weathering steel is known as Atmofix. It was possible to formulate and practically verify the main principles of the optimal design structure of weathering steel, the manufacturing processes and rational maintenance during this long period. These principles are necessary to ensure long life and reliable function [6].

Basic property of the weathering steel is its increased corrosion resistance in atmospheric conditions. A major economic advantage of using weathering steel lies in the elimination of costs associated with repair or recovery of the corrosion protection system. Production costs and mounting are lower compared with the construction with traditional corrosion protection system (2 to 10 %) [7-9]. The range of environmentally-intensive manufacturing operations associated with the application of corrosion protection coating significantly reduces as well when the weathering steel is being used.

This article describes an experimental atmospheric test on composite weathering steel and concrete girder railway bridge situated in Prague-Motol across Jeremiášova street. This bridge is part of a long-term program of atmospheric tests on constructions from the weathering steel. This bridge is the second from the list of surveyed constructions in this research. The description of the bridge, the processes of measuring thicknesses of patina layers and the results are presented in the following chapter.

2. Railway bridge in Prague-Motol

The researched construction is the composite weathering steel-concrete railway girder bridge. The bridge was built in 1981 and the assembling was completed in 1983.

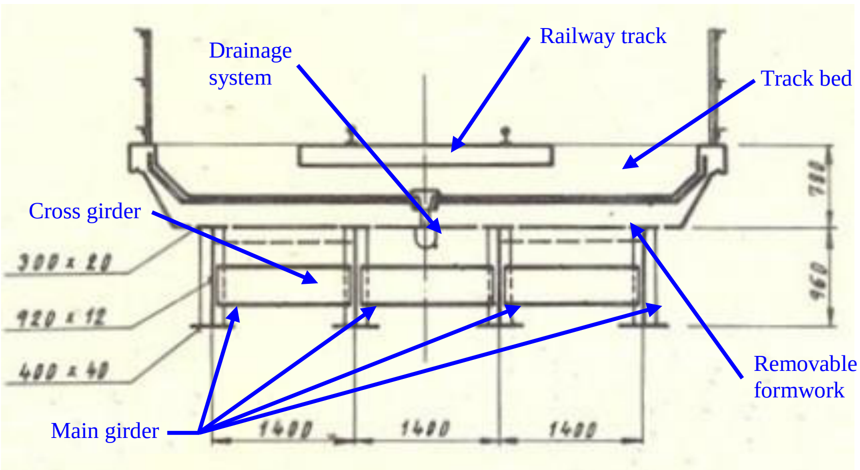

Fig. 1. Cross sectional view of the bridge (authentic original design).

The steel construction is designed from low-alloyed weathering steel Atmofix B. The supporting construction is created by four main I-section girders and these girders are coupled with a concrete board deck, see Figure 1. The bridge consists of three fields, girders in every one of the fields are simply supported with the length of 20 m (the distance between the bridge supports). There are stiffening cross members (not coupled with concrete deck) above the supporting and the stiffeners are joined by screws to the transverse reinforcement of the main girders. On the track bed a simple track is placed. The total weight of the steel construction is approximately 155 tons. The view of the bridge is illustrated on Figure 2.