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STRUCTURAL STAINLESS STEELS: PRESERVING THE PAST AND CREATING TODAY'S LONG-LIFE ICONIC STRUCTURES

A.P. Backhouse[1] , S.H. Mameng[2]

[1]Outokumpu Stainless Ltd, Sheffield, United Kingdom.
[2]Outokumpu Stainless AB, Avesta Research Centre, Avesta, Sweden.

e-mail: andy.backhouse@outokumpu.com

SUMMARY

This paper aims to provide guidance, experience and inspiration for engineers using stainless steel as a structural material in helping preserve existing heritage and in creating new iconic structures. Grades such as 316L/1.4404 are well known as building façade materials, but in most structural uses such as in bridges, high strength duplex stainless steel (DSS) grades are most often used. The paper describes how both types of stainless steel are helping to preserve existing structures. The use of stainless steels in non-visible long-life structural components is contrasted with the additional demands of long-term appearance in highly visible iconic structures. Results of a field test of the durability of different surface finishes of DSS in a coastal environment show that smoother finishes retain a better appearance. This can help refine the material selection guidance in Eurocode EN 1993-1-4 Annex A. Several examples of pedestrian bridges and large cultural works in which artist or architect and structural engineer combine their talents are discussed.

Keywords: *Stainless Steel, Duplex, Durability, Surface Condition, Aesthetics.*

1. INTRODUCTION

Stainless steels can be useful materials for architects and structural engineers faced with the challenge of preserving historical structures and in creating new structures which are intended to have long life. This paper follows on from previous recent papers [1] [2] [3], in which the experience of use of structural duplex stainless steel (DSS) for a range of bridge types and environments has been presented. These papers discussed life cycle costing, durability in structural use and the recent use in bridge construction of leaner alloyed, lower cost DSS grades. The family of DSSs are all high strength steels, typically $Rp_{0.2}$ = 450MPa minimum, which gives a possibility to optimise structural designs with thinner cross sections, reducing weight and cost compared with using austenitic stainless steels such as 316L / EN1.4404. The specific grade of DSS selected determines the durability (corrosion resistance) of the material and is selected according to the environment; Eurocode EN1993-1-4 Annex A gives straightforward guidance for stainless steel selection for structural use in European environments. The conference theme of *Synergy of Culture and Civil Engineering* gives an opportunity to consider use of stainless steel in two distinct areas: Firstly, in use as a non-visible material, used for preserving or enhancing existing bridges and large structures that have historical significance. Stainless steel was first produced in Sheffield, UK in 1913, and thus the world's very old heritage from more than 100 years ago could not benefit at the time from the longevity that stainless steel confers. Nevertheless, refurbishment work on old and decaying structures can utilise stainless steel to enhance future durability whilst preserving the essence of the original character. Secondly, stainless steel can be used as a highly visible material as a long-life feature on modern day iconic bridges or other large artwork structures. The Eurocode does not take into account surface finish and appearance in its material selection guidance, but for some projects long term aesthetic performance can be an important aspect of durability. Thus, results are presented in this paper from an atmospheric test programme that considers the impact of surface finish on long term durability and aesthetics. The results are discussed in light of the performance of existing structures that have used different stainless steel surface finishes.

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