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Mechanical Properties of Stainless Steel Bolts at Elevated Temperatures

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Abstract

In order to promote fire resistance of bolts connections, this paper developed an experimental program for investigating mechanical properties of stainless bolts at elevated temperatures, in which standard coupon specimens were prepared and performed for two types of stainless bolts subjected to tensile loading. The research findings accomplished on fire resistant bolts have been reviewed carefully and compared with mechanical properties of stainless steel bolts in fire. In addition, stainless steels (EN 1.4401 and EN 1.4571) as their parent materials were included in this investigation. It can be found that strength and stiffness reduction of stainless bolt materials is almost in consistency with their parent materials in fire. A better performance in strength retention has been observed for these materials in the temperature range of 500 to 900℃, compared to fire resistant bolts. Relying on the experimental data, strength and stiffness reduction factors have been derived for stainless steel bolts for help with determination of their stress-strain relationships at elevated temperatures.

Keywords: Stainless bolts; elevated temperatures; stainless steel; bolt failure.

1 Introduction

Previously high-strength structural bolts has been widely utilized in bolted connections as a crucial component of replacing the rivets for connection of beams and columns. However, a post-flashover fire has the potential to damage the connections in a steel-framed building structure, on account of its significantly reduced strength and stiffness in a fire situation. References [1-3] discovered that failure of 8.8 structural bolts in the bolted connections comprised threads stripping and bolt shank failure (ductile necking). Then reference [4] indicated that connections with failure of brittle components (e.g. bolts and welds) may be vulnerable to a certain extent in a fire situation. For safety and robustness, promoting fire performance of brittle components is needed for connection robustness design.

Investigation on 8.8 structural bolts can trace back to 1960s or even earlier. The previous research efforts are focused on performance of structural bolts in bolted connections under either static or

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