Methodology for Construction Stress Evaluation for Reuse of Structural Steel

Philipp Keller, Jennifer McConnell PhD, Erik T. Thostenson PhD

University of Delaware, Newark, DE, USA

Thomas Schumacher PhD

Portland State University, Portland, OR, USA

Contact: phkeller@udel.edu

Abstract

Reuse of structural steel is uncommon despite significant environmental advantages that could be achieved via this practice. The most commonly known reason for this fact is the lack of information about stress history in used structural steel members. To address this deficiency, prior to construction, selected steel members of a steel-framed building were instrumented before they are delivered to the construction site. Continuous strain data was collected during the entire erecting process of the new building using a wireless sensor network to obtain novel information on construction-induced stresses. The collected data will be used to assess the magnitude of construction induced stresses. These stresses are assumed to deviate from design assumptions the most and are therefore the greatest concern for reusing structural steel.

Keywords: steel; reuse; construction; strain; wireless sensor network; temperature; field monitoring; buildings

1 Introduction

Climate change and its many ancillary effects are one of the biggest societal concerns of the current decade, and the scientific community agrees that this is mainly a result of excessive emission of greenhouse gases by humans. Although most of these emissions are a result of fossil fuel combustion, the production of iron and steel (even with the use of recycled steel) is responsible for approximately 6.7% of CO_2 emissions in the world due to its energy demanding fabrication processes [1,2].

To reduce the impact of any material on the environment, the material (steel in this case) should be used according to the waste management hierarchy [3], which explains the most environmental efficient use of a material in form of a pyramid. Since prevention of using steel is not possible in the current era, this top part of the pyramid (least environmental impact) is not taken into account. Reduction of steel use is currently achieved by highly researched and efficient design practices with the help of accurate design software such as finite element programs. The developed design practices are used to obtain efficient structural designs with minimized material use. Recycling is another part of the material use pyramid; this practice is well established at the current time in the steel

https://doi.org/10.2749/stockholm.2016.1404
Distributed by structurae