



A Sustainable Structural Design method to analyse structural and environmental performances of a building

Kassiani Tsimplokoukou, Marco Lamperti Tornaghi, Paolo Negro

European Commission, Joint Research Centre (JRC), Institute for the Protection and Security of the Citizen (IPSC)

Contact: marco.lamperti@jrc.ec.europa.eu

Abstract

Current environmental assessment methods evaluate buildings for their life-cycle at a later design stage, providing an indication of their environmental performance. At that stage the environmental information cannot be effectively used in the general design process, whereas the sole aspect of the environmental performance cannot provide comparable building solutions. The *Sustainable Structural Design* (SSD) method, here introduced, considers environmental and structural parameters with a life-cycle approach. The integration of environmental data in the structural performance is the focus of this method, structural performances are considered as a probabilistic variable, through the introduction of a simplified Performance-Based Assessment method. The SSD method is implemented in a case study of a commercial building both for cast-in-situ and precast structure solutions.

Keywords: Structural design; Life Cycle Assessment; Performance-Based design; Risk Analysis.

1 Introduction

Sustainability of constructions draws an increasing interest to reduce the environmental impact of buildings, for this purpose different frameworks have been developed and initiated. Among those, the EU framework includes regulations and initiatives that are mainly oriented to improve the environmental performance of buildings, including energy efficiency and eco-friendly materials. These regulations are instrumental to achieve the EU targets on climate policy, which require to a 20% reduction of the carbon emissions and energy use, both by 2020 [1]. In an attempt to define an objective definition of the *Sustainable construction* and to provide a common framework to compare results, the *International Organization for Standardization* (ISO) and the *European Committee for Standardization* (CEN) have actively worked for the definition of standard

requirements for the environmental and sustainability assessment of buildings. They drafted the *Sustainability in Building Construction* framework, provided by ISO, and the *Sustainability of construction works* framework introduced by CEN. All those standards aim to provide harmonised methods for the assessment of environmental and *life cycle cost* (LCC) performance of buildings along with quantifiable social performance aspects, e.g. health and comfort of building [2],[3]. In addition, during the last two decades a significant number of environmental and sustainability assessment tools for buildings have been developed by different organisations [4]. The *Building Research Establishment Method* (BREEAM) together with the *Leadership in Energy and Environmental Design* (LEED) method and the *Sustainable Building Tool* (SbTool) have provided the basis for the development of other tools