Chapter

5 Measuring Sustainability and Life-Cycle Assessment

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5.1 Introduction

Structural engineers make design decisions based on objective criteria. From the strength of materials to finite element analysis, engineers rely on quantifiable metrics to design structural systems. With the emergence of sustainability objectives within the design profession, engineers have a unique opportunity to utilize their analytical expertise to produce structural systems with a positive impact on the natural environment. This chapter presents sustainability goals, an overview of life-cycle assessment (LCA), life-cycle assessment case studies answering common engineering questions, green design rating systems, and emerging trends in measuring environmental performance.

The concept of sustainability has achieved widespread acceptance and support from design professionals and in particular from the international structural engineering community (e.g., American Society of Civil Engineers (ASCE) Structural Engineering Institute, Sustainability Committee; IABSE Working Commission 7: Sustainable Engineering). Although sustainability has become a central pillar of contemporary design, there remain significant challenges in achieving sustainability objectives due to the opaqueness and qualitative nature of terminology used and its numerous interpretations. The U.N. Report of the World Commission on Environment and Development defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [1]. The ASCE defines sustainable development as "the process of applying natural, human, and economic resources to enhance the safety, welfare, and quality of life for all of society while maintaining the availability of the remaining natural resources" [2]. An overarching challenge for sustainable design is in verification: defining and quantifying metrics in order to achieve sustainability objectives.

In addition to defining and quantifying sustainability metrics, it is necessary to ensure that all impacts and a systems-based approach are considered. For example, reducing the operational energy use of a building alone omits the trend of increasing building size [3], increasing use

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