



Designation: E1991 – 05

Standard Guide for Environmental Life Cycle Assessment (LCA) of Building Materials/Products¹

This standard is issued under the fixed designation E1991; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

This is a general guide for the application of environmental Life Cycle Assessment (LCA) as a tool for evaluating the environmental aspects of materials/products, processes, and services produced and used in buildings and the built environment. This guide does not include, necessarily, all of the environmental features and impacts of the complete building life cycle, but focuses on those issues directly related to building materials/products and those elements of the building's environmental performance affected by these materials/products. Fig. 1 illustrates the total life cycle of a building. Fig. 2 is an example of the relationship between the life cycle processes of building materials/products and the total life cycle of a building and illustrates how these product/material life cycle processes merge with the total building life cycle. Fig. 3 illustrates an example of the life cycle of a building construction material within the context of the total building life cycle.

1. Scope

1.1 This guide covers a common framework and set of principles for potential users, such as product manufacturers, environmental analysts, consultants, architects, and the building industry in general. It describes a framework for life cycle inventory analysis, and describes various options and aspects of Impact Assessment and Interpretation.

1.2 The complexity and level of detail of an LCA will vary greatly depending on the material/product or system studied, the purpose and use of the study, the intended users of the study, and the resources committed to complete the study. The level of detail can range from generic to material/product specific.

1.3 This guide does not describe in detail the actual techniques for performing a LCA.

1.4 LCA is an emerging methodology, which is still evolving. This guide will present its concepts and major features. It should enable the user to better understand LCA and its application to building materials/products, and help to identify

sources of additional information and guidance. LCA is only one of many tools designed to aid in environmental evaluation and decision making.

1.5 The component phases of LCA, including goal definition and scoping, inventory, impact assessment, interpretation, and the various methodologies used in these phases are in various stages of development. Consequently, the results of an LCA must be understood in the context of their completeness and accuracy and must be applied appropriately. LCA does not necessarily proceed as a linear process through these phases but is conducted in an iterative fashion.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

E631 Terminology of Building Constructions

E1765 Practice for Applying Analytical Hierarchy Process (AHP) to Multiattribute Decision Analysis of Investments Related to Buildings and Building Systems

¹ This specification is under the jurisdiction of ASTM Committee E60 on Sustainability and is the direct responsibility of Subcommittee E60.01 on Buildings and Construction.

Current edition approved July 1, 2005. Published July 2005. Originally approved in 1998. Last previous edition approved in 2004 as E1991 – 98 (2004). DOI: 10.1520/E1991-05.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

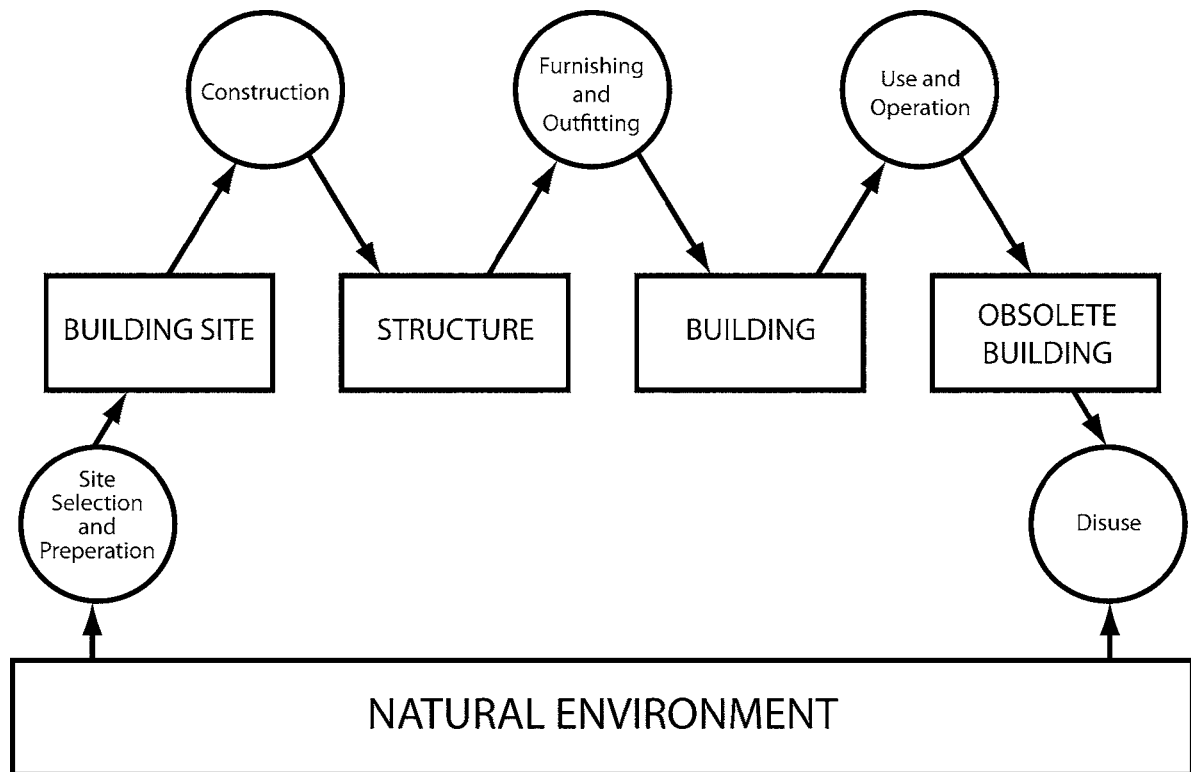


FIG. 1 Total Life Cycle of a Building

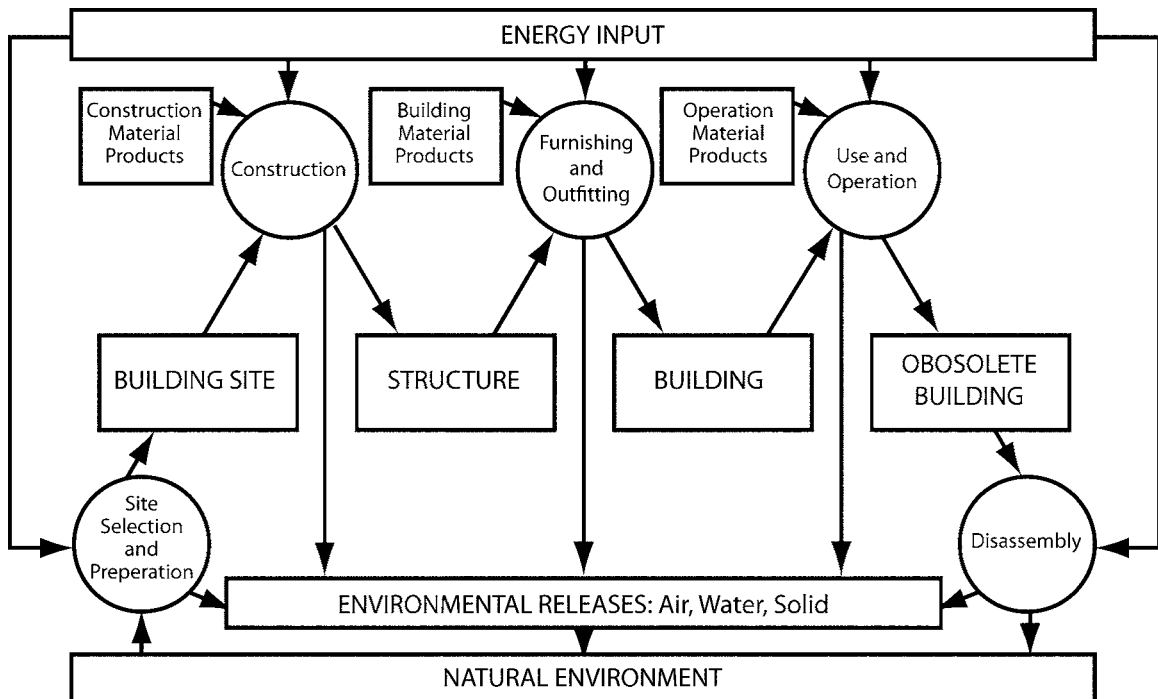
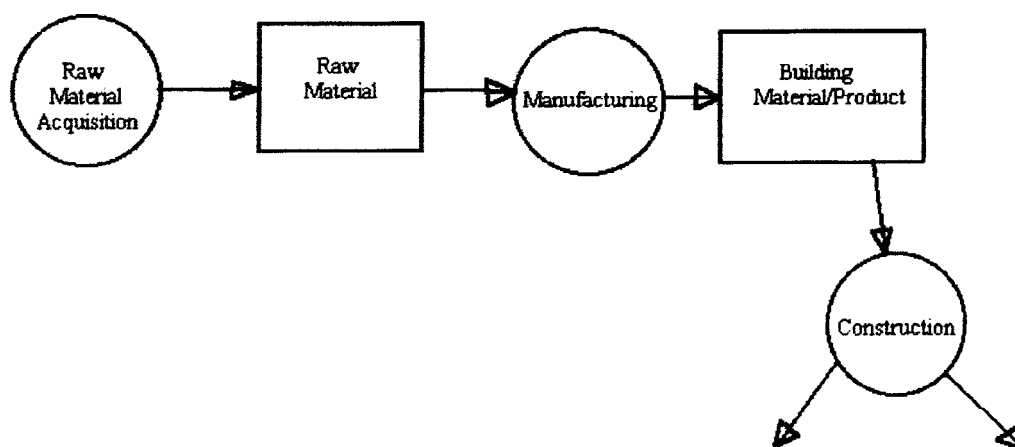


FIG. 2 Flow of Building Materials/Products into Building Life Cycle



Building Life Cycle (See Figure 1)

FIG. 3 Example of Building Material/Product Segment of Total Building Life Cycle

E2114 Terminology for Sustainability Relative to the Performance of Buildings

2.2 Other Standards:

ISO 14040 Environmental Management—Life Cycle Assessment—Principles and Framework³

3. Terminology

3.1 Definitions:

3.1.1 For terms related to building construction, refer to Terminology E631. Some of these terms are reprinted here for ease of use.

3.1.1.1 *building, n—*(1) A shelter comprising a partially or totally enclosed space, erected by means of a planned process of forming and combining materials; *v—*(2) The act or process of constructing.

(a) *apartment building*—a building containing more than two dwelling units not intended for individual unit ownership.

(b) *condominium*—an apartment building, group of townhouses, or single dwellings in which each dwelling unit is individually owned and each owner holds an interest in common areas. Also commonly used to denote an individual unit.

(c) *house*—a building intended in its entirety as a dwelling.

(d) *manufactured building*—a structure wholly or substantially made in a manufacturing plant for installation or assembly at the building site.

3.1.2 For terms related to sustainability relative to the performance of buildings, refer to Terminology E2114. Some of these terms are reprinted here for ease of use.

3.1.2.1 *life-cycle assessment (LCA), n—*a method of evaluating a product by reviewing the ecological impact over the life of the product.

Discussion—At each stage, the product and its components are evaluated based upon materials and energy consumed, and the pollution and waste produced. Life stages include extraction of raw materials, processing and fabrication, transportation, installation, use and maintenance, and reuse/recycling/disposal. ISO 14040 defines LCA as the compilation and evaluation of the inputs, outputs, and the potential environment impacts of a product system throughout its life cycle from which pollutants are discharged; any single identifiable source of pollution.

3.2 Descriptions of Terms Specific to This Standard:

3.2.1 *building material/product, n—*a manufactured or produced unit or component that goes into any of the building life cycle processes. In the text of this guide, this term is used in a broad context and is meant to include fundamental construction material, for example, stone, as well as manufactured products, such as, windows, roofing, HVAC, and electrical systems, interior furnishings, maintenance products, and so forth, used throughout the total building life cycle.

3.2.2 *deconstruction*—disassembly of buildings to recover materials

3.2.3 *energy input, n—*all forms of energy necessary for the accomplishment of the particular building life cycle process under consideration.

3.2.4 *environmental releases, n—*all air, water, and solid emissions, which are given off by the building life cycle process under consideration that return to the natural environment.

3.2.5 *furnishing and outfitting, n—*the complete series of activities and actions that begins with a building structure and results in a completed building.

3.2.6 *interior furnishings, n—*those temporary and semipermanent systems and components, which generally are required for the normal utilization of the building for its intended purpose including decorative components.

³ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, <http://www.iso.ch>.