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Standard Guide for General Principles of Sustainability Relative to Buildings[1]

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1. Scope

1.1 Sustainabilty has three types of general principles: environmental, economic, and social. This guide covers the fundamental concepts and associated building characteristics for each of the general principles of sustainability.

1.2 This guide distinguishes between ideal sustainability and applied sustainability. Ideally, human activities would not require making trade-offs among environmental, economic, and social goals. However, this guide recognizes that, in applying sustainability principles to buildings, decision makers must often balance opportunities and challenges associated with each of the general principles.

1.3 This guide identifies general methodologies associated with the decision-making process used in pursuing sustainability.

1.4 This guide addresses buildings individually and in aggregate (collectively).

1.4.1 The general principles identified in this guide are applicable to all scales of building projects, including: interior spaces, individual buildings and groups of buildings, infrastructure systems, and land use.

1.4.2 The general principles identified in this guide are applicable to all life-cycle stages of a building and its components, including: material extraction, product manufacturing, product transportation, planning, siting, design, specification, construction, operation, maintenance, renovation, retrofit, reuse, deconstruction, and waste disposal of buildings.

1.5 A variety of tools and standards exist that qualify and quantify impacts of buildings, building materials, and building methods in terms of one or more of the general principles of sustainability. It is not within the scope of this standard to recreate or replace these tools.

1.6 This guide does not provide direction as to the specific implementation of the general principles; nor does it provide direction as to the specific weighting of principles necessary for achieving balance.

~~1.7Implementation of~~1.7 Applying the principles in this guide will require professional judgment. Such judgment should be informed by experience with environmental, economic, and social issues as appropriate to the building use, type, scale, and location.

1.8 This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.

1.9 *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

E917 Practice for Measuring Life-Cycle Costs of Buildings and Building Systems

E2114 Terminology for Sustainability Relative to the Performance of Buildings

2.2 *ISO Standards:*[3]

ISO 14040 Life Cycle Assessment

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[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.

[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.

3. Terminology

3.1 *Definitions:*

3.1.1 For terms related to building construction, refer to Terminology E631.

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.

3.1.3 *biodiversity*, *n*—the variability among living organisms from all sources including: terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems.

3.1.4 *deconstruction*, *n*—disassembly of buildings for the purpose of recovering materials.

3.1.5 *ecosystem*, *n*—community of biological organisms and their physical environment, functioning together as an interdependent unit within a defined area.

3.1.5.1 *Discussion*—For the purposes of this definition, humans, animals, plants, and micro-organisms are individually all considered biological organisms.

3.1.6 *green building*, *n*—a building that provides the specified building performance requirements while minimizing disturbance to and improving the functioning of local, regional, and global ecosystems both during and after its construction and specified service life.

3.1.6.1 *Discussion*—A green building optimizes efficiencies in resource management and operational performance; and, minimizes risks to human health and the environment.

3.1.7 *indoor environmental quality (IEQ)*, *n*—the condition or state of the indoor environment.

3.1.7.1 *Discussion*—Aspects of IEQ include but are not limited to qualitative and quantitative measures for thermal comfort, light quality, acoustic quality and air quality.

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

3.1.8.1 *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 environmental impacts of a product system throughout its life-cycle.

3.1.9 *life-cycle cost (LCC) method*, *n*—a technique of economic evaluation that sums over a given study period the costs of initial investment (less resale value), replacements, operations (including energy use), and maintenance and repair of an investment decision (expressed in present or annual value terms).

3.1.9.1 *Discussion*—LCC is distinct from LCA in that LCA is an environmental review methodology and LCC is an economic review methodology.

3.1.10 *non-renewable resource*, *n*—resource that exists in a fixed amount that cannot be replenished on a human time-scale.

3.1.10.1 *Discussion*—Non-renewable resources have the potential for renewal only by the geological, physical and chemical processes taking place over hundreds of millions of years. Non-renewable resources exist in various places in the earth's crust. Examples include iron ore, coal, and oil.

3.1.11 *perpetual resource*, *n*—a resource that is virtually inexhaustible on a human time scale.

3.1.11.1 *Discussion*—Examples include solar energy, tidal energy, and wind energy.

3.1.12 *renewable resource*, *n*—a resource that is grown, naturally replenished, or cleansed, at a rate which exceeds depletion of the usable supply of that resource.

3.1.12.1 *Discussion*—A renewable resource can be exhausted if improperly managed. However, a renewable resource can last indefinitely with proper stewardship. Examples include: trees in forests, grasses in grasslands, and fertile soil.

3.1.13 *reuse*, *v*—using a material, product or component of the waste stream in its original form more than once.

3.1.14 *sustainability*, *n*—the maintenance of ecosystem components and functions for future generations.

3.1.15 *sustainable building*, *n*—see **green building**.

3.1.16 *sustainable development*, *n*—development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *carbon sinking*, *n*—an approach to offset carbon dioxide emissions through the absorption potential of forests and other vegetation.

3.2.2 *Design for the Environment (DfE)*, *n*—the systemic consideration of design performance with respect to environmental, health, and safety objectives over the full product life-cycle.

3.2.3 *external costs/benefits*, *n*—economic impact associated with the action of a party that is not borne by that party, but rather by a third party or parties.

3.2.3.1 *Discussion*—This is intended to include economic costs and benefits associated with environmental and social impacts arising out of the action.

3.2.4 *green roof system*, *n*—an assembly that supports an area of planting/landscaping, built up on a waterproofed substrate at any level that is separated from the natural ground by a human-made structure.

3.2.5 *heat island effect*, *n*—a phenomenon in which urban air and surface temperatures are higher than nearby rural areas due to the replacement of natural land cover with pavement, buildings, and other infrastructure.

4. Significance and Use

4.1 Every building and building product has environmental, economic, and social impacts. These impacts occur at all life-cycle stages in multiple ways and on local, regional, and global scales. It is imperative to understand the nature of these impacts and their relationship to the general principles of sustainability in order to address the opportunities and challenges they present in buildings.

4.1.1 Buildings impact the environment. In order to advance sustainability, it is necessary to identify environmental impacts, mitigate negative environmental impacts, and promote positive environmental impacts.

4.1.2 Buildings have economic impacts. In order to advance sustainability, it is necessary to quantify and optimize life-cycle costs/benefits and external costs/benefits to the greatest extent possible.

4.1.3 Buildings impact society. In order to advance sustainability, it is necessary to identify the health, safety, and welfare impacts, and to contribute to a positive quality of life for current and future generations.

4.2 The general principles of sustainability—environmental, economic, and social—are interrelated. Decisions founded on the opportunities and challenges of any of the principles will have impacts relative to all of the principles. However, to facilitate clarity in the presentation of the general principles of sustainability relative to buildings, they are discussed individually in Section 5.

4.3 Sustainability is an ideal. The practical application of the general principles of sustainability relies upon balancing environmental, economic, and social impacts and committing to continual improvement to approach this ideal. Section 6 discusses this balancing of environmental, economic, and social impacts in pursuit of sustainability.

4.4 The marketplace is evolving as technology, economics, and society become globalized. The range of topics and approaches to standards development has evolved in tandem with the changes in the marketplace. This guide addresses one of the primary issues of today's global marketplace—sustainability. It provides an overview of sustainability, as it is applicable to buildings. It provides general guidance but does not prescribe a specific course of action.

4.5 This guide is intended to inform professionals associated with the building industry, including specifiers, planners, developers, architects, landscapers, engineers, general contractors, subcontractors, owners, facility managers, financial organizations related to the building industry, product manufacturers, and government agencies including building officials, and other building professionals.

4.5.1 The general principles identified in this guide are intended to assist users in making decisions that advance sustainability.

4.5.2 The general principles identified in this guide are intended to inform the development and refinement of tools and standards to qualify and quantify impacts of buildings, building materials, and building methods.

5. Principles of Ideal Sustainability Relative to Buildings

5.1 *Environmental Principles*—Buildings impact the environment. From gathering raw materials, production of components, assembly into structures, day-to-day operations, periodic maintenance, to the final disposition of the components, there are impacts on the environment. Environmental impacts affect ecosystems, biodiversity, and natural resources. In order to advance sustainability, it is necessary to identify environmental impacts, mitigate negative environmental impacts, and promote positive environmental impacts.

5.1.1 *Fundamental Concepts*:

5.1.1.1 *Ecosystems*—Ecosystems provide critical services that support life on the earth and the continued viability of a large range of flora and fauna. Sustainability protects existing ecosystems and strives to restore damaged ecosystems.

5.1.1.2 *Biodiversity*—Biodiversity provides environmental options, both known and unknown, that contribute to the genetic resilience of the earth's flora and fauna. Sustainability protects or enhances the biodiversity and interdependencies of species.

5.1.1.3 *Natural Resources*—Natural resources provide the basic requirements of life and the material/energy from which all human-made material/energy is derived. Sustainability balances the use of earth's renewable, non-renewable, and perpetual resources in order to preserve these resources for future generations.

5.1.2 *Associated Building Characteristics*:

5.1.2.1 *Ecosystems*—Sustainable buildings contain features that protect or enhance local, regional, and global ecosystems. For example, energy efficiency features, both active and passive, can reduce the amount of energy used by the building. This approach can reduce the regional impacts associated with air emissions from electric power generation facilities and reduce the local impacts of the heat island effect.

5.1.2.2 *Biodiversity*—Sustainable buildings contain features that protect or enhance species' habitats. For example, a green roof system can retain and utilize stormwater through the use of climate-appropriate plants. This approach can reduce the amount of polluted stormwater runoff and creates new habitats within the built environment.

5.1.2.3 *Natural Resources*—Sustainable buildings maximize the effective use of resources. Sustainable buildings preserve or enhance the quality of resources and do not adversely alter the balance between renewable resources and their rate of consumption for building-related purposes. For example, water resource stewardship approaches such as water-efficient, native landscaping, and permeable surfaces can reduce the use of water and help to naturally filter contaminants. These approaches can assist in recharging groundwater resources. Similarly wood building products obtained from sustainably managed forests offer a renewable resource