



# Standard Guide for Specifying and Evaluating Performance of Single Family Attached and Detached Dwellings—Functionality<sup>1</sup>

This standard is issued under the fixed designation E2351; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## INTRODUCTION

This standard guide, L-Functionality is part of a set which together presents a complete performance standard guide for specifying and evaluating single family attached and detached dwellings. The complete set in the series, when finished, is to include the attributes given in [Table 1](#).

The series provides a framework for specifying and evaluating qualities of building products and systems to meet user needs without limiting ways and means. The format for this standard guide includes performance statements that consist of four components (Objectives-Criteria-Evaluation-Commentary) which together provide a systematic performance based approach for the intended purpose. These performance statements are presented in [Appendix X2](#) against a Hierarchy of Building Elements as tabulated in [Table 2](#).

To some extent, the Hierarchy of Building Elements reflects the structure of the housing industry, and therefore, the organization of the provider teams. For example, a homebuilder or developer is likely to be the systems integrator responsible for “0. Whole Building System.” The provider teams may include separate subcontractors for “2.1 Foundation,” “2.2 Superstructure,” “5. Plumbing,” “6. HVAC,” and so forth, and separate suppliers for components such as “3.2.2 Windows,” “4.1.2 Doors,” “3.4 Joint Sealants,” “5.1 Plumbing Fixtures,” and so forth.

The purpose of these standard guides is to provide a standardized methodology for describing performance parameters of single family attached or detached dwellings. This methodology standardizes the descriptions of performance of a single family dwelling, attached or detached, that can be expressed as performance statements (O-C-E-C) for a particular attribute, agent, and user need.

These standard guides are intended for use by those who need to prescribe required levels of performance and those who need to rate a product which forms a single family dwelling or part thereof. The standard guides include examples of performance statements which may be used for the specification and evaluation of design, materials, products, components, subsystems, and systems.

## 1. Scope

1.1 This guide provides examples of performance statements for functional and operable, spaces, products, components, and subsystems for single family attached and detached dwellings. These include the location, relationships, and dimensions of Spaces and Fittings, Furnishings and

Equipment, and the operability and other parameters of Functionality of the Exterior Enclosure, Interior Space Division, Plumbing, HVAC, Fire Protection Subsystems, Electrical Network, Communication and Security Networks, Fuel Networks and Fittings, and Furnishings and Equipment that are not covered by the performance statements of the other attributes. See [Fig. 1](#), Matrix of Parameters of Functionality.

1.2 The SI units of measurement system is provided with the English units parenthetically listed throughout this standard guide.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the*

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**TABLE 1 Attributes Addressed in the Series of Performance Standards**


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A— Structural Safety and Serviceability
B— Fire Safety
C— Accident Safety
D— Health and Hygiene
E— Indoor Air Quality
F— Light
G— Acoustics
H— Durability
I— Accessibility
J— Security
K— Economics
L— Functionality
M— Aesthetics
N— Adaptability
O— Maintainability
P— Sustainability

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**TABLE 2 Hierarchy of Building Elements Included in the Series of Performance Standards for Single Family Attached and Detached Dwellings**


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0. Whole Building System
0.1 All Building Subsystems
0.2 Groups of Buildings Subsystems
1. Spaces
1.1 Entries
1.2 Living Spaces
1.3 Dining Spaces
1.4 Kitchens
1.5 Sleeping Spaces
1.6 Bathrooms
1.7 Water Closets
1.8 Outdoor Living Spaces
1.9 Storage Spaces
1.10 Other
1.10.1 Laundry
1.10.2 Garage
1.10.3 Work Space
1.10.4 Mechanical Space
2. Structure
2.1 Foundation
2.2 Superstructure
3. Exterior Enclosure
3.1 Grade Enclosure
3.1.1 Floor on Grade
3.1.2 Floor over Air Space
3.1.3 Other
3.2 Vertical and Sloped Enclosure
3.2.1 Walls
3.2.2 Windows
3.2.3 Doors
3.2.4 Other (for example, railings, louvers, screens etc.)
3.3 Roofs
3.3.1 Roof Coverings
3.3.2 Skylights
3.3.3 Other Roof Openings
3.4 Joint Sealants
4. Interior Space Division
4.1 Vertical Space Dividers
4.1.1 Partitions
4.1.2 Doors
4.1.3 Other
4.2 Horizontal Space Dividers
4.2.1 Floors
4.2.2 Ceilings
4.2.3 Floor/Ceiling Openings
4.2.4 Other
4.3 Stairs and Ramps
5. Plumbing
5.1 Plumbing Fixtures
5.2 Domestic Water Distribution
5.3 Sanitary Waste
5.4 Rain Water Drainage
6. HVAC
6.1 Heating
6.1.1 Heating Generation
6.1.2 Heating Distribution
6.1.3 Heating Terminal and Package Units
6.1.4 Heating Controls and Instrumentation
6.2 Cooling
6.2.1 Cooling Generation
6.2.2 Cooling Distribution
6.2.3 Cooling Terminal and Package Units
6.2.4 Cooling Controls and Instrumentation
6.3 Ventilation
6.3.1 Ventilation Distribution
6.3.2 Ventilation Terminal and Package Units
6.3.3 Ventilation Controls and Instrumentation
7. Fire Protection Subsystems
7.1 Suppression
7.2 Detection
7.3 Notification
7.4 Fire Protection Specialties
8. Electrical Network
8.1 Electrical Service and Distribution

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responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

**C976** Test Method for Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box (Withdrawn 2002)<sup>3</sup>

**E119** Test Methods for Fire Tests of Building Construction and Materials

**E154** Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

**E241** Guide for Limiting Water-Induced Damage to Buildings

**E283** Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

**E330** Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

**E331** Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

**E547** Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference

**E631** Terminology of Building Constructions

**E783** Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors

**E1105** Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

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- 8.2 Lighting and Branch Wiring
  - 9. Communication and Security Networks
    - 9.1 Telephone
    - 9.2 Intercom
    - 9.3 Television
    - 9.4 Security
    - 9.5 Other
  - 10. Fuel Networks
    - 10.1 Gas
    - 10.2 Oil
    - 10.3 Other
  - 11. Fittings, Furnishings and Equipment
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**E1486** Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria

**E1486M** Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria (Metric)

**E1677** Specification for Air Barrier (AB) Material or System for Low-Rise Framed Building Walls

**E1825** Guide for Evaluation of Exterior Building Wall Materials, Products, and Systems

**E2151** Terminology of Guides for Specifying and Evaluating Performance of Single Family Attached and Detached Dwellings

**MNL18** Moisture Control in Buildings

2.2 *AAMA Standards:*<sup>4</sup>

**AAMA 901-96** Voluntary Specification for Rotary Operators In Window Applications

**AAMA 902-99** Voluntary Specification for Sash Balances (Revised)

**ANSI/AAMA 1002.10-93** Voluntary Specifications for Insulating Storm Products for Windows and Sliding Glass Doors

**ANSI/AAMA/NWWDA 101/I.S.2-97** Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

2.3 *ANSI Standards:*<sup>5</sup>

**ANSI Z124.2** Plastic Shower Receptors and Shower Stalls

**ANSI Z765-1996** American National Standard for Single family Residential Buildings, Square Footage—Method for Calculating

2.4 *ANSI/AHAM Standard:*<sup>6</sup>

**ANSI/AHAM HRF-1-1988** Household Refrigerators, Combination Refrigerator-Freezers and Household Freezers

2.5 *ANSI/DASMA Standard:*<sup>7</sup>

**ANSI/DASMA 102-1996** Specification for Sectional Overhead Type Doors

2.6 *ASHRAE Standard:*<sup>8</sup>

**ANSI/ASHRAE 55-1992** Thermal Environmental Conditions for Human Occupancy and the ASHRAE 55a-1995 Addendum

2.7 *ASME Standard:*<sup>9</sup>

**ASME/ANSI A112.19.2M** Vitreous China Plumbing Fixtures

2.8 *ASSE Standard:*<sup>10</sup>

**ASSE/ANSI 1037** Performance Requirements for Pressurized Flushing Devices for Plumbing Fixtures

2.9 *AWI Standard:*<sup>11</sup>

**AWI Architectural Woodwork Quality Standards**

2.10 *ICC Standards:*<sup>12</sup>

**ICC/ANSI A117.1-98** Accessible and Usable Buildings and Facilities

**International Building Code ®-2000**

**International Energy Conservation Code™-2000**

**International Residential Code™ for One- and Two-Family Dwellings-2000**

2.11 *NFRC Standards:*<sup>13</sup>

**NFRC 100-97** Procedure for Determining Fenestration Product Thermal Properties (Currently Limited to U values)

**Attachment A** Interim Standard Test Method for Measuring the Steady State Thermal Transmittance of Fenestration Systems Using Hot Box Methods

**Section B** Procedure for Determining Door System Product Thermal Properties (Currently Limited to U values)

**NFRC 200-97** Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence

**NFRC 300-94** Procedures for Determining Solar Optical Properties of Simple Fenestration Products

**NFRC 301-93** Standard Test Method for Emittance of Specular Surfaces Using Spectrometric Measurements

**NFRC 400-95** Procedure for Determining Fenestration Product Air Leakage

2.12 *NWWDA Standard:*<sup>14</sup>

**NWWDA I.S.1** Industry Standard for Wood Flush Doors

2.13 *UL Standard:*<sup>15</sup>

**UL 250** Household Refrigerators and Freezers (1993)

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<sup>8</sup> Available from American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Inc. 1791 Tullie Circle, N.E Atlanta, GA 30329.

<sup>9</sup> Available from American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990.

<sup>10</sup> Available from American Society of Sanitary Engineering (ASSE), 28901 Clements Road, #100 Westlake, OH 44145.

<sup>11</sup> Available from Architectural Woodwork Institute (AWI), 1952 Isaac Newton Square, West Reston, VA 20190; Telephone: 703-733 0600.

<sup>12</sup> Available from ICC, 5203 Leesburg Pike, Suite 708 Falls Church, Virginia 22041-3401; Telephone: 703-931-4533.

<sup>13</sup> Available from National Fenestration Rating Council (NFRC), Suite 120, 1300 Spring Park, Silver Spring, MD 20910.

<sup>14</sup> Available from National Wood Window and Door Association (NWWDA), 1400 E. Touhy Ave., Des Plaines, Illinois 60018; Telephone: 847-299-5200 or 800-223-2301.

<sup>15</sup> Available from Underwriters Laboratories (UL), Inc. 333 Pfingsten Road, Northbrook, IL 60062-2096; Telephone: 847-272-8800 E-mail: northbrook@ul.com

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<sup>4</sup> Available from American Architectural Manufacturers Association (AAMA), 1827 Walden Office Square, Suite 104, Schaumburg, IL 60173-4628; (t) 847-303-5664 (f) 847-303-5774 E mail: webmaster@aamanet.org

<sup>5</sup> Available from American National Standards Institute 11 West 42nd Street, 13th floor New York, NY 10036-8002.

<sup>6</sup> Available from Association of Home Appliance Manufacturers (AHAM), 20 North Wacker Drive, Suite 1600 Chicago, IL 60606.

<sup>7</sup> Door and Access Systems Manufacturer's Association International (DASMA), 1300 Summer Ave., Cleveland, Ohio 44115-2851.

### 2.14 Other References:

Ramsey/Sleeper Architectural Graphic Standards—Latest Edition<sup>16</sup>

U.S. Department of Commerce Builder's Foundation Handbook

Humanscale 7/8/9 Diffrient, N., Tilley, Alvin R., and Harman, D.<sup>17</sup>

Fair Housing Accessibility Guidelines<sup>18</sup>

Peterson, Mary Jo, Universal Bathroom Planning, Design That Adapts To People<sup>19</sup>

Peterson, Mary Jo, Universal Kitchen Planning, Design That Adapts To People<sup>19</sup>

Time-Saver Standards For Architectural Design Data—Latest Edition<sup>20</sup>

Time-Saver Standards For Building Types—Latest Edition<sup>20</sup>

Time Saver Standards for Housing and Residential Development—Second Edition<sup>20</sup>

level or range of performance necessary to meet an *objective* or, where such a level or range cannot be established, the units of measurement of the performance.

3.2.7 *detached dwelling, n*—a dwelling unit standing by itself.

3.2.8 *evaluation, n*—the third part of a *performance statement*, consisting of the method(s) of assessing conformance of the element being addressed to the *criteria*.

3.2.8.1 *Discussion*—The *evaluation* states the standards, inspection methods, review procedures, historical documentation, test methods, in-use performance, engineering analyses, models, or other means to be used in assessing whether or not a criterion has been satisfied.

3.2.9 *functionality, n*—that part of *serviceability* that addresses issues such as activity support, shape and size, spatial relationships, visual privacy, circulation, and operability.

3.2.9.1 *Discussion*—See Guide “G”—Acoustics for audio issues, for discussions of visual privacy issues.

3.2.10 *habitable rooms, n*—a room that is used for sleeping, living, cooking or dining purposes, excluding such spaces as closets, pantries, bath or toilet (water closet) rooms, hallways laundries, storage spaces, utility rooms and similar spaces.

3.2.11 *means of egress, n*—a continuous and unobstructed path of travel from the dwelling unit directly to the exterior with no shared or common entry with another dwelling unit.

3.2.12 *not interfere w/ neighbor*—not to hinder the use, enjoyment, functionality, etc. of the adjacent dwellings, property, site, buildings, etc.

3.2.13 *service entrance, n*—in regard to electrical or other power or fuel network, the location where the electricity or fuel enters the building.

3.2.14 *serviceability, n*—the capability of a building, assembly, component, product, or construction to perform the function(s) for which it is designed and used.

3.2.15 *solar heat gain coefficient (SHGC), n*—the fraction of solar radiation admitted through a window or skylight, both directly transmitted, and absorbed and subsequently released inward.

3.2.15.1 *Discussion*—The solar heat gain coefficient has replaced the shading coefficient as the standard indicator of a window's shading ability. It is expressed as a number between 0 and 1. The lower a window's solar heat gain coefficient, the less solar heat it transmits, and the greater its shading ability. SHGC is expressed for the entire window assembly.

3.2.16 *specifier, n*—the individual or organization using the standard guides to create specifications for dwelling designs, materials, products, components, subsystems, or buildings to be provided by *providers*.

3.2.17 *user need, n*—a statement of the activities and behavior to be carried out in relation to the dwelling by its residents, or other users, defined in terms of motor, kinetic, physiological, psychological, emotional and other parameters of human behavior.

3.2.17.1 *water closet, n*—a compartment or room for defecation and excretion into a toilet bowl.

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this standard guide refer to Terminology E631, and E2151.

### 3.2 Definitions:

3.2.1 *air infiltration, n*—the amount of air leaking in and out.

3.2.2 *circulation, n*—as used in the performance statements, the passing of people, pets and objects from place to place, room to room, or space to space, unless otherwise noted.

3.2.3 *comfort, n*—contented well being; satisfying or enjoyable experience; physical, thermal, and visual contentment; not too cold or warm; not painful; and supportive.

3.2.4 *commentary, n*—the fourth part of a *performance statement*, consisting of an informative narrative explaining aspects of the *performance statement*.

3.2.4.1 *Discussion*—A *commentary* may include one or more of the following: an explanation of how the *objective* relates to *user needs* in fields such as physiology, psychology, and culture or tradition; an explanation of how the *criteria* are established including guides for setting different levels of performance to meet various *user needs*; a discussion of the reliability of the *evaluation* method; and example solutions that may be deemed, by the *specifier*, to comply with the *performance statement*.

3.2.5 *convenient, adj*—available to be utilized with the most effective, efficient, and accessible means.

3.2.6 *criteria, n*—the second part of a *performance statement*, consisting of quantitative statements defining the

<sup>16</sup> Available from John Wiley and Sons, Inc., 605 Third Avenue New York, NY 10157.

<sup>17</sup> Available from Henry Dreyfuss Associates, The MIT Press, Massachusetts Institute of Technology, Cambridge, MA 02147.

<sup>18</sup> Available from Office of the Assistant Secretary for Fair Housing and Equal Opportunity, U.S. Department of Housing and Urban Development, 451 7th Street, Southwest Washington, DC 20410.

<sup>19</sup> Available from National Kitchen and Bath Association (NKBA), 687 Willow Grove Street, Hackettstown, NJ 07840; Telephone: 908-852-0033.

<sup>20</sup> Available from McGraw Hill Ryerson, Order Desk 300 Water Street, Whitby ON, L1N 9B6 CANADA; Telephone: 1-800-565-5758.



3.2.18 *water closet fixture, n*—a toilet bowl and its accessories.

3.2.19 *water infiltration, n*—water penetration that passes beyond the interior face of the unit and overflows into the room or into the wall area.

3.2.20 *U-factor, n*—a measure of the rate of non-solar heat loss or gain through a material or assembly. It is expressed in units of  $W/m^2 \cdot ^\circ C$  ( $Btu/h \cdot ft^2 \cdot ^\circ F$ ).

3.2.20.1 *Discussion*—Values are normally given for AAMA/ASHRAE/NFRC winter conditions of 18°C (0°F) outdoor temperature, 21°C (70°F) indoor temperature, 24 km/h (15 mph) wind, and no solar load. The U-factor is expressed for an entire window or windows, which includes the effect of the frame and the spacer materials. The lower the U-factor, the greater a window’s resistance to heat flow and the better its insulating value.

#### 4. Significance and Use

4.1 This standard guide and the use of consensus performance standards for housing can significantly contribute to the removal of barriers to the acceptance of housing innovation in the global marketplace. This standard guide in conjunction with the balance of the set of standard guides can also serve to improve communications between producers and consumers leading to enhanced quality and performance of housing.

4.2 This standard guide is not intended for use in specifying and evaluating residential construction other than single family attached and detached dwellings.

4.3 Although this standard guide addresses site planning as it affects functionality of single family attached and detached dwellings, the site-planning issues considered are not be construed as a comprehensive site specification.

4.4 This standard guide can be useful to managers of housing procurement projects, home builders, designers, product manufacturers, and evaluation services in addressing functionality issues related to single family attached and detached dwellings. Such applications can require that the examples of performance statements be written in mandatory language.

##### 4.5 *Methodology/Special Conditions:*

4.5.1 In order to provide the specifier added flexibility in the choice of specific building elements, the specifier may choose to require that the providers submit information on certain building elements representing alternative levels of quality, beyond those which are defined by the attributes in the complete set of standard guides. For each of these the providers should be required to submit details, specifications, or other appropriate information as determined by the specifier.

4.5.2 Some elements that may need these alternatives are finishes, fixtures and hardware.

4.6 *Code Compliance*—This guide does not intend to take precedence over applicable standards, federally regulated standards local rules, codes and regulations.

##### 4.7 *Data and Dimensions:*

4.7.1 *Anthropometric*—The specifier should provide the potential providers with important dimensions such as the height, width, reach, stretch, eye level of potential occupants standing

and sitting, as well as other relevant anthropometric dimension so the occupants can conveniently use the dwelling unit. The Specifier should take into consideration occupants who do not fit into the population mean; the dimensions should be adjusted as required. See the standard Guide “I”—Accessibility for Dimensions Associated with Access for the Disabled.

4.7.1.1 *Discussion*—The 97.5 percentile (large male) dimensions may be used to determine space envelopes, the 2.5 percentile (small person) may be used to determine the maximum reach areas by hand or foot, and the 50 percentile (average person) may be used to establish control and display heights. Reference: “Humanscale 7/8/9” (see Section 2).

4.7.2 *Furniture Sizes*—The specifier may provide potential providers with typical furniture dimensions that will be used in conjunction with the performance statements that address furnishability to evaluate the appropriateness of room shapes and layouts. Providers wishing to suggest other furniture types for the purpose of evaluation should provide justification, dimensions, and documentation that a variety of each of these furniture types to be substituted is readily available. Reference: Residential chapter of “Time-Saver Standards For Building Types,” Residential Furnishings section of “Architectural Graphic Standards” (see Section 2).

4.7.3 *Movement and Circulation Minima*—See the Ease of Movement Performance Statements, in **Appendix X2** for minimum movement and circulation. Where such movement and circulation conditions exist, the guidelines are intended to be used with the furniture size information (see 4.7.2) and with the furnishability criteria in section **X2.2.3** and the Performance Statements in **Appendix X2**. The specifier may choose to modify and add to these minimum guidelines based on project specific objectives. Providers wishing to use alternative minimum circulation dimensions should be required to provide documentation from a source acceptable to the specifier indicating that the intended dimensions are adequate. Also, where the specifier has included accessibility considerations see ASTM Designation: I-\_\_ Pre-Standard Guide for Specifying and Evaluating Performance of Single Family Attached and Detached Dwellings—Accessibility.

4.8 *Provisions for a Functional Building Site*—See Section 6.

4.8.1 *Site Planning*—See Section 6.

4.9 *Automobile Parking*—See Section 6.

#### 5. Parameters of Functionality

5.1 One of the first tasks of a specifier may be the development of a program of needs.

5.1.1 A program of needs may include eating, entertaining, living, relaxing, sleeping, etc.

5.1.2 The program of needs may differ depending on the characteristics of the family and family members.

5.2 The following parameters, affecting functionality, are examples of parameters that relate to the program of needs.

5.2.1 The parameters, affecting functionality, listed are examples only. This document in no way suggests that the listed parameters are the only ones affecting functionality.

5.2.2 **Fig. 1** is a matrix displaying the interaction of examples of Parameters affecting the Functionality of the building elements. Typical examples of parameters are indicated; the specifier should delete parameters that are not applicable (for example, “not interfere w/neighbor” if there are not close neighbors) or add others (for example, “natural elements” such as a stream) as warranted. In some cases, only general criteria in terms of Parameters are specified (designated by “q” in **Fig. 1**). These elements are covered in Section 4, Significance and Use, the general discussion at the beginning of **Appendix X2**, the whole building performance statements in **Appendix X2**, and the activity support performance statements for spaces in **Appendix X2**. Footnotes located in the same cell as the “q” indicates where there is further discussion of the issue. Also indicated in this matrix are letters “A” through “P” which represent the complete series of attribute guides. An issue that has a letter in its box is an issue that has a relationship to functionality but is more appropriately covered in the indicated attribute guide.

5.2.3 *Climate Effects*—The climate effects vary as a function of geographic location, and in some cases the micro-climate effects may lead to different building designs and configurations. For example, the location of a breakfast nook may depend on the entry of the morning sun into the room. For another example, whether the garage is connected to the dwelling unit may depend on the temperature extremes and the amount of precipitation in the area. If site-specific information is available for the project, the specifier should provide it to providers. Micro-climate can be affected by site design; see 6.1 for further discussion.

5.2.4 *Cultural Effects*—Culture effects may vary as a function of religious beliefs, ethnic background, and historic background. For example, the size, shape and equipment provided in a kitchen will differ depending on cultural needs. If such specific information is available for a specific dwelling project, the specifier should provide it to providers.

## 6. Site Considerations Affecting Functionality

### 6.1 Site Design:

6.1.1 There are many conditions specific to a building site that can have significant effects on the functionality of a dwelling. This section addresses information that should be considered in order to adequately provide for the functionality of the building.

6.1.2 The specifier should provide information in the form of site design and site-building interface of sufficient detail for providers to complete the design of the dwelling.

6.1.3 Alternatively the specifier may choose to make housing providers responsible for the design and layout of the site. If so, each provider should determine in the site design the layout and grading of the site, and how it interfaces with the building. In such cases, the specifier should provide site planning performance criteria.

6.1.4 Planning the siting of the dwelling should be performed to facilitate the efficient use of the land, to provide drainage away from the building, to provide privacy and other amenities for the occupants, to provide for views or other

aesthetic considerations, to provide needed space in which to perform normal activities and to allow for the needs of the building for utilities and waste removal. Site planning should also include sensitivity to possible negative impacts on adjoining properties. The site design may include:

6.1.4.1 A layout that provides easy access throughout the site and into the building.

6.1.4.2 Control or to mitigate against nature’s elements, for example, surface water, so as not to adversely affect the building or to adversely interfere with the use of the dwelling and the site.

*Discussion*—Grading to divert water away from buildings and pathways, and to provide protection from seasonal flooding, is an example of controlling rain water. Also, the location of the buildings and pathways usually should not be prone to flooding. Of course, if circulation through the site is by water transport (boat), then this would not apply.

6.1.4.3 Exterior circulation paths that do not accumulate rainwater.

6.1.4.4 Building orientation and landscaping that responds to seasonal sun angles and locations.

6.1.4.5 Building orientation and landscaping that responds to seasonal wind directions.

6.1.4.6 A layout that provides easy access from adjacent vehicle and pedestrian routes.

6.1.4.7 A layout that provides easy access to available utilities.

6.1.4.8 Building and path locations that are not prone to flooding.

### 6.2 Solid Waste Management:

6.2.1 Functionality criteria related to solid waste management may vary widely from site to site. Solid waste may be treated on site, or it may be stored on site or in the dwelling unit, awaiting transport to a treatment facility.

6.2.2 If solid waste is treated on site, then site or building area and possibly utilities; such as power, heat, and water; may be needed.

*Discussion*—On site solid waste treatment may include composting, incinerators, garbage disposals, etc.

6.2.3 If solid waste is stored on site, then it is a function of the method and frequency of solid waste removal from the site. The more frequent the removal schedule, the less area will be needed for storage. The specifier should provide providers with the information on trash collection method and frequencies at the site. (See performance statements in Appendix section **X2.2.12**.)

6.2.3.1 Alternatively, in any specific solicitation, the specifier may choose to make the housing providers responsible also for design of site solid waste removal. If so, each provider should be required to determine the method of solid waste removal and trash collection frequencies, based on the site design. In such cases, the specifier needs to provide criteria for site solid waste removal.

### 6.3 Water Supply:

6.3.1 Water supply may or may not be a site issue. Water may be provided at each dwelling unit, from a central location on the site with more than one dwelling unit, from a municipal water system, or any combination thereof.



	Ventilation	Shelter	Serve Communication	Security	Safety	Protect Neighbor	Protect Health	Promote Efficiency	Not Interfere W/Neighbor	Comfort	Odor Control	Acoustical	Access to Water	Access to View	Access to Power	Access to Light	Access to Fuel	Operability	Circulation	Visual Privacy	Spatial Relationships	Shape & Size	Activity Support
Roofs		<input type="checkbox"/> 3 E				B		PE				G									<input type="checkbox"/> 25	<input type="checkbox"/> 2	●
Roof coverings																							
Skylights		<input type="checkbox"/> 3 E			C			PE	M			G						●					●
Other Roof openings		<input type="checkbox"/> 3						PE		<input type="checkbox"/> 4	E												H
Joint Sealants		<input type="checkbox"/> 4						PE															
<b>4 INTERIOR SPACE DIVISION</b>																							
Vertical Space Dividers											G E	G											●
Partitions																							●
Doors					C J G						E	G											●
Other											E												●
Horizontal Space Dividers							D				E	G											●
Floors							D				E												●
Ceilings							D				E	G											●
Floor/ceiling openings							D	PE			E												●
Other							D	PE			E												●
Stairs and Ramps							D	PE			E												●
<b>5 PLUMBING</b>																							
Plumbing Fixtures											E		6,7										<input type="checkbox"/> 21
Domestic Water Distribution													<input type="checkbox"/> 8,9										<input type="checkbox"/> 21
Sanitary Waste												G		<input type="checkbox"/> 10									●
Rain Water Drainage																							●
<b>6 HVAC</b>																							
Heating																							<input type="checkbox"/> 4
Heating Controls & Instrumentation												G			<input type="checkbox"/> 16								<input type="checkbox"/> 4
Cooling																							<input type="checkbox"/> 4
Cooling Controls & Instrumentation												G			<input type="checkbox"/> 16								<input type="checkbox"/> 4
Ventilation																							<input type="checkbox"/> 4
Ventilation Controls & Instrumentation												G			<input type="checkbox"/> 16								<input type="checkbox"/> 4
<b>7 FIRE PROTECTION SUBSYSTEMS</b>																							
Electrical Service and Distribution																							<input type="checkbox"/> 2
Lighting and Branch Wiring																							<input type="checkbox"/> 2
<b>8 ELECTRICAL NETWORK</b>																							
Lighting and Branch Wiring																							<input type="checkbox"/> 2
<b>9 COMMUNICATION AND SECURITY NETWORKS</b>																							

FIG. 1 Matrix of Parameters of Functionality (continued)





4 - This parameter is covered in the comfort performance statement for whole buildings.
5 - This parameter is covered in the activity support performance statement for outdoor living.
6 - This parameter is covered in the activity support performance statement for kitchen.
7 - This parameter is covered in the activity support performance statement for bathrooms.
8 - This parameter is covered in the activity support performance statement for water closets.
9 - This parameter is covered in the activity support performance statements for laundry, workroom & mechanical spaces.
10 - This parameter is covered in the activity support performance statement for water distribution.
11 - This parameter is covered in the activity support performance statement for entry.
12 - This parameter is covered in the activity support performance statement for living.
13 - This parameter is covered in the activity support performance statement for dining.
14 - This parameter is covered in the activity support performance statement for sleeping.
15 - This parameter is covered in the activity support performance statements for laundry, workroom, mechanical & garage spaces.
16 - This parameter is covered in the activity support performance statement for mechanical spaces.
17 - This parameter is covered in the operability support performance statement for fittings, furnishes, & equipment.
18 - This parameter is covered in the visual privacy performance statements for bathrooms & water closets.
19 - This parameter is covered in the visual privacy performance statements for sleeping & outdoor living.
20 - This parameter is covered in the shape & size performance statement for this building element.
21 - This parameter is covered in the comfort performance statement for this building element.
22 - This parameter is covered in the activity support performance statement for service and distribution.
23 - This parameter is covered in the visual privacy performance statement for this building element.
24 - This parameter is covered in the activity support performance statements for telephone and intercom.
25 - This parameter is covered in the visual privacy performance statement for whole buildings.

FIG. 1 Matrix of Parameters of Functionality (continued)

6.3.2 Functionality criteria related to the plumbing distribution network water supply system, and to minimum quantities and pressures of water required for operation of fixtures; may be a function of the design of the water supply network of the entire site or the individual dwelling unit. The specifier needs to provide providers with the information on water supply source characteristics, quantities, system design and pressures.

6.3.3 Alternatively, in any specific solicitation, the specifier may choose to make the provider responsible also for the design of the site water or dwelling unit distribution network. If so, the provider should be required to determine the characteristics of the water supply source at each building or site. In such cases the specifier needs to provide criteria for site water or individual dwelling unit distribution design, since such criteria will be beyond the scope of the housing performance specification.

6.3.4 See appendix section **X2.6.2**, Domestic Water Distribution, for examples of performance statements covering building related issues.

#### 6.4 *Electrical Supply:*

6.4.1 Functionality criteria related to the electrical network may involve the service entrance in a building or the production of electricity within the building.

6.4.2 If a service entrance is needed, the location may depend on the design of the site electrical distribution network. The site distribution network may require connection to on site power production or to some central municipal power supply. It is anticipated that this design will not be the responsibility of providers. The specifier should provide providers with information on the required location of the building service entrance. Alternatively, the specifier may choose to make providers responsible also for the design of site electrical distributions. If so, each provider may locate the building's service entrance based on the site design. In such cases, the specifier needs to provide criteria for site electrical designs since such criteria will be beyond the scope of the housing performance specification.

6.4.3 If electrical power is being produced in the dwelling, then space needs to be provided for the equipment. If fuel is needed, then fuel storage or fuel connection is needed. If a renewable energy production is used, such as solar or wind, then space needs to be provided on the site or on the building for the energy gathering equipment.

6.4.4 Refer to examples of performance statements, in appendix section **X2.9**, that cover the functionality of electric use in dwelling units.

#### 6.5 *Communication and Security Networks:*

6.5.1 Functionality criteria related to the communication and security networks refer to the design of telephone, television, intercom, security, and telecommunication networks. The specifier should provide providers with information and the design of the communication networks, including cabling, antennas, satellite dishes, etc.

6.5.2 Functionality criteria related to the communication and security networks may involve the service entrance in a building, for hardwire connections, or the space, on the site or on the building, for wireless reception equipment.

6.5.3 Refer to examples of performance statements, in appendix section **X2.10**, that cover the functionality of communication and security networks within dwelling units. See Standard Guide “J”—Security, for a more comprehensive coverage of security issues.

#### 6.6 *Liquid and Gas Fuel Supply:*

6.6.1 Functionality criteria related to the liquid fuel distribution network and gaseous fuel distribution system may involve a “connection to central distribution network,” on site storage of fuel, or on site production or gathering of fuel.

6.6.2 If such a central network is anticipated, the connection to it is a function of the design of such a site gas distribution network which may take a variety of forms, including distribution from on-site tank farms for the storage of gas, regional piping network, etc. It is anticipated that the design and construction of the site network will not be the responsibility of the provider. The specifier needs to provide the provider with the information on the characteristics of the connection to the central network. Alternatively, in any specific solicitation, the specifier may choose to make the providers responsible also for the design of site gas distribution. If so, each provider needs to determine the characteristics of the gas connection at each building. In such cases the specifier should provide criteria for site gas network design.

6.6.3 If on-site storage is anticipated, the provider should be expected to provide space or storage site for each dwelling unit for the storage of gas or other fuel containers in compliance with local codes.

6.6.4 If on-site fuel production or gathering is anticipated, then space needs to be provided for the equipment. If raw material is needed, then raw material storage is needed. If a renewable fuel production is used, such as fuel gas from plant material, then space needs to be provided on the site or on the building for the fuel production equipment.

6.6.5 Refer to examples of performance statements, in appendix section **X2.11**, that cover the functionality of fuel networks within dwelling units.

#### 6.7 *Vehicle Parking on the Site:*

6.7.1 Where personal transportation vehicles are anticipated to be used, parking should be provided either at each dwelling unit or at a central location.

6.7.1.1 See the performance statements covering garage spaces.

6.7.1.2 If parking is provided at a central location or locations, a convenient pedestrian path should be provided, by the provider of the site amenities, to each dwelling unit.

6.7.1.3 Vehicle parking may be protected or unprotected from the outdoor environment and weather.

6.7.1.4 Types of vehicles and how they affect the aesthetics of the site are important considerations. For example, is it desirable for the vehicles to be seen from the street or the dwelling units, or should they be hidden from view?

6.7.1.5 The connection to a public road system may be desired, or traffic circulation may be internal only to the site.

#### 6.8 *Site Investigation Report:*

6.8.1 A site investigation report may be deemed necessary. The site investigation report for the layout and grading of the site may be based on a site investigation to be carried out by the specifier or provider.

*Discussion*—The following information may typically be included in the report: (1) Exact dimensions and location of the site. (2) Enough spot elevations and/or contour elevations to understand the slope and drainage of the site. (3) Solar orientation of the site (may affect interior spatial relationships). (4) Seasonal prevailing winds (may affect interior spatial relationships). (5) Adjacent conditions that affect the site such as location and use of roads, sidewalks, utilities, structures. (6) Maximum flood levels with a specified year recurrence interval. (7) Seasonal temperature and humidity swings and/or degree days. (May affect exterior spatial relationships as to distance separations and treatment of pedestrian pathways). (8) Maximum precipitation with a specified year recurrence interval.

6.8.2 For functionality of the site and the building, the report may correlate and present the site information of section 6.8.1 in the following three areas of site and building design:

6.8.2.1 Site,

6.8.2.2 Site-building interface, and

6.8.2.3 Building systems.

6.8.3 The presentation of the information may be in both graphic and written form, and may be based on the proposed site design topography and elevations (provided by the specifier or the provider) and the proposed design locations, positions, configurations, and elevations of buildings and structures near, at and below ground.

6.8.4 The site investigation report may show the effect specific design considerations can have on the functionality of the building and the site. Along with this building performance standard guide, a detailed site plan or a site performance specification by which the site can be designed may be provided by the specifier. In the absence of either of these, the provider cannot be held responsible for those attributes relating the building to site elements.

#### 6.9 Mail Delivery:

6.9.1 Provisions for mail delivery may or may not be needed for a site.

6.9.2 If mail is delivered to each dwelling unit or group of dwelling units, then access to the site and buildings need to be provided for.

*Discussion*—In a situation where the dwelling unit occupants pick up their mail at a central location, such as a post office box, then access to the site and buildings, for mail delivery would not be needed.

## 7. Evaluation Methods and Documentation of Conformance for Functionality

7.1 Conformance of building materials, spaces, products, components, assemblies, and subsystems to many of the examples of functionality criteria may be determined by the common evaluation methods described in [Appendix X1](#). These evaluation methods are based on considerations of the most common types of user and environmental functions. The evaluation methods, described in [Appendix X1](#), are designated EM-1 through EM-11. These evaluation methods are cited in the example performance statements given in [Appendix X2](#). The specifier is cautioned to check the appropriateness of the evaluation methods before adding them to the specifications.

## 8. Performance Statements (O-C-E-C)

8.1 Examples of performance statements for building elements are given in Objective, Criteria, Evaluation Method, and Commentary (O-C-E-C) format. The objectives are based on considerations of normally encountered uses of the particular space or item. Examples of performance statements are found in [Appendix X2](#).

8.1.1 The example performance statements are presented against the Hierarchy of Building Elements tabulated in [Table 2](#). The order of presentation begins with “0. Whole Building system” followed in order by each of the 11 subsystems. Within each subsystem, the example performance statements follow in order down to the lowest levels of the hierarchy as needed.

8.1.2 The performance statements in [Appendix X2](#) are for illustration purposes only. These examples are not intended to illustrate the only accepted method of providing functionality in dwelling units.

8.1.3 Many of the examples of performance statements in [Appendix X2](#) are based on conditions existing in northern North America. The performance statements, in [Appendix X2](#), are examples of how the Parameters affecting the Functionality can respond to specific site conditions and location. A specifier, for dwelling units in a different climate or locale, may use the performance statements as a guide, but revision will be needed to respond to the different climate or locale.



**APPENDIXES**
**(Nonmandatory Information)**
**X1. EXAMPLES OF SPECIAL EVALUATION METHODS THAT MAY BE USED IN THE EVALUATION OF THE FUNCTIONALITY PERFORMANCE STATEMENTS CRITERIA**

X1.1 *Observation and Review Drawings*—Compare the dwelling unit with the criteria of this performance statement.

X1.1.1 *Observation*—Observe a typical unit after construction and compare with the parameters of this guide. Walk through the unit while comparing it to the specific performance statement.

X1.1.2 *Review Drawings* consists of analyzing the documents provided by the specifier and compare the drawings with the parameters of this guide. Compare the drawings with the specific performance statement. Dimensions given are to be measured in accordance with ANSI Z765-1996.

X1.2 *EM-2*—Simulate the thermal comfort conditions, as defined by ANSI/ASHRAE 55-1992 Thermal Environmental Conditions for Human Occupancy and the ASHRAE 55a-1995 Addendum, in a typical unit before construction and/or measure the thermal comfort conditions in a typical unit after construction.

X1.2.1 Thermal comfort can be simulated, in a typical unit before construction, by using energy simulation software such as IDA Indoor Climate and Energy from EQUA, [www.equa.se](http://www.equa.se).

X1.2.2 Temperature can be simulated, in a typical unit before construction, by using energy simulation software such as Energy 10 from the Sustainable Buildings Industry Council (202-628-7400), DOE-2 from the Lawrence Berkeley National Laboratory (510-486-5711), REM-Rate from the Architectural Energy Corporation (303-444-4149), BLAST from Building Systems Laboratory (217-333-3977), Builder Guide from the National Renewable Energy Laboratory (303-384-7507), Energy Gauge USA from the Florida Solar Energy Center (407-638-1492), or Home Energy Saver from the Center For Building Science Environmental Energy (510-525-7655).

X1.2.3 Humidity can be simulated, in a typical unit before construction, by using humidity simulation software such as DOE-2 from the Lawrence Berkeley National Laboratory (510-486-5711) or Moist from the National Institute of Standards and Technology (301-975-6433).

X1.2.4 The thermal comfort conditions can be measured, in a typical unit after construction, with the equipment recommended by ANSI/ASHRAE 55-1992 Thermal Environmental Conditions for Human Occupancy and the ASHRAE 55a-1995 Addendum.

X1.3 *EM-3*—Typical unit waste water removal volume and velocity test.

X1.3.1 Test a typical dwelling unit, after construction, by turning on a water appliance such as a washing machine or flushing a toilet, and simultaneously turning on the shower on full. Verify that the waste water removal system has the volume capacity and maintains the proper velocity for the simultaneous

operation of both. The number of water appliances simultaneously turned can be adjusted at the request of the specifier.

X1.4 *EM-4*—Verify with authority having jurisdiction (AHJ) what are the applicable standards.

X1.4.1 Review AHJ's laws, codes and ordinances for specific applicable referenced standards.

X1.4.2 Contact AHJ to obtain specific applicable referenced standards.

X1.4.3 Verify with AHJ that the applicable standards are in keeping with the protocol of the municipality to which the AHJ represents.

X1.5 *EM-5*—Observation of typical product and review manufacturer's documentation.

X1.5.1 Observe a full size sample of the product for appropriateness for the specific use envisioned for the dwelling unit and the occupants.

X1.5.2 Review the manufacturer's cut sheets and descriptive documentation for appropriateness for the specific use envisioned for the dwelling unit and the occupants.

X1.6 *EM-6*—Typical unit water supply and pressure test.

X1.6.1 Test a typical dwelling unit, after construction, by turning on a water appliance such as a washing machine or flushing a toilet, and simultaneously turning on the shower. Verify that there is enough pressure and supply for the simultaneous operation of both. The number of water appliances simultaneously turned can be adjusted at the request of the specifier.

X1.6.2 Test a typical unit daily, at three different times, for one year for water supply and pressure.

X1.6.3 Test a typical unit once daily, for a full year, and record what days the water supply and pressure was not at full quality as specified.

X1.7 *EM-7*—Typical unit electrical system test.

X1.7.1 Test a typical dwelling unit, after construction, for voltage, amperage, and frequency, with the required electrical m.

X1.7.2 Test a typical unit daily, at three different times, for one year, for electrical quality.

X1.7.3 Test a typical unit, once daily, for a full year, and record what days the electrical supply was not at full quality as specified.

X1.8 *EM-8*—Bubble Diagram Study.

X1.8.1 Draw circles relative to the size of the spaces in the dwelling. Name the circles the different spaces in the dwelling.

Draw the circles, representing dwelling spaces, adjacent to other circles, representing dwelling spaces, to represent dwelling spaces that need to be adjacent to each other.

X1.8.2 Draw arrows from circles to other circles to show dwelling spaces that need direct access to each other. Draw darker arrows for more important relationships and lighter arrows for less important relationships.

X1.8.3 Change the locations of the circles and the arrows until the best relationship is found.

X1.9 *EM-9*—Visual privacy analysis.

X1.9.1 Place a camera, with a lens that is equivalent to 20/20 vision of a person, on a tripod at a set distance above the finish grade, at the exterior of the dwelling, at a set distance perpendicular to the window being analyzed.

X1.9.2 Place a colored ball on the top of a stick whose length will cause the ball to be 300 mm (1 ft) above the height of the window sill.

X1.9.3 Move the ball into the room perpendicular to the window being analyzed. Measure the perpendicular distance from window to the ball at the point when the ball first can not be clearly seen from the camera set outside.

X1.10 *EM-10*—ASTM E783-93 Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.

X1.11 *EM-11*—ASTM E1105-96 Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference; or E547-96 Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential; or E331-96 Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

X1.12 *EM-12*—Typical unit fuel supply and pressure test.

X1.12.1 Test a typical dwelling unit, after construction, by turning on all the fuel appliances such as a gas boiler and gas cooking range. Verify that there is enough pressure and supply for the simultaneous operation of both. The fuel appliances simultaneously tested must use the same fuel source.

X1.12.2 Test a typical unit daily at three different times for one year for fuel supply and pressure.

X1.12.3 Test a typical unit once daily for a full year and record what days the fuel supply and pressure was not at full quality as specified.

X1.13 *EM-13*—E1486M-98 Standard Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria. (Metric)

X1.13.1 E1486-98 Standard Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria. (English Units)

X2. EXAMPLES OF FUNCTIONALITY PERFORMANCE STATEMENTS

X2.1 *Whole Building*:

X2.2 *Spaces*: This section contains a variety of typical functional areas or spaces. This list is not a comprehensive or complete categorization of all spaces that may be required by the specifier. Also, some of the spaces suggested herein may not be applicable, and some spaces may be required in combination with others. The specifier should determine which functional areas or spaces are required to meet the user needs. All areas and dimensions given are to be measured in accordance with ANSI Z765-1996.

X2.2.1 *Providing for the Disabled and Others*—The minimum performance statements assume use by able bodied

adults. Construction for those using wheelchairs and people with other disabilities should comply with ICC/ANSI A117.1-98, the Fair Housing Act, and the Americans with Disabilities Act. See Standard Guide “I”—Accessibility.

X2.2.2 *Spatial Interrelationships*—See the following performance statements for private spaces. Necessary circulation and desired privacy should be defined by the specifier in the form of graphics (affinity diagrams), text, or other forms of representation. Such representations should serve as the criteria for evaluation of these performance statements.

X2.2.3 *Reference*—For examples of furniture, fixtures and equipment sizes and clearances refer to “Time-Saver Standards

L—FUNCTIONALITY	
0.1. WHOLE BUILDINGS—ALL BUILDING SUBSYSTEMS	
A. Functionality of the Dwelling in Regard to Activity Support	
Objective	The dwelling should serve all the activities listed in the specific space performance statements as needed.
Criteria	C-1: The dwelling should serve all the various activities of each space while not allowing these activities to interfere with each other. C-2: The dwelling should provide shelter from the elements.
Evaluation Methods	E-1: EM-8: Bubble Diagram Study. E-2: EM-1: Observation and Review drawings.
Commentary	<ul style="list-style-type: none"> <li>See the spatial relationship performance statements for the dwelling unit spaces to see how activities of each space are supported without interfering with each other.</li> <li>For maintenance issues, see Attribute O—Maintainability.</li> </ul>

FIG. X2.1 Functionality of All Building Subsystems in Regard to Activity Support