Designation: E 2166 – 01

Standard Practice for Organizing and Managing Building Data[1]

This standard is issued under the fixed designation E 2166; 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.

1. Scope

1.1 This practice describes a method of organizing building information to support informed decision making. The kinds of data considered in this practice includes text, numeric, and graphic data. The system of organization is applicable to a wide range of data collection and organization tasks from routine in-depth analysis of a single building, to situations where many buildings must be evaluated and prioritized in a short time frame.

1.2 The organizational structure is based on UNIFORMAT II (ASTM E 1557), a system which groups building elements according to the way buildings are constructed and function.

1.3 The use of UNIFORMAT II provides a set of recognized summary levels that are relevant throughout the industries that design, construct, and manage buildings.

2. Referenced Documents

2.1 *ASTM Standards:*

E 917 Life-Cycle Cost Analysis[2]

E 1334 Practice for Rating the Serviceability of a Building or Building Related Facility[2]

E 1557 UNIFORMAT II[2]

E 1699 Performing Value Analysis (VA) of Buildings and Building Systems[2]

E 1765 Practice for Applying Analytical Hierarchy Process (AHP) to Multi-attribute Decision Analysis of Investments Related to Buildings and Building Systems[3]

E 1836 Classification for Building Floor Area Measurements for Facility Management[3]

3. Significance and Use

3.1 Use this practice to organize information that describes new or existing buildings of any size. The concepts presented here can also be applied to other categories of construction where a standard corresponding to UNIFORMAT II does not yet exist.

3.2 The hierarchical structure of UNIFORMAT II enables the user to focus on building elements in functionally consistent groups. It can be applied by an administrator initiating a data system as a facility standard, as well as a consultant reporting on building conditions.

3.2.1 A consistent method of arrangement for subject matter expedites the preparation and use of source documents, and simplifies the process of comparing information from several sources.

3.3 This practice is suitable for arranging the content of individual reports, managing physical files, as well as automated data applications. Personal computers operating commercially available software are able to meet the functional requirements of this practice.

3.4 This practice provides a consistent and comprehensive outline suitable to track the evolution of specific building conditions in one or many buildings. It can be applied to historical building data as well as new information.

3.5 Administration of this practice will reveal categories of building data that have been overlooked in prior data gathering efforts that did not rely on a systems approach. The comprehensive hierarchy of Systems and Elements, readily displays the amount and depth of information distributed among the categories and levels. The pattern of available information highlights voids among the categories. It is also possible to quickly focus on the quality and sufficiency of cataloged data to determine whether an appropriate level of detail exists to address the needs of decision-makers.

4. Procedure

4.1 Organize existing physical information to correspond to the categories of UNIFORMAT II. Initial data-gathering efforts for new or existing buildings can easily make information conform to the hierarchical structure of UNIFORMAT II.

4.2 Legacy data and pre-existing text are likely to be found in the prevailing style of the preparer. In order to preserve the clarity and continuity of concept presented in text which was arranged in a non-UNIFORMAT II outline, it will be necessary in many instances, to associate the same block of text to several hierarchical levels in order to adequately communicate conditions or intent.

4.3 Where a large body of existing data is available, the initial organizing effort will involve some degree of judgment based on the quality of existing historical data, the present condition of the subject building, and some expectation of the range of potential uses for the building. Make objective

[1] This practice is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.81 on Building Economics.

Current edition approved Oct. 10, 2001. Published January 2002.

[2] *Annual Book of ASTM Standards*, Vol 04.11.

[3] *Annual Book of ASTM Standards*, Vol 04.12.

decisions on the acquisition, retention, and application of data. Avoid stacking data to force outcomes that are situationally perceived to be "obvious" or "inevitable."

4.3.1 Many buildings lack significant existing data for certain Systems. In order to reliably establish baseline conditions, consult with relevant building specialists. Direct consultants to provide copies of new studies in formats compatible with the facility's resident system.

4.4 Inventory a complete list of rooms or named spaces. Each room or space is delimited by a finite set of constructed entities such as floors, walls, and ceilings that correspond directly to a UNIFORMAT II element. Make on-site observations of existing building conditions, or compile available data from the drawings of a proposed building to develop a suitable inventory. Reference UNIFORMAT II elements to the constructed entities of the room inventory.

4.5 Develop a list of elements within the third level of UNIFORMAT II. Make distinctions among the functional attributes of similar elements. These distinctions form subsets of elements or types. A type refers to a kind of assembly that possesses a unique combination of function and components consistent with, and subordinate to, elements within the third level of the UNIFORMAT II outline. Elements which superficially appear to be similar are constructed with purposeful physical variations in order to accommodate a variety of functional or situational requirements. For example, the exterior envelope of certain buildings is uniform on all sides and on all levels while the exterior of other buildings vary by facade, as well as by groupings of floor levels. Partitions which separate rooms from each other possess different functional requirements, such as fire rating, than the partition that separates the rooms from the corridor, or a room from a stairwell. Limits of connections, distinctions of substrate conditions and basic functional definitions must also be discerned in order to definitively name a type. For example, within the family of partition types, wood stud-framing covered on each side with a single layer of gypsum wall board (GWB) is a wall type, as is a concrete masonry [unit] block (CMU) wall. If these walls are painted with the same kind of paint system, that paint system is the finish type common to both wall types. If the CMU wall is to be covered with GWB and painted, the GWB, furring or other sub framing, as well as the paint is considered to be a finish type since the GWB is incidental to the function of the CMU. If the CMU wall needs to achieve a certain fire-rating which is only possible with the application of plaster or stucco, the CMU plus the applied coating is considered together as a type, because the coating is essential to its basic function. Frequently, these types correspond to an existing standard assembly which has been tested and published by recognized testing laboratories or industry interest groups. Develop a list of types peculiar to the study building at the earliest opportunity.

4.6 Identify the connections between the different elemental types and segments of the same type. These connections or joints are designed to maintain the functionality of the system by mitigating certain conditions within designed limits. Develop a list of joint types rather than attempting to account for the joint as a component of an adjacent element type. The function of the joint is necessarily more complex than the types being joined. An awareness of the joint as an entity helps to focus attention on its functional criteria. For instance, a basic function of an exterior wall type is to keep weather out of the building. The joints must additionally accommodate movement, possibly provide galvanic isolation, and present an appearance consistent with an overall architectural vocabulary. The materials used to make joints are frequently unique to the joint and different than the materials comprising the basic types being joined. The useful life and maintenance cycles of many kinds of joints vary sufficiently from the adjacent assemblies to merit scheduled attention.

4.6.1 Organize the list of joint types to respond to relevant needs such as maintenance. The function and composition of the joint determines the nature and frequency of attention. Elastomeric sealant in an exterior wall for example, will fatigue or deteriorate at a reasonably predictable rate based on the material and exposure. Joints which respond to specific events such as fire or earthquake need to be occasionally checked to confirm that the joint continues to have the capacity to perform as intended. After an event, those joints need to be inspected for repair or replacement. Fixed joints such as structural connections are of great interest during the design and construction phases, but generally require no further attention until the next renovation.

4.7 Naming conventions for types depend upon the needs of the study in the context of the overall building documentation effort and are not standardized in this practice.

4.8 Existing buildings frequently lack sufficient available documentation to confidently identify types without performing invasive exploration. Where such activity is not warranted at the time of the data gathering effort, identify only directly observable materials and note observable functions at the appropriate UNIFORMAT II level. Include more detailed information as it becomes known.

4.9 Associate relevant combinations of types. Within a single room, a structural element such as a column and an envelope element such as an exterior wall and two different interior wall types present the same finished appearance to the occupant. Associate all of these elements with the same finish type.

4.10 Use standard MASTERFORMAT[3] designations to identify the individual components and materials which are assembled to make up a type. The use of MASTERFORMAT at this level is consistent with industry accepted construction specifications and cost estimating practice.

4.11 Identify the relevant Mechanical Systems and distinguish the services and groups of components within each system that comprise a functionally and physically discrete entity. Each service distribution system begins at a piece of equipment that "originates" or "modulates" that service, is distributed through some form of duct, pipe, or wire, and terminates at a utilization device. In district heating and cooling systems, as well as public utility grids, such as water, gas, and electricity, a "shut-off" device and metering equipment are located where the service enters the building and for the purposes of the system, considered an "originator." Gas pressure regulators, booster pumps, and sewage ejectors similarly are considered in the category of "originators" because of their relationship to a grid external to the building. Some types of equipment contain components that terminate one service and originate another. For example, a boiler is a terminal device for a gas supply and a primary generator of hot water. If that hot water is supplied to the coils of an Air Handling Unit (AHU), the coil of the AHU is the utilization device for the hot water system. Most likely, the AHU will also contain cooling coils fed by a chilled water distribution system which begins at the chiller, a device which generates very cold water. The blower component of the AHU is the primary generator of conditioned air, which is distributed through ducts to diffusers or registers in a space.

4.12 Categorize Systems information to support both operations and management needs. Information organized at the level of a system presents a comprehensive overview of the effectiveness of that system. Based on the size of the building and the complexity of the respective systems, services can be further classified by functional zones that correspond to: (*1*) building specific areas, such as floor levels or horizontal fire-areas, (*2*) system specific limits such as zones served by dedicated equipment, (*3*) areas defined by metering, monitoring, or control points, and (*4*) component specific relationships such as trunks and branches, or sets of mains, submains, and circuits. Associations made according to this arrangement will allow parallel references that are useful to describe physical relationships, adjacencies, dependencies, and interconnections in large or complex facilities.

4.13 Make all reference to the systems, sub-systems, and components with a consistent nomenclature. Design documents frequently employ naming conventions that are coordinated with existing equipment identification tags. Coordinate documents with actual field conditions to resolve conflicting nomenclature where systems modifications have been made over time.

4.14 Associate beginning and end points of services system branches with a room identification. Inventory primary equipment and associate the equipment with the room in which it is located and the system branch it feeds. Associate capacities, relevant sizes, and other useful engineering data with the inventory.

4.15 Identify and list "in line" devices. Large systems have devices to adjust or "balance" the system through-put to achieve design conditions and other controls to isolate portions of the system for service or emergency considerations. Referring to the example air-handler, the hot water supply, and return lines as well as the chilled water supply and return lines usually have balancing valves to optimize the fluid temperature at the coil by altering the flow of water to that coil. "Stop" valves are also used in the system to isolate individual coils and distribution branches. The air delivered to the space is balanced or modulated by special dampers in the duct system. If a duct branch must pass through a fire-rated partition, a the duct must contain a fire-damper in the plane of the partition to isolate the air handling system in the event of a fire. All such controls require access for periodic maintenance, inspection or emergency control. Associate these devices with the relevant system and the rooms in which they are located. Information concerning the need for special keys or tools required to actuate the device and guidance to identify obscure access points adds greater functionality to the data.

4.16 Inventory utilization devices and associate each device with the room in which it is located and the system branch it terminates. Utilization devices include items such as luminaires, switches, outlets, plumbing fixtures, fan-coil units, grilles, and registers, special filters, sprinkler heads, and control sensors. Include information on model, color or style, where such information is relevant to the character of the space. Include maintenance data and parts lists where necessary.

4.16.1 Organize existing component information for utilization devices and equipment including service records, parts lists, vendors, and on-site spare parts inventories. Information available on a component basis can expedite a number of routine operations oriented activities. While this practice is not intended to be used directly as a "work order" system, the availability of shared data will enhance the functionality of such a system, as well as increase the quality of information available to certain reports.

4.17 Identify available mechanical systems operational data. This information can represent conditions at the point of generation and conditions in the delivery system as well as effectiveness at the point of utilization. The condition or interaction of dependent building elements, such as envelope integrity, is indicated by energy consumption. Comparison of space utilization and energy profiles can suggest scheduling modifications to improve overall energy cycling. The quality of operational data can range from energy bills in relatively simple building types, to charts plotted by various kinds of analog recorders, to direct digital metering and control systems. Data associations depend directly on the sensitivity of the building's uses and the sophistication of the recording technology.

4.18 Associate relevant dimensions with the list of rooms. Using Classification E 1836 as a guide, measure each floor plate in accordance with the gross square footage guidelines and measure each room according to the net square footage guidelines. List room heights measured to the finished ceiling. Include additional measurements to the underside of the structure above if the ceiling is suspended beyond the bottom of the structure.

4.19 Determine "baseline" conditions. Associate text descriptions of relevant conditions at the appropriate hierarchical level. Include citations to corroborate the date and source of the text when portions of text are extracted from the body of an original report. Determine units of time relevant to the subject system for the purposes of measuring changes.

4.20 Associate descriptions of proposed repairs, modifications or interventions. These descriptions are frequently available in combinations of text, drawings, and photographs. Include references to physical file locations, even where drawings and photographs are converted to electronically retrievable formats.

4.21 Identify element-specific aspects and user-specific attributes to enable ranking or to make distinctions for specific purposes. Aspects and attributes are useful to identify areas of concern for long range planning, as well as context specific issues for ad hoc reports. Typical categories provide a method of ranking conditions or recommendations for action. For example, a list of attributes can indicate a range of relative importance, purpose, and economic benefit. Correlate text descriptions with the ranking codes for the benefit of future system users.

4.22 Associate costs of completed or proposed work. Where possible, organize cost categories to include the correct proportion of General Conditions and General Requirements costs at the UNIFORMAT II level which generates those costs. General Requirements include costs expended directly in support of the Work, but not permanently incorporated into the building. Such items include scaffolding, temporary light, heat, toilets, stairs, elevators, cranes, temporary partitions, bracing and shoring, and protection. General Conditions include the business costs attributable to the Work, such as insurance, bonding, permits, fees, and office expenses. Typically, General Conditions costs are project sensitive and are reduced to a percentage that is consistent within a geographic region for a particular building type. General Requirements include some costs which are assignable to the entire project, such as casual labor, carting, and temporary sanitary facilities. Certain General Requirements costs, are element sensitive and unique to the complexity of particular elements of work and the situation of the building. When cost data is used to compare similar building types, accurate apportionment of these costs is essential to describe the relative complexity of the work. For example, the cost of scaffolding used exclusively for a masonry tower restoration would be applied to that element's cost category rather than dividing the cost among all categories thereby skewing the apparent unit-costs. List the total cost of General Conditions and General Requirements separately to provide an additional comparable cost.

4.23 Associate actions taken in response to recommendations to relevant levels. Indicate preferred option, reason for preference, and comments of decision makers when such information provides context for directives.

4.24 Record changes made during construction. Require the final Schedule of Values to be summarized in UNIFORMAT II. Associate costs of changes with appropriate elements.

4.25 Using the room list, record building management and occupancy data, such as the prescribed occupancy loads, use types (in Mixed Use buildings), and special environmental conditions.

4.25.1 The functional profile of a room or named space can be described using the Serviceability Scales detailed in Practice E 1334.

5. Relevant Measurements

5.1 Classification E 1836 describes a systematic method for categorizing floor area in buildings.

6. Reports

6.1 The number of different kinds of reports and the presentation depth are a function of the data management system, the quality and focus of the data, and the extent of successfully managed cross-referencing. Three families of reports are possible based on the original quality of the data and the sophistication of the management system.

6.2 The most basic form of "report" returns data from one particular source document. This report format works with manual filing procedures and index card cross referencing.

6.3 Comparative reports present findings of more than one source report. An example is a report which includes a text description of baseline conditions, consecutive observations at years 1, 2, 3, ...n, and a stabilization cost proposed in $year_{n+x}$ dollars. Sorting options include priority, element, and cost.

6.4 Analytic reports employ the mathematical functions native to the software to perform elementary parametric analysis. Typical computations include SUMS of costs, areas, or time increments and RATIOS such as: cost per unit area, area per type, cost per type, cost per element, cost per year-in-service, and service-years per type.

6.4.1 Defensible projections of costs and interpretations of likely future conditions can be made by the thoughtful consideration of physical trends identified in comparative reports in combination with calculated values derived from the analytic reports.

7. Limitations of Use

7.1 The structure of this practice supports the documentation and analysis of aspects and attributes of elements at any hierarchical level. It does not, however, specify or recommend the use of particular aspects, attributes, or relationships. The application of these concepts will vary across building and use types, management interests, and data support systems.

7.2 While this practice does facilitate comparisons and juxtapositions of information, the author of a particular report must select appropriate and comparable data. Limitations are inherent in the quality and completeness of the data and in the context of the representation of that data.

7.3 This practice makes no recommendations for action, nor does it indicate threshold values or offer interpretations of building data.

7.4 Building conditions represented by reports generated according to this practice frequently indicate matters regulated by codes, laws or statutes. Obtain suitable guidance to interpret that data.

8. Application

8.1 A standard practice for organizing building data supports the preparation, response, and review of Requests for Proposals to perform evaluations of existing facilities.

8.1.1 This practice provides a recognized structure for the commissioning agent to articulate the scope of the investigation under consideration.

8.1.2 The required proposal elements, as well as alternatives, enhancements, or reductions to the requested scope are readily compared to other proposals when stated in terms of this practice.

8.2 This practice is applicable to an investigation of many buildings requiring focused critical evaluations where a "triage" approach is appropriate, such as the first inspections after a natural disaster, an urban "blighted structures" inventory, or the initial review of a large property portfolio. A team of investigators is able to report comparable categories of summary findings at a level appropriate to the immediate needs of the study. Action plans constructed to parallel the reported findings simplify reconciliation.

8.3 Information organized according to this practice serves the analysis of a single building or multi building facilities.

8.3.1 In a single building the record of changes in conditions, actions taken, and costs attributed to building elements are available for inspection and comparisons over time.

8.3.2 Multi-building owners have a data structure suitable to compare costs or conditions of similar building elements across an entire portfolio.

8.3.3 Members of industry interest groups are able to exchange comparable data on a wide range of concerns.

8.4 Data derived from this practice contributes to efforts to accurately forecast, schedule, and budget routine maintenance and capital replacement projects. The rate of change in conditions due to the effects of altered maintenance or replacement activity is easily demonstrated using the information documented according to this practice.

8.5 Space programming and building design benefit from a coherent knowledge base.

8.5.1 During the design phases, an available list of element types provides a useful quality control tool. An available list of types reveals inconsistencies among the design intent, functional requirements, and detail conventions, as well as incompatible combinations and adjacencies of types. A clear understanding of the full range of elements and attributes in an existing building also yields a degree of confidence in support of early planning decisions where cooperative interpretations are required from authorities having jurisdiction.

8.5.2 The Value Analysis (see E 1699) process is expedited by a uniform awareness of the quantity and nature of the functional types.

8.5.3 Where complex relationships are modeled using Analytic Hierarchy Process (AHP) (see Practice E 1765) techniques, the system of types derived for a project possess inherent functional attributes which can either contribute to the analysis or be determined by the outcome of the process. For instance, if the AHP exercise was directed to locate the best place for a music practice room in a new building, a possible outcome would be a list of criteria for the floor, walls, finishes and accessories to satisfy the "optimum location" criteria. If the practice room were to be located in an existing building with a criteria of "east modification," the typology of existing construction elements would be an immediate consideration for the purposes of the AHP exercise. The inherent attributes of the building's various constructed elements, which could include acoustic qualities, fire resistance, structural capacity and cost would be summarized by type and contribute to the evaluation of the room placement.

8.5.4 A list of components, whether existing or proposed, reduces assumptions and enhances the communications among members of a project team. Opportunities for redundancies and omissions in cost estimates are minimized by having an available and up-datable matrix of types and components. Estimates can be readily checked against commercially available systems that use components as well as assemblies.

8.5.5 An awareness of components is necessary to achieve sound results when performing Life-Cycle Cost Analysis (see E 917). Attributes which directly affect the service life of an assembly are indicated by the qualities of the constituent parts.

8.5.6 When it is necessary to compare the Serviceability Rating of a space to the Demand Profile of a potential occupant, use the available list of types and systems to evaluate the feasibility of any modifications needed to approach a best-fit condition.

9. Keywords

9.1 building condition assessment; building information; buildings; data management; facilities; facilities management; UNIFORMAT II