



Designation: E2103 – 11

Standard Classification for Bridge Elements—UNIFORMAT II¹

This standard is issued under the fixed designation E2103; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This standard establishes a classification of bridge elements within the UNIFORMAT II family of elemental classifications. It covers most highway bridges, railroad bridges, and pedestrian bridges.

1.2 UNIFORMAT II classifications have an elemental format similar to the original UNIFORMAT² building elemental classification. However, the title UNIFORMAT II differs from the original in that it now takes into consideration a wide range of constructed entities that collectively form the built environment.

1.3 Elements, as defined here, are major physical components that are common within constructed entities. Elements perform their given function(s), regardless of the design specification, construction method, or materials used.

1.4 This elemental classification serves as a consistent reference for analysis, evaluation, and monitoring during the feasibility, planning, and design stages when constructing bridges.

1.5 Using UNIFORMAT II elemental classifications ensures a consistency in the economic evaluation of construction projects over time and from project to project.

1.6 UNIFORMAT II classifications also enhance reporting at all stages of a constructed entity's life cycle—from feasibility and planning through the preparation of working documents, construction, maintenance, rehabilitation, and disposal.

1.7 This classification is unsuitable for process applications or for preparing trade estimates.

1.8 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered standard.

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:*³

- E631 Terminology of Building Constructions
- E833 Terminology of Building Economics
- E917 Practice for Measuring Life-Cycle Costs of Buildings and Building Systems
- E964 Practice for Measuring Benefit-to-Cost and Savings-to-Investment Ratios for Buildings and Building Systems
- E1057 Practice for Measuring Internal Rate of Return and Adjusted Internal Rate of Return for Investments in Buildings and Building Systems
- E1074 Practice for Measuring Net Benefits and Net Savings for Investments in Buildings and Building Systems
- E1121 Practice for Measuring Payback for Investments in Buildings and Building Systems
- E1185 Guide for Selecting Economic Methods for Evaluating Investments in Buildings and Building Systems
- E1369 Guide for Selecting Techniques for Treating Uncertainty and Risk in the Economic Evaluation of Buildings and Building Systems
- E1699 Practice for Performing Value Analysis (VA) of Buildings and Building Systems and Other Constructed Projects
- E1804 Practice for Performing and Reporting Cost Analysis During the Design Phase of a Project
- E1946 Practice for Measuring Cost Risk of Buildings and Building Systems and Other Constructed Projects
- E2013 Practice for Constructing FAST Diagrams and Performing Function Analysis During Value Analysis Study
- E2506 Guide for Developing a Cost-Effective Risk Mitigation Plan for New and Existing Constructed Facilities
- E2691 Practice for Job Productivity Measurement

¹ This classification 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 Nov. 1, 2011. Published December 2011. Originally approved in 2000. Last previous edition approved in 2006 as E2103 – 06. DOI: 10.1520/E2103-11.

² The original UNIFORMAT classification was developed jointly by the General Services Administration (GSA) and the American Institute of Architects (AIA).

³ 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.

2.2 *ASTM UNIFORMAT II Classification Standards Family*.³

E1557 Classification for Building Elements and Related Sitework—UNIFORMAT II

E2083 Classification for Building Construction Field Requirements, and Office Overhead & Profit

E2168 Classification for Allowance, Contingency, and Reserve Sums in Building Construction Estimating

E2514 Practice for Presentation Format of Elemental Cost Estimates, Summaries, and Analyses

E2516 Classification for Cost Estimate Classification System

2.3 *ASTM Adjuncts*.⁴

Discount Factor Tables Adjunct to Practices E917, E964, E1057, E1074, and E1121

3. Terminology

3.1 *Definitions*—For definitions of general terms used in this classification, refer to Terminology **E631**, and for general terms related to building economics, refer to Terminology **E833**.

4. Significance and Use

4.1 This standard builds on the concepts and organizational framework established in Classification **E1557**. This classification describes bridge elements that are major components of most highway, railroad, and pedestrian bridges. The elemental classification is the common thread linking activities and participants in a bridge project from initial planning through operations, maintenance, and disposal.

NOTE 1—As this classification refers solely to permanent, physical parts of any construction, two additional classifications, Classifications **E2083** and **E2168**, need to be included when calculating construction cost. These standards provide for the inclusion of construction enabling, temporary, and risk mitigation cost figures. Procedures for reporting all these figures are described in Practices **E1804** and **E2514** and Classification **E2516**. While these three latter standards were primarily written for building construction, they are nonetheless appropriate and readily applied to other forms of construction as well.

4.2 *The Users of Bridge UNIFORMAT II Include:*

4.2.1 *Financial and Investment*—Typically owners, developers, bankers, lenders, accountants, and financial managers.

4.2.2 *Implementation*—Primarily project managers; facilities programmers; designers, including engineers; and project controls specialists, including cost planners, estimators, schedulers, specification writers, and risk analysts.

4.2.3 *Facilities Management*—Comprising property portfolio managers, operating staff, and maintenance staff.

4.2.4 *Others*—Public officials, manufacturers, educators, students, and other project stakeholders.

4.3 *Apply This Classification When Undertaking the Following Work on Bridges*.⁵

4.3.1 *Financing and Investing:*

4.3.1.1 Structuring costs on an elemental basis for economic evaluations (Guide **E1185** and Practices **E917, E964, E1057, E1074, E1121, and E1804**) early in the design process helps reduce the cost of early financial analysis and can contribute to substantial design and operational savings before decisions have been made that limit options for potential savings.

4.3.2 *Implementing:*

4.3.2.1 *Cost Modeling, Cost Planning, Estimating and Controlling Project Time and Cost During Planning, Design, and Construction*—Use the bridge UNIFORMAT II classification to prepare budgets and to establish elemental cost plans before design begins. Project managers and project controls specialists use these cost plans against which to measure and control project cost, and quality, and to set design-to-cost targets.

4.3.2.2 *Conducting Value Engineering Workshops*—Conducting value engineering workshops (Practices **E1699** and **E2013**). Use this classification as a checklist to ensure that alternatives for all elements of significant cost in the bridge project are analyzed in the creativity phase of the job plan. Also, use the elemental cost data to expedite the development of cost models for bridge systems.

4.3.2.3 *Developing Initial Project Master Schedules*—Since projects are essentially built element by element, UNIFORMAT II classifications are an appropriate basis for preparing construction schedules at the start of the design process. Project managers and project controls specialists use these time plans against which to measure and control project time (Practice **E2691**), and to set milestone target dates.

4.3.2.4 *Performing Risk Analyses—Simulation* (Guides **E1369** and **E2506**) is one technique for developing probability distributions of bridge costs when evaluating the economic risk in undertaking a bridge project. Use individual elements and group elements in this classification for developing probability distributions of elemental costs. From these distributions, build up probability distributions of total costs to establish project contingencies (Practices **E1946** and **E2168**) or to serve as inputs to an economic analysis.

4.3.2.5 *Structuring Preliminary Project Descriptions During the Conceptual Design Phase*—This classification facilitates the description of the scope of the project in a clear, concise, and logical sequence for presentation to the client; it provides the basis for the preparation of more detailed elemental estimates during the early concept and preliminary design phases, and it enhances communication between designers and clients by providing a clear statement of the designer's intent.

4.3.2.6 *Coding and Referencing Standard Details In Computer-Aided Design Systems*—This classification allows a designer, for example, to reference an assembly according to

⁵ For a more comprehensive discussion of the uses of UNIFORMAT II, see Bowen, Charette, and Marshall, UNIFORMAT II—A Recommended Classification for Building Elements and Related Sitework, National Institute of Standards and Technology Special Publication 841, Gaithersburg, MD, 1992; and Charette and Marshall, UNIFORMAT II Elemental Classification for Building Specifications, Cost Estimating, and Cost Analysis, National Institute of Standards and Technology NISTIR 6389, Gaithersburg, MD, 1999.

⁴ Available from ASTM International Headquarters. Order Adjunct No. ADJE091703. Original adjunct produced in 1984.

this classification's element designations and build up a database of standard details. This is particularly appropriate to design modeling and building information modeling (BIM) applications.

4.3.3 *Managing Facilities:*

4.3.3.1 Recording and writing property condition assessment reports in a structured way, using UNIFORMAT II classifications, provides for a consistent, accessible, and searchable database of real property inventory.

4.3.4 *Other Activities:*

4.3.4.1 Structuring cost manuals and recording construction, operating, and maintenance costs in a computer database. Having a cost manual or computer database in an elemental format assists the preparation of an economic analysis early in the design stage and at a reasonable cost.

5. Basis of Classification

5.1 The framework in Fig. 1 shows the various constructed entities that collectively are used to create the built environment. Each entity is treated as a module. Appropriate modules used together will effectively describe any planned or built development. This standard classification describes exclusively the elements that make up one of those constructed entities, bridge structures, shown as the shaded block under the heading of Heavy (Civil) Entities.

5.1.1 This bridge classification is applicable to most types of highway, railroad, and pedestrian bridges crossing over highways, railroads, walkways, and waterways. The classification includes slab bridges; beam/girder bridges; truss bridges; true and tied-arch bridges; cable-stayed bridges; and suspen-

sion bridges. The classification does not include the following movable bridge types: draw bridges; lift bridges; and bascule bridges.

5.2 The classification is consistent with typical costing practices used at the conceptual design phase.

5.3 Each element has a significant impact on the cost, and it usually occurs frequently.

5.4 Each element performs a specific function.

5.5 Table 1 divides the classification of bridge elements into three hierarchical levels: Level 1—Major Group Elements, Level 2—Group Elements, and Level 3—Individual Elements. The Major Groups are listed in the normal chronological order of construction.

5.6 Sub-Classifications (not included in this standard) are named Sub-Elements and comprise as many hierarchical levels (Level 4 and below) as are deemed appropriate to the needs of that specific example.

5.7 The decision as to where among the classification elements to include specific construction items will rely on professional judgment as to where professionals in current practice normally look for such items.

5.8 Only items that impact the choice and cost of the bridge elements are included. Other civil works in the transportation system are not included. Consequently, this classification does not include utilities—pipelines (water, natural gas, and petroleum) and transmission lines (electrical, communication, and video)—sharing the same right of way as the transportation system.

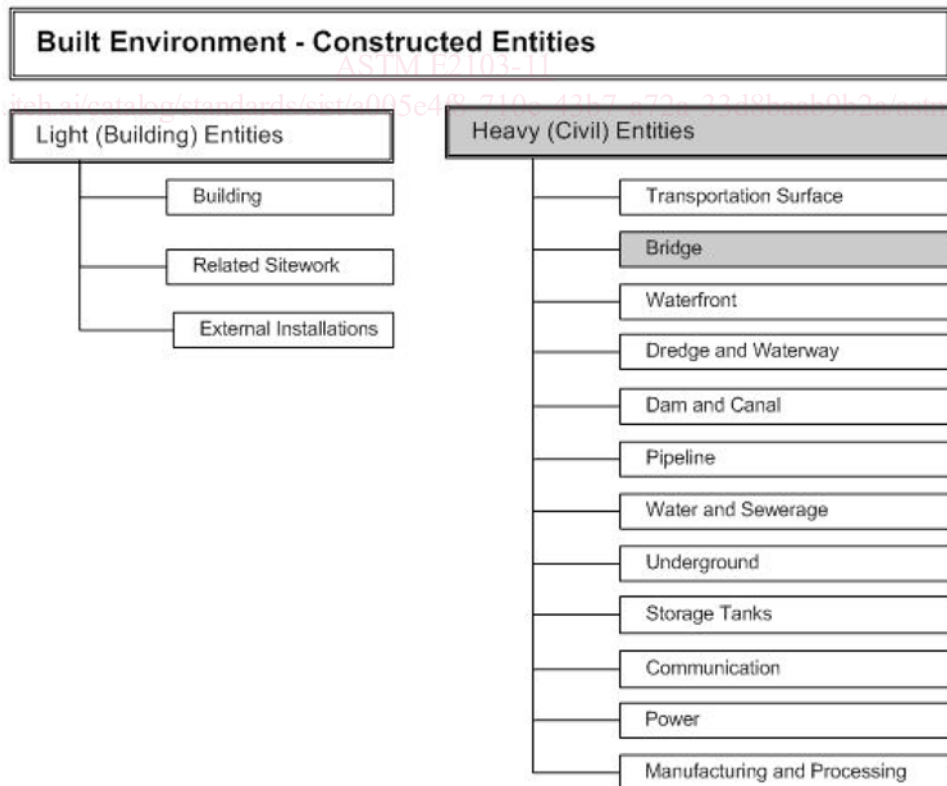


FIG. 1 List of Constructed Entities Suitable for Inclusion in the Family of UNIFORMAT II Elemental Classifications

TABLE 1 UNIFORMAT II Classification of Bridge Elements

Level 1 Major Group Elements	Level 2 Group Elements	Level 3 Individual Elements	
Substructure	Piers	Foundations Walls Columns Cap Beams	
	Towers	Foundations Walls Columns Cap Beams	
	Abutments	Foundations Stem Abutments Wing Walls	
	Other Supports	Thrust Blocks Anchorages	
Superstructure	Short Span Assemblies	Flexural Members Diaphragms Bracings Bearings	
	Long Span Assemblies	Ribs Cables Hangers and Sprandrels Ties Truss Members Segmental Box Girders	
	Deck	Structural Surface Wearing Surface	
Protection	Structure Protection	Slope Walls Expansion Joints Protective Coats Sacrificial Beams Drainage Systems Inspection and Maintenance Systems	
		Traffic Protection	Barriers Protective Shields Traffic Controls
		Other Protection	Lighting Signage Sound Barrier Walls Air Pressure Barriers Enclosure
Sitework	Site Preparation	Clearing and Grubbing Demolition and Relocation Earthwork Hazardous Material Handling Environmental Restoration/Replacement	
	Approach Construction	Approach Slabs Sleeper Slabs Earth Retention Systems	

5.9 Elements, as used and defined in UNIFORMAT II, will ideally display the following additional attributes:

- 5.9.1 Capable of being defined precisely;
- 5.9.2 Self explanatory;
- 5.9.3 Separable at all stages of development;
- 5.9.4 Quantifiable at all stages of development;
- 5.9.5 Capable of reconciliation with other elemental classifications;
- 5.9.6 Allow comparisons, project to project, in a meaningful way;
- 5.9.7 Is a functional component of the constructed entity.
- 5.10 Sitework elements are provided for exclusive use in support of the construction of bridges, not to classify elements

of major civil construction works. Sitework elements presented in **Table 1** are designed to provide sufficient detail to planners so they will not need to resort to other elemental classifications when working on a bridge project.

6. Description of Project Elements

6.1 *Elements and Functions*—**Table 2** provides, for each Level 3 Individual Element, the name, functions, description, inclusions, exclusions, and unit of measure. The functions are classified as Primary, Secondary, and Tertiary. All three levels of functions may be served. However, one or two functions may be the driving force behind the existence of the element, and they are classified as Primary functions.