



~~Designation: E2103-06~~ Designation: E2103 – 11

~~Standard Classification for Bridge Elements and Related Approach Work~~ 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 reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

~~1.1 This classification covers bridge elements and related approach work. Elements, as defined here, are major components common to most bridges. Elements usually perform a given function, regardless of the design specification, construction method, or materials used. This classification serves as a consistent reference for analysis, evaluation, cost estimating, and monitoring during the feasibility, planning and design stages of bridges. It also enhances reporting at all stages from feasibility and planning through the preparation of working documents, construction, maintenance, rehabilitation, and disposal.~~

~~1.2 This classification applies to bridges and related approach work. It excludes specialized structures such as signs and signals related to general highway use, but it does include bridge parapets, medians, drainage, and barriers needed to lessen vehicular impact.~~

~~1.3 This classification is similar to the Classification E1557.~~

~~1.4~~

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](#)

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.

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

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.

- [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](#)
- [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](#)
- 2.2 ASTM UNIFORMAT II Classification Standards Family:³
- [E1557 Classification for Building Elements and Related Sitework](#)
- [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 [Terminologies Terminology E631](#) and, and for general terms related to building economics, refer to [Terminology E833](#).

4. Significance and Use

4.1 This classification defines bridge elements that are major components of most bridges. The elemental clarification is the common thread linking activities and participants in a bridge project from initial planning through operations, maintenance, and disposal.

4.2 The users of this classification include federal, state, county and city officials, cost planners, estimators, schedulers, engineers, project/program managers, specification writers, operating and maintenance staff, manufacturers, and educators.

4.3 Use this classification when doing the following:

4.3.1 Estimating and controlling costs during planning, design, and construction. Use this classification to prepare budgets and to establish elemental cost plans before design begins. The project manager uses cost plans to control project cost, time, and quality, and to set design-to-cost targets.

4.3.2 Conducting value engineering workshops. 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.

4.3.3 Developing initial project master schedules. Since projects are built element by element, this classification is an appropriate basis for preparing construction schedules at the start of the design process.

4.3.4 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.

4.3.5 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.

4.1 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

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

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 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 how bridge structures and related approaches fit with the rest of the built environment. This classification does not include general road features such as pavements, drainage structures, and noise walls:

5.2 Criteria for the Classification—The selected elements are grouped according to the following criteria:

5.2.1The classification is applicable to any type of bridge:

5.2.2The classification is consistent with that used in typical costing practices:

5.2.3Each individual element has a significant impact on the cost, and it usually occurs frequently.

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.

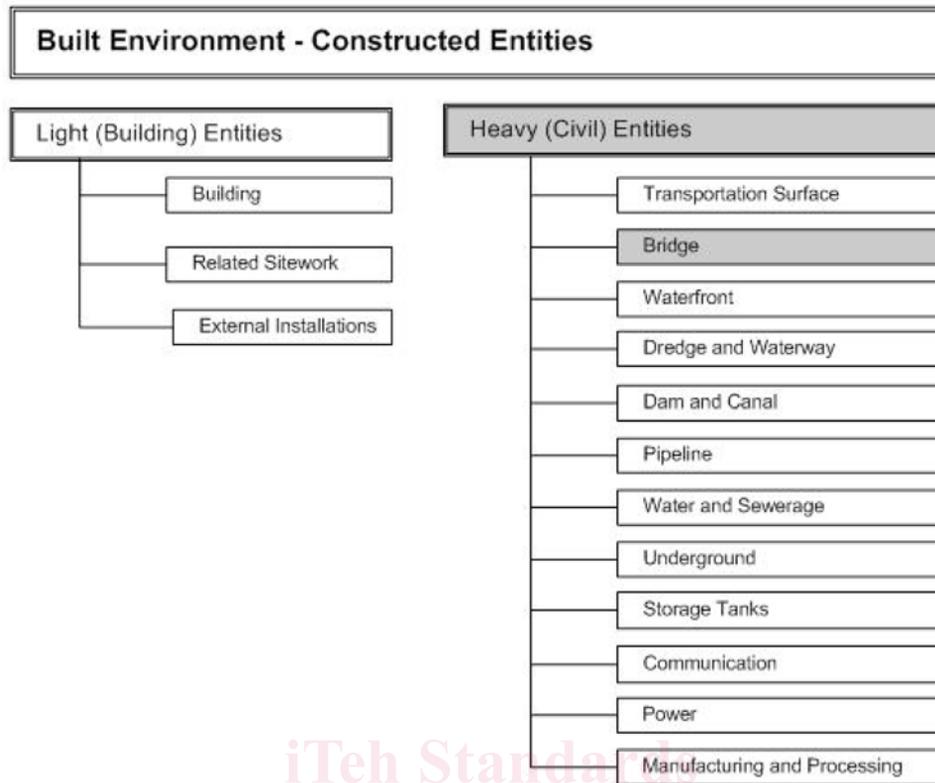


FIG. 1 List of Constructed Entities Suitable for Inclusion in the Family of UNIFORMAT II Elemental Classifications

5.2.4 Only items that impact the choice and cost of the bridge elements are included. Other civil works in the transportation system are not included.

5.2.5 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 suspension 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 represents 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. 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.

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;

TABLE 1 UNIFORMAT II Classification of Bridge Elements

Level 1 Major Group Elements	Level 2 Group Elements	Level 3 Individual Elements
A—SITE WORK Substructure	A10—Utility Relocation Piers	Foundations
	A20—Existing Structures Removal	Walls
	A30—Excavation	Columns A4010—Sheeting
	A40—Cofferdam	Cap Beams
	Towers	A4020—Seal-Coat Foundations A4030—Dewatering Walls A4040—Under Water Excavation Columns
	A50—Embankment	Cap Beams
	A60—Traffic Maintenance Abutments A70—Environmental Mitigation	Foundations
	A80—Demolition	Stem Abutments A8010—Excavation
	Other Supports B10—Foundations	Wing Walls
	B—SUBSTRUCTURE	
Superstructure	Short Span Assemblies	Anchorage
	B20—Piers	B1020—Piles Flexural Members B1030—Drilled Shafts, Cap Beams Diaphragms B2010—Cap Beams Bracings B2020—Columns-single, Multiple
	Long Span Assemblies	Bearings
	B30—Abutments	B2030—Walls-Grade, Crash, Debris Ribs B2040—Slab Piers Cables B3010—Sill Type Hangers and Sprandrels B3020—SpillThrough Ties B3030—Retaining WallType Truss Members B3040—Integral-Semi-Integral
	Deck G10—Railings	Segmental Box Girders
	G—SUPERSTRUCTURE	B3050—Vaulted Structural Surface G1010—Traffic
	Protection	Wearing Surface
	Structure Protection	G1020—Pedestrian Slope Walls G1030—Bicycle Expansion Joints G2010—Slabs Protective Coats G2020—Sidewalks Sacrificial Beams G2030—Medians Drainage Systems G3010—Stringers
	G20—Decks	Inspection and Maintenance Systems
	G30—Beams	G3020—FloorBeams Barriers G3030—Transverse Beams Protective Shields G3040—Box Girders
Traffic Protection	Traffic Controls	
G40—Special Types Other Protection	G4010—Tied Arch Lighting G4020—Suspension Signage	

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 Bridge elements A, B, C, and D are primary elements to bridge the gap between approach roadways. Element E includes secondary components which may or may not be needed and which vary from project to project. Element F includes incidental components, which the bridge must support.

6.2 The elements listed are generic. Sizes, types, materials, strength and connections are included in each generic element.

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.

6.2 *Description*—The element descriptions help you understand the purpose and application of the element.

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