

ASTM's UNIFORMAT II applied to Civil Works: A Progress Report

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Abstract

ASTM's Elemental Classification – E 1557 Standard Classification for Building Elements and Related Sitework-UNIFORMAT II –has provided valuable service in planning and design stage cost control, and other essential building recording and management activities for more than twenty years. Essentially restricted to buildings there have been calls to extend its unique approach into other construction sectors.

The paper will provide a current progress report on ASTM's extension of UII into the civil construction sector. It will briefly describe the unique characteristics of elemental classification, ASTM's specific guidelines, the currently proposed schema, and examples of work in progress. Some of the difficulties encountered in applying the elemental concept consistently through a range of authors and disciplines will also be discussed.

Paper

1. General Introduction

UNIFORMAT II, or elemental cost planning and analysis, will be familiar to those members of CSVA who undertake value analysis for buildings. It's a costing and analysis method used where data and design is minimal and changing rapidly.

Elemental analysis, like Value Engineering, has its genesis in World War II. Not in the waging of war, nor the development of equipment for war, but from the immediate and subsequent effects of the peace after war.

Developed within the UK Department of Education and Science in the late 1940's, and implemented in 1950, to solve the problem of budgeting for school construction projects. The technique has been successfully used around the world since then, although known it is not a well understood process in North America.

Given its wide spread use it, not surprisingly, comes in various flavours, for example:

- BCIS (Building Cost Information Service)
- UNIFORMAT II (ASTM International)
- CIQS (Canadian Institute of Quantity Surveyors)
- and many others, worldwide.

2. UNIFORMAT II (UII)

Developed by Charette and Bowen and based upon Bowen's earlier work on UNIFORMAT created for the General Services Administration and the American Institute of Architects.

Specifically applied to Buildings throughout all these years, and applied primarily to cost, it is easily transferred to other activities also, although only when applied to buildings. UII is a standard published by the American Society of Testing and Materials (ASTM) International and is published under the designation of E 1557 Standard Classification for Building Elements and Related Sitework – UNIFORMAT II.

UNIFORMAT II is maintained under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.81 on Building Economics.

3. Achieving Development and Transition within ASTM's strictures

ASTM, being a 'standards' organisation, has a prescribed protocol for publishing new standards, both in regard to the development process and a prescribed written style. Applying this need for consistency should follow through when using a common name or technique, in this case UNIFORMAT II. So anything newly developed must retain the look and feel of the original. This does prove to be difficult with potential authors coming from different backgrounds, with different opinions, and a varied perception of what UII is. Consequently it was necessary to write a set of Guidelines to ensure that the concept and application is retained. ASTM is a standards organisation after all!

4. Just what is an 'element'?

There are international definitions (ISO and others), in addition to the ASTM definition. These are well understood worldwide and have been in use for a significantly long period of time. ASTM's definition is as follows;

element (*noun*) – *in construction planning, design, specification, estimating and cost analysis*, is a significant component part of the whole that performs a specific function, or functions, regardless of design, specification or construction.

DISCUSSION – While through analysis, or by direct application, construction estimates categorised into elements (functional elements) with allocated costs, may be summarized in an *elemental cost summary*, or *elemental cost analysis*, elements (functional elements) also provide a framework for consistent preliminary description, outline and performance specification, through all stages of planning, design, construction and maintenance.

5. Elemental Summary and Analysis

Developing construction cost using elements in a structured way inevitably leads to a process of summary and analysis. It is important to remember that it's:

- Primarily a summary and NOT a new way of estimating;
- A way of creating simplicity out of complexity;
- Appropriate at all stages of design development.

As UNIFORMAT II classifications refer solely to permanent, physical parts of any construction two additional 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 ASTM's E1804, E2514, and E2516. While these three additional standards were primarily written for building construction, they are nonetheless appropriate and readily applied to other forms of construction as well.

Despite the frequent reference to cost UNIFORMAT II elements are applicable to other forms of usage beyond cost.

The users of UNIFORMAT II include:

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

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

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

Others—Who may be manufacturers, educators, students, and other project stakeholders.

Apply this UII classification when undertaking the following work on constructed entities:

Financing and Investing:

Structuring costs on an elemental basis for economic evaluations 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.

Implementing:

Cost Modeling, Cost Planning, Estimating and Controlling Project Time and Cost During Planning, Design, and Construction—Use UNIFORMAT II classifications 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.

Conducting Value Engineering Workshops—Use UNIFORMAT II as a checklist to ensure that alternatives for all elements of significant cost in the building 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 building systems.

Develop 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, and to set milestone target dates.

Performing Risk Analyses—Simulation is one technique (Practice E1369) for developing probability distributions of building costs when evaluating the economic risk in undertaking a building project. Use individual elements and group elements in UNIFORMAT II for developing probability distributions of elemental costs. From these distributions, build up probability distributions of total project costs to establish acceptable project contingencies or to serve as inputs to an economic analysis.

Structuring Preliminary Project Descriptions During the Conceptual Design Phase—It facilitates the description of the scope of the project for the client in a clear, concise, and logical sequence; it provides the basis for the preparation of more detailed elemental estimates during the early concept and preliminary design phases, and it enhances communications among designers and other building professionals by providing a clear statement of the designer's intent.

Coding and Referencing Standard Details In Computer-Aided Design Systems—This allows an architect, for example, to reference an exterior wall assembly according to UNIFORMAT II element

designations and build up a database of standard details structured according to the classification. This is particularly appropriate to design modelling and Building Information Modelling (BIM) applications.

Managing Facilities:

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.

Other Activities:

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

Before I set off on a trip I like to know where I'm going. Consequently a significant amount of work has gone into overall planning, in advance of the writing any of the additional classifications.

Guidelines have been written for the use of persons developing new ASTM UII standards and have identified potential classifications for a whole 'family' of UII Standards beyond light construction.

6. A word about ASTM's Process for Standards development

Standards are voluntarily used – in themselves there are not law but can become so if included, or referenced, within any mandatory regulation or legislation.

ASTM's intent is to develop and publish "Consensus" standards and is achieved by a rigorous balloting process. Presently there are three ballots through which all standards must pass

- Sub-committee ballot
- Full committee ballot
- Society ballot

ASTM standards are written by volunteers and there are industry participation rules and guidelines for membership to avoid any group monopolizing the development of a standard. Moreover ASTM's style sheet dictates those section headings that are suggested for use in the various types of standard being written, e.g.

- Test Methods;
- Specifications;
- Classifications;
- Practices and Guide;
- Terminology and Definitions, and other;
- Reference materials.

The content of any standard generally reads with subsequent sections, many being mandatory, becoming progressively more detailed, with possible exception of a referenced documents section, which seems out of order to my eye by being placed 'up-front'.

7. Calls for “improvement”

In recent years there have been some individuals seeking an extension of UII into the heavy civil works sector. Which, while I personally am unaware of any specific problem that needed to be solved by a UII classifications in this sector, if the industry is calling for such a classification then by all means write one.

Also, there have been several calls for extending UII into greater levels of detail i.e. creating complexity out of simplicity! My personal view is that they are essentially breaking the basic concept of elemental analysis by attempting to move toward a wholly prescriptive classification. This, again in my view, is unlikely to be achieved. Nevertheless such additional complexities can be incorporated within Appendices to a standard. These appendices are Non-mandatory sections of a standard and so can be used to publish ‘examples’ of a particular adaptation of a standard.

8. E06.81’s Specific Elemental Guidelines

These guidelines were written because of an observed need to maintain the basic intent and integrity of the elemental system. The variety of perceptions held by people about what elemental classifications and cost analyses actually are is legion.

We have deliberately set up a three level hierarchy where the all important elements (which are the heart of any elemental system) can be grouped.

These are called Group and Major Group Elements. And, for the purposes of convenience in use, and to aid in locating a particular element from within a longer listing of elements, elements will be collected within the appropriate group element. Groups will include elements classified by their primary function, and Major Groups will collect these Groups under appropriate broad scope titles.

Groups, and especially major groups, will best be ordered by typical construction sequence; e.g. structure before shell, shell before interiors, and shell before services, and building before related sitework, etc.

These guidelines are made available to all ASTM members writing new classifications to help ensure uniformity of intent and application throughout a ‘family’ of UII standard classifications.

9. Some Specifics

The sub-committee made a conscious decision to write several discrete classifications, rather than one humungous long list of elements, such as that proposed by the Construction Specifications Institute in their evolving UniFormat and previous OmniClass publications. The currently proposed list of proposed discrete UII classifications has been extricated from the aforementioned guidelines and is provided in Appendix A attached to this paper

10. UII Classifications – Works in Progress

- Bridge (at sub-committee ballot stage)
- Waterfront (at subcommittee ballot stage)
- Revised sitework (in planning and writing stage)
- Transportation surfaces (in planning stage)
- Water and Sewage (in planning stage)

11. Campus like constructions

Many seem to be confused by the ‘building block’ or modular approach that the use of several discrete classifications permits. In essence, for any particular project, one needs only to apply the appropriate classifications available and required. For example

- Highway Projects will use the transportation surface classification for each road section (main roads, secondary roads, for each project length and the bridge classification for each individual bridge).
- An Airport would include various classifications, including the various transportation surfaces (runway, taxiway, road), bridges, buildings, and sitework.

12. Need to Extend the range of Contributors

There is a tendency for writing these UII classifications in a far too individual way. This tends to move away from the concept of industry consensus in writing and publishing these standard classifications. It’s understandable that few in this day and age have the time and/or the wherewithal to commit to voluntarily writing something that will become an ASTM standard published under an ASTM copyright.

13. Personal Views and Lessons Learned to Date

The extension of UII into a greater range of constructed entities, beyond buildings, will take a significant amount of time, many years in fact. The success of the endeavour rests very much on the need to limit a wide range of inputs that are proposed. It’s about construction and NOT operation. A simple example being one proponent who wished to include fuel trucks within a UII classification.

Maintaining the rigour required to maintain a consistent and standard approach to UII classifications has not been easy. This, despite written guidelines which help only when read. So it is likely that maintaining a “standard” will not get any easier, any time soon.

The sub-committee is always looking for subject experts who are willing to write additional standards in the broad field of building economics, and now more specifically in the realm of UNIFORMAT II elemental classifications for construction work in the heavy and civil engineering branches of construction.

Late breaking ideas and suggestions may be emailed to the speaker at alhcomnet@keynetz.net

Appendix A – Discrete Classifications – Constructed Entities

UNIFORMAT II elemental classifications are specifically written as discrete classifications for specific constructed entities. A project, program, or portfolio may contain several constructed entities that, as a collection, describe that project, program or portfolio. It is not expected that these discrete classifications be combined into an omnibus classification, although their functional elements may. UNIFORMAT II approved discrete classifications are currently planned to be as follows:

<i>Major Subdivision</i>	
<i>Classification Name – EntityID</i>	<i>Narrative Description</i>
Heavy (Civil) Construction	
Dam and Canal – DAMC	Includes: Dams, Canals, Locks, Levees, Reservoirs. NOTE: Essentially those constructed entities that contain, channel or control surface water
Transportation Surface – TRAN	Includes: Roadways, Railways, Runways, Taxiways and Aprons. NOTE: Essentially all those constructed entities that aid, support, channel or direct mechanical transportation devices at grade level.
Bridge – BRDG	Includes: Bridge constructions that carry transportation surfaces and other entities (pipes and pipelines) over and across natural or man-made obstacles. NOTE: This is an entity that is common to many constructed entities.
Underground - UGRD	Includes: Tunnels, shafts, subways, and mines that require or provide access. Excludes: Entities (utilities) that are buried.
Waterfront - WFR	Includes: Wharfs, Piers, Jetties, Docks, Breakwaters, Groynes (groins). NOTE: Essentially all those constructed entities at the interface

of land and water created for the purpose of facilitating an exchange between waterborne and land-based transportation, maintaining controlled access to aquatic areas, or providing erosion control and protection.

Dredge and Waterway - DRGW

Includes: Work in waterways, natural and man-made. Locations will include, waterfronts, navigation channels, harbours, canals, rivers, lakes, ponds, and reservoirs.

Pipeline – PIPL

Includes: Pipelines conducting large quantities of natural commodities in raw, amended, modified, or refined form. A pipeline can be above or below ground and may require pumping, bulk storage, and termination/delivery stations.
Excludes: storage tanks, potable water and sewerage.

Water and Sewerage – WTRS

Includes: Potable water supply – wells, pipelines, and treatment plants.
Includes: Sewerage – waste water trunk sewers, treatment plants, treatment ponds, and anti-pollution facilities.
Excludes: Reservoirs and storage tanks

Storage Tanks - STNK

Includes: Storage tanks of all forms, whether below or above ground.
Excludes: Reservoirs
NOTE: This is an entity that is common to several constructed entities.

Power – Generation - PWRG

Includes: All forms of generating facilities including, nuclear, fossil fuel, hydro, geothermal, wind, solar and ocean (currents, tides, wave action).
Excludes: Dams and reservoirs.

Power – Transmission – PWRT

Includes: Power transmission lines – above ground and below ground – switch stations, and transformer sub-stations.
Excludes: End user facilities

Manufacturing and Processing – MP

A very wide ranging classification that will be difficult to describe given the wide diversity of manufacturing and processing applications.

An initial division into four discrete sub-classifications that describe distinct phases of operations may assist:

- Collection – MPCOL
- Processing (treatment) – MPPRC
- Storage – MPSTR
- Disposal – MPDSP

NOTE: The disposal sub-classification will need to address chemical, petrochemical, manufacturing and construction debris, recycling, and final disposal of both hazardous and non-hazardous waste.

Communication – COMM

Includes:

- Broadcast Towers (public and private), Radar Towers (weather, missile, tracking) and;
- Communication Lines (above and below ground) including, repeaters, terminators, load balancers etc.

Light (Building) Construction

Building – BLDG

Includes:

- Residential
- Educational
- Cultural
- Health
- Religious
- Government and Public
- Commercial
- Transportation (road, rail, air and water)
- Industrial
- Recreation and Entertainment
- Scientific Research
- Farm and Animal

Excludes: Related sitework and other external installations and entities

Related Sitework – RSWK

Includes: Light construction work that is related to the building and within its specific (or immediate) site boundaries (see E1557 for a more complete description of inclusions and exclusions).
Excludes: External installations

External Installations – EXTI

Includes: Open and special purpose entities e.g.

- Tracks
- Surfaces
- Courses
- Fields
- Recreational areas
- Monuments and memorials

Excludes: Stadium structures, whether enclosed or not (they will use the Building classification, although simple bleachers, isolated scoreboards, and sports lighting may be an exception when not included with related sitework).

Major Developments

Includes: A combination of light and/or heavy construction in campus-like developments with several constructed entities e.g.

- University campus
- Research Parks
- Airports
- Military facilities
- Industrial facilities
- Residential housing developments
- City, Town and other major municipal centres

NOTE: No classifications of major Developments are required as each is a collection of the appropriate and applicable constructed entity classifications noted elsewhere.

Appendix B – Selected Short List of References

Books

- Douglas J. Ferry and Peter S. Brandon , Cost Planning of Buildings (Oxford, UK: BSP Professional Books, 1991)
- Peter E. Bathurst and David A. Butler, Building Cost Control Techniques and Economics (London, UK: William Heinemann Ltd., 1973)
- Roger Flanagan and Brian Tate, Cost Control in Building Design (Oxford, UK: Blackwell Science Ltd., 1997)
- David Jaggar et al, Building Design Cost Management (Oxford, UK: Blackwell Science Ltd., 1997)
- Peter S. Brandon, ed. Quantity Surveying Techniques, New Directions (Oxford, UK: Blackwell Science Ltd., 1990)
- Ivor H. Seeley, Building Economics (London , UK: The Macmillan Press Ltd., 1972)
- Donald E. Parker and Alphonse Dell’Isola, Project Budgeting for Buildings (New York, USA: Van Nostrand Reinhold, 1991)
- Frank W. Helyar, Construction Budgeting (Toronto, CAN: Canadian Institute of Quantity Surveyors, 1998)
- Ministry of Public Buildings and Works, Cost Control in Building Design (London, UK: Her Majesty’s Stationery Office, 1968).
- Department of Education and Science, Cost Study ((London, UK: Her Majesty’s Stationery Office, 1972).
- Property Services Agency, Cost Planning and Computers (London, UK: Her Majesty’s Stationery Office, 1981).
- Rick Best and Gerard de Valence, ed’s. Building In Value: Pre-Design Issues (London, UK: Arnold, 1999).

Articles

“UNIFORMAT II Support Document Developed”, Architectural Engineering Institute (AEI) – Fall 2000, Robert P. Charette

“Estimating and Design Cost Analysis” McGraw-Hill Time Saver Standards – 2003, Robert P Charette and Brian Bowen

Papers and Reports

SAVE International, Monograph Function: Definition and Analysis (SAVE International, Original approved October 1998).

SAVE 2004 Montreal Conference, Paper, Increase VE Team Performance With UNIFORMAT II, Robert P. Charette P.E., CVS and Mark Kalin FAIA, FCSI

National Institute of Standards and Technology, Report (NISTIR 6389), UNIFORMAT II Elemental Classification for Building Specifications, Cost Estimating, and Cost Analysis, Robert P. Charette, Harold E. Marshall, October 1999.