BIMForum Webinar

It’s 2023, Let’s Take a Second Look at How Model-Based Estimating Has Evolved

DATE | TIME: Thursday, January 26, 2023 | 11:00 am EST

PRESENTER: Brent Pilgrim
Director of Preconstruction at
The Beck Group (www.beckgroup.com)

CONTACT: www.bimforum.org; communications@bimforum.org

Presentation Agenda

1. The State of the Model-Based Estimating in Industry
2. A Spark for Something New
3. The Technical: Qualifying the Workflow
4. The Practical: Applying the Concepts
5. The Why: What is the Value?

BIM FORUM

BRENT PILGRIM

Multidisciplinary Career With The Beck Group

- 2001 - Construction
- 2005 - Architecture
- 2007 - Preconstruction
- 2008 - Technology & Cost Consulting w/ Beck Technology
- 2016 - Preconstruction & Technology Director
- 2022 – National Preconstruction Director

Passion for the Model-Based Estimating Workflow

- 2020 – Chair of BIMForum Taskforce
- 10,000+ Hours of Model-Based Estimating Experience

PICS OR IT DIDN'T HAPPEN

That's me…
…a much younger version. ☺

…and I apparently missed the memo on shirts that day!

THE STATE OF MODEL-BASED ESTIMATING IN INDUSTRY

BIM FORUM

POLL RESULTS FROM RECENT CONFERENCE

1) Who is performing model-based estimating regularly, using a standardized approach, that is deployed consistently?

83% Said “No”

2) On a scale of 1-10, how effective would you say you are with your model-based workflow?

Majority reported 5 and lower in effectiveness

3) Do you often use Model-Based Estimating for conceptual & schematic design level exercises specifically?

Majority Said “No”

POLL RESULTS FROM RECENT CONFERENCE

1) Who is performing model-based estimating regularly, using a standardized approach, that is deployed consistently?

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WHY??

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3) Do you often use Model-Based Estimating for conceptual & schematic design level exercises specifically?

A SPARK FOR SOMETHING NEW

BIM FORUM

THE SPARK FOR SOMETHING NEW

Georgia Tech

THE SPARK FOR SOMETHING NEW

MODEL-BASED ESTIMATING

3D model utilized, but not the SSOT*

Model objects authored primarily for design purposes

Model objects may not contain necessary data

Ad-hoc quantity extraction process/strategy

Automation not applied

Not deployed in early design phases

Chain of custody is broken

**SSOT = Single Source of Truth*

THE SPARK FOR SOMETHING NEW

MODEL-BASED ~~ESTIMATING~~

QUANTITY TAKE-OFF

3D model utilized, but not the SSOT*

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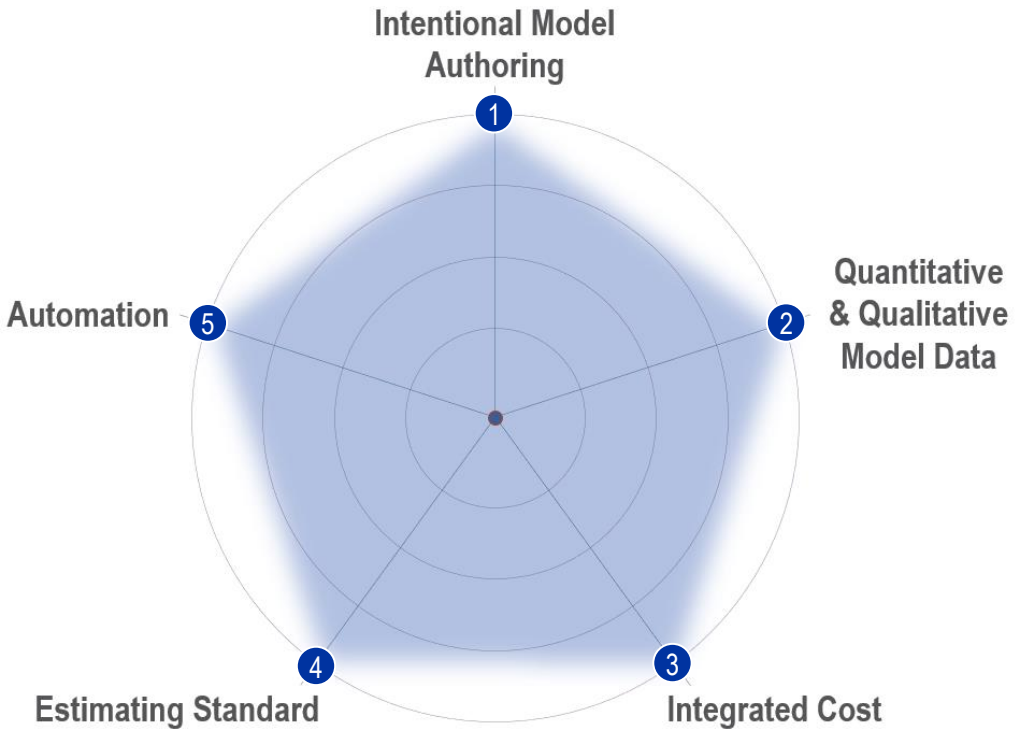
*SSOT = Single Source of Truth

FIVE QUALIFYING CHARACTERISTICS

INTEGRATED ESTIMATING



Note: This is a software agnostic workflow!

INTEGRATED ESTIMATING
“*THE TECHNICAL*”

BIM FORUM

FIVE QUALIFYING CHARACTERISTICS

1) Intentional Model Authoring…

- Every object in the model has a purpose
- Intentionality creates organization and structure to the model objects
- Intentionality offers single-source of truth for project area calculations (GSF)
- Supports downstream and multiple discipline integration and utilization
    - Recognizes discipline-specific needs

Note: This is a software agnostic workflow!

INTENTIONAL MODEL AUTHORING

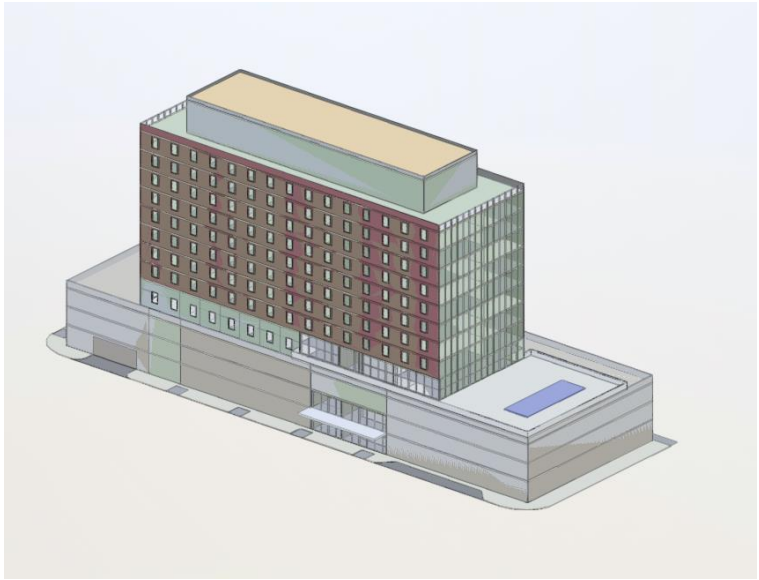
- Intuitive object/element breakdowns (along functional component boundary lines)
- Mass models for project GSF calculations

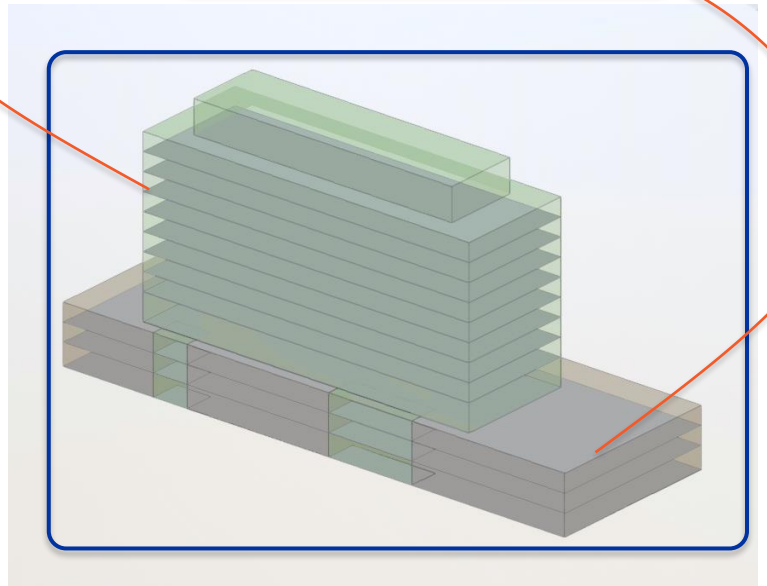
Estimating Location 1 | Residential Tower

GSF = 95,750

Estimating Location 1 | Parking Structure

GSF = 57,400





Note: This is a software agnostic workflow!

FIVE QUALIFYING CHARACTERISTICS

2) Quantitative & Qualitative Model Data…

- Model objects must have qualitative data.
- Qualitative data is Identity Data and includes three specific types:

  i) Location 1 Value or Functional Component Breakdown
    - Ex: "*Office Building*" or "*Building A*"

  ii) Uniformat Category Representing Building System
    - Ex: Revit Assembly Code or *A4010 Slab on Grade*

  iii) Intuitive Naming Convention, or Model Object Family Type name
    - Ex: *6" Slab on Grade*" or "*Exterior Brick Wall*"

Note: This is a software agnostic workflow!

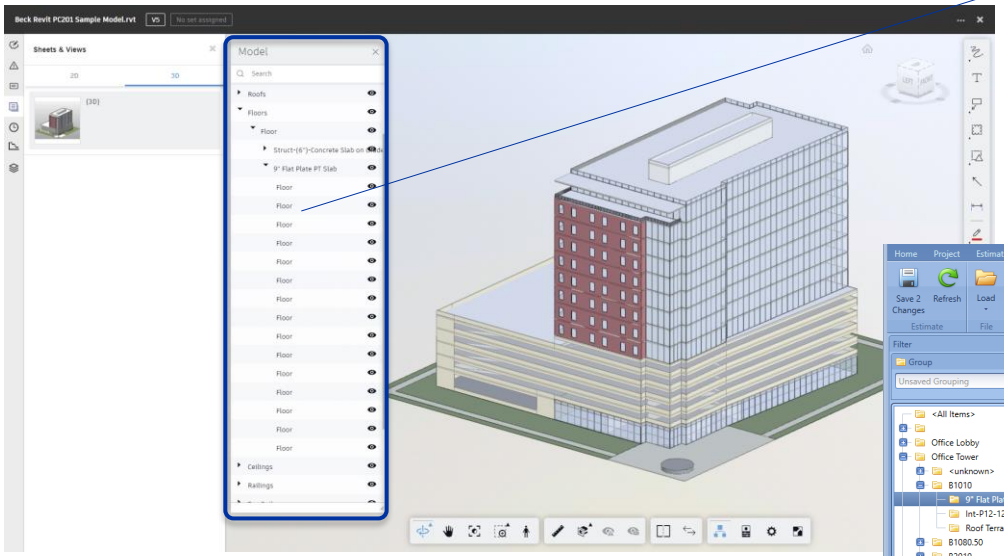
QUALITATIVE AND QUANTITATIVE DATA

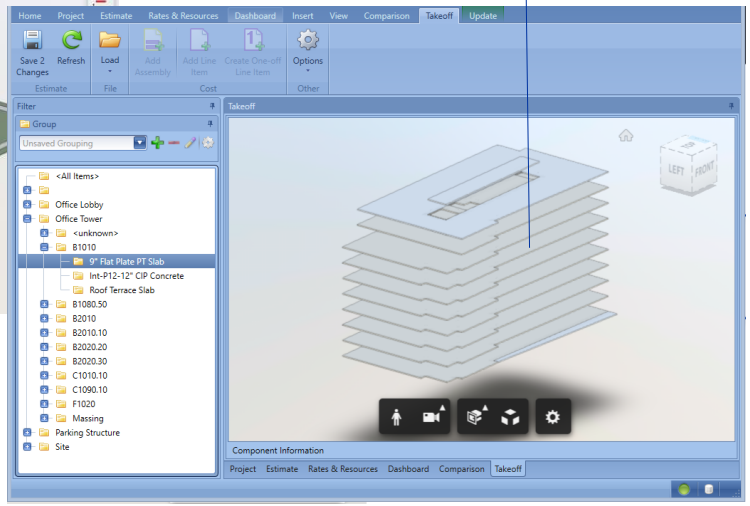
Three Types of Identity Data

Functional Component | Office Tower

Assembly Code | B1010 Floor Structure

Type Name | CIP Concrete Flat Plat Slab





Note: This is a software agnostic workflow!

FIVE QUALIFYING CHARACTERISTICS

2) Quantitative & Qualitative Model Data…

- Model objects must have necessary quantitative data.
- Measurable & Quantifiable
- First-class dimensional properties or otherwise

Note: This is a software agnostic workflow!

QUALITATIVE AND QUANTITATIVE DATA

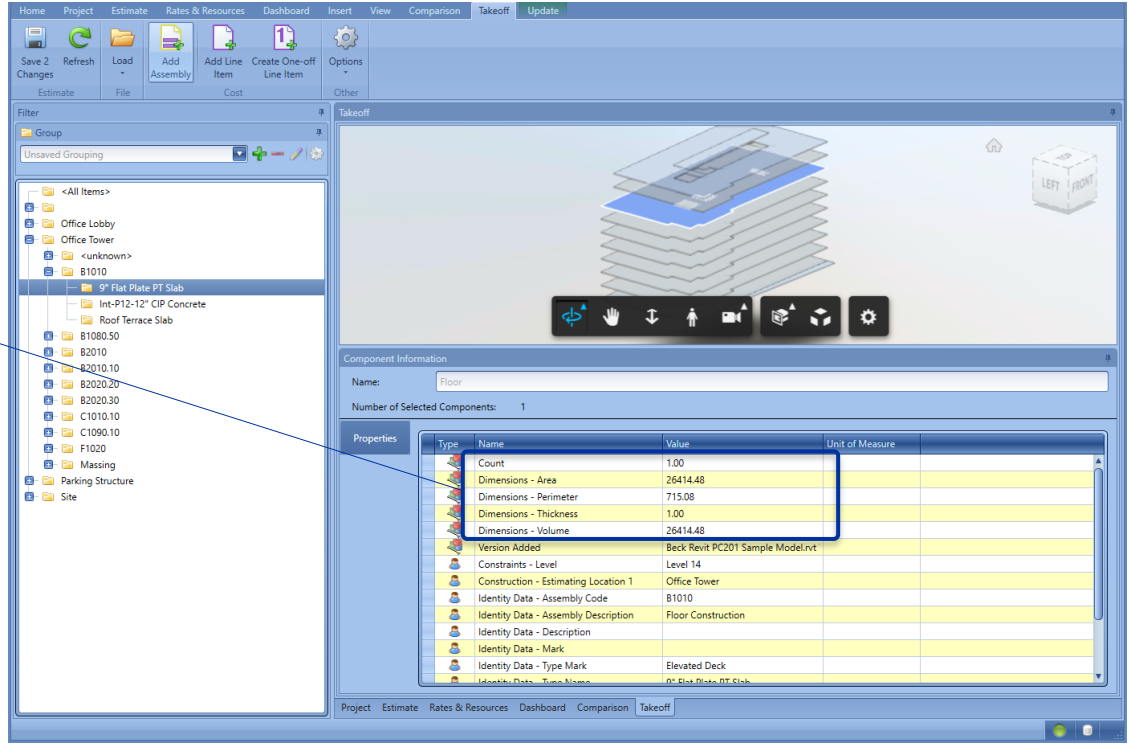
Measurable and Quantifiable

Dimensions | Area

Dimensions | Perimeter

Dimensions | Thickness

Dimensions | Volume



Note: This is a software agnostic workflow!

FIVE QUALIFYING CHARACTERISTICS

3) Integrated Cost…

- Workflow must be able to maintain the “chain of custody”
- The workflow must allow for or provide means of a digital “link” between Model Objects and Quantities in the Estimate.
  - Quantity data explicitly *must not be* manually inputted into an estimate.
- Workflow or software solution must maintain and protect the *chain of custody*.

Note: This is a software agnostic workflow!

INTEGRATED COST

Chain of Custody - Digital “breadcrumbs” that allow users to trace quantity from cost item back to the originating model object source.

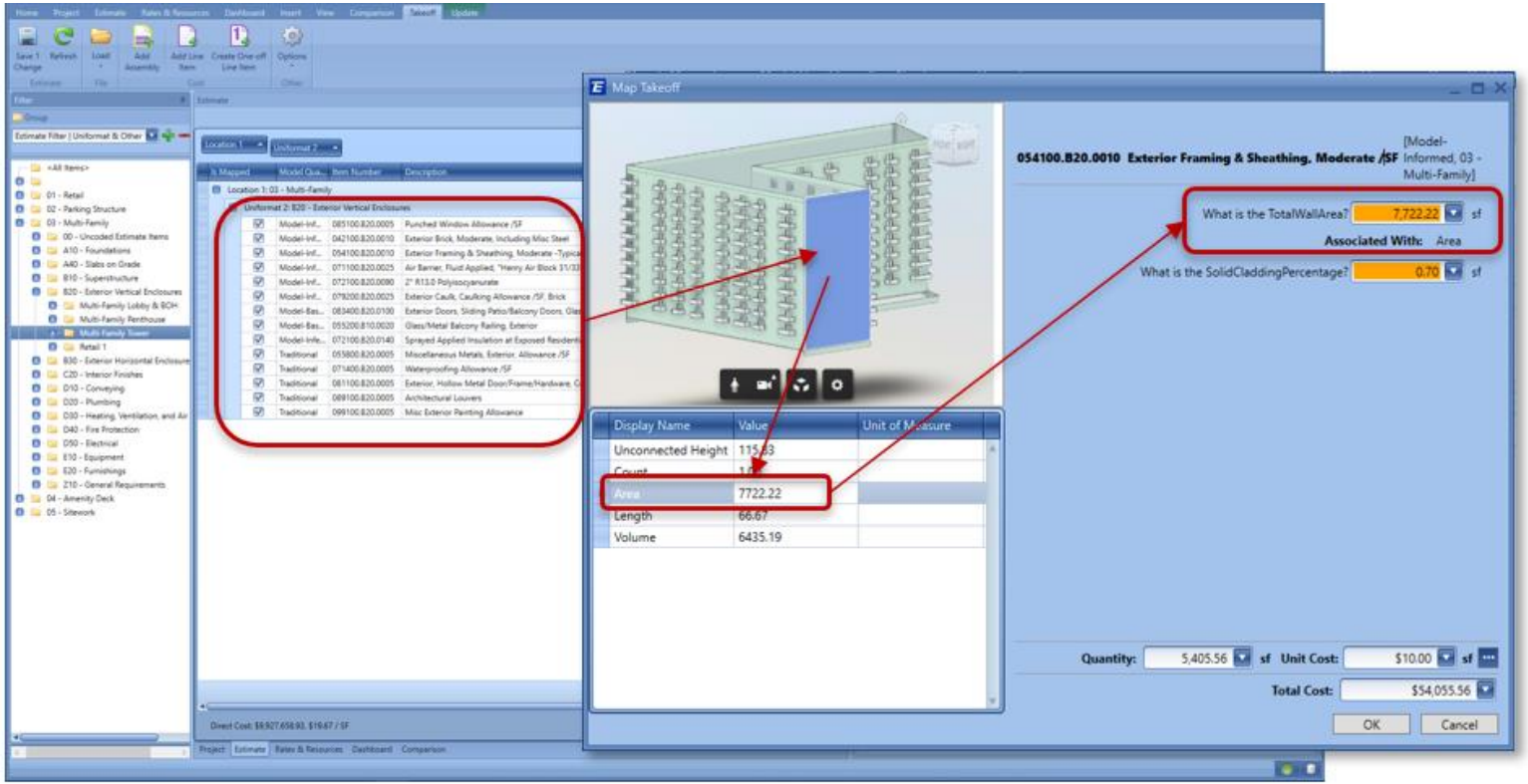
Quantities= “Evidence”

- Gather the Evidence:
  Identify the Quantity Source
- Establish a Paper Trail:
  Link/Map Objects to Line Items
- Prevent Contamination:
  No Manual Entry of Quantities
- Introduce into Court:
  Transparency of the Estimate

Note: This is a software agnostic workflow!

INTEGRATED COST

Chain of Custody



Note: This is a software agnostic workflow!

FIVE QUALIFYING CHARACTERISTICS

4) Estimating Standard Applied…

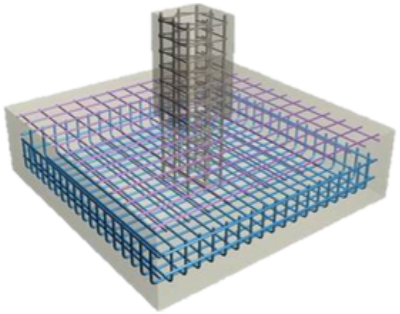
- Eliminates “ad-hoc” approach to quantity take off or quantity survey
- Supports LOD Flexibility
- Standardizes how quantity take-off is performed
- Expands the reach of model-based estimating to earlier design phases

Note: This is a software agnostic workflow!

ESTIMATING STANDARD

Model Quantity Origin as Standard Approach for Integrated Estimating

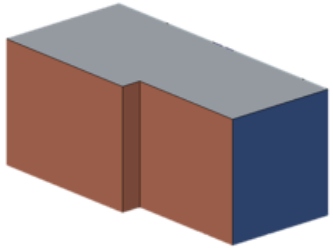
Model-Based



Definition

The linked object is a virtual representation of the cost item being estimated

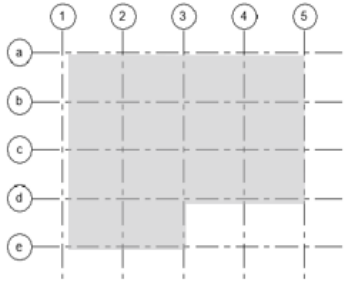
Model-Informed



Definition

The linked object is related to the cost item being estimated but has not been modeled as an exact virtual representation of that scope

Model-Inferred

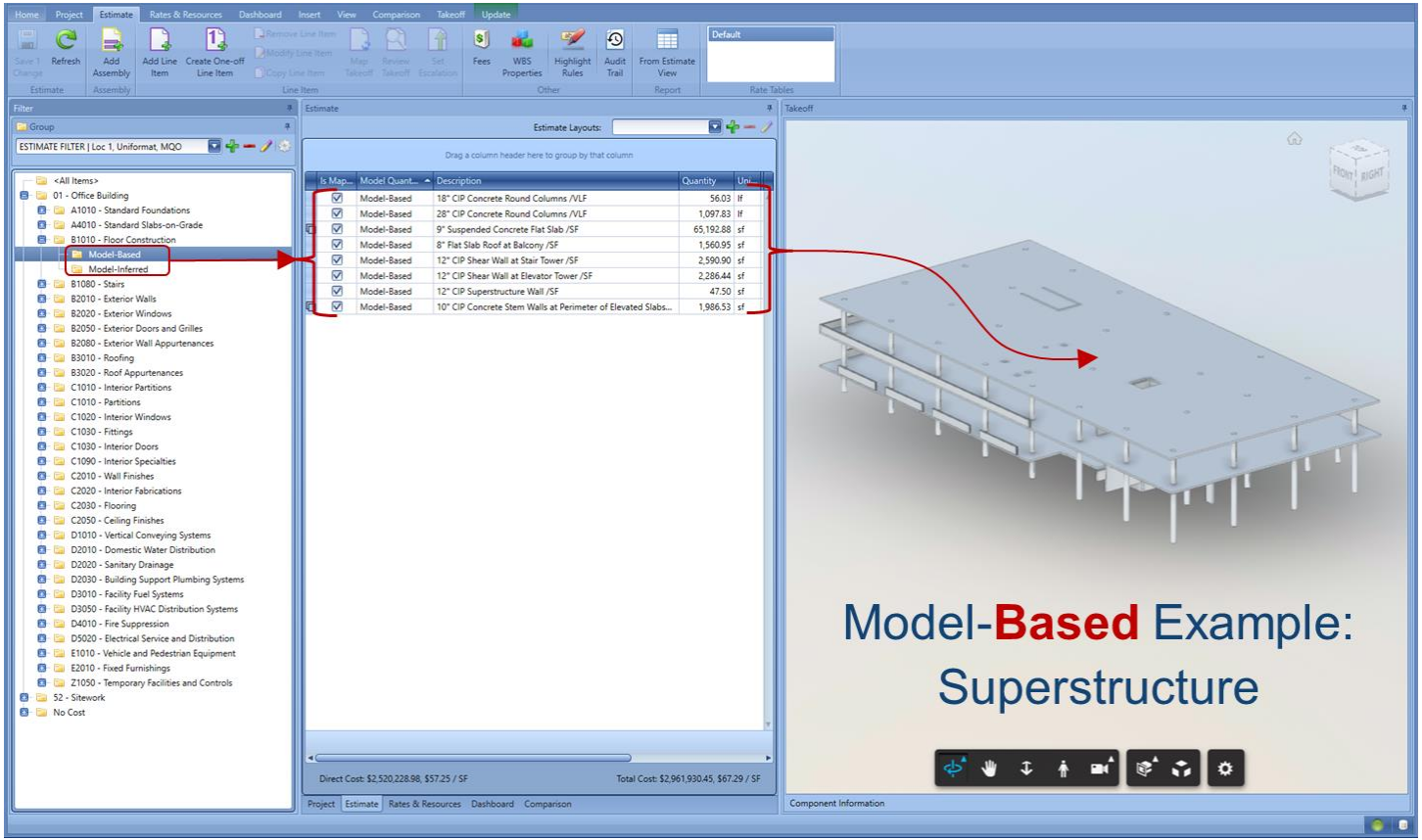


Definition

The linked object has no real relationship to the cost item, but quantities are being inferred from the object

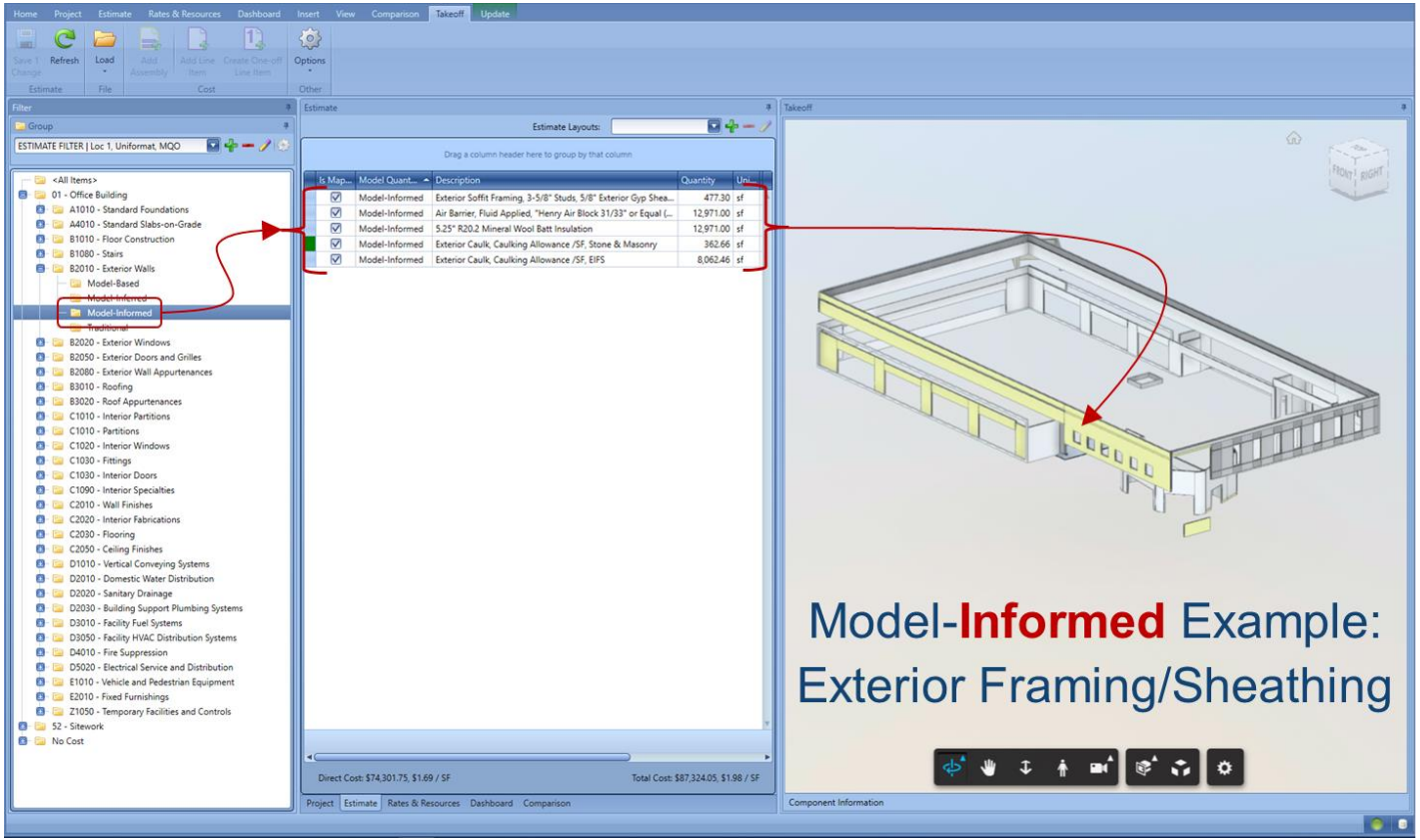
Note: This is a software agnostic workflow!

MODEL-BASED EXAMPLE



Note: This is a software agnostic workflow!

MODEL-INFORMED EXAMPLE



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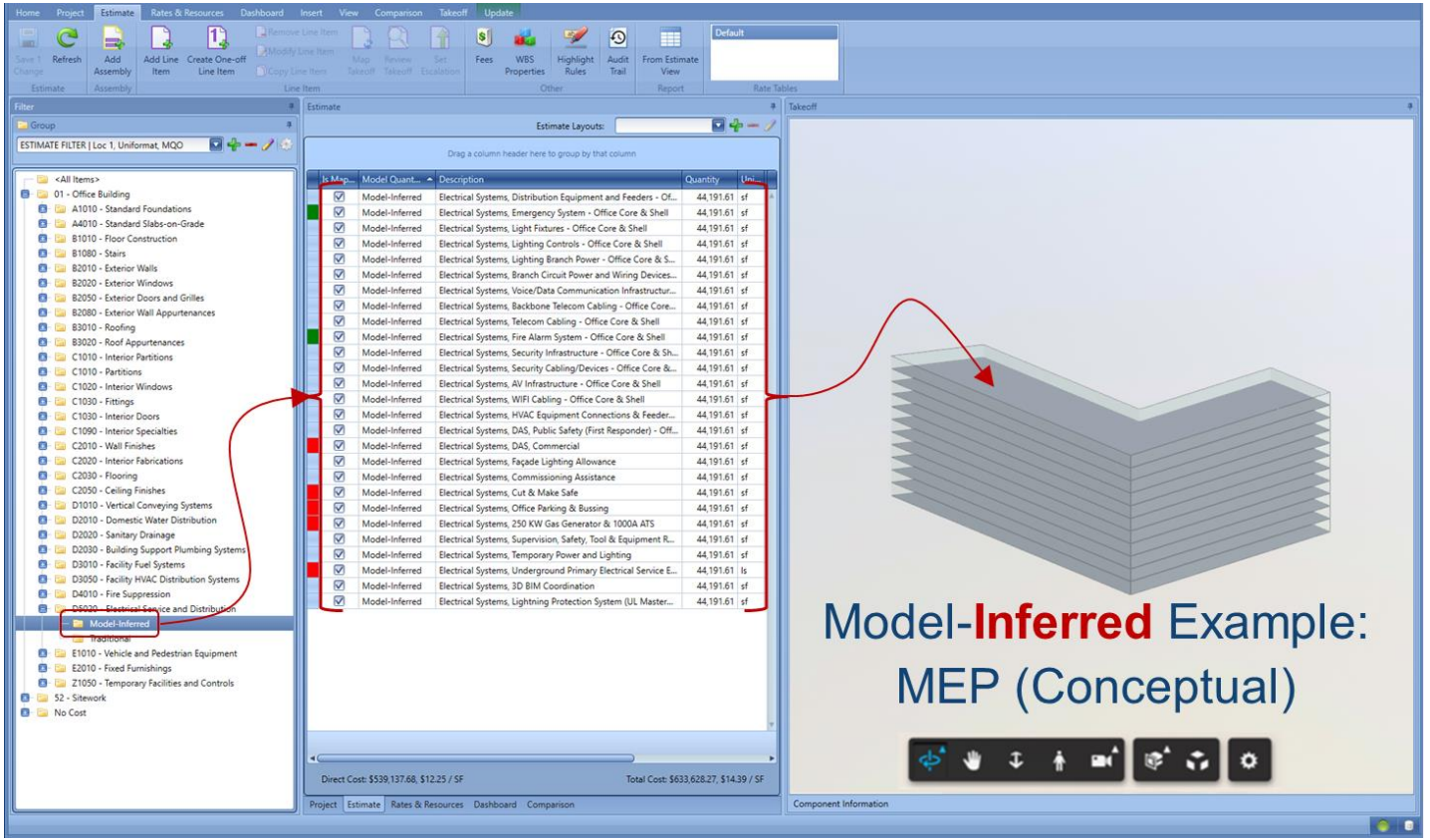
MODEL INFERRED EXAMPLE



Note: This is a software agnostic workflow!

FIVE QUALIFYING CHARACTERISTICS

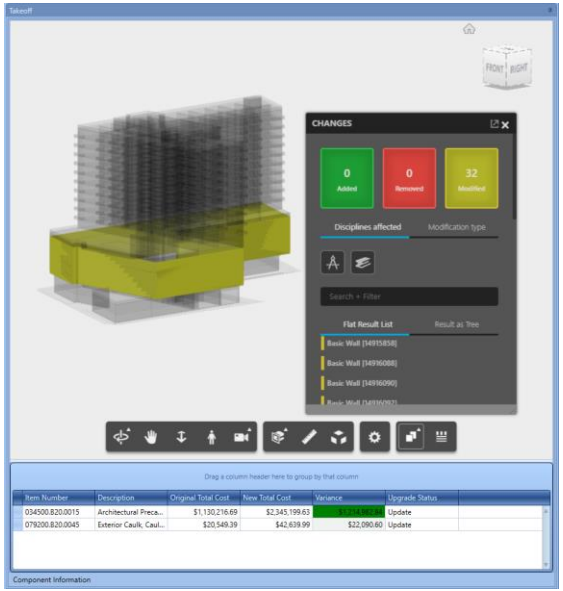
5) Automation and/or Augmentation Applied…

- The workflow allows for, and utilizes automation or applies machine augmentation resulting in…
  - Reduction in Waste and/or improvements in Efficiency
  - Reinforces Consistency & Expectations
  - Encourages Standardization

Note: This is a software agnostic workflow!

AUTOMATION/AUGMENTATION APPLIED

Automation/Augmentation Applied



Automatic Model Updates

Supports Real-Time Estimating as Updates are Automated

Note: This is a software agnostic workflow!

INTEGRATED ESTIMATING
“*THE PRACTICAL*”

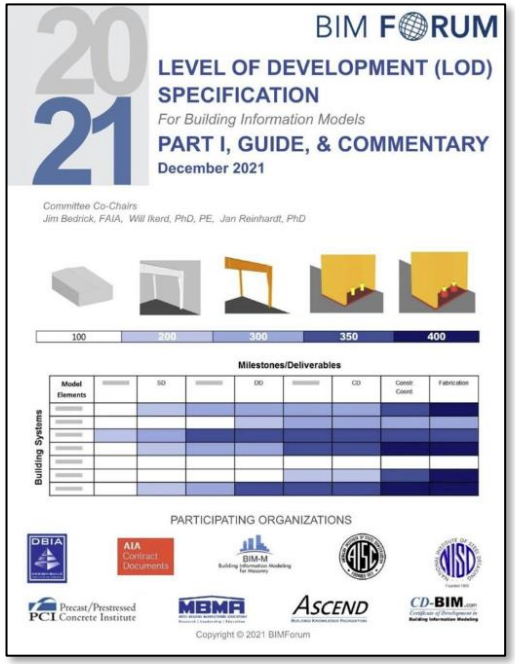
BIM FORUM

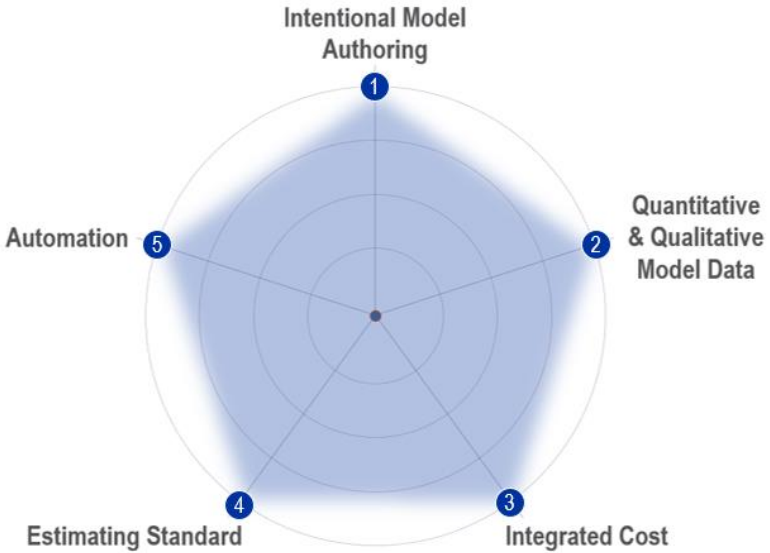
The BIMForum
"*Estimating with BIM*" Taskforce

Were We've Come & We're We Are Going

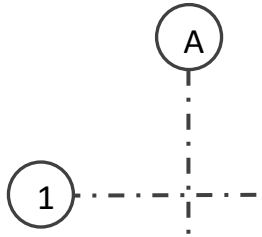
The Perfect Combo for Forward Progress

BIMForum LOD + The Five Essentials For IE



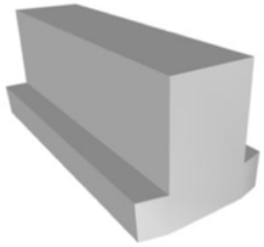


BIMForum LOD Specification



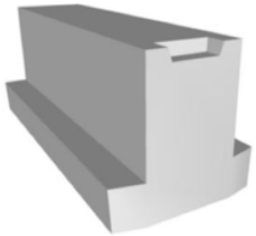
LOD 100

*The Model Element may be graphically represented in the Model with a symbol or other generic representation, but does not satisfy the requirements for LOD 200. Information related to the Model Element (i.e. cost per square foot, tonnage of HVAC, etc.) can be derived from other Model Elements.**



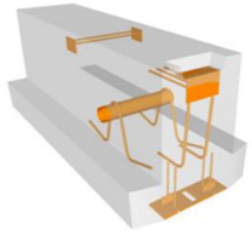
LOD 200

*The Model Element is graphically represented within the Model as a generic system, object, or assembly with approximate quantities, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.**



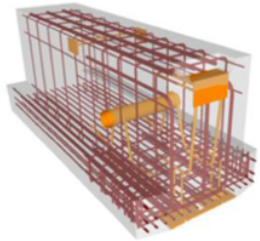
LOD 300

*The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.**



LOD 350

*The Model Element is graphically represented within the Model as a specific system, object, or assembly in terms of quantity, size, shape, location, orientation, and interfaces with other building systems. Non-graphic information may also be attached to the Model Element.**

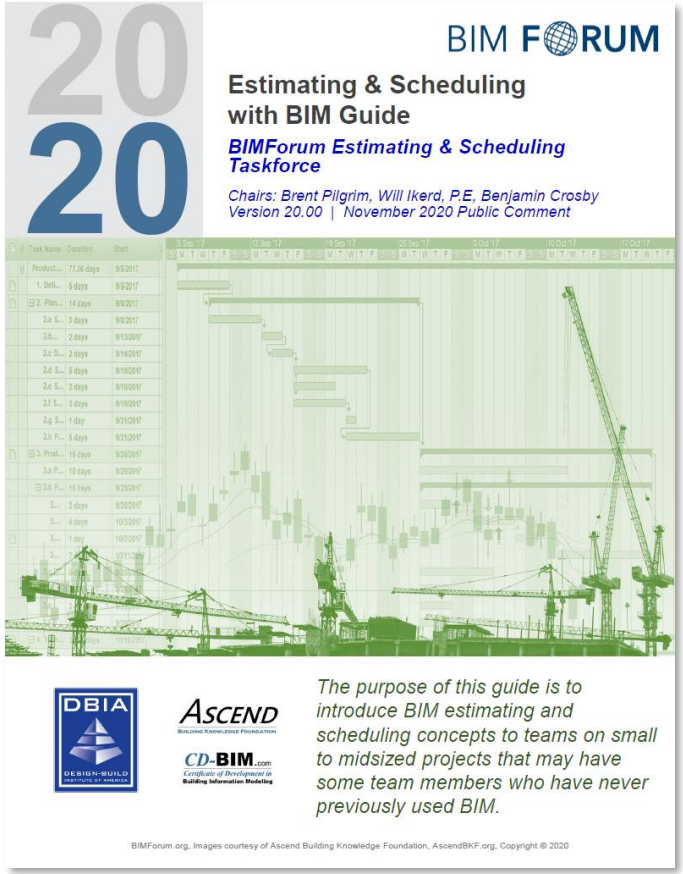


LOD 400

*The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the Model Element.**

*All language and images referenced are from BIMForum LOD Specification

BIMForum Estimating w/ BIM Taskforce



Taskforce Goal

"Qualify short-term behavioral, workflow, and functional challenges preventing adoption of model-based quantity take-off and identify long-term strategies and best practice solutions that enable and support scalable, 4D and 5D practices in the AEC industry."

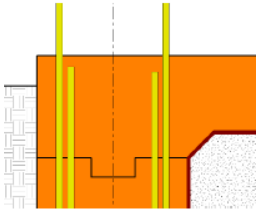
BIM FORUM

Model-Based Estimating Guidelines

ESTIMATING TASKFORCE
MODEL-BASED COST ESTIMATING

BIM FORUM

Primary Cost Element/Scope Item:	
Uniformat 2 Category:	
Omniclass Category:	
Example Use Case:	
Model Quantity Origin:	
Model Quantity Source Geometry:	
Estimating-based Model Parameters & Properties:	
Identification-based Model Parameters & Properties:	
Correlated Cost and Scope Items:	
Adjacent, Modeled Cost Elements	
Supporting Information:	
Project Meta Data:	
Cost Estimating Guidelines:	



LOD 350

BIM Forum LOD Specification Reference

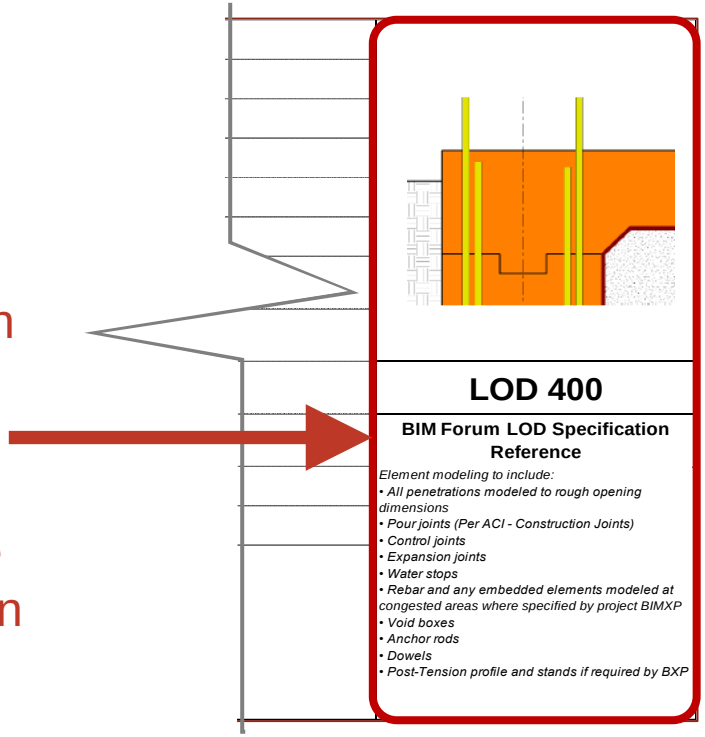
Element modeling to include:
- *All penetrations modeled to rough opening dimensions*
- *Pour joints (Per ACI - Construction Joints)*
- *Control joints*
- *Expansion joints*
- *Water stops*
- *Rebar and any embedded elements modeled at congested areas where specified by project BIMXP*
- *Void boxes*
- *Anchor rods*
- *Dowels*
- *Post-Tension profile and stands if required by BXP*

BIM FORUM

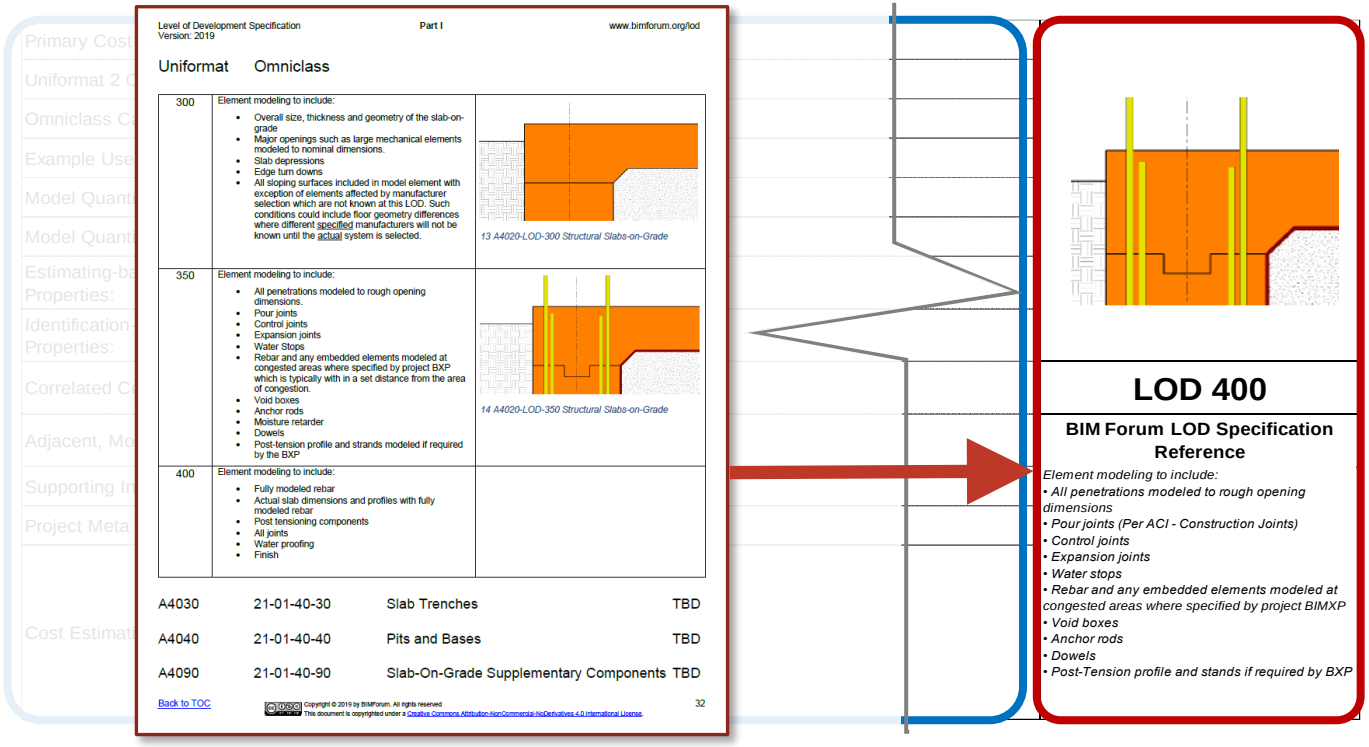
Model-Based Estimating Guidelines

Identifies the LOD of a given model object.

References Existing Language Published by the BIMForum LOD Specification



Model-Based Estimating Guidelines



Level of Development Specification
Version: 2019

Part I

www.bimforum.org/lod

Uniformat Omniclass

300	Element modeling to include: • Overall size, thickness and geometry of the slab-on-grade • Major openings such as large mechanical elements modeled to nominal dimensions. • Slab depressions • Edge turn downs • All sloping surfaces included in model element with exception of elements affected by manufacturer selection which are not known at this LOD. Such conditions could include floor geometry differences where different specified manufacturers will not be known until the actual system is selected.	13 A4020-LOD-300 Structural Slabs-on-Grade
350	Element modeling to include: • All penetrations modeled to rough opening dimensions. • Pour joints • Control joints • Expansion joints • Water Stops • Rebar and any embedded elements modeled at congested areas where specified by project BXP which is typically with in a set distance from the area of congestion. • Void boxes • Anchor rods • Moisture retarder • Dowels • Post-tension profile and strands modeled if required by the BXP	14 A4020-LOD-350 Structural Slabs-on-Grade
400	Element modeling to include: • Fully modeled rebar • Actual slab dimensions and profiles with fully modeled rebar • Post tensioning components • All joints • Water proofing • Finish	

A4030	21-01-40-30	Slab Trenches	TBD
A4040	21-01-40-40	Pits and Bases	TBD
A4090	21-01-40-90	Slab-On-Grade Supplementary Components	TBD

Back to TOC

LOD 400

BIM Forum LOD Specification Reference

Element modeling to include:
- *All penetrations modeled to rough opening dimensions*
- *Pour joints (Per ACI - Construction Joints)*
- *Control joints*
- *Expansion joints*
- *Water stops*
- *Rebar and any embedded elements modeled at congested areas where specified by project BIMXP*
- *Void boxes*
- *Anchor rods*
- *Dowels*
- *Post-Tension profile and stands if required by BXP*

References Existing BIMForum Published LOD Specification

BIM FORUM

Model-Based Estimating Guidelines

Primary Cost Element/Scope Item:	
Uniformat 2 Category:	
Omniclass Category:	
Example Use Case:	
Model Quantity Origin:	
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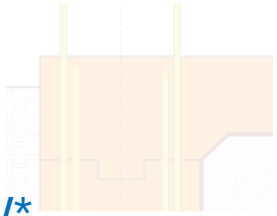
Estimating-based Model Parameters & Properties:	
Identification-based Model Parameters & Properties:	
Correlated Cost and Scope Items:	
Adjacent, Modeled Cost Elements	
Supporting Information:	
Project Meta Data:	
Cost Estimating Guidelines:	

NEW
Model-Based Estimating Guidelines Defined



LOD 400

um LOD Specification Reference

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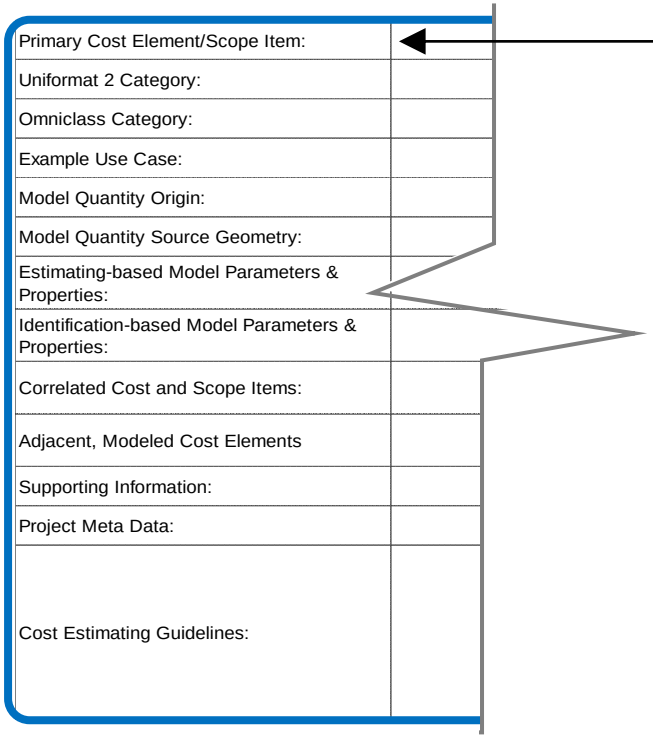
• Void boxes
• Anchor rods
• Dowels
• Post-Tension profile and stands if required by BXP

BIM FORUM

Model-Based Estimating Guidelines

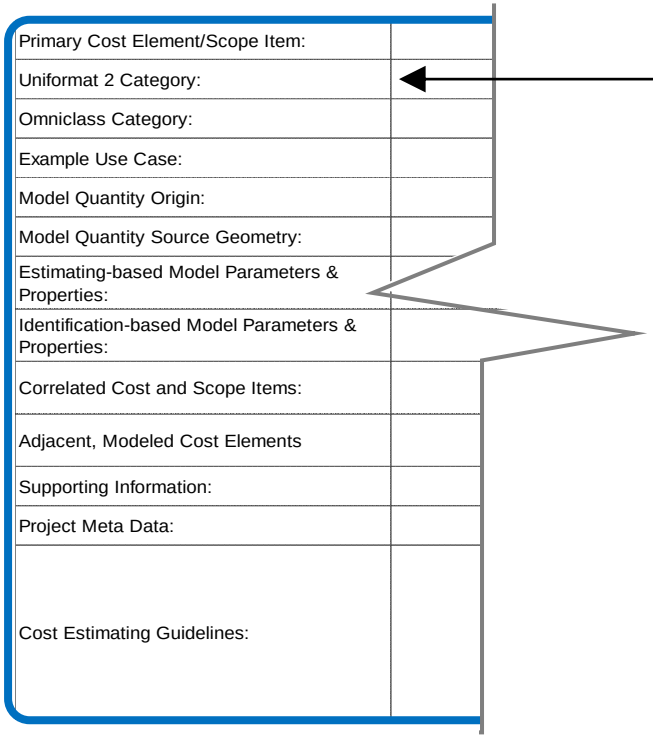
NEW
Estimating Guidelines Defined



Primary Cost Element / Scope Item:
Describes the Scope of Work being estimated

Model-Based Estimating Guidelines

NEW
Estimating Guidelines Defined



Uniformat 2:

Informs the model author and/or the estimator where to locate the scope of work in the Uniformat classification system

Model-Based Estimating Guidelines

NEW
Estimating Guidelines Defined

Primary Cost Element/Scope Item:	
Uniformat 2 Category:	
Omniclass Category:	
Example Use Case:	
Model Quantity Origin:	
Model Quantity Source Geometry:	
Estimating-based Model Parameters & Properties:	
Identification-based Model Parameters & Properties:	
Correlated Cost and Scope Items:	
Adjacent, Modeled Cost Elements	
Supporting Information:	
Project Meta Data:	
Cost Estimating Guidelines:	

Omniclass Category:

Informs the model author and/or the estimator where to locate the scope of work in the Omniclass classification system

BIM FORUM

Model-Based Estimating Guidelines

NEW
Estimating Guidelines Defined

Primary Cost Element/Scope Item:	
Uniformat 2 Category:	
Omniclass Category:	
Example Use Case:	
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Estimating-based Model Parameters & Properties:	
Identification-based Model Parameters & Properties:	
Correlated Cost and Scope Items:	
Adjacent, Modeled Cost Elements	
Supporting Information:	
Project Meta Data:	
Cost Estimating Guidelines:	

Example Use Case:
Provides an example use case of when this template could be utilized.

- Feasibility Study
- Conceptual Design
- Schematic Design
- Design Development
- Construction Documentation
- Shop Drawings/Fabrication

BIM FORUM

Model-Based Estimating Guidelines

NEW
Estimating Guidelines Defined

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Adjacent, Modeled Cost Elements	
Supporting Information:	
Project Meta Data:	
Cost Estimating Guidelines:	

Model Quantity Origin:

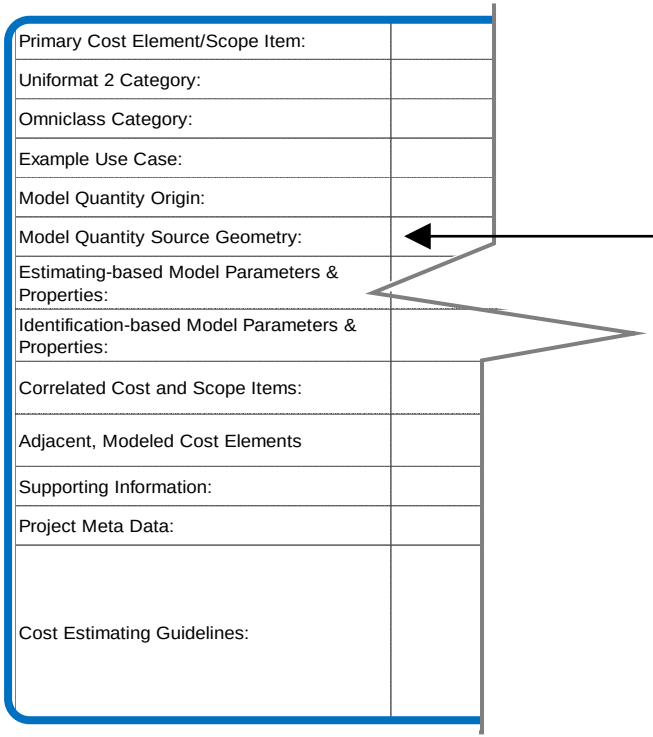
Defines how the quantity can be derived from the model.

- Model-Inferred
- Model-Informed
- Model-Based

BIM FORUM

Model-Based Estimating Guidelines

NEW
Estimating
Guidelines
Defined



Model Quantity Source Geometry:

Informs the model author and/or estimator where (which object) to find quantity information for estimating purposes for a particular scope of work.

Model-Based Estimating Guidelines

NEW
Estimating Guidelines Defined

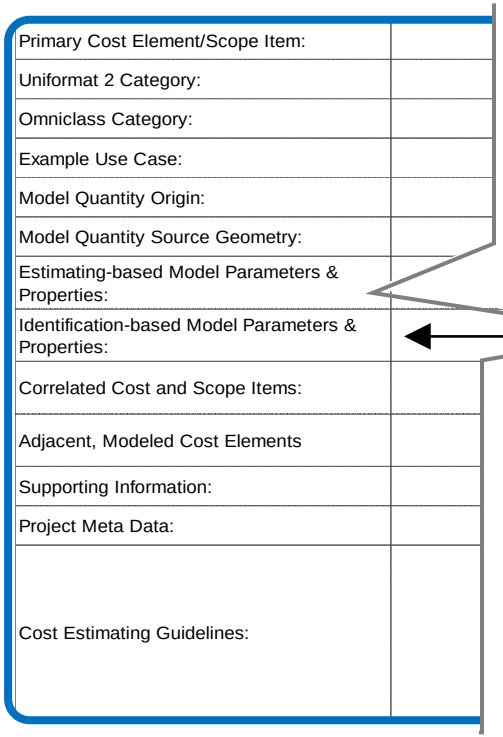
Primary Cost Element/Scope Item:	
Uniformat 2 Category:	
Omniclass Category:	
Example Use Case:	
Model Quantity Origin:	
Model Quantity Source Geometry:	
Estimating-based Model Parameters & Properties:	
Identification-based Model Parameters & Properties:	
Correlated Cost and Scope Items:	
Adjacent, Modeled Cost Elements	
Supporting Information:	
Project Meta Data:	
Cost Estimating Guidelines:	

Estimating-Based Model Parameters & Properties:
Describes which model parameters & properties should be used to generate *quantities* for estimating the scope of work, and based on the Model Quantity Origin above.

BIM FORUM

Model-Based Estimating Guidelines

NEW
Estimating Guidelines Defined



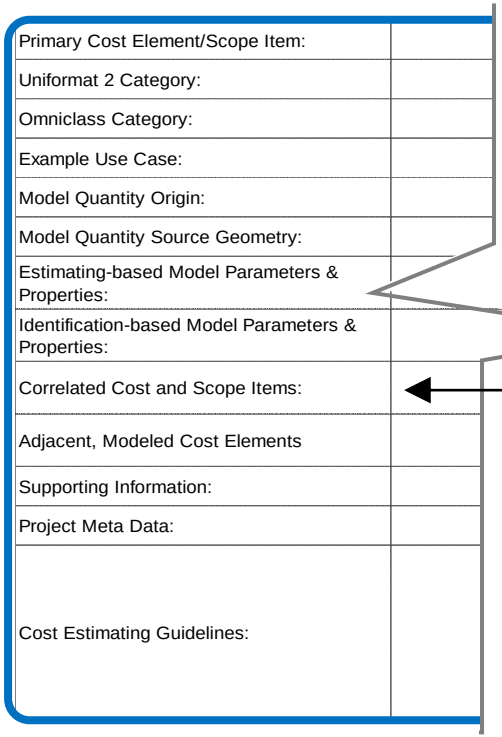
Primary Cost Element/Scope Item:	
Uniformat 2 Category:	
Omniclass Category:	
Example Use Case:	
Model Quantity Origin:	
Model Quantity Source Geometry:	
Estimating-based Model Parameters & Properties:	
Identification-based Model Parameters & Properties:	
Correlated Cost and Scope Items:	
Adjacent, Modeled Cost Elements	
Supporting Information:	
Project Meta Data:	
Cost Estimating Guidelines:	

Identification-Based Model Parameters & Properties:

Describes what properties the model author and/or estimator can use to *locate and identify* the model object in the model.

Model-Based Estimating Guidelines

NEW
Estimating Guidelines Defined



Primary Cost Element/Scope Item:	
Uniformat 2 Category:	
Omniclass Category:	
Example Use Case:	
Model Quantity Origin:	
Model Quantity Source Geometry:	
Estimating-based Model Parameters & Properties:	
Identification-based Model Parameters & Properties:	
Correlated Cost and Scope Items:	
Adjacent, Modeled Cost Elements	
Supporting Information:	
Project Meta Data:	
Cost Estimating Guidelines:	

Correlated Cost and Scope Items:

Identifies related cost items that can also be quantified using this model object.

Model-Based Estimating Guidelines

NEW
Estimating Guidelines Defined

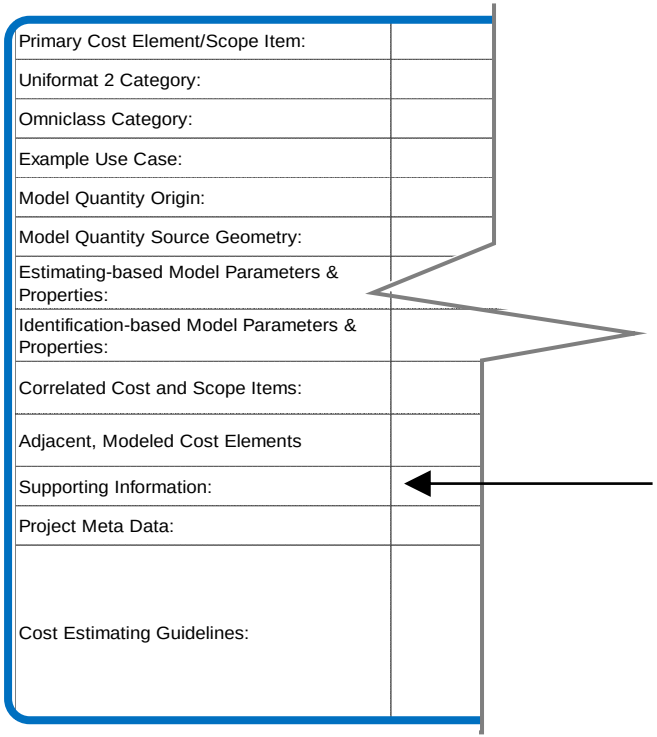
Primary Cost Element/Scope Item:	
Uniformat 2 Category:	
Omniclass Category:	
Example Use Case:	
Model Quantity Origin:	
Model Quantity Source Geometry:	
Estimating-based Model Parameters & Properties:	
Identification-based Model Parameters & Properties:	
Correlated Cost and Scope Items:	
Adjacent, Modeled Cost Elements	
Supporting Information:	
Project Meta Data:	
Cost Estimating Guidelines:	

Adjacent, Modeled Cost Elements:

Identifies model objects and scope of work that are adjacent to this particular scope of work item.

Model-Based Estimating Guidelines

NEW
Estimating Guidelines Defined



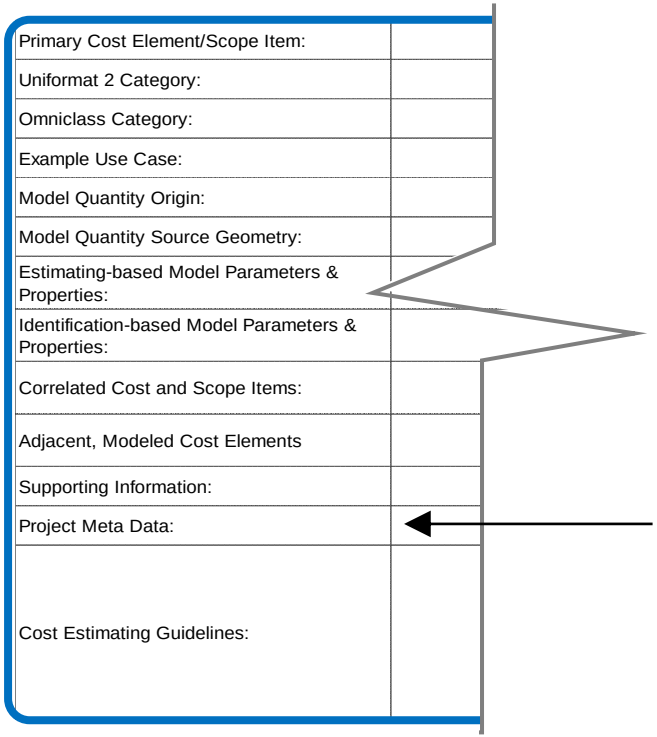
Primary Cost Element/Scope Item:	
Uniformat 2 Category:	
Omniclass Category:	
Example Use Case:	
Model Quantity Origin:	
Model Quantity Source Geometry:	
Estimating-based Model Parameters & Properties:	
Identification-based Model Parameters & Properties:	
Correlated Cost and Scope Items:	
Adjacent, Modeled Cost Elements	
Supporting Information:	
Project Meta Data:	
Cost Estimating Guidelines:	

Supporting Information:

Describes supplemental information that might help model and/or estimate the particular scope of work.

Model-Based Estimating Guidelines

NEW
Estimating Guidelines Defined



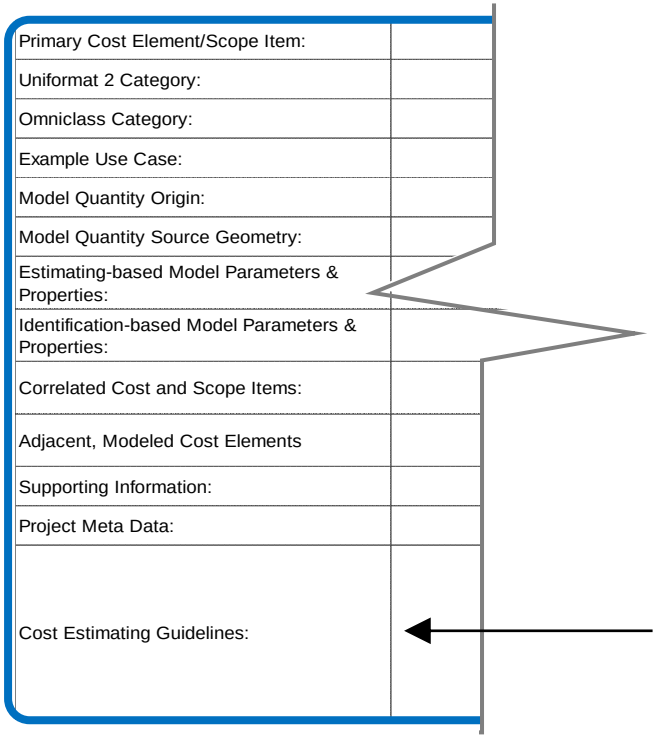
Primary Cost Element/Scope Item:	
Uniformat 2 Category:	
Omniclass Category:	
Example Use Case:	
Model Quantity Origin:	
Model Quantity Source Geometry:	
Estimating-based Model Parameters & Properties:	
Identification-based Model Parameters & Properties:	
Correlated Cost and Scope Items:	
Adjacent, Modeled Cost Elements	
Supporting Information:	
Project Meta Data:	
Cost Estimating Guidelines:	

Project Meta Data:

Identifies project meta data (other data) that will aid in the estimating process.

Model-Based Estimating Guidelines

NEW
Estimating Guidelines Defined



Cost Estimating Guidelines:

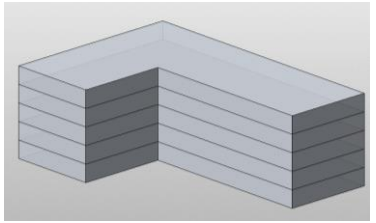
Provides additional information to help aid in the estimation of this particular scope of work.

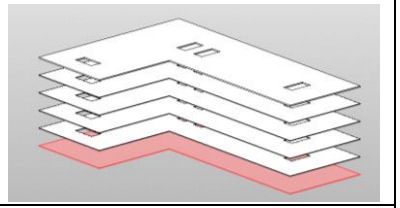
Examples

How does this actually work?

Real-World Examples – LOD 100

Primary Cost Element/Scope Item:	Slab on Grade	
Uniformat Category:	A40	
Omniclass Category:	21-01-40	
Example Use Case:	Feasibility Study/Conceptual Design Phase	
Model Quantity Origin:	Model-Inferred or Model-Informed	
Model Quantity Source Geometry:	Massing Model with Floors or Levels	
Estimating-based Model Parameters & Properties:	Level 1 Floor Area (SF) Perimeter (LF)	
Identification-based Model Parameters & Properties:	Uniformat System Classification Element Type Name	Parent Project Location (Functional Component)
Correlated Cost and Scope Items:	Building Pad Preparation Foundation System	
Adjacent, Modeled Cost Elements	Building Envelope Superstructure	
Supporting Information:	Any known information or stated project assumptions related to project or site conditions, substructure requirements, etc.	
Project Meta Data:	Omniclass Table 11 - Entity by Function Category Level 3	
Cost Estimating Guidelines:	While first class slab objects may or may not be modeled at this LOD. At a minimum, a level ought to be present in the massing model that represents the "at-grade" level slab area. Cost for slabs should be Model-Inferred from this type of object in the model, or Model-Informed if an actual slab object exists at this LOD. Cost are often calculated on a $/SF value being assigned to the component or system representing the "at-grade" level of the model and are based on historical cost of similar tyle projects and other known information.	





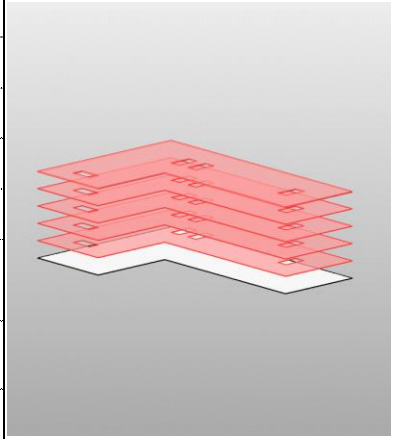
LOD 100

BIM Forum LOD Specification Reference

Assumptions for slabs are included in other modeled elements such as volumetric mass or architectural floor elements that contain a layer for assumed structural framing depth.

Real-World Examples – LOD 200

Primary Cost Element/Scope Item:	Superstructure - Floor Decks, Slabs, and Supporting Members	
Uniformat Category:	B1010	
Omniclass Category:	21-02 10 10	
Example Use Case:	Conceptual Design through Schematic Design	
Model Quantity Origin:	Model-Informed or Model-Based	
Model Quantity Source Geometry:	First-Class Slab Object (Native Object) Slab divided into sections by "Use" when appropriate (Reference Omniclass Table 13) First-Class Column Objects (Native Object) First-Class Wall Objects (Shear walls, Perimeter Walls, etc.) (Native Objects)	
Estimating-based Model Parameters & Properties:	Slab Area (SF) Perimeter (LF) Slab Thickness (Inches), if available	
Identification-based Model Parameters & Properties:	Uniformat System Classification Element Type Name Parent Project Location (Functional Component)	Materials and Finishes - Material Name
Correlated Cost and Scope Items:	Vertical Structural Elements (Columns/Shear Walls) Roof Structure, if applicable	
Adjacent, Modeled Cost Elements	Slab at Grade Roof Structure, if applicable Building Envelope	Roof Covering Interior Construction & Finishes
Supporting Information:	Any known information or stated project assumptions related to project such as superstructure requirements, structural load information, anticipated slab type (flat plate, pan slab, other), etc.	
Project Meta Data:	Omniclass Table 11 - Entity by Function Category Level 3	
Cost Estimating Guidelines:	Cost for Superstructure should be Model-Informed or Model-Based at this LOD, meaning costs are based on model parameters of a first-class slab model objects (in this case, the area of an elevated slab), and use a unit price appropriate for the project. The cost should take into account any structural narrative information that may also support it including anticipated slab types (flat plate, pan slab, post-tension, etc.), as well as assumptions for other superstructure related objects that form a complete system, such as shear walls, columns, beams, etc that may not be modeled at this LOD.	



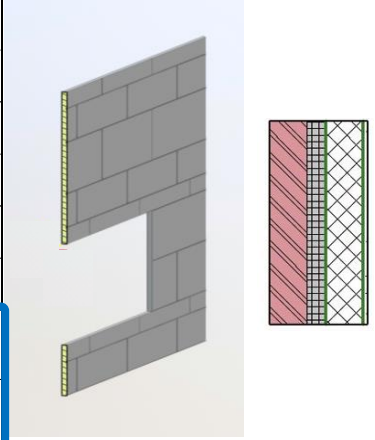
LOD 200

BIM Forum LOD Specification Reference

Element modeling to include:
- *Floor with approximate dimensions*
- *Approximate supporting framing members*
- *Structural grids defined accurately*

Real-World Examples – LOD 300

Primary Cost Element/Scope Item:	Exterior Walls Including Wall Construction and Finish Veneers	
Uniformat Category:	B2010	
Omniclass Category:	21-02 20 10	
Example Use Case:	Schematic Design through Design Development	
Model Quantity Origin:	Model-Based	
Model Quantity Source Geometry:	First-Class Wall Object (Native Object) Representing Specific and Separate Layers of Wall Construction as a Composite Object	
Estimating-based Model Parameters & Properties:	Wall Area (SF) Wall and/or Material Thickness (Inches)	
Identification-based Model Parameters & Properties:	Uniformat System Classification Element Type Name Parent Project Location (Functional Component)	Materials and Finishes - Material Name
Correlated Cost and Scope Items:	Exterior Wall Backup Construction Exterior Wall Veneer Finishes Supporting Construction Elements	
Adjacent, Modeled Cost Elements	Exterior Openings & Doors Roof Enclosure	
Supporting Information:	Any known information or stated project assumptions related to project that would support the exterior envelope estimating activities.	
Project Meta Data:	Omniclass Table 11 - Entity by Function Category Level 3	
Cost Estimating Guidelines:	Cost for the exterior envelope individual components (backup sytems and finish systems) should be model-based (as a composite object) at this LOD, referencing the parameters of specific, first class wall and finish system model objects, whose measurements (wall area) are quantifiable. Estimates for exterior envelope should be inclusive of the backup system, the finish system, supporting elements, miscellaneous elements, and access or other constructability concerns.	



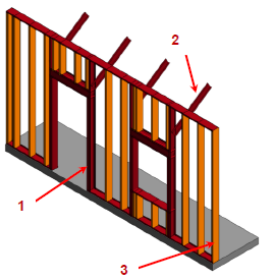
LOD 300

BIM Forum LOD Specification Reference

Element modeling to include:
• Single model element with specific overall thickness that accounts for veneer, structure, insulation, air space, and interior skin specified for the wall system. (Refer to LOD350 and LOD400 for individually modeled elements).
• Penetrations are modeled to nominal dimensions for major wall openings such as windows, doors, and large mechanical elements.

Real-World Examples – LOD 350

Primary Cost Element/Scope Item:	Interior Wall (Cold-Form Metal Framing & Gypsum Board)	
Uniformat Category:	C1010.10.20	
Omniclass Category:	21-03 10 10 10 20	
Example Use Case:	Design Development through Construction Documents	
Model Quantity Origin:	Model-Informed or Model-Based	
Model Quantity Source Geometry:	First-Class Generic Wall Object (Native Object)	
Estimating-based Model Parameters & Properties:	Wall Surface Area (SF) Length of Wall (LF) Height of Wall (LF)	
Identification-based Model Parameters & Properties:	Uniformat System Classification Element Type Name Parent Project Location (Functional Component)	Wall Construction Type Materials and Finishes - Material Name
Correlated Cost and Scope Items:	Wall Framing Wall Sheathing Supplementary Construction Items	Wall Support Systems Wall Finishes
Adjacent, Modeled Cost Elements	Interior Doors & Openings	
Supporting Information:	Any known information or stated project assumptions related to project such as interior construction assumptions such as wall type.	
Project Meta Data:	Omniclass Table 11 - Entity by Function Category Level 3	
Cost Estimating Guidelines:	Cost for the interior partition framing system should be model-based at this LOD, meaning it is based on parameters of a first class model object (in this case a wall object). The element should be modeled with separate, identifiable layers for the parts and pieces of the system, i.e. framing, sheathing, insulation, finishes, etc.	



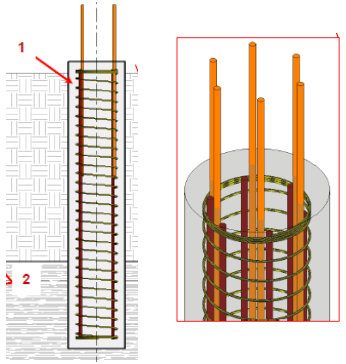
LOD 350

BIM Forum LOD Specification Reference

Element modeling to include:
- *Structure and finish layers of partition assembly modeled as separate elements.*
- *All penetrations are modeled at actual rough-opening dimensions.*
- *Major framing elements such as king studs, kickers, diagonal bracing, and headers are modeled.*

Real-World Examples – LOD 400

Primary Cost Element/Scope Item:	Caissons	
Uniformat Category:	A1020.20	
Omniclass Category:	21-01 10 20 20	
Example Use Case:	Shop Drawings or Fabrication Drawings	
Model Quantity Origin:	Model-Based	
Model Quantity Source Geometry:	First-Class Pier or Column Object (Native Object)	
Estimating-based Model Parameters & Properties:	Diameter of Pier (Inches) Length of Pier (LF) Top of Pier & Bottom of Pier Elevations	Pie Bell Sizes, If Applicable Reinforcing Steel
Identification-based Model Parameters & Properties:	Uniformat System Classification Element Type Name Parent Project Location (Functional Component)	Materials and Finishes - Material Name
Correlated Cost and Scope Items:	Pier Drilling Pier Casing, If Applicable (Permanent or Temp) Rebar/Reinforcing Steel	Concrete Delivery Method (Pump, Chute, Crane, etc.) Pier Accessories (Sleds, Bolster Chairs, etc.)
Adjacent, Modeled Cost Elements	Pier Caps Concrete Columns Foundation Walls	Other Foundation Elements
Supporting Information:	N/A	
Project Meta Data:	Omniclass Table 11 - Entity by Function Category	
Cost Estimating Guidelines:	Model objects for structural elements at this level are assumed to be fully detailed, virtual representations of the actual, in-place element.	



LOD 400

BIM Forum LOD Specification Reference

Element modeling to include:
- *Depth to bearing stratum*
- *Penetration into bearing stratum*
- *Locations of lap slices*
- *Rebar including hooks and lap splices*
- *Dowels*
- *Pier sled or pier wheel for side clear cover*
- *Pier bolster for bottom clear cover*
- *Pier modeling is developed to include all fabrication content that is part of the element*
- *Geotechnical regions are shown for context and not required to be modeled as part of this element at this LOD*
- *Peir sled, pier wheel, pier bolsters and other related items are not shown for clarity*

Case Studies

Real-World Applications of the BIMForum Estimating w/ BIM Guide Concepts

Application & Testing of Concepts

How achievable are the 5 characteristics of 5D using today's workflows and available technology?

What % of direct cost can be attributable to model-based, model-informed, and model-inferred practices?

How easy, or burdensome is it for model authors to ensure basic identify data and dimensional data is included in each model?

Integrated Estimating Case Study #1

Project Type: Office Building

Project State: Design Development

Gross Area: 45,000 SF

Levels: 2.5

Finish-out: Full Finish + Shell Space

Foundations: Shallow

Frame: Concrete

Envelope: Metal Panel, Stucco

Interiors: Full Finishes

Integrated Estimating Case Study #1

How achievable are the 5 characteristics of 5D using today's workflows and available technology?

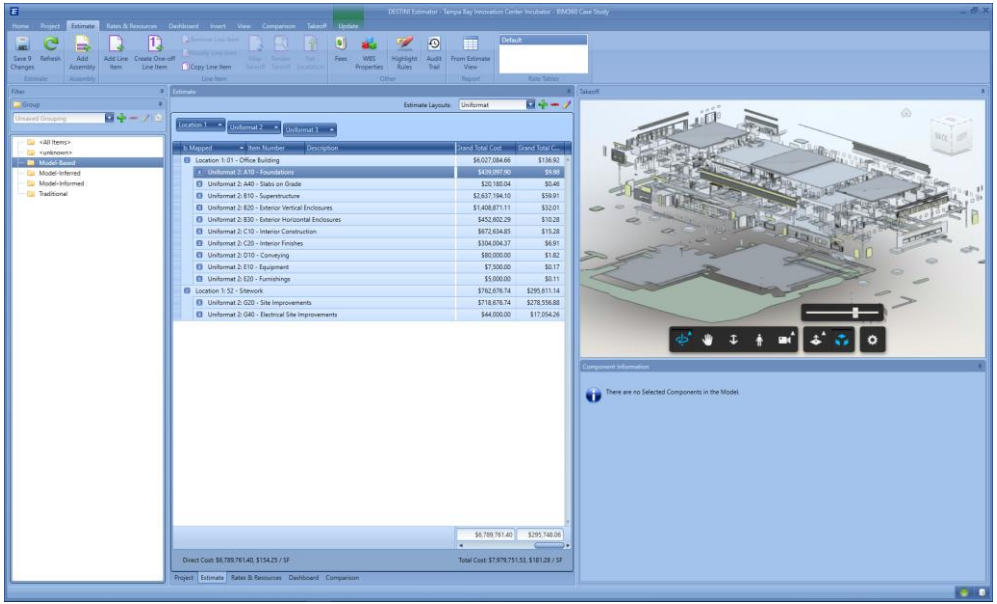
FIVE ESSENTIALS FOR 5D (INTEGRATED ESTIMATING)	Required for 5D	Used in This Project
Intentional Model Authoring	✓	X
Quantitative and Qualitative Model Data	✓	✓
Integrated Cost	✓	✓
Estimating Standard Applied	✓	✓
Automated	✓	X

Integrated Estimating Case Study #1

What % of direct cost can be attributable to model-based, model-informed, and model-inferred practices?

Model Quantity Origin	% of Cost	Total Direct Cost
Traditional	18%	$ 2,007,719.63
Model Based	61%	$ 6,790,009.84
Model Informed	2%	$ 202,270.58
Model Inferred	19%	$ 2,149,717.28
		$ 11,149,717.33

82% Attributable to BIMForum Concepts As Compared to 64% Using Traditional MBE Workflows

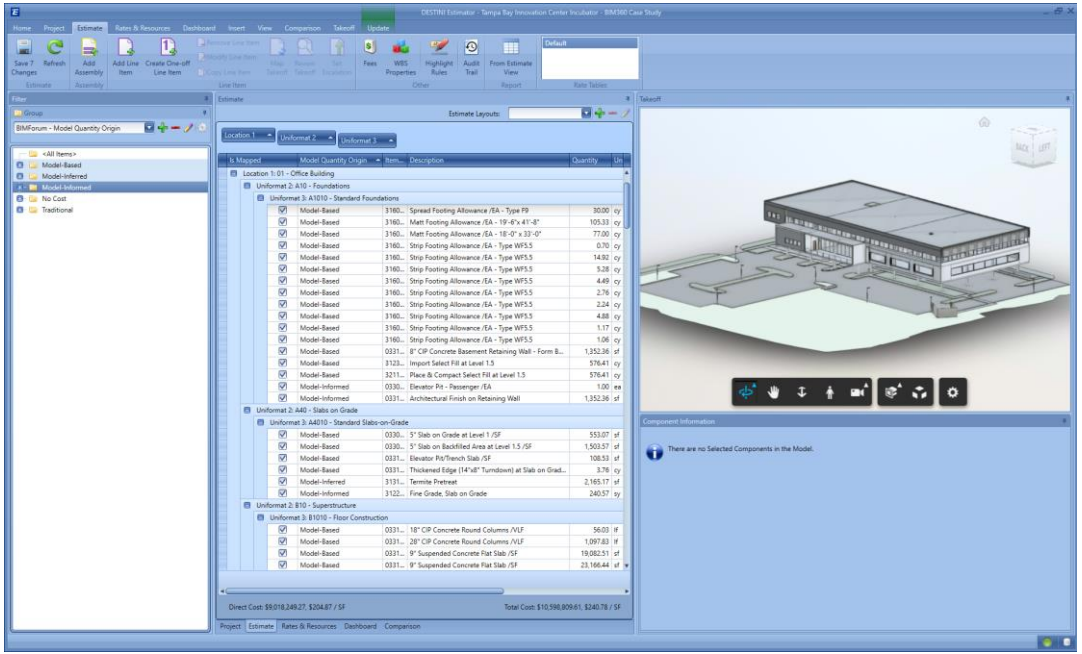


**Model image is exploded view of the model showing all objects mapped to cost items*

Integrated Estimating Case Study #1

How easy, or burdensome is it for model authors to ensure basic identify data and dimensional data is included in each model?

- Easy – No special preparation efforts by the design team
- BIMForum, model-based estimating concepts were applied as defined and intended
- Speed was not evaluated. However, using this workflow did not protract the process unnecessarily.



Integrated Estimating Case Study #2

Project Type: Nursing School

Project State: Design Development

Gross Area: 35,000 SF

Levels: 2

Finish-out: Full Finish

Foundations: Deep

Frame: Tilt-up & Joist/Joist Girders

Envelope: Tilt-up & Ribbon Windows

Interiors: Full Finishes

Integrated Estimating Case Study #2

How achievable are the 5 characteristics of 5D using today's workflows and available technology?

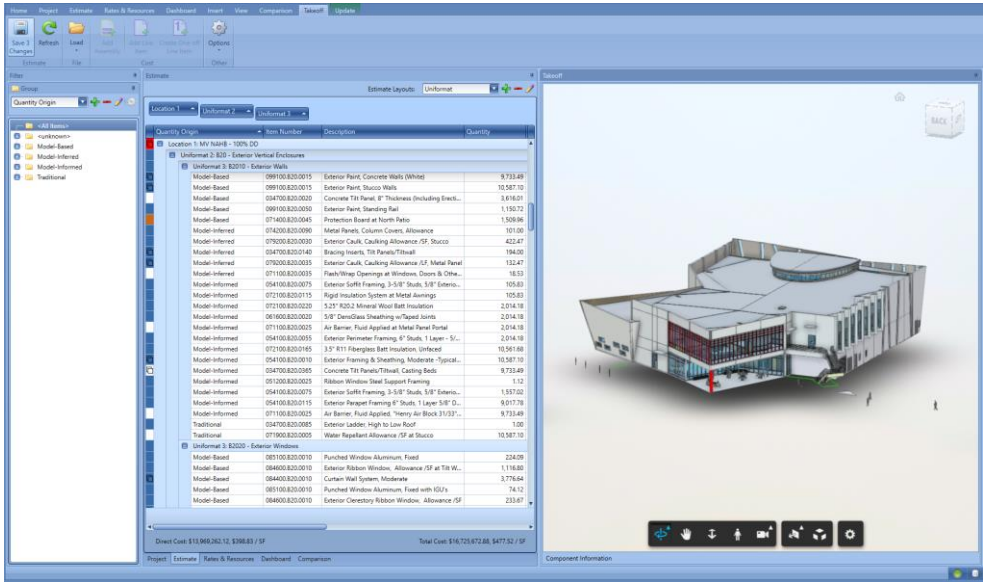
FIVE ESSENTIALS FOR 5D (INTEGRATED ESTIMATING)	Required for 5D	Used in This Project
Intentional Model Authoring	✓	X
Quantitative and Qualitative Model Data	✓	✓
Integrated Cost	✓	✓
Estimating Standard Applied	✓	✓
Automated	✓	X

Integrated Estimating Case Study #2

What % of direct cost can be attributable to model-based, model-informed, and model-inferred practices?

Model Quantity Origin	% of Cost	Total Direct Cost
Traditional	23%	$ 3,219,496.65
Model Based	26%	$ 3,598,411.28
Model Informed	8%	$ 1,140,128.76
Model Inferred	43%	$ 6,011,225.42
		$ 13,969,262.12

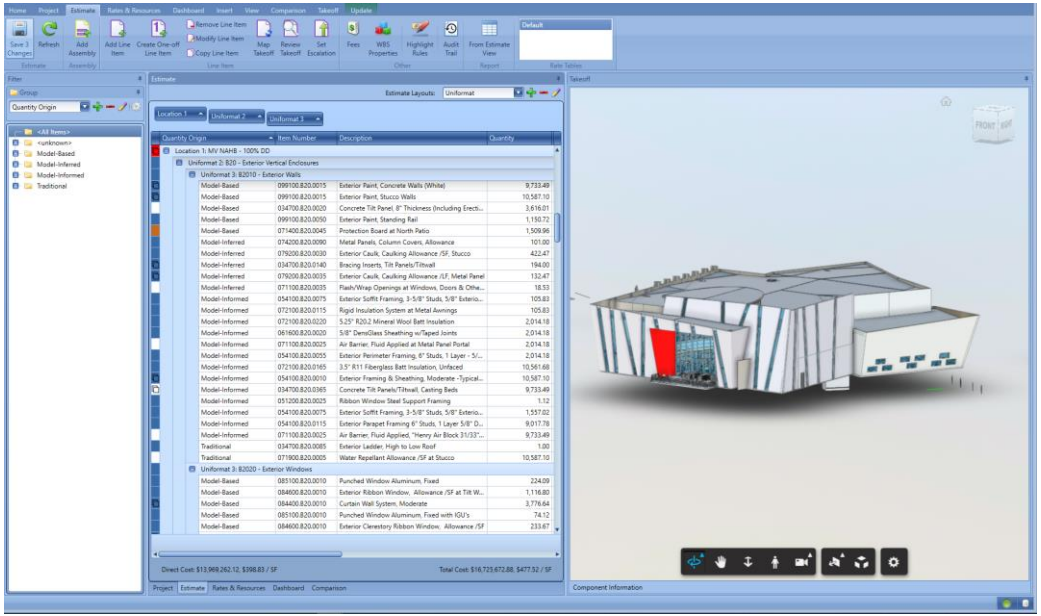
77% Total Attributable to Integrated Workflows



Integrated Estimating Case Study #2

How easy, or burdensome is it for model authors to ensure basic identify data and dimensional data is included in each model?

- Easy – No special preparation efforts by the design team
- BIMForum, model-based estimating concepts were applied as defined and intended
- Speed was not evaluated. However, using this workflow did not protract the process unnecessarily.



Integrated Estimating Case Study #3

Project Type: Residence Hall

Project State: Design Development

Gross Area: 53,590 SF

Levels: 3

Finish-out: Full Finish

Foundations: Deep

Frame: Structural Studs/HC Precast

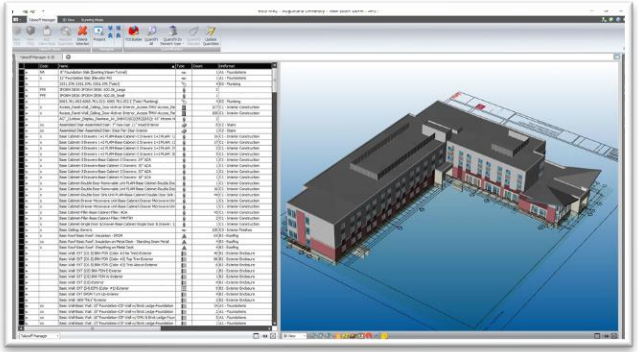
Envelope: Brick/EIFS

Interiors: 200 Beds

Mortenson

Integrated Estimating Case Study #3

How achievable are the 5 characteristics of 5D using today's workflows and available technology?



FIVE ESSENTIALS FOR 5D (INTEGRATED ESTIMATING)	Required for 5D	Used in This Project
Intentional Model Authoring	✓	X
Quantitative and Qualitative Model Data	✓	✓
Integrated Cost	✓	✓
Estimating Standard Applied	✓	✓
Automated	✓	✓

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Integrated Estimating Case Study #3

What % of direct cost can be attributable to model-based, model-informed, and model-inferred practices?

Traditional	Model Based	Model Informed	Model Inferred
$2,125,338	$5,870,061	$1,417,711	$3,789,044
16%	44%	11%	29%
Misc Metals	Structure	Rebar	MEP
Site Prep	Enclosure/Roofing	Brick/EIFS/VB	Misc Items
Site Improvements	Interior Construction / Finishes		
Site Utilities			
Rough Carpentry	Stairs		

Mortenson

Case Study Summaries

Estimating Quantities (% of Cost) Derived from Model Geometry

	Traditional	Model Based
Case Study 1	18%	82%
Case Study 2	23%	77%
Case Study 3	16%	84%
Average	**19%**	**81%**

INTEGRATED ESTIMATING

“*THE WHY*”

BIM FORUM

Integrated Estimating

It is not, first generation model-based estimating from the 2000's

What is the Value?

- Standardization
- Consistency & Expectations
- Opportunity for Automation &
- Reduction in Waste

BIM FORUM

Standard of Care

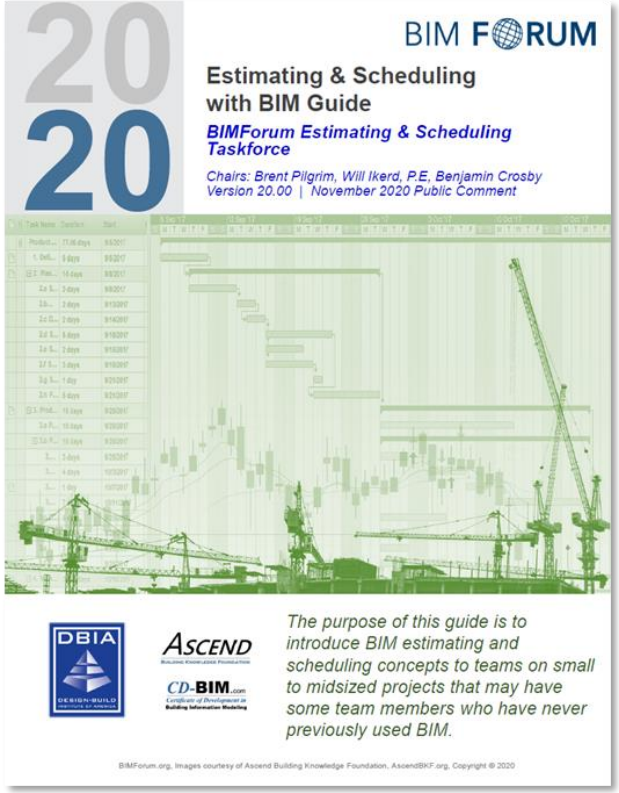
Professional Responsibility

The introduction or use of a model does not abdicate the estimating professional's responsibility and standard of care in the process.

Resources

New, Updated Version Coming Soon!

https://bimforum.org/



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Contact Information

Want more info?
Give me a shout!

brentpilgrim@beckgroup.com