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The Foundation for The Gator Nation

Evaluation of the Cost Impact of 2015 IBC Prescriptive Code Changes

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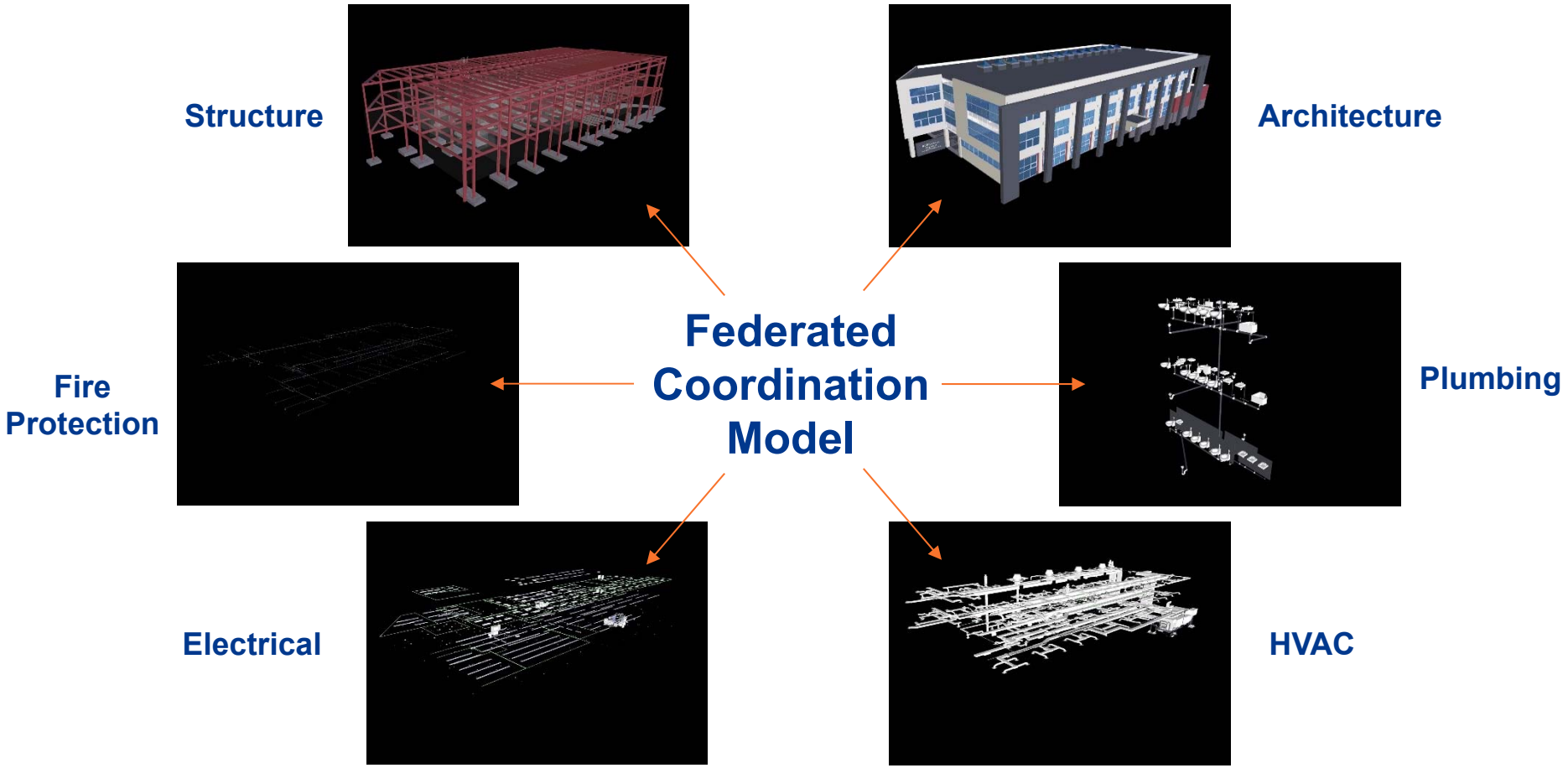
BIM: What is Building Information Modeling?

1. An intelligent 3D model with embedded **information** and specifications for all the material and system selections of a project, as well as their associated properties.
2. Virtual collaboration resource which aids in the decision making and information exchange process throughout the lifecycle of a building from conception to facilities management.

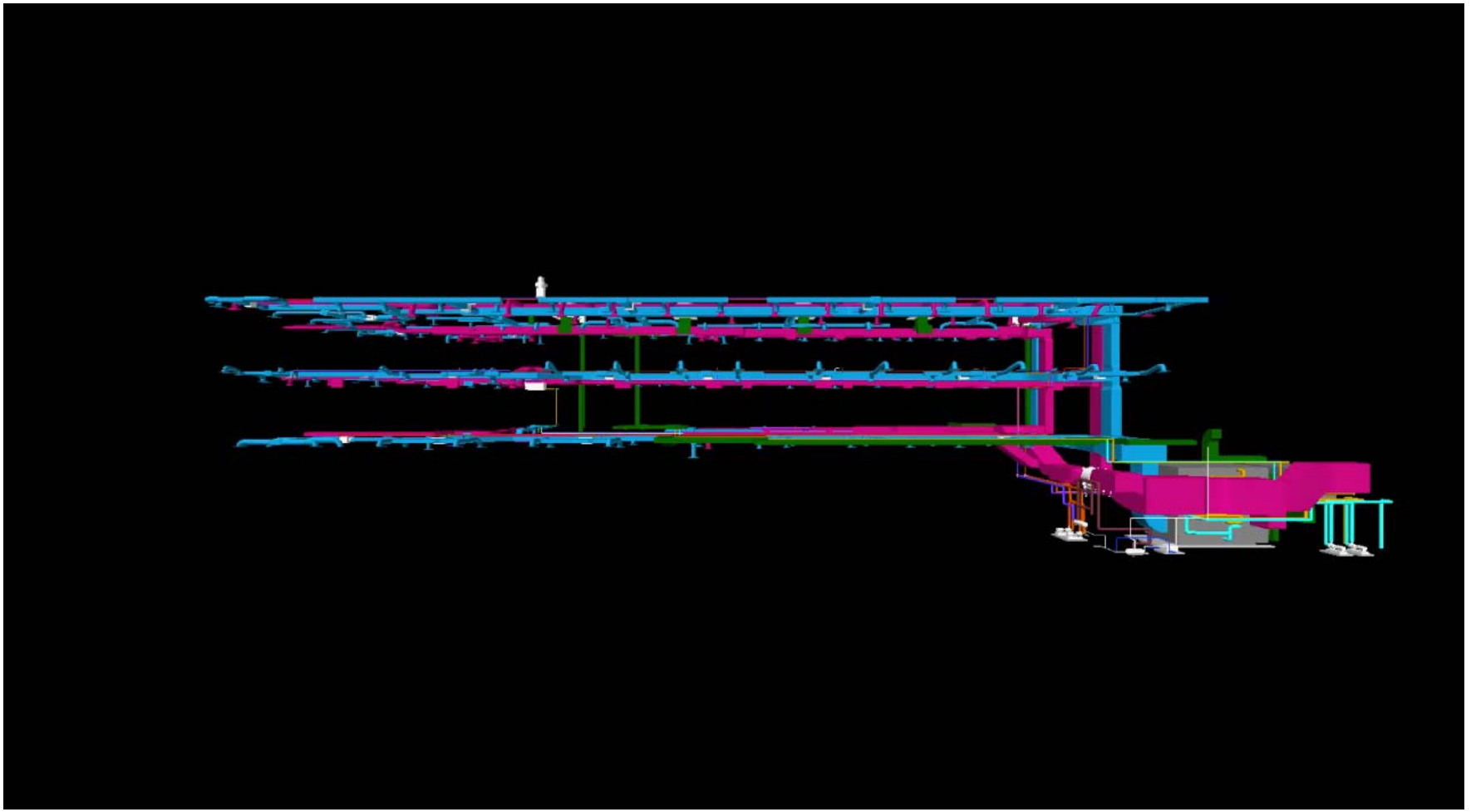
BIM: Benefits of BIM?

1. Enhanced collaboration capabilities among all members of a project team.
2. Coordination of all building systems and the testing of design alternatives prior to construction.
3. Ability to tie model to schedule for visualization and quality assurance purposes. (4D BIM)
4. Greater access to live data regarding building material quantities for more accurate cost estimates. (5D BIM)
5. Creation of more accurate and thorough as-built documents.

BIM: Collaborative Platform



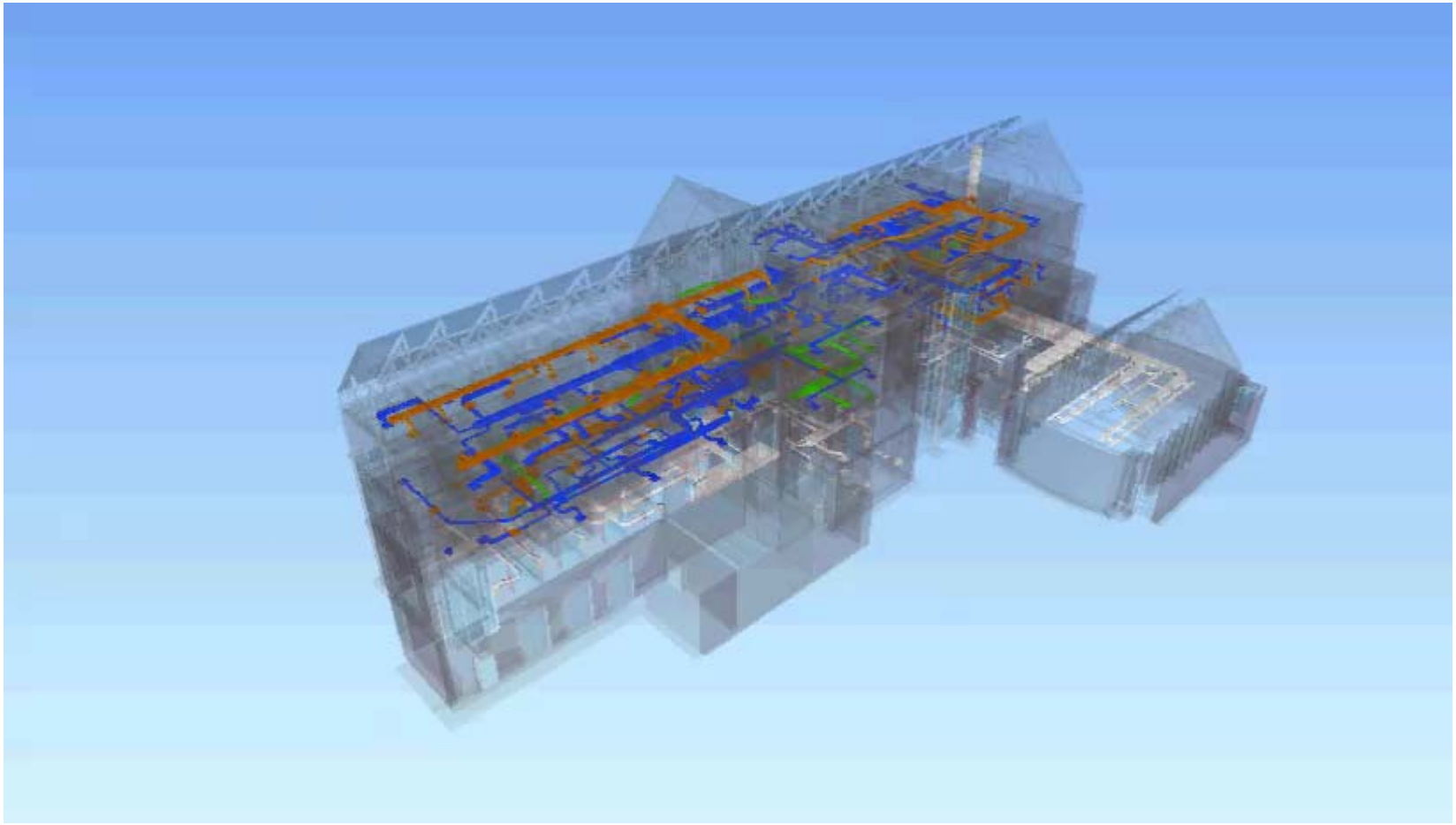
BIM: HVAC Model of Rinker Hall



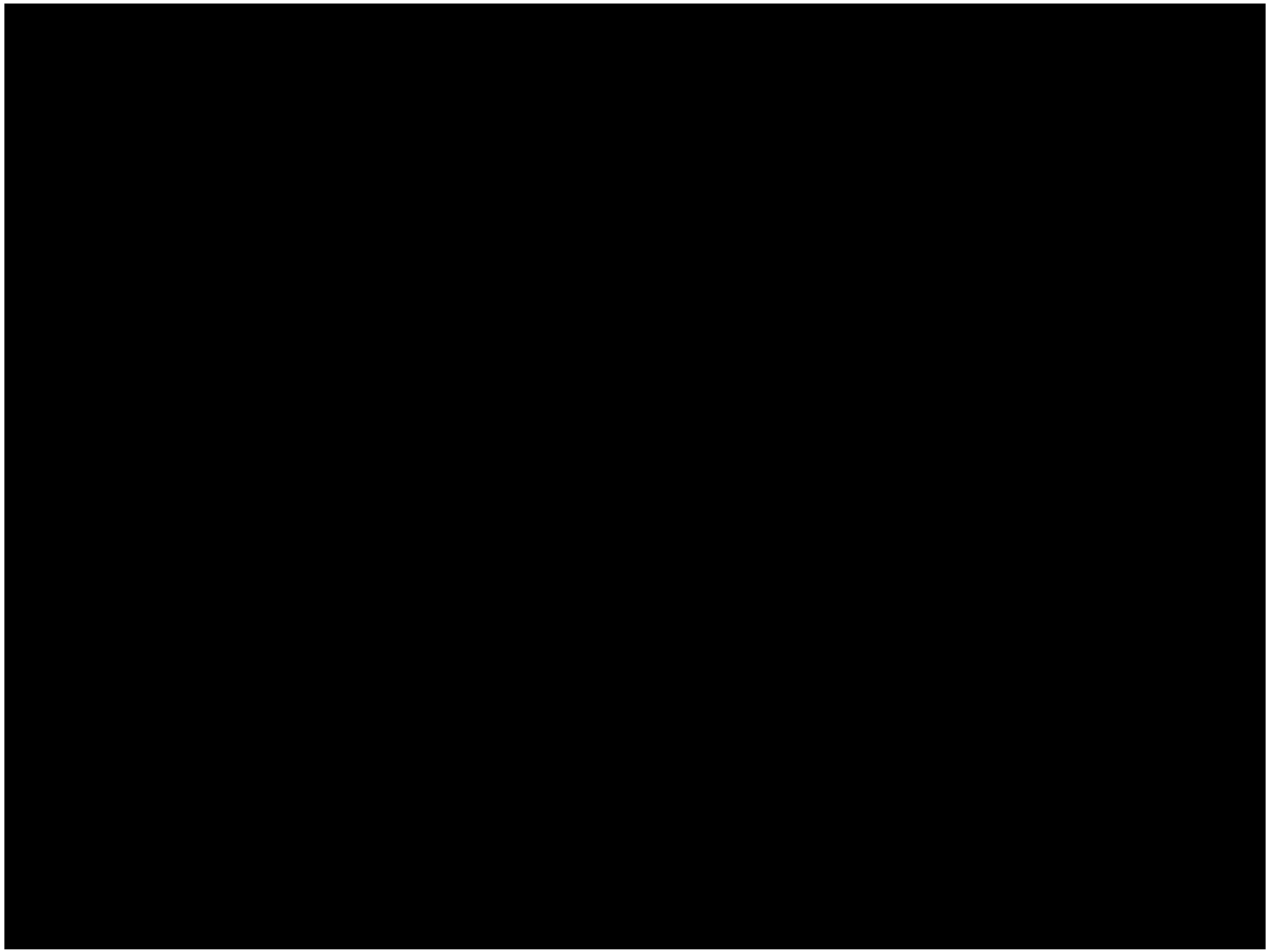
BIM: Building Information Modeling

- Federated Multi-Disciplinary Model

BIM: Embedded MEP Model of Gerson Hall

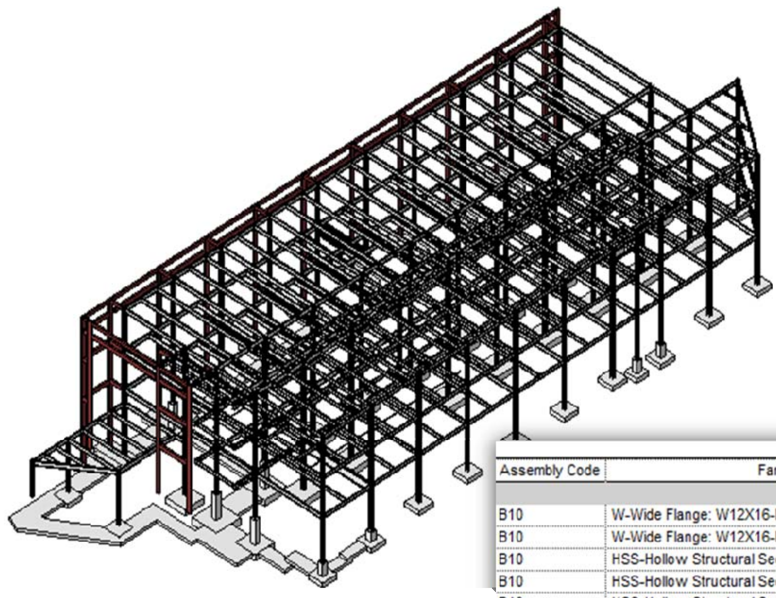


BIM: Ramp Construction Simulation



BIM: Quantity Surveys

- Material quantity data built into model for instantaneous updates as the project changes.



F7-84"x84"x18"					
A101010	Footing-Rectangular	F7-84"x84"x18"	6' - 0"	6' - 0"	1
A101010	Footing-Rectangular	F7-84"x84"x18"	6' - 0"	6' - 0"	1
A101010	Footing-Rectangular	F7-84"x84"x18"	6' - 0"	6' - 0"	1
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A101010	Footing-Rectangular	F7-84"x84"x18"	6' - 0"	6' - 0"	1
A101010	Footing-Rectangular	F7-84"x84"x18"	6' - 0"	6' - 0"	1
F7-84"x84"x18": 10					10

Structural Steel

Assembly Code	Family and Type	Count	Length	Cost
B10	W-Wide Flange: W12X16-Rinker	1	12' - 11"	
B10	W-Wide Flange: W12X16-Rinker	1	12' - 11"	
B10	HSS-Hollow Structural Section: HSS12X8X.3125-RINKER	1	5' - 0"	10.00
B10	HSS-Hollow Structural Section: HSS12X8X.3125-RINKER	1	18' - 9 5/16"	10.00
B10	HSS-Hollow Structural Section: HSS12X8X.3125-RINKER	1	18' - 8"	10.00
B10	HSS-Hollow Structural Section: HSS12X8X.3125-RINKER	1	18' - 8"	10.00
B10	HSS-Hollow Structural Section: HSS12X8X.3125-RINKER	1	18' - 8"	10.00
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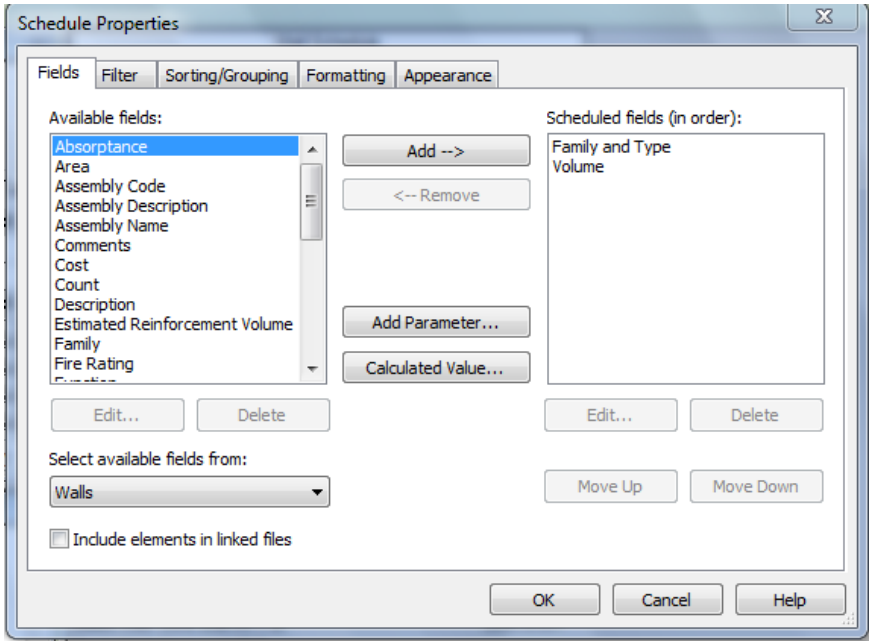
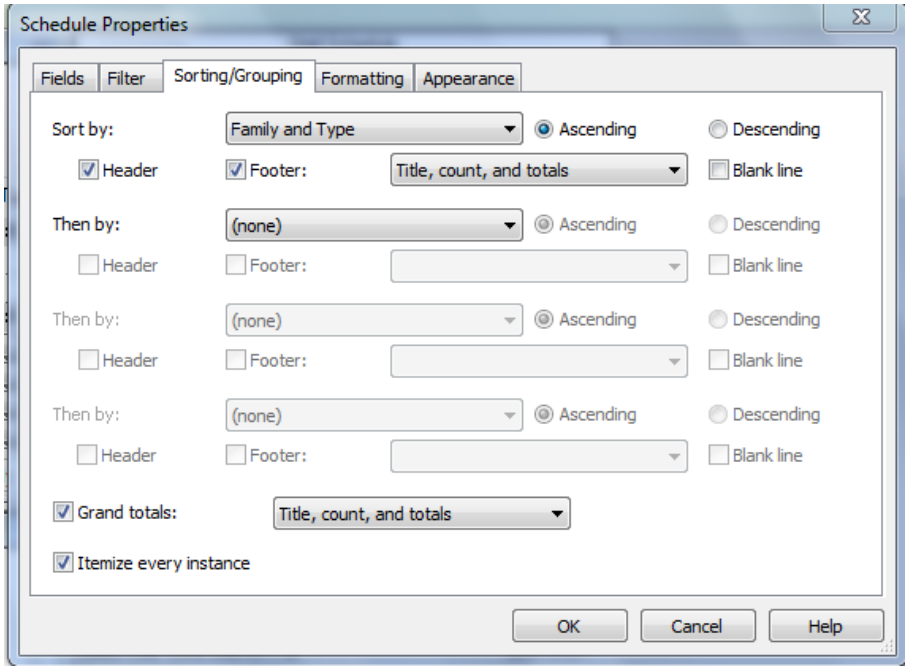
B10	HSS-Hollow Structural Section: HSS12X8X.3125-RINKER	1	18' - 8"	10.00
B10	HSS-Hollow Structural Section: HSS12X8X.3125-RINKER	1	9' - 10"	10.00
B10	HSS-Hollow Structural Section: HSS12X8X.3125-RINKER	1	11' - 7"	10.00
B10	HSS-Hollow Structural Section: HSS12X8X.3125-RINKER	1	26' - 11"	10.00

BIM: Quantity Surveys

- A wide range of data fields within the BIM environment can be accessed and exported to show the specific information needed.



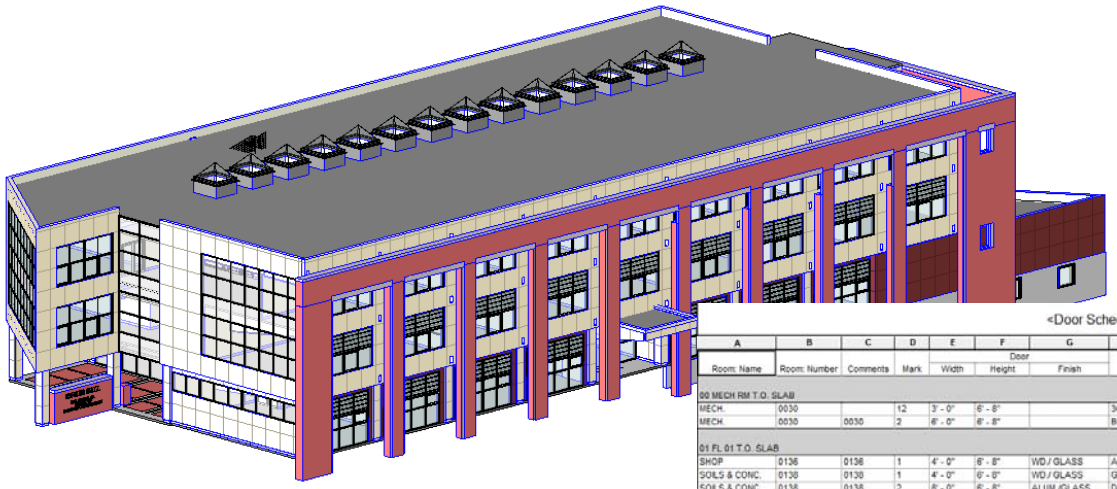


BIM: Quantity Surveys

- Quantities can be exported from the model of any system and used to calculate cost.

<Room Schedule>

A	B	C	D	E	F	G	H	I
Room Nu	Room Name	Area	Floor Finish	Base Finish	Wall Finish	Ceiling Finish	Ceiling Height	Comments
0030	MECH.	1420 SF						
0030A	ELEC. ROOM	251 SF						
0106	MEDIUM CLASSROOM	908 SF						
0110	LARGE CLASSROOM	1750 SF						
0110A	ELEC.	65 SF						
0115	STUDENT LOUNGE	471 SF						
0125	M.E.P STUDIO	1611 SF						
0134	SHOWER	75 SF						
0136	SHOP	274 SF						
0138	SOILS & CONC. LAB	706 SF						
0140	STRUCTURES STUDIO	1292 SF						
0140A	STORAGE	418 SF						
0141	INTERVIEW	100 SF						
0143	INTERVIEW	100 SF						
0145	MEN	224 SF						
0146	WOMEN	253 SF						
0146A	MECH. ROOM	66 SF						
0201	BIM LAB	845 SF						



<Door Schedule>

A	B	C	D	E	F	G	H	I	J	K	L	M
				Door				Frame	Fire			
Room: Name	Room: Number	Comments	Mark	Width	Height	Finish	Type	Type	Rating	Hardware	Cost	Level
00 MECH RM T.O. SLAB												
MECH.	0030		12	3' - 0"	6' - 8"		36" x 80"					00 MECH RM T.O.
MECH.	0030	0030	2	6' - 0"	8' - 8"		B		45			00 MECH RM T.O.
01 FL 01 T.O. SLAB												
SHOP	0136	0136	1	4' - 0"	8' - 8"	WD./ GLASS	A	H.M./PTD.	60 min	9		01 FL 01 T.O. SLA
SOILS & CONC.	0138	0138	1	4' - 0"	6' - 8"	WD./ GLASS	G	H.M./PTD.		4		01 FL 01 T.O. SLA
SOILS & CONC.	0138	0138	2	8' - 0"	6' - 8"	ALUM./GLASS	D-Doule	ALUM.		4		01 FL 01 T.O. SLA
STORAGE	0140A	140	2	8' - 0"	6' - 8"	ALUM./GLASS	D-Doule	ALUM.		6		01 FL 01 T.O. SLA
INTERVIEW	0141	141	1	3' - 0"	6' - 8"	ALUM./GLASS	C	ALUM.		5		01 FL 01 T.O. SLA
CORRIDOR	C199D	143	1	3' - 0"	6' - 8"	ALUM./GLASS	C	ALUM.		5		01 FL 01 T.O. SLA
MECH. ROOM	0146A	0146A	1	3' - 0"	6' - 8"	H.M./PTD.	E-FIRE RATED	H.M./PTD.	45 min	4		01 FL 01 T.O. SLA
CORRIDOR	C199D	C196A	4	3' - 0"	6' - 9 11/16"	ALUM./GLASS	D-Left	ALUM.		1		01 FL 01 T.O. SLA
CORRIDOR	C199D	C196A	5	6' - 1"	6' - 9 11/16"	ALUM./GLASS	D-Doule	ALUM.		3		01 FL 01 T.O. SLA
CORRIDOR	C199D	C196A	6	3' - 0"	6' - 9 11/16"	ALUM./GLASS	D-Right	ALUM.		2		01 FL 01 T.O. SLA
MEDIUM CLASS	0106	C199B	1	6' - 0"	8' - 8"	WD./ GLASS	K	H.M./PTD.		10		01 FL 01 T.O. SLA
LARGE CLASS	0110	C199B	2	6' - 0"	8' - 8"	WD./ GLASS	K	H.M./PTD.		10		01 FL 01 T.O. SLA
ELEC.	0110A	C199B	3	6' - 0"	6' - 8"	H.M./PTD.	B	H.M./PTD.	45	21		01 FL 01 T.O. SLA
ELEC.	0110A	C199B	4	6' - 0"	6' - 8"	H.M./PTD.	B	H.M./PTD.	45	12		01 FL 01 T.O. SLA
LARGE CLASS	0110	C199C	1	3' - 0"	8' - 8"	H.M./PTD.	A - 6'8x3'0	H.M./PTD.	45 min	13		01 FL 01 T.O. SLA
WOMEN	0146	C199D	1	3' - 0"	6' - 8"	H.M./PTD.	E	H.M./PTD.		14		01 FL 01 T.O. SLA
MEN	0145	C199D	2	3' - 0"	6' - 8"	H.M./PTD.	E	H.M./PTD.		14		01 FL 01 T.O. SLA
STRUCTURES S	0140	C199D	3	3' - 0"	6' - 8"	WD./ GLASS	G- 6'8x3'0	H.M./PTD.		15		01 FL 01 T.O. SLA
STUDENT LOUN	0115	C199D	4	3' - 0"	6' - 8"	WD./ GLASS	G- 6'8x3'0	H.M./PTD.		15		01 FL 01 T.O. SLA
M.E.P STUDIO	0125	C199D	5	3' - 0"	6' - 8"	WD./ GLASS	G- 6'8x3'0	H.M./PTD.		15		01 FL 01 T.O. SLA

ISSUES

- The proposed research assesses the cost impact of the 2015 International Building Code changes to the 2012 International Building Code that are prescriptive in nature and that have the potential of adding cost to construction.

STATEMENT OF WORK

- **1. Review/analyze the 2015 I-Code changes to the 2012 I-Code to identity those code changes/provisions that are prescriptive in nature and have the potential of adding cost to construction.**
  - The listed consultants will participate in this process to help the research team with the specifics of the design changes.

STATEMENT OF WORK

- **2. Review available literature/studies on the subject of estimating the costs of the code changes to the 2012 I-Codes including the ICC code proceedings/ code hearings. Information gathered from this task will be used to document potential costs for the code changes as identified in (1) and as applicable.**
  - The research team will conduct an extensive literature review on cost estimates due to Code changes.

STATEMENT OF WORK

- **3. Estimating the additional construction cost of those provisions that are not covered under (2) using good engineering judgment and feedback from general contractors and consulting engineers.**
  - The listed consultants and general contractors will help the research team with the cost estimates for these changes.

STATEMENT OF WORK

- **4. Use a standard set of baseline residential and commercial building designs for use to determine the cost impact of code changes.**
  - A recent study for the USDOE on the cost impact of the ASHRAE Standard 90-1-2013 changes used: 1) a small office building; 2) a standalone retail building; 3) a primary school; 4) a small hotel; and 5) a mid-rise apartment building as cost reference commercial buildings, since these type of buildings represented over 74% of new construction by floor area.

STATEMENT OF WORK

- Another recent study by the NAHB on the estimated cost of the 20152 IRC changes used one-story and two-story houses on slab and basement foundations, since these type of houses represented approximately 85% of the last decade's new single-family construction. The houses were also deemed to have a gas furnace with central (electric) air conditioner in order to be representative of the majority of new US houses being built. Table 1 shows the adaptation of the NAHB Reference House Parameters proposed for this study.

Reference House	1	2
Square Feet	2,607	2,607
Foundation	Slab	Slab
Number of Stories	1	2
Number of Bedrooms	3	4
Number of Bathrooms	2	2.5
Garage, attached	2-car	2-car
Heat, Gas Furnace	Yes	Yes
Cooling, (Electric) central air	Yes	Yes
Hot Water, Gas 50 gallon tank	Yes	Yes
9 ft. Ceilings, 1st	Yes	Yes
8 ft. Ceilings, 2nd	n/a	n/a
Energy Star appliances	Yes	Yes
Laundry Room	Yes - Mudroom	Yes
Furnace Location	Attic	Attic
Water Heater Location	Interior	Garage
Window SF/% gross wall	360/18%	315/12%
Cladding*	Stucco, 4 sides	Stucco, 4 sides

*Changed from Brick in NAHB version to Stucco

For the purposes of this study the five commercial buildings and a one-story and a 2-story house on slab foundation will be used as the initial prototypes.

STATEMENT OF WORK

- **5. Building information modeling (BIM) will be used to develop digital sets of the permit-ready residential (2 houses) and five commercial/institutional buildings models.**

STATEMENT OF WORK

- **6. Use BIM tools to produce for each of the prototype buildings for each of the 2012 and 2015 I-Codes:**
  - Schedule of Material Quantities (exportable to MS Excel)
  - Architectural 3D view and walk-through
  - Isolated Structural 3D view and walk-through
  - Isolated MEP/MEPF 3D view and walk-through

STATEMENT OF WORK

- **7. Use the information in 6(a) and cost databases to produce cost estimates and extract cost impact of changes on the reference houses and commercial buildings.**
  - Sources of cost data will include R.S. Means Cost Data; distributors' or big box retailers' websites, and building contractors.
  - Cost estimates of the code changes that do not directly apply to the selected reference houses will be listed separately and can be added or subtracted from the aggregated costs for these reference houses.

DELIVERABLES

- A report providing technical information on the problem background, results and cost implications of the prescriptive Code changes submitted by 15 December 2016.
- An analysis of individual code changes will also be provided in the Appendix.

Cost Impact Analysis 2015 IBC & IRC

- Preliminary finding is that were very few prescriptive cost impact changes and several were related to seismic requirements

2015 IECC Changes Cost Impact Analysis
Disclaimer - Probable Construction Costs Opinions

Assumptions

- This Estimate is not a guarantee of Final Bid Cost or of Final Project Cost.
- This is an Opinion of Probable Cost of Mechanical, Electrical, and Piping (MEP) Systems for the proposed buildings.
- The estimate was compiled using documents provided by various sources.
- The estimate is representative of average unit pricing and labor from historical job costs of similar type, cost and labor data from Mechanical Contractors Association of America (MCAA), CostWorks 2015 Qtr. 2 (Change Date and Qtr) by R.S. Means Company Inc, National Electrical Contractors Association (NECA) and Sheet Metal Estimating by Wendes.
- The subcontractor unit rates include the subcontractor's overhead and profit, unless otherwise stated.
- The mark-ups included in the unit prices cover the cost of field overhead, home office overhead and profit, and range from 15% to 25% of the costs of a particular item.
- Since we have no control over the cost of labor, material and equipment, or the contractor's method of carrying out the work and determining the price, or over competitive bidding or market conditions, this opinion of probable construction cost provided is made on the basis of experience and qualifications. This opinion represents our best judgment as professional construction consultants with the Construction Industry. However, we cannot and do not guarantee that proposals, bids or the construction cost will not vary from the opinions of probable cost in this estimate.

2015 IECC Changes Cost Impact Analysis
Disclaimer - Probable Construction Costs Opinions

General Assumptions:

- "Allowances" are considered to be an allotted sum of money for a particular system or scope of work for which sufficient detail is not available to determine a definitive cost.
- These cost allowances are included to project a final cost to include labor, material, equipment and any subcontractor costs.
- The owner receives the savings for any amount under the allowance and is at risk for any amount over the allowance.
- The estimate is in today's dollars, and has been adjusted to the local area.
- This estimate does not include any fees or permits.
- This estimate is intended to reflect construction costs only.
- This estimate is intended to reflect normal construction schedules only.
- Variations in material costs, labor efficiencies, wage rates, union practices, and bid climate will effect final costs.
- Workers will report to the actual job site.
- Materials delivered to the actual job site will need to be scheduled.
- No premium or overtime has been included.
- No General Construction costs have been included.
- All utilities have sufficient capacity for the added loads.

Excerpts – 2015 IBC Structural Changes Cost Impact Analysis

APPENDIX I - Table 9. IBC Structural Changes Cost Impact		
CODE CHANGE #	2015 IBC STRUCTURAL CHANGE SUMMARY	ESTIMATED AMOUNT*
S24-12	**1505.9 (NEW) and Chapter 35 (NEW).** Added standard for external fire design for vegetative roofs.	
S102-12	**Sections 202 (New), 1403.7, 1603.1.7, 1612.4, 1612.5, G103.7, G301.2, G401.2, IPC 309.3 and IMC301.16.1** Defined the Coastal A Zone not just by the presence of specific wave conditions, but whether the Limit of Moderate Wave Action has been delineated, or the coastal A zone is otherwise designated by the AHJ.	
S300-12	**2407.1 and 2407.1.1.** Clarification of glazing used in handrails and design factor for loads	
S308-12	**Section 2509.3.** Removed requirement for supplemental framing in	

*For prescriptive Code changes only.

Excerpts – 2015 IRC Structural Changes Cost Impact Analysis

APPENDIX I - Table 9. IRC Structural Changes Cost Impact		
CODE CHANGE #	**2015 IRC STRUCTURAL CHANGE SUMMARY**	**ESTIMATED AMOUNT***
RB224-13	**Table R404.1.1(1)** Using the allowable flexural tensile stresses in Table 2.2.3.2, the values shown in Table R404.1.1 (1) cannot be justified. The proposed change is to make the values shown in Table R404.1.1 (1) compliant with the prescriptive and analytical requirements of TMS 402/ACI 530/ASCE 5. With this proposal the IRC table for plain masonry wall will meet the requirements found in the referenced standard.	Minimal increase
RB225-13	**Tables R404.1.1(1), R404.1.1(2), R404.1.1(3), R404.1.1(4) and R404.1.2(2) thru R404.1.2(8)**. Use prohibited for soil classifications not shown. Wall design is a function of a maximum of 60 psf. hydraulic pressure. Soils with CH, MH, OL, OH and Pt have higher hydraulic pressures and therefore are not allowed for backfilling purposes unless the wall is designed by a registered design professional.	
RB226-13	**Section R404.1.4.1.** Changed so that the requirements for masonry and concrete foundation walls follow the same format. No. 3 bars are changed to No. 4 bars for seismic reinforcement in SDC D0, D1 and D2. TMS 402/ACI 530/ASCE 5. The change in bar size and spacing will bring the minimum requirements of the referenced standard into the IRC.	Slight increase
RB287-13	**Sections R602.7 and R602.7.1 and Tables R602.7.1 and R602.7.1(2) (NEW).** Specified king stud requirements for wall openings spanned by single member headers over the span of wall openings.	~$100
RB293-13	**Table R602.10.3(1).** Provides a method to determine the bracing where the braced wall line spacing is different on each side.	~$100
RB297-13	Table R602.10.3(3). Clarification of what to do where a building is greater than 50 feet in length.	Minimal increase

***For prescriptive Code changes only.**

QUESTIONS ?