UF UNIVERSITY of FLORIDA

The Foundation for The Gator Nation

2015 IECC Prescriptive Code Changes Cost Impact Analysis

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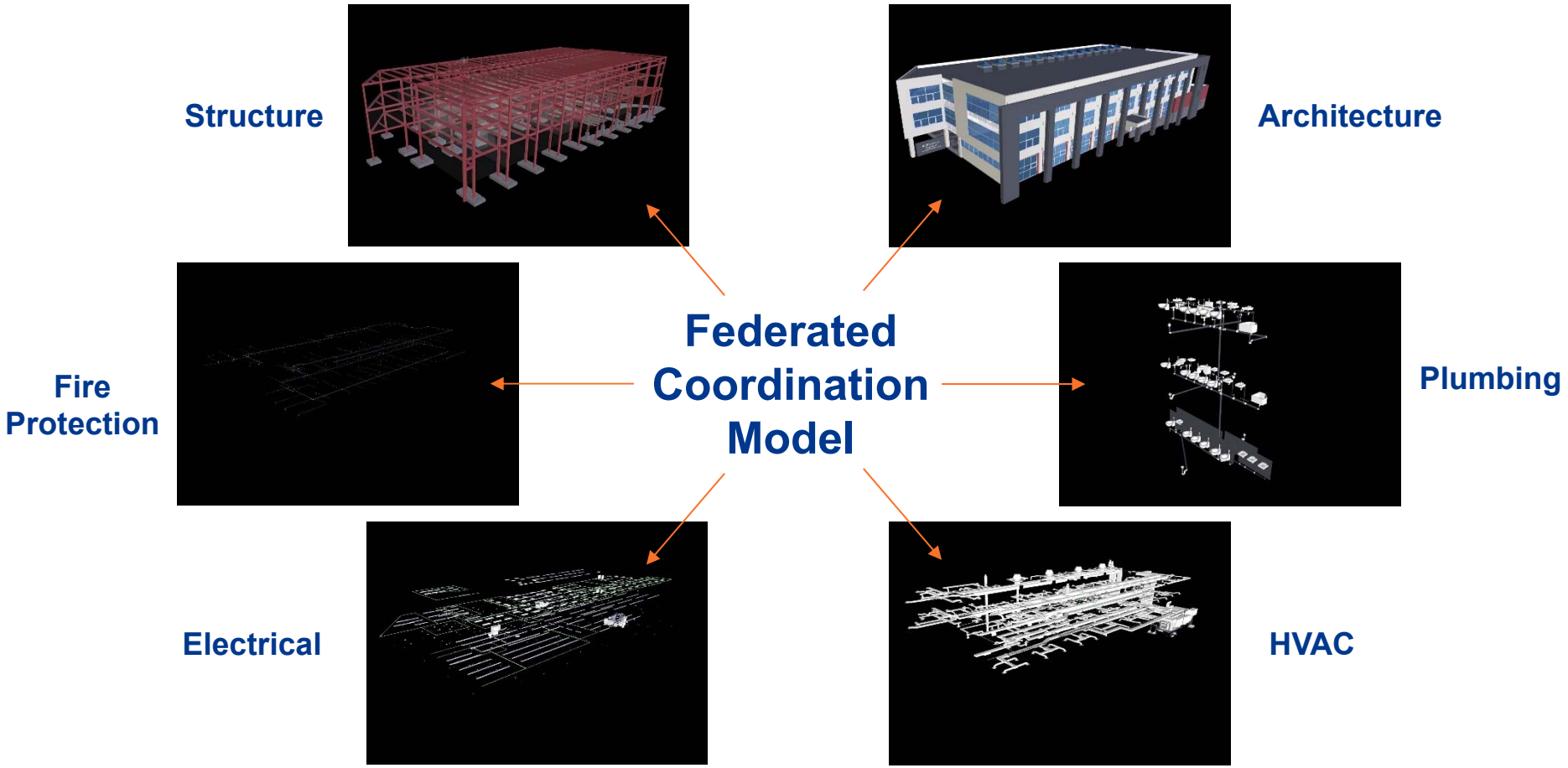
BIM: What is Building Information Modeling?

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.

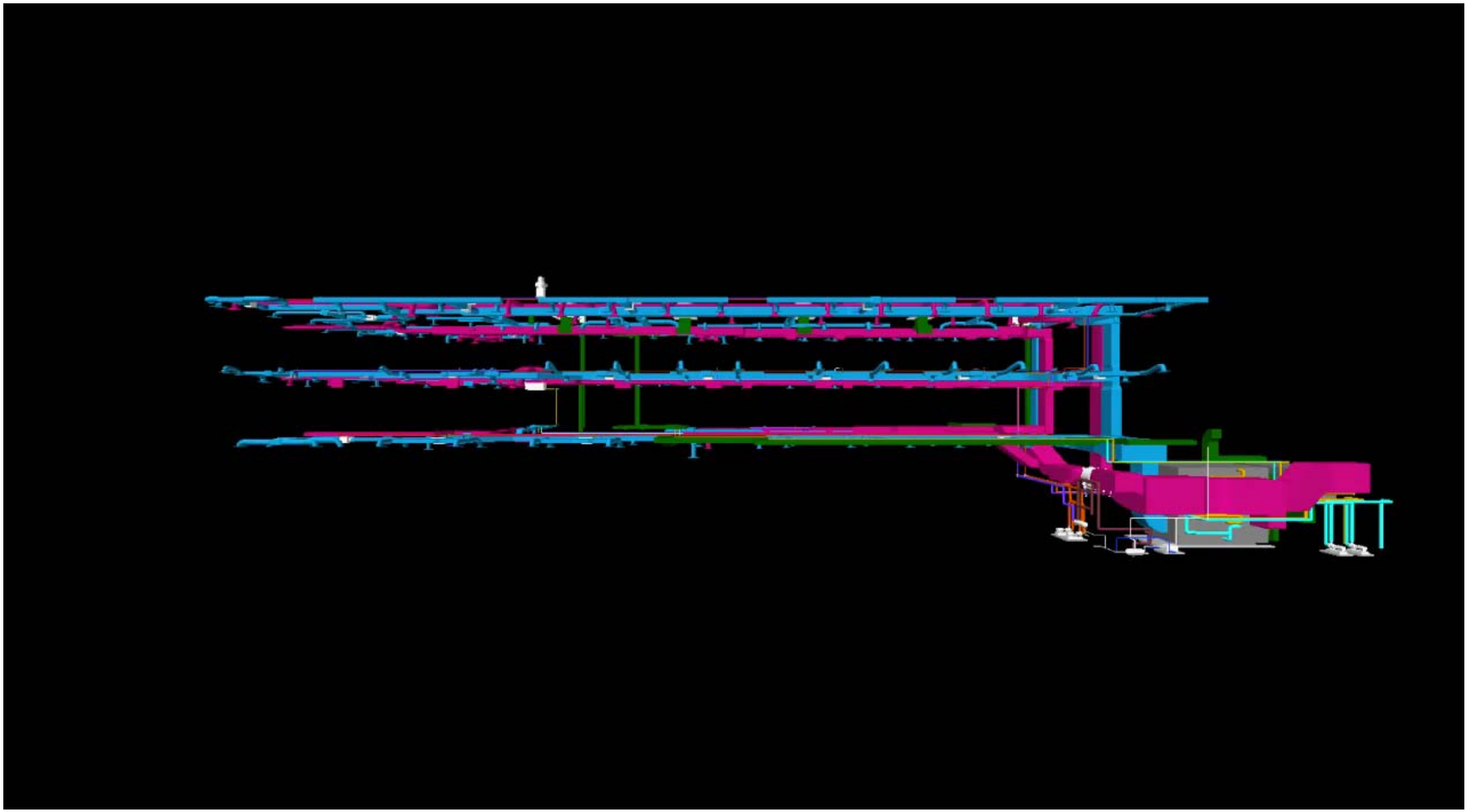
BIM: Benefits of BIM?

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



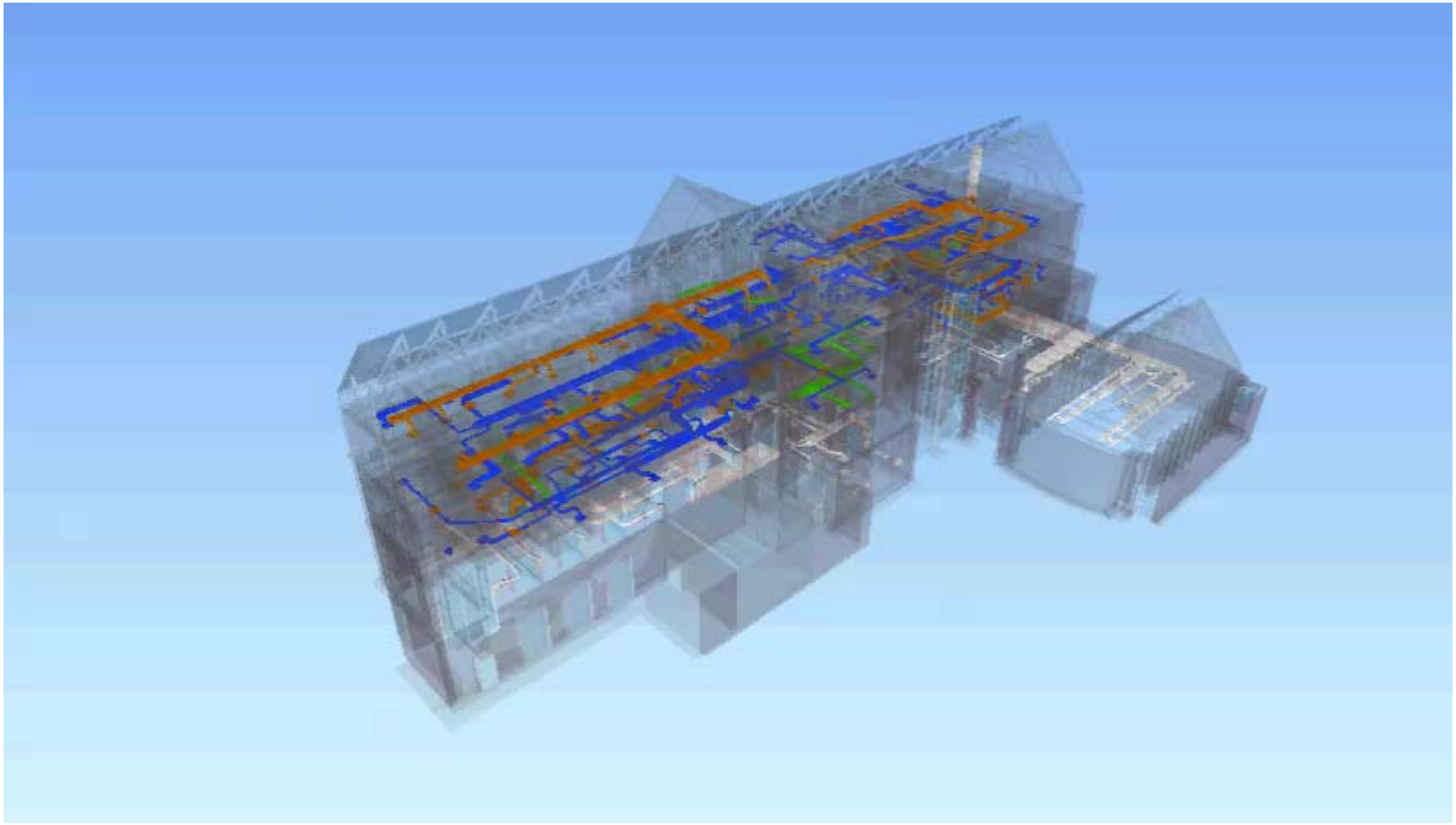
BIM: HVAC Model of Rinker Hall



BIM: Building Information Modeling

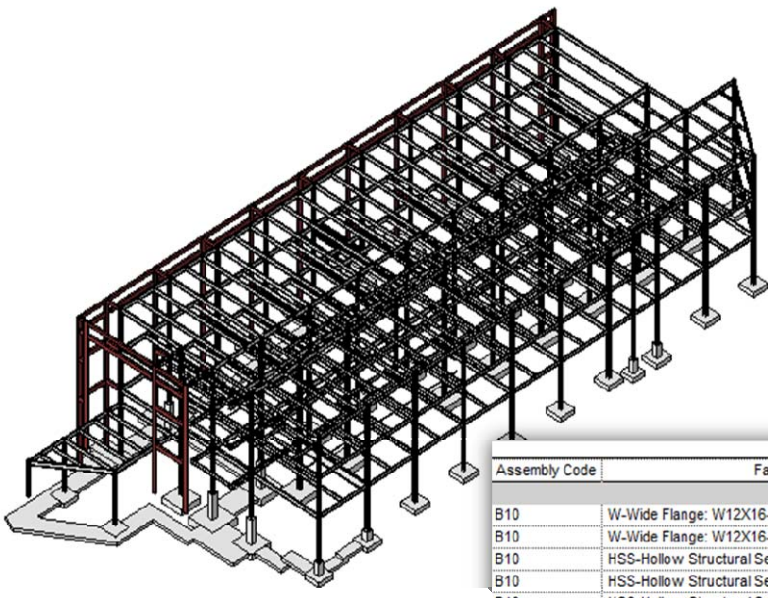
- Federated Multi-Disciplinary Model

BIM: Embedded MEP Model of Gerson Hall



BIM: 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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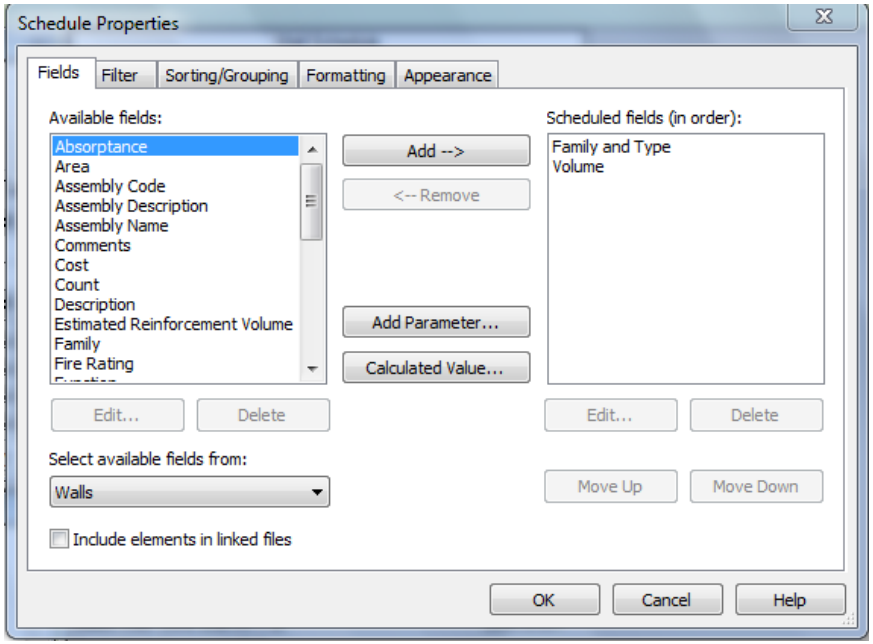
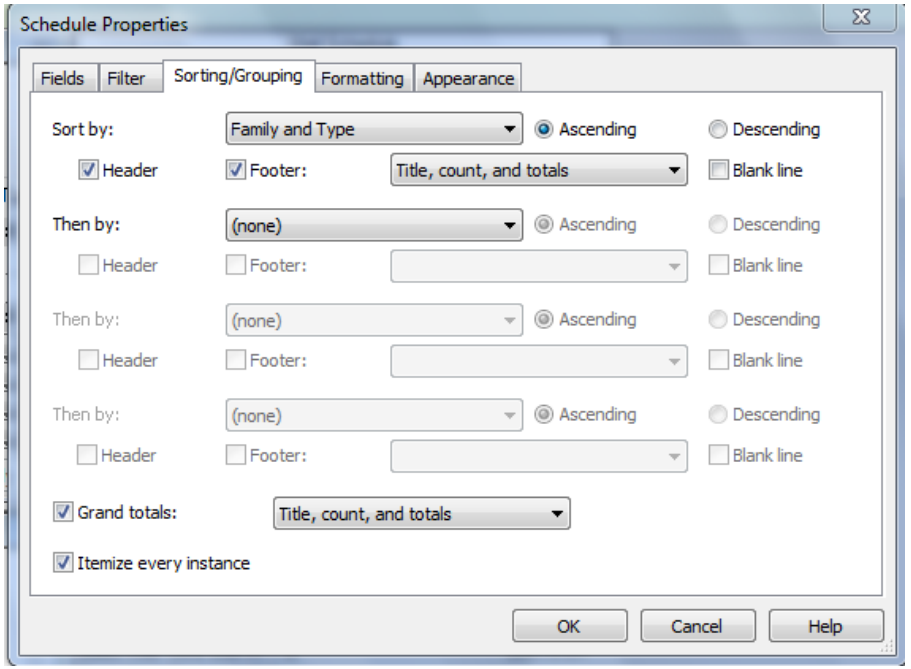
B10	HSS-Hollow Structural Section: HSS12X8X.3125-RINKER	1	18' - 8"	10.00
B10	HSS-Hollow Structural Section: HSS12X8X.3125-RINKER	1	9' - 10"	10.00
B10	HSS-Hollow Structural Section: HSS12X8X.3125-RINKER	1	11' - 7"	10.00
B10	HSS-Hollow Structural Section: HSS12X8X.3125-RINKER	1	26' - 11"	10.00

BIM: Quantity Surveys

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



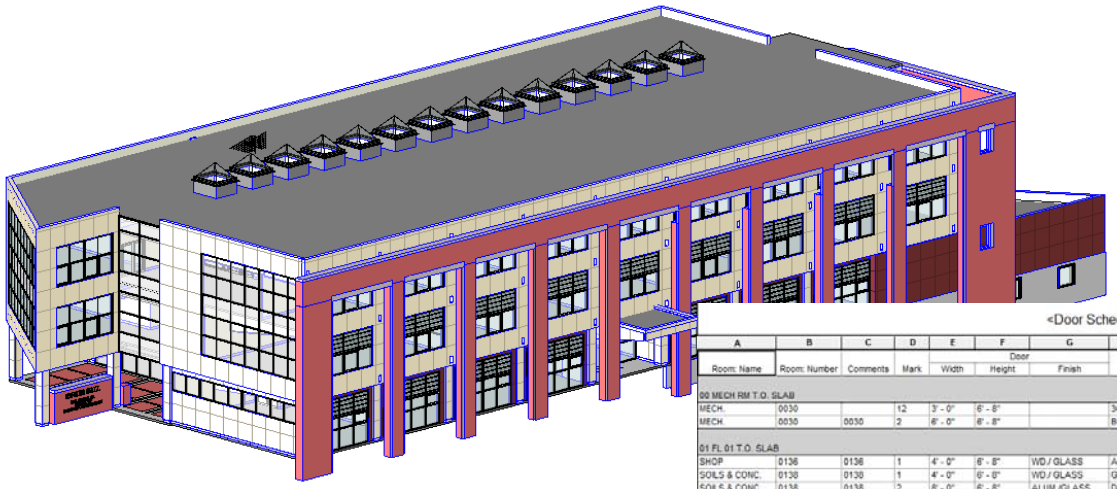


BIM: Quantity Surveys

- 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	6' - 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.

2015 IECC Changes Cost Impact Analysis

- Of the 2015 I Codes reviewed with respect to mechanical, electrical and plumbing (MEP) systems, the majority of impactful changes were observed in the International Energy Conservation Code.
- A significant portion of the International Energy Conservation Code changes have been incorporated in an effort to align the code more closely with ASHRAE 90.1-2013.

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 IECC Changes Cost Impact Analysis

APPENDIX B - Table 2. 2015 IECC Changes Cost Impact		
CODE CHANGE #	**2015 IECC CHANGE SUMMARY**	**ESTIMATED AMOUNT***
CE200-13	**Section(s): Table C403.2.3(1), Table C403.2.3(2), Table C403.2.3(3), Table C403.2.3(8), Chapter 5** MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS	1% to 2% of Equipment cost
CE201-13	**Section(s): C202 (NEW), Table 403.2.3(9) (NEW), Chapter 5** MINIMUM EFFICIENCY AIR CONDITIONERS AND CONDENSING UNITS SERVING COMPUTER ROOMS	1% to 2% of Equipment cost
CE203-13	**Section(s): C403.2.3.1, C403.2.3.2, Table C403.2.3(7)** Water Chilling Packages – Efficiency Requirements	1% to 2% of Equipment cost
CE205-13	**Section(s): C403.2.4.5 (NEW)** **C403.2.4.5** Zone isolation. HVAC systems serving zones that are over 25,000 square feet in floor area or that span more than one floor and designed to operate or be occupied non-simultaneously shall be divided into isolation areas. Each isolation area shall be equipped with isolation devices and controls configured to automatically shut off the supply of conditioned air and outdoor air to and exhaust air from the isolation area. Each isolation area shall be controlled independently by a device meeting the requirements of Section **C403.2.4.3.2.** Central systems and plants shall be provided with controls and devices that will allow system and equipment operation for any length of time while serving only the smallest isolation area served by the system or plant.	Range of 10% to 20% of total HVAC construction costs

2015 IECC Changes Cost Impact Analysis - Excerpts

APPENDIX B - Table 2. 2015 IECC Changes Cost Impact		
CODE CHANGE #	**2015 IECC CHANGE SUMMARY**	**ESTIMATED AMOUNT***
CE284-13	**Section(s): C404.8 (NEW), C408.1, C408.2, C408.2.3.2, C408.2.4, C408.2.4.1, C408.2.5.2, C408.2.5.4** **C404.8** Service water heating systems commissioning and completion requirements. Service water heating systems, swimming pool water heating systems, spa water heating systems and the controls for those systems shall be commissioned and completed in accordance with Section C408.2. **C408.2** Mechanical systems and service water heating systems commissioning and completion requirements……. **C408.2.3.2** Controls. HVAC and service water heating control systems shall be tested to document that control devices, components, equipment, and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. The report shall be organized with mechanical and service hot water findings in separate sections to allow independent review …….. **C408.2.4.1** Acceptance of report. Buildings, or portions thereof, shall not pass the final mechanical and plumbing inspections, until such time as the code official has received a letter of transmittal from the building owner acknowledging that the building owner has received the Preliminary Commissioning Report. C408.2.5.2 Manuals. An operating and maintenance manual shall be provided and include all of the following: ……. **C408.2.5.4** Final commissioning report. A report of test procedures and results identified as "Final Commissioning Report" shall be delivered to the building owner ~~and shall include.~~ The report shall be organized with mechanical system and service hot water system findings in separate sections to allow independent review. The report shall include the following: ……	2% to 3% of total Service Water Heating System construction cost

Excerpts – 2015 IECC Changes Cost Impact Analysis

APPENDIX B - Table 2. 2015 IECC Changes Cost Impact		
CODE CHANGE #	**2015 IECC CHANGE SUMMARY**	**ESTIMATED AMOUNT***
CE292-13	**Section(s): C405.2.2.2** **C405.2.2.2** Occupancy sensors. Occupancy sensors shall be installed in all classrooms, conference/meeting rooms, employee lunch and break rooms, private offices, restrooms, warehouse spaces, storage rooms and janitorial closets, and other spaces 300 square feet (28 m2) or less enclosed by floor-to-ceiling height partitions. These automatic control devices shall be installed to automatically turn off lights within 30 minutes of all occupants leaving the space, and shall either be manual on or shall be controlled to automatically turn the lighting on to not more than 50 percent power.	$4 to $6/ SQF of building *Not applicable to building types in this study
CE294-13	**Section(s): C202, Figure C405.1 (NEW), Figure C405.2 (NEW), C405.2.2.3, C405.2.2.3.1 (NEW), C405.2.2.3.2 (NEW), C405.2.2.3.3 (NEW), Figure C405.3 (NEW), Figure C405.4 (NEW)** ~~**C405.2.2.3** Daylight zone control. Daylight zones shall be designed such that lights in the daylight zone are controlled independently of general area lighting and are controlled in accordance …….~~ **C405.2.2.3** Daylight responsive controls. Daylight responsive controls complying with Section C405.2.2.3.1 shall be provided to control the electric lights within daylight zones in the following spaces: 1. Spaces with a total of more than 150 watts of general lighting within sidelight daylight zones complying with Section C405.2.2.3.2. General lighting does not include lighting that is required to have specific application control in accordance with Section C405.2.3. 2. Spaces with a total of more than 150 watts of general lighting within toplight daylight zones complying with Section C405.2.2.3.3. Exceptions: Daylight responsive controls are not required for the following: 1. Spaces in health care facilities where patient care is directly provided. 2. Dwelling units and sleeping units. 3. Lighting that is required to have specific application control in accordance with Section C405.2.3. C405.2.2.3.1 Daylight responsive control function. Where required, daylight responsive controls shall be provided within each space for control of lights in that space and shall comply with all of the following: 1. Lights in toplight daylight zones in accordance with Section C405.2.2.3.3 shall be controlled independently of lights in sidelight daylight zones in accordance with Section C405.2.2.3.2; 2. Daylight responsive controls within each space ……	$7 to $10/SF of building area

Excerpts – 2015 IECC Changes Cost Impact Analysis

APPENDIX B - Table 2. 2015 IECC Changes Cost Impact		
CODE CHANGE #	**2015 IECC CHANGE SUMMARY**	**ESTIMATED AMOUNT***
CE329-13	**Section(s): C405.8 (NEW), Table C405.8 (NEW)** **C405.8** Electrical transformers (Mandatory). Electric transformers shall meet the minimum efficiency requirements of Table C405.8 as tested and rated in accordance with the test procedure listed in DOE 10 CFR 431. The efficiency shall be verified through certification under an approved certification program or, where no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the transformer manufacturer.	2% to 4% of total Transformer cost
CE331-13	**Section(s): C405.8 (NEW), Table C405.8(1) (NEW), Table C405.8(2) (NEW), C405.8(3) (NEW), Table C405.8(4) (NEW), Chapter 5** **C405.8** Electrical motors (Mandatory). Electric motors shall meet the minimum efficiency requirements of Tables C405.8 (1) through C405.8 (4) when tested and rated in accordance with the DOE 10 CFR 431. The efficiency shall be verified through certification under an approved certification program or, where no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the motor manufacturer.	2% to 4% of total Motor cost
CE333-13	**Section(s): C405 (NEW), C405.1 (NEW), C405.2 (NEW), Chapter 5** **C405** Vertical and horizontal transportation systems and equipment. Vertical and horizontal transportation systems and equipment shall comply with this section. **C405.1** Elevator cabs. For the luminaires in each elevator cab, not including signals and displays, the sum of the lumens divided by the sum of the watts shall be no less than 35 lumens per watt. Ventilation fans in elevators that do not have their own air conditioning system shall not consume more than 0.33 watts/cfm at the maximum rated speed of the fan. Controls shall be provided that will de-energize ventilation fans and lighting systems when the elevator is stopped, unoccupied and with its doors closed for over 15 minutes. **C405.2** Escalators and moving walks. Escalators and moving walks shall comply with ASME A17.1/CSA B44 and shall have automatic controls configured to reduce speed to the minimum permitted speed in accordance with ASME A17.1/CSA B44 or applicable local code when not conveying passengers.	2% to 4% of total Elevator cost

QUESTIONS ?