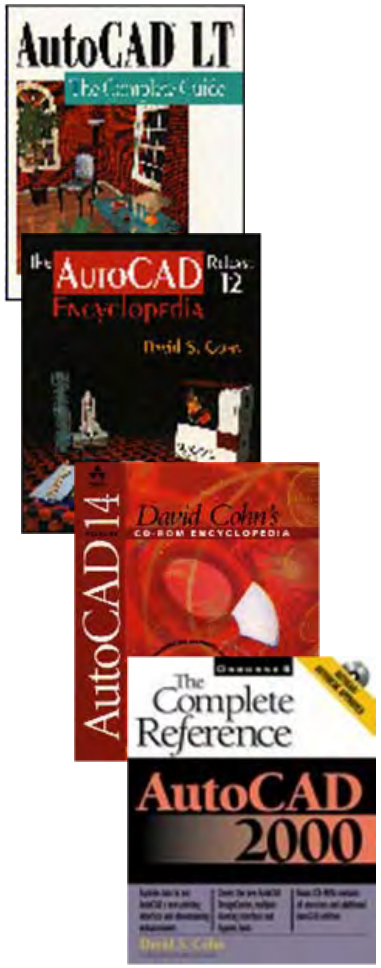
Working Together: BIM-based Project Collaboration

David Cohn

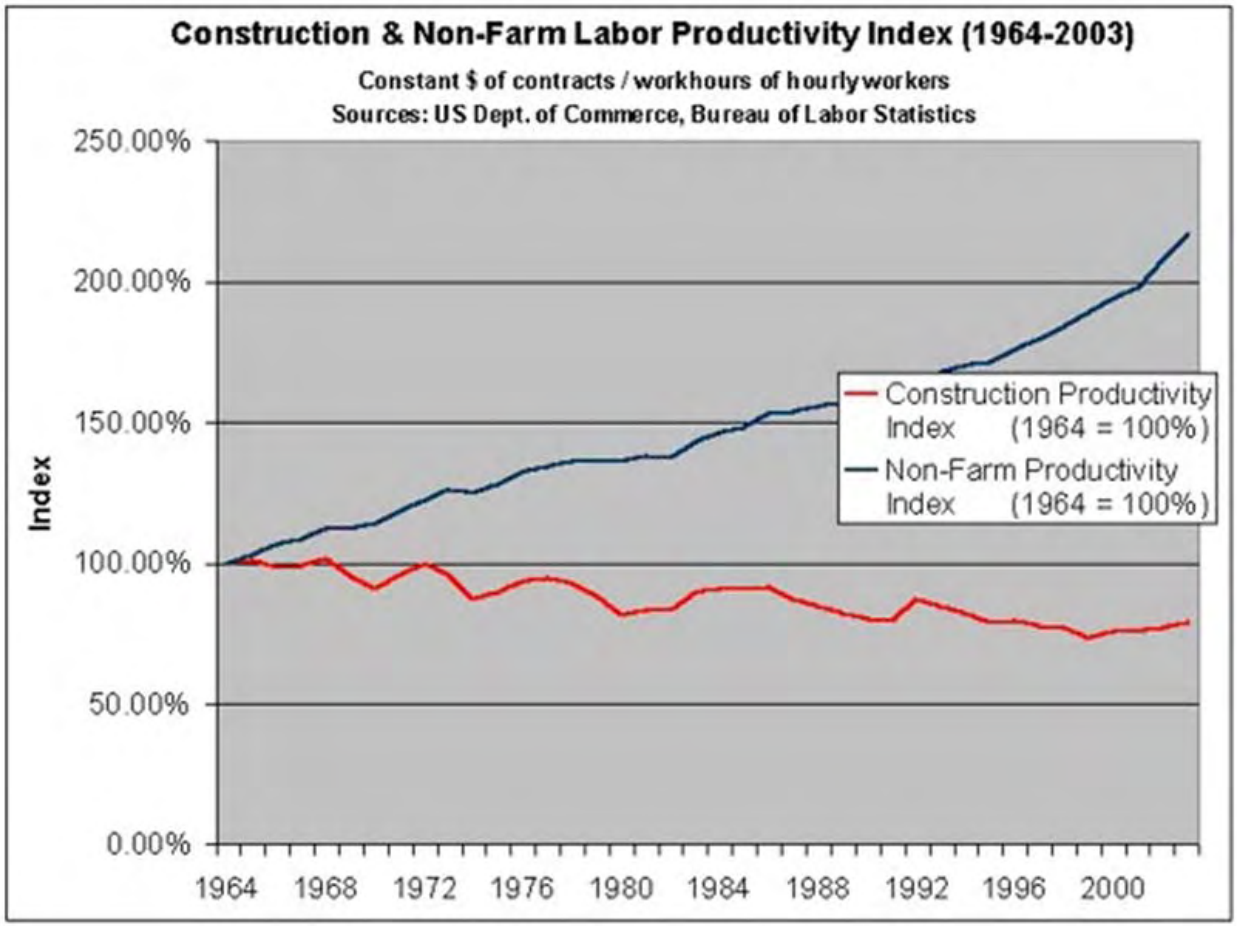
David S. Cohn



- Application engineer with The PPI Group
- Contributing editor *Desktop Engineering* contributing editor
- Former editor of *CADalyst*, *Engineering Automation Report* and *CADCAMNet*
- Frequent contributor to *Computer Graphics* World, *PC* Magazine, and others
- Registered architect—25+ years experience
- AutoCAD experience—20+ years
- Author of numerous books & articles
- President of Eclipse Software

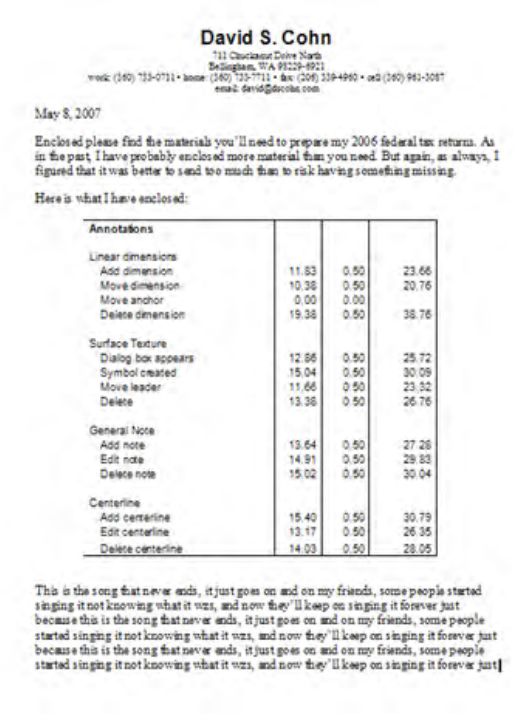
COMPUTER GRAPHICS WORLD DE PC MAGAZINE

Productivity



Computable Building Model

- Digital versus **computable**
  - Word processor vs. spreadsheet
  - CAD vs. BIM



David S. Cohn

711 Cincinnati Drive North
Bellingham, WA 98229-6921
work: (360) 733-0711 • home: (360) 733-7711 • fax: (206) 339-4960 • cell (360) 961-3087
email: david@dscohn.com

May 8, 2007

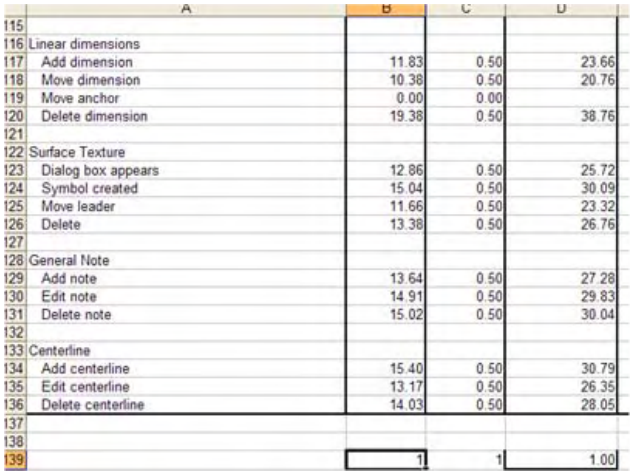
Enclosed please find the materials you'll need to prepare my 2006 federal tax returns. As in the past, I have probably enclosed more material than you need. But again, as always, I figured that it was better to send too much than to risk having something missing.

Here is what I have enclosed:

Annotations			
Linear dimensions			
Add dimension	11.83	0.50	23.66
Move dimension	10.38	0.50	20.76
Move anchor	0.00	0.00	
Delete dimension	19.38	0.50	38.76
Surface Texture			
Dialog box appears	12.86	0.50	25.72
Symbol created	15.04	0.50	30.09
Move leader	11.66	0.50	23.32
Delete	13.38	0.50	26.76
General Note			
Add note	13.64	0.50	27.28
Edit note	14.91	0.50	29.83
Delete note	15.02	0.50	30.04
Centerline			
Add centerline	15.40	0.50	30.79
Edit centerline	13.17	0.50	26.35
Delete centerline	14.03	0.50	28.05

This is the song that never ends, it just goes on and on my friends, some people started singing it not knowing what it was, and now they'll keep on singing it forever just because this is the song that never ends, it just goes on and on my friends, some people started singing it not knowing what it was, and now they'll keep on singing it forever just because this is the song that never ends, it just goes on and on my friends, some people started singing it not knowing what it was, and now they'll keep on singing it forever just

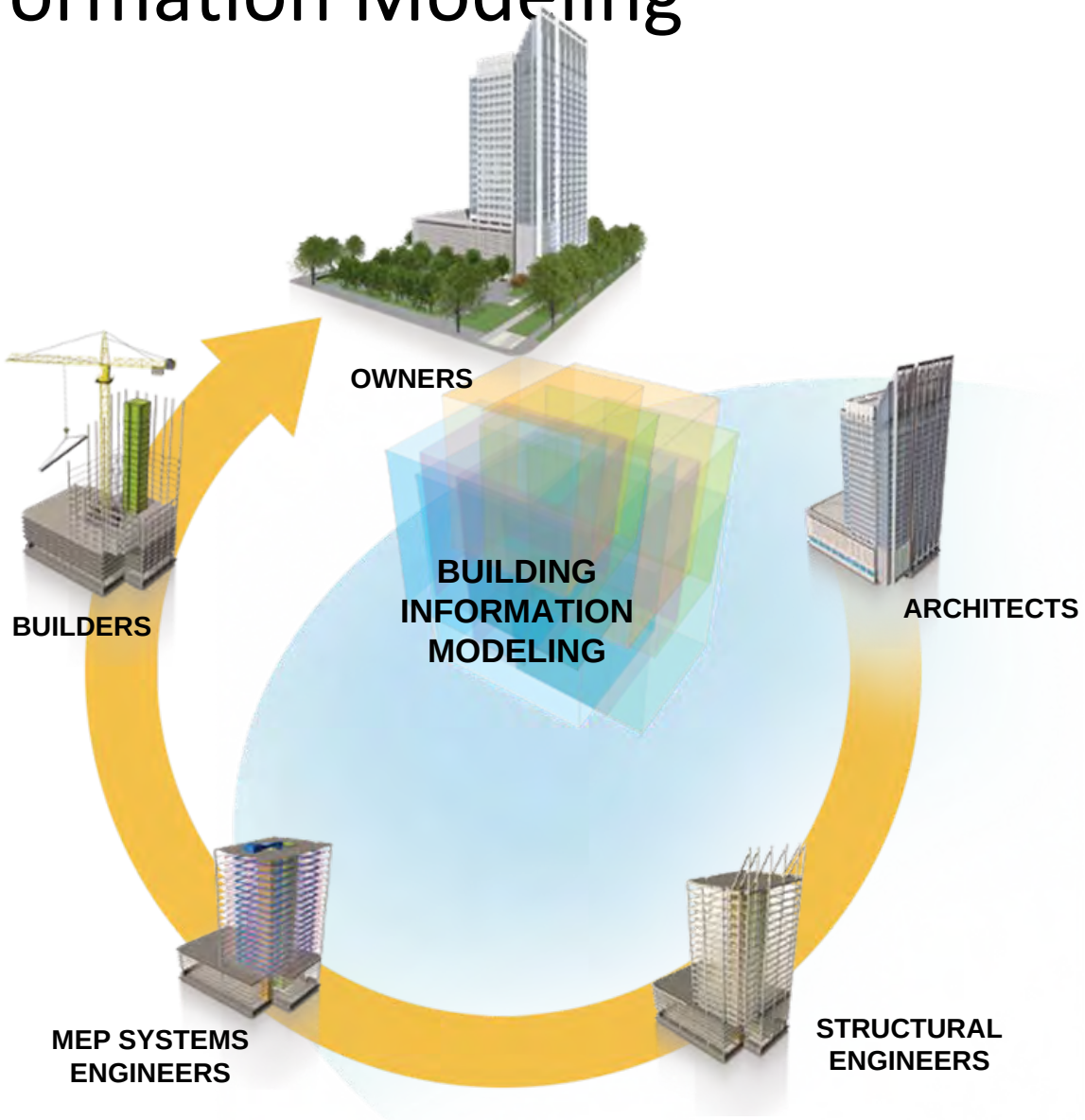
vs



	A	B	C	D
115				
116	Linear dimensions			
117	Add dimension	11.83	0.50	23.66
118	Move dimension	10.38	0.50	20.76
119	Move anchor	0.00	0.00	
120	Delete dimension	19.38	0.50	38.76
121				
122	Surface Texture			
123	Dialog box appears	12.86	0.50	25.72
124	Symbol created	15.04	0.50	30.09
125	Move leader	11.66	0.50	23.32
126	Delete	13.38	0.50	26.76
127				
128	General Note			
129	Add note	13.64	0.50	27.28
130	Edit note	14.91	0.50	29.83
131	Delete note	15.02	0.50	30.04
132				
133	Centerline			
134	Add centerline	15.40	0.50	30.79
135	Edit centerline	13.17	0.50	26.35
136	Delete centerline	14.03	0.50	28.05
137				
138				
139		1	1	1.00

Building Information Modeling

Building Information Modeling (BIM) – The creation and use of coordinated, internally consistent, **computable information** about a building project in design and construction.

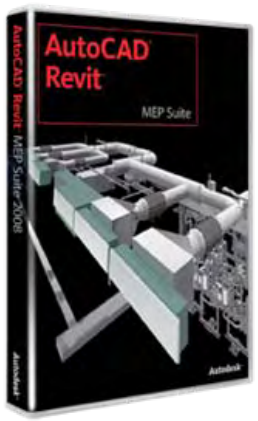


The Revit Family of Products

Revit Architecture

(formerly Revit Building)

Revit Structure

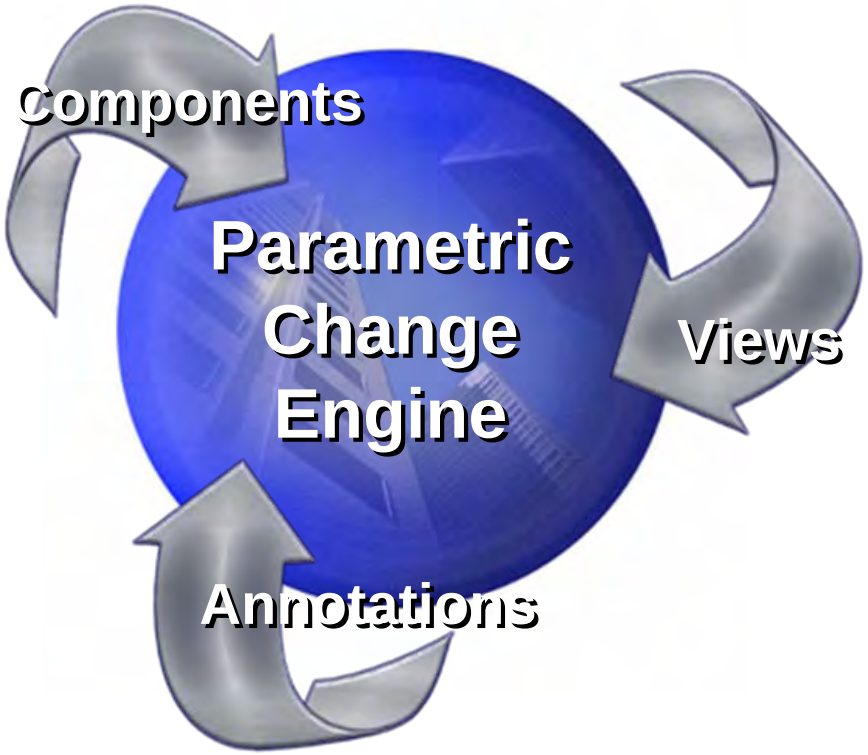


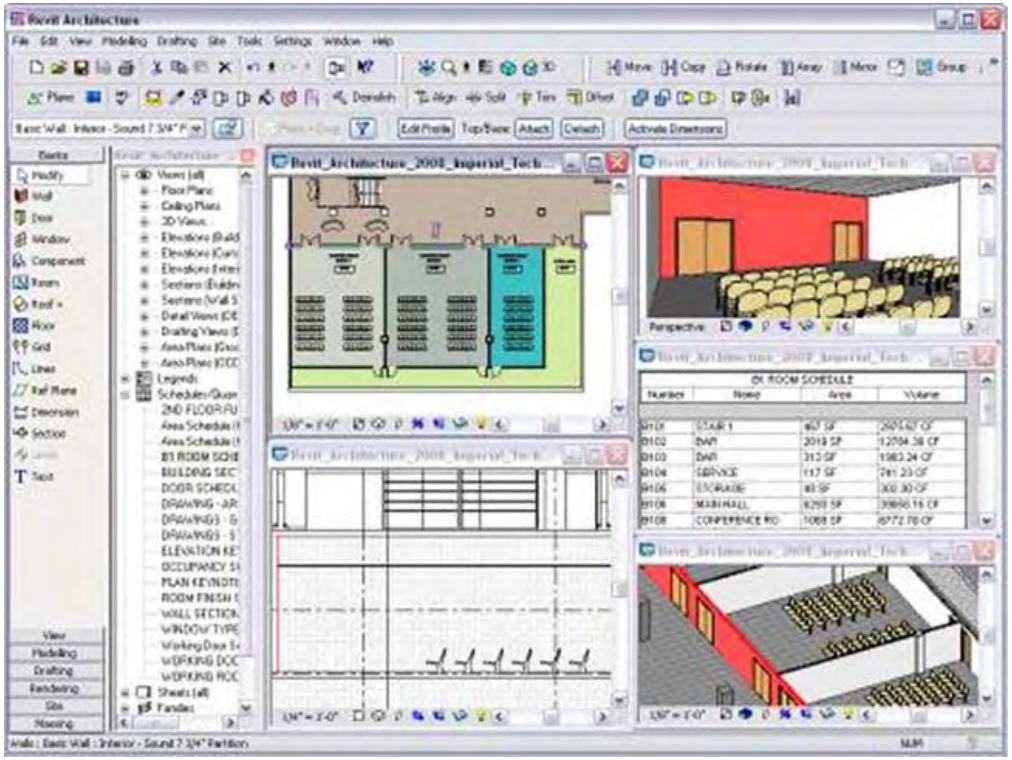
Revit MEP

(formerly Revit Systems)

- All three are purpose-built
- Based on a parametric building modeling technology
- Use the same underlying relational database and behavioral model to dynamically capture building information

A Change Anywhere = A Change Everywhere



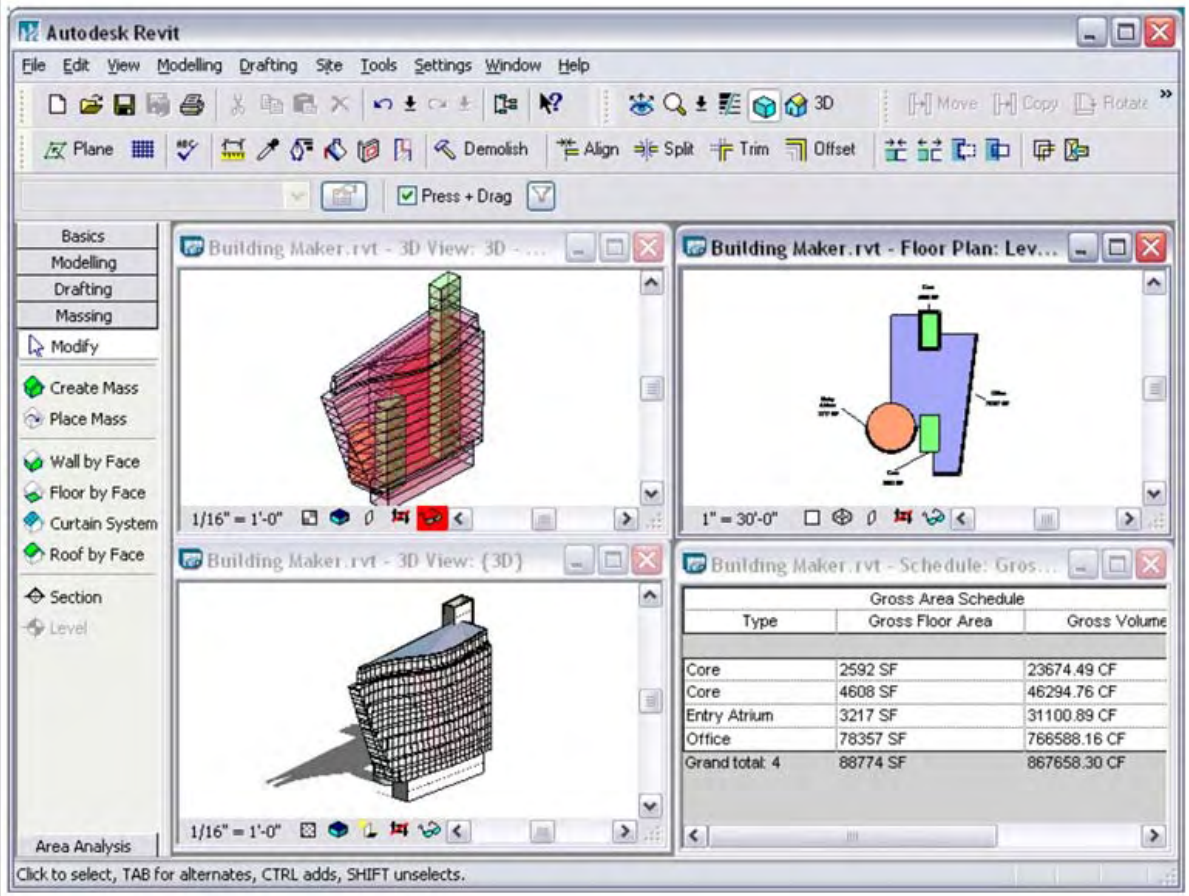


Conceptual Modeling

Revit Building Maker

Conceptual Design inside Revit

- Map conceptual models to BIM components
  - –3D shapes
  - –2D profiles
- Import ACIS solids
- Import SketchUp files

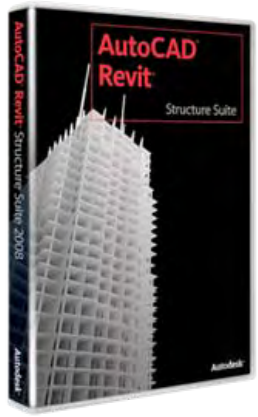


Revit Architecture

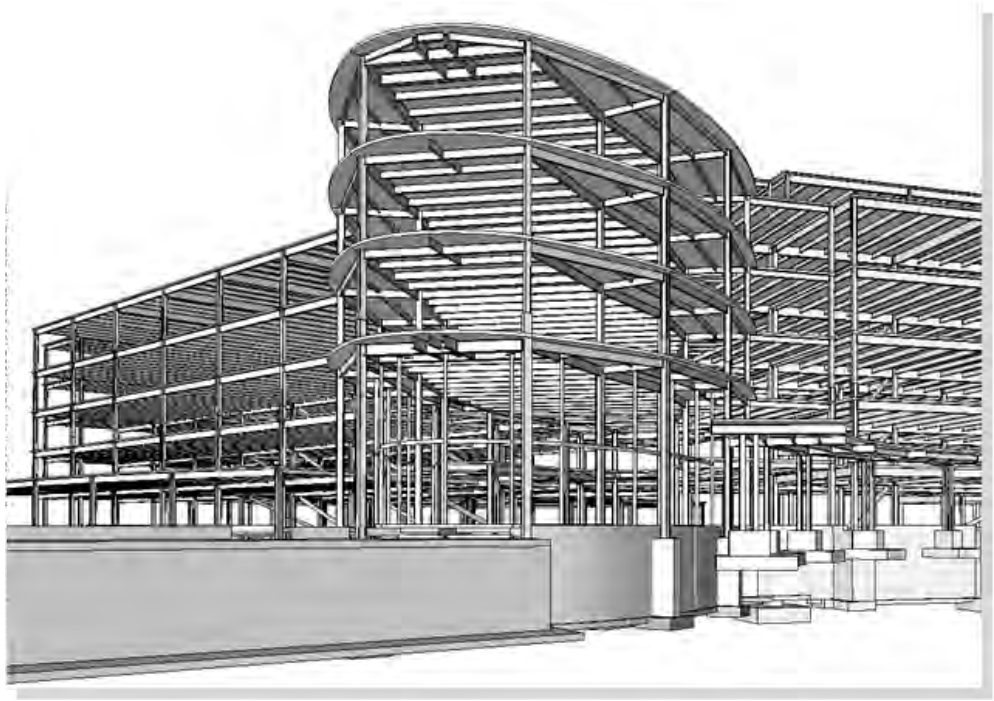
- Works the way you think
- Eliminates coordination mistakes
- Study design options
- Share model among team members
- Interoperability across entire AEC team

Image Courtesy of Ivan Kubík & Marek Németh Architects

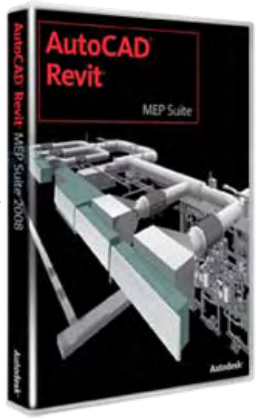
Revit Structure



- Leverage the architectural model
- Link bi-directionally with analysis software
- Easily respond to changes
- Use BIM to drive detailing and fabrication drawings
- Built-in interference checking



Revit MEP



- Use the same BIM model for HVAC, Piping, Electrical, Plumbing
- Built-in sizing and system layout tools
- Perform engineering calculations on the model
- Check continuity of systems

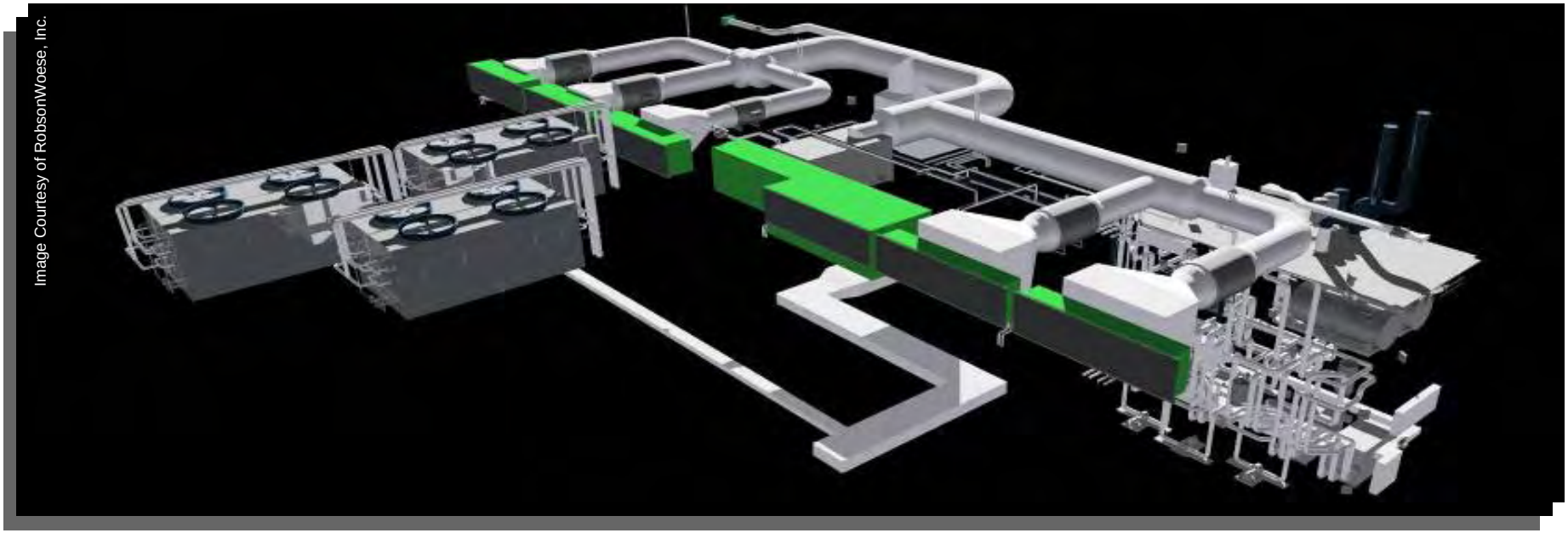
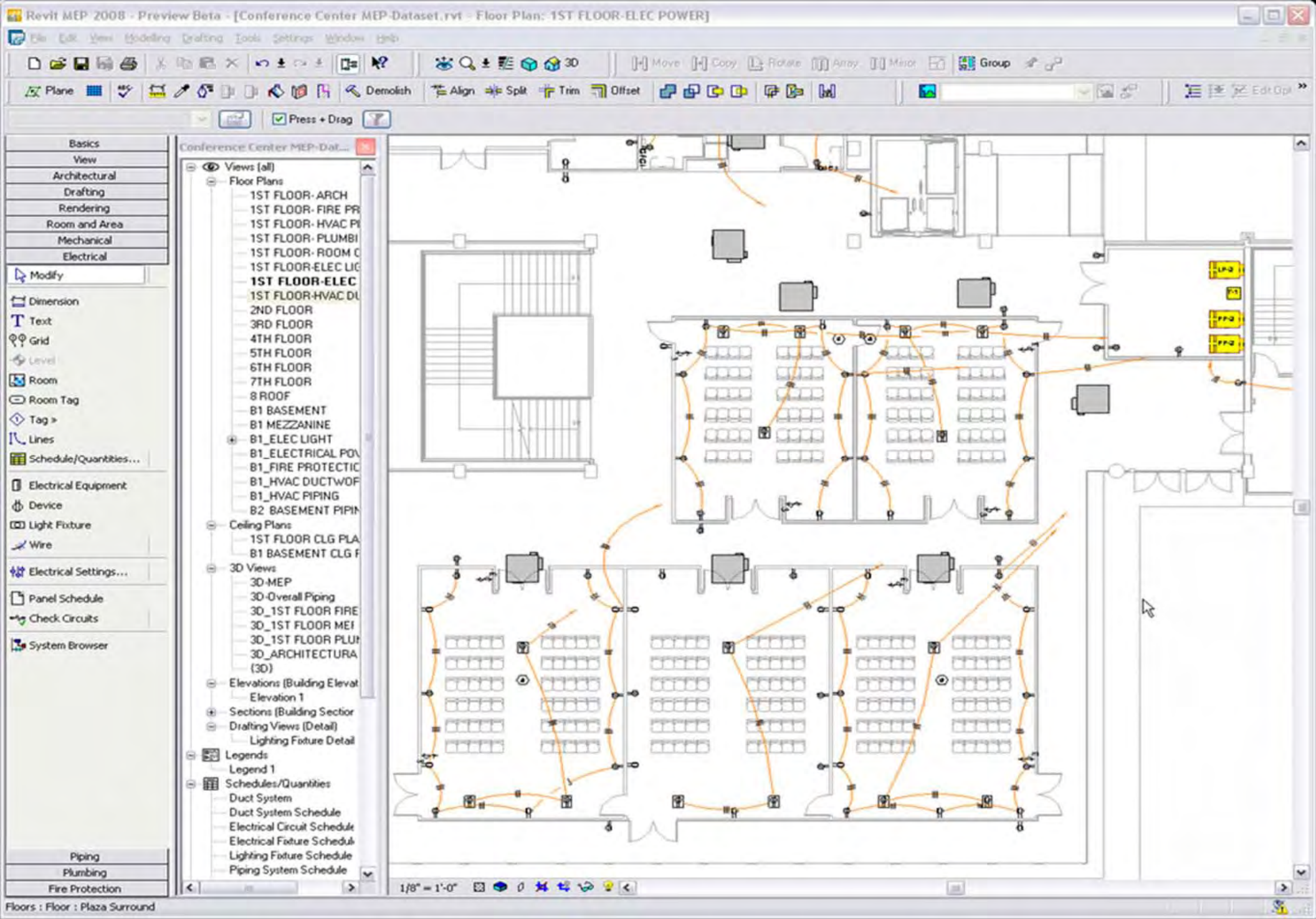
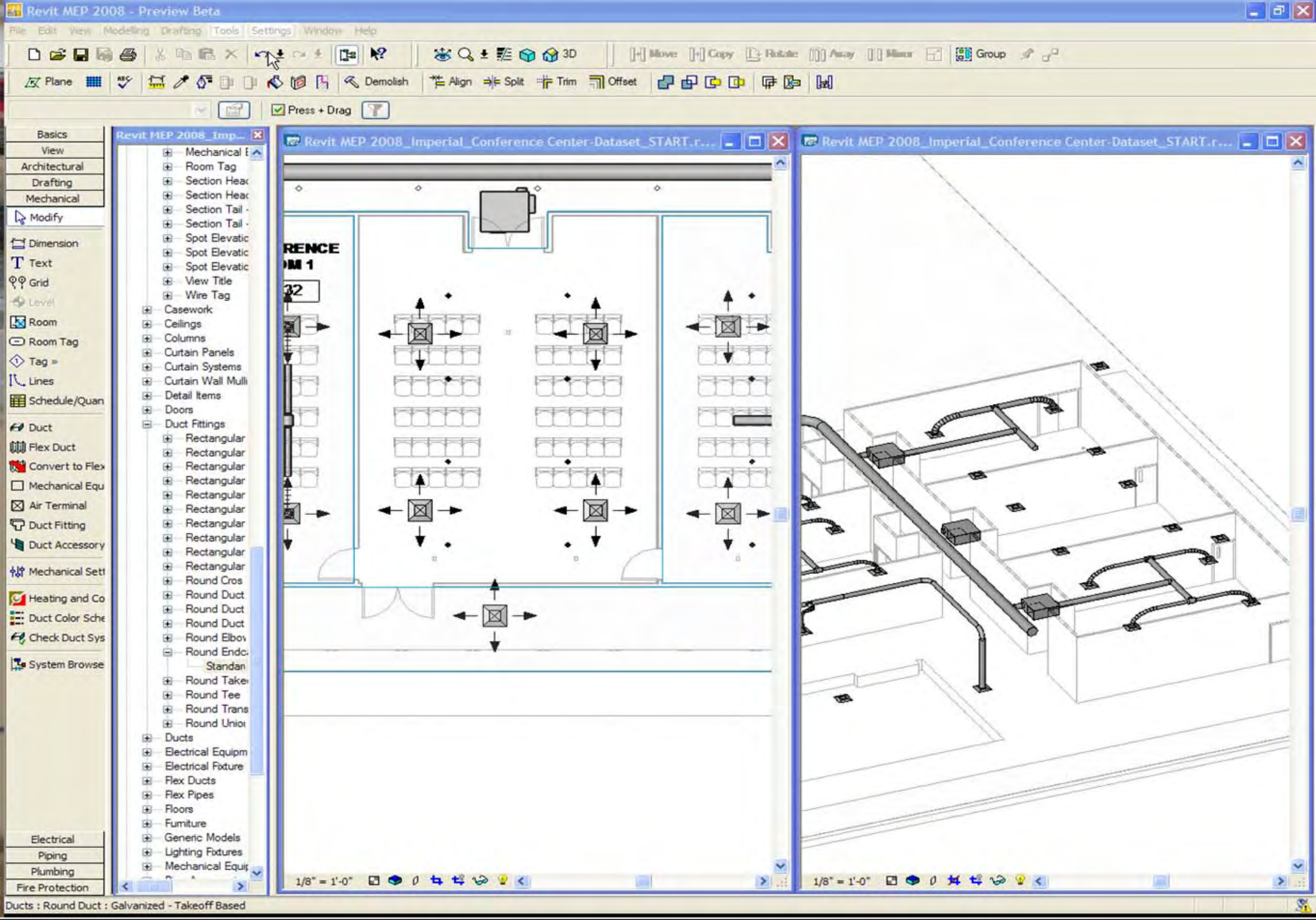


Image Courtesy of RobsonWoese, Inc.


Revit MEP 2008 - Preview Beta - [Conference Center MEP-Dataset.rvt - Floor Plan: 1ST FLOOR-ELEC POWER]
Basics
View
Architectural
Drafting
Rendering
Room and Area
Mechanical
Electrical
Modify
Dimension
Text
Grid
Level
Room
Room Tag
Tag »
Lines
Schedule/Quantities...
Electrical Equipment
Device
Light Fixture
Wire
Electrical Settings...
Panel Schedule
Check Circuits
System Browser
Piping
Plumbing
Fire Protection
Conference Center MEP-Dat...
Views (all)
Floor Plans
1ST FLOOR-ARCH
1ST FLOOR-ELEC POWER
2ND FLOOR
3RD FLOOR
4TH FLOOR
5TH FLOOR
6TH FLOOR
7TH FLOOR
8 ROOF
B1 BASEMENT
B1 MEZZANINE
B1_ELEC LIGHT
Ceiling Plans
1ST FLOOR CLG PLA
B1 BASEMENT CLG F
3D Views
3D-MEP
3D-Overall Piping
Elevations (Building Elevat
Elevation 1
Sections (Building Sectior
Drafting Views (Detail)
Lighting Fixture Detail
Legends
Legend 1
Schedules/Quantities
Duct System
Duct System Schedule
Electrical Circuit Schedule
Electrical Fixture Schedule
Lighting Fixture Schedule
Piping System Schedule
Move
Copy
Rotate
Array
Mirror
Group
Plane
Demolish
Align
Split
Trim
Offset
Press + Drag
1/8" = 1'-0"
Floors : Floor : Plaza Surround

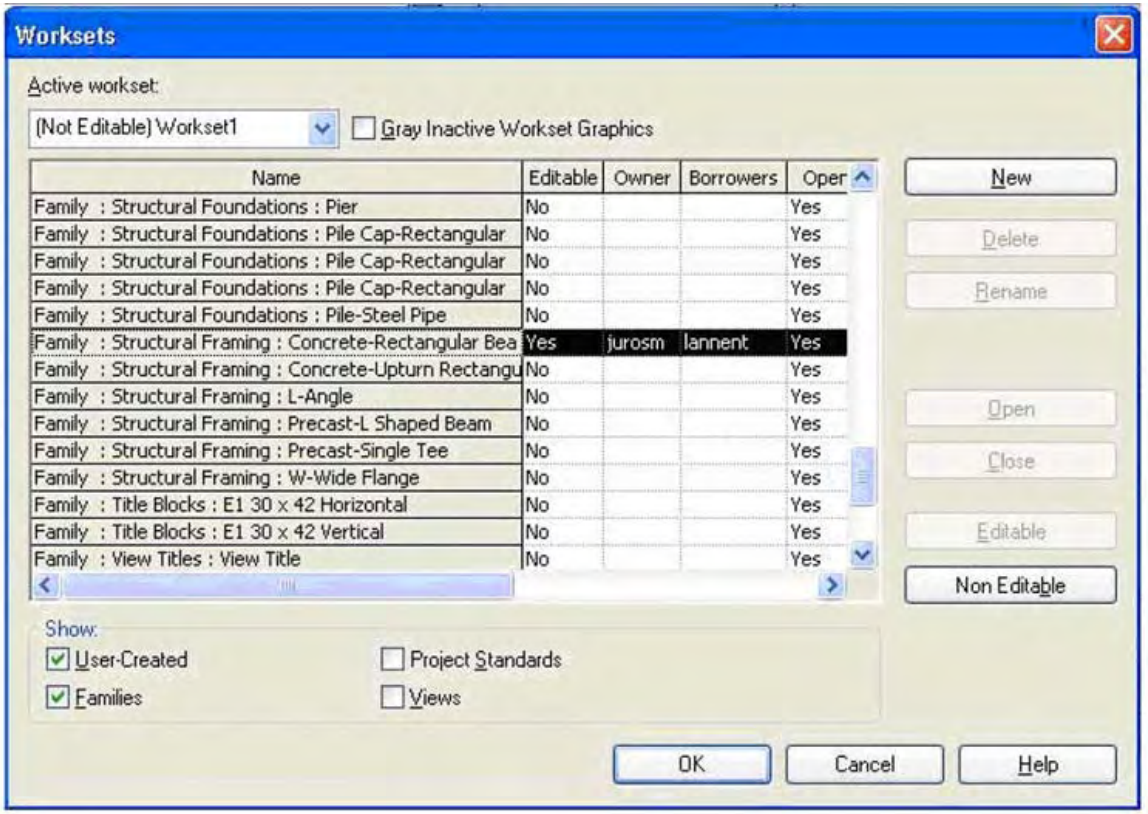

Revit MEP 2008 - Preview Beta
File Edit View Modeling Drafting Tools Settings Window Help
3D
Move Copy Rotate Array Mirror Group
Plane
Demolish Align Split Trim Offset
Press + Drag
Basics
View
Architectural
Drafting
Mechanical
Modify
Dimension
Text
Grid
Level
Room
Room Tag
Tag
Lines
Schedule/Quan
Duct
Flex Duct
Convert to Flex
Mechanical Equ
Air Terminal
Duct Fitting
Duct Accessory
Mechanical Sett
Heating and Co
Duct Color Sche
Check Duct Sys
System Browse
Electrical
Piping
Plumbing
Fire Protection
Revit MEP 2008_Imp...
Mechanical E
Room Tag
Section Heac
Section Heac
Section Tail -
Section Tail -
Spot Elevatic
Spot Elevatic
Spot Elevatic
View Title
Wire Tag
Casework
Ceilings
Columns
Curtain Panels
Curtain Systems
Curtain Wall Mulli
Detail Items
Doors
Duct Fittings
Rectangular
Rectangular
Rectangular
Rectangular
Rectangular
Rectangular
Rectangular
Rectangular
Rectangular
Rectangular
Round Cros
Round Duct
Round Duct
Round Duct
Round Elbov
Round Endc
Standan
Round Take
Round Tee
Round Trans
Round Unio
Ducts
Electrical Equipm
Electrical Fixture
Flex Ducts
Flex Pipes
Floors
Furniture
Generic Models
Lighting Fixtures
Mechanical Equi
Revit MEP 2008_Imperial_Conference Center-Dataset_START.r...
RENCE
M 1
32
1/8" = 1'-0"
Revit MEP 2008_Imperial_Conference Center-Dataset_START.r...
1/8" = 1'-0"
Ducts : Round Duct : Galvanized - Takeoff Based

Linking Revit Models

- The preferred means to share models between architects and engineers if all are using Revit-based applications, but are in separate organizations without access to a shared network (or even when they are)
  - Works similar to an external reference
  - Can reload versions of models as needed to coordinate changes

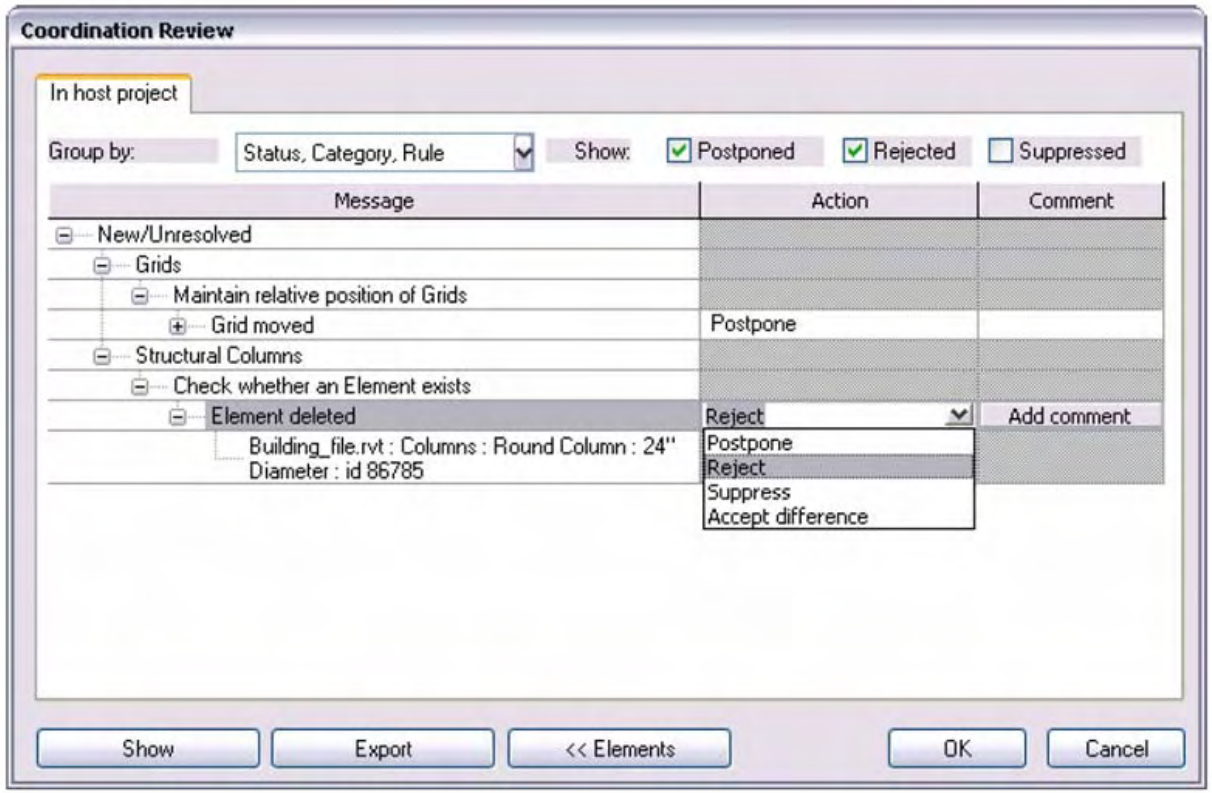
Revit Worksharing

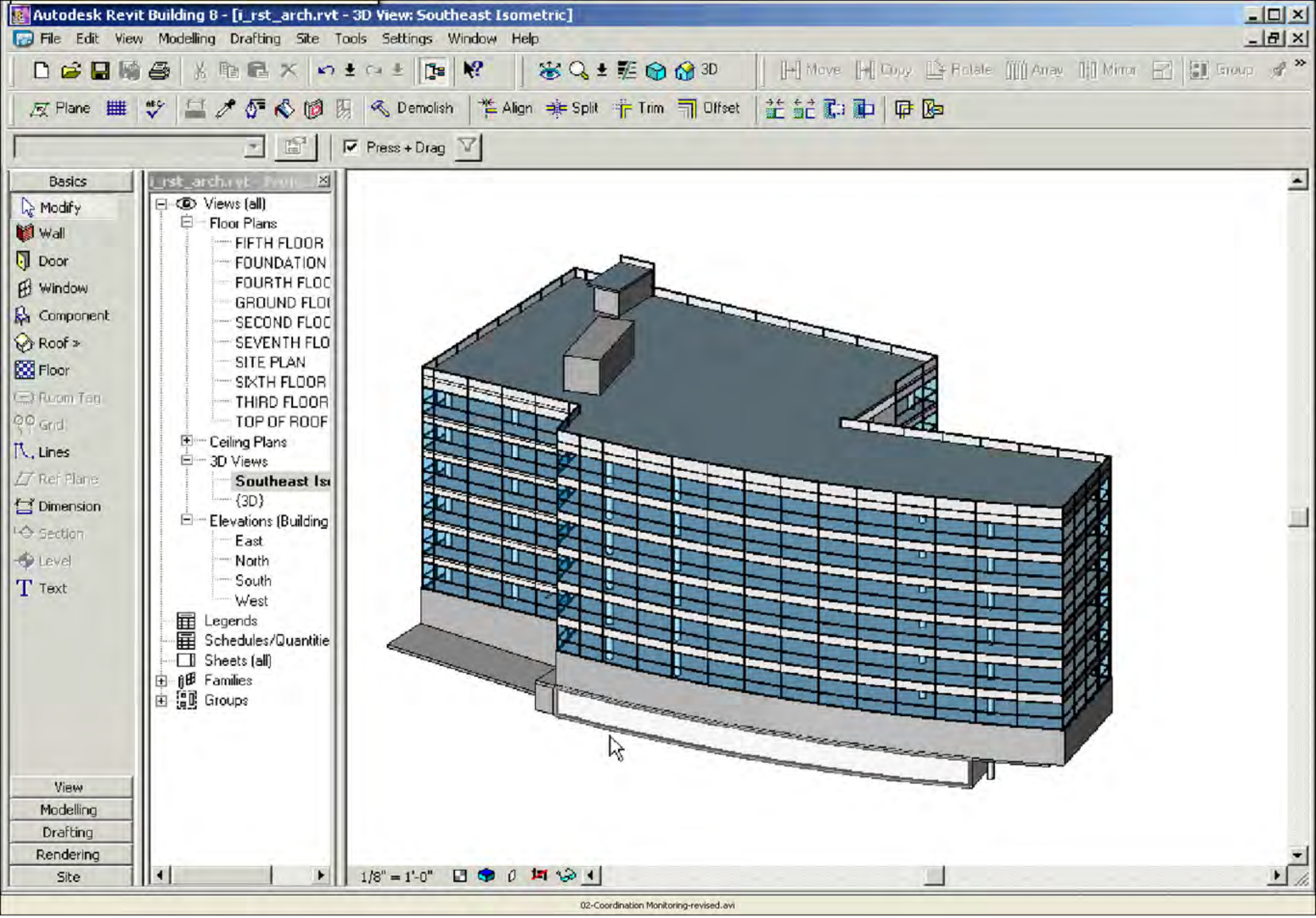
- Allows team members to share a single building information model
  - Uses worksets (logical groupings of objects in a building project that are reserved for editing by a single member at a time)
  - Worksets correspond to zones of responsibility
  - Worksets are flexible (can be changed)
  - Users can borrow
  - Local version/central store



Revit Coordination Monitoring

- Supported by Copy/Monitor function
  - When changes are made to monitored components, the user sees a notification and can postpone, reject, suppress or accept the change

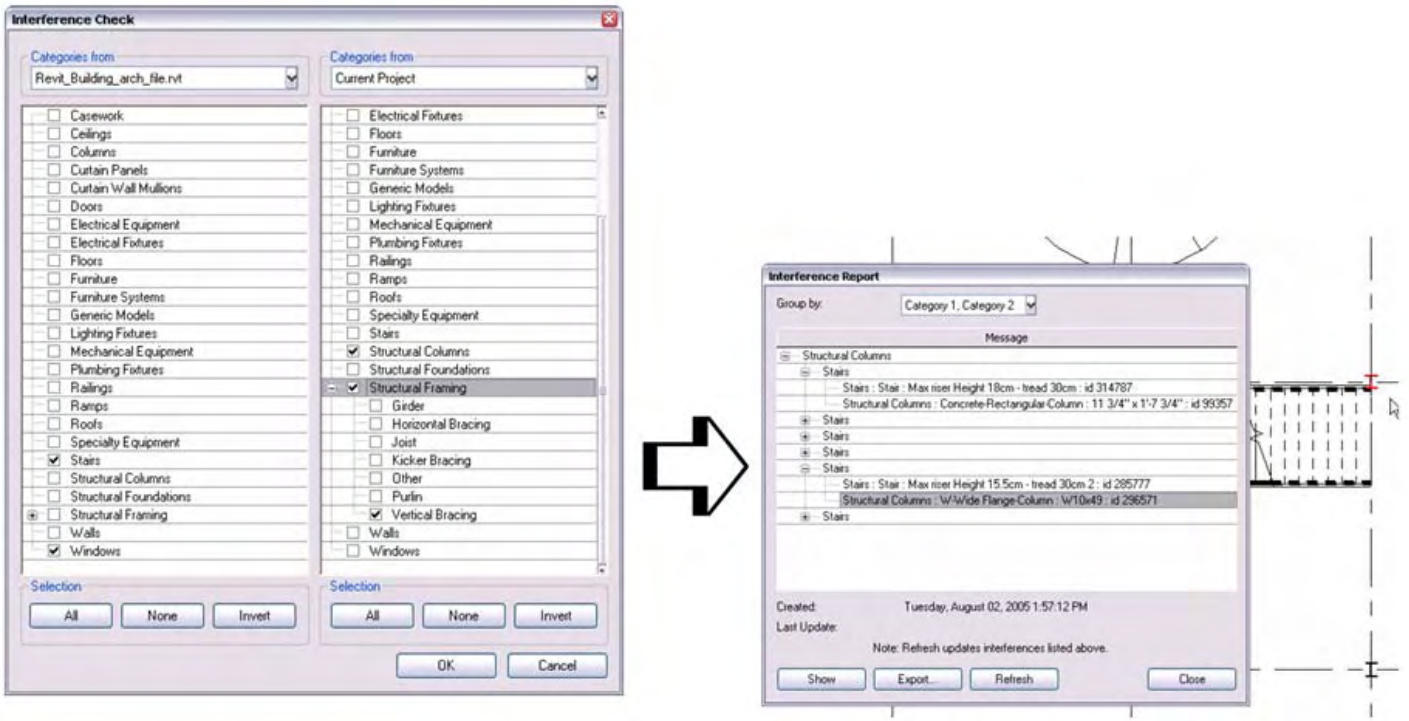


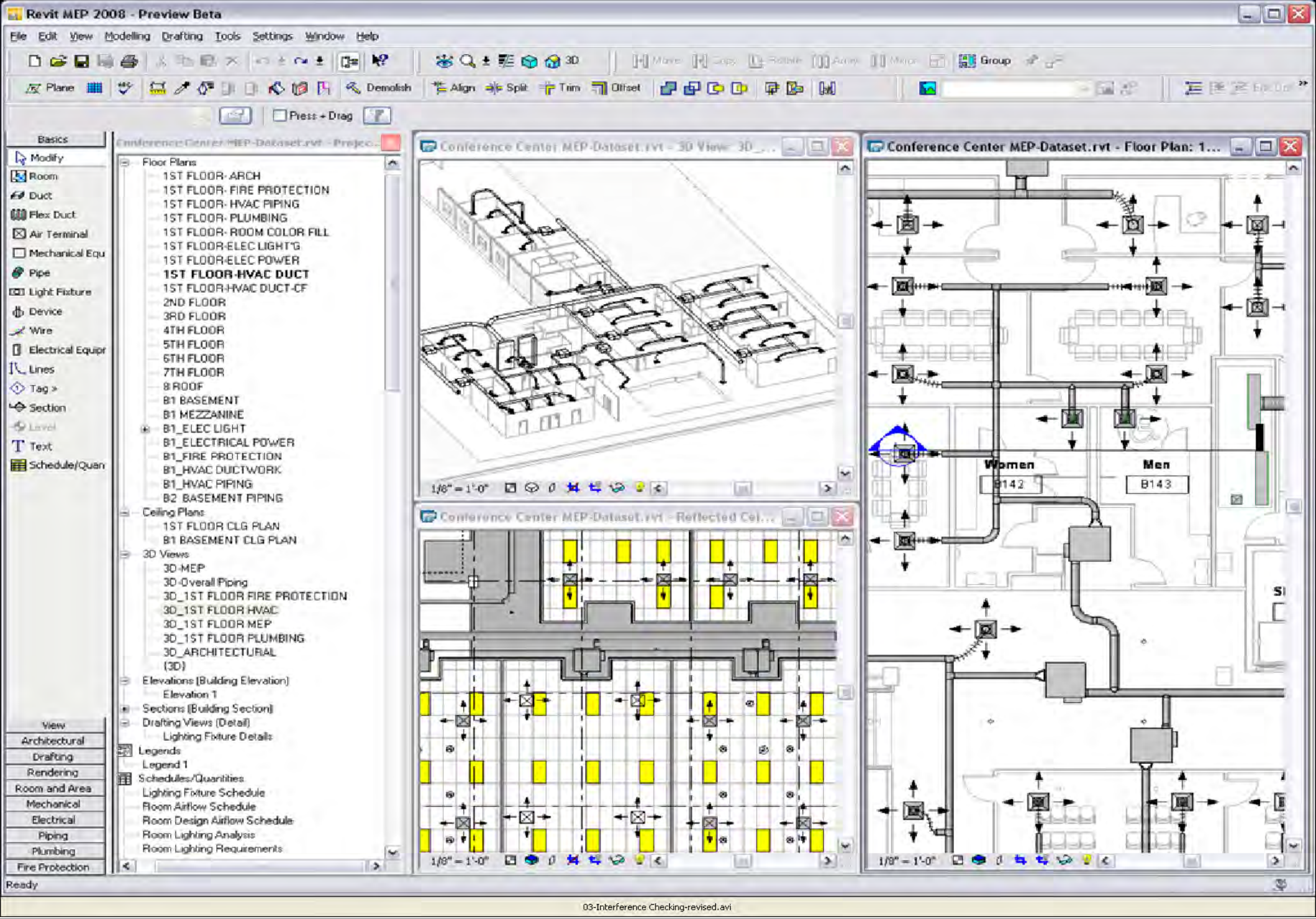


02-Coordination Monitoring-revised.avi

Revit Interference Checking

- Check for interference between types of components
  - Within the same model or two different models
    - Report shows interference
    - Selecting highlights condition within the model





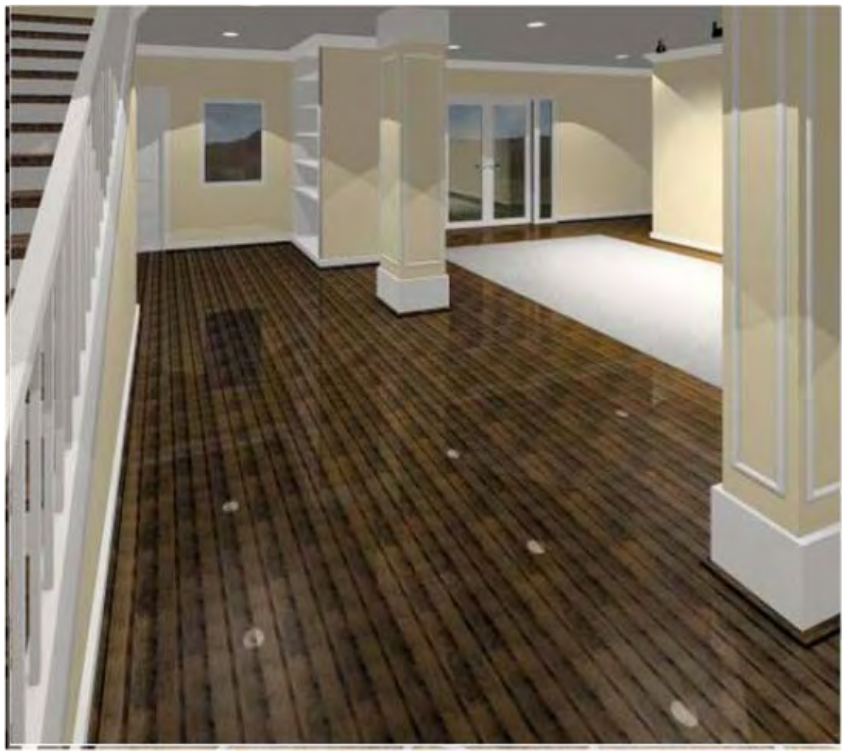
03-Interference Checking-revised.avi

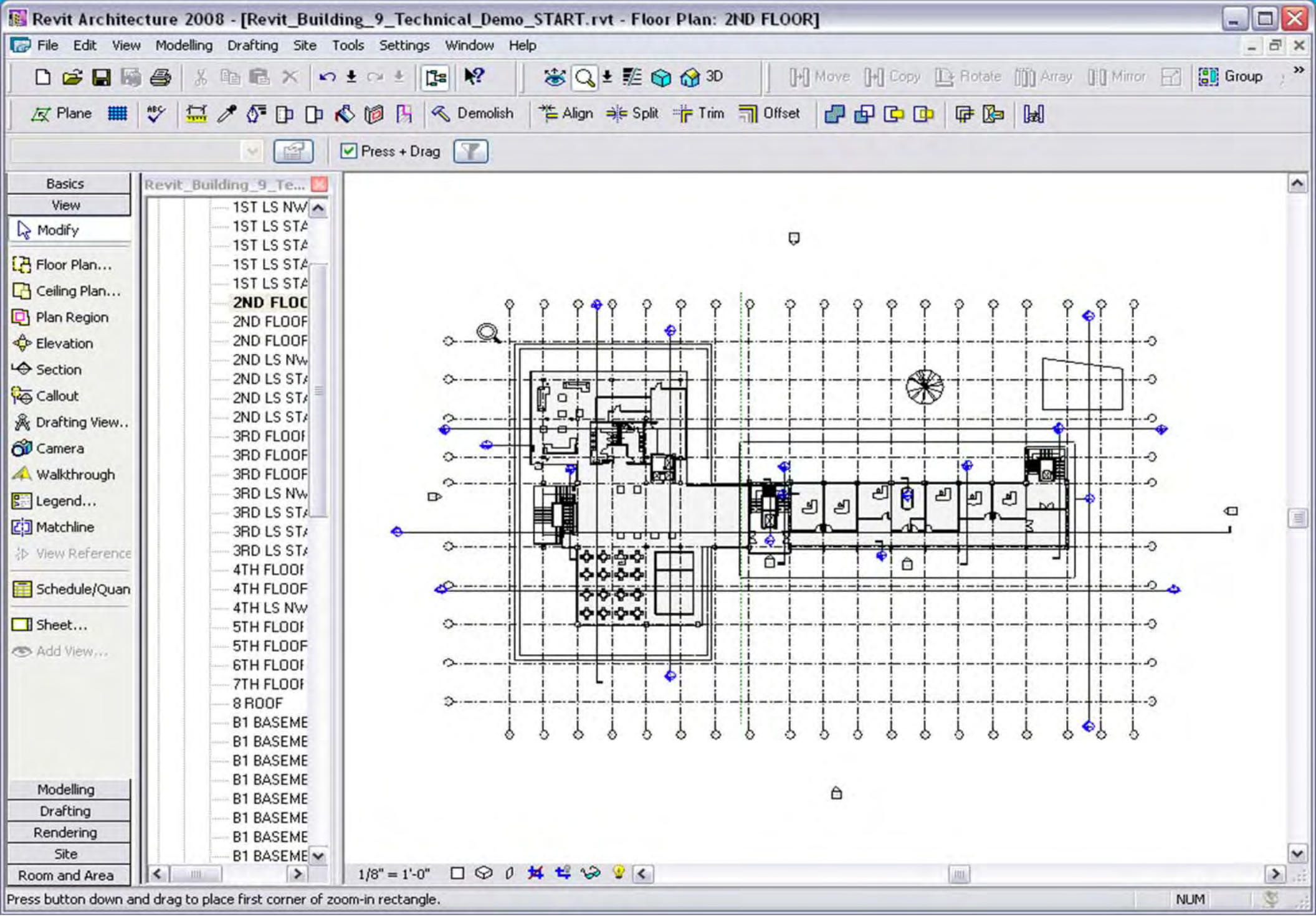
Linking with Other Products

- Many ways to work with other products
  - Import and export CAD formats (DWG, DWF, DXF, DGN)

Design Visualization

- Create renderings and walkthroughs inside Revit
- Export models for use in Autodesk VIZ or Autodesk 3ds max
  - Understand context of project before it is real




Revit Architecture 2008 - [Revit_Building_9_Technical_Demo_START.rvt - Floor Plan: 2ND FLOOR]
File Edit View Modelling Drafting Site Tools Settings Window Help
Move Copy Rotate Array Mirror Group
Plane Demolish Align Split Trim Offset
Press + Drag
Basics
View
Modify
Floor Plan...
Ceiling Plan...
Plan Region
Elevation
Section
Callout
Drafting View..
Camera
Walkthrough
Legend...
Matchline
View Reference
Schedule/Quan
Sheet...
Add View...
Modelling
Drafting
Rendering
Site
Room and Area
Revit_Building_9_Te...
1ST LS NW
1ST LS STA
2ND FLOC
2ND FLOOF
2ND LS NW
2ND LS STA
3RD FLOOF
3RD LS NW
4TH FLOOF
4TH LS NW
5TH FLOOF
6TH FLOOF
7TH FLOOF
8 ROOF
B1 BASEME
1/8" = 1'-0"
Press button down and drag to place first corner of zoom-in rectangle.
NUM

Sustainable Design

- In the U.S., commercial & residential buildings consume:
  - 40% of total energy
  - 70% of electricity
  - 40% of all raw materials
  - 12% of fresh water supplies
- Buildings produce:
  - 30% of all greenhouse gases
  - 136 million tons of construction & demolition waste

Sustainable Design

Process Issues

- **Manual calculation of material quantities is difficult, expensive and error-prone**
- **Solar effects and lighting analysis are difficult to perform**
- **Ability to share design information with building performance analysis applications**

Images Courtesy of RTKL Associates Inc

Sustainable Design

Visualizing Green Ideas

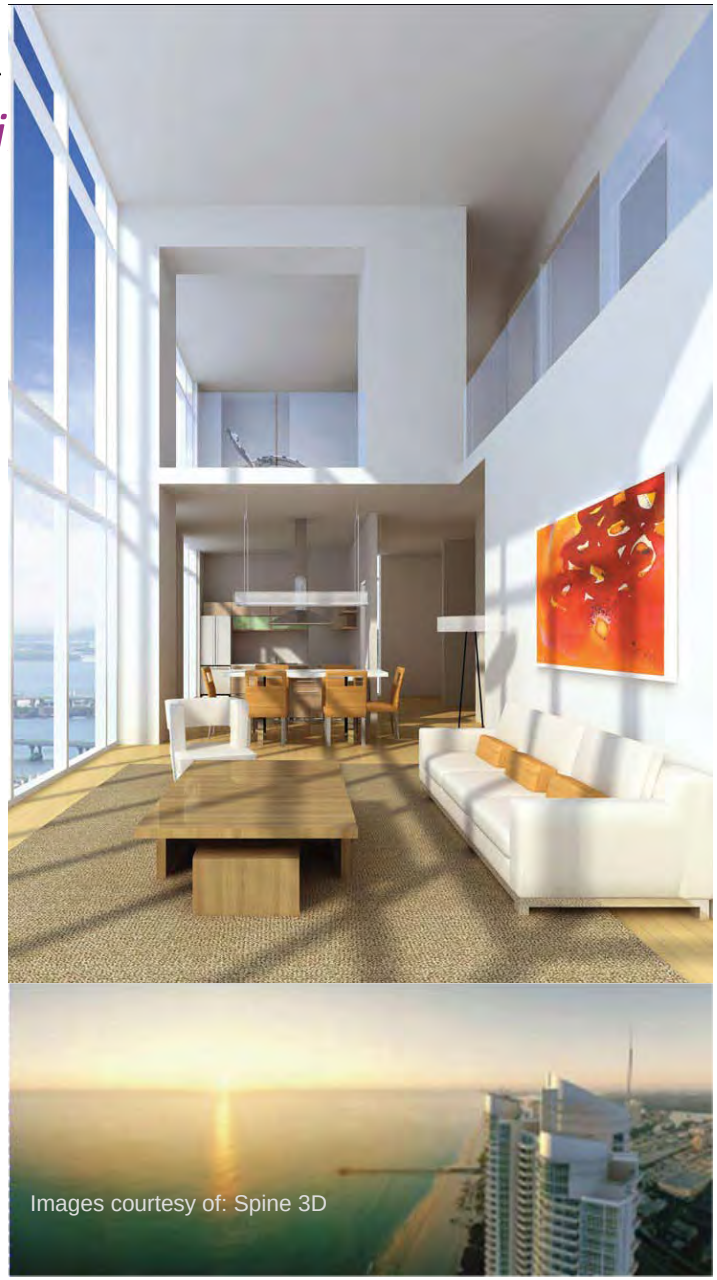
Lighting and modeling tools enable architects to quickly modify their building to *see* the impact on energy efficiency.

Integrate the sun's energy into the design of the building envelope and fenestration, and knowing ahead of time that it will work is sustainable design in action.

Better Decision Mak

Tools to Create Sustainable Bui

- **Calculating material quantities is greatly simplified**
- **Sun studies enable designers to quickly analyze sun positions and solar effects**
- **Designers can perform energy analysis and study building performance utilizing the gbXML interface**



Partner Products

Integrated Environmental Solutions (IES)

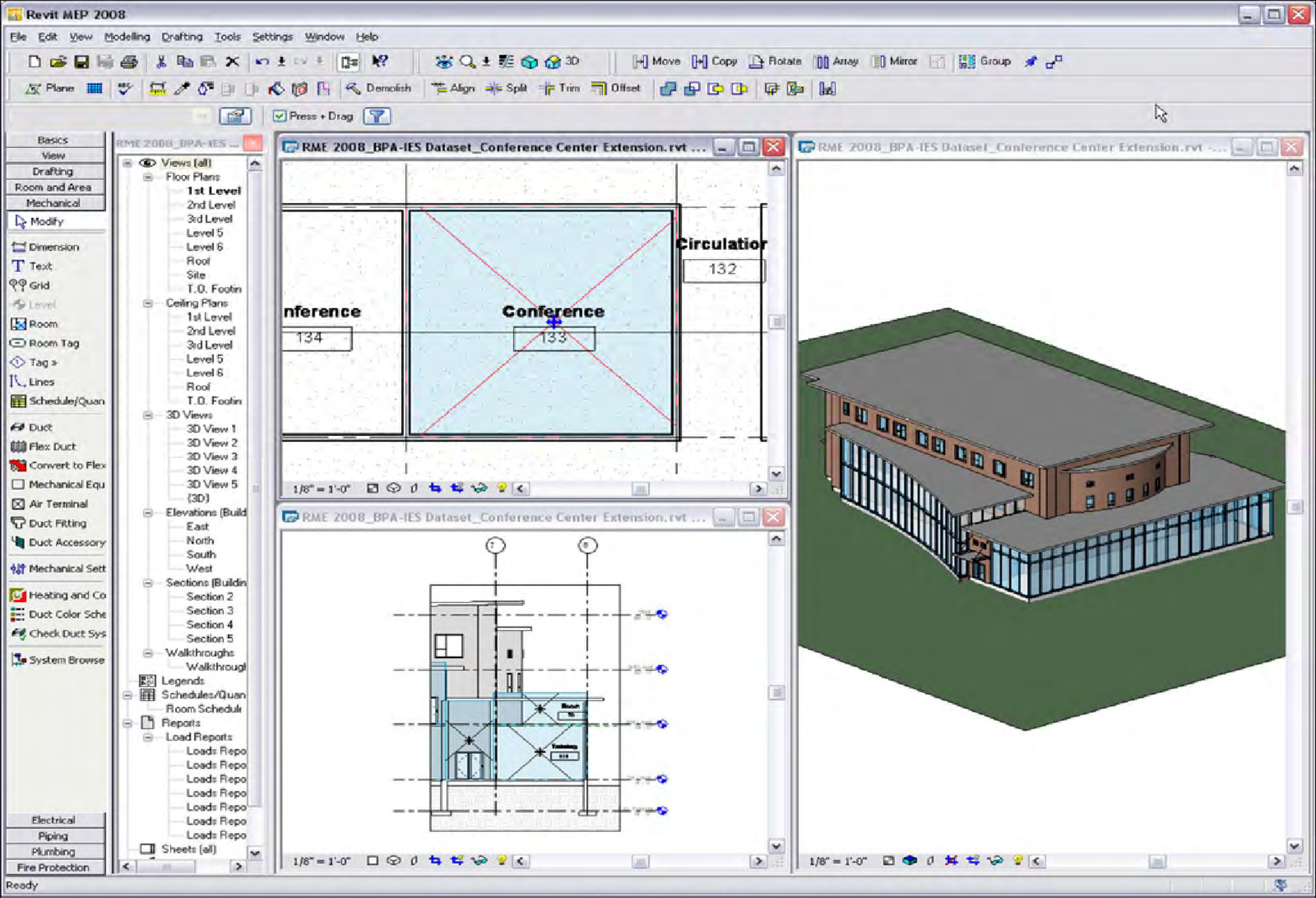
Sustainable design support through Building performance analysis. Virtually analyze the Revit model testing different building variables throughout design

www.iesve.com

Green Building Studio, Inc.

Energy analysis through FREE web service that integrates through gbXML export/import

www.greenbuildingstudio.com



05-Sustainable Design-narrated.avi

Cost Estimating

- 50-80% of the time needed to create a cost estimate using old methods is spent just on quantification
- Revit links to cost estimating software via:
  - Application Programming Interface (API)
  - ODBC connection
  - Output to Excel

Example partner product:

Innovaya

Visual cost estimating providing integration with Sage Timberline

www.innovaya.com

Specifications

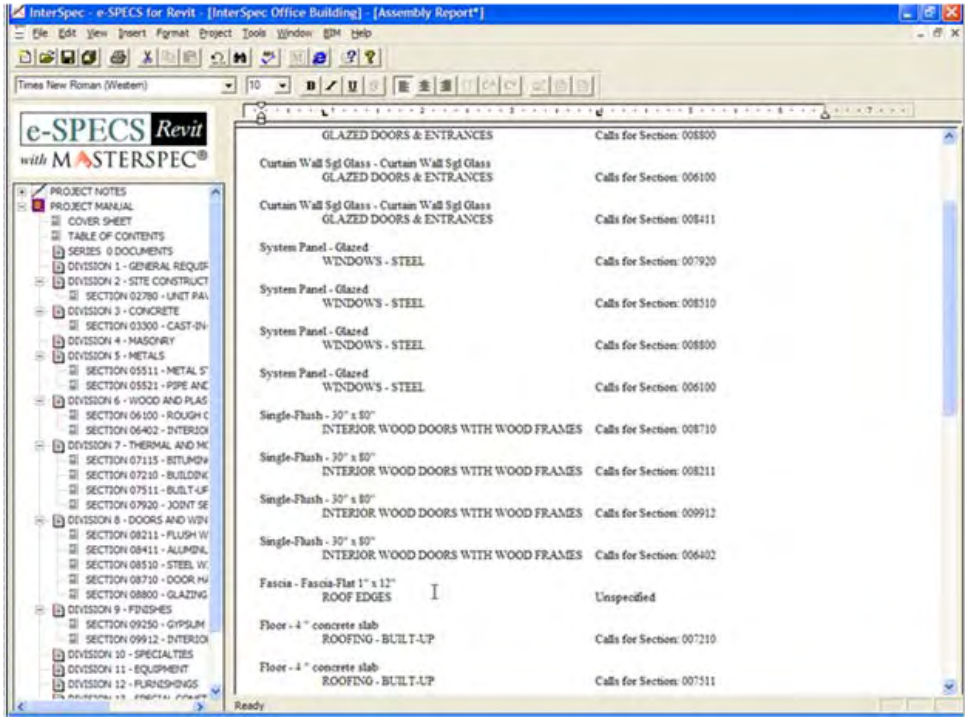
- Link specifications to the building model so that the building model and project specifications remain coordinated

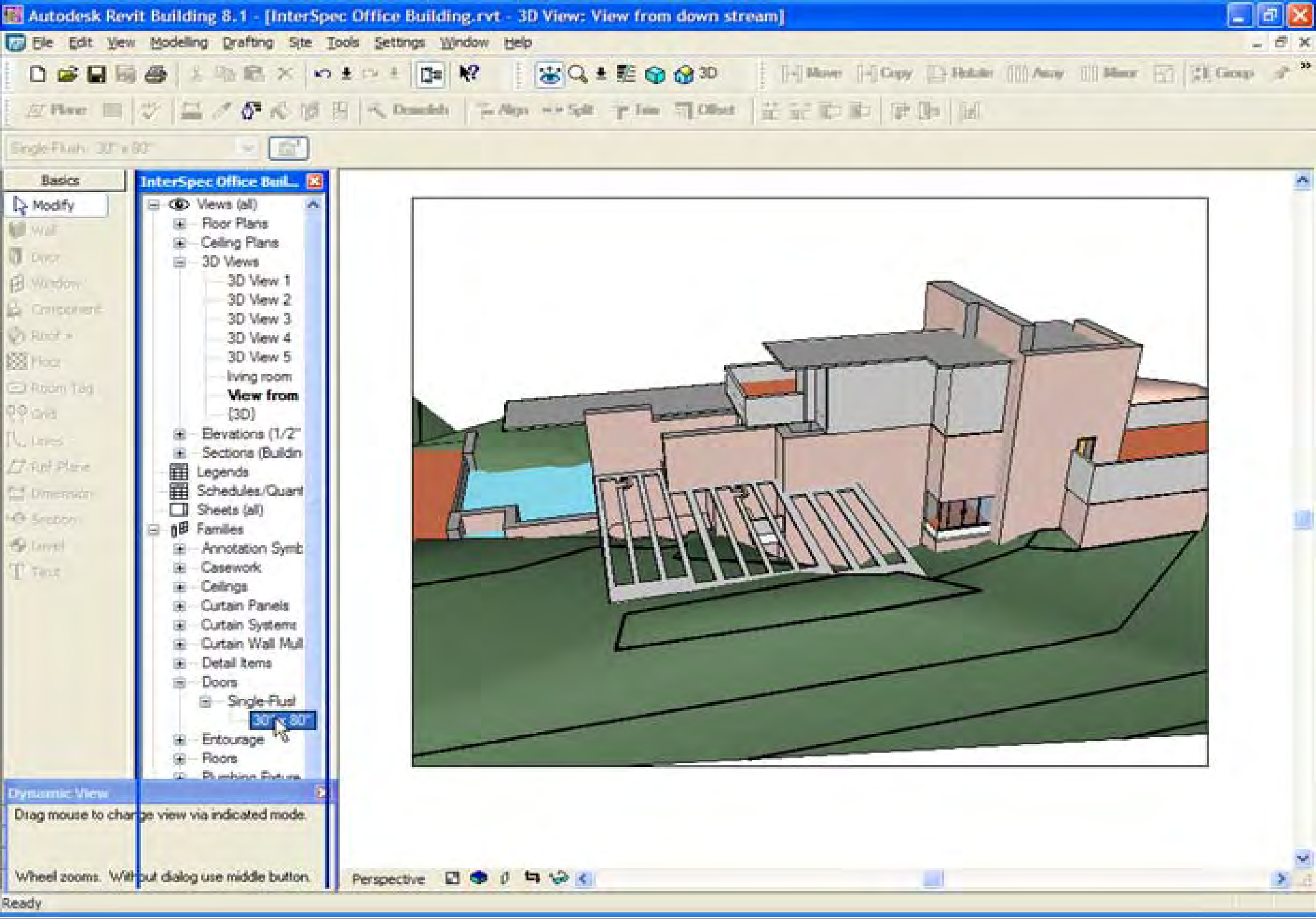
Example partner product:

e-SPECS

Specification management system that integrates with Revit through ODBC

www.e-specs.com

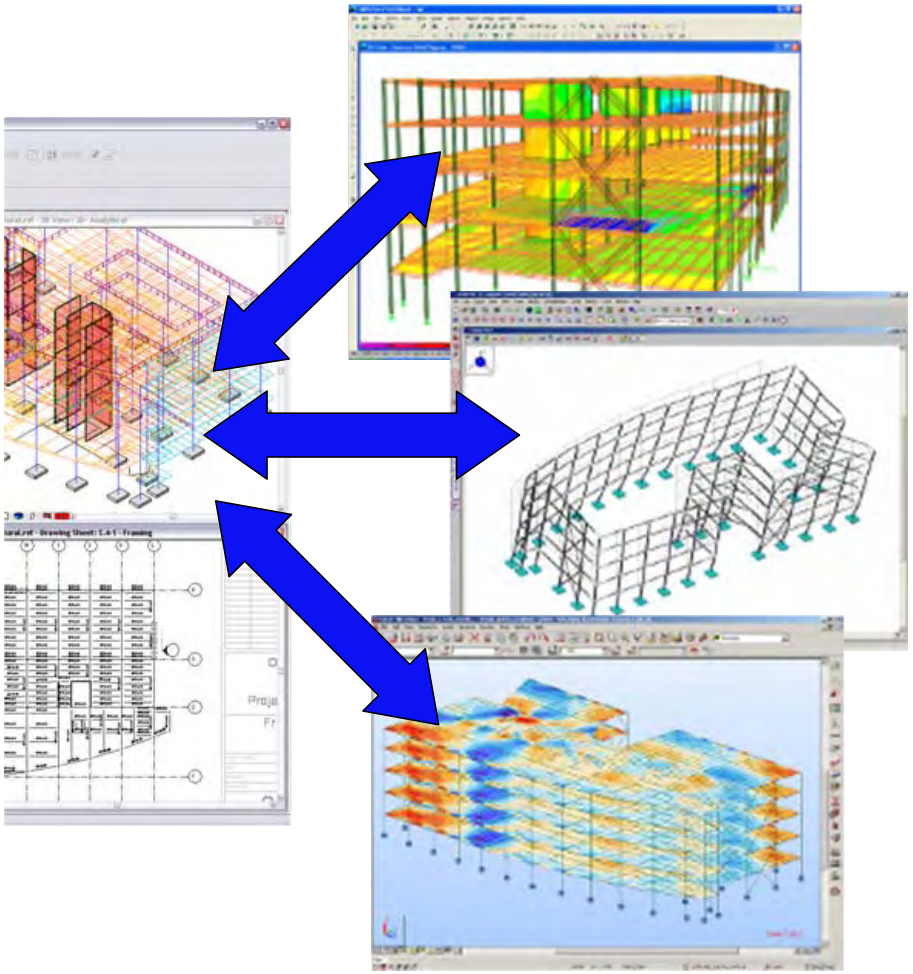


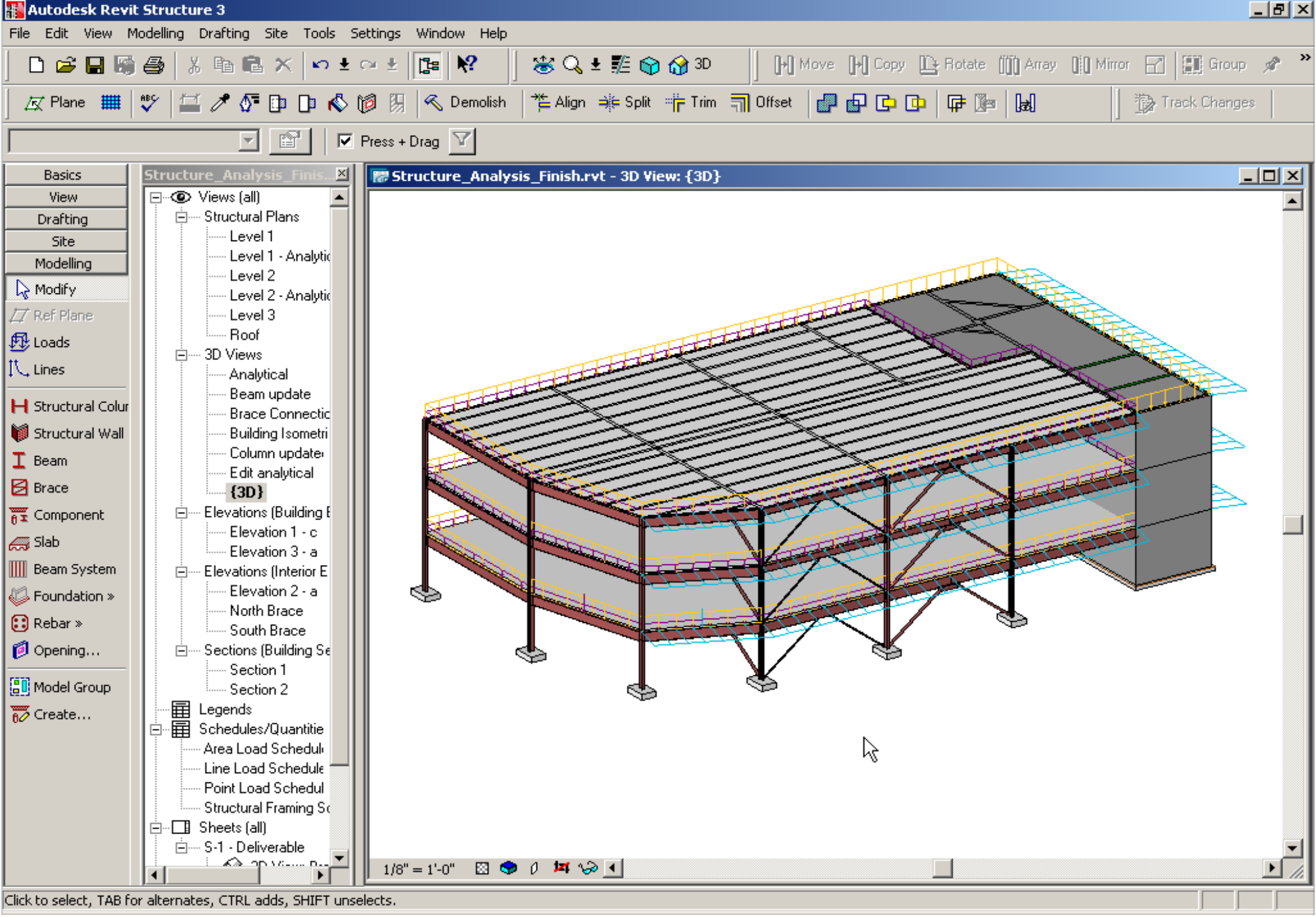

Autodesk Revit Building 8.1 - [InterSpec Office Building.rvt - 3D View: View from down stream]
File Edit View Modeling Drafting Site Tools Settings Window Help
Basics
Modify
InterSpec Office Buil...
Views (all)
Floor Plans
Ceiling Plans
3D Views
3D View 1
3D View 2
3D View 3
3D View 4
3D View 5
living room
View from
{3D}
Elevations (1/2"
Sections (Buildin
Legends
Schedules/Quant
Sheets (all)
Families
Annotation Symb
Casework
Ceilings
Curtain Panels
Curtain Systems
Curtain Wall Mull
Detail Items
Doors
Single-Flust
Entourage
Floors
Dynamic View
Drag mouse to change view via indicated mode.
Wheel zooms. Without dialog use middle button.
Perspective
Ready

Structural Analysis

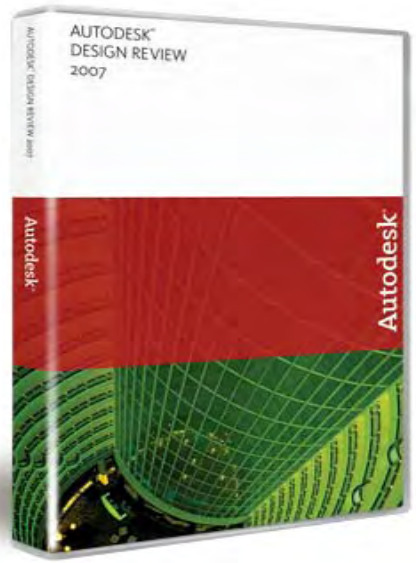
Coordinating with a number of analysis packages

- Coordinate analysis results more reliably with structural design
- Reduce errors through bidirectional linking to industry-leading analysis software

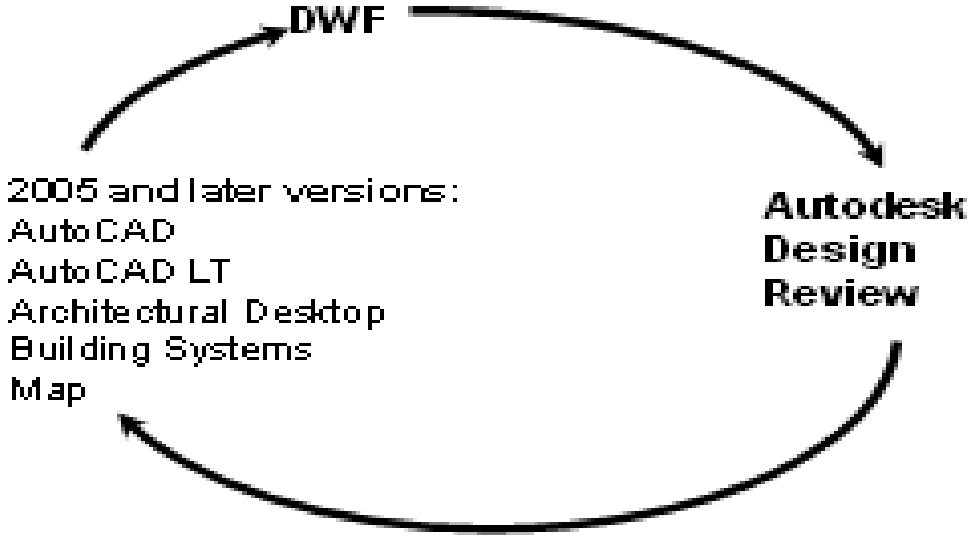


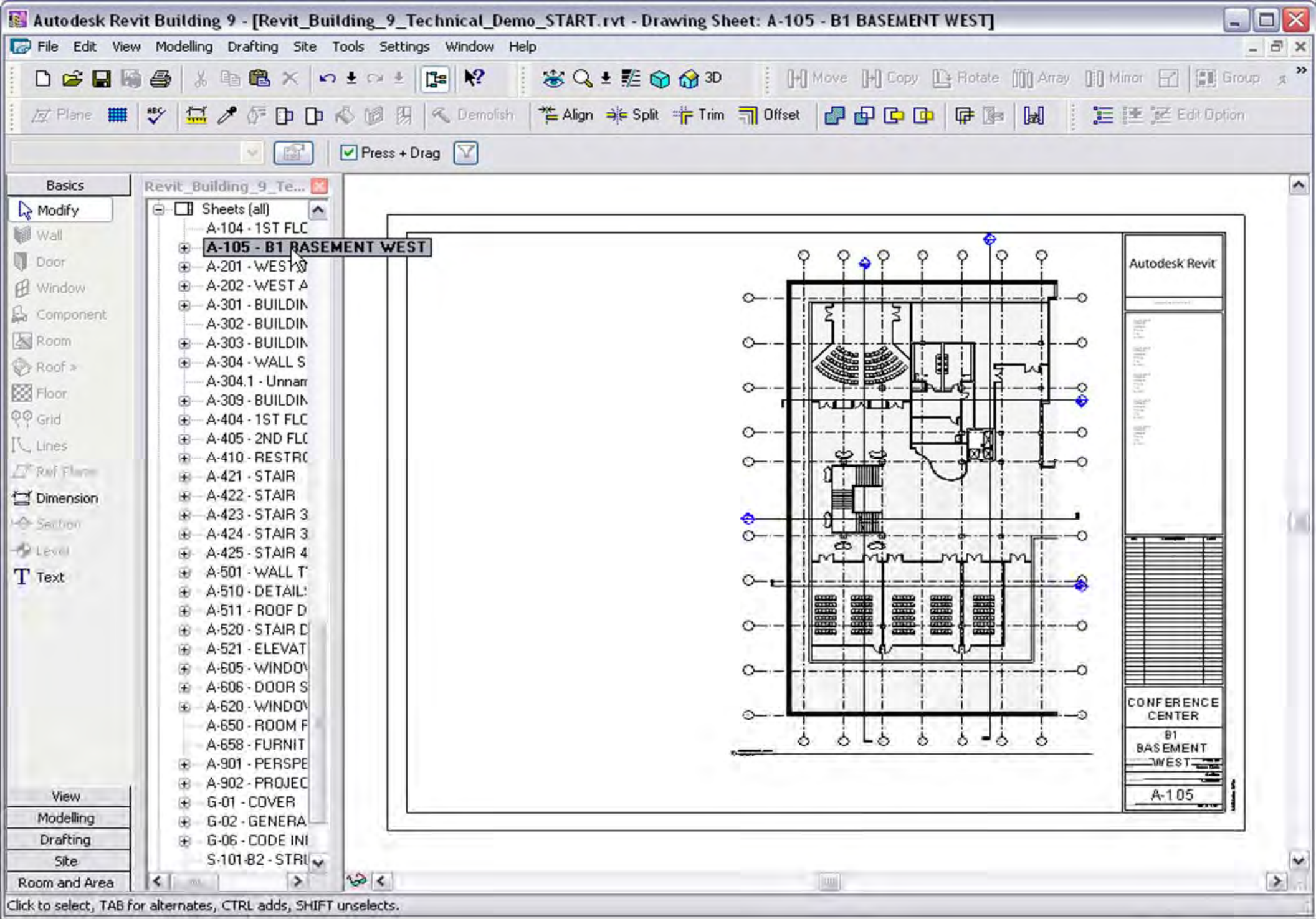

Autodesk Revit Structure 3
File Edit View Modelling Drafting Site Tools Settings Window Help
Move Copy Rotate Array Mirror Group
Plane Demolish Align Split Trim Offset Track Changes
Press + Drag
Basics
View
Drafting
Site
Modelling
Modify
Ref Plane
Loads
Lines
Structural Colur
Structural Wall
Beam
Brace
Component
Slab
Beam System
Foundation »
Rebar »
Opening...
Model Group
Create...
Structure_Analysis_Finis...
Views (all)
Structural Plans
Level 1
Level 1 - Analytic
Level 2
Level 2 - Analytic
Level 3
Roof
3D Views
Analytical
Beam update
Brace Connectic
Building Isometri
Column update
Edit analytical
{3D}
Elevations (Building E
Elevation 1 - c
Elevation 3 - a
Elevations (Interior E
Elevation 2 - a
North Brace
South Brace
Sections (Building Se
Section 1
Section 2
Legends
Schedules/Quantitie
Area Load Schedul
Line Load Schedule
Point Load Schedul
Structural Framing Sc
Sheets (all)
S-1 - Deliverable
Structure_Analysis_Finish.rvt - 3D View: {3D}
1/8" = 1'-0"
Click to select, TAB for alternates, CTRL adds, SHIFT unselects.

Digital Design Review



- For every person who creates design data
  10 people need to use that data
- DWF was created to facilitate those users
  - Do not need the original design data
  - “Light geometry” that retains the original model geometry AND intelligent design data
  - Facilitates electronic review cycles



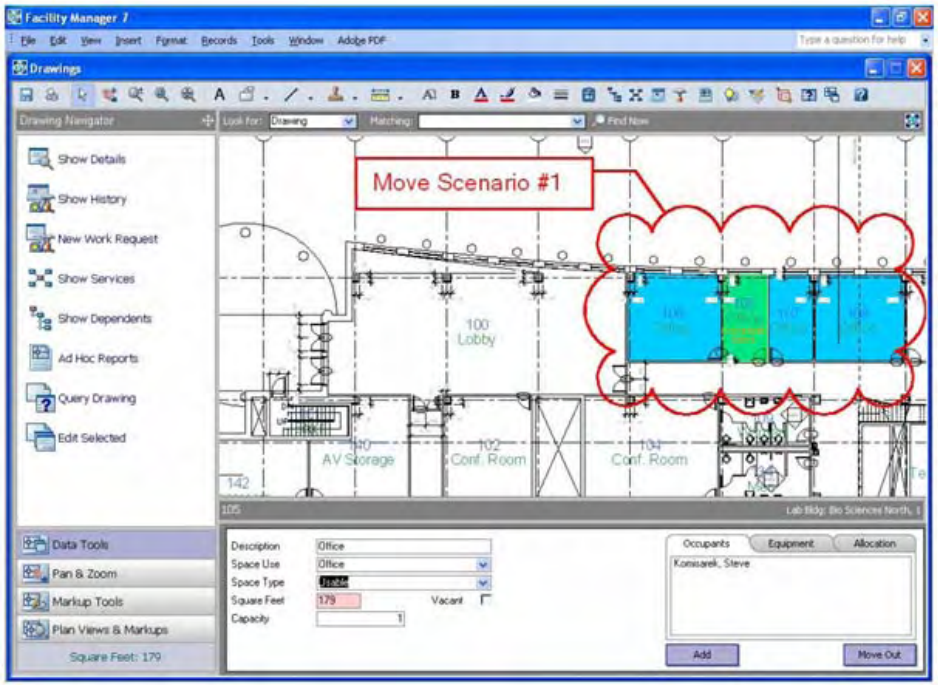

Autodesk Revit Building 9 - [Revit_Building_9_Technical_Demo_START.rvt - Drawing Sheet: A-105 - B1 BASEMENT WEST]
File Edit View Modelling Drafting Site Tools Settings Window Help
Move Copy Rotate Array Mirror Group
Plane Demolish Align Split Trim Offset Edit Option
Press + Drag
Basics
Modify
Wall
Door
Window
Component
Room
Roof
Floor
Grid
Lines
Ref Plane
Dimension
Section
Level
Text
View
Modelling
Drafting
Site
Room and Area
Revit_Building_9_Te...
Sheets (all)
A-104 - 1ST FLC
A-105 - B1 BASEMENT WEST
A-201 - WEST
A-202 - WEST A
A-301 - BUILDIN
A-302 - BUILDIN
A-303 - BUILDIN
A-304 - WALL S
A-304.1 - Unnam
A-309 - BUILDIN
A-404 - 1ST FLC
A-405 - 2ND FLC
A-410 - RESTRC
A-421 - STAIR
A-422 - STAIR
A-423 - STAIR 3
A-424 - STAIR 3
A-425 - STAIR 4
A-501 - WALL T
A-510 - DETAIL
A-511 - ROOF D
A-520 - STAIR D
A-521 - ELEVAT
A-605 - WINDO
A-606 - DOOR S
A-620 - WINDO
A-650 - ROOM F
A-658 - FURNIT
A-901 - PERSPE
A-902 - PROJEC
G-01 - COVER
G-02 - GENERA
G-06 - CODE INI
S-101-B2 - STRU
Autodesk Revit
CONFERENCE CENTER
B1 BASEMENT WEST
A-105
Click to select, TAB for alternates, CTRL adds, SHIFT unselects.

Facilities Management

- Inadequate interoperability costs $15.8 billion annually
  - $10.5 billion cost to owners/operators as a result of ongoing facilities operation and maintenance
- Much of that cost can be mitigated by using information from BIM in FM

Autodesk FMDesktop

Reads DWF files published from Revit and automatically interprets space and room data. Users can then manage facilities in FMDesktop and publish markups back to Revit via DWF.



Facilities Management

With the increase of BIM for design, the owner/operator's use of that building information for facilities management is becoming more commonplace and more anticipated. Consider these examples:

- Government agencies such as the U.S. GSA now require the delivery of spatial program information from building information models for major projects that are receiving design funding in Fiscal Year 2007 and beyond (http://www.gsa.gov/bim).
- To facilitate life-cycle building process integration and sharing digital datasets, the National Institute of Building Sciences (NIBS) formed a committee in early 2006 to create a National Building Information Model Standard to provide a common model for describing facility information (http://www.nibs.org/newsstory1.html#).
- The American Institute of Architects (AIA) is considering how to modify their contract documents to codify the transfer of a building information model (http://www.aia.org/nwsltr_tap.cfm?pagename=tap_a_documents); putting in place an agreement structure whereby the building information model and the intellectual property it represents can flow naturally from the architect to the owner/operator, who can then get better data to manage a building from the most appropriate source of that data: the architect who designed the building.

Conclusions

- Increase productivity and accuracy while reducing cycle times
- Reduce waste and inefficiency
- Create more sustainable environment
- Better manage buildings throughout their lifecycle

"It's sad to see an architect drafting in CAD—such a waste of talent and energy."

Jeff Millett, AIA
Director of Information and Communications Technology
The Stubbins Associates

Questions & Answers

To contact me:

David S. Cohn
711 Chuckanut Drive North
Bellingham, WA 98229-6921

360-733-0711
mailto:david@dscohn.com
www.dscohn.com