



November 30 – December 3, 2004 ♦ Las Vegas, Nevada

## From Napkin to BIM: Preliminary Design in Autodesk® Revit

Matthew Jezyk – Product Designer, Autodesk Revit

### BD25-2

You just got a building sketch from the principal of your firm. Great! Now it's time to build a BIM. You can start using Autodesk Revit even before you need walls, doors, and windows. Learn how to perform preliminary and conceptual design in Revit. Cover such topics as space planning, area analysis, design options, massing, and advanced geometry creation. We'll also cover how to create compelling presentations and how to transition to walls, roofs, and floors from the initial design.

#### Who Should Attend

Architectural designers, managers, and principals in firms

#### Topics Covered

- Learn how to use Revit as a preliminary design tool and then turn the design into a usable building shell
- Explore alternate conceptual designs using Design Options and Phasing
- Schedule meaningful data such as gross floor areas, volumes, and more
- Create compelling presentation images to help you win new work
- Create complex forms and turn them into usable building shells with walls, curtain systems, roofs, and floors

#### About the Speaker:

##### Matthew Jezyk

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Matt works in product management for Autodesk® Revit® and led the overall direction of Revit 7.0. He works closely with the development team and has designed large parts of the software. Since 1999, Matt and other architects on staff have helped Revit become a tool that speaks the language of architecture. Matt graduated from Carnegie Mellon University with a Bachelor of Architecture degree.

Have you ever been in a situation like this one?



**“Mmmm, Yeah... Peter, Here’s the thing... I’m gonna need you to come in on Saturday and work on this presentation...”**

There is a classic scene from the movie “Office Space” where Mr. Lumbergh (on the left) asks Peter on a Friday to come in over the weekend to finish some work.

This movie illustrates and parodies the all-too common relationships and practices that (sadly) occur in many architectural offices.

- Someone comes up with a design and someone else does the work of creating plans, sections, elevations and 3d images to convey the design idea to others.
- Even small shops and sole practitioners go through this process, they just happen to do all the work themselves.

Here are a few questions to ask yourself:

- Are your current schematic design presentations compelling and convincing?
- So you spend a great deal of time creating presentation drawings?
- Do you create ‘throw-away’ presentation materials that are not usable later in the process?
- Do you need to use separate applications (graphics applications or 3d modeling tools)?

This class will discuss how to use technology available today to make your life easier and make your presentations more compelling.

And, of course, at the same time you are making a Building Information Model that can be used later on to create your construction documents.

**Here is a scenario that's pretty common in architectural firms across the country:**

It's 10:00 am on a Friday morning. You're at your desk, drinking coffee and finishing up work on a project. You're looking forward to nice relaxing weekend. Maybe do some fishing or take your girlfriend out for a nice dinner....

**In walks the Principle of your 50-person architectural design firm with a bunch of sketches in his hand.**

Uh-oh.... Trouble is in the air. You know a pile of work is going to land on your desk in a second....

He comes up to you and says, "Hey Peter, how's it going?"

"Oh Hi, Mr. Lumbergh, how are you today?"

"Oh just great, Peter. I was just talking with one of our clients. They'd like to put a new building up on the university campus."

"Wow, Mr. Lumbergh, that's great! Do you have an idea about what they'd like to build?"

"Funny you should mention that Peter. I sketched up some ideas this morning that I'd like you to put into the computer."

Uh-oh. You know what's going to happen next, but try to stall for time, "Sure thing Mr. Lumbergh, give me what you have and I can have something for you to look at by Wednesday or so of next week."

**"Mmm... Yeah, Peter, Here's the thing... I told our client I'd show him a few ideas on Monday. Do you think you could whip up a presentation for me by then?"**

"Well Mr. Lumbergh, let me see what you have so far. I can work on it today and show you something this afternoon."

**He lays out his sketches on your desk.**

"Mmmmm...Yeah, Peter, If you could just go ahead and do that, that'd be great.... "

**"I might need you to work this weekend to, y'know, punch up the presentation a little bit though... Mmm, Ok"?**

**Damn. This always happens. Do a couple good presentations and now you're the go-to guy....**

Ok, let's take a look at the sketches he has given us...

Here is starting point for the building we will be creating:

**Overall Site Plan:**

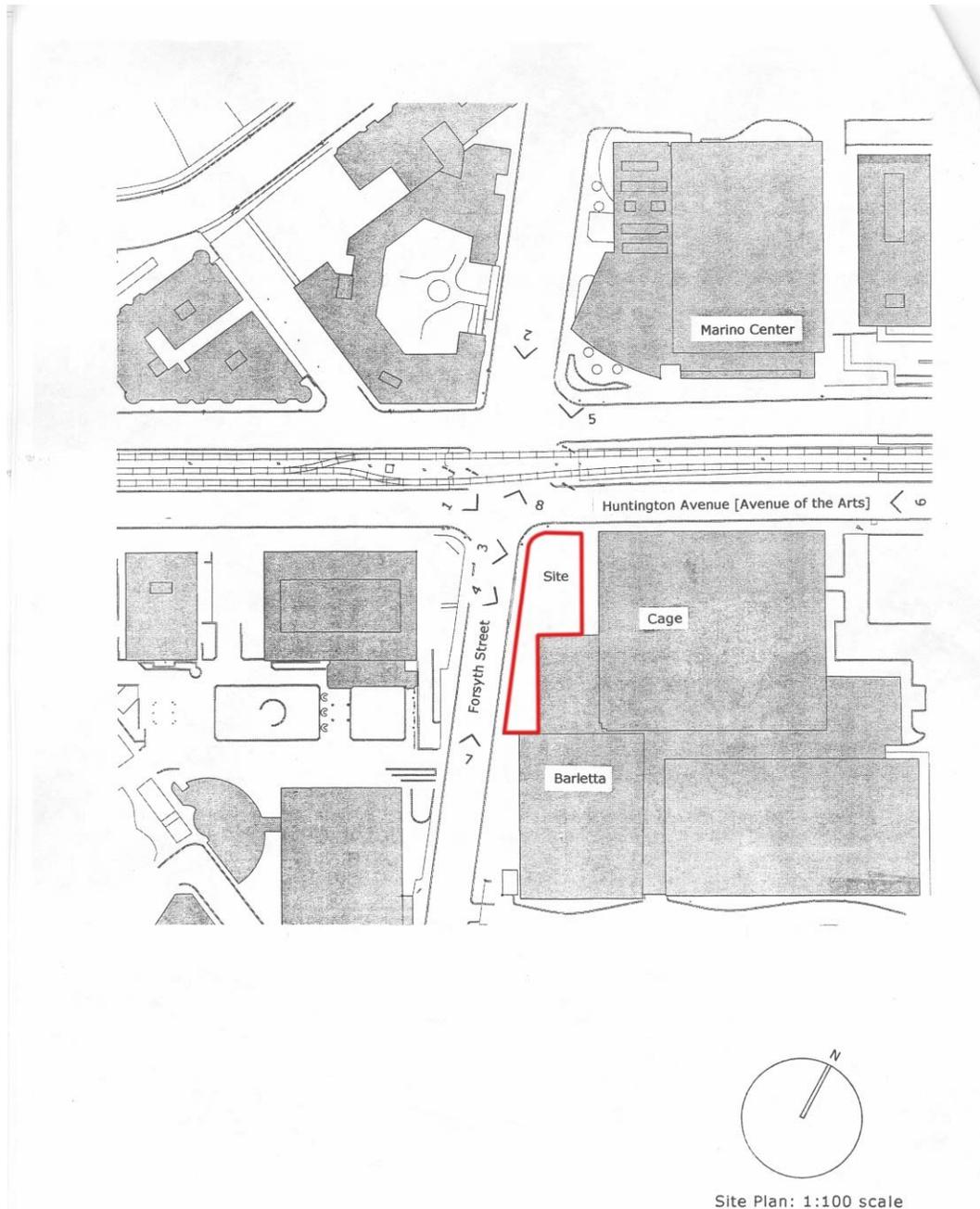
Here we have a pretty dense urban site in Boston. The site is in the middle of a major university, directly across from a new athletic facility and student center. It's on a major axis through Boston, on a 4 lane road with a major surface trolley line in the center.



**Site Plan:**

The site is a slot 'infill' site on a fairly major intersection in Boston. There is not a whole lot of space at grade, so it looks like we'll need to go up to fit the programmatic requirements.

Both the cross streets have a good deal of foot traffic between university students and the general public. It would probably make sense to take advantage of the street frontage for some of the public space requirements.



## Building Requirements:

- New school of architecture building for a major university in Boston.
- Maximize an under-utilized site
- Bring together currently disparate functions under one roof
- Provide a focal point for the university on a major road / axis through campus
- The building needs to have a strong visual presence on the site
- Provide a counterpoint to the new student center across the street.
- Be relatively inexpensive (cost is always an issue!)
- Large amount of public space at street level
- Architectural studios must be private space

## Conceptual Building Program:

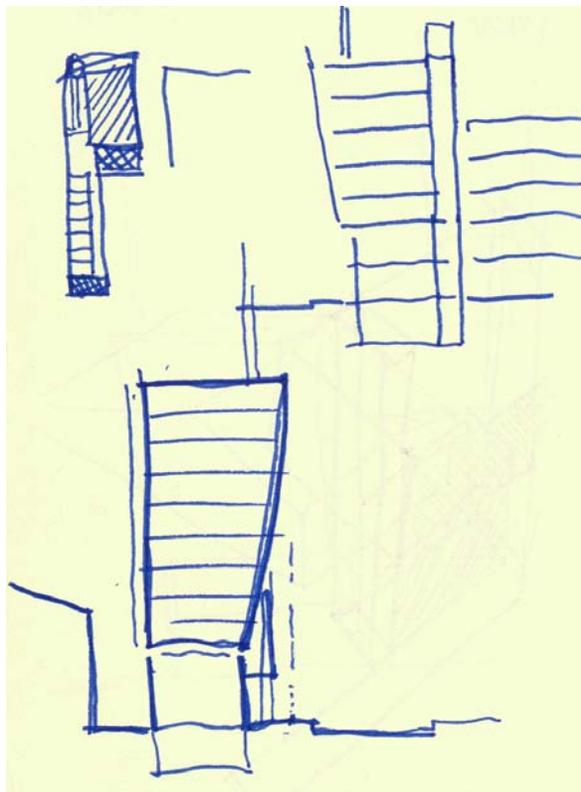
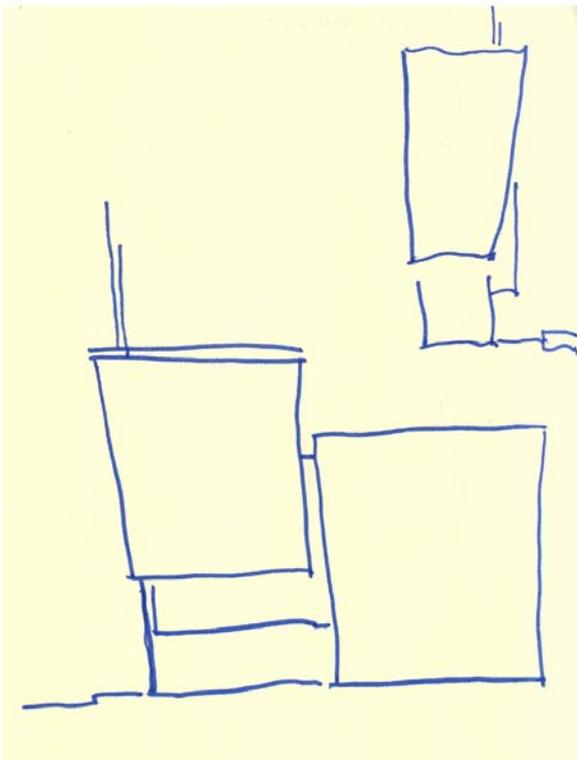
- Public Space
  - Lobby 2000 sf
  - Circulation 2500 sf
  - Gallery 1500 sf
  - Lecture 2000 sf
  - Library 2000 sf
  - Subtotal: 10000 sf
- Private Space
  - Arch Studios 15000 sf (5 studios)
  - Offices 2000 sf
  - Shop 2000 sf
  - Subtotal: 19000 sf
- Services
  - Mechanical 3000 sf
  - Stair/ Elev 9000 sf
  - Subtotal: 12000 sf
- Total: 41000 sf**

### Conceptual Elevations and Sections:

Here are a few ideas that Mr. Lumbergh sketched out pretty quickly on some trace. Take a look at the elevations and sections sketches below.

Looks like he's thinking about going up and creating a vertical layout to fit the program in. From the site plan, looks like there is minimal usable footprint on the site.

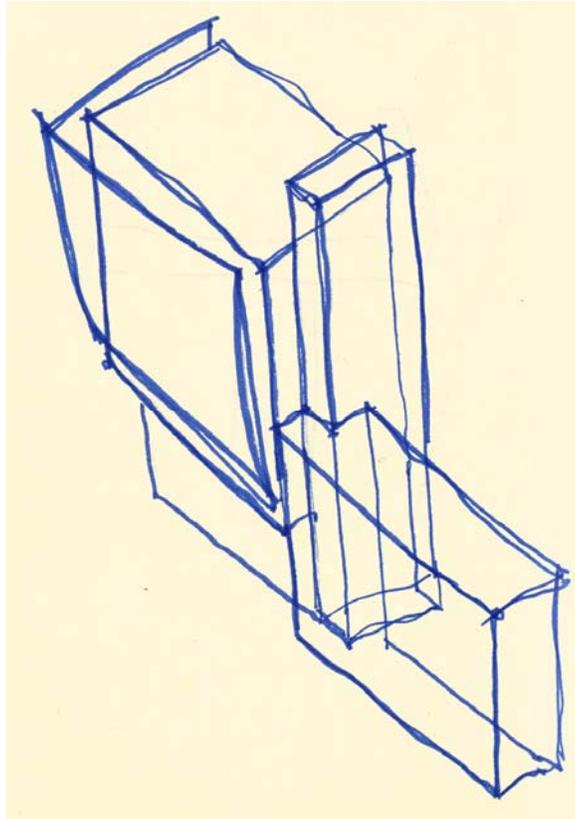
I'm not sure, but it looks like he's thinking of some sort of curving curtain wall for the exterior facade.



## Conceptual Massing Study:

This drawing gives a better understanding of the form that Mr. Lumbergh might be thinking of. Take a look at the 3d sketch below.

If I interpret his sketch correctly, it looks like there will be a few strong volumes in the Conceptual Mass. These forms will probably house the different functional areas of the building.



- The main form is vertical tower on what will be the front of the site.
- The secondary form is a horizontal 'bar' shaped volume on the 'dog-leg' of the site.
- The third form is a very thin, tall rectangular volume that will probably house the core and some services.
- The curvy form in the front we'll need to explore. I think he wants this to be a 'shell' of curtain wall that will help the building take on a singular image and be recognizable

I know Mr. Lumbergh wants two presentation boards by Monday that illustrate a pretty integrated conceptual design for the building.

Hopefully this new version of Revit that I have can help me finish this work today so I don't need to come in over the weekend!

### **Sounds like a tall order. How can Revit 7 help me do this?**

There are a few new features in Revit 7 we can take advantage of (we won't have time to cover them all in 90 minutes!):

1. All new Conceptual Design and Massing tools
  - a. Create Massing forms in-place or via loaded families.
  - b. Analyze the Massing study and extract Gross Area, Volume, etc
  - c. Tag and schedule the Massing forms to check areas against programmatic requirements.
  - d. Use Design Options to create quick conceptual schemes and option studies
  - e. Use Phasing to explore ways to construct over time
2. All new tools to create a Building Information Model from the Conceptual Design
  - a. Create objects (Walls, Curtain Systems, Floors and Roofs) by simply picking faces of the form.
  - b. Update these elements if the underlying Mass changes
  - c. Turn complicated forms into buildable objects like Curtain Systems (assemblies of curtain panels and mullions)
3. All new Presentation Views capabilities to "punch up" the design
  - a. Vectorial Shadows in all 2d and 3d views
  - b. Silhouette edges
  - c. Sectional Perspectives
  - d. Section Box graphics
4. And, of course, there are many existing Revit tools that help create great presentations:
  - a. Rooms and Area Studies
  - b. Color Fill diagrams (no need to edit polylines and hatches!)
  - c. Course scale fill for objects.
  - d. Live Views on Sheets / Easy layout of views and images
  - e. Rendering through Accurender or using the new VIZ 2005 plugin
  - f. Easy creation of DWF and PDF files

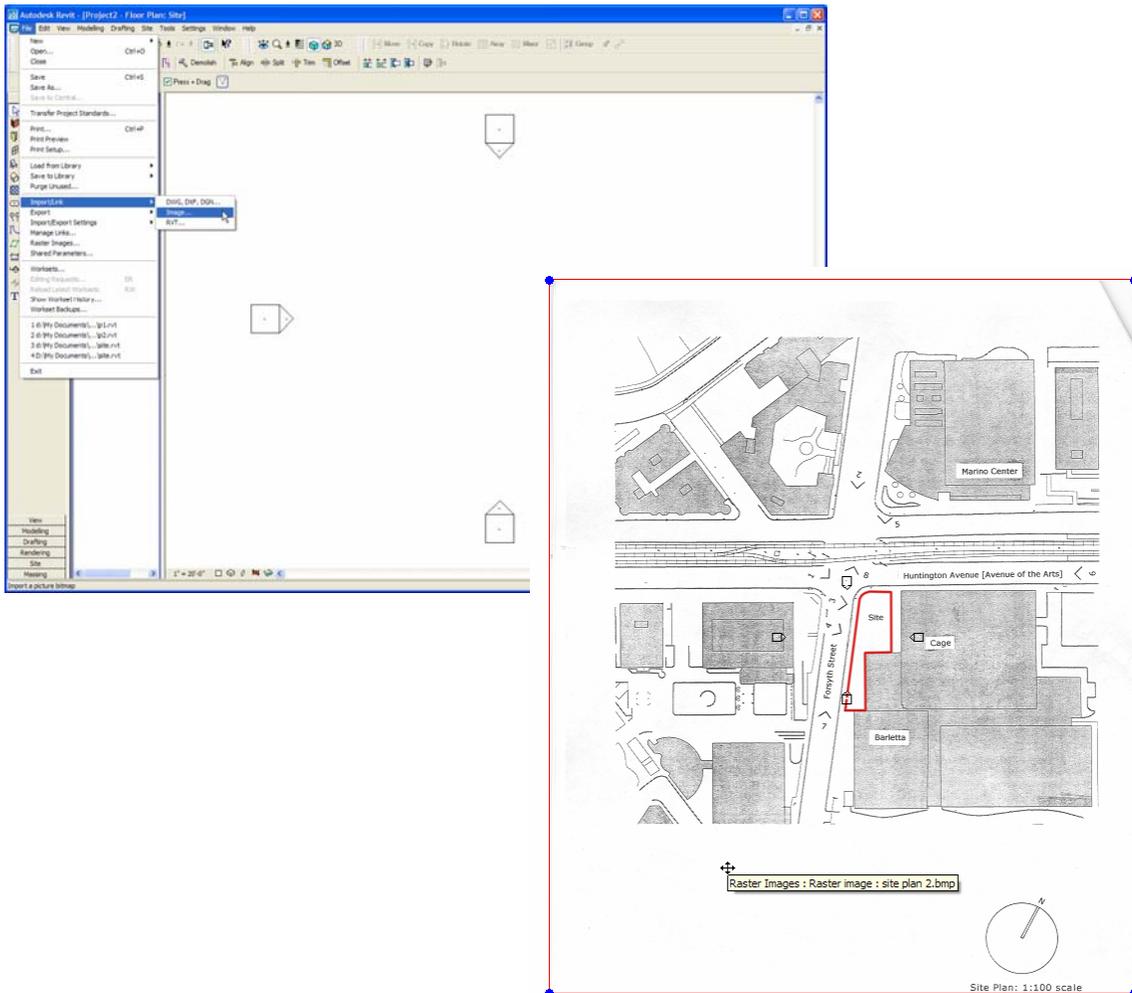
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**Ok, enough background. Let's do the demo!**

1. We will create building from scratch using a blank revit file.
  - a. Review basic building idea (above in handout)
  - b. Review rough building program (above in handout)

**Start with some scanned pictures of the site and the concept**

1. We will use the existing images to jumpstart the design.
2. site plan, plan, section, elevation and 3d sketch
3. Import pictures
  - a. Import Site Plan Raster into Site Plan view



Let's scale the site plan to a real model dimension and trace over it

- b. We know the site is 172' -0" long so let's scale the site plan image to fit.
- c. Select the site plan image
- d. Line up corner of site
- e. Scale site plan image to fit using Re-Size tool
- f. Pick the two vertical points on the bitmap and type in 172'
- g. The image will scale to the model size

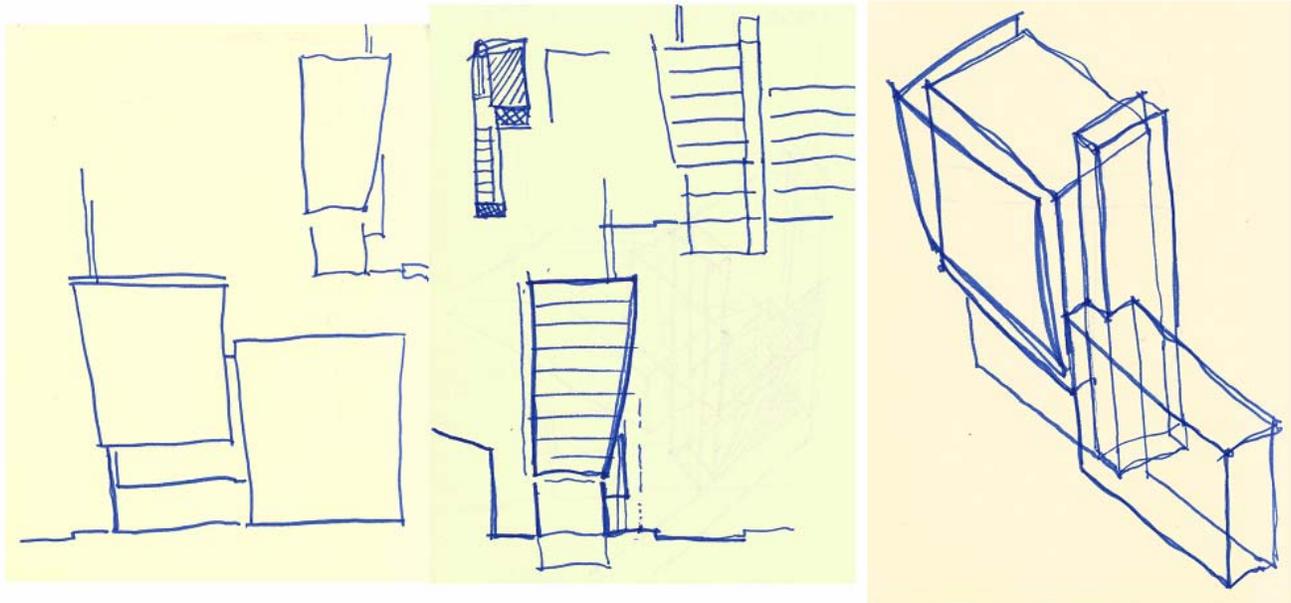
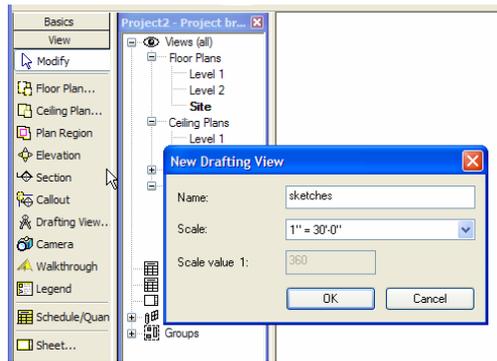


- h. Sketch a rough outline using model lines for use later (it doesn't matter at this point how precise we are, we can refine it later using vector data from the civil engineer)



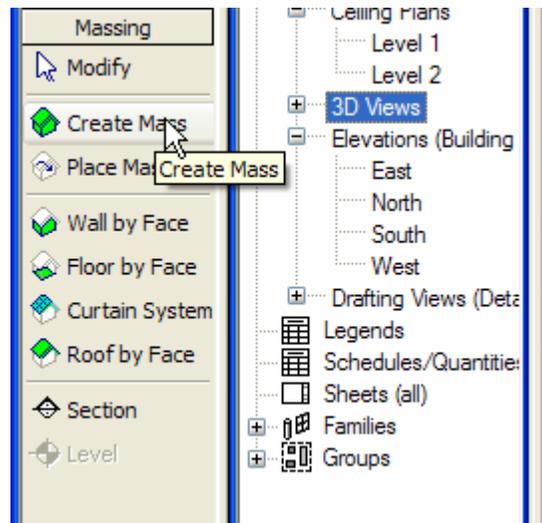
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- i. Import sketches into Drafting view for reference later
  - i. Elev
  - ii. Section
  - iii. 3d

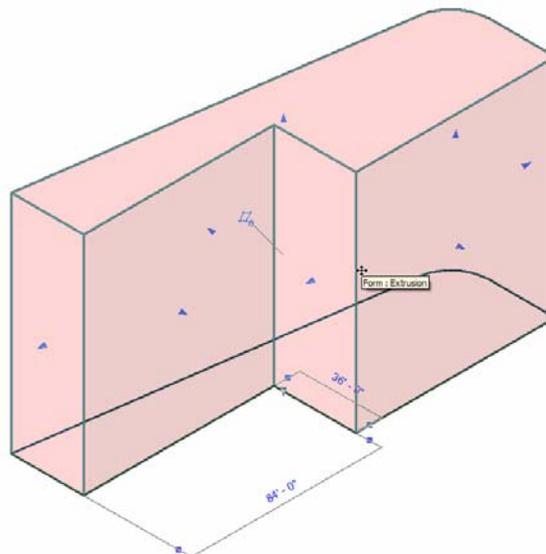


## Use Revit to layout forms quickly and iterate through designs

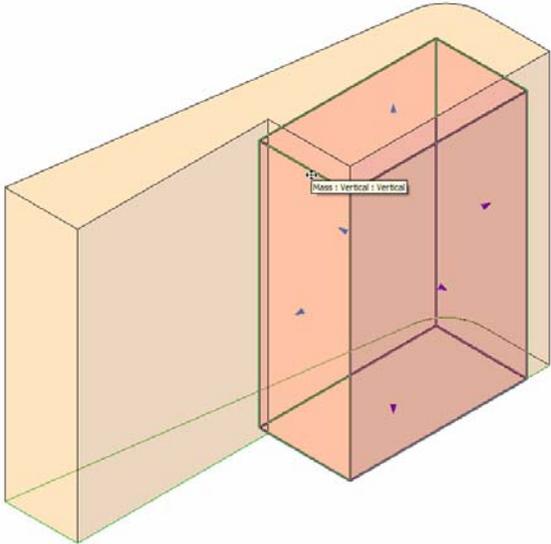
1. Ok, now that we have all the raster image data in Revit, we can start sketching over it.
2. Let's create the exterior Massing model using the site plan bitmap as a guide
  - a. Activate the Massing design pane
  - b. Using "Create Mass" (creates an Inplace Mass family) to make the basic forms



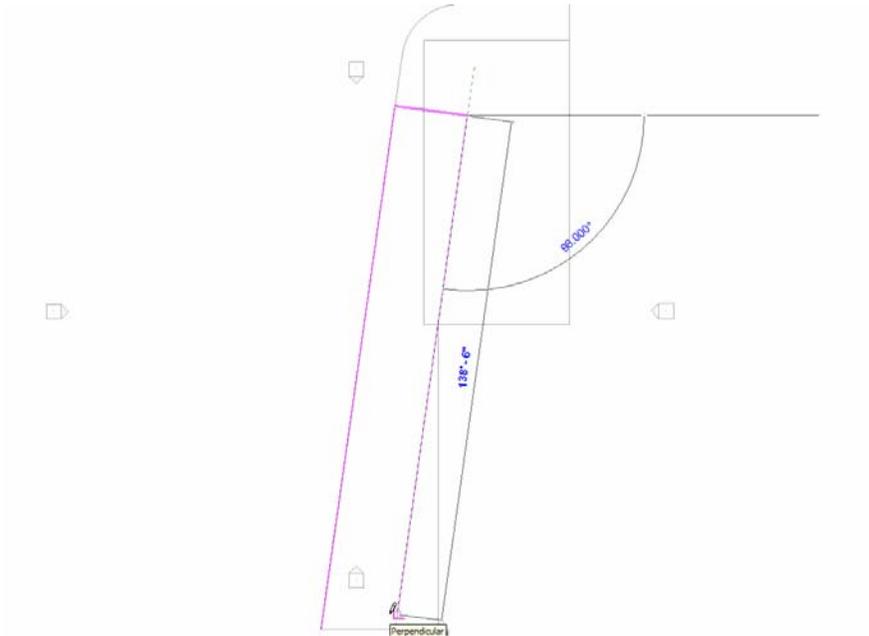
- i. Create a mass named "Zoning" and then a basic extrusion by picking the model lines. Set the depth to 120' and Finish Sketch. You can also set the material and the subcategory of the Form for greater control later.
- ii. Hit Finish Mass to exit out of the first form.
- iii. This makes a basic zoning envelope for the site. You can use it to evaluate the design later. The form should look something like this:

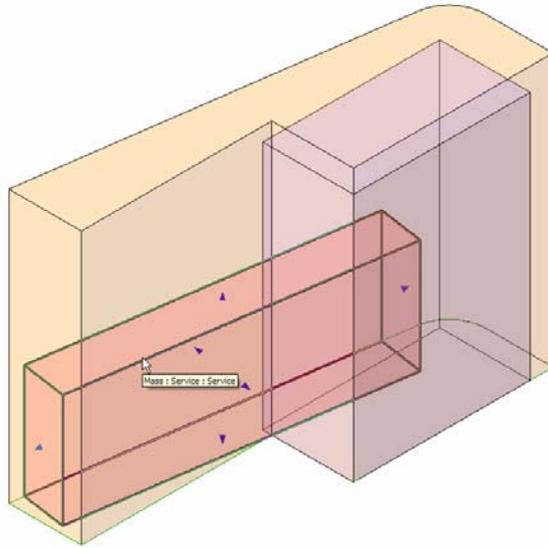


- iv. Create a new mass named "Vertical Tower". Create the main Vertical Tower by create an extrusion and then sketching a rectangle. Set the depth to 110'.

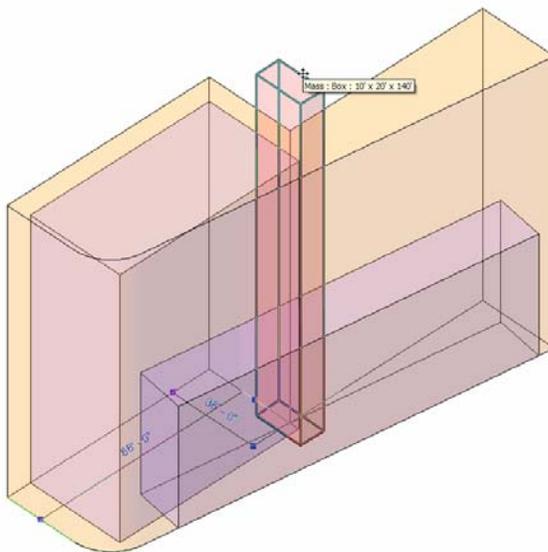


- v. Create a new mass named "Service Bar". Create main horizontal Service Bar by sketching an extrusion. Set it's depth to 50'





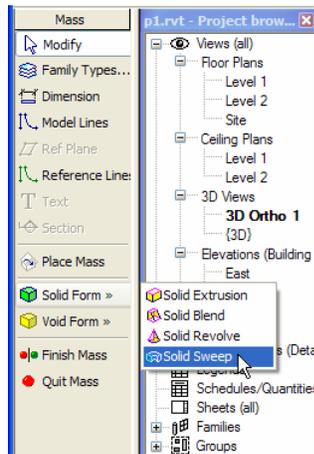
- c. Using Loaded Mass Families to make the Cores. Loaded Mass families can be used to create a 'kit of parts' of repeatable portions of the building
  - i. Let's create the cores, where all the vertical circulation and services will be.
  - ii. Load Mass family "Box.rfa"
  - iii. Place an instance and set the instance properties to 10' wide x 20' long x 140' tall



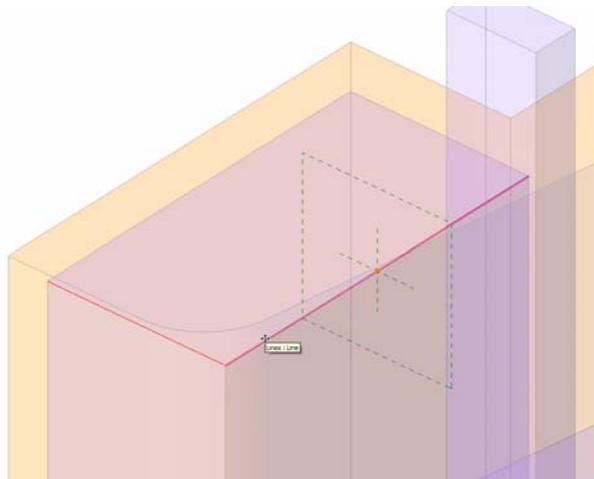
- iv. Loaded Mass families can help you perform 'inside-out' design to meet the programmatic requirements

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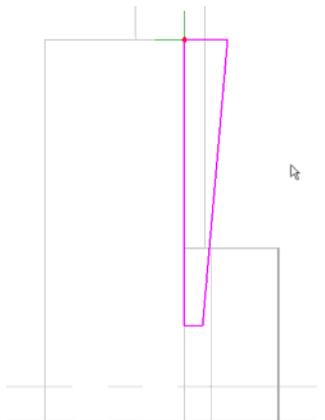
3. Now let's add some articulation using a Sweep and editing it in 3d and elevation views
  - a. Adding exterior articulation of the curvy 'shield' form (Edit existing "Vertical Tower" mass)
    - i. Create a new solid Sweep



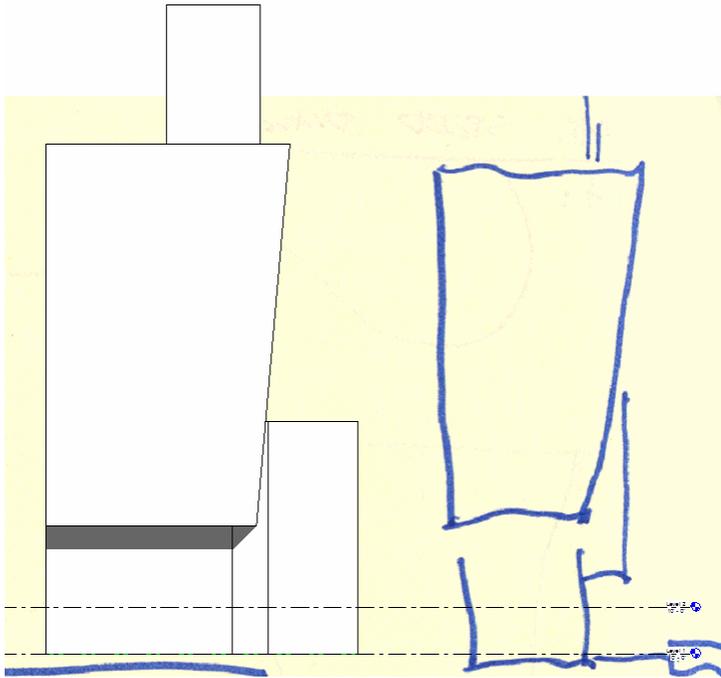
- ii. Use the "Pick Path" tool and pick the top edges of the Vertical Mass. This will make the sweep be associated with the Mass and update if it changes.



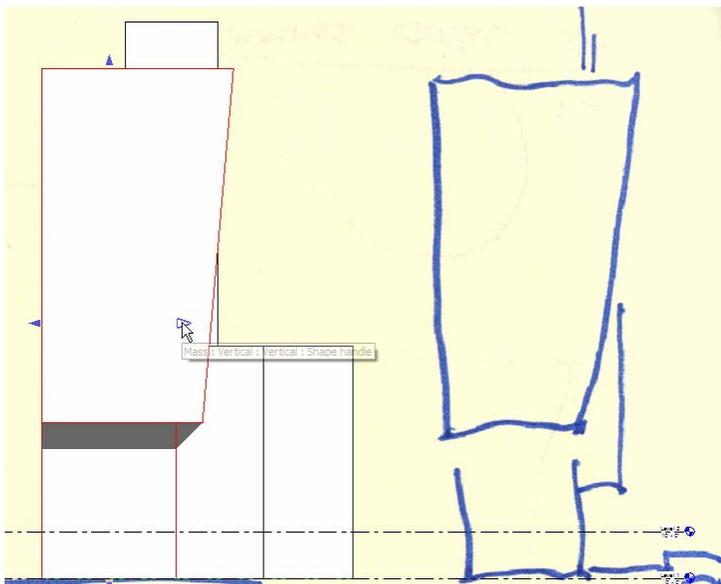
- iii. Create a profile sketch in the elevation view that looks like this:



- b. After you Finish Sketch and Finish Mass, you can compare the basic 3d Mass with the elevation sketches by copy-pasting the sketches we imported previously into the elevation view.



- c. Hmm. Not really that close yet, but it does not matter, I can edit the shapes easily to get closer to the original design intent.
- d. Let's first 'thin' out the elevation a little by dragging on the Blue Arrow Grips

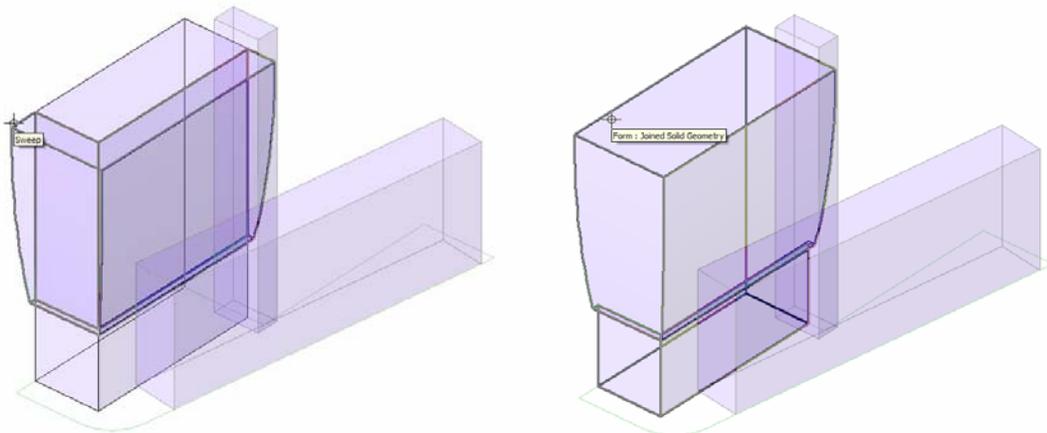


- e. Still not quite right. I think we need a shallow arc or a spline to really create the right form. You can go back in and edit the Sweep profile at any time

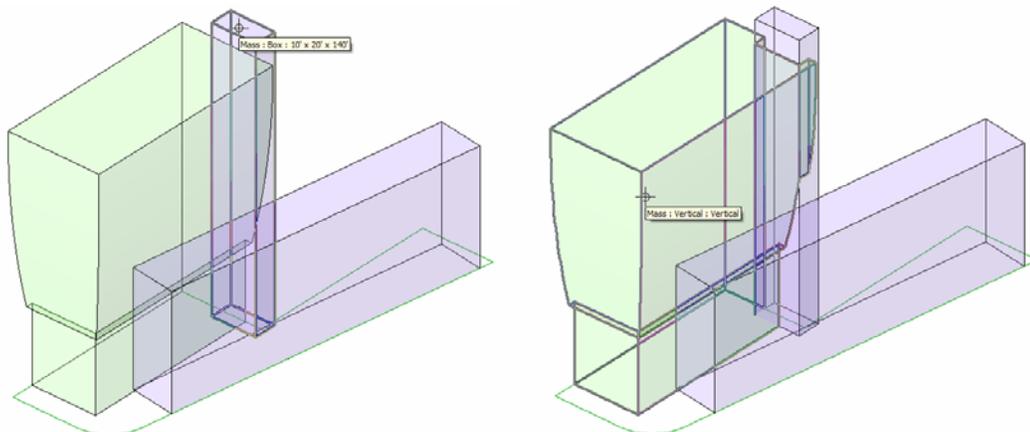
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4. Here we have added an arc to the sweep profile sketch to match the desired shape.
5. We can also refine the design by using the Join Geometry tool to clean up the overlapping geometry between the Masses
  - a. While editing a family, you can use the Join Geometry tool to combine forms



- b. Using Join Geometry between separate Mass families will cut one Mass from the other and get rid of overlapping geometry.



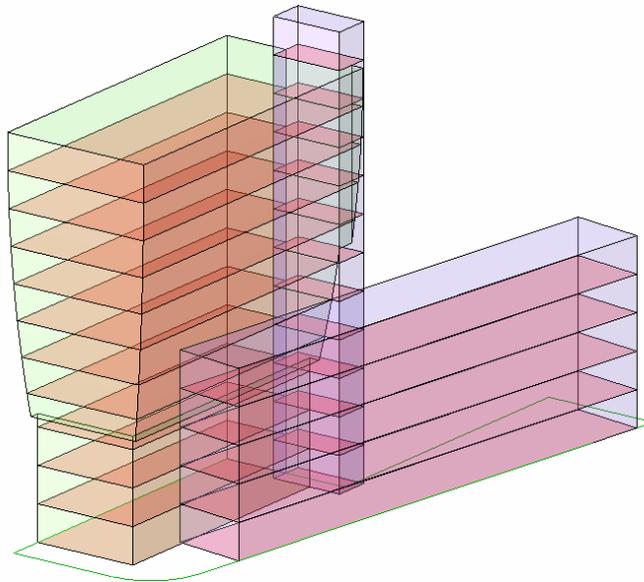
6. Now for the fun part. Let's start to analyze the design!

a. Create an array of 12 new Levels in elevation, with a 12' floor to floor



b. In a 3d view, let's create some Floor Area Faces from the Masses.

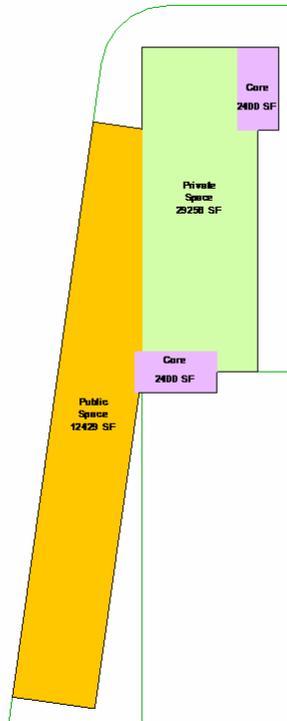
- i. Floor Area Faces are 'Slices' through a Mass family at selected Level heights.
- ii. They are a conceptual way to think about 'inhabitable' floors of the building
- iii. Select the Mass families, hit the 'Floor Area Face' button and then select the Levels 1-13
- iv. This will slice the Masses by the levels and make Floor Area Faces



- v. If you select a Mass instance and look at the 'Gross Floor Area' property, you'll notice it is now filled out. It is calculated by adding up the areas of all Floor Area Faces from a Mass instance.
- vi. Mass Floor Area Faces stay associated with their Level. If you change the height of any Level, the Floor Area Face will be updated.

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c. Mass tags can be used to illustrate the programmatic requirements in plan views



d. Mass schedules can be used to evaluate the current areas against the building program. Not bad, the original program called for 41,000 SF. We are only 1100 SF over at this point!

Mass Schedule	
Family and Type	Gross Floor Area
Vertical: Vertical	28150 SF
Service: Service	9145 SF
Box: 10' x 20' x 140'	2400 SF
Box: 10' x 20' x 140'	2400 SF
<b>Grand total: 4</b>	<b>42095 SF</b>

7. At this point, you could create different conceptual schemes using Design Options. You could create as many schemes as you want and present them internally in your office or to your client. All options are stored in the building information model.
  
8. You could also using Revit's Phasing capabilities to explore constructing portions of the building at different points in time. The horizontal bar, for example, could have a few floors added onto it after 3 years.
  
9. Let's skip over these points for now. They deserve (and actually have) classes devoted strictly to discussing these powerful tools

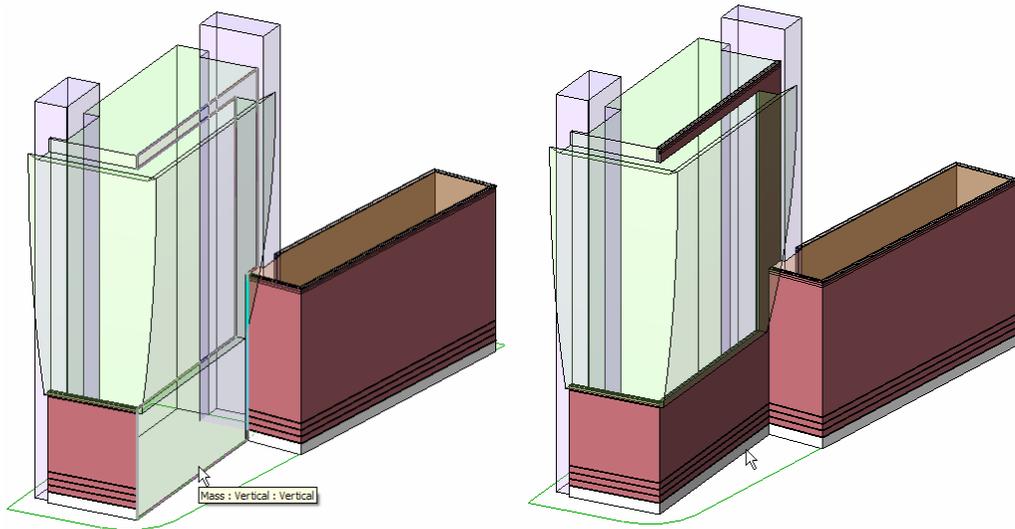
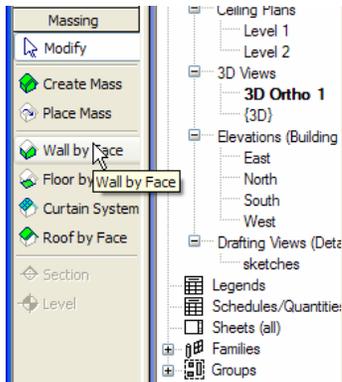
## Now it's time to create the building from the form

The work we have done so far has created some associative, 'smart' geometry in Revit. We have a Massing model that can be manipulated, flexed and stretched.

This is really only part of the powerful new Conceptual Design features though. There are also new ways to create the building shell.

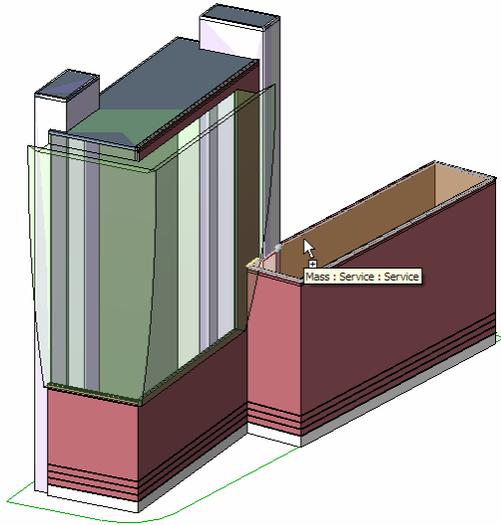
### 1. Walls by Picking

- a. Let's create some walls around the form by simply picking the faces of the Mass families



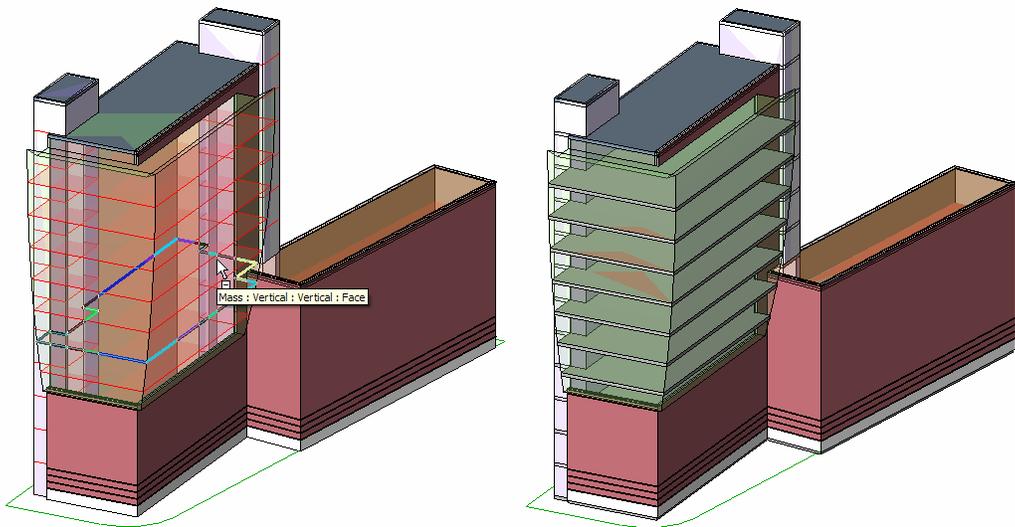
### 2. Roofs

- a. Same idea for Roofs



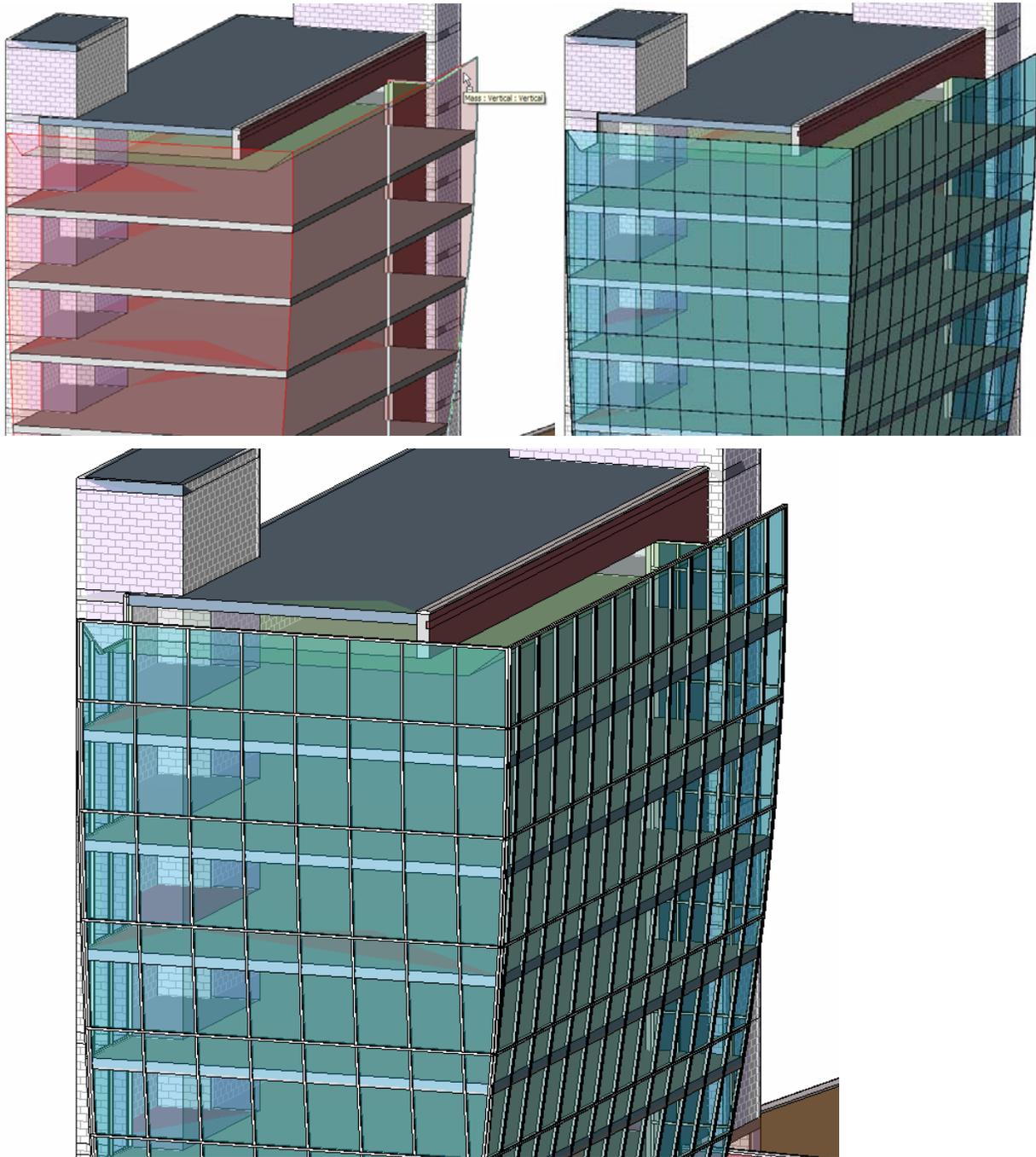
### 3. Floors by Picking

- a. Floors can be created by selecting Floor Area Faces from a Mass. You can box-select to create many floors at once

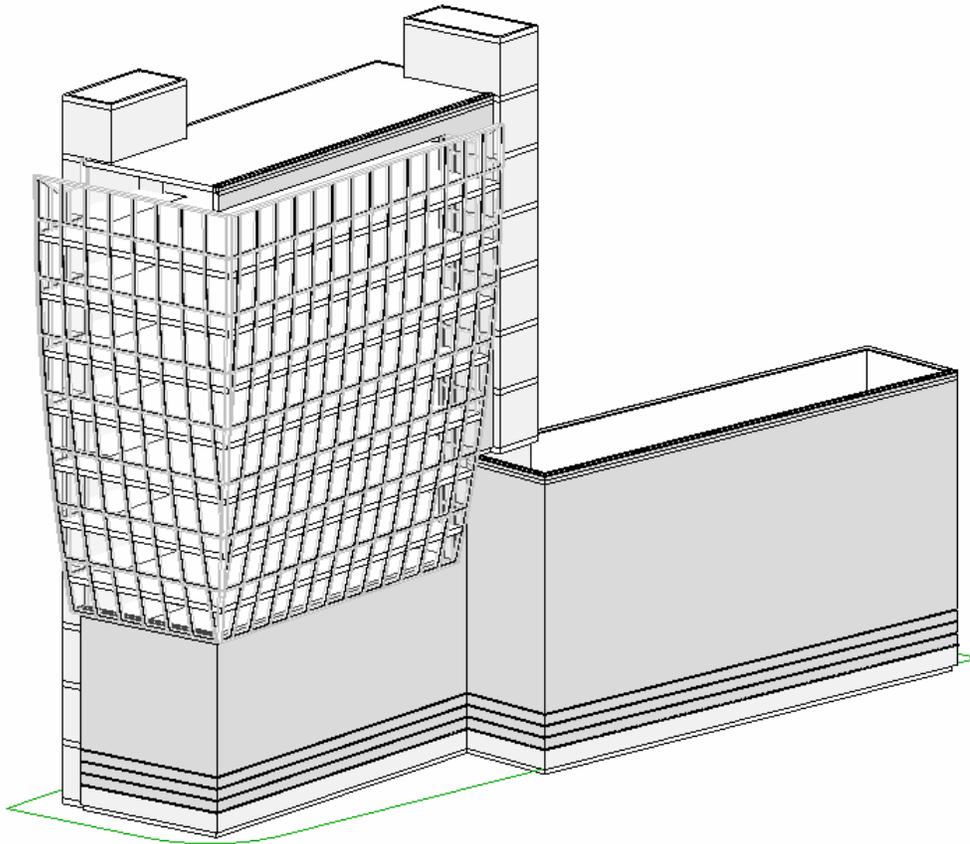


#### 4. Curtain Systems by Picking

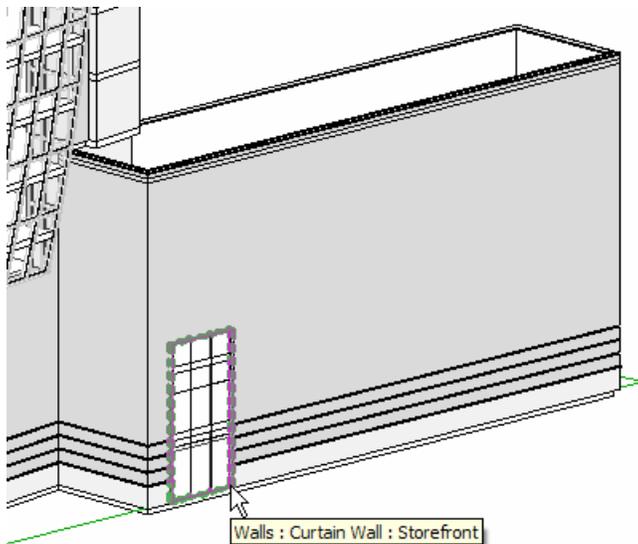
- a. Curtain Systems are a new type of object in Revit 7. They are similar to Curtain Walls – you can place curtain grids, mullions and panels on them.
- b. The big advantage to curtain systems is they can be created on faces of any shape and in any orientation



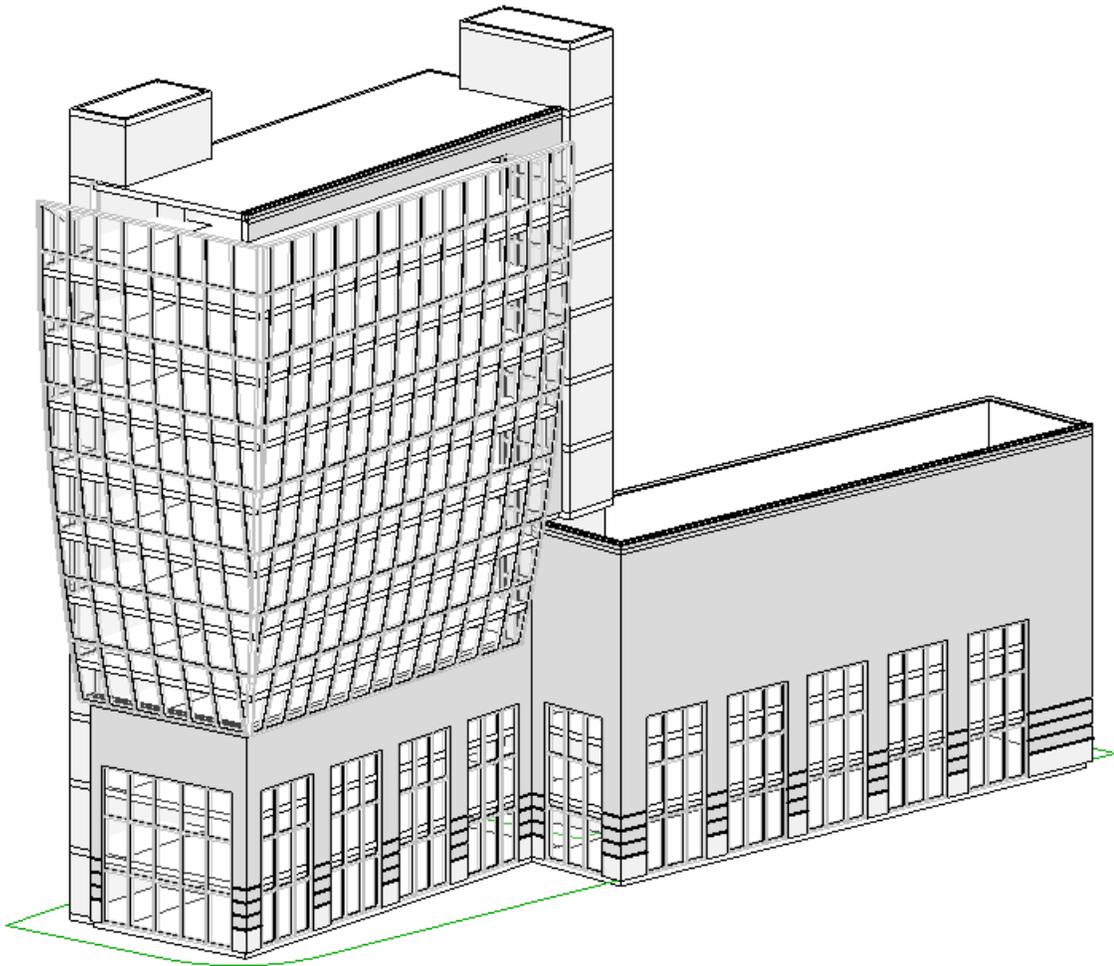
The building shell stays associated with the underlying Mass. If you change the underlying Massing geometry, the building shell can update on demand.



5. Not bad for one half hour worth of work! We still need to flesh out the exterior a little. Let's work on articulating the façade at the street level.
6. We will use the new embedded curtain wall to create the storefront at grade.
  - a. If you sketch a curtain wall over a solid wall, Revit will automatically cut the curtain wall from the main wall, like it was a window.



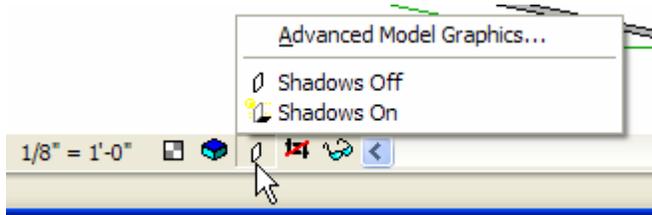
b. Here is the street level after adding all the storefront:



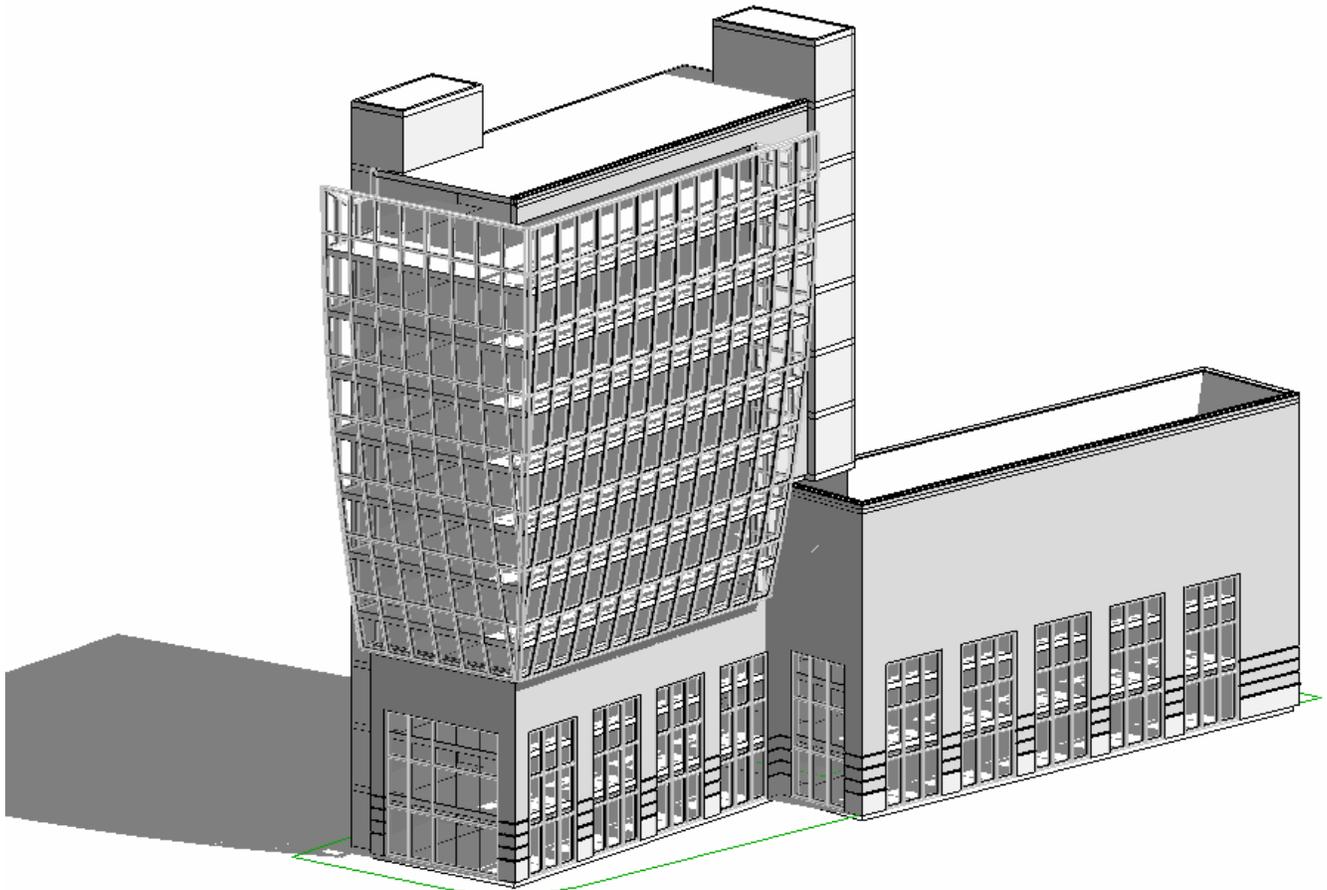
- c. We can continue to flesh out the interior and exterior using Revit's existing modeling tools
- d. For now, let's take a look at new Presentation Views in Revit

## Using Presentation Views

7. Now that we have a building model, let's turn on Revit's new Vectorial Shadows using the View Frames at the bottom of the view



8. Here we see the view with Shadows on. Shadows are calculated in real-time using OpenGL rendering technology. There is no need to render the model to create shadows any more. Shadow direction can be set for a certain Time, Date and Place or can be set manually.



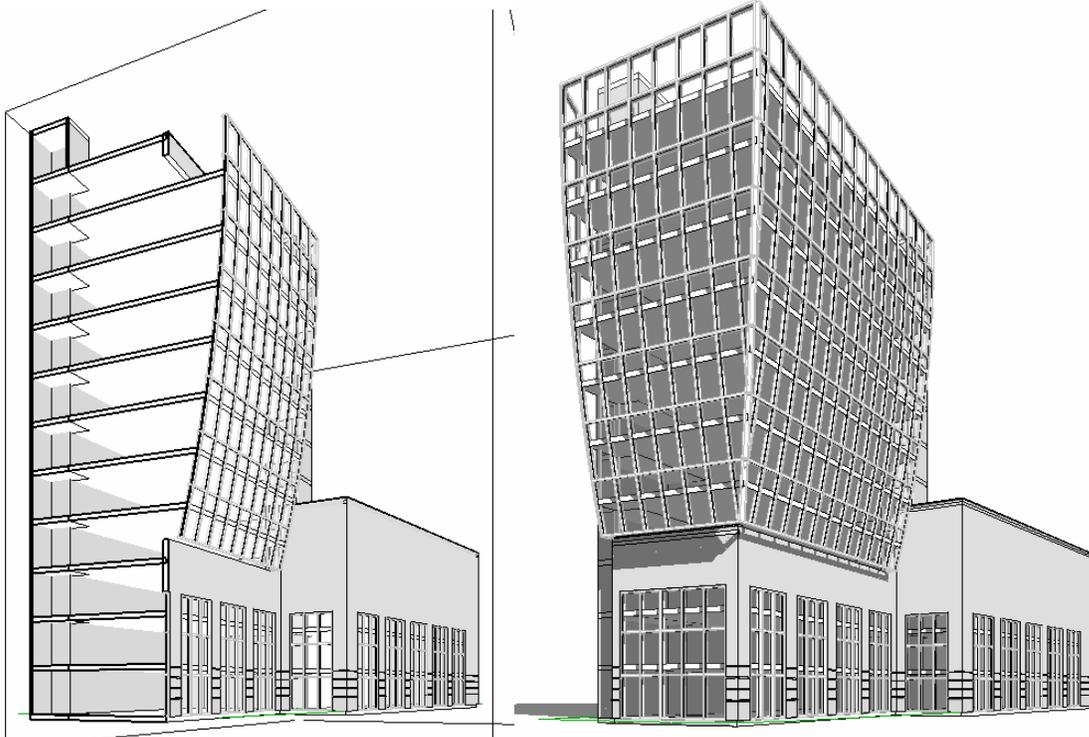
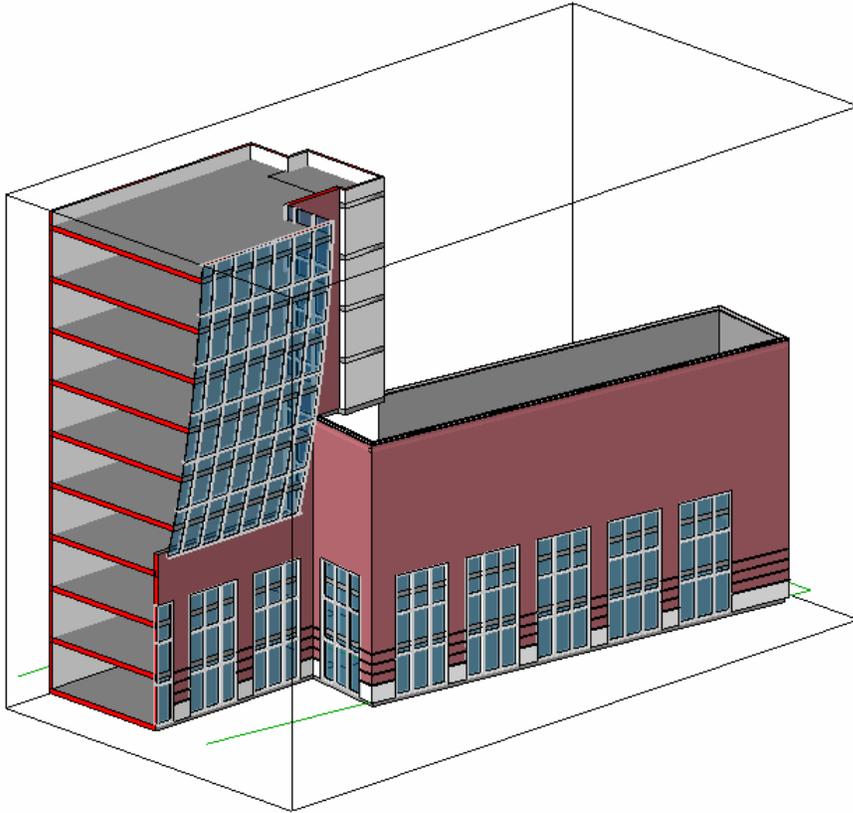


9. There is another option in the “Advanced Model Graphics” dialog called “Override Sillhouettes” that will also help ‘punch up’ your elevations and 3d views by thickening boundary edges of the design (think Francis Ching drawings!)



10.

11. The last two aspects of "Presentation Views" are Sectional Perspectives and True Cutting of the model with Section Box. Two more tools for conveying design to non-spatial clients!



## Flesh out the presentation using other Revit tools

There are other tools in Revit that can be used quite successfully to create compelling presentations. Let's review a few of them.

1. Area Plans can be used to show basic space definitions (per department, tenant, etc)
2. They can divide up arbitrary spaces (before there are even walls) and calculate areas per floor
3. Color fill diagrams can be used with Area Plans to create views like these:



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4. Presentation layouts can be created very easily by simply dragging views onto a sheet
  - a. Create a new Sheet View
  - b. Either replace the CD titleblock with a presentation titleblock or simply delete the titleblock that is there for a 'clean slate'
  - c. Drag the Views onto the Sheet
    - i. Add Area Plan and other Plan Views
    - ii. Add the site plan (with the raster image in it)
    - iii. Add the elevation views
    - iv. Create perspective and 3d isometric views and add them
    - v. Add raster images and linework as needed
5. It's very easy to 'storyboard' a presentation very early in the process. This way you spend more time on modeling and then just print when you need to.

Hopefully, these examples will give you some insight into how to use Revit to create compelling presentations.

Here is what Peter was able to put together for that Monday presentation:

