12 TIPS FOR EFFICIENT CONCEPTUAL MASSING

Many of the most compelling reasons to use Revit for Building Information Modeling are to solve the building issues earlier in the design process. Many early adopters of Revit saw Revit as a tool to capture the concept of the building in early design and were not so focused on creating a construction drawings set. These early adopters captured what I call the “essence of BIM” by providing the needed information to expedite decision making. These adopters also experienced the promised productivity that BIM can provide to an already tight schedule.

Over the years one of the most compelling and underutilized tools in Revit Architecture have been the Conceptual Massing tools (aka building maker tools). For some Architecture firms these tools are a boon to providing a streamlined workflow that reduces restarts and provides their clients with a good foundation in early design. I have found that these tools can provide greater value than just massing and visualization when applied in a strategic method. To some Architectural firms these techniques don’t require a full rework of workflow as they may be using Rhino, Sketch Up, and AutoCAD in massing applications. Although they may have realized limited success with these tools they have not fully realized the full potential of reducing restarts, redrawing, and capturing of the valuable information provided by Revit’s BIM offering.

Another advantage is that Architecture firms that are using the Conceptual Massing have noticed their clients feel that their preliminary designs resemble a building and not just a colored cartoon set (which actually may be desired). The Architects that have shared the Conceptual Massing workflow have actually delivered on BIM’s promise of increased productivity and have helped solve building problems in early design without binding their designers’ hands.

MASS TEMPLATE AND SETUP
The conceptual mass tools work with specific building Element Tools. We begin by creating a “New Conceptual Mass” from the start-up screen. The New Conceptual Mass is a new family that was previously only available as an in-place mass when drawn in the project environment (see Figure 1). After the mass object (usually the shape of a building) is drawn we load the mass family into the project where we can associate specific objects to the mass’ shape, more specifically the faces. http://www.screencast.com/t/ZTdhZjkzMDQt

Figure 1 – CONCEPTUAL MASSING TOOLS
These objects are restricted to four building maker tools: Walls by Face, Roof by Face, & Floor by Face; this includes Storefront or curtain glazing but is restricted to rectilinear (i.e. vertical forms) See Figure 2

1. CONSTRUCTS & PARAMETERS
When starting a mass there are 2 primary constructs already set up and one level grid. These reference planes are usually pinned so if your project extends beyond these boundaries make sure that you temporarily unpin them to extend them beyond the project like a traditional family as this will aid you in locking down geometry, but don’t forget to re-pin these reference planes as we want our family to maintain an origin once we place it in a project. Use reference planes to define common points vertically, especially when trying to align your scanned napkin sketches into place. Once you have these sketches in place, make sure to pin these down also.
http://www.screencast.com/t/NDAzYWMyZmUt

Once you start to develop your mass you will identify areas in a project that need to be flexible and adjusted in the project space. First draw the work plane and then align the model to the work plane and select the lock function. I found establishing work planes very valuable when creating shade devices for establishing proper day lighting validation. I also like to use this to maintain
consistent set-back distance for storefront windows. Establishing work planes is not enough, we also need to add a dimension and turn these into parameters. When drawing a form I like to select the “pick” button to deliberately select the work plane I want to work on.

http://www.screencast.com/t/MWI0M2U0MG

2. FORM CREATION STRATEGIES

Forms are created with a combination of Model Lines, Reference Lines, & Points and the form creation tools. When creating a form you simply pick a work plane and start drawing model lines that represent the faces you want to create (see Figure 3).

Figure 3 – Lofted forms spline, with edges, and stack/join

Loft Forms
Creating a loft form starts by creating an extrusion then adding a profile to it by selecting the form. As we add profiles we can twist and turn the form but these create b-splines also called NURBS. These forms can be rationalized now through rationalization and custom patterns. If you don’t want to create curvilinear forms and want to have planar forms you have two options. http://www.screencast.com/t/NjdiOTlhM The first option is to add an edge to opposite corners and then later add the profile. This acts like a bed sheet, forms will sway like a spline until you pinch in-between at two ends. http://www.screencast.com/t/OTYwM2EymNT

The second option is to host a new form on top of the initial extrusion and treat these as two separate extrusions. http://www.screencast.com/t/MzhiOGY0OTA

Sweeps
Creating a sweep form requires a path and profile, this can also include a swept blend. The secret to a sweep form is to create points on a line and create the profile on the work plane of point (note: this work will be perpendicular to the alignment including arcs and splines) http://www.screencast.com/t/OWNkZDk1ZT

Creating a blend form is similar to a loft and a sweep but both ends have different profiles. The process is similar in that you have a path and 2 point hosted on that path with different profiles. This allows for us to have one form blend into another. http://www.screencast.com/t/YTdhYjJk

Complex NURBS (including parameter controls)
Creating a spline through points is done by placing at least 3 points and selecting the spline tool. This tool is great for creating revolve forms and also creating NURBS and wave like faces. These forms are easy to create but if you want to exercise control over the points after the form is created you will need to draw with reference lines or change the properties of your model lines to be reference lines by selecting the “is a reference” checkbox. Now when you add a parameter to the point through these splines you can parametrically control the behavior of the spline as it is being driven by the points (see Figure 5). http://www.screencast.com/t/ODY4OTJmY2
Those of you that may have used massing before may have noticed that there is no more curtain panel by two points. Now you will need to build a mass or a face to create these curtain elements. This is a much better solution as I can continue to edit and manipulate the form.  http://www.screencast.com/t/NzNiNDI3M

Manipulating points, faces and lines requires a selection of the units and then using the gizmo to manipulate the points. See Figure 6 for outline of tools.

3. VOIDS & SOLID TO VOID CONVERSIONS

Creating void forms is fairly simple and only requires a polygon and selecting create form, this will create a void form which will subtract any solid that it comes in contact with. Voids however are difficult to control and don’t mix well with multiple solids. I like to create my solid form and manipulate this into place and then change the solid to a void. This will allow me to select the geometry I want to cut rather than relying on the void’s hosting. This also helps to maintain independence from the hosted work plane or face.  http://www.screencast.com/t/NGI3NTI3Yz

4. CUTTING AND JOINING ELEMENTS

If drawing the walls in 2d could tell the full story we wouldn’t draw building elevations, interior elevations, and building sections. Many times our building shape and construction is very complex. If we could draw in Revit every building element editing every wall profile, we would spend hours drawing something I could draw in a mass very easily. Furthermore if we drew this in 2d we would find ourselves calculating, checking and rechecking our sections to see if what we drew in elevation matched what we drew in sections and plans, never mind if we needed to change something. This is where I like using cutting & joining elements to assist in form creation. You will need to create the forms, whether solid or void, and use the cut & join tools to make these edits. Now in Revit 2011 we can cut out solid forms from other solid forms making it easier to separate buildings with different materials (see Figure 7).  http://www.screencast.com/t/ZTg3MjYxY2

5. SHOULD I DELETE THE MASS

Many times I am on a site visit with a customer or prospective customer who is playing with massing and they draw their form and quickly delete the mass element. I had one case where the client had deleted the form, and a few days later were having issues. Having a form turned off visibly is a lot easier than redrawing an element from scratch. It’s also sometimes easier to edit the mass than it is to edit the wall. We do massing to create complex forms and also edit them later as the drawing advances.

6. SOLID FORM EDITING TECHNIQUES

There are also forms that Revit tools can’t create without edits. When creating a roof I can do a profile extrusion but I can’t change the outline shape of that extrusion. This can be done by creating an in-place mass form, preferably a void, and void out the material that we don’t need.  http://www.screencast.com/t/MTMwODVjZTYt

The massing environment is usually not the best environment to create sloped roofs; especially those roofs that resemble residential or resort style roofs. My best practice is to bring my mass in, add walls then do a roof by footprint using those walls; as the walls change in my mass so should my roof shape in the project.

7. WHEN TO STOP MASSING & USE PROJECT EDITS

One of the biggest complaints I get from modelers is that no design tool can do everything; this may be true with most programs and is true with the conceptual mass as well. Although the conceptual massing can’t do everything, once in the project there are several tools that can clean up the drawing and actually make it look like a building with character and not just walls with a painted surface.

The first area where the project tools work better than attempting to mass is using the roof by footprint. This tool will calculate the roof pitches and intersects based on the walls that are selected. I typically recommend using this tool for almost all pitched roof instances.

When modeling a building I have seen many hours waste modeling extruded foam shapes, wall reveals and trim profiles. As these could be modeled in the conceptual massing family it would be best to create these either as wall sweeps / reveals or gutters and take advantage of the profile family to reduce the number of times you redraw an individual profile. This also reduces the redraw
for later design as these can be re-used as part of the elevations and details. These synergies are advantageous as there will be no miscommunication to the client of the designer’s intent moving forward into design development (see Figure 8). http://www.screencast.com/t/NzMyNDI2Z

Although this may not be obvious, I have seen people model individual curtain wall or storefront mullions in other design programs. They say that this isn’t time consuming but when compared to using the Revit project tools for curtain walls / storefront walls the time saved for layout alone are saved even when learning these tools for the first time. http://www.screencast.com/t/MjlmyZQ0O

The other embellishments can be addressed by creating simple place holder geometry for standard shapes using Revit Families; these objects include: Lintels, Corbels, Quoins, keystones, Pediments, Surrounds, & Vents etc. There are other tools handled by system families including: Gutters, Cornice, & soffits. http://www.screencast.com/t/NmI5ZjlhNTU1 These tools not only help in placing these but can be scheduled for rough quantity take off. The last component that should be placed in a project is columns. These include: architectural columns, pilasters, piers, and capitals. Capitals can be nested into a typical column family to allow flexibility to the designer when swapping between column types.

8. FORM REITERATION & DISOLVE
The greatest thing about Revit has always been the ability to revise, reiterate and manage change. As we know our designers are always taking an idea and developing it further. One of the biggest critiques of the new massing tools in Revit 2010 was the inability to revise a form once it was created. In Revit 2011 they have allowed us to edit the original model lines and dissolve the make-up of the form. Included with this is also a work plane viewer, this viewer option allows us to have a view (where one may not exist) perpendicular to view to create a detailed and accurate edit of the shape. http://www.screencast.com/t/YTM3YmM2NDEt

9. SKETCHUP USES & CHALLENGES
One of the biggest obstacles for designers is that they are a creature of habit or ease. Whether a designer is still using bumwad and colored pencils or a combination of AutoCAD & SketchUp they can easily integrate these tools into a Revit workflow. Some Designers are importing their preliminary forms into Revit conceptual massing and others are taking the Revit project via AutoCAD export into SketchUp to “make it sketchy”. I also recommend using Autodesk Impression to keep things sketchy and loose also this tool is a hidden gem and is a Subscription Entitlement.

If you are able to scan a bumwad sketch this can be easily inserted into the different level views and scaled up or down to make the drawing to scale. Make sure to pin these down in the views, mostly so you don’t accidentally select them. After you place these images, begin tracing the major shell elements and begin to create your exterior mass form.

If you are using SketchUp you need to understand that you are not modeling solids but are creating faces. These faces can be imported into the Revit mass family and then imported into the project to use the wall by face and roof by face tools. Because you are not working with a solid form Revit can’t break up the mass by floor levels. The other limitations with SketchUp stems from the fact that the forms created are not solids but faces and as a result you are unable to create schedules and do rough QTO. Also when changes are made to the SketchUp model we are unable to update to face since the faces are unintelligent. Similar to the rules for over modeling the mass forms in Revit you must also be careful to not over model your SketchUp form.

10. PRESENTATION DRAWINGS
Outside of exporting your project to SketchUp or printing your project views to PDF and then adding color in Photoshop most studios should seriously explore the new visualization offerings with Revit Architecture 2011. In 2011, Autodesk added two new visual styles to our views. The most impressive of these visualization styles is the realistic view. These views are similar to partially rendering the project and allow ambient occlusion (i.e. realistic material mapping). This tool with a combination of the sun path tools can provide realistic and accurate sun studies. Another impressive tool is the ability to take background photo images and place them inside the background of your rendering images (see Figure 9). http://www.screencast.com/t/MzM0ZDcxMDU
these fixes are not enough you can always use the FBX export to Autodesk 3ds Max Design for extreme photorealistic images and walk through animations.

One of the final tricks is to use a combination of paint and split face to “paint” on generic walls your materials. This trick is quick but doesn't provide that accurate of a presentation and presents similar to other design products. http://www.screencast.com/t/YmMwZDcw

11. SCHEDULES AND QTO
One most commonly forgotten aspect of BIM is the I or rather the Information, sometimes I call this the intelligence of BIM. Most times designers that favor a specific product for their design tool or technique will talk about the speed of laying out design as if this were the only aspect of conceptual design that was important. This superficial assessment usually doesn't take into account the other nuances happening in the project; including: Programming, estimating, 2d plan creation, and validation of the program against client expectations. When you add all these variables together you will see a more comprehensive view of what is being done in early design and that it's not all about the Building & the Model as the model Intelligence is also a major factor. See figure 10 for examples.

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Figure 10 – Preliminary Design Data

First take advantage of the Mass Schedule as this schedule can provide baseline information about a project including: gross floor area, gross surface area and gross volume. Another Schedule is the Floor Area Mass Schedules; this schedule includes more detailed information including floor perimeter, floor area, floor volume, & exterior surface area. We can further tap into other parameters like wall material take-off or floor material take off by creating additional schedules. One important step is to finish drawing in the interior partitions. These are important, especially if you want to take advantage of validating the building program. I have taught some clients to even create program validation formulas using conditional formatting. This room schedule can be used to validate when we are out of specification. Another tool is Autodesk Quantity Takeoff (QTO). This tool is a Construction Managers friend as it works with BIM models, CAD drawings and scanned images including PDF.

12. ENERGY ANALYSIS IN EARLY DESIGN
One last area that should not be ignored is how to leverage our early design data for sustainability. This is where I believe Revit and other Autodesk tools have a significant advantage over the competition. You will need to complete your building by drawing the interior walls and laying out a rough ceiling grid. Your building model can then be exported to Autodesk Green Build Studio (GBS) which is now available to those on subscription with Revit Architecture 2011 & Revit MEP 2011. With a little preparation you can take your rough model into GBS and gather rich information about your building's energy usage based on location, building type and the data found in your building model. These calculations may not be engineer accurate but are a good baseline to start. GBS also lists possible alternative energy potentials based on your area that you can explore. Another tool is Autodesk Ecotect; this tool is something that goes beyond GBS into day lighting and detailed energy analysis. See your local reseller for more information on this tool and Ecotect.

One other tool in Revit is the sun path tool; this tool is similar to the Ecotect tool except that we can directly manipulate the sun based on date and time directly in the Revit environment. This can aid in developing passive solar design and validate where shadows are cast to value engineer canopies, roof overhangs and sun baffles. These also can be used as a valuable presentation tool that has tangible, content rich graphics that simulate sun studies. These tools can be valuable assets and can help you to differentiate yourselves from the competition. http://www.screencast.com/t/OWRkYzg5M

CONCERNS, CONSEQUENCES, COMPARISON & CONCLUSIONS
These techniques are but a good start to understanding Revit Conceptual Massing. I don't recommend walking in to your lead designer and slapping this article on his desk and tell him he's doing it all wrong, remember to have a bit of tact. When working with an Architect be sensitive to the ego and that you may very well be moving his cheese. Don't compare or criticize his tools, just provide him with a new set of tools, rules and a little bit of vision. I would focus on developing a solid conceptual template. The biggest reason most companies don't undertake doing conceptual massing is that they are worried their designers can't use the program or are so addicted to their other tools that they are not willing to change. To address this I removed most of the barriers that would cause confusion or challenge the designers. One technique is by creating flexible families that are not too specific. These fixes are not enough you can always use the FBX export to Autodesk 3ds Max Design for extreme photorealistic images and walk through animations.

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I enjoyed this article and want to know more, feel free to contact me to discuss a customized business assessment and I can help you decide if these tools are right for you.

Jeremiah Bowles is an AEC Applications Engineer in Kansas City Metro area for Applied Technology Group, an Autodesk Gold Partner. He has been in the AEC industry since 1992 in many AEC facets. His early adoption of BIM including Revit has helped him to be an industry leader and innovator. His experience helps him to provide applicable knowledge with relevant business context. He started while in Architecture school in Structural Design and his Architecture studio experience is primarily in Public, Transportation, Religious Facilities, Higher & Lower Education, and Residential Design. He paid his way through College by winning drafting & design competitions through VICA (Skills USA), and other craftsman fairs. He can be found speaking at AIA, CSI, SEA Conventions, and Revit User Groups in the Mid-Western United States and as a speaker at Autodesk University. As an Architecture Major he also holds a B.A. degree in Business Management with a focus on Strategic Communications and Technology Integration. He is currently undertaking a Masters in Construction Management. This article is a preview of his 2010 Autodesk University hands on learning course titled: Revit conceptual massing – merging “old-school” techniques with technology strategies. He also has online quarterly workshop expanding on Revit Conceptual Design, contact him for more info. As a consultant he provides services including: Business Assessment, Strategic Technology Planning and Implementation, BIM/CAD Standards Management, Revit courses in Architecture, MEP & Structure and other BIM applications. He can be found on LinkedIn or by contacting him at bullfrog4d@gmail.com