Revit® Platform 2009

Technical Note

Model Performance Technical Note

Like any design instrument, the Revit platform's performance can depend as much on the knowledge, skill and practices of its users as on the hardware environment provided for the software. To address both areas which can affect model performance, the Revit platform team has assembled this collection of hardware requirements, recommendations and modeling best practices as researched by both internal development and our community of dedicated customers.

Just as no two buildings are identical, no two models of differing buildings are precisely identical in the tactics and strategies that will yield the most robust performance, but the recommendations that follow are designed as a set of tools to be selected singly or in combination to help produce in a timely fashion models that are consistent, computable, and communicative of design intent.

Many people on the Revit platform team from Quality Assurance, Development, Consulting and Product Management contributed to this document, but a number of recommendations arose from the community of Revit-based application users, who generously contributed their time and expertise to their peers in a number of forums, and urged Autodesk to help share their knowledge with an even wider audience.

As always, our thanks go to our customers, who are part of the team helping to improve the Revit platform with every release through their insightful comments and suggestions.

The Revit Platform Development Team

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Hardware Requirements for the Revit platform

System Requirements

Description	Requirement
Operating System	Microsoft® Windows® XP® SP1 or SP2 ▪ Home ▪ Professional ▪ Tablet PC Microsoft Windows XP Professional x64 Edition Microsoft® Windows® Vista® 32 bit ▪ Business ▪ Home Premium ▪ Ultimate Microsoft Windows Vista 64 bit ▪ Business ▪ Home Premium ▪ Ultimate
Browser	Microsoft Internet Explorer® 6.0 SP1 (or later)
CPU type	Intel® Pentium® 4 1.4 GHz or equivalent AMD® processor
Memory	*3 GB RAM (1 GB RAM if no rendering required)
Video Display	1280 x 1024 monitor and display adapter capable of 24-bit color
Hard Disk	3 GB free disk space
Pointing Device	MS-Mouse compliant
Media	Download or Installation from DVD
Connectivity	Internet connection for license registration

* For more information, see "Memory" section.

System Recommendations

Description	Requirement
Operating system	Microsoft Windows XP Professional SP2 (or later) Microsoft Windows XP Professional x64 Edition
Browser	Microsoft Internet Explorer 6.0 SP1 (or later)
CPU type	Intel™ Core 2 Duo 2.40GHz or equivalent AMD processor
Memory	*4 GB RAM
Video Display	Dedicated video card with hardware support for OpenGL spec 1.3 or later and support for DirectX 9 or later.
Hard Disk	5 GB free disk space
Pointing Device	Two-button mouse with scroll wheel

* For more information, see "Memory" section.

Detailed Hardware Recommendations

Central Processing Unit (CPU)

The Revit platform is a computationally intensive application, and will benefit from a high-performance CPU.

- Most users select Pentium$^®$ 4 3.4 GHz processors or faster.

- Some customers have gained performance benefits through moderate overclocking of the CPU. Customers should consult with manufacturers to determine safe values of processor overclocking.

- Centrino$^®$/Pentium-M$^®$/Core Duo$^®$ Intel processors for laptops work well with the Revit platform, and are recommended for laptops given their higher efficiency and reduced heat output. Multiply a Centrino/Pentium-M's processor speed by 1.6 to find its approximately equivalent Pentium 4 processor speed.

Multiple-Core / Multiple Processors

- Although the Revit platform is generally not optimized for multi-threading, multiple-core processors reduce cycle use by other applications running concurrently. Some reports show as much as a 20% increase in Revit platform performance in a multi-core or multiple processor environment.

- The Revit platform's rendering function is optimized to use up to four processors. The Revit platform will share processing time with one of these four rendering processors, so there is no exclusive gain for the Revit platform in making available more than four processors. Additional processors may be desired if other computationally-intensive applications need to run while the Revit platform is rendering.

CPU Performance

A variety of benchmarks are available to compare CPU performance. The following links are provided as a service to customers who may wish do further research. Autodesk makes no warranties about the accuracy or veracity of this data:

http://www.tomshardware.com/charts/cpu-charts-2007/3d-studio-max-9,369.html

http://www.cpubenchmark.net/

http://www.spec.org/benchmarks.html

L2 Cache

Because of their substantial performance benefits, the Revit platform team strongly recommends CPUs which include an L2 cache. Larger L2 caches of 2MB and beyond can provide performance benefits for computationally-intensive operations such as model regeneration.

Processors with a smaller or no L2 cache, such as the Celeron® and Sempron® models are not recommended for use with the Revit platform.

Hard Drive

Speed

Workstation hard drive speed affects Revit platform performance during model load, local model save, and hard disk swapping managed by the Microsoft Windows operating system.

If higher performance is desired during these operations, a faster hard drive may provide some benefit; however the Revit platform team considers this workstation improvement of lower priority when compared with performance enhancements related to CPU speed and available RAM.

Type

SCSI or SATA drives are optional for the Revit platform.

Configuration

For the Windows operating system swap file, it is recommended that you set both the minimum and maximum settings to the same value, which should be at least twice the value of your installed RAM. This approach will prevent Windows operating system from changing the size of the swap file while you are working.

Defragmentation

It is recommended that you defragment local PCs and servers periodically. Highly fragmented drives may noticeably slow PC performance.

Video Cards

- The Revit platform team strongly recommends dedicated video cards supporting OpenGL specification 1.3 or later and support for DirectX 9 or later.

- Consider video cards designed to support CAD applications.

- Integrated video support should be avoided because of the use such schemes make use of machine RAM rather than on-card memory.

- Relatively inexpensive video cards may perform as well or better than more expensive cards.

- Revit platform rendering does not benefit from the video card graphics processing unit (GPU), nor does it not benefit from a large amount of video RAM. 128MB of video memory should be more than sufficient.

Hardware Acceleration

To take full advantage of OpenGL hardware acceleration, please follow these steps:

1. In the Settings menu, select "Options…"

2. Select the "Graphics" tab.

3. Check the "Use OpenGL Hardware Acceleration" box, illustrated below.

4. Close and restart the Revit-based application.
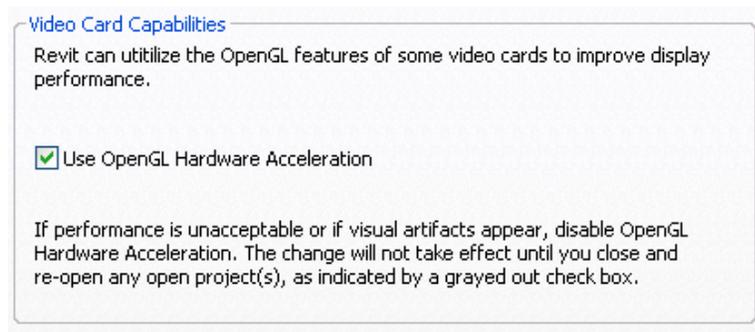
Memory

Installed RAM

- Minimum RAM is 1 GB but 4GB is highly recommended. Larger, more complex models will make use of more RAM. See "Operating Systems (OS)" below for configuration notes.

- The quantity of RAM available to the Revit platform is partially dependent on the Windows® operating system environment. See "Operating Systems (OS)" below.

- The amount of local machine RAM required is approximately 20 times the size of your compacted central project file.

- Revit platform rendering now operates in a separate process, and could benefit from memory available beyond the limits accessible by the Revit-based application itself.

- Memory specifications vary, but higher speed dual channel RAM such as the 1066 type may yield some performance benefits.

Management

Revit-based applications maintain model data in memory and hard disk caches to increase performance against repeated data access, but as a consequence of extended model manipulation Revit platform performance may benefit from an application restart once or twice a day, and especially before triggering the following memory-intensive tasks:

- Printing

- Rendering

- Exporting

- Upgrading models to the current the Revit-based application version

In addition, before performing any of the operations listed above, performance can be increased by reducing memory use through the following tactics:

- Close other applications

- Turn off shadows for all printed views if not absolutely necessary.

- Detach local copies from central before printing and exporting to limit network resources and reduce project chatter between local and central files. Use this tactic with caution since changes subsequent to detachment cannot be saved to the central file.

Paging File Optimization

Verify that the paging file size is optimized for your system. The paging file should be at least the size recommended for Windows and at most twice the amount of installed RAM. Larger page files may provide more memory to the Revit platform, but performance could degrade noticeably with expanded page files.

Follow these steps:

1. On the Start menu (Windows), click Settings > Control Panel.

2. In Control Panel, double-click System.

3. In the System Properties dialog box, click the Advanced tab.
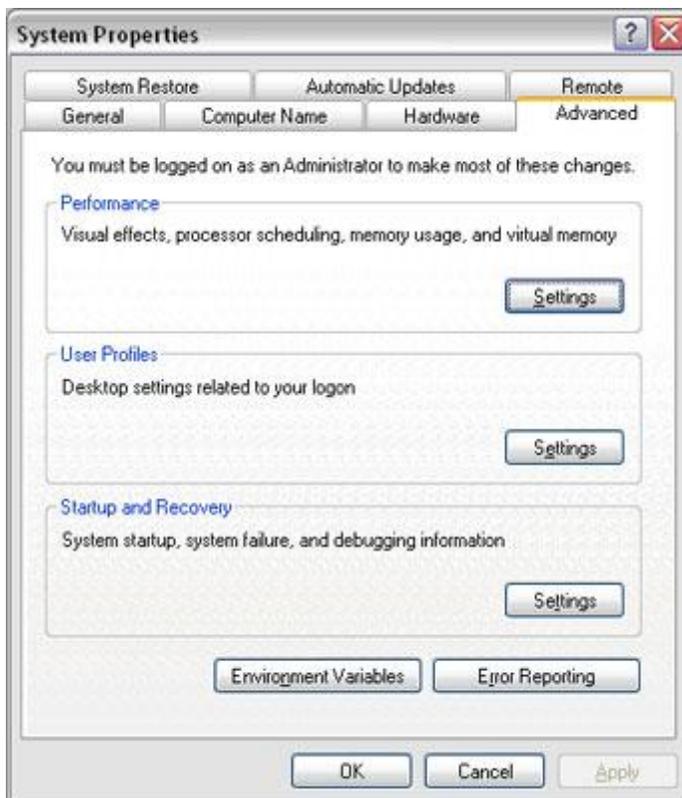
4. Under Performance, click Settings.

5. In the Performance Options dialog box, click the Advanced tab.

6. On the Advanced tab, under Virtual Memory, click Change.

7. In the Virtual Memory dialog box, change the Initial and Max values to 4092 (2 * 2GB) for a 2GB machine.
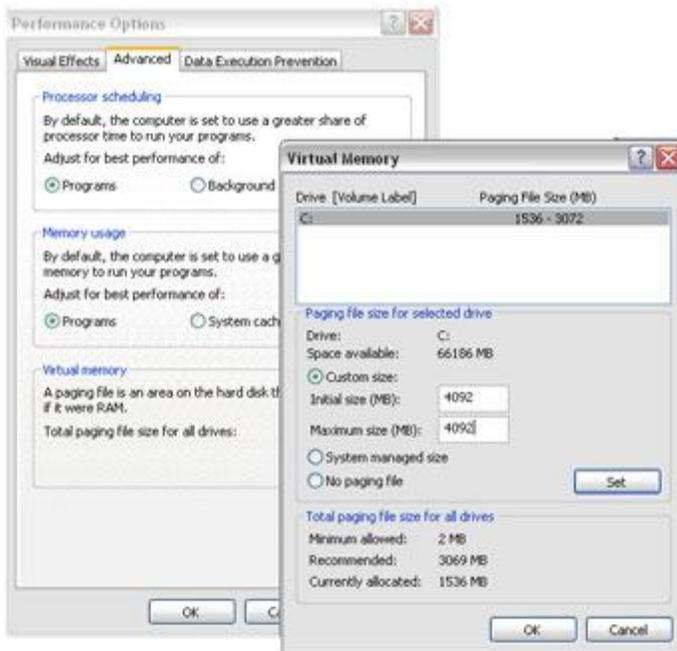
8. Click Set.

9. Click OK to close the Virtual Memory dialog box.

10. Click Apply

11. Click the Visual Effects tab
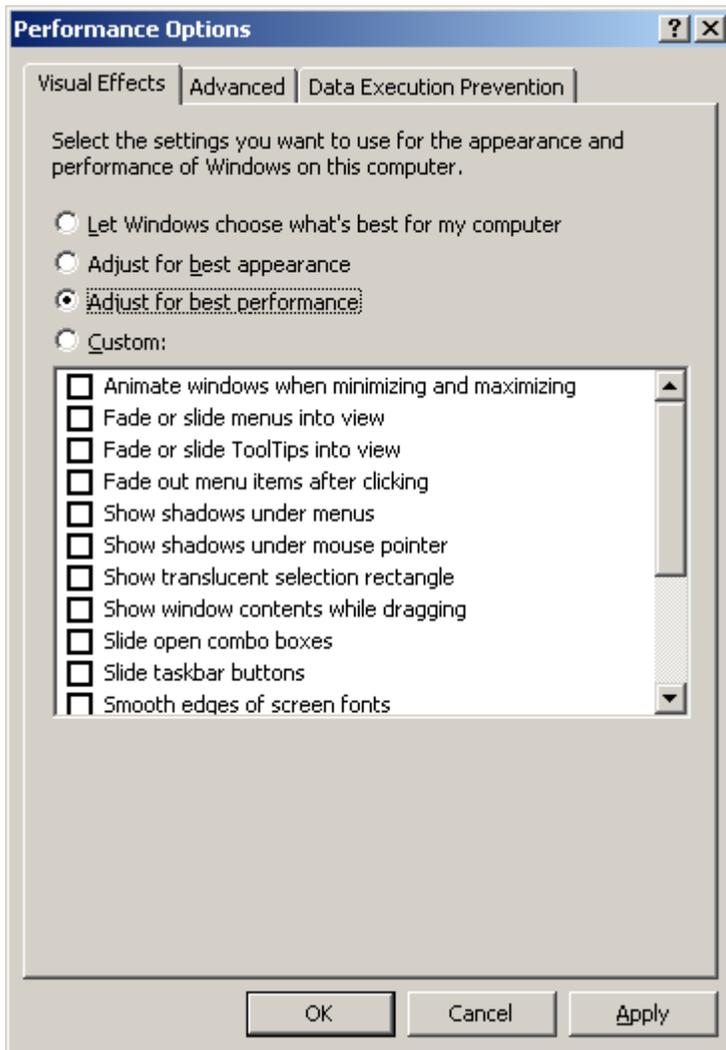
12. Select Adjust for Best Performance

13. Click Apply

14. Click OK to close each dialog box

See also the Autodesk Technical Document on the Revit platform and Virtual Memory:

http://usa.autodesk.com/adsk/servlet/ps/item?siteID=123112&id=8018971&linkID=9243099

Operating Systems (OS)

32-Bit Windows Operating Systems

- **Windows XP** only makes 2GB of system memory available to applications unless the **/3GB** switch is enabled in the **boot.ini** file. For complete information on enabling access for Revit-based applications to 3GB of memory, please see the Autodesk technical document:

  http://usa.autodesk.com/getdoc/id=TS1060353

  And the Microsoft technical document:

  http://www.microsoft.com/whdc/system/platform/server/PAE/PAEmem.mspx

- **Windows Vista** similarly limits applications to 2GB of memory use, unless the /**increaseuserva 3072** switch is enabled. Windows Vista no longer employs the boot.ini file. Instead, the command line utility **bcdedit** must be used. Please see the Microsoft technical document:

  http://msdn2.microsoft.com/en-us/library/aa906211.aspx

64-Bit Windows Operating Systems

- 64-bit operating systems place no practical limit to the quantity of memory available to applications. 32-bit Revit-based applications will access between 3 and 4GB of RAM in a 64-Bit OS environment if at least 5GB of total memory is available. The Windows OS will always reserve at least 1GB of memory for OS services and hardware management. A total of 8GB of memory is recommended for such systems to make available 4GB of memory to the Revit platform, at least 1GB for the OS, and additional memory for other commonly used applications to run comfortably alongside the Revit-based applications.

- A 64-bit OS will provide similar performance to a 32-bit OS. However, due to the capability of the Revit platform to access additional memory, Revit may exhibit increased stability and performance when editing larger models.

Network Recommendations

Performance

The Revit platform team strongly recommends a gigabit speed local area network (LAN) for workshared projects. The gigabit threshold should be maintained at all stages of the network, including:

- Gigabit speed Ethernet cards at the desktop.

- Category 5e or Category 6 cabling.

- Gigabit switches.

- One or more gigabit Ethernet cards at the data storage device (server or Storage Area Network) housing the central model

When serving a geographically diverse project team across a wide area network (WAN) the Revit platform team strongly recommends traffic optimization and acceleration as provided by several appliances currently on the market.

Data Server Specification

Servers storing Revit-based application central files can benefit from:

- Hard drive speeds as fast as economically practical

- Multiple processors

Remote Desktop Sharing

An alternative or additional strategy beyond increasing network and server performance can be remote desktop sharing, where keystrokes, mouse clicks and screen paints are transmitted between remote locations and local desktops dedicated to offsite control for the Revit-based application model interaction, as in the following diagram:
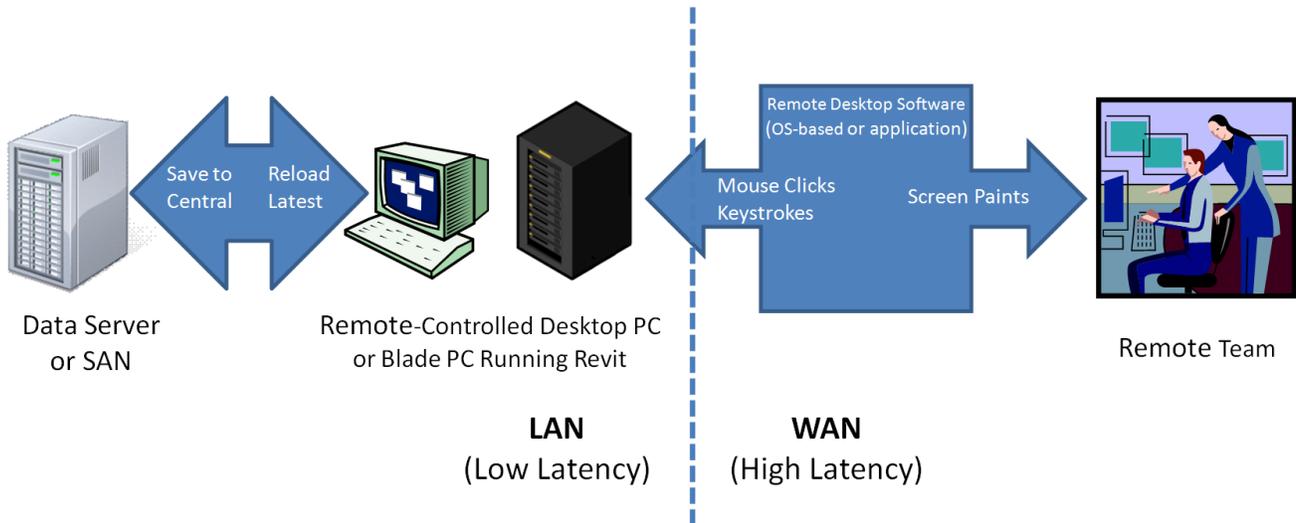
User Group Comments

The Autodesk community maintains a vigorous discussion regarding hardware and operating system performance in the field. Please reference the following links to see the latest comments. Viewing these comments may require a free Autodesk User Group International (AUGI) membership.

http://forums.augi.com/showthread.php?t=70735 (Desktop recommendations)

http://forums.augi.com/showthread.php?t=71767 (Hardware benchmarking)

http://forums.augi.com/showthread.php?t=70896 (ATI & nVidia Video Cards)

Revit Platform Model Optimization and Best Practices

General Guidelines

In general, the following characteristics of a Revit-based application model can affect performance:

- o Complex geometry
- o Multiple parametric relationships
- o Multiple constraints
- o Linked files

The following sections will examine many aspects of modeling and recommend certain practices in particular situations, but examining a model and its constituent families with these factors in mind will aid in optimizing model performance.

Arrays

Arrays can be used to copy and associate objects together. After the array is deployed, performance may be improved by ungrouping the arrayed, removing the parametric associations of the copied objects.

The Group And Associate checkbox may also be cleared before creating the array to attain the same result.

Constraints

Minimal constraints will help prevent:

- o "Can't keep joined" errors when moving objects.
- o Workset sharing issues where a user may unknowingly take ownership of an object.

Design Options

- Limit the use of rooms in design options to necessities to avoid additional processor time spent on detecting room option conflict. (See Volumes - Rooms and Spaces, below.)

- Use separate models for variations of the whole building wings.

- Preserve design options only as long as they are useful to the project. Even though options may not be active and visible, when changes are made within the main model all design options will update to maintain the model's consistency.

- Consider whether options should be preserved long term in separate models which can be linked as needed.

DWG Files

- Minimize the number of linked or imported DWG files.

- Avoid importing unnecessary data like hatching or AutoCAD®-specific linework such as construction lines. Delete unnecessary parts and layers of the DWG file within AutoCAD and import only the cleaned, smaller DWG.

- Avoid exploding the geometry imported from DWG files. The exploding operation within a Revit-based application can change a DWG from a single managed element to hundreds or thousands of additional elements depending on the number of entities in the imported DWG.

- Only link essential DWG files into necessary views.

- Switch off visibility of 2D AutoCAD DWGs in perpendicular views. A 2D AutoCAD file linked into a plan view will show as collinear lines in elevation, causing performance degradation.

Family Creation

- Create a family component instead of in-place families for repetitive components. When an in-place family is copied (which may itself be problematic), it makes an entirely new entity each time, as opposed to referencing the type information from the first instance.

- Limit the use of detailed/nested/parameterized families to necessities.

- Families require fewer resources than groups. Use families instead of groups, where possible. Groups are very powerful, but updating large quantities of group instances consumes significant computing resources.

- Where possible, avoid widespread use of voids in family geometry.

- Where possible, avoid arrays and formulas.

- Use symbolic lines and masking regions instead of geometry in plan views.

- Parametric families place a greater computational burden on the model than static families. Consider carefully whether a family needs parametric flexibility and confine that flexibility to necessary adjustments.

- Families which cut their hosts consume significant computing resources on regeneration when compared to families that reside on a given surface without cutting the host. Consider modeling building components such as HVAC registers as 2D ceiling- or face-based families to reduce penetration calculation.

- Model designs selectively. Objects only viewed from certain points need only be modeled to appear correct in those selected views. The following illustrations show two families, both designed to represent the same toilet in plan:
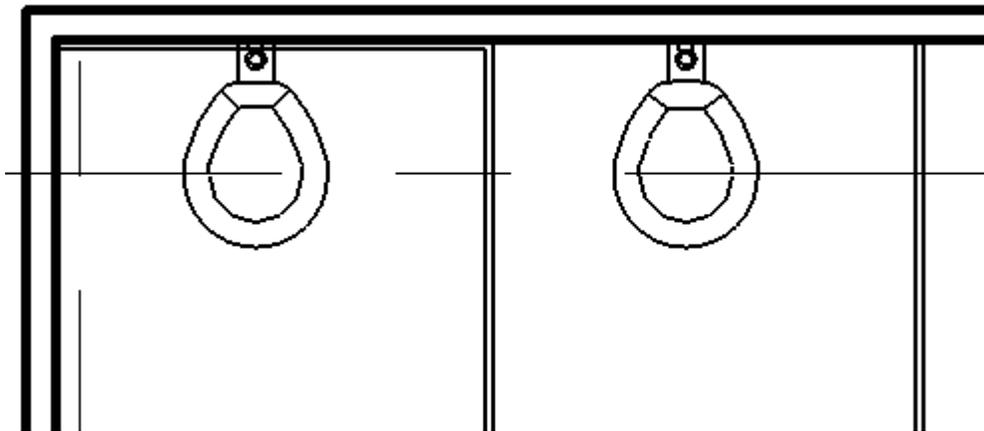
The 3D toilet on the right is completely modeled:
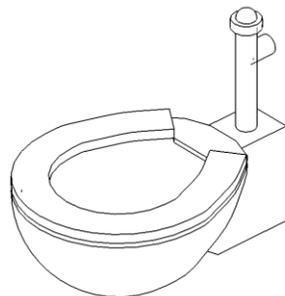
The 2D version of the toilet is invisible in a 3D view. There are only views available of the toilet in elevation and plan, which is sufficient for most project needs.
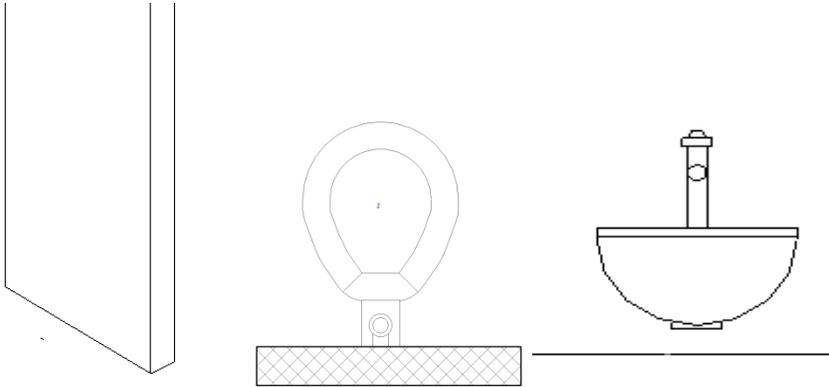
The 2D version of this family is 20% smaller than the 3D version. Multiplied over an entire project, a larger family can add significantly to a model's size and computational burden.

Carefully consider what to model. Performance gains may be found as much in the construction of individual families as in other modeling practices.

Create simplified representations of imported solid geometry (ACIS SAT, DWG, etc.) using Revit Solids. After importing and remodeling the geometry using Revit, delete the imported solid from the family. The simplified geometry will improve performance, and in addition, provides improved display control.

Importing & Linking

- Unload links of all types if not used. Temporarily unload links if not needed in the view and reload them as required to limit memory resources necessary to open a project file.

- If the link is located on the network, importing rather than linking may improve performance.

- Host files containing RVT file links will consume more memory on version upgrade than files lacking RVT links. Upgrade links before upgrading the host file, or if necessary, unload all RVT links before upgrading the host file.

- Large projects may benefit from breaking a model into separate project files and linking them into a single central file and assigning each model to a workset (see Worksets section). Some typical cleavage points to divide a single project into multiple models include:

    o Separate buildings

    o Building core

- o Building shell

- o Interiors

- o Expansion joints

- o Individual towers

- o Parking structure(s)

- Files may be linked, but not imported, using Shared Coordinates. Files may be imported using internal coordinates only.

Modeling Economically

- Minimize geometric detail that will be invisible at the chosen output scale. The necessary level of detail in a given model can often be conveyed to a team in terms of a commonly understood drawing scale, such "Provide detail to a ¼" level of detail" or some other commonly employed measure of scale. As much as possible, leverage the project team's understanding of typical 2D drawing conventions to invest the correct level of complexity into the model.

- Until wall, roof, window and door type construction are determined, use the generic versions of these elements which incorporate less geometry. Unless material use or other types of analysis will be applied to the model, consider that a generic wall may be sufficient for some projects or project areas.

- Consistent customer practice is to break up a large model into multiple files of about 160 MB each and link together the resulting project files. Such a procedure will work best if the user can work on one file while the other links are unloaded for a majority of the time. Engineering consumers of architectural models may have to maintain one or more constantly loaded links, which may affect model size estimation and thresholds for those disciplines.

- When creating detail views, model hatches with filled regions not lines.

- Limit joined geometry to necessities.

- Remove unneeded area schemes.

- Avoid maintaining unnecessary groups. Delete unused groups from the project browser.

- Purge unused objects. Since purged objects cannot be recovered, you may wish to make a backup of the project before purging.

- Regularly review and fix warnings *(Tools -> Review Warnings).*

Project Templates

- Avoid populating project templates with an excessive number of families that may or may not be useful for every project. Favor a minimal rather than a comprehensive template.

Railings

- Avoid use of railings for extensive fences or separation systems, or at the very least limit the visibility of these elements. There is no warning offered by Revit-based applications, but performance is impacted because of the number of lines required to generate each railing element.

- If a lengthy railing element is desired, consider modeling a simplified railing representation, relying on railing details to fully describe the design.

Raster Images

- Remove unneeded raster images and renderings. Raster images represent a performance and file size cost which should be minimized.

- Monochrome raster images are smaller than color images. Save black and white raster images as 1 bit per pixel format instead of JPG or TIF. MS Paint refers to this format as Monochrome Bitmap.

- Large raster images such as logos scaled down to fit into title blocks will still retain the original file size. Consider creating a smaller, simplified image for import into a Revit-based application.

Stairs

- Like railings, stairs are complex elements, but may not be easily simplified. Confine stair visibility to essential views.
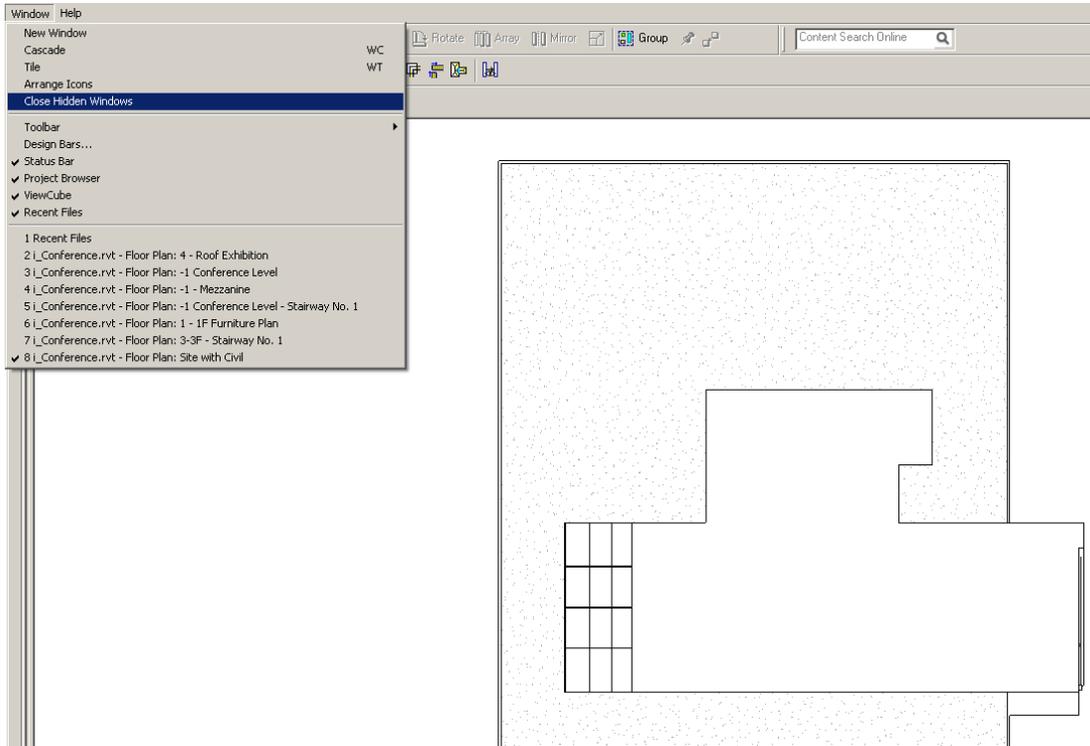
Views

- Before closing a file, keep only a simple drafting view open to accelerate saving and subsequent opening of the file.

- Minimize view depth where possible in elevation, plan, and section views.

- Consider back clipping views to reduce the quantity of geometry maintained in a view. Right-click in views to select View Properties >> Far Clip Offset and set the distance from the view camera to the desired view depth.

- Use section boxes to limit visible geometry when working in a 3D view.

- Minimize view quantity to help reduce model size. To optimize static models to be linked into active models (for instance, in the case of an existing contextual building model adjoined to a model of new construction) delete as many views as possible from the static model to be linked.

- Use "Wireframe" or "Shading" display modes when working in linked file environment. "Wireframe" and "Shading" modes can be 3 times faster than "Hidden Line" or "Shading with Edges" modes.

- Avoid hiding large quantities of individual elements in views.

- "Paste aligned" into closed views will open and close the target views. When repeating such an operation several times, performance will be improved by opening all the target views before beginning the sequence of paste operations.

- Zoom in to speed up drawing and snapping.

- Clear the "Snap to Remote Objects" setting in the snap dialog (Settings -> Snap) if you have a very dense view and snap lines appear to be shooting off in all directions.
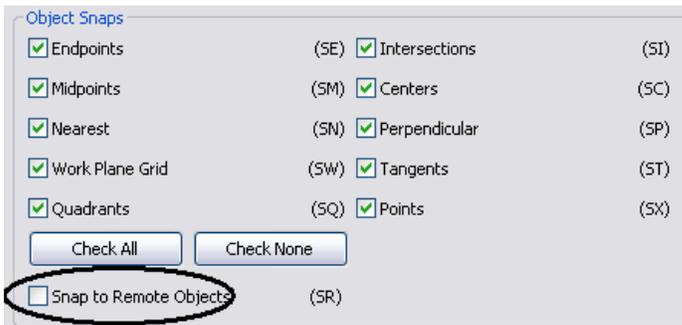
- Close unnecessary windows. When working in a 3D view, most of the file is placed into RAM. It is also recommended that these views should be closed when saving to central, since the Revit-based applications will regenerate this complex view as part of the save process.

- Revit-based applications will update all currently open views affected by changes in the model. Often, users will not realize that half a dozen or more views are currently open. In the following illustration, although the current view appears relatively simple, the Window menu shows there are a number of other views open. Selecting "Close Hidden

Windows" will close the concealed views, allowing the Revit-based application to update only the current view with changes until other views are reopened:

- Assign the proper level of visual detail to a given view. In a 1/8" plan view, assigning a "fine" level of display detail may be unnecessary. Plan views with fine and medium detail level are slow to open if there are many wall join layers to route. Favor a "Coarse" view setting unless required to show greater detail:
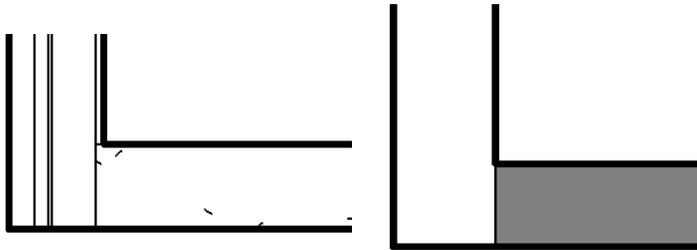
- Turn off shadows in views where they are unnecessary.

- Turn off shadows before printing views if not absolutely necessary:
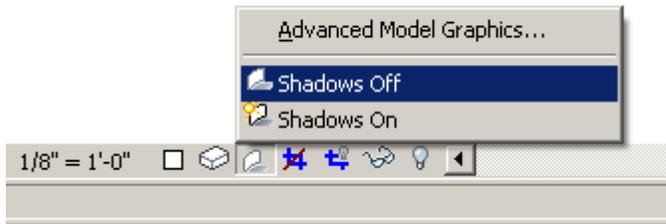
Volumes - Rooms and Spaces

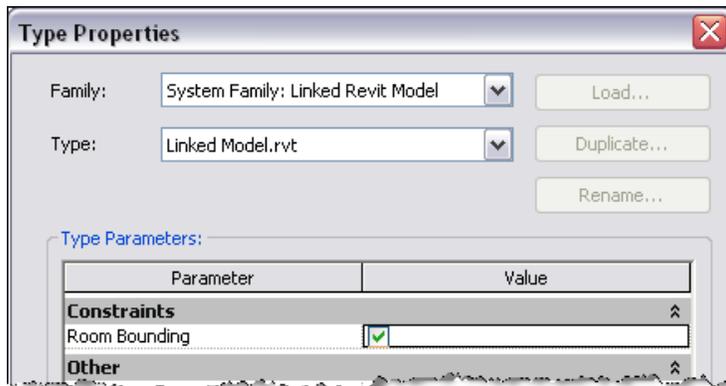- Only make linked files Room Bounding if they are absolutely needed to bound Volumes (Rooms and Spaces). The Revit-based application will need to process these additional boundaries, which can affect model performance. This setting is a Type Parameter on the Linked File itself.

- Promptly resolve warnings about Volume boundaries overlapping.

- If you have two levels with the same elevation, Revit-based applications will perform better if all Volumes are placed on one of the two levels, rather than dividing the same Volumes between the two levels.

- Avoid coincident Room or Space Separation Lines overlapping each other and overlapping walls. To locate Room or Space Separation Lines in a model, create a wireframe view template with walls and Room or Space Separation Lines visible.

- Set Room or Space Separation Line color to red with a heavy line weight so they are easy to identify.

- Place Room or Space Separation Lines on one workset for better control. (see Worksets section).

- Turning Volumes OFF can improve performance, but will disable much of the Volume analytical functionality in Revit MEP. When room volumes are OFF, Revit-based applications will represent rooms as simple extrusions, without considering ceilings, roofs, floors, or other upper or lower boundaries. Because Volume computations may affect the performance of your Revit project, it is disabled by default, except in Revit MEP where the setting is enabled by default. Turn Volume computations ON, when you need:

  o To show more accurate room color fills in section views

- o Revit-based applications to compute the volume numbers for each room prior to printing scheduled room volumes.

- o To export a gbXML file.

- o Carry out Building Performance Analysis.

- o Account for the location of Elements in Volumes based upon the bounded Volume geometry.

- o To change the room volumes settings, follow these steps:

  1. Click Settings menu >> Area and Volume Computations, or on the Room and Area tab of the Design Bar, click Settings.

  2. On the Computations tab of the Area and Volume Computations dialog, under Volume Computations, select Areas and Volumes.

  3. Click OK.
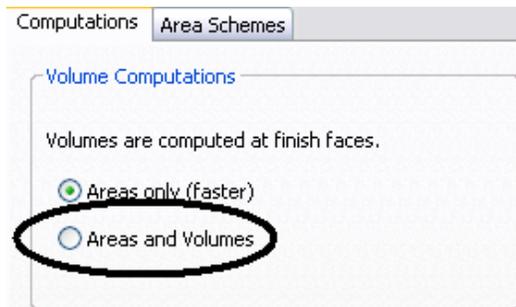
Worksets

The Revit platform originally implemented Worksets as a mechanism to enable multiple users to collaborate on a single model by taking temporary ownership of user-defined element groups. Making an entire Workset editable, or "Checking out" a Workset, prevented other users from editing any part of that Workset until control was relinquished on a Save to Central operation.

Revit® Architecture 8.0 implemented transparent element borrowing, which automatically assigns ownership of an edited element to a user, allowing more intuitive interaction with the model in a multi-user environment. Using element borrowing, users select the elements to edit, allowing the Revit platform to silently grant and manage ownership of the elements until the user's next Save to Central makes the edited elements available to all other users of the model.

Worksets remain extremely valuable for data segregation and managing workflow, since they enable selectively opening and closing portions of a project across all project views. This level of control can represent an advantage over view dependent features such as View Filters or Visibility / Graphics in certain workflows.

While the capability to check out a Workset remains valuable under certain circumstances outlined below, in general the best practice is to utilize Element Borrowing rather than checking out entire worksets. The Revit platform team recommends that Worksets should be employed most often to segregate conceptual areas of a project, such as:

- o Separate buildings

- o Grid and levels

- o Building core

- o Building shell

- o Furniture and equipment spanning multiple categories

- o Spatially identifiable areas of a single building (wings, for example)

- o Linked RVT and DWG files

- o Room or Space Separation Lines (see Volumes - Rooms and Spaces section)

- Checking out a Workset may occasionally be of use if certain model elements, such as the building grid or linked files, need to be protected from accidental change. In that event, BIM managers or team leaders will sometimes check out a Workset containing project elements that should not be casually edited or relocated.

- Worksets can help manage element visibility to reduce visual clutter during editing, as well as the Revit platform's use of memory. Closing currently unneeded Worksets can release allocated RAM for the Revit platform's use in memory-intensive tasks such as printing and exporting.

  Although closed Worksets will not appear in views, Elements contained in closed Worksets will still be updated if changes made in open Worksets impact them during model regeneration, in order to maintain data coordination across the model.

  Note: Upgrading models to the current version of the Revit-based application will force every Workset to open, and will therefore not benefit from selective Workset closure before file upgrade.

- Use selective Workset opening when accessing a workshared project file.

- Close Worksets not required for a given editing session.

- When creating a Workset, leave checked the default option "Visible by default in all views". Unchecking this option can render the Workset completely invisible and become problematic in multi-discipline workflows where feature visibility can be of paramount importance.

Worksharing

- Any large project requires constant team coordination. Most customers have realized many benefits by providing teams with instant messaging (IM) software to help coordinate model editing and saving between geographically dispersed teams.

- When making significant changes in a project (moving a level or major geometry changes), it is recommended that you perform the operation when no other users are working on the file and they have relinquished all elements. Once the changes are Saved to Central, have all users make new local files.

- Save to Central operations can be accelerated by a preceding "Reload Latest" command.

- When a project has been edited by other users for a day or more, it may be faster to create a new local from the central model rather than relying on the "Reload Latest" command to update the individual local model a day or more behind the remainder of the team.

- Attempt to keep project team workstation specifications equivalent. A dramatically weaker machine specification used by a single team member can reduce overall project performance.

- Revit-based applications save only one local model at a time to the central file. As deadlines approach and the frequency of saving to central increases, use the "Worksharing Monitor" feature to coordinate Save to Central commands across the team. Alternatively, team members could stagger their regular saves to central by either communicating an intention to save to central to the team or by assigning a standard saving time to each team member, i.e., at ten or fifteen minutes after the hour.

- When attempts to Save to Central collide, Revit-based applications display a dialog notifying that another user is currently saving to central. Cancelling Save to Central will prevent queuing the save request, allowing the user to continue to edit the local file before another Save to Central command.

- Because the Revit platform attempts to update all open views before saving, both local saves and saving to central will increase in performance if a simple view, such as a drafting view, is the only view open when the save operation begins.

- To reduce disk usage and memory usage, regularly compact central and local files:
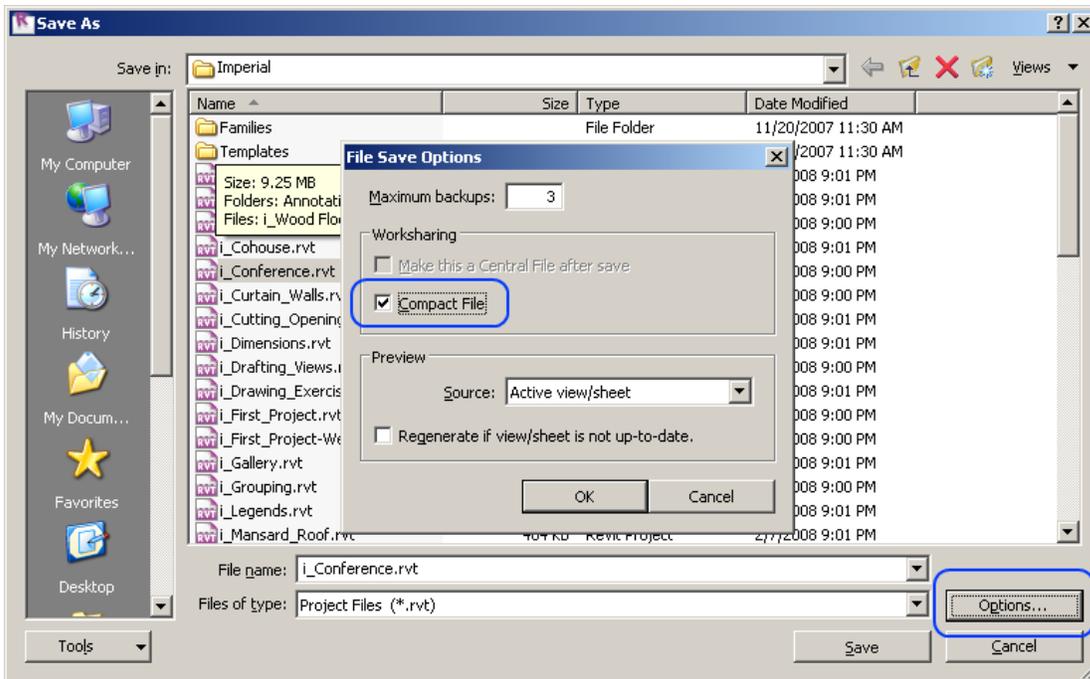
Revit Structure 2009 Software Optimization and Best Practices

Analytical Model Management

Disable <u>Analytical Support Check</u> in the Structural Settings dialog (*Settings -> Structural Settings*), only if you are NOT using the analytical model features of Revit Structure.
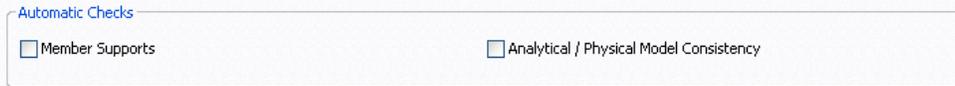
If the Revit Structure user is not using or is not too concerned about the analytical model accuracy, user can always disable the automatic Analytical Support Check feature which may improve significantly the performance of the model. To disable such feature, user must open with Notepad the Revit Structure .ini file (located in *C:\Program Files\the Revit Structure 2009\Program folder*) and add the two following lines at the end of the .ini page:

```
ContentSearch=1
[Spelling]
UseMSLex=0
OptionFlags=327680092
[Recent File List]
File1=C:\Documents and Settings\All Users\
File2=C:\My Documents\REVIT Structure\Revi
File3=C:\Documents and Settings\All Users\
[Recent Workset List]
Config1=AllLocal
Config3=All
[Analytical]
DontUpdateAnalyticalSupportInfo=1
```

Note: To Disable the Analytical Support Check feature for a Worksharing project, please make sure to modify all the Revit Structure .ini files in ALL user local computers that are working on this project.

If user decides to re-enable such feature again for the existing project or for a new project, user can either: 1- delete/remove the above two lines from the .ini file; or 2- set the value =0.

```
VSTAMacros=0
ContentSearch=1
[Spelling]
UseMSLex=0
OptionFlags=327680092
[Recent File List]
File1=C:\Documents and Settings\All Users\Application
File2=C:\My Documents\REVIT Structure\Revit Structure
File3=C:\Documents and Settings\All Users\Application
[Recent Workset List]
Config1=AllLocal
Config3=All
[Analytical]
DontUpdateAnalyticalSupportInfo=0
```

Note: After re-enabling the Analytical Support Check feature on an existing project, when opening the model or adding new structural elements again into the model, user may experience a very long delay and waiting time because Revit Structure has to repopulate all the Analytical Check information into the model. Once the computation is done, such delay should no longer occur.

If possible, user should avoid excessive modeling of the 3D connections in Revit Structure. When doing typical detail, user should create or use 2D detail component connections instead. (For example, connection plates, bolts, etc.)

Revit® MEP 2009 Software Optimization and Best Practices

View Performance

The largest impact on View manipulation performance (scroll, pan, zoom operations) is the Model Graphics Style settings. The Hidden Line Style, due to the requirement to dynamically generate gaps and hidden lines when elements overlap in the View, requires the most processing and thus results in a noticeable performance impact in Views with many visible Elements. The following best practices will help to mitigate this performance impact and streamline project workflows.

Modeling and Sheet Views

In order to streamline project workflow, it is recommended to create both Modeling and Sheet Views for the same regions of the building.

Follow these guidelines

- Modeling Views should be configured to utilize the Wireframe Model Graphics Style.

- Sheet Views should be configured to utilize the Hidden Line Model Graphics Style to produce the desired appearance for Construction Documentation.

- Use Dependent Views for your Sheet Views. This allows you to have multiple regions of an overall Level in different views, while not requiring duplicate Annotations.

Figure 1 - Modeling and Sheet Views

- Differentiate Modeling Views from Sheet both in View Name and Sub-Discipline, as see to the right in Figure 1. This will provide a logical organization of the view for users, and help to ensure proper usage.

- Utilize View Templates to streamline the creation of these Views and achieve consistency.

- Utilize Duct and Pipe Color Fills only in your Modeling Views, where the Wireframe Model Graphics Style is used.
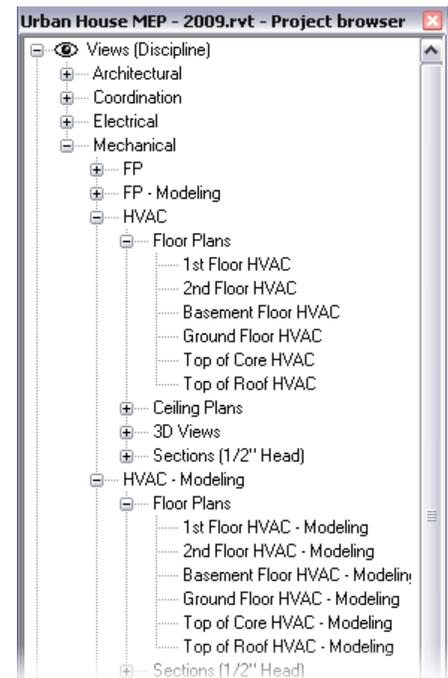
Optimizing Hidden Line Performance

Performance in Views with the Hidden Line Model Graphics Style enabled is directly related to the number of Faces displayed in the View. While Elements appear as 2D Lines in a Revit View, they are 3D Objects made up of faces in the model. It is those faces that are processed

by the Revit graphics system and show up in the View as 2D Lines. Use the following best practices to optimize the performance of your Views with the Hidden Line Model Graphics Style enabled.

- Avoid using Fine detail level when working in mechanical views if not necessary, as this displays Pipes as 1-Line Medium detail level is useful for Views working with HVAC systems.

- If using complex 3D Components in your Building Service designs, turn off the visibility of the complex 3D geometry in your Sheet Views. In place of the complex 3D geometry, utilize Model Lines that convey the overall component shape in the Family definition. Make those Model Lines visible in the Detail Level defined in your Sheet Views.

- If not necessary for documentation of working on a View, set the Inside and Outside Gap settings for Hidden Lines to 0, as seen on the right in Figure 2. This can provide substantial performance improvements.
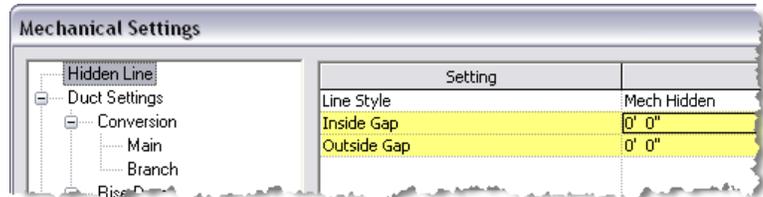

Figure 2 - Turning Off Hidden Line Gaps

Model Manipulation Performance

Revit MEP allows users to create models of Building Services, often in the form of large connected networks. The powerful analytical capabilities of Revit MEP, in conjunction with the Revit Parametric Change Engine, allow data to flow throughout the connected network when manipulations are made.

Improper structure and configuration of large connected networks has been shown to have a severe impact on model manipulation performance. In comparative testing, models have been shown to perform up to perform significantly better when structured properly.

As a connected network grows, the performance of model manipulations (moving Elements, changing Flows, connecting new Elements, etc.) is impacted by a number of factors. Understanding these factors, and adhering to the Best Practices outlined below, will allow for optimal model performance.

Create Systems
Create logical Systems for your connected networks, rather than leaving all Elements on the "Default System". Associating Elements into Systems helps to streamline data propagation and facilitates the analytical uses of Systems like Pressure Drop calculations.

Testing of customer models with all elements on the Default System showed significant improvements when the connected network was re-structured as logical Systems.

Set Correct Connector Flow Directions
Ensure that the Flow Direction Parameter for Connectors on Families in the connected network is not set to Bidirectional unless the Family is placed in-line with connected networks like Dampers and Valves. This can make flow determination more difficult and thus impact regeneration performance.

Create Strategic Breaks and/or Use Multiple Files
While maintaining the entire design for a building service in one well connected model allows for full data propagation, the size of the connected network is directly related to its manipulation performance. Testing has shown a linear decrease in manipulation performance as a connected network size grows. The rate of decrease is directly related to the topics mentioned in this section.

As the performance of connected networks decreases with larger size, the benefits of data propagation and connectivity are overcome by the need for better model manipulation performance. Thus, for large projects it is a best practice to employ one or both of the following strategies to ensure productive manipulations of your connected networks.

- **Strategic Breaks**
  Creating disconnections in a connected network stops data propagation during model manipulations, as well as the constraints engine that maintains connections. Product Team testing has determined that strategic breaks in a connected network produces the most significant improvements in model manipulation performance. The recommended practice for this strategy is to create disconnections at logical sections of the connected network.

  For example, in a VAV air distribution system, create disconnections at the upstream connection point on the VAV box. This allows the VAV flow to still be calculated based upon the downstream Air Terminals. A Duct System Schedule can then be used to manually coordinate flow at the Air Handler or Package Unit.

  The most efficient way to accomplish such a disconnect, while still maintaining proper appearance for documentation, is to model the upstream element without connecting to the VAV and then using the Align tool to locate the end of the Duct at the same location as the VAV connection. To download a video showing this procedure, click here. Example files for such a system can be obtained by clicking on the following links; Revit MEP 2008 and Revit MEP 2009.

- **Multiple Files**
  For large, complex buildings, using strategic breaks as well as the aforementioned best practices may still not provide optimum model manipulation performance. In these

cases, the model should be built across multiple Revit Project files.

There are two fundamental ways to structure the MEP project files, by MEP discipline and by region of the building. Both of these approaches have their benefits and drawbacks, and ultimately it is the choice of the BIM/CAD Manager.

o **By Discipline**
This strategy creates separate Project files for each MEP discipline, such as a Mechanical, Electrical, Plumbing, Fire Protection files.

o **By Region**
This strategy creates separate Project files for different regions of the building, keeping all disciplines in each file.

In order to achieve optimal coordination between the MEP disciplines, each discipline must be within the same Revit Project file. This allows disciplines to connect to each other's elements directly, like electrical connections or drain connections on mechanical equipment. Additionally, Product Team testing has shown that separate connected networks do not have a significant impact on each other; a duct network does not have a significant impact on model manipulation of a plumbing network in the same Project file.

With these considerations in mind, it may be helpful to structure large projects by region of the building.

Simplify the Display of Architectural Elements

Simplifying the display of architectural elements may help improve performance by reducing the visible elements that must be generated and maintained within the view. This may be done by overriding the Detail Level in the view.

For example, the Coarse Detail Level may be applied to walls even when the view is configured to use Medium or Fine (refer to figures below). In the Visibility / Graphics Overrides for the view, set the detail level of the appropriate components to the simplest level acceptable.

These settings may be configured in view templates and applied to your views to quickly simplify the detail level throughout your project.

Figure 3: Wall with medium detail level in medium detail view.

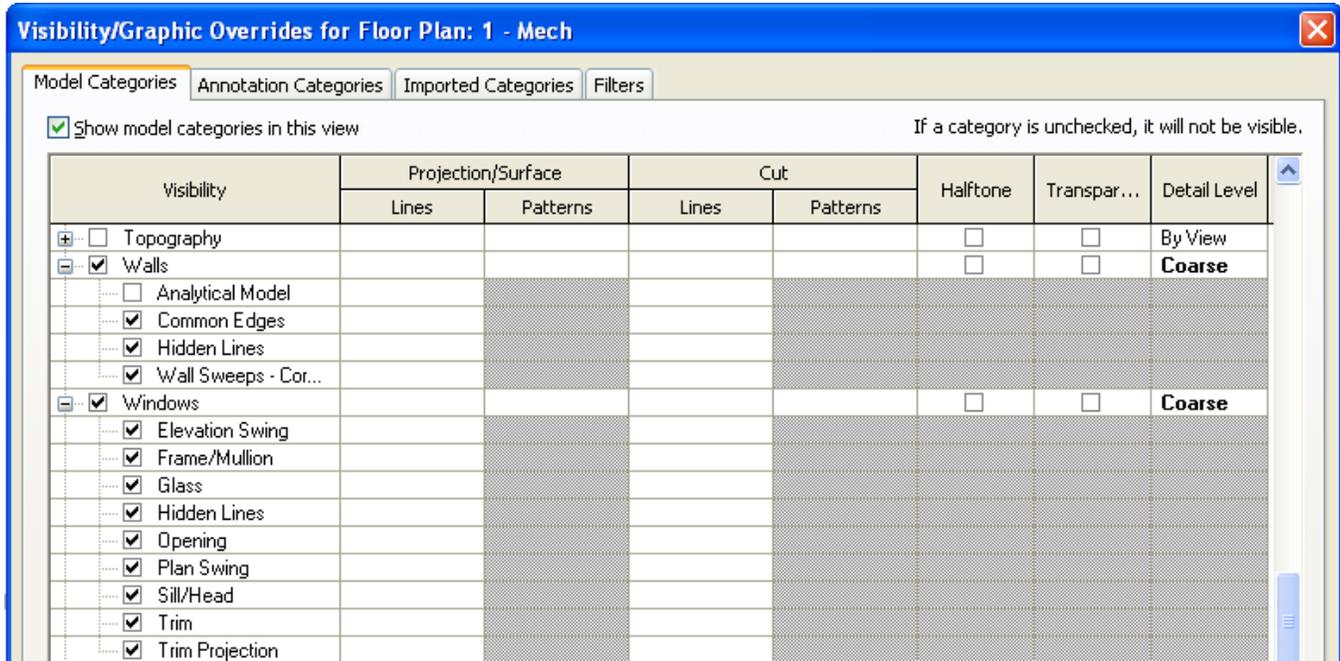Figure 4: Wall with coarse detail level in medium detail view.

Figure 5: Coarse detail overrides for architectural elements.

Interacting with Autodesk Support

When contacting Autodesk technical support concerning performance issues, please provide the following information and materials to support services:

- A description of the issue, including:

  - When the problem began to occur (if no date is available, an approximate date is better than none).

  - Whether the problem has occurred before.

  - Recent changes, if any, to the hardware and software of the affected machine.

  - A summary of any attempts to resolve the issue before contacting support.

- Accompanying materials:

  - The Autodesk design files involved in the project:

    - Local file

    - Central file

    - Any linked RVT, DWG and DWF files

  - The Revit-based application journal file from the affected computer. See the following link for the procedure to obtain the journal file:

    http://usa.autodesk.com/getdoc/id=TS1067426

  - If a network problem or operating system problem is suspected, obtain a System Information (NFO) file. See the following link for the procedure to obtain an NFO file:

    http://usa.autodesk.com/getdoc/id=TS1057804

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