

Revit Architecture 2010, Revit MEP 2010 and Revit Structure 2010

Model Performance Technical Note

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March 2009

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Model Performance Technical Note

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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 of these areas, 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 building models are identical in the tactics and strategies that will yield the most robust performance. Nonetheless, 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. These users 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

Platform Hardware Requirements and Recommendations

32-bit Revit System Requirements

Description	Requirement
Operating System	Microsoft® Windows® XP® SP1 or SP2 <ul style="list-style-type: none">■ Home■ Professional
	Microsoft® Windows® Vista® 32 bit SP1 <ul style="list-style-type: none">■ Business■ Home Premium■ Ultimate

Description	Requirement
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	5 GB free disk space
Pointing Device	MS-Mouse compliant
Media	Download or installation from DVD
Connectivity	Internet connection for license registration

32-bit Revit System Recommendations

Description	Recommendation
Operating System	Microsoft Windows XP Professional SP2 (or later)
Browser	Microsoft Internet Explorer 6.0 SP1 (or later)
CPU type	Intel™ Core 2 Duo 2.4 GHz or equivalent AMD processor
Memory	4 GB RAM
Video Display	Dedicated video card with hardware support for Microsoft® DirectX 9 or later
Hard Disk	5 GB free disk space
Pointing Device	Two-button mouse with scroll wheel

64-bit Revit System Requirements

Description	Requirement
Operating System	Microsoft® Windows® XP Professional x64 Edition SP1 Microsoft Windows Vista® 64 bit SP1 <ul style="list-style-type: none"> ■ Business ■ Home Premium ■ Ultimate

Description	Requirement
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
Video Display	1280 x 1024 monitor and display adapter capable of 24-bit color
Hard Disk	5 GB free disk space
Pointing Device	Microsoft-mouse compliant
Media	Download or installation from DVD
Connectivity	Internet connection for license registration

64-bit Revit System Recommendations

Description	Recommendation
Operating System	Microsoft Windows XP Professional x64 Edition SP1 (or later)
Browser	Microsoft Internet Explorer 6.0 SP1 (or later)
CPU type	Intel Core® 2 Duo 2.40GHz or equivalent AMD processor
Memory	8 GB RAM (or more)
Video Display	Dedicated video card with hardware support for Microsoft® DirectX® 9 or later
Hard Disk	5 GB free disk space
Pointing Device	Two-button mouse with scroll wheel

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 not fully 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.
- In Revit 2010, multi-threaded methods for printing and wall join cleanup have been made available. Multi-threaded hidden line removal for printing has been enabled by default.
- Due to the operating system overhead of maintaining multiple threads, multiprocessing of wall join cleanups can experience a minor degradation when only 2 CPU cores are present, but up to a 27% performance increase when 4 hyper-threaded CPU cores are present. Because 2 CPU core systems remain the most common configuration of Revit systems as reported by CIP data, multiprocessing of this features is OFF by default.
- To enable multiprocessing for wall join cleanup, add the following entries to the Revit.ini file:

```
[PerformanceOptimizations]  
ParallelWallJoins=ON
```
- To disable multiprocessing for wall join cleanup, you may omit any entries in the [PerformanceOptimizations] section of the Revit.ini file, or explicitly set the state of either one or both multiprocessing optimizations:

```
[PerformanceOptimizations]  
ParallelWallJoins=OFF  
ParallelPrintProcessing=OFF
```
- 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 more than four processors available. 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 to do further research. Autodesk makes no warranties about the accuracy or veracity of this data:

<http://www.tomshardware.com/charts/cpu-charts-2008-q1-2008/3D-Studio-Max-9,369.html>

<http://www.cpubenchmark.net/>

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

L2 Cache

The Revit platform team strongly recommends CPUs that include L2 caches because of their substantial performance benefits. 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 the 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.

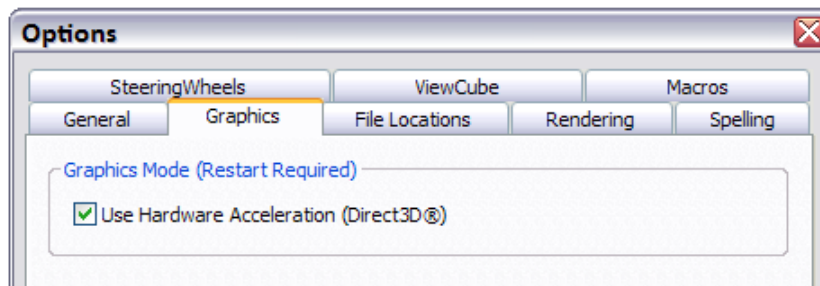
Video Cards

- The Revit platform team strongly recommends dedicated video cards supporting DirectX 9 or later.
- Consider video cards designed to support CAD applications.
- Integrated video support should be avoided because such schemes use machine RAM rather than on-card memory.
- Relatively inexpensive video cards may perform as well as 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 Direct3D hardware acceleration, please follow these steps:

- 1 On the Revit application menu, click Options.
- 2 Select the Graphics tab.
- 3 Select the Use Hardware Acceleration (Direct 3D) option, shown 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; however, 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 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:

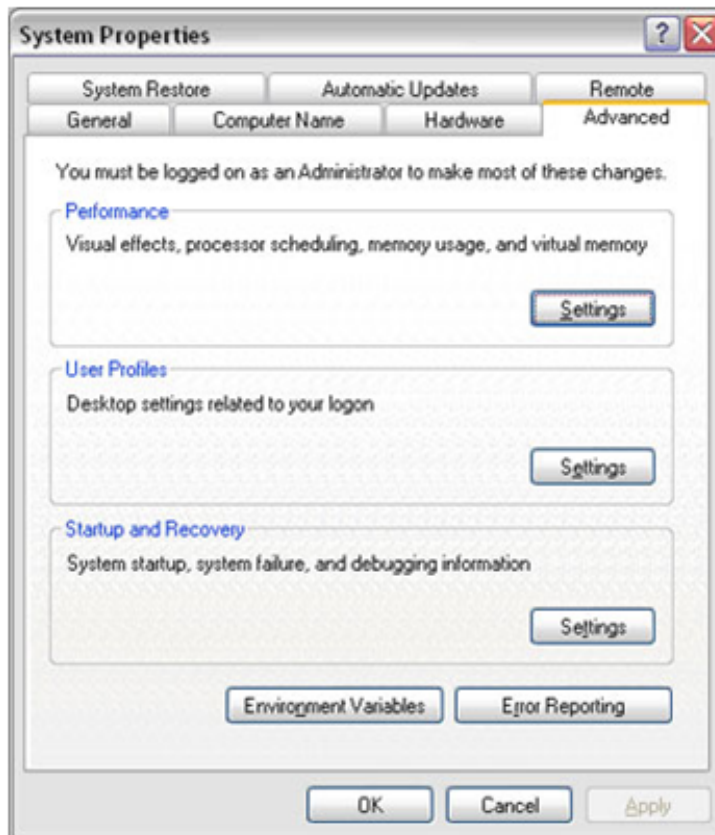
- Close other applications
- Turn off shadows for all printed views if not absolutely necessary.
- Detach local copies from central before printing and exporting to limit network resources and reduce project chatter between local and central files. Use this tactic with caution because changes subsequent to detachment cannot be saved to the central file.

Optimizing OS for Performance

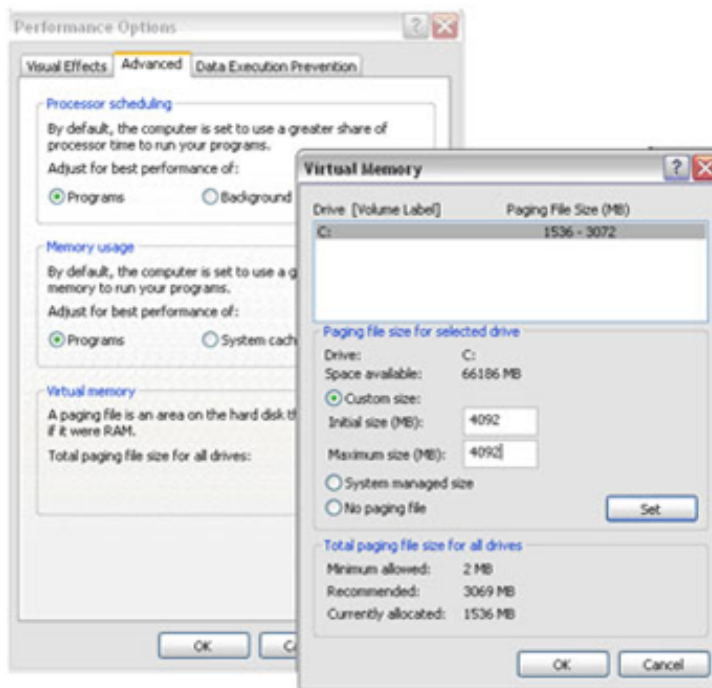
Verify that the paging file size is optimized for your system. The paging file should be at least the size recommended for Windows and at most twice the amount of installed RAM. Larger page files may provide more memory to the Revit platform, but performance could degrade noticeably with expanded page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

Follow these steps:

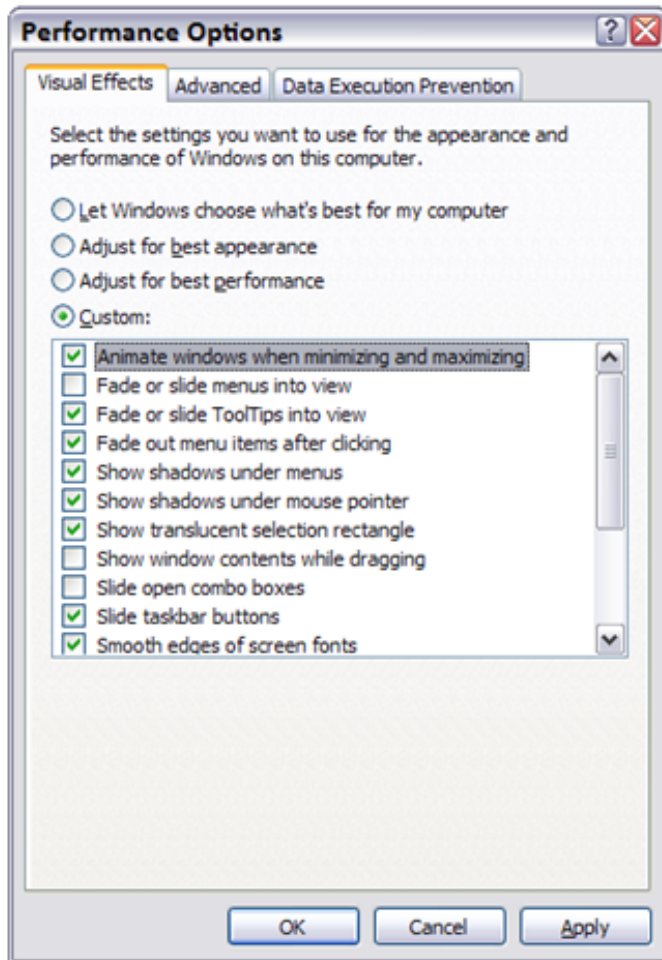
- 1 On the Start menu (Windows), click Settings ► Control Panel.
- 2 In Control Panel, double-click System.
- 3 In the System Properties dialog, click the Advanced tab.



- 4 Under Performance, click Settings.
- 5 In the Performance Options dialog, click the Advanced tab.
- 6 On the Advanced tab, under Virtual Memory, click Change.
- 7 In the Virtual Memory dialog, 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.
- 10 Click Apply.
- 11 Click the Visual Effects tab.



- 12 Select Custom.
- 13 Clear the Fade or slide menus into view option.
- 14 Clear the Show window contents while dragging option.
- 15 Clear the Slide open combo boxes option.
- 16 Click Apply.
- 17 Click OK to close each dialog.

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

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.msp>

- 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

- 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, 64-bit Revit may exhibit increased stability and performance when editing larger models. 64-bit Revit is optimized to take advantage of the 64-bit Operating System.

Network Recommendations

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.

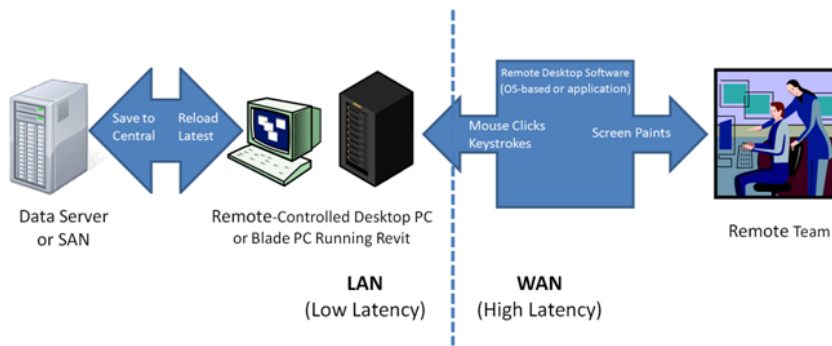
Data Server Specification

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:

- Complex geometry
- Multiple parametric relationships
- Multiple constraints
- 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 array and removing the parametric associations of the copied objects.

You can also attain the same result by clearing the Group And Associate option before creating the array.



Constraints

Minimal constraints will help prevent:

- "Can't keep joined" errors when moving objects.
- 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.

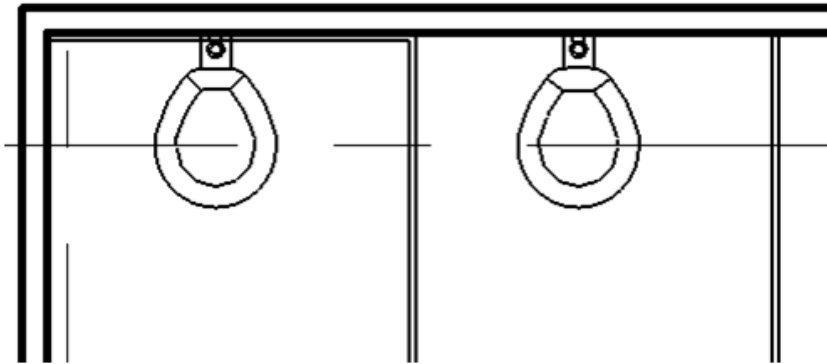
DWG Files

- 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 that cut their hosts consume significant computing resources on regeneration as compared to families that reside on a given surface without cutting the host. Consider modeling building components such as HVAC registers as 2D ceiling-based 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:

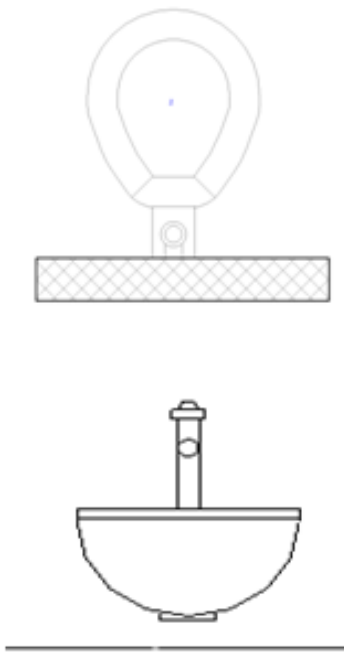


The 3D toilet is completely modeled:



The 2D version of the toilet is invisible in a 3D view. Views of the toilet are available only 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 (such as ACIS SAT or DWG) 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 provide improved display control.

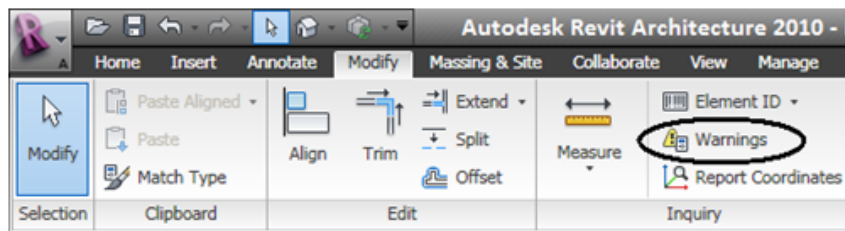
Importing & Linking

- Unload links of all types if they are not used. Temporarily unload links that are 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, 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:
 - Separate buildings
 - Building core
 - Building shell
 - Interiors
 - Expansion joints
 - Individual towers

- Parking structure(s)
- Files may be linked, but not imported, using Shared Coordinates. Files may be imported using Project 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 as "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 types 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 for 32-bit Revit, or 200 MB for 64-bit Revit, then 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 rather than lines.
- Limit joined geometry to necessities.
- Remove unneeded area schemes.
- Avoid maintaining unnecessary groups. Delete unused groups from the project browser.
- Purge unused objects. Because purged objects cannot be recovered, you may wish to make a backup of the project before purging.
- Regularly review and fix warnings (ModifyRibbon ► 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 that 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.

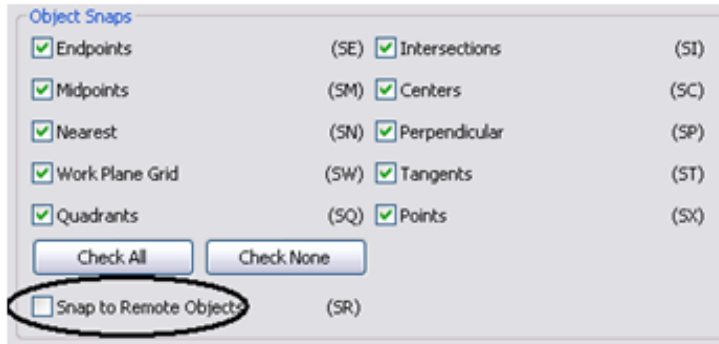
Upgrading Linked Projects to a New Version of Revit

- Temporarily rename all central files. Renamed central files will fail to locate any Revit models linked to the renamed central, and Revit will avoid temporarily upgrading the links.
- After you have upgraded each central file, use the Save As command to return each to its original name.
- Upgrade each central file's linked files. The upgraded central files will once again find the upgraded linked file.

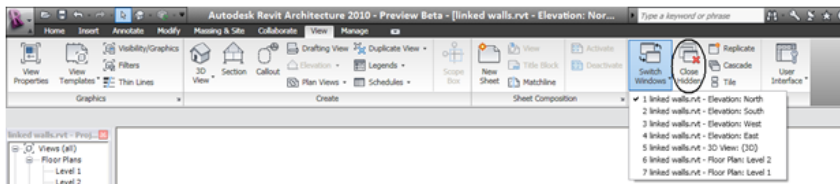
Views

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

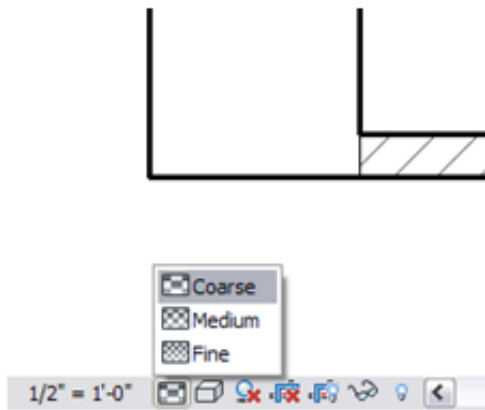
- Avoid hiding large quantities of individual elements in views.
- Using the Paste Aligned command to paste into closed views will open and close the target views. When repeating such an operation several times, performance will be improved by opening all the target views before beginning the sequence of paste operations.
- Zoom in to speed up drawing and snapping.
- If you have a very dense view, and snap lines appear to be shooting off in all directions, click Manage tab > Settings panel > Snaps, and in the Snaps dialog, clear the Snap to Remote Objects option.

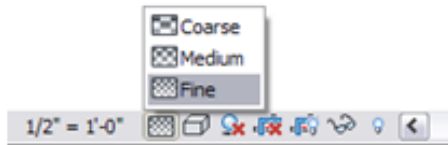
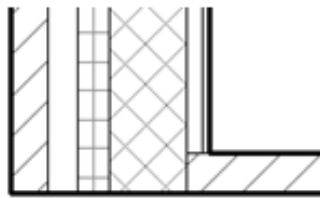


- Close unnecessary windows. When you are working in a 3D view, most of the file is placed into RAM. It is also recommended that these views should be closed when saving to central, since the Revit-based applications will regenerate this complex view as part of the save process.
- Revit-based applications 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, the Switch Windows drop-down shows there are a number of other views open. Clicking the Close Hidden button will close the concealed views, allowing the Revit-based application to update only the current view with changes until other views are reopened.

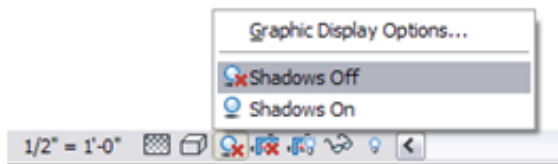


- Assign the proper level of visual detail to a given view. In a 1/8" plan view, assigning a display detail level of Fine may be unnecessary. Plan views with the detail level set to Fine or Medium are slow to open if there are many wall join layers to route. Favor a setting of Coarse unless greater detail is required.



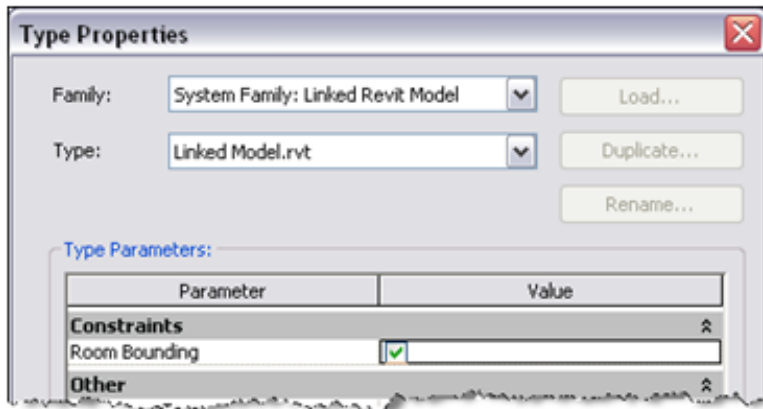


- Turn off shadows in views where they are unnecessary.
- Turn off shadows before printing views if not absolutely necessary.



Volumes - Rooms and Spaces

- Only select the Room Bounding option for linked files 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 option is a type parameter for the linked file itself.

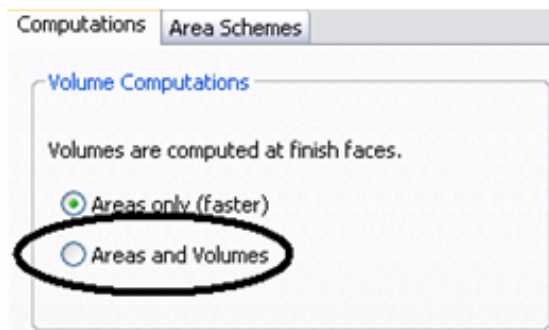


- Promptly resolve warnings about volume boundaries overlapping.
- If you have two levels with the same elevation, Revit-based applications will perform better if all volumes are placed on one of the two levels, rather than dividing the same volumes between the two levels.
- Avoid coincident room or 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 the color for room or space separation lines 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 area and volume computation off can improve performance, but will disable much of the volume analytical functionality in Revit MEP. When volume computation is 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 to:
 - Show more accurate room color fills in section views
 - Compute the volume numbers for each room prior to printing scheduled room volumes
 - Export a gbXML file
 - Carry out building performance analysis
 - Account for the location of elements in volumes based upon the bounded volume geometry.

To change the room volumes settings, follow these steps:

- 1 On the ribbon, click Home tab ► Room and Area panel ► Area and Volume Computations.
- 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 (by checking it out) prevented other users from editing any part of that workset until control was relinquished upon 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 operation makes the edited elements available to all other users of the model.

Worksets remain extremely valuable for data segregation and managing workflow, because 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 settings 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 use 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:

- Separate buildings
- Grid and levels
- Building core
- Building shell
- Furniture and equipment spanning multiple categories
- Spatially identifiable areas of a single building (such as wings)
- Linked RVT and DWG files
- Room or space separation lines (see Volumes - Rooms and Spaces section)

More workset information:

- 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, any elements within them will still be updated during model regeneration if they are impacted by changes made in open worksets, thus maintaining data coordination across the model.

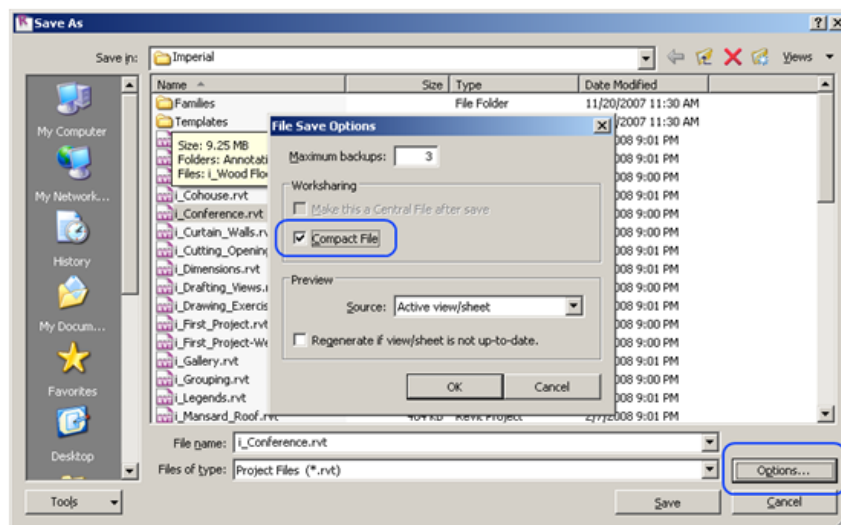
NOTE Upgrading models to the current version of the Revit-based application will force every workset to open, and will therefore not benefit from selective workset closure before file upgrade.

- Use selective workset opening when accessing a workshared project file.
- Close worksets not required for a given editing session.
- When creating a workset, leave the Visible by default in all views option selected. Clearing this option can render the workset completely invisible and 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 all other users 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.
- Try 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; for example, at ten or fifteen minutes after the hour.
- When attempts to save to central collide, Revit-based applications notify you that another user is currently saving to central. Cancelling the Save to Central operation 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.



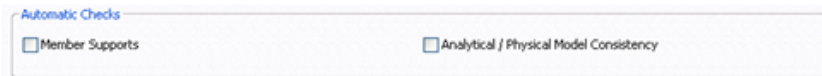
TIP When you need to upgrade a workshared file from one version of Revit to another, rename all of the central files first. If you have linked files, Revit cannot find the links and thus will not try to temporarily upgrade the links. After you have upgraded, you can then use the Save As command to revert to the original name. Then, when you upgrade the linked files, Revit will once again find the upgraded linked file.

Revit Structure 2010 Software Optimization and Best Practices

Analytical Model Management

If you are not using the analytical model features of Revit Structure or are not too concerned about the analytical model accuracy, you may be able to significantly improve model performance by turning these features off in the user interface or disabling them in the RevitStructure.ini file.

To turn off the features in the user interface, click Manage tab ► Project Settings panel ► Structural Settings. Then, on the Analytical Model Settings tab of the Structural Settings dialog, under Automatic Checks, clear the Member Supports and Analytical/Physical Model Consistency options.



To disable these features, use Notepad to open the RevitStructure.ini file (located in the C:\Program Files\RevitStructure2010\Program folder) and add the two lines shown below to the end of the file:

```
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 feature for a worksharing project, make the above modification to the RevitStructure.ini file on all local computers that are used on the project.

To enable this feature again for the existing project or for a new project, either delete the above two lines from the .ini file; or change the value from 1 to 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 analytical support on an existing project, you may experience a significant delay when opening the model or adding new structural elements, because Revit Structure must reload all the analytical check information into the model. After the computation is done, no further delays should occur.

If possible, avoid excessive modeling of 3D connections in Revit Structure. For typical detail creation, use 2D detail component connections (such as connection plates and bolts) instead.

Revit MEP 2010 Software Optimization and Best Practices

View Performance

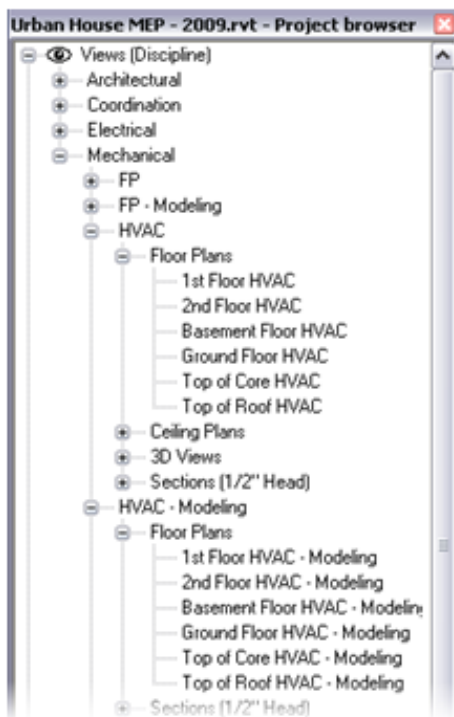
The Model Graphics Style settings have the largest impact on performance for view manipulation operations (scroll, pan, and zoom). Due to the requirement to dynamically generate gaps and hidden lines when elements overlap in the view, the Hidden Line style requires the most processing and thus results 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

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 use the Wireframe model graphics style.
- Sheet views should be configured to use the Hidden Line model graphics style to produce the desired appearance for construction documentation.
- For your sheet views, use dependent views, which allows you to have multiple regions of an overall level in different views, without requiring duplicate annotations.
- Differentiate modeling views from sheet views both in the view name and sub-discipline to provide a logical organization of the view for users, and help to ensure proper usage.

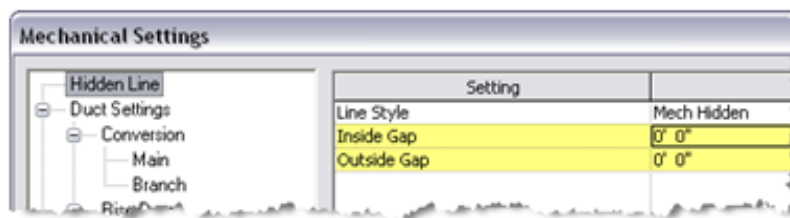


- Use view templates to streamline the creation of these views and achieve consistency.
- Use duct and pipe color fills only in modeling views where the Wireframe model graphics style is used.

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. Although elements display as 2D lines in a Revit view, in the model they are 3D objects made up of faces. The faces are processed by the Revit graphics system and display in the view as 2D lines. Use the following best practices to optimize the performance of views with the Hidden Line model graphics style enabled.

- Avoid using the Fine detail level when working in mechanical views unless necessary, as multi-line representations slow performance. Displaying pipes as 1-line at Medium detail level is usually sufficient when 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, use model lines that convey the overall component shape in the family definition. Make those model lines visible at the detail level defined in your sheet views.
- If not necessary for documentation when working with hidden lines in a view, setting the Mech Hidden value for Inside Gap and Outside Gap to 0 can provide substantial performance improvements.



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 significantly better when structured properly.

As a connected network grows, the performance of model manipulations (such as moving elements, changing flows, and connecting new elements) 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, such as in pressure drop calculations.

Testing of customer models with all elements on the default system showed significant improvements when the connected network was restructured 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. The Bidirectional setting can make flow determination more difficult and thus impact regeneration performance.

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.

Because the performance of connected networks decreases with larger size, the benefits of data propagation and connectivity may be outweighed by the need for better model manipulation performance.

For large, complex buildings, 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 or 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.

By Discipline

- This strategy creates separate project files for each MEP discipline; that is, separate Mechanical, Electrical, Plumbing, and Fire Protection files.

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 organization 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.

Based on these considerations, 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 setting 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/Graphic Overrides dialog for the view (click View tab ► Graphics panel ► Visibility/Graphics), 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.

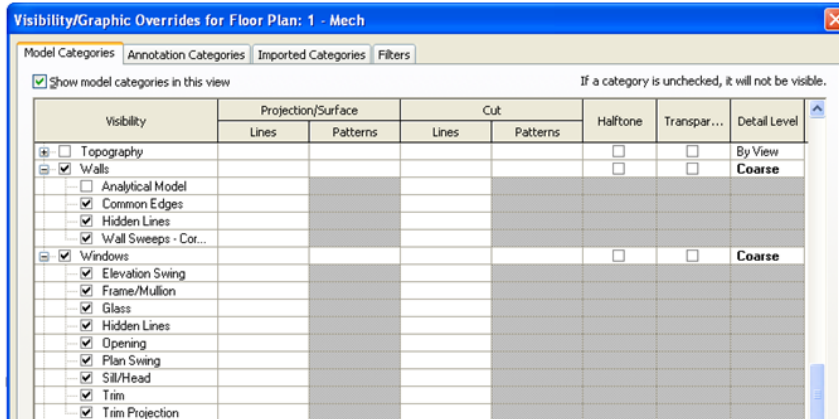
Wall with medium detail level in medium detail view



Wall with coarse detail level in medium detail view



Coarse detail overrides for architectural elements



Interacting with Autodesk Support

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

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 and 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>