AutoCAD® Civil 3D® 2010

Technical Note

Harnessing the Power of AutoCAD Civil 3D

AutoCAD® Civil 3D® software is not your typical design and analysis software. AutoCAD Civil 3D uses a dynamic engineering model that helps project teams explore civil engineering projects digitally before they are built.

What Advantages Does AutoCAD Civil 3D Offer?

3D Model Based Design
AutoCAD Civil 3D software uses an object-oriented architecture. Design entities in the drawing, such as points and surfaces or alignments and corridors, are intelligent objects that maintain relationships with other objects in the model. The AutoCAD Civil 3D object model automates part of the design process by utilizing dynamic updating, so when changes to one object occur, this change is propagated through to all related objects, including labels and tables.

Integrated Geospatial Analysis and Mapping
AutoCAD Civil 3D is built on top of AutoCAD® Map 3D software, adding full featured geospatial application functionality to the software, without the need to launch a separate application. The geospatial analysis and mapping capabilities permit the user to connect to commonly used data sources directly, enabling engineering teams to make use of the diverse sources of information that is readily available, without the purchase of a separate, dedicated GIS software application.

Production Drafting and Plans Production

Civil 3D is based on the AutoCAD® platform, which means that all the productivity boosting tools for production drafting found in AutoCAD® software are also available in Civil 3D. Civil 3D is also fully integrated with the AutoCAD® Sheet Set Manager, which assists with the layout and management of construction documents.

Data Management Functionality Built-In

With AutoCAD Civil 3D, you have a choice of data management mechanisms. Autodesk® Vault software is supplied with AutoCAD Civil 3D. Autodesk Vault is a complete and secure document management system for drawings, project objects and project-related files.

Using Civil 3D, engineering objects can be referenced into other drawings, so that teams can work from the same consistent, up-to-date model. The use of references leverages the dynamic relationships between objects. When a source object is edited, these changes automatically flow through all referenced copies in other drawings. Beyond using referencing with Autodesk Vault, users have options to use data shortcuts and external reference files (xrefs), enabling workflows that meet varying needs.

Strategies to Enhance the Civil 3D Experience

AutoCAD Civil 3D follows the typical pattern of software development, whereby each release adds new features which requires an increasing amount of system resources to run. In parallel, customers work with increasingly larger datasets as their machines get faster.

Like any design instrument, performance of AutoCAD Civil 3D 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 performance, the AutoCAD Civil 3D team has assembled this collection of hardware requirements, recommendations and best practices as researched by both internal development and our community of dedicated customers.

No two civil models are precisely the same 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.

Hardware Requirements for AutoCAD Civil 3D

System Requirements

Description	Requirement
Operating System	• Microsoft®Windows® Vista® Ultimate/Business/Enterprise • Microsoft®Windows® XP SP2 or SP3 • Microsoft Windows XP 64 and Windows Vista 64 are supported in 32-bit compatibility mode only.
CPU Type	Intel®Pentium® 4 or AMD Athlon®dual-core processor, 3 GHz or higher with SSE2 technology
Memory	*4 GB RAM – suggested /3 GB switch (on 32 bit operating systems)
Hard Disk	7 GB disk space, 2 GB free after installation
Video Display	• 1280 X 1024 display with true color, 1600 X 1200 or greater recommended • OpenGL® accelerator with full OGL ICD support not required • 32-bit color video display adapter (true color), 128 MB or greater, Direct3D®-capable workstation class graphics card. • Multiple monitors are supported.
Browser	Microsoft® Internet Explorer® 7.0 or later.
Media	Download or Installation from DVD

* For more information, see "Memory" section.

Performance

Performance can be affected by many things including characteristics of the computer (hardware), video cards, memory, operating system and characteristics of the software.

Memory Primer

Memory is categorized in two ways. One is physical memory, or RAM, which is hardware based. The other kind of memory is virtual memory. Virtual memory is a computer system technique that uses hard disk space to extend the physical memory and gives a software program the impression that it has contiguous working memory, while in fact it may be physically fragmented. When people think of virtual memory, they think of paging, or swap files.

Paging is where pieces of memory are parsed in chunks and these chunks are written to the hard disk in page files. Page files can be noncontiguous. Page files sizes can be configured by the users to help with performance, but typically users let the operating system handle the size.

Something to keep in mind is that the more physical memory, or RAM, that is available the better the software will perform. This is due to the fact that the system does not have to take the time to write information to disk.

AutoCAD Civil 3D needs memory in contiguous blocks of varying sizes. If a block of memory large enough for a particular requested allocation by Civil 3D is not available, then out-of-memory scenarios can occur. The longer a session of Civil 3D has been running, the more fragmented the available memory becomes due to the various allocations and releases of memory that occur during different Civil 3D sessions.

Operating Systems Primer

AutoCAD Civil 3D 2010 is a 32-bit application only. That being said, Civil 3D can be installed and ran on a 64-bit operating system. Regardless of operating system, 32-bit applications cannot address more than 4 GB of virtual memory. By default, the Windows operating system reserves the first 2 GB of RAM for the operating system itself, and things like video drivers. As each software program is started, they are each given 2 GB of memory address space. If the actual amount of memory used by the programs exceeds the amount of physical RAM on the computer, the hard disk is used as "virtual memory" and information is swapped in and out of memory as needed. As described in the previous section, there are ways to move this memory around, but the bottom line is that 4 gigabytes is the maximum memory that a 32-bit operating systems can use.

The operating system is one of the most influential factors affecting performance of Civil 3D, not the hardware itself.

Optimizing Memory Usage

AutoCAD Civil 3D is large address aware. This means that it can utilize up to 3 GB of RAM for the application.

32-Bit Windows Operating System

- **Windows XP** only makes 2GB of system memory available to applications unless the **/3GB** switch is enabled in the **boot.ini** file. You can use the **/userva=xxxx** switch for fine tune the amount of virtual memory space allocated to individual programs (note that xxxx is expressed in megabytes).

  When the /3GB switch is activated, its default configuration is to assign 3GB of address space to Civil 3D and 1GB of address space to the operating system. Since 1GB can cause significant stability issues with the computer, the userva switch allows the user to set the amount of address space allocated to Civil 3D to an arbitrary value between 2 and 3 gigabytes. For complete information on enabling access for AutoCAD Civil 3D to 3GB of memory, please see the Autodesk technical document:

  http://usa.autodesk.com/getdoc/id=TS1071001

  For more information on the 3GB switch, refer to the following Microsoft MSDN article:

  http://msdn2.microsoft.com/en-us/library/ms791558.aspx

- **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.

  http://usa.autodesk.com/adsk/servlet/ps/item?siteID=123112&id=9583842&linkID=9240697

Keep in mind that video cards can also affect memory usage. Some video cards are designed to grab virtual memory to help them run better. It is important to know the characteristics of your video card to fully understand the impacts it may have on performance.

Operating System Recommendations

Over the past six months, Autodesk has done an in-depth review of how Civil 3D works with some of the more popular operating systems on the market. The following table summarizes the findings. Operating systems are listed in order of decreasing preference, based on performance testing with Civil 3D.

Recommended Operating System (decreasing preference)
Windows Vista 64 bit
Windows XP 64 bit
Windows Vista 32 bit; 3GB enabled
Windows XP 32 bit; 3GB enabled
Windows Vista 32 bit
Windows XP 32 bit

Windows Vista handles memory better than Windows XP, but it is important to note that Civil 3D works better with Windows XP 64-bit than with Windows Vista 32-bit. This is because a 64-bit operating system can give 32-bit applications the full 4 GB of RAM for virtual memory usage. This means that if you have a computer with more than 4 GB of RAM, the operating system is going to allow the application to grab the full 4 GB. However, 32-bit applications, such as Civil 3D, can only leverage around 3-3.2 GB of virtual memory due to the non-contiguous paging files. That said, having more than 4 GB of RAM on a 64-bit operating system does improve the performance of Civil 3D when multiple applications are open and running, which is typically the way people work.

Note: Updating the operating system on an existing computer will result in a substantial improvement to performance. This is an effective and inexpensive option to purchasing new hardware.

More detail on running Civil 3D with each operating system is provided below.

Windows Vista 64-bit
Running the current 32-bit version of Civil 3D on a 64-bit operating system offers many benefits, making Windows Vista 64 the best operation system to run Civil 3D 2010 on.

While the four gigabyte memory limit is still in place since Civil 3D is a 32-bit application, running in Windows Vista 64 enables the application to grab the full 4GB, maximizing the amount of memory for the application and data.

Windows XP 64-bit
Because it is a 64-bit operating system, the eight year old Windows XP is a better alternative to any of the 32-bit operating systems. While Windows XP doesn't have as enhanced memory management seen with Windows Vista 64-bit, it still provides the critical four gigabyte address space for 32 bit applications.

Windows Vista 32-bit /3G
The 3G switch is available to be used in Windows Vista 32-bit, compressing the process memory reserved for Windows' internal data to a single gigabyte. The way the switch works is to compress the process memory reserved for Windows' internal data from two gigabytes down to one. The downside to this is that this compression can disrupt the functioning of sensitive video drivers that are expecting fixed address locations for their subroutines. When the compression happens, these addresses are changed and can lead to graphic problems and in some cases, create notable instability. If the switch is successful it will provide an additional one gigabyte of pristine memory for your data.

Windows Vista 32-bit
Windows Vista 32-bit offers a better memory management scheme than Windows XP 32-bit. The memory management scheme greatly reduces memory fragmentation by loading each application sequentially after the reserved system memory. By loading sequentially, the amount of contiguous memory for your data is greatly increased and allows Civil 3D to successfully get the larger chunks of memory that is requires.

Windows XP 32-bit with /3G
The 3G switch is also available to be used in Windows XP 32-bit and works in the same way as described in the Windows Vista 32-bit /3G section.

Windows XP 32-bit
Eight year old Windows XP 32-bit is the most widely used operating system for Civil 3D. Unfortunately, the small, highly fractured memory address space inherent to Windows XP 32-bit makes it the least capable, resulting in degradation in performance when running Civil 3D. When Civil 3D asks for a large chunk of memory that is unavailable, the result is the 'out of memory' message or the spontaneous closure of Civil 3D.

Model Optimization and Best Practices

If an operating system change is not plausible, the following best practices can help to optimize performance when working with Civil 3D.

- **Maintain master drawings of common design objects**
  For all but the smallest projects, it is best to maintain master drawings of objects such as existing ground surfaces and alignments. These objects can then be referenced into other drawings as lightweight copies of the original, requiring very little space.
- **Stop Caching Layouts**
  When set to "2", AutoCAD will store a copy of the graphics for each layout that is opened in a drawing session. This is especially problematic if you are plotting a series of layouts. Research indicates it is best to set AutoCAD layout regen setting (LAYOUTREGENCTL) to 1 so that the graphics of modelspace and the current layout are cached allowing faster switching between the two. We have also found that even when you switch between multiple layouts, the performance is equivalent, and in some cases better, than caching the graphics. The setting of 0 will disable the cache.
- **Reduce the frequency of automated operations**
  These operations include rebuilding surfaces, saving drawings, and virus scanning.
- **Limit surface size**
  Civil 3D can build and store surfaces created from millions of points, but performance can be an issue for surfaces containing more than a million points. Such surfaces take a long time to build, edit and draw. Methods to reduce surface size include 1) simplifying the surface, which reduces the number of points on a triangulated irregular network (TIN) and 2) using a data clip boundary, which defines a region of interest, so only points that fall within the boundary are added to the surface.
- **Avoid surface snapshots**
  With large surfaces, avoid creating surface snapshots; instead, retain the active links to point files, XML files, or other input data. The drawback of a snapshot is that it uses system memory, so it can double the amount of memory required for the surface.
- **Minimize the number of open drawings**
  In a single session of Civil 3D, each open drawing is loaded into the same 32-bit address space. When working with multiple drawings simultaneously, it is more optimal to open different documents in different sessions of Civil 3D.

- ***Use minimal object styles***
  For the most efficient processing, use styles that have very little or no displayed elements. Minimal display styles draw faster, and are especially relevant for large objects such as surfaces, point groups and corridors. Only display what you need to help streamline the design process. Display styles necessary to create construction documents can be assigned to the pertinent elements in the sheet file when design is complete.
- ***Remove or simplify profile views***
  When drawings contain several profile views, this adds significant time to the file size and processing time. To minimize these effects, keep each profile view as simple as possible, with minimal labels. Delete profile views from corridor drawings after designing the proposed profiles. The profile objects remain in the drawing, but the rebuilding operations are faster without the profile views.
- ***Turn off labels***
  As with object styles, different label styles can be used during different stages of a project. An empty 'No Label' style allows you to quickly turn off object labels to help reduce clutter and drawing time.
- ***Turn off corridor regions***
  As the design gets more detailed, it is best to turn off corridor regions you are not working in to experience faster rebuilds.
- ***Set assembly frequency and section swath to minimum values***
  In each corridor region, set the assembly frequency to minimum values to avoid loading the design with unnecessary data. For example, assemblies can be widely spaced along a straight roadway across flat terrain, but may need to be placed more closely in regions with frequent topography changes. Section swath width should be set to a value not much wider than the maximum corridor width between the daylight lines on each side to avoid taking in excessive amounts of existing ground surface beyond the corridor boundary.
- ***Create separate drawing for section views***
  After corridor design is complete, create a separate drawing for the section views, to keep the drawings at manageable sizes. Use a data reference to bring in the alignment and use an external reference (xref) to bring in the corridor drawing.
- ***Suppress tooltips***
  Your computer can use a lot of resources to display tooltips for each location of the cursor in the drawing window. Reduce the number of tooltips by changing the tooltip settings at the appropriate level.
- ***Optimize AutoCAD system variables related to 3D display***

The display of a complex surface in 3D is memory intensive. You can improve the performance of 3D display at the expense of graphic detail, a trade-off that may be acceptable during the design process.

- o ***Adaptive degradation***
  Depending on the data you are displaying and the graphics card in your computer, you may get better performance by turning off adaptive degradation.
- o ***Dynamic tessellation***
  Turn off dynamic tessellation to significantly improve the display speed of pipe networks as 3D solids. By doing this, system resources will not be used to store surface tessellation in memory for different zoom levels. To compensate for this setting, regenerate the display (REGEN) after you have set your 3D display to the desired zoom level.

- ***Minimize the use of viewports in working drawings***
  Similar to the layout cache, each time a viewport is created in a drawing, a separate display list for all the objects in the drawing is added to memory so they can be quickly displayed. The quick viewing/pan/zoom takes system memory to execute, reducing the amount you have left for the model, so if you aren't using the extra viewports, turn them off.

More Strategies and Tactics

Beyond changing operating systems and employing best practices, there are a few other things you can do to better harness the power of AutoCAD Civil 3D and improve the overall Civil 3D experience.

Install AutoCAD Civil 3D 2010 SP2

A number of memory, performance and scalability-related improvements are included in AutoCAD® Civil 3D® 2010 SP2. Notable improvements include:

- The way that memory is allocated when Civil 3D is initially launched has changed. The change results in larger blocks of memory being available.
- Performance improvements working with Autodesk Vault. These improvements help decrease the time needed to login, check in and check-out files, and refresh the file list in prospector.
- Feature-specific memory improvements that result in less memory being consumed by the application. These include addressing performance issues related to opening legacy drawings and the reduction of feature specific memory leaks.

- Feature improvements that will help limit unnecessary increases in drawing file size. This will result in more memory being available during the editing session.
- Rebasing. This will result in larger areas of memory being available to the application. Civil 3D operations can perform more effectively with larger open memory area available.

Uninstall Vault Client

By default the Vault Client is installed and loaded in AutoCAD Civil 3D. If you are not using Vault for data management, you can either uninstall the Vault Client or rename the "VaAc_startupUI.arx'. This will free an additional 88 MB of memory for your data.

Disable AutoCAD Map 3D on Startup

If the Map 3D functionality is not something that you use on a daily basis, you can download a Windows Script File that will allow you to disable the autoloading of AutoCAD Map 3D to increase available memory. Instructions on how to use this file can be obtained from

http://usa.autodesk.com/adsk/servlet/ps/dl/item?siteID=123112&id=13390398&linkID=9240697

The civil3dmapcontrol.zip file contains a Windows Script File. Using the Windows Script File, two desktop icons can be created, allowing you to enable or disable Map 3D on startup. Disabling Map 3D will free up approximately 85 MB of address space and, equally as important, will result in significantly less address space fragmentation.