



## White Paper

# Using Autodesk Civil 3D with Autodesk Land Desktop 2004

Engineering firms have been using Autodesk® Land Desktop software for many years to design the places we live and work, the streets we drive, and the utilities that provide our water and electricity. Some engineering firms have adapted well to the changes in technology and have implemented the software into their design process. Others use only a small portion of the software's capabilities. Not knowing what they don't know is costing them in a big way.

In a typical civil engineering firm a project design team consists of a lead engineer or project manager, a junior engineer or designer, and a drafter. This setup can vary with the type of project and company. Most lead engineers spend little time, if any, actually using the software to design, instead relaying the design to other team members in the form of a hand-drawn sketch. The drafters spend their days redrawing and interpreting these sketches into a CAD format and the rest of the project's budget doing redlines and markups. This is not an effective process, especially when you consider that this project team's *design* tool is being used only for *drafting*.

Why do companies work this way? Many companies are not always sure when to use Autodesk Land Desktop in their design process and when to use AutoCAD® software to generate construction documents. They simply moved the drafting process from the boards to the computer.

Adding Autodesk® Civil 3D™ software to the mix raises even more questions for users, such as the following:

- How do I use Autodesk Civil 3D?
- Will it change my current design process?

This white paper addresses these questions and discusses the options and recommended procedures for using Autodesk Civil 3D with Autodesk Land Desktop 2004 on a typical civil design project.

## Concept Plan

Land development is the process of converting a section of land from one use to another. Some development projects, such as large-scale planned communities, include a combination of residential, commercial, educational, and transportation designs. No matter what type of project, however, the design process is similar. They all start with the concept or the master plan.

A concept plan turns the client's idea or vision into a schematic plan that guides the rest of the project's design. During this planning stage, designers gather data about the site and create maps and exhibits that depict the intent for the land being developed. This plan identifies important information about the land. Is the property zoned for the intended use?

Are there areas that cannot be developed because of regulations, preservation guidelines, or severe slopes? The data needed to answer these questions can come from a variety of sources. Some of this data can be acquired at little to no cost to the project.

The first place to look for such data is the Internet. Numerous sites contain geographical information system (GIS) data such as aerial imagery, topography, political boundaries, natural features, and so forth. Especially useful are gisdatadepot.com, spaceimaging.com, and gis.com (see Figure 1). Most state and local governments have GIS systems where you can also obtain this data.

Once you have acquired the data for the site, it needs to be compiled in a format that can be used not only for viewing but for analyzing the crucial information that may affect the development of the project.

The design process starts with the creation of a project in Autodesk Land Desktop 2004. The project setup defines the correct project standards, such as drawing scale, units, and zone. Then satellite or aerial imagery is brought in using Autodesk® Raster Design and correlated to the project data. Autodesk Raster Design can translate imagery from one coordinate system to another. Since most data found on the Internet is in universal transverse mercator (UTM) meters and most projects must use a local system, such as a state plane system, this step is typically required.

Next, the GIS data, including parcels, topography, utilities, soils information, and wetland areas, is imported using the Autodesk Map™ capabilities in Autodesk Land Desktop. Autodesk Map can import ESRI® coverages and shape files, MapInfo® MIF/MDF files, Microstation® DGN™ files, and Spatial Data Transfer Standard (SDTS) files, converting this data to AutoCAD entities, including any attribute information assigned to the GIS data. Autodesk Map can also translate data from one coordinate system to another, making data produced or stored in another format usable.

### Autodesk Civil 3D

Autodesk Land Desktop 2004 can perform the analysis needed to start laying out the schematics of the site, but this point in the process is a good time to take advantage of the tools provided in Autodesk Civil 3D. To begin working in Autodesk Civil 3D, simply open the drawing created in Autodesk Land Desktop 2004, or create a new drawing in Autodesk Civil 3D, and then import any project data using the Import Data from Land Desktop command (see Figure 2).

The topography can be turned into a preliminary surface to perform a slope analysis and predeveloped drainage conditions. The surface objects in Autodesk Civil 3D make performing these two operations simple and faster than the current method in Autodesk Land Desktop. The soil data can be turned into parcels for obtaining areas. The aerial



Figure 1: GIS Data

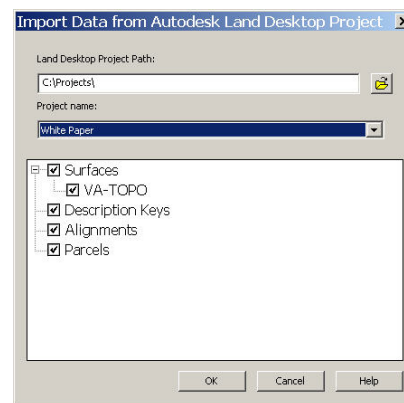


Figure 2: Import Data

imagery can be used to identify and create land use and land cover area parcels, and when combined with the soils data, it can provide the required information for determining runoff curve numbers. The utility information helps determine the locations and possible routing of utilities needed for the project.

## Survey

While this preliminary work is being performed, the client may give the go-ahead for the design process to begin or field survey work to start. It would be ideal to have a complete and accurate property boundary in hand before any layout begins. This complete boundary and topographic survey identifies possible encroachments and underground utilities, and provides an accurate surface to design on.

Using current collection techniques, either conventional field location or global positioning system (GPS) technology, the surveyor collects the required data to locate boundary evidence and surface data for the office staff to determine the boundary and generate a surface using Autodesk Land Desktop with Autodesk® Survey.

Most surveyors have a separate survey project where they do their work. Also, because not all civil engineering firm have their own survey department, a subconsultant sometimes performs the survey. How does this data get into a design project? The surveyor can provide a LandXML file for the engineer to import the required data into the design project. If it is available, you can read in the Autodesk Land Desktop project file directly. The method you use depends on how your company is set up to share project data.

## Geotechnical Survey

In addition to the survey, subsurface borings may be performed on site. Using Autodesk Land Desktop 2004, engineers can create subterrain surfaces and use them in the design. For example, on a site that contains a large amount of rock, it may be crucial to avoid these areas when determining the placement of underground utilities.

## Transportation, Traffic Flow Design

After design constraints have been identified, the schematic design can start with the transportation network or traffic flow patterns and parking, depending on whether the design is a residential project or commercial site design. Using the alignment objects in Autodesk Civil 3D, you can quickly lay out multiple design alternatives. Another advantage of Civil 3D is the dynamically linked profile views that automatically update when the horizontal alignment is modified. This capability enables you to optimize the design of the roads and site access. This capability is also useful on a site where the subterrain contains areas that would prove to be costly for the construction of underground utilities.

## Parcel Layout

For a commercial development, the next phase of the design process consists of using Autodesk Civil 3D to subdivide the property into residential lots or parcels. The horizontal alignments divide the main site parcel into sections on a residential site. A Right of Way command defines a right-of-way parcel based on the horizontal alignment. When the alignment is modified, the right-of-way parcel, as well as any parcels created along the right of way, dynamically update.

Each section becomes a parcel that can then be subdivided into individual lots using the parcel layout tools. A typical design constraint on most projects is for the lot lines to be created perpendicular or radial to the right of way. Autodesk Civil 3D provides powerful parcel creation tools to handle this and other design constraints. For example, parcel lines

can be drawn perpendicular to a selected property line. These design constraints are reflected on the lot line segment. When the line is selected, only one grip is available at the start of the line and only the line can be moved along the right of way. The lots can then be adjusted using the slide-bearing or swing-bearing tools.

In addition, parcels have a fill property that you can display to show the client information about the site layout. A large-scale planned community may require a zoning map. By assigning different parcel styles to the sections based on the current or proposed zoning, you can quickly produce a thematic zoning map for approvals. You can also use this capability to generate a thematic map of property values.

### Vertical Alignments and Sections

On completion of the transportation network and parcel layout, the vertical design phase can begin. Although Autodesk Civil 3D does not include section design tools, existing surface sections can still be sampled. These sections are also dynamically linked to the horizontal alignments. This aids in the layout of the road network because of the interaction of the objects. If the horizontal alignment of the road needs to be relocated because of severe cross slopes identified by the sections, all parcels, profiles, and sections associated with the alignment update automatically.

The profile layout tools provide simple and powerful tools for laying out the vertical alignment of the road networks. The profiles, just like all Autodesk Civil 3D objects, have object and label styles that control the display properties of the data associated with the object.

Once the profiles for the road network have been determined, the design of the road can be completed using Autodesk Land Desktop 2004. To do this, you can create a LandXML file of the project data in Autodesk Civil 3D and then import this file into the original Land Desktop 2004 project created at the beginning of the project design. You need to send only the information necessary to finish the road design.

When the road design has been completed in Autodesk Land Desktop 2004, a surface is created using the Create Road Surface command. You can now import this road surface into the Autodesk Civil 3D drawing to continue the design of the project.

### Grading

Site grading can also be started at this time. The grading functionality in Autodesk Civil 3D has been dramatically improved. Grading objects, just like all other objects in Autodesk Civil 3D, react dynamically to other 3D objects. The grading features also interact with other grading features. An important advantage to grading in Autodesk Civil 3D is the ability to create groups of grading features that you can use to create a surface object. If any of the grading features are modified, the surface object generated from the grading group updates automatically.

The enhancements to grading in Autodesk Civil 3D enable you to make design decisions, perform grading changes, and check the site to see if the site volume balances effectively.

This does not mean the grading object and other tools in Autodesk Civil Design are obsolete, however. Using Autodesk Land Desktop 2004 with Autodesk Civil Design and Autodesk Civil 3D together provides the tools necessary to take model-based grading to the next level.

## Utilities

With the grading completed and the proposed surfaces created, you can next design the utilities. This release of Autodesk Civil 3D does not provide the tools required for designing gravity-based utilities. However, the horizontal layout can certainly be defined in Autodesk Civil 3D to take advantage of object intelligence and interoperability with other objects. Once you have completed the horizontal layout using the alignment object, you can bring the alignments into Autodesk Land Desktop 2004 via the LandXML utility to design the gravity systems.

Once the gravity systems have been designed, using xrefs, or wblocks, to combine the pipe graphics into the Autodesk Civil 3D profile view takes advantage of the labeling features of the profile view object. This process requires a little coordination with insertion points and layers, but helps maintain data integrity.

## Construction Documentation

Construction documentation is still a necessary part of the design process. Paper documents of the design must be compiled for review and approval. What software product works best to create these paper documents?

With a hybrid approach using Autodesk Land Desktop 2004 and Autodesk Civil 3D, there is no need to open a plan and profile drawing created in Autodesk Civil 3D in Autodesk Land Desktop just to put a border on it and plot it. Autodesk Civil 3D includes all the AutoCAD capabilities and drafting features required to perform this task.

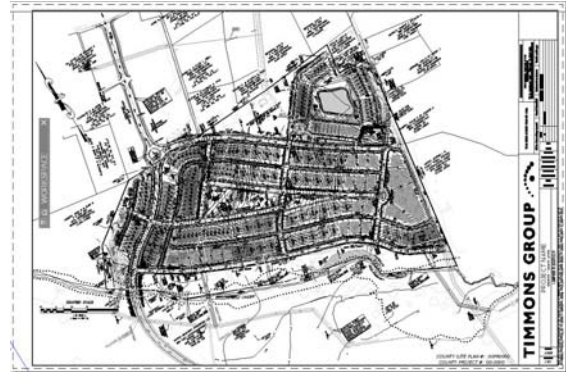


Figure 3: Construction Document

Changes are inevitable for even the best designs. Maintaining the design in Autodesk Civil 3D takes advantage of the object and labels styles, making editing easier and providing a multitude of ways to display the design. For example, on a multiphase project, parcels can change from future to proposed to existing. Assigning a different object style and label style to the parcels changes the display properties and creates three different representations of the same data. If the drawing scale changes, the text size of labels and tables automatically updates. The labels and tables can also be set to remain plan readable if the view orientation of the drawing changes. These features enable you to concentrate on the design and let the software take care of the drafting and CAD standards.

## Construction Stakeout

The completed and approved design is turned over to the surveyor for stakeout. Just as the surveyors provided the engineer with a LandXML file of the existing site conditions, the engineer provides the surveyor with a LandXML file of the completed design.

If the surveyor is using Trimble GPS equipment for stakeout, the Trimble Link™ program provided within Autodesk Land Desktop 2004 can upload the road design and surfaces to the controller, eliminating the need to compute stakeout points for every feature of the road.

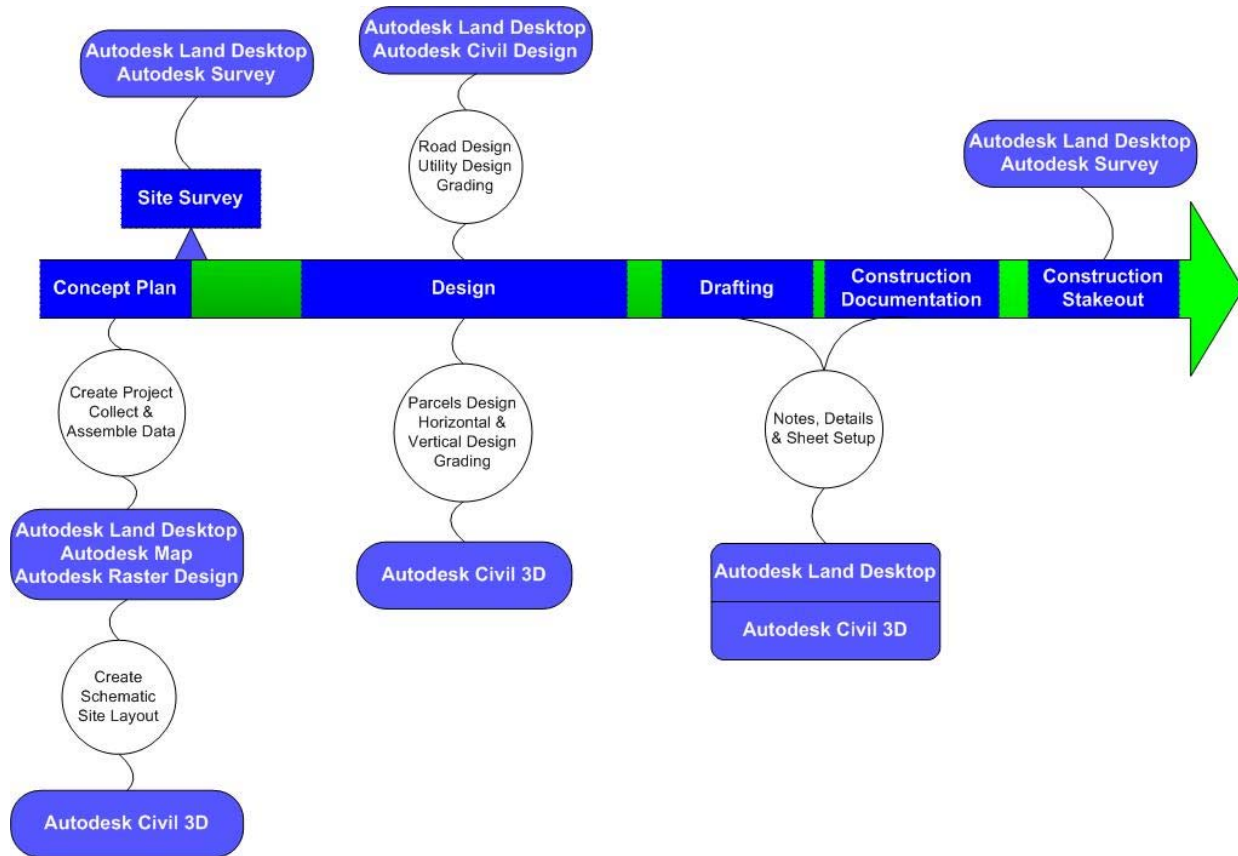


Figure 4: Project Process

## Conclusion

Both Autodesk Land Desktop 2004 and Autodesk Civil 3D provide powerful tools for designing the infrastructure we use everyday. This white paper has discussed a typical project's lifecycle using these Autodesk products. Is this the only way to use the products? Of course not. Every project and every design team is different, and each has its own unique characteristics and design process. Figure 4 shows a typical project workflow and what software could be used to accomplish each task.

Autodesk Civil 3D is not a replacement for Autodesk Land Desktop and Autodesk Civil Design, but a companion to it. Using Autodesk Civil 3D is different from using Autodesk Land Desktop 2004, but the learning time is relatively short because the tools are easy to understand.

The biggest challenge is how it will change the design process. If your current design process hasn't changed over the past few years, take some time to figure out what challenges you face and how you can meet them by implementing Autodesk Civil 3D.

And last, put Autodesk Civil 3D in the hands of your best designers and engineers and let them design.

## About the Author

Michael Carris is a K-TEK Certified Professional, an Autodesk Authorized Consultant, and Autodesk Certified Instructor. He has more than 14 years' experience in civil and survey software, engineering design, and surveying. Carris provides consulting, training, and technical support to public and private engineering and surveying firms across the country. He is known for his expertise in design visualization, GIS, mapping, civil engineering, and land surveying software applications.

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