BIM and Civil Engineering

Through an integrated, dynamic model linking design and documentation, AutoCAD® Civil 3D® software delivers consistent, coordinated, computable information about a civil engineering project - much as Revit® software products do for a building project. This white paper examines how civil engineering businesses using Civil 3D are better able to support design projects using a BIM workflow.

With the growing adoption of building information modeling (BIM), architect/engineering teams using BIM are seeking partners in related disciplines who can support this way of working. Civil engineering, for example. The Revit family of products - purpose-built to support BIM for building design - does not support civil engineering design needs for building sites, subdivisions, roads, utility systems, and similar projects. So how can civil engineering businesses best support design projects using a BIM workflow? By using AutoCAD Civil 3D software.

BIM and Civil Engineering Working Together

Model-based design isn't new to civil engineering by any means; consider the prevalence of COGO (Coordinate Geometry) and DTM (digital terrain model) applications. What is new is the concept of linking the civil engineering model environment (i.e., the design) and the drafting environment (i.e., the documentation).

Through this dynamic model, Civil 3D automatically coordinates the design and the drawings. When one aspect of the design changes, other related parts of the design - including labels, annotation, and other documentation items - automatically update to reflect that change. For example, when the elevation of the surface model is changed, the contours and profiles for that surface update automatically, as do the contour labels, reporting, and spot elevations relating to that surface. This capability will be familiar to BIM adopters - as change management is at the heart of BIM.

To illustrate how civil engineering businesses can support BIM-based design projects, below is an example of a BIM workflow using Revit and Civil 3D: an office building project that is potentially derailed by two major changes.

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Using Revit and Civil 3D in a BIM Workflow - During Early Design

In this Revit and Civil 3D example, the architectural and the site designs are brought together early in the process - enabling both firms to better visualize and coordinate their designs. Design data is exchanged between Revit and Civil 3D by using DWG™ files.

For example, early conceptual building shapes are exported from Revit in DWG format and sent to the engineer, who “xrefs” them into the Civil 3D model to produce the building envelope and to develop the preliminary site plan. The resulting building envelope and preliminary site model is easily communicated back to the architectural firm for schematic design by sending the Civil 3D model (the DWG file), which can then be imported into Revit.

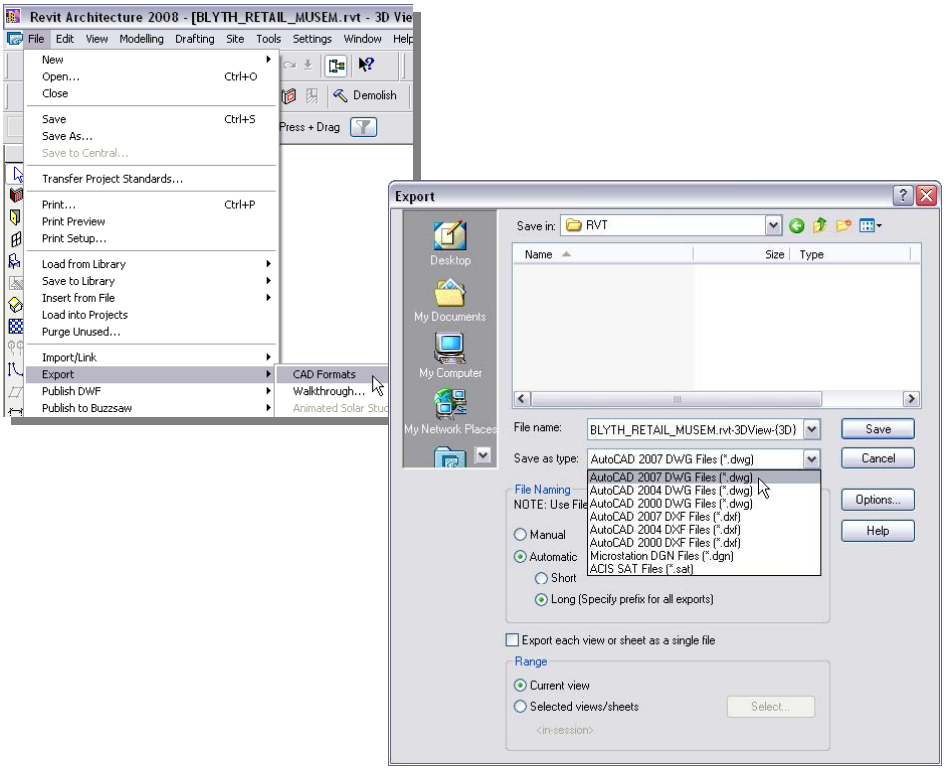

Figure 1:

Design data is exchanged between Revit and Civil 3D by using DWG files. Here, a Revit model is exported to an AutoCAD DWG file.

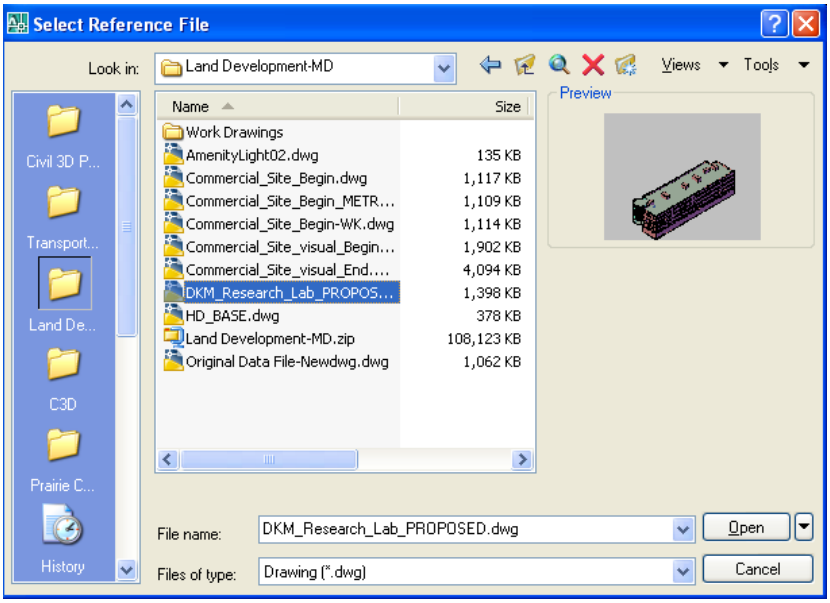

Figure 2:

The building model exported to the DWF file is then xref’d into a Civil 3D model.

In this project example, the owner has an aggressive schedule for their new building and wants to fast-track the project, so the engineers create a preliminary design with all the site grading based on the location of the building envelope. The preliminary site design is nearly complete when the first major project change occurs. The owner needs to increase the building size, which impacts both the building envelope and preliminary site design.

The architect using Revit revises the building information model and all the documentation is automatically updated. The revised building model is exported to a DWG file and sent to the civil engineer, who simply refreshes the xref to see the revised building and then updates the site model and grading design to accommodate the larger building. Like Revit, Civil 3D automatically coordinates the design and the documentation, and the affected drawings are updated automatically.

Figure 3:

Civil engineering firms using Civil 3D can work in concert with a building team using Revit to quickly update and reconcile design changes, such as the increased building footprint shown in this before and after sequence of images (Figures 3 to 6).

Note the original building footprint is shown here in blue.

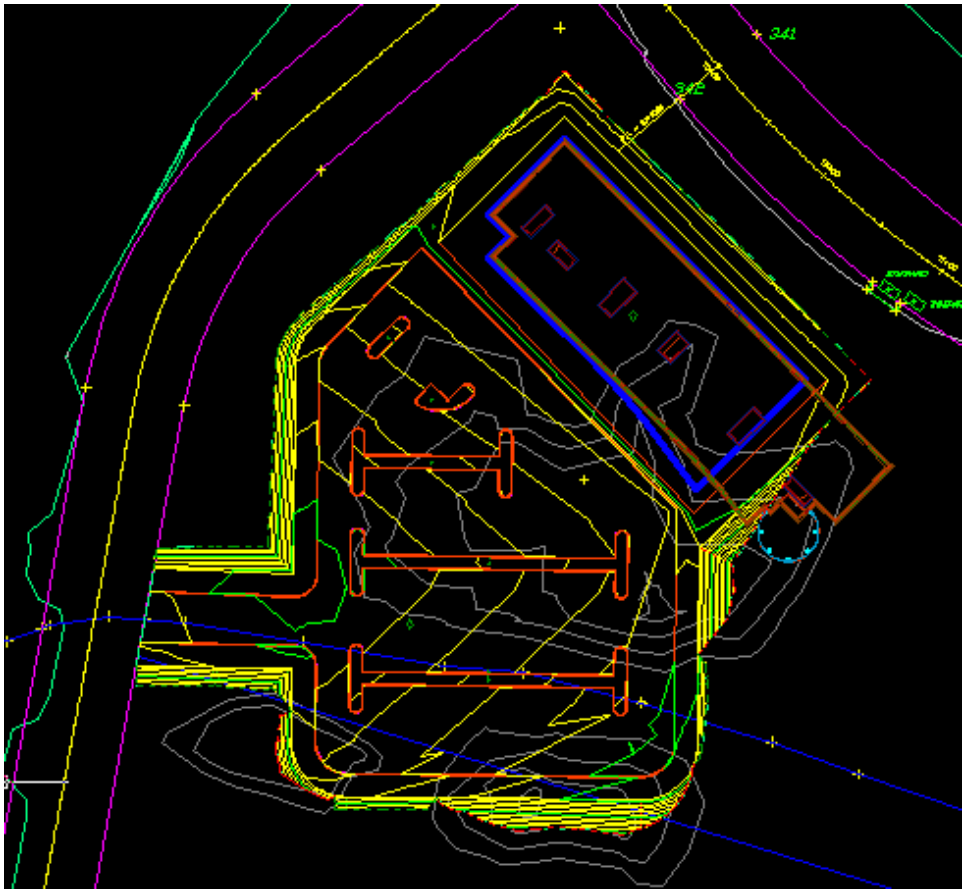

Figure 4:

The architect using Revit exports the revised building model to a DWG file and sends it to the civil engineer, who then refreshes the xref to see the revised footprint (shown here in orange).

Figure 5:

Civil 3D is then used to update the site model and grading design to accommodate the larger building.

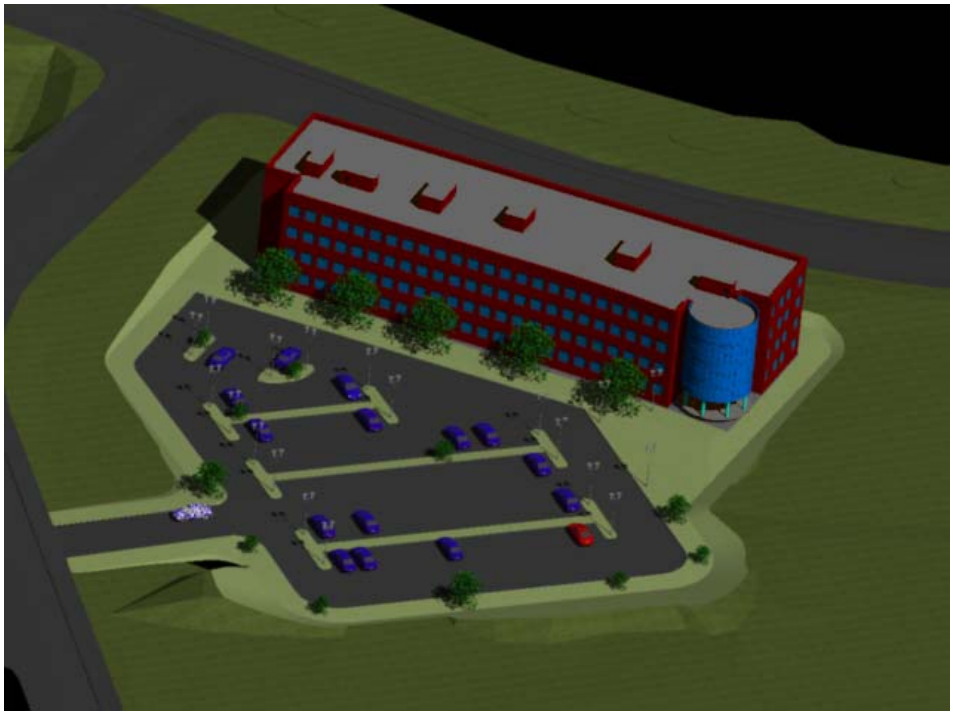

Figure 6:

After the Civil 3D design model is updated, that site information can be communicated back to the architect via a DWG file for incorporation into the building information model.

Using Revit and Civil 3D in a BIM Workflow - During Detailed Design

As the project moves into detailed design and then construction documentation, coordination between the architect and engineer becomes particularly important. The engineers create their construction documents using the architectural backgrounds, and vice versa. When the MEP engineers began their work and need to tie the building mechanical systems into the pre-existing town services (water, sewer, drainage, electric) the coordination becomes even more critical. The high-fidelity model information from Revit and Civil 3D is easily shared among all these participants through the use of DWG files.

Remember that this project is fast-tracked, so the CD set for the site excavation is issued while the rest of the project is still in design. That's when the second major project change occurs. Early site excavation reveals a large amount of contaminated material that has to be removed and hauled offsite - in over 200 truckloads! But the owner wants to forge ahead with this particular site, so the engineering firm decides to slightly lower the elevation for the whole site (generating additional excavation material so the owner doesn't have to purchase and haul in new material). Time is crucial at this point, as the contractor is charging the owner for down time while the site is being reengineered.

The engineering firm uses Civil 3D to quickly rebalance the cut and fill for the site and calculate how much they need to lower the entire site. When the Civil 3D design model is updated, all the related objects and annotation are updated as well. All the contours, the spot elevations, the building's finished floor elevation, the utility profiles, the pond volumes, and the earthwork volumes - they are all updated without manual intervention, producing a consistent, coordinated site design and documentation set. In turn, that high-fidelity site information can be easily communicated back to the architect via a DWG file for incorporation into the building information model, to vertically coordinate the architectural design on the revised site.

Summary

The core concepts of BIM apply similarly to building design and civil engineering. Through the creation and use of coordinated, internally consistent, computable information, BIM is revolutionizing how technology is used across the AEC industry - transforming drawing-based processes to model-based processes. Civil 3D supports this way of working for civil engineering, resulting in faster design, higher quality, better coordination, and ultimately a better performing project

About Revit

The Revit platform is Autodesk's purpose-built solution for building information modeling. Applications such as Revit® Architecture, Revit® Structure, and Revit® MEP built on the Revit platform are complete, discipline-specific building design and documentation systems supporting all phases of design and construction documentation. From conceptual studies through the most detailed construction drawings and schedules, applications built on Revit help provide immediate competitive advantage, better coordination, and quality, and can contribute to higher profitability for architects and the rest of the building team.

At the heart of the Revit platform is the Revit parametric change engine, which automatically coordinates changes made anywhere — in model views or drawing sheets, schedules, sections, plans… you name it.

For more information about building information modeling please visit us at *http://www.autodesk.com/bim*. For more information about Revit and the discipline-specific applications built on Revit please visit us at *http://www.autodesk.com/revit*.

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