

CAD & BIM: **Is There A Free Pass?**

A Report on GRAPHISOFT
ArchiCAD's DWG Workflow

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December 2010

■ a **research** paper from upFront.reSearch
funded by Graphisoft

an imprint of upFront.eZine Publishing, Ltd.

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ISBN: 978-1-926897-15-8

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■ Abstract

Some 40 years after the introduction of 2D computer-aided drafting, programs like AutoCAD and IntelliCAD that mimic the hand drafting process are still popular. This is surprising, given that 3D modeling software programs, like Revit and ArchiCAD, are nearly as old, yet have the added advantage that they simulate the real world. True, it is easier to start drawing right away with a 2D design program, but it is puzzling that many architectural and engineering firms still prefer to represent walls and floors with four lines, rather than model them as 3D walls and floors, complete with structural information.

Because the two wildly different design systems are in common use, it is not uncommon to find that users of both systems must work with each other. The problem is that the approach to 2D drafting is so different from that of 3D modeling, and so the two are not particularly compatible.

This paper describes the incompatibilities between the two design systems, and then provides a solution: *the hybrid workflow*. This paper suggests a two-fold solution to the problem of converting drawings between AutoCAD and ArchiCAD:

- Visual accuracy
- Functional accuracy

The title to this paper asks the question, “Is there a free pass between CAD and BIM?” There is no free pass. But by understanding the issues involved and by pre-planning, 2D line drawings can be made to work with 3D models — and vice versa.

About the Author

Ralph Grabowski is an engineer with 25 years of experience with computer-aided design. He is the author of over 100 books on CAD, the editor of *upFront.eZine* e-newsletter and *WorldCAD Access* weblog, and the publisher of eBooks.onLine.

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About upFront.reSearch

This research paper was prepared by upFront.reSearch on behalf of Graphisoft.

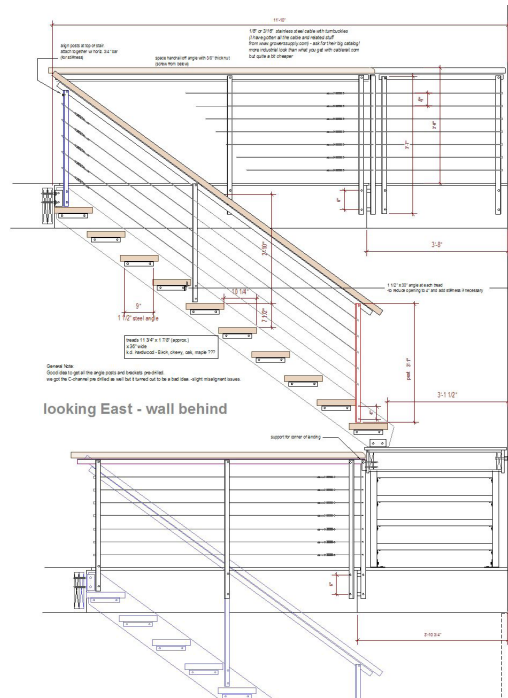
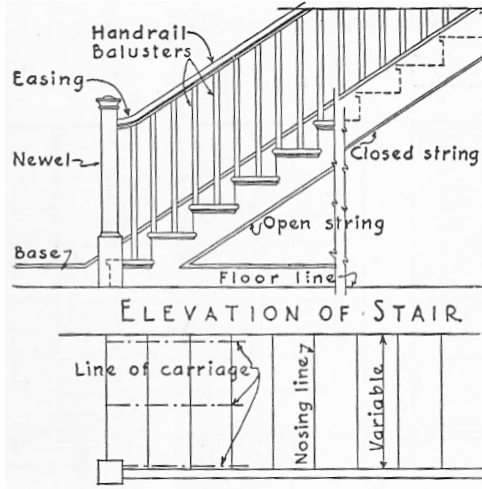
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Two Approaches to Design

2D LINEWORK

Traditional computer-aided design software mimics traditional hand drafting, in which drawings are almost always made in 2D, with lines and arcs representing objects in floor plans, elevations, framing plans, and details. In the 1980s, computer-aided design began replacing drafting boards, yet three decades later, many design packages, such as AutoCAD and IntelliCAD, continue to mimic the hand drafting process.



Left: Elevation drawn by hand in 1940.

Right: Elevation drawn in 2D by design software in 2010.

The lines and arcs drawn by these design systems contain basic knowledge about themselves, such as their length and angle. In addition, limited amounts of information can be added to 2D drawings, such as tables of data. While many of these design packages can create 3D models, they are not much more intelligent than 2D linework. For instance, these 3D models don't know how much they weigh!

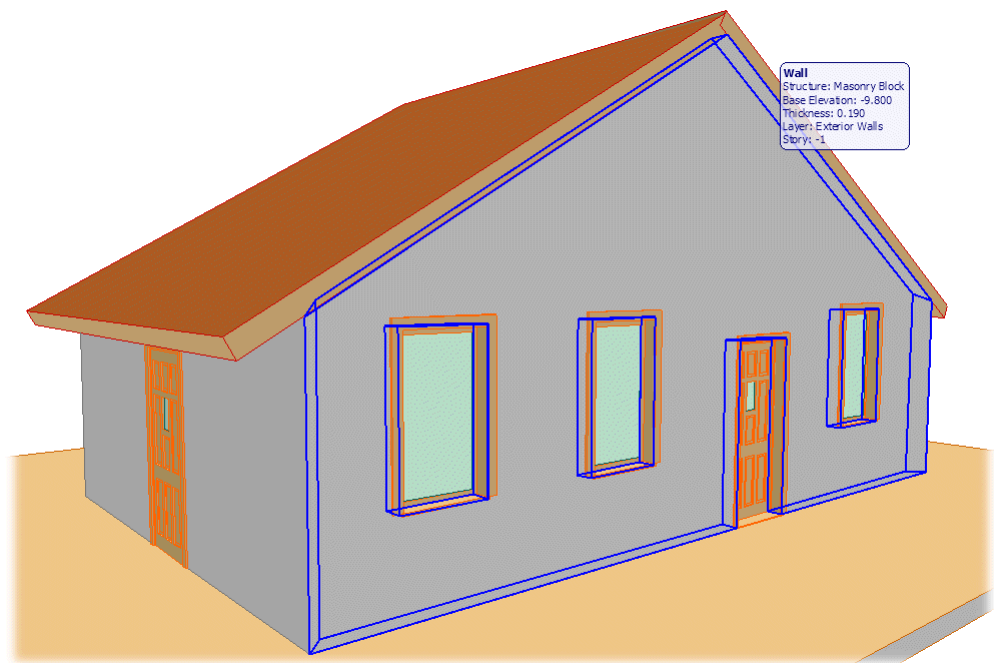
Many drawing files are employed when buildings are designed using 2D-oriented design packages. For instance, AutoCAD has a "sheet set manager," a control panel meant for keeping track of the dozens or hundreds of drawings needed for building projects. Many users purchase additional software to make it easier for them to design buildings with linework-based software.

They needn't, for alternatives are readily available.

3D BUILDING STRUCTURES

In the late 1980s, a completely different kind of design software was developed. Instead of mimicking hand drafting, it used 3D models to mimic the real-world structures that make up buildings, such as the walls, floors, windows, and doors.

With the old style of design software, drafters drew four independent lines to represent the edges of a wall. With the new style of software, drafters draw the entire wall fully three-dimensionally with useful information embedded, such as the material from which it should be constructed. See the figure below.



Wall drawn by 3D modeling software.

The new line of software uses intelligent objects. Walls know that they are upright, connect to other walls, have floors above and below them, and make openings for doors and windows. They contain information, such as the materials from which they are made, whether they are interior or exterior, and whether they contain insulation or are faced with cladding. This kind of information is missing from the four lines.

This 3D modeling software is available from companies such as Autodesk (Revit), Graphisoft (ArchiCAD), and Nemetschek (AllPlan). They work in roughly the same way: when a building is designed in 3D, the design is stored in a single file that contains everything known about the building, from its core structure to electrical wiring, carpet colors, and bills of material. When necessary, 2D drawings can be extracted from the 3D model.

Projects contain all data relating to a single building model, as illustrated by ArchiCAD's Navigator panel. See figure at right. The Navigator panel shows how a single 3D model integrates 3D data, elevations and floor plans, object inventories, 2D drawing sheets, reports, and more.

2D DRAWING VS. 3D MODELING

Although 3D modeling software is almost as old as 2D drafting software, 2D software surprisingly became much more popular — and remains that way in today's market. There are two factors that may have contributed to this:

- 2D drafting tends to be easier to understand, and to thus begin using.
- 2D drafting software can be cheaper than 3D modeling software, though not always.

And so here we are in 2010 with two completely different ways of creating drawings, each employing a method that is inherently incompatible with the other.

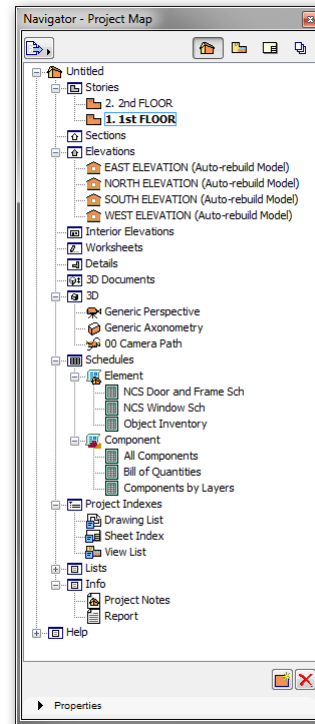
The good news is that as long as different systems remain separate, they work well within their own spheres. For instance, AutoCAD users can easily exchange drawings with AutoCAD LT and IntelliCAD users, because all use the same file format. Data exchange between 2D packages is not problematic, because there aren't conceptual differences between the systems.

A problem occurs, however, when the AutoCAD user wants to access 3D models created by a Revit or an ArchiCAD — and vice versa. AutoCAD cannot understand what they are saying, and so data exchange between 2D CAD and 3D BIM is a challenge in both directions. Freely-composed 2D line-work needs to be integrated into a modelling environment; complex BIM models need to be translated into 2D primitives.

A well thought-out translation system provides the solution for those times when users need to mix and match drawings from AutoCAD and ArchiCAD. For instance, it is not uncommon for an ArchiCAD-using architect to read site elevation data recorded by an AutoCAD-using surveyor; thus translation system needs to ensure the AutoCAD drawings mesh well with the 3D model.

As it turns out, there are two solutions. One is to maintain *object integrity*; the other is to maintain *visual accuracy*. Translated drawings may function correctly or look correctly, but not necessarily both.

The purpose of this white paper is to examine the differences between functional and visual accuracy, and then explain the solutions provided by Graphisoft in its ArchiCAD software.



Basic Approaches to Conversion

CAD programs primarily create 2D linework, and at the binary level they are incompatible with BIM solutions that primarily create 3D models. To complicate matters further, both have conceptual differences as well. As a result, you will need to be prepared for a few compromises, should you need to exchange data between these systems.

Now, it is true that standard element information, such as basic objects and properties, tends to translate without problems, but to translate system-specific information you have two choices: as we have seen: to maintain functional correctness or to maintain visual accuracy. Either choice works fine in its own way, but you cannot mix the two.

The choice you make should be based on the exact purposes for which you need information from the other system:

- If you need to further edit elements, then your obvious choice is **functional correctness**.
- If you only need drawings as references or backgrounds, then you should go for **visual accuracy**.

TRANSLATION CHOICE #1: FUNCTIONAL CORRECTNESS

Oft times, your 3D building models need to access the information stored in AutoCAD drawings (a.k.a. “DWG format”). The information can range from survey data of the land, to symbols (blocks) of windows drawn by manufacturers in DWG format.

In these cases, you want the lines and other information from the AutoCAD files translated to a format understood by your 3D modeling software. Because the two systems treat data in such a different manner, they face many subtle difficulties in translation. Do colors and plot styles match? How should unique entities be handled? What about layer names? Should layouts be included? Are the same sets of fonts available on both systems? Do the drawing scales match?

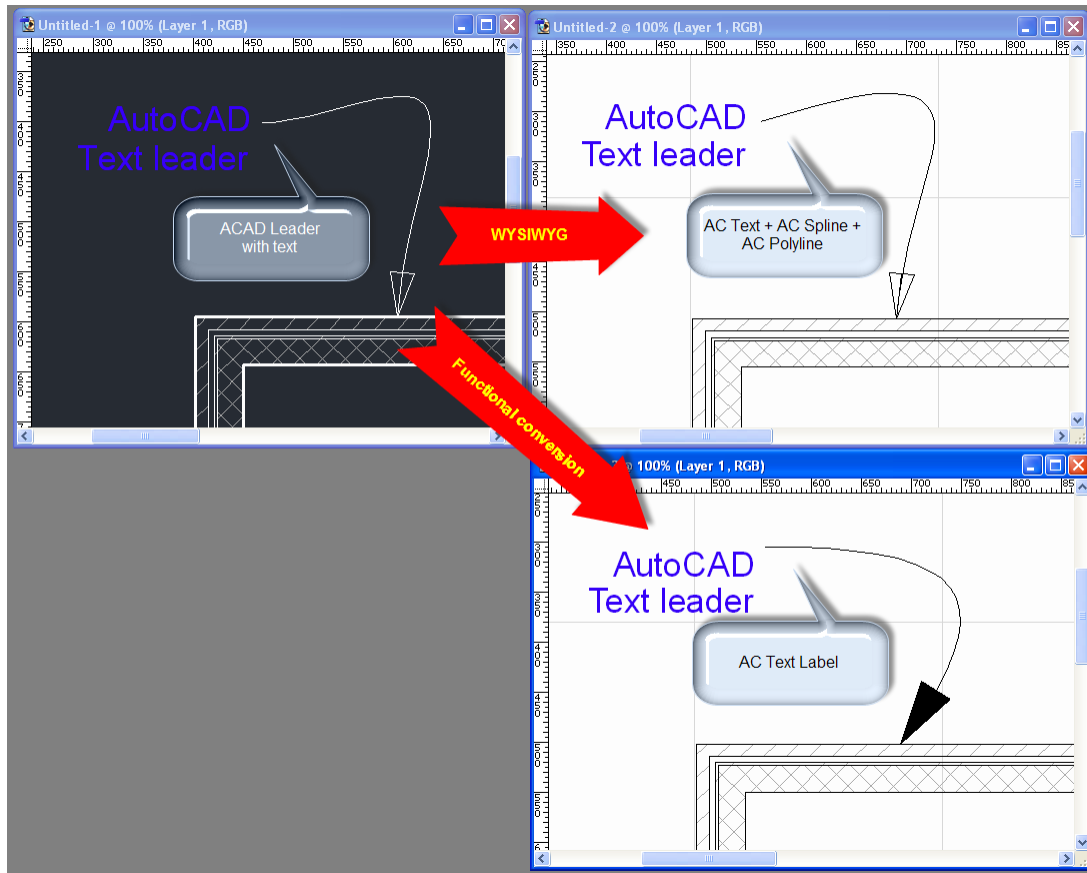
The issue of scale may come as a surprise to you, since we always work with design software at full-size scale, 1:1. The problem lies in the fact that AutoCAD measures distances in “generic” units that are neither metric nor Imperial. As a result, one stage in any translation process is specifying whether AutoCAD’s linear units should be interpreted as inches, feet, millimeters, meters, or perhaps some other esoteric unit. (Fortunately, AutoCAD’s angle measurements do not suffer from this problem.) I talk about these translation issues in greater detail later in this white paper.

Once you spend a few moments setting up the parameters correctly for an optimal translation, you simply reuse the same settings for subsequent translations. The result is a drawing that you can modify with the 3D modeling software’s tools.

TRANSLATION CHOICE #2 VISUAL ACCURACY

Other times, you need to see only what the AutoCAD drawings look like. For instance, you might need to reference adjacent buildings, or some old plans of the existing building being remodeled. Sometimes engineering consultants need drawings to locate load-bearing structures and electrical or plumbing systems. These drawings don't need to be edited; they just need to be seen or referred to.

In this case, a visually-accurate translation is the better solution. This WYSIWYG translation displays an image of the AutoCAD drawing, just as it looks. It can be placed in the 3D model for reference purposes; the original is unmodified.



Top: A functionally correct translation not resulting in visual accuracy.
Above: A visually correct conversion may not be editable.

Summary of Pros and Cons

A functionally correct translation is used when there is a need to edit the source drawings, or to use elements of the drawings, such as blocks. The pros and cons are as follows:

- Inherent logic of elements is maintained.
- Further editing is allowed.
- Visual representation may be altered.

A visually-correct conversion is used when there is a need to see the source drawings. The pros and cons include the following:

- Inherent logic of elements is lost.
- Further editing is limited.
- Visual representation is maintained 100%.

Concern	Functional	Visual
Inherent logic of elements	Maintained	May be lost
Further editing of elements	Allowed	Limited
Visual representation of elements	May be altered	Maintained 100%

One of the limitations of AutoCAD is its weakness in the translation and conversion of drawings from other design systems. This means the onus is on other systems to do the heavy work of importing and exporting drawings in AutoCAD's DWG format.

In the next section, we look at how this issue affects your design workflow.

■ II. Philosophy of ArchiCAD's Support for DWG

Openness = Multi-format Support

Graphisoft's goal is to be open by supporting as many formats as possible. ArchiCAD is able to import and export a larger number of CAD and vector file formats than AutoCAD, as shown by the table below.

ArchiCAD	AutoCAD	Notes
PLN	...	ArchiCAD project files
PLP	...	ArchiCAD Teamwork files
2DL	...	ArchiCAD 2D line files
LBK	...	PlotMaker layout book
IFC	...	Industry foundation classes
EMF	...	Windows Enhanced Metafile
C4D	...	CINEMA 4D
DWG	DWG	AutoCAD drawing file
DXF	DXF	Drawing interchange format
DWF	DWF	Design web format
WMF	WMF	Windows Metafile
DGN	DGN	MicroStation
3DS	3DS	3D Studio
PDF	PDF	Portable document format
HPGL	HPGL	Hewlett-Packard Graphics Language
...	SAT	ACIS 3D model interchange format
...	FBX	FilmBox files
SKP	...	SketchUp (ArchiCAD requires free plug-in from www.graphisoft.com/products/archicad/addons/google_earth)

Geometry is just one aspect of 3D modeling. (Geometry means lines, arcs, 3D shapes, and so on.) Drawings also specify the *properties* of geometry, such as colors, layer names, line types (patterns), and lineweights. Drawings also include *data*, such as dimensions, bills of material, links to databases, and reports.

Incompatibility = Translation + Problems

When design programs are incompatible with each other, translation is required, but this creates problems. A good translator handles all three aspects of design — geometry, properties, and data — in an intelligent manner. When one package does not, however, support some aspect, then the translator must make a decision. Should the incompatibility be

- replaced by the closest equivalent entity or property, automatically?
- adjusted by the end-user, manually?
- discarded or ignored?

Here are some examples of how the translator handles problem entities:

Problem	Solution
AutoCAD units are unitless.	Specify units as metric or imperial in ArchiCAD.
Unitless units affect scale.	Specify units as 1mm, 1m, 1 inch, 1 foot, or other in ArchiCAD.
AutoCAD does not understand 3D models created by ArchiCAD.	Have ArchiCAD (a) export 3D models as 2D views, or (b) convert 3D geometry to 3D bodies in DWG.
ArchiCAD links properties to entities, but not layers.	Have AutoCAD link properties to entities.
ArchiCAD does not use blocks.	Convert blocks to groups or library parts in ArchiCAD.
ArchiCAD does not use viewports.	Convert to embedded drawings in ArchiCAD.
Colors (pens) do not match between AutoCAD and ArchiCAD.	Map AutoCAD colors to ArchiCAD pens; use RGB if ACI color numbers cannot be matched.
Linetypes do not necessarily match between AutoCAD and ArchiCAD.	Map the linetypes names in ArchiCAD.
Fonts and text styles do not necessarily match between AutoCAD and ArchiCAD.	Map the fonts and text styles in ArchiCAD.

Design systems have different kinds of entities. For example, AutoCAD does not have the ArchiCAD entities listed in the following table. The solution is to convert them to equivalent entities.

ArchiCAD Entity	Solution
Hotspots	Convert to AutoCAD points
Complex entities	Convert to AutoCAD blocks or exploded entities
Zones	Convert to filled (hatched) areas
Pen weights	Convert to AutoCAD line weights
Line ends	Convert to AutoCAD blocks to keep line ends with lines

ArchiCAD Does the Heavy Lifting

AutoCAD cannot read drawings created by BIM programs, and so ArchiCAD must import and export its drawings in AutoCAD's drawing format. ArchiCAD provides three ways to do this:

- Translates AutoCAD drawings, and then opens them as new ArchiCAD plans; see *Importing AutoCAD Drawings* below.
- Merges AutoCAD drawings into existing ArchiCAD plans; see *Merging Design Files* below.
- References AutoCAD drawings in existing ArchiCAD plans; see *Referencing Design Files* below.

In addition, ArchiCAD provides you with these additional workflows:

- Controls the import and export processes; see *Translation Options and Settings* below.
- Exports its plans in AutoCAD format; see *Exporting ArchiCAD Drawings* below.

Let's now look at each of these ways in a bit more detail.

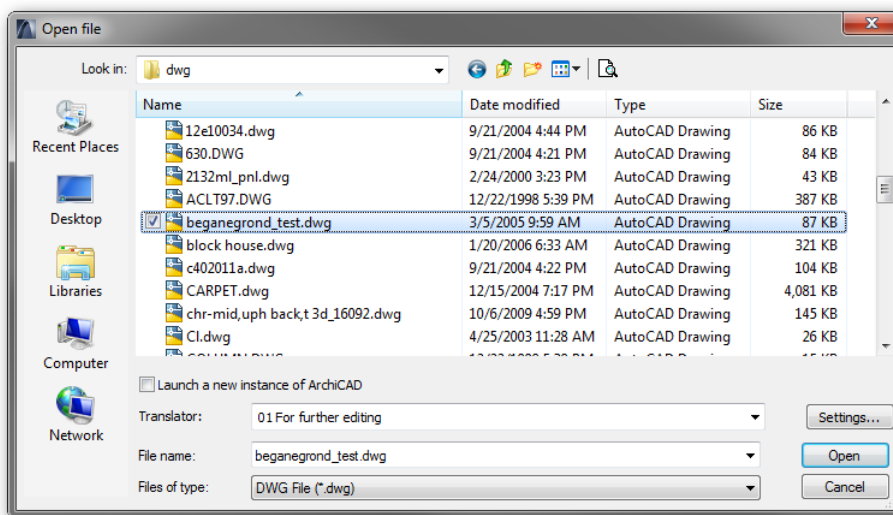
METHOD 1: IMPORTING AUTOCAD DRAWINGS

File | Open

To import an AutoCAD drawing as a new project in ArchiCAD, follow these steps:

1. In ArchiCAD's **File** menu, choose **Open**.

Notice the Open File dialog box.



The Open File dialog box accessing DWG import settings.

2. In the **Files of Type** droplist, choose "DWG File (*.dwg)." Notice that two new elements appear in the dialog box: a Settings button and a Translator droplist:
 - To use a preset translation setting, select one from the **Translator** droplist.
 - To customize the translation settings, click the **Settings** button.
3. Choose a DWG file, and then click **Open**. Notice that the drawing is added to the current project.

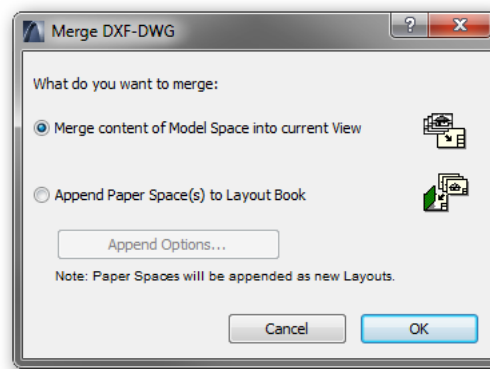
DWG files are not opened independently, as in AutoCAD. Instead, the contents of model and paper-space layouts are merged into their proper places in the current ArchiCAD project.

METHOD 2: MERGING DESIGNS

File | File Special | Merge

The second way to import designs from AutoCAD is to merge them into an existing ArchiCAD plan. You would use this approach when you want to add details from AutoCAD drawings which you need to edit in ArchiCAD. (If there is no need to edit the AutoCAD design, then use the Reference option, which is described next.)

1. In ArchiCAD's **File** menu, choose **File Special**, and then choose **Merge**.
Notice the Merge File dialog box.
2. In the **Files of Type** droplist, choose "DWG File (*.dwg)."
Choose a DWG file, and then click **Open**.
Notice the Merge DXF-DWG dialog box.



Merge DXF-DWG dialog box letting you choose between model and paper space.

3. Because AutoCAD designs can exist in model and paper space (a.k.a. layout mode), you need to choose one.
 - **Model Space** — entities from model space are added to the current view.
 - **Paper Space** — the contents of paper space are placed as new layouts. (The Append Options button lets you decide how blocks are treated.)

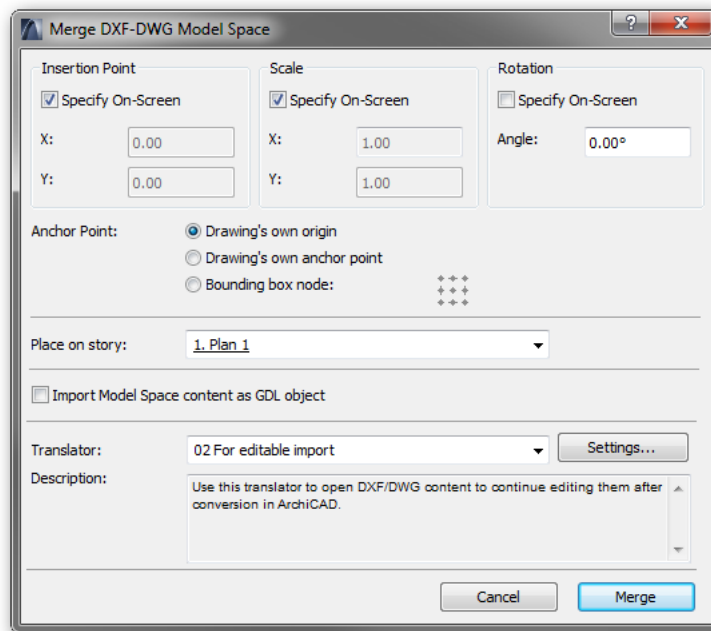
If you wish to merge both model and paper space, then you need to run this procedure twice.

4. Click **OK**.

Notice that the Merge DXF-DWG Model Space dialog box looks somewhat like AutoCAD's Insert dialog box, in which you specify insertion point, scale, rotation, and so on.

You need to specify the following options:

- **Place on Story** — choose the floor plan (“Story”) on which to place the drawing.
- **Translator** — select the translation setting.



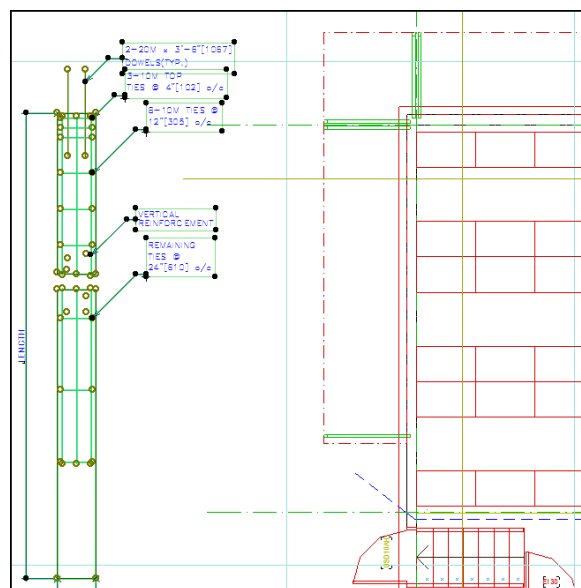
Options for merging designs

5. Click **Merge**.

ArchiCAD asks which layers you wish to import. In most cases, you import them all.

6. Click **OK**.

Notice that the entities are translated, and then placed in the plan.



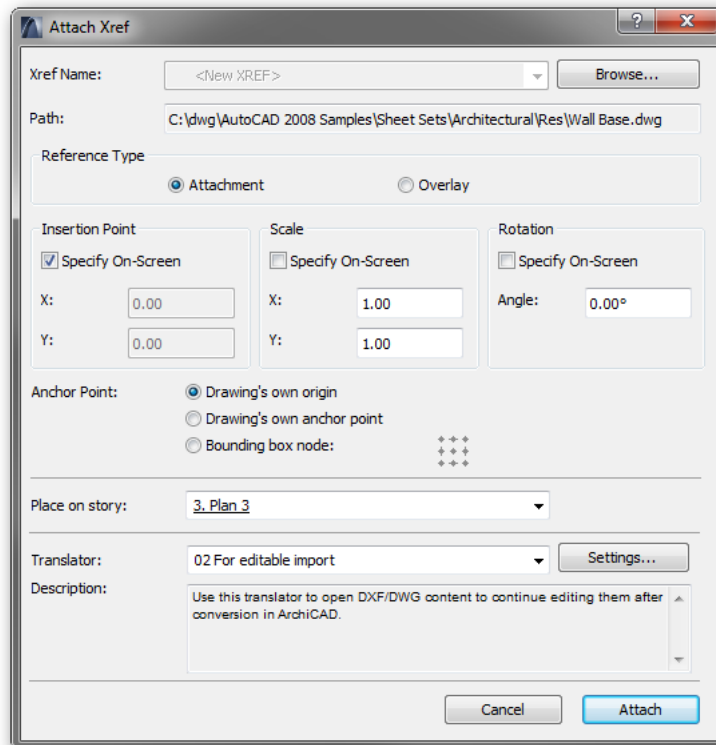
Detail from AutoCAD (shown in green, at left) merged into ArchiCAD floor plan.

METHOD 3: REFERENCING DESIGNS

File | External Content | Attach Xref

The third way to import designs from AutoCAD is to attach them as references to existing ArchiCAD plans. The approach is nearly identical to using xrefs in AutoCAD: you use this approach when you only want to see the drawing, and not edit it.

1. In ArchiCAD's **File** menu, choose **External Content**, and then choose **Attach Xref**.
Notice that the Attach Xref dialog box looks like AutoCAD's dialog box for attaching xrefs.



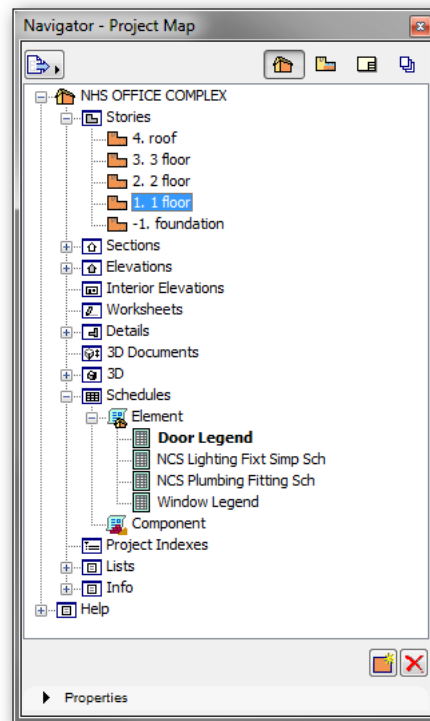
Options for attaching references.

2. Click the **Browse** button, and then choose a DWG file. (Only DWG and DXF files can be referenced.)
3. Click **Open**.
4. Back in the Attach Xref dialog box, you can specify the insertion point, scale, rotation, and so on. Just with the Merge option, you also need to choose the floor plan ("Story") on which to place the drawing, and select the translation setting.
5. Click **Attach**.
ArchiCAD prompts you to position the reference. Notice that the drawing is placed in the plan.

EXPORTING ARCHICAD DRAWINGS

File | Save As

A *project* in ArchiCAD contains all data related to the building design, and so there is no single way to export it to AutoCAD. You begin the process with the help of ArchiCAD's Navigator panel: choose a specific view of the BIM model to export, such as the "I Floor" drawing or the "Door Legend" schedule. The view you choose determines the export formats available to you.

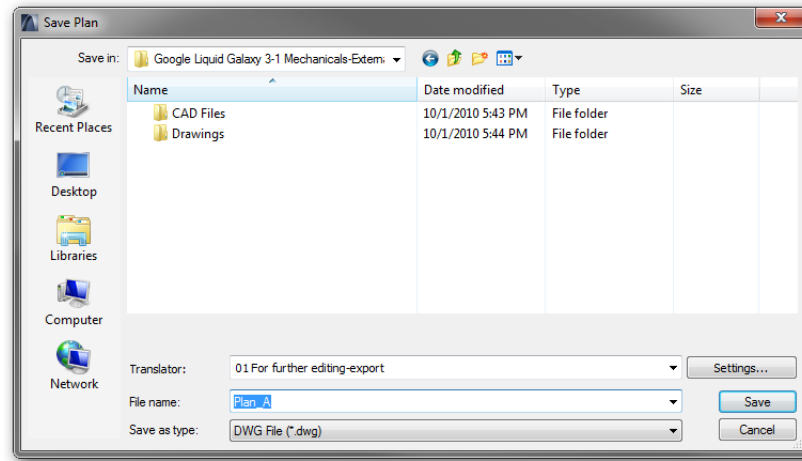


*Selecting a drawing view of the model for export.
 In this case, "I floor" is selected.*

For example, "I Floor" is a drawing that must be exported in a drawing format, such as DWG or HPGL. In contrast, door schedules are bills of material that consist of text, and so they must be exported in a text format, such as tabbed text or a spreadsheet file. (The text can subsequently be imported into AutoCAD drawings as mtext or tables.)

To export a project to AutoCAD, follow these steps in ArchiCAD:

1. In ArchiCAD's Navigator, choose the plan to export, such as "I Floor." (See figure above.)
2. From the **File** menu, choose **Save As**. Notice the Save Plan dialog box.

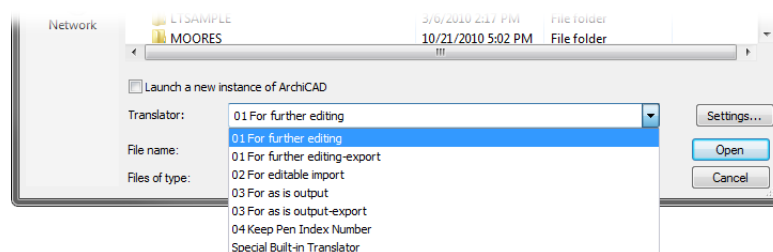


The Save Plan dialog box accessing DWG export settings.

3. In the **Files of Type** droplist, choose "DWG File (*.dwg)." Notice the elements that appear: the Settings button and the Translator droplist. These two lead to the same dialog box and droplist options described earlier.
4. Enter a name for the DWG file, and then click **Save**.
5. Open the DWG file in AutoCAD.

TRANSLATOR OPTIONS AND SETTINGS

The **Translator** droplist controls how design data are imported and exported:



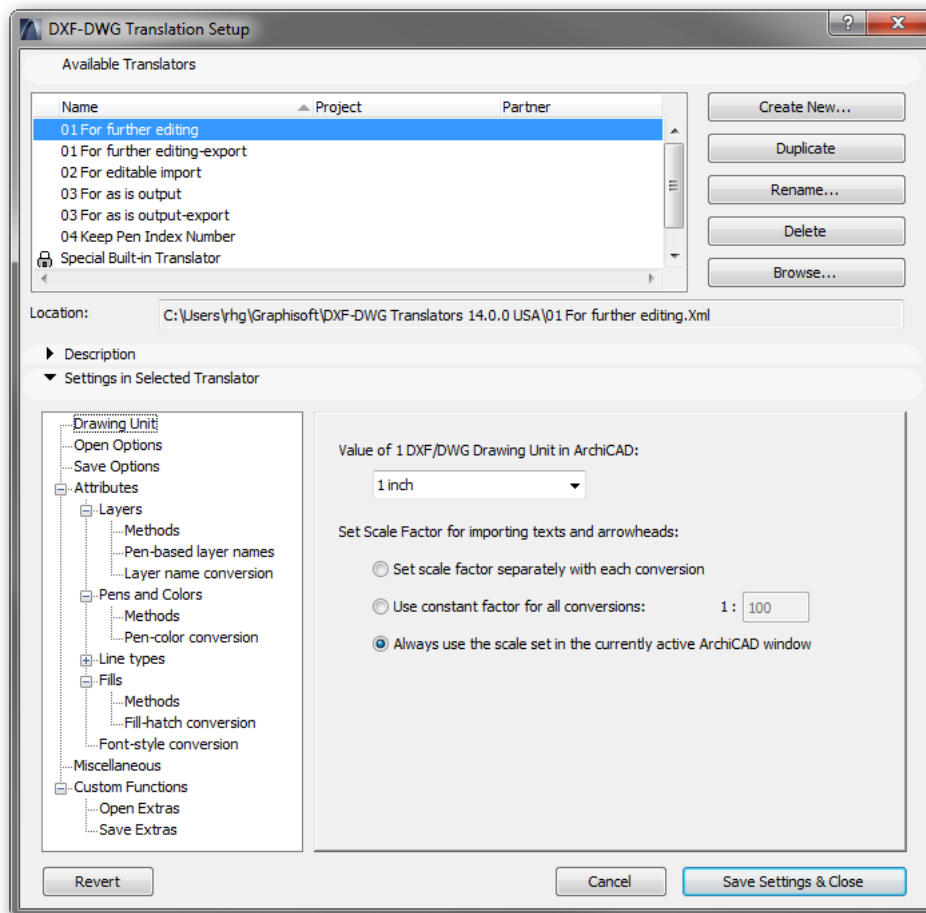
Selecting preset translation settings.

- **For Further Editing** — use this translator when you need to edit ArchiCAD designs in AutoCAD after conversion.
- **For Editable Import / Export** — use this translator to open DXF/DWG content to continue editing them after conversion in ArchiCAD.
- **For As-is Import / Export** — use this translator to output ArchiCAD designs as-is, without further editing after conversion, such as when submitting plans for approvals in DWG format, or when sending drawings to service bureaus.

- **Keep Pen Index Number** — use this translator when designs need to retain their pen index numbers.
- **Special Built-in Translator** — use this translator when no other translation option is available; this one is locked so that it cannot be modified.
- **Create Your Own** — edit the translation parameters through the **Settings** button. See *Translation* below.

File | File Special | DXF-DWG Translation Setup

You can customize the translation parameters by clicking the Settings button in the file dialog box discussed above, or by using the File menu: choose File Special and then DXF-DWG Translation Setup. See the online help for the meaning of the various options.



Specifying translation settings.

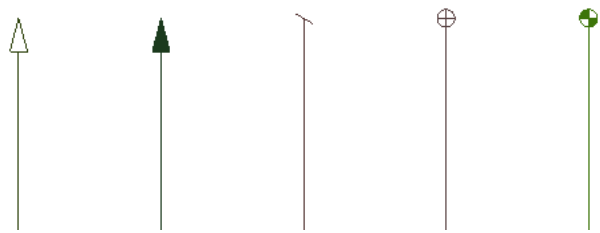
Understanding Compromises

Just as there is no perfect translation between human languages, there is none between design systems — whether among AutoCAD, Revit, Vectorworks, ArchiCAD, or any other system. While many concepts translate just fine, it is important to understand the compromises made by each program in reading and displaying the other’s drawings and models.

In this section, tables list the changes that occur when ArchiCAD drawings are brought into AutoCAD, and vice versa.

ENTITIES

The following table lists those ArchiCAD entities that do not have an exact equivalent in AutoCAD. For instance, ArchiCAD lines can have line ends, such as dots and boxes. When ArchiCAD translates one of these to AutoCAD format, it turns it into a collection of lines, arcs, and solid filled hatches, and then bundles it together as a block.

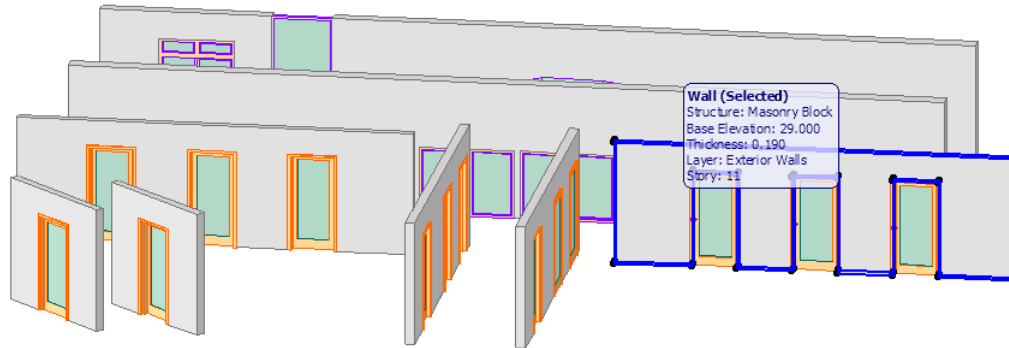


ArchiCAD lines with ends.

ArchiCAD Entity	AutoCAD Equivalent	Remarks
Line with ends	Block	Block composed of lines and end pieces made from solid-fill hatches, lines, and/or circles.
Spline with ends	Block	Block composed of polylines and end pieces made from solid-fill hatches, lines, and/or circles.
Linetype	Linetype	ArchiCAD generates a <i>linetype.shx</i> file, which is read by AutoCAD. Translation is accurate, except for Double linetypes, where AutoCAD adds a small dot (as required by its linetype definitions).

OBJECTS

AutoCAD does not have any of the following objects created by ArchiCAD, and so the ArchiCAD translator outputs them as blocks containing lines, arcs, hatch patterns, and/or attribute data, as described by the table below.

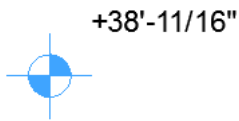


ArchiCAD wall, door, and window objects.

ArchiCAD Object	AutoCAD Equivalent	Remarks
Column	Block	Block composed of circles, lines, and hatches.
Wall	Block	Block composed of lines, arcs, and a block representing the hatch pattern. The hatch pattern block is made of lines and arcs; the arcs are simulated by very short lines.
Zone	Block	Block composed of hatches, lines, and attribute definitions.
Roof	Block	Roofs composed of many individual blocks and a background color, one for each roof section. Each block is made of hatches and polylines.
Window	Block	Openings are blocks that nest in wall blocks.
Door	Block	Block composed lines, hatches, and so on.

DIMENSIONS

For the most part, AutoCAD's dimension types match those of ArchiCAD. There are, however, a few missing from AutoCAD, as listed in the table below.

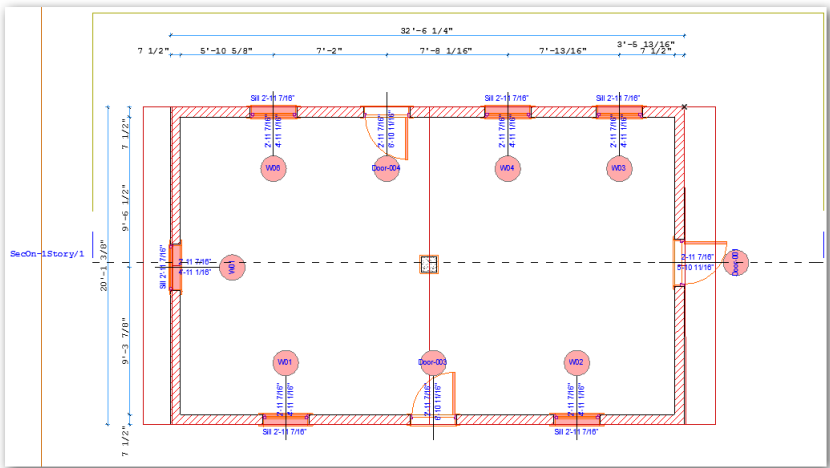


ArchiCAD level dimension

ArchiCAD Dim	AutoCAD Equivalent	Remarks
Elevation	Block	Block composed of lines and mtext.
Level	Block	Block composed of lines, text, hatches.
Radial w/o leader	Block	Block composed of mtext, arc, line (arrowhead).

3D MODELS 2D VIEWS

ArchiCAD displays 3D models from a variety of 2D viewpoints, such as plans, sections, and elevations. In the conversion to AutoCAD, perspectives, viewpoints, and shadings are lost. The 2D entities tend to be converted to blocks made of polyface meshes.



ArchiCAD 2D floor plan generated from 3D model.

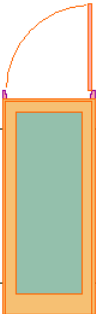
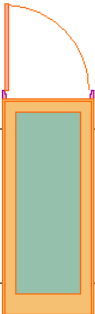
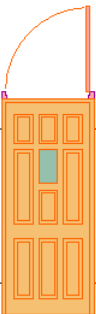



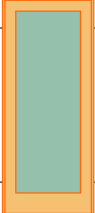
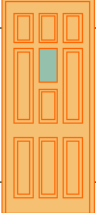


ArchiCAD Object	AutoCAD Equivalent	Remarks
Wall	Block	Block composed of polyface meshes.
Roof	Block	Connected blocks are composed of polyface meshes.
Column	Block	Block composed of polyface meshes.
Slab	Block	Block composed of polyface meshes.
Window	Block	Block composed of polyface meshes.
Door	Block	Block composed of polyface meshes.
Patch	Block	Block composed of polyface meshes.
Mesh	Block	Block composed of polyface meshes.

SCHEDULES

Schedules are reports that ArchiCAD generates automatically from 3D models. Usually, these are best output as spreadsheet files, which can then be imported by AutoCAD as tables. Follow these steps to bring ArchiCAD schedules into AutoCAD:

- 1. In ArchiCAD, export schedules in XLS (Excel) format.
- 2. In AutoCAD, create a table, and then fill it with data linked to the XLS file. (When the XLS files change, the data in the AutoCAD table update automatically.)

XLS and TXT formats are editable in AutoCAD. PDF can be imported, but not edited. HTML files cannot be imported into AutoCAD.

Door List					
Door Name	D1 14	D1 14	D1 Entrance 14	D1 Entrance 14	D1 Metal
Quantity	7	7	1	2	1
To Room Number					
W x H Size	2'-11 7/16"x6'-10 11/16"	2'-11 7/16"x6'-10 11/16"	2'-11 7/16"x6'-10 11/16"	2'-11 7/16"x6'-10 11/16"	2'-11 7/16"x6'-10 11/16"
Orientation	L	R	L	R	L
Door sill height	0"	0"	0"	0"	0"
Door head height	6'-10 11/16"	6'-10 11/16"	6'-10 11/16"	6'-10 11/16"	6'-10 11/16"
2D Symbol					
3D Front View					

ArchiCAD door schedule

ArchiCAD Schedules	Remarks
Door Schedules	Exportable as DWF, XLS, PDF, text, and other text formats.
Wall Schedules	Same as door schedules.
Project Indices	Same as other schedules.
Lists	Same as other schedules, but export formats are limited to text, HTML, and PDF.
Info	Export in text format.

■ III. Making BIM Work with 2D CAD

Practical Workflows

We have seen that moving drawings between elementary 2D drafting environments and rich 3D BIM environments is not a simple matter. There are, however, specific solutions to solve any problem you may face. To determine the route to the best conversion, you need to know the destination for the drawing data.

This chapter describes practical solutions to using drawing data with both ArchiCAD and AutoCAD.

MAKING USE OF DWG DATA IN ARCHICAD

The following scenarios begin with drawings in AutoCAD format, and then describe the best approach to using them with ArchiCAD.

Scenario 1. Base Plans

You have to access drawings made in AutoCAD of site information, as-built environments, historic plans of buildings, and so on. To use this DWG data as base data input, the best approach is to do the following in ArchiCAD:

- Reference the DWG files on worksheets or layouts in ArchiCAD.
- From ArchiCAD's **File** menu, choose **External Content**, and then choose **Attach Xref**.

Scenario 2. Design Details

Sub-contractors are providing details drafted with AutoCAD. You need to use their DWG data as 2D content in ArchiCAD:

- Merge the DWG files to specific plan views in ArchiCAD or onto layouts.
- From ArchiCAD's **File** menu, choose **File Special**, and then choose **Merge**.

Scenario 3. 2D Coordination

You are part of a group of several engineering consultants, some using AutoCAD and some ArchiCAD. Coordinate the drawings between the group members:

- Xref (externally reference) the AutoCAD drawings in ArchiCAD.
- From ArchiCAD's **File** menu, choose **External Content**, and then choose **Attach Xref**.

Scenario 4: 3D Content

A supplier sent you AutoCAD drawings of 3D furnishing blocks and building parts. To use these in ArchiCAD, your best approach is as follows:

- Convert the 3D DWG files to GDL objects or libraries, and then use them in plan view.
- From ArchiCAD's **File** menu, choose **Libraries and Objects**, and then choose **Import Blocks from DXF/DWG**.

(GDL is Graphisoft's parametric object technology, short for Geometric Description Language. For more information, see www.graphisoft.com/products/gdl-object-technology.)

Scenario 5. 3D Coordination

To coordinate between several disciplines, import 3D DWG designs of building systems into 3D models in ArchiCAD, as follows:

- Merge drawings into ArchiCAD's 3D view, and then run collision detection.
- Install the optional MEP (mechanical, electrical, plumbing) add-on, and then run collision detection

MAKING USE OF ARCHICAD DATA IN DWG

The following scenarios begin with designs in ArchiCAD, and then describe the best approach to bringing them over to AutoCAD.

Scenario 6: Coordination with Engineering Disciplines

You need to coordinate drawings amongst various engineering disciplines, including some that use AutoCAD. Each of you works with designs created by others, and so your best approach is to do the following in ArchiCAD:

- Export plan views by saving PLN data as DWG files, which can be edited.
- In Navigator, choose a story or section. Then, from ArchiCAD's **File** menu, choose **Save As**, and then choose **DWG** format.

Scenario 7: Provision of Documents to Partners

Partners want to see the final drawings, but not necessarily edit them. To provide drawings as technical documents, take this step in ArchiCAD:

- Export layout books of final drawings as DWG files.
- In ArchiCAD's Navigator, choose **Publisher Set**, and then select **DWG** as the file format.

Scenario 8: 3D Reference Models Shared with Engineers

AutoCAD-using engineers have a need to reference drawings from ArchiCAD. You can provide reference models to engineers from ArchiCAD, as follows:

- Export 3D models as 3D DWG surfaces.
- In Navigator, choose a 3D view. Then, from ArchiCAD's **File** menu, choose **Save As**, and then choose **DWG** format.

Summary of Solutions

The source and the destination matter, and the solution is to split up the data, and then perform specific kinds of imports — depending on the need. These are the work flows available for moving designs between 2D CAD and 3D BIM:

FROM AUTOCAD TO ARCHICAD

If you need from AutoCAD...	Then import into ArchiCAD...
Floor plans	import AutoCAD's model space to ArchiCAD's plan views as 2D objects.
Details	import AutoCAD's drawings to ArchiCAD's detail/section views.
Preserved viewports	import AutoCAD's paper space layouts to ArchiCAD's layouts.
Block libraries	import AutoCAD's model space to ArchiCAD's 3D as GDL objects/libraries.
Updateable xrefs	xref AutoCAD's drawings into ArchiCAD's plan views.
Editable xrefs	xref AutoCAD's drawings into ArchiCAD's layouts as placed drawings.

FROM ARCHICAD TO AUTOCAD

If you need in AutoCAD...	Then export from ArchiCAD...
2D linework	export ArchiCAD's plan views to DWG model space as 2D linework.
Paper space	export ArchiCAD's layoutbook layouts to AutoCAD's paper space.
Model space	export ArchiCAD's placed drawings to AutoCAD's model space.
3D models	export ArchiCAD's 3D models as 3D surfaces to AutoCAD's model space.

■ IV. Conclusion

The world of design software is split into two approaches, one fundamentally different from the other. Basic CAD programs, like AutoCAD and IntelliCAD, build on the tradition of hand drafting by using lines, arcs, and other basic 2D geometry to mimic building components. BIM is the other approach, in which building components are simulated by intelligent 3D models.

The popularity of both approaches continues now in the 21st century, which means that they must be able to work together. **This title to this paper asks the question, “Is there a free pass between CAD and BIM?” There is no free pass.** But with an understanding of the issues involved and some pre-planning, then 2D line drawings can be made to work with 3D models — and vice versa.

Despite the conceptual differences between CAD and BIM, some software developers are forging a solid path between the two approaches. Users of CAD and users of BIM can employ drawings from each other's systems — once they understand how best to convert them. This paper suggested a two-fold solution to the problem of converting drawings between AutoCAD and ArchiCAD:

- Visual accuracy
- Functional accuracy

Some entities are identical in both systems, such as lines, dimensions, and text. Designs using these elements pose no problem in either system. Other elements, however, are not standard in CAD or on BIM. The conversion of non-standard elements needs to be handled either by functional conversion or by WYSIWYG conversion.

This paper described tactics suitable for both types of conversion, exploring which works best for both parties. They can import AutoCAD drawings as new ArchiCAD plans, or else merge or attach drawings into existing plans. The conversion works best when all the parties involved understand the ultimate goal (pure data input, coordination, and so on), and then set up the translation settings correctly.

Hybrid Workflows

BIM software is becoming common-place, yet design software that uses 2D linework will remain popular for the foreseeable future. These two different approaches to design mean that a hybrid workflow becomes part of everyday practice.

For design firms to remain competitive, it is worthwhile for them to establish a solid hybrid workflow — for themselves, their partners, and their clients. ■

