



White Paper

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DWF: The Best File Format for Published Design Information

This white paper provides background on the industry need for a standard digital medium for sharing design data, and summarizes the DWF™ file format. It also explores the technical advantages of DWF, Autodesk® DWF™ Viewer, Autodesk® DWF™ Composer, and Volo® View over competing offerings from Adobe.

Finding the Ideal Medium for Lifecycle Management

Building construction, infrastructure/mapping, and product design/manufacturing are all intrinsically collaborative processes. From conception and design, to bidding, construction/manufacturing, and ongoing maintenance, all points in the lifecycle of any building, product, or infrastructure element involve the work of fluctuating teams of designers, engineers, developers, clients, and contractors. Even as the Internet has changed the way these types of projects are carried out, the essential nature of the group endeavor remains.

Recent studies tell us that for each design creator there are on average ten consumers of that design information within an extended team, both inside and outside the enterprise. Distributing design information to these team members, and soliciting feedback, has been a major cost in building construction, infrastructure, and manufacturing projects. The Internet, project collaboration tools, and email have done much in this area by making it possible for architects, cartographers, and engineers to distribute CAD model data to other designers nearly instantaneously anywhere around the world. But while physical barriers to communication among the design profession have been effectively removed, what hasn't changed is the inability of designers to share the full scope of their published work quickly, efficiently and accurately with colleagues, clients, and partners outside the design profession.

Moving Away From Paper

The costs of working with paper add up to millions of dollars in losses every year. Delays involved in physically distributing designs, the difficulty of keeping distributed workers up to date, and the inability to track feedback on paper often result in costly construction and manufacturing mistakes. Secondary and directly measurable costs for creating and delivering printed designs also remain.

Changing the process from paper to an electronic process utilizing standard CAD or GIS authoring software often leads to challenges both from a technological sense and in terms of cost/time. In the first instance, it is not practical for professionals who are not CAD users/designers to purchase, learn, and use sophisticated design applications such as AutoCAD®, Autodesk Inventor®, Autodesk® Land Desktop or Revit®. In the second instance, while paper plans can be printed and sent to dispersed team members, the process is time consuming,

inefficient, and not easily tracked. On a typical large construction project, for example, costs associated with courier services like FedEx can easily reach as high as \$500,000. Moreover, any input or changes made to printed designs have to be physically sent back to the designer who then must compile, resolve, and reconcile the various versions. Errors are often introduced when document markups are missed. From a cycle-time standpoint, the traditional paper publish-distribute-markup-return-revise-republish process involves a four-day turnaround or longer.

An alternative method that has been gaining popularity in recent years is for designers to recreate the current paper process in an electronic form using formats such as TIFF, JPEG, CALS, HPGL, and PDF. The drawback is that these electronic paper formats can't capture the intelligence within a design, and don't fix the costly process issues of tracking, workflow, and accountability. Because they are capable only of presenting two-dimensional images of what are actually complex three-dimensional models, electronic paper formats lack the attributes necessary to serve as an effective medium for sharing design information. A new standard has emerged, however, that combines the convenience of electronic paper with the rich viewing, tracking, querying, plotting, printing, workflow, and security capabilities demanded by designers. Known as the Design Web Format™ (DWF), this file type was specifically developed by Autodesk as a medium for architects, engineers, and GIS professionals to quickly capture and securely distribute rich design data anywhere it is needed. DWF, from the beginning, has been intended to be an open standard, providing the specifications and technology for any vendor to develop applications that utilize DWF.

Intelligence You Can See

The open, compact, and secure DWF file format enables the efficient distribution of rich design data to anyone who needs it. DWF protects the integrity of the designs, precisely publishing, rendering and printing the designs. Furthermore, unlike other paper-centric file formats, DWF can convey the rich design intent of the original CAD model, thereby ensuring that the user is receiving exactly what the author intended. As a format that's ready for viewing, printing, plotting, or placing in a web page, DWF also has distinct advantages over paper-based documents.

By using DWF files, firms can reduce or eliminate many of the hard costs associated with communicating and sharing design data: courier and mailing services; the labor needed to print, organize, sort, and store large document sets; and materials such as paper and ink. More importantly, the DWF format reduces the time it takes to manage the design creation and review processes. Consider its principal attributes:

- Highly scalable, DWF is an extensible print-ready format that supports multiple pages, passwords, and XML metadata.
- DWF files are highly compressed so that huge design models can be easily transmitted via email and viewed with Autodesk® DWF Viewer, a small, free¹, downloadable application.
- Users of Autodesk publishing applications (AutoCAD, Autodesk Inventor, Revit, Autodesk® Civil Design, etc.) can easily create DWF files without sacrificing design integrity or printability. It is far easier to publish a multisheet drawing, map or model into single DWF with all the sheets and layers preserved with a single click, than create a multi-page PDF one sheet at a time.

¹ This product is subject to the terms and conditions that accompany download of the software.

- There is no need to purchase another software program since DWF publishing is integrated into Autodesk applications. Furthermore, with the free Autodesk® DWF™ Writer, anyone can create DWF files from all Windows®-based applications, by simply selecting Autodesk DWF Writer from their standard Printer Name drop-down list. The DWF Writer allows users of other CAD applications that do not offer built-in DWF publishing, such as Bentley® MicroStation® and Solidworks®, to create DWF files.
- With DWF 6, the latest DWF release, publishers of design data can select the specific design data, layers, views, and plot styles they want recipients to see.
- The format supports multisheet drawing sets, so designers can build a complete set of complex design documents, pages, or layouts into a single DWF file in one easy process.
- DWF files are secure helping protect the intellectual property of the original design. DWF files are similar to paper plots – by default they include only what the designer intends to share. Layer information can be turned on or off; object definitions metadata, block attributes, or properties are not included unless published by the CAD user. Password protection and encryption of the DWF file further ensure the security of the DWF files.
- DWFs are also ideal for archival use, since they're essentially an electronic plot. Their compact file size require less network storage space than native CAD files such as DWGs and certainly less cabinet space than multiple paper copies of project sheet sets.
- Beyond just graphics, DWF files can contain the data rich information of the original CAD model, including drawing scale, precise design coordinates, assorted views, hyperlinks, sheet details, and XML-based object properties. This means that users can query object information like the dimensions of a door and the part numbers of materials to be used.
- The open source DWF Toolkit enables developers to build applications that read and write multi-sheet DWF drawings. There's security in knowing that multiple vendors will support DWF into the future.

In addition, when an extended team needs to provide input on a design, Autodesk® DWF™ Composer and Volo® View software provide a complete set of review tools that enable users to contribute comments and ideas to DWF files without altering the original data. These high-performance review, markup, measure, printing, and plotting applications for digital design data make it easy for entire teams to work with designs. Familiarity with the originating design application is not necessary, and learning to use DWF Composer and Volo View is quick and easy for everyone, from construction supervisors and senior executives to engineers and contractors.

For team members who simply need to view or print DWF files, the Autodesk DWF Viewer is a free, downloadable application that provides the same rich visual and print fidelity as Autodesk's advanced publishing applications. Clearly, with its ability to accurately capture rich digital design data in a compact, open, secure, and readily transmittable format, DWF—in concert with the Autodesk DWF Viewer and DWF Composer or Volo View—is the ideal solution for sharing design information.

A Matter of Specialization: The Advantages of DWF File Format over PDF for the Design Team

Increasingly, designers and project managers are concluding that using printed plans and delivery services to get team input during the design process is simply too expensive and time consuming. Since many project teams today are already set up on collaboration sites, or are connected via basic email and Web access, most architects, contractors, engineers, suppliers, and vendors can be reached whenever and wherever they may be. The question now is how to distribute designs to everyone in a format that will allow them to see and understand the true intent of the designer.

Actual working design files (DWG format) created with an AutoCAD software program can be impractical for a variety of reasons. Security of the designer's intellectual property is a concern with DWG because anyone with the AutoCAD application can edit the file or steal the design. Moreover, paying for everyone on the team to install and then learn to use a sophisticated CAD or mapping application itself would be costly. So, for many in the building, product design and mapping industries, the choice for a standard design collaboration/management format has been narrowed down to two possibilities: PDF or DWF. Let's consider each format's features and capabilities.

File Format Features and Capabilities

	DWF	Adobe PDF
History	Design Web Format, an open secure format designed specifically for sharing rich engineering design data.	Portable Document Format, a generic format designed for textual-based document exchange.
Basic Functionality	Enables team members who don't use CAD to participate in the digital design review process by viewing building, GIS or product designs.	Preserves document integrity, and enables businesses to simplify document processes.
Publishable from AutoCAD	Yes. DWF creation is a native feature of Autodesk design applications such as AutoCAD, AutoCAD-based products, Autodesk Inventor, Autodesk MapGuide, and Autodesk Revit software. Users can "publish" rich design data with a single click.	Yes, but only if the user purchases Adobe Acrobat Professional 6.0. However not all features are available. Adobe Acrobat is a "printer driver" and does not "publish" the full intent of the designs.
Plot Style Support	Yes. Given that DWF creation is part of the native design applications, plot styles are leveraged when the DWF is created.	No. Plot-to-scale function not available with Adobe Acrobat.
Scalability for Design Data	Yes. Extensible print-ready format supports multiple pages, passwords, and metadata.	No. Limited compression, not architected for large data sets or design metadata.
Multisheet Drawing Sets	Yes. The user can publish multisheet drawing sets from multiple DWG source files to a single DWF file automatically. DWF also preserves design coordinates	Yes, but projects must be printed one sheet at a time and then manually assembled into a multi-sheet set, significantly increasing time needed for

	and sheet properties.	publishing.
Preserves Design Coordinates And Sheet Properties	Yes. Viewport aware coordinate transforms allow precise real world measurements.	No.
Optimum File Compression	Yes.	No. PDF files are often three times larger, straining bandwidth and system resources, and slowing opening times.
Open Access, Extensible to Other Applications	Yes. The DWF Toolkit enables users to develop applications that read or write multisheet DWF drawings for free. In addition, the Autodesk DWF Viewer API makes it possible to embed DWF drawings in HTML.	Yes, but the developer will have to purchase a license to the libraries to create a PDF.
Self-contained file	Yes.	Yes.
Multiple pages	Yes.	Yes.
Preserve CAD layers	Yes, automatically publishes only those layers the author intended as defined by the AutoCAD layout. For security purposes layer information is not published unless selected by the author.	Yes, but only with the additional purchase of Acrobat 6 Professional. Uses a layer selection tool separate from the AutoCAD layout, which can lead to standards violations. Layer information is published by default, creating a security issue where end-users may print a document with critical layers inadvertently turned off.
Print to scale	Yes.	Yes, with some caveats on large format devices
AutoCAD-based views	Yes.	Supported by the raw file format, but not exported by Acrobat Professional.
Xref support	Yes.	Yes.
Hyperlinks	Yes.	Supported by the raw file format but not exported by Acrobat Professional.
Redlines / comments	Yes, with the purchase of DWF Composer.	Yes, but only with the additional purchase of Acrobat 6

		Professional.
Copy protection	No.	Yes. Several cracking tools are available on the internet for breaking this protection.
Password Protection	Yes.	Yes. Several cracking tools are available on the internet for breaking this protection especially for older versions of PDF.
Raster graphics	Yes.	Yes.
Vector graphics	Yes.	Yes.

Looking at DWF versus PDF file formats there are some commonalities between the two. Both formats produce self-contained files, support multiple pages, copy, print and password protection, as well as raster and vector graphic support. With the purchase of Acrobat 6 Professional, users can publish files from AutoCAD, preserve CAD layers and perform redlines/comments as they can with DWF.

However, PDF falls short compared to DWF in terms of a number of key capabilities for the design industry. While DWF was designed specifically for sharing rich design data, PDF, or Portable Document Format, was designed for textual-based document exchange. Today Autodesk provides a better format for distributing and sharing engineering design data with DWF. DWF provides:

- *Accuracy, Fidelity and Data Richness.* DWF is built to support real-world coordinate measurement and understands that the world is 3D not 2D. DWF files can be produced at a much higher precision than PDF, which is required for accurate presentation and measurement of engineering designs.
- *Performance and Scalability:* DWF files are normally much smaller than PDF. DWF files transmit faster, load faster and can be emailed more easily without hitting system limits. The DWF viewing technology renders large models faster, and allows real-time manipulation of huge data-sets through the use of spatial indexing technology not available with PDF.
- *Productivity and Workflow:* DWF supports advanced markup, measurement, and workflow features not available with PDF. DWF includes markup remarks, timestamps, history, and status information and supports standard engineering markup symbology to improve communication. DWF measurements reflect real-world units rather than paper-distances and do so on a viewport-aware basis without requiring user calibration. The Autodesk DWF Composer and AutoCAD applications fully leverage DWF intelligence with markup browsing and round-trip markup workflow.
- *3-dimensional graphics:* This summer DWF will go fully 3D in order to best capture the design intent of engineering models including assembly metadata.

DWF: Meeting the Unique Needs of Design Teams

The comparison above shows us that PDF matches some but not all of the DWF feature categories. In fact, in the areas that are most crucial for accurately conveying rich design information—plot style information for viewing and printing support, scalability for design data, capturing design coordinates and sheet properties—PDF falls short. Without these critical functions the PDF format is not optimized for designers to leverage all the capabilities of CAD applications. And in the larger picture, PDF prevents designers from sharing the full intent of their work with the extended team.

DWF, on the other hand, is specifically designed to meet the unique needs and demands of the design profession, and to facilitate the sharing of design information with extended teams. As an evolutionary enhancement to current processes, DWF requires little if any learning curve and no investment in new publishing applications. Moreover, by leveraging the plot styles, multiple pages, and metadata that give CAD designs their depth and complexity, DWF enables all members of the extended team to access the full capabilities of CAD data. The clear advantages of DWF over PDF include:

- DWF functionality lets non-designers see the full integrity of the designer’s work with complete fidelity.
- DWF file format is non-editable, so it protects the designer’s intellectual property and ensures that the user sees exactly what the designer intended.
- With richer design data the level of information and knowledge available within the team is elevated and the decision-making process improves.
- The more compact DWF file sizes help to boost productivity and efficiency because they transmit and download faster, and allow for faster application functions such as pan, zoom, and print.
- Total cost of ownership is lower for DWF in at least two ways:
 - DWF files can be created from Autodesk publishing applications at no extra charge, but to create PDFs from AutoCAD or other design creation applications requires the additional purchase of Acrobat 6 Professional.
 - The smaller DWF file sizes place less of a burden on system, bandwidth, and storage resources, leading to cost savings over the long term.

The Viewing Applications Autodesk DWF Viewer vs. Adobe Acrobat Reader

Just as the DWF file format has many advantages over the PDF format, so does the Autodesk DWF Viewer provide more benefits to design teams than does Adobe® Acrobat® Reader®. Both are simple, free applications that allow users to view and print their respective “published” formats, but there the similarities end. Autodesk DWF Viewer uses the same printing and rendering engines as the other Autodesk design products, such as AutoCAD, Autodesk Inventor or Revit. Because of these capabilities DWF Viewer provides full visual and print fidelity for designs and drawings, and enables users to print to original scale or specified scale. Not so with Adobe Acrobat Reader. Moreover, while it is relatively easy for an AutoCAD user to create a PDF and quickly distribute it, much of the detail of the original file will be lost when published to PDF and viewed in Adobe Acrobat Reader. Autodesk DWF Viewer, provides easy access to information-rich data to anyone who needs it. DWF Viewer includes the complex information embedded in design files, including detailed information about each sheet within the DWF file and access to object properties published from applications like Autodesk® Architectural Desktop. Put simply, the depth and

scope that are essential to accurate engineering and architectural designs simply cannot be rendered in the Acrobat Reader.

The Reviewing Applications Autodesk DWF Composer and Volo View vs. Adobe Acrobat Professional

The same issues of designer intent and viewing/printing integrity also hold true in the case of Autodesk's and Adobe's reviewing applications, Autodesk DWF Viewer and Volo View versus Acrobat 6.0 Professional. Created to help speed the document review process, Acrobat 6.0 Professional offers many of the same redlining tools, layering attributes, and pan and zoom capabilities featured in DWF Composer and Volo View. Yet Acrobat Professional was built as a general application to serve the needs of business executives, creative professionals, and administrative staff across a range of industries. As such, it not only lacks the DWF Composer and Volo View key plotting and visual rendering elements, but it also doesn't have specialized attributes that are vital to efficient design collaboration in the construction, mapping, engineering, and manufacturing sectors.

Specifically, when *reviewing* designs, whereas Acrobat Professional works only with PDF files, DWF Composer and Volo View works with DWF *and* the native file formats generated by the AutoCAD, Autodesk Inventor, and various other raster applications. What this means is that Autodesk users can leverage all the technology underlying these file formats. When redlining, marking-up, measuring, plotting, printing or even creating new DWF files, Autodesk users are assured of the highest fidelity. What's more, Autodesk users get the same viewing capabilities as the software that the design was created in—with dynamic pan, zoom, and 3D orbit. Team members can measure design elements right from the data and be assured of accuracy.

The *markup* and *revision* processes are also dramatically improved with Autodesk DWF Composer and Volo View. Both applications support smart markups with tools that snap to the underlying objects, easing the speed of markups. Furthermore, any markups made in DWF Composer can be brought back into the AutoCAD 2005 family of products, for the complete round-tripping of markups, annotations and other changes back into the original application, streamlining the design review process. DWF Composer also supports advanced sheet set organization and workflow capabilities, allowing users to fully control the design review process with the team. And with Volo View, redlines can be saved to a DWF file or stored as Redline Markup Language (RML) files for import into AutoCAD products and Autodesk® OnSite applications. In either case, the designer can simply review and consolidate all changes to determine how best to modify the original drawing.

For a more detailed comparison between viewers, please see the Viewer Comparison Matrix available online at www.autodesk.com/viewercomparison.

Total Cost of Ownership

Because the Autodesk and Adobe solution sets share many attributes—free downloadable viewer applications, for instance—it would seem at first glance that there would be little difference in the value they deliver over time. A closer look, however, reveals significant differences. First, the file formats. As mentioned above, PDF files and DWF files created from the same design file are not even close in size: DWFs are on average one-third the size of PDFs. Considering that a large construction project can easily generate 150,000 documents, the much larger sizes of PDFs are likely to require added storage capacity, bandwidth, and system resources, inevitably resulting in greater costs. Also, DWF publishing

is a native feature of all Autodesk design applications and is free to non-Autodesk applications with the Autodesk DWF Writer, a downloadable application available at www.autodesk.com/dwfwriter. To create PDFs from an Autodesk publishing application, however, the user must purchase Adobe Acrobat 6.0 Professional. Also, it must be added that the DWF Composer and Volo View reviewing tools are far less expensive than Acrobat Professional. Lastly, it is important to note that Autodesk provides a fully open specification and technology solution, providing the ability for users to develop applications to read, writer, create, view, query, and print DWF files. Autodesk is committed to freely providing these developer tools to customers.

Summary

A feature-by-feature comparison of the PDF and DWF file formats, along with the Autodesk and Adobe viewing and reviewing applications, shows that only the Autodesk offering provides unique capabilities and advantages to building, mapping, and product design project teams. Only with DWF can designers capture and securely communicate the full extent of their work with colleagues inside and outside the enterprise. DWF files are smaller and require fewer resources to transmit and store. Users of Autodesk design applications do not need to invest in any other application in order to create DWF files. The viewing application and reviewing tool for the DWF format are better equipped for the specific needs of the building and engineering industries. With regard to total cost of ownership, the Autodesk solution set is far less expensive than the alternative. In short, the DWF file format is the ideal medium for packaging, delivering, and collaborating on design information.

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