



Empowering Engineers with Easy to Use Civil Design Software

EXECUTIVE SUMMARY

This paper looks at the overall use of software for transportation design and drafting. It evaluates software tools, workflow, and the associated cost/benefit relationships. A hybrid software strategy based on RoadEng® (an engineering design tool) and a CAD based system is proposed.

This article will be of interest to organizations that answer “Yes” to any of the following questions.

- Are there engineers, supervisors or project managers who could benefit from design software but don't have the time to learn a complicated product?
- Is our engineering staff doing CAD drafting?
- Is our CAD drafting staff doing engineering design?
- Is our current civil design software too expensive or unsuitable for use by all members of the project team?

Today the use of design software is largely restricted to computer specialists and CAD technicians. This is due to the complexity of CAD based design software packages. Civil engineers are becoming increasingly separated from the tools, which enable them to make better engineering decisions. Many are working on paper or “standing over the shoulder” of the CAD technician during the design cycle. This methodology is inefficient. It limits the engineer's ability to try alternate designs.

The Problem : Drafting vs. Engineering

Drafting is the practice of creating accurate representations of objects for technical and engineering needs. *Engineering* is the design, analysis, and/or construction of works for practical purposes.

In the early days, CAD (Computer Aided Drafting) was really a replacement for the traditional drafting board. Now, CAD usually means *Computer Aided Design*, reflecting the fact that modern CAD tools have been extended to include design capabilities.

Some argue that since the emergence of CAD, the line between drafting and engineering has become blurred. Engineers proficient in CAD can produce detailed drawings, eliminating the need for a draftsman. Similarly, a draftsman can perform engineering design with the use of CAD design software. In theory this is a good concept, but from the engineers perspective it runs into practical problems:

- 1) Engineers must undergo significant training in order to use the software. In many cases this is simply not feasible and the lost opportunity costs are prohibitive.
- 2) In order to remain proficient, the engineer must regularly use the software. This is a problem for busy engineers who have a variety of responsibilities such as meetings, client negotiations, construction supervision, administration and reporting etc.

- 3) CAD software is general in purpose. For land development specific applications this flexibility is overhead in the software. It limits the optimization that can be done for specific processes like contouring, cross section calculations, volumes etc. The result is that CAD based software is generally not as quick and reactive as specialized standalone software.

The net result of these problems is that the engineer does not use design software. He designs on paper or by 'looking over the shoulder' of the CAD tech. In many cases, the CAD technicians struggle to use the software and require extensive and ongoing training.

Standalone Software for Engineering Design

There are a variety of Civil Engineering software packages on the market today. Some well known products include AutoCad's Civil 3D® and Land Development Desktop (LDD), Bentley's Geopak® and InRoads®, EaglePoint's RoadCalc®, Trimble's Terra Model®, Softree's RoadEng®, and a variety of others. Most of these packages require a CAD platform to run. In addition to being large sophisticated products in their own right, they require a thorough understanding of the CAD engine. It is worth noting, that Autodesk and Bentley are principally CAD software vendors.

For many companies, this complexity of design software restricts its use to CAD specialists or computer 'gurus'. Many engineers are forced to rely on these technicians to carry out their design work.

CAD software is feature rich. It can be used to design widgets and jet airliners. This flexibility brings with it a significant processing overhead. Additional information (entities, object types, proxies, layers, blocks etc.) must be saved and processed. This slows everything down.

Free from this CAD overhead, standalone software is easy to use and can optimize application specific tasks such as surface modeling or volume calculations. The result is a highly interactive design tool capable of processing larger data sets.

Is CAD Based Software Becoming Bloated?

Software bloat, or bloatware, is a term used in both a neutral and disparaging sense, to describe the tendency of software to become larger, or to use larger amounts of system resources (memory, disk, processing power etc.), while adding little or no value to the end user.

One of the main catalysts for software bloat is money. In the software world a key source of revenue is to add *more* features to a product, up the version number, and charge the end user more money. Certainly the *more* can be something you want. This is generally true in the early versions of a new product. However, there is a point beyond which *more* actually makes the product *less* effective.

CAD based software systems try to do too much. *More* is no longer better. A recent survey of CAD based design users revealed that only a fraction of the software's functionality is used. More than 90% of those surveyed indicated that they use less than 10% of the features in the software. In many cases, users weren't even aware if their software could do a specific function, much less how to go about doing it.

Questions to consider:

- Is the software I am using appropriate for the work I do?
- Is it focused on that type of work I do or does it contain a large number features which are not of interest to me?
- Is it becoming bloated? What is the cost in terms of training, licensing and lost productivity as a result of the ongoing bloat?

Compatibility and Interoperability

Obviously compatibility and interchangeability of data between software packages is very important.

In the software industry, compatibility has a lot to do with market share. In markets where there is a dominant leader (such as Microsoft in the word processing market) the industry standard format generally becomes that of the leader (e.g. *.doc format).

For drafting, AutoCad's DWG format is generally the CAD standard. However, DWG files are not suitable for storing Civil/Survey data such as surfaces, alignments, profiles, cross sections etc.

There is no commercial standard format for civil/survey data. This is because there isn't a dominant market leader. Autodesk, Bentley and EaglePoint each have a large share of the civil/survey market. By its own reckoning, and based on figures from Daratech, Autodesk guestimates it has a 33% market share of the infrastructure market¹. Bentley controls the DOT transportation sector (48 out of the 50 US States' Department of Transports are Bentley customers, and six out of Canada's twelve provinces also use Bentley's Civil products²).

The bottom line is that there is no commercial standard for civil/survey data. To address this issue the civil/survey software industry has adopted the LandXML standard to provide true compatibility and interoperability.

LandXML

In January 2000, an industry consortium LandXML.org was formed to create the LandXML standard. Founding members include Autodesk, Bentley and many other software and survey equipment suppliers.

LandXML is a generic interchange format used to save Civil/Survey project data. It allows project data including Points, Surfaces, Parcels, Alignments, and Profiles to be moved from one software vendor to another. For example, you can export a surface created in Civil 3D® and import it into InRoads®.

LandXML offers true vendor compatibility of civil/survey data.

The Solution: RoadEng® an Engineering Tool

RoadEng® is an easy to use site and road design software package. It works either as a companion to other civil design software or as an independent standalone system. It includes functions for data collection, terrain modeling, contouring, volumes, profiles, sections and road design.

RoadEng focuses on engineering, not CAD. It was designed from the ground up to work with objects such as surfaces, cross sections, alignments, drainage structures, and templates. Its interactive capabilities allow the engineer to quickly evaluate different design situations.

RoadEng requires minimal training, often new users will be up and running in an afternoon. More than 90% of RoadEng users don't require formal training. Occasional users such as Project Engineers and Managers are able to use the software to try alternatives, review and check alignments, profiles, cross sections etc.

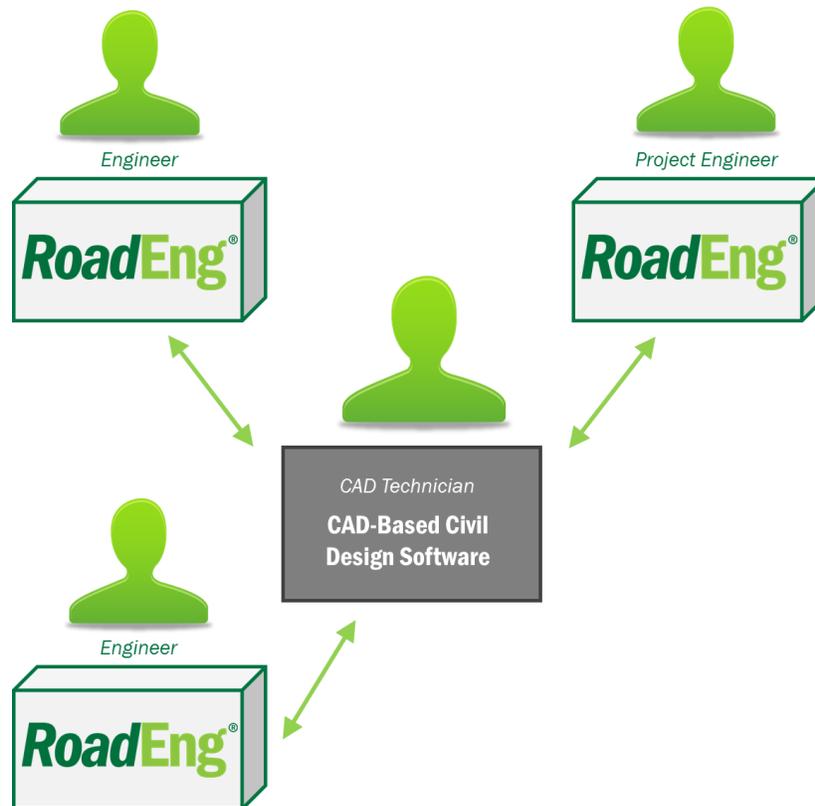


Figure 1: Engineering Office Configuration using both RoadEng and CAD software

RoadEng can be deployed as a standalone tool or as a complement to CAD based design software. Drawings can be output directly or saved in DWG format. Alignments and surfaces can be moved easily between CAD design software using LandXML for final drafting and completion.

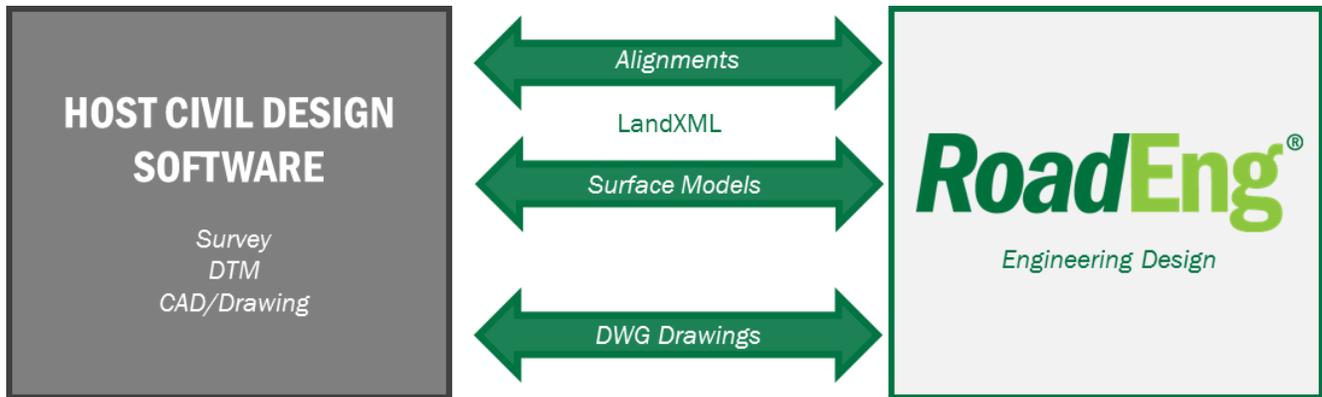


Figure 2: LandXML Data Interoperability

Conclusion

Civil Engineers are becoming increasingly separated from design software tools. This is due to the complexity and steep learning curve associated with CAD based software.

Software tools have the potential to empower the design engineer. They allow him to be creative, to try different alternatives and to determine the best design through an iterative process. This potential is not being realized using CAD based software.

RoadEng® has been introduced as a supplement to CAD based civil design software. It is an easy to use site and road design software package. Significantly different from other civil design software, RoadEng focuses on engineering, not CAD. Its interactive capabilities allow the engineer to quickly evaluate different design situations.

It supports industry standard formats such as DWG and LandXML, allowing data to be moved back and forth to CAD or CAD based design software.

The proposed solution improves the engineering workflow and requires minimal training.

¹. "By its own reckoning, and based on figures from Daratech, Autodesk gúestimates it has a 33% market share of the infrastructure market." – source *Cad Digest*, September 2004.

² Bentley controls the DOT transportation sector (48 out of the 50 US States' Department of Transports are Bentley customers, with six out of Canada's twelve provinces also standardizing on Bentley's Civil products – source *AEC Magazine*, December 2005

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