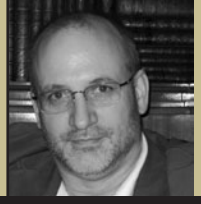

By Kenneth A. Crawford, PE

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The How-To Guide to Successful Surface Modeling, Part 5

Welcome back! In my last article I stated that the next installment of this discussion would examine some field techniques to help create more accurate base models, but I will cover that topic at a later time. Presently, the time is right to examine one of the hot topics surveyors must face today: whether to "get into" automated machine guidance (AMG), or machine control (MC). This article discusses AMG in general. In a future article I will examine some techniques of getting work done in a timely and cost-effective manner.

Where Are the Opportunities?

The present stage of the industry and our "new economy" demands that practitioners must constantly seek out new services to offer clients to help us keep revenue streams flowing. One area that should not be overlooked is AMG. Some have said, "That's not surveying… it's CAD!" and turned their backs on a great opportunity. Some may reason that they don't want to do surface data prep for AMG, preferring to get a stakeout contract and bill more hours. This assumes, of course, that they actually *get* the stakeout contract. The new breed of savvy contractors and owners are well aware that they can save time, money, and errors in the field by having a digital surface model delivered to the equipment on-site, while the surveyor hoping for stakeout work is in danger of being cut out of the picture altogether.

Often, the contractors who have embraced AMG have hired staff or

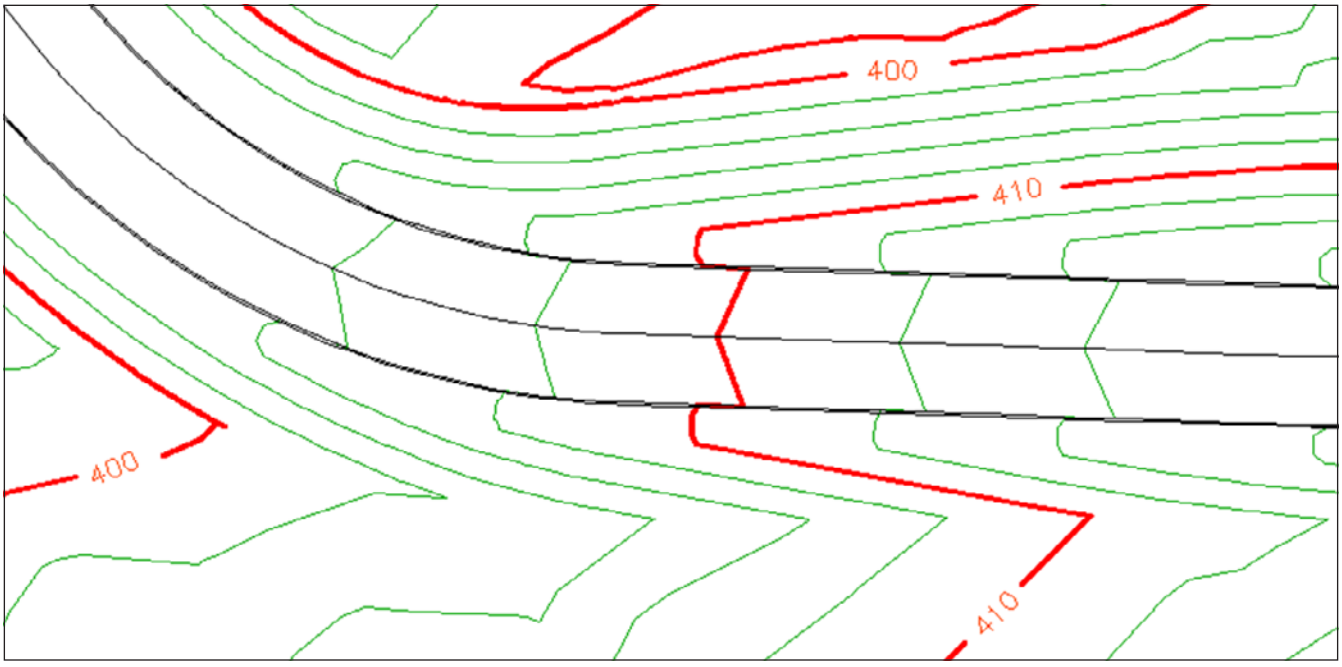

Figure 1 "Drawn" contours as source

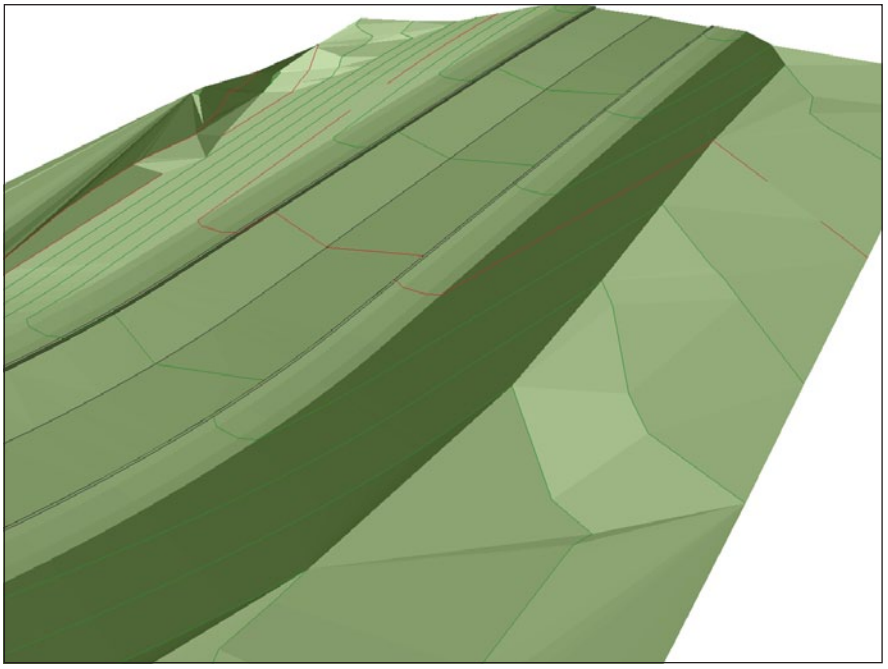

Figure 2 Proper interpretation

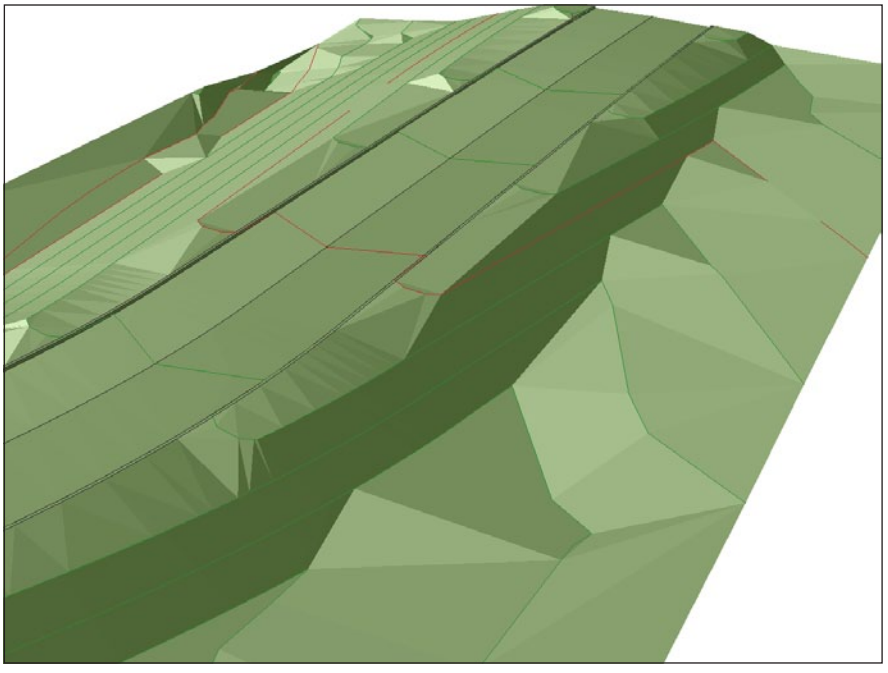

Figure 3 TIN "from contours" only

engaged non-professional service firms that promise a quick (and cheap!) ability to perform the model development from the design plans, thereby circumventing opportunities to stay engaged in the project at construction. Many proactive surveying firms have recognized this trend and, in fact, several state boards of registration have proposed new legislation that will require licensed professional surveyors to be in charge of this operation. But what do we do in the meantime? Good business practice is based on providing the best alternatives for the customer. While it may mean less total hours billed during construction, it also opens the door to more opportunities in future work and for other contractors. Once actively engaged in the process, surveyors can be a part of the total project development team by allying with design engineering firms (or even your own in-house engineering staff) from the start of the project through construction.

As an example of opportunities lost, my business partner was involved in a training project for a contractor on a very large development in California. The training went well, but in the end the contractor convinced the owner that as part of their contractor duties, they could do all the 3D data prep work for the project, and they walked away with the work. This was a nice bit of additional revenue for them, while the design engineers/surveyors who had expected to get the stakeout contract (worth substantially more money) as part of their services during construction wound up with nothing! Had they been more proactive in their approach, perhaps they could have salvaged their level of involvement in the project.

Our firm was recently contracted by a large engineering firm to provide data prep services on a construction project that they designed, working directly with them and the contractor. This, too, illustrates an important point: the engineers had a large surface model constructed in the CAD files, but were unable to transform that model into something the contractor could use. The important issue here is that many civil design engineers have *no idea* how to do this work properly! (I can say this without malice aforethought since I was once one of those design engineers.) We see this in most of our training classes. Engineers (and some surveyors) still think of the "surface" as the resulting set of contours drawn on the plans and they design accordingly. Gone are the days when we can simply draw proposed contours to serve as our surface model for AMG. It is important to learn the underlying concepts behind the model and how to apply techniques to develop that model accurately enough to use downstream in the construction phase of the project.

Here lies the opportunity: learn how to build accurate models that can serve the AMG market, and short-circuit the traditional "drawn contour" and stakeout approach offered by so many traditional firms.

What We'll Learn

There are a couple of key considerations in developing surface models for AMG. First, know the source material. Often, the only item delivered in this phase

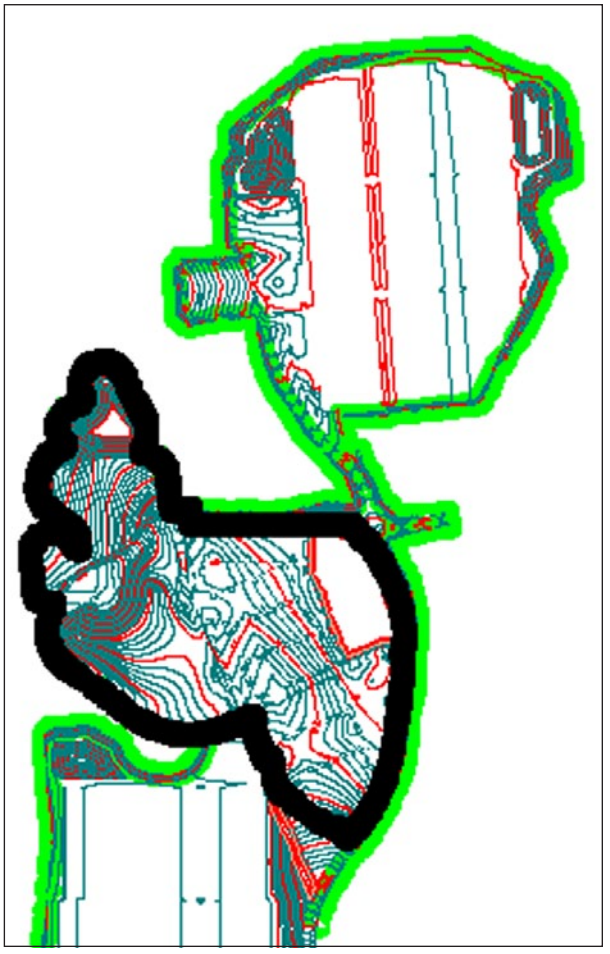

Figure 4 Site fragmentation

Figure 5 Typical in-cab AMG controller

is a "drawn" set of construction plans, sometimes only on paper, although more often also available as an AutoCAD or MicroStation CAD file. Less often we have access to the entire design model, but this too has its own set of potential pitfalls. Second, be aware of the target environment for the AMG model. Several manufacturers have specific formats for surface models (usually TIN-based) for their equipment. Most notably, Trimble, Leica, and Topcon make controllers for heavy equipment that can accept a surface model and use it in conjunction with GPS sensing equipment to control the grading and excavation work.

By considering the source material, particularly if we are given a set of "drawn" contours, we can transform those contours into a surface model. The standard (but incorrect) way is to simply build a TIN "from contours." I discussed that in prior articles, and I'll examine it more closely in an upcoming article to discuss how to optimize the model from this scant data set, and how to make sure that **Figure 1** results in the surface indicated in **Figure 2** instead of **Figure 3**.

I will also examine ways to transfer digital design models so that they can work successfully with AMG equipment. Keep in mind that sometimes the model is actually wrong! It is important to know how to resolve those discrepancies. Remember, our job is to provide a digital replacement for the traditional stakeout of points to control construction, and the model needs to be correct.

In considering our target environment and AMG equipment, one of the key items to consider is the amount of data that the AMG controllers can accept. Most will work comfortably with a maximum of anywhere from one to three megabytes of data, and sometimes we will be tasked with "cracking" the data sets down into more manageable sizes. **Figure 4** shows an example of areas that have been fragmented into more manageable sizes.

I will discuss how to identify natural breaks in the work and effective techniques of simplifying the data without compromising the design intent. Additionally, I'll discuss when and where data must be supplemented to make it more information-rich for the AMG operator. I'll also examine ways of translating suitable TIN data developed in the design environment (typically, Autodesk's Civil 3D, Bentley's InRoads or GEOPAK, or Carlson Civil Design, and others) into a form suitable for the target equipment.

The Bottom Line

The focus of this series is the model, which, if done correctly, allows the process to flow smoothly downstream. This is where surveyors can have a positive impact on the bottom line. Embrace change! Consider the future, learn the tools, and go out there and be a part of it.