Guidelines for importing Civil Designs

Basic prerequisites for successfully converting landform design work from civil engineers and surveyors.

Civil landform designs

Many civil construction works are laid out in software like AutoCAD, Civil3D, 12D, and BricsCAD. These packages are normally fundamentally vector based. T3RRA Design has no problem importing designs from these packages as long as a few basic rules are followed.

Machine control files

Machine control files *at a minimum* require a continuous 3 dimensional design surface. It is *not sufficient* to supply line work layouts that are only suitable for printing and human interpretation. In general, it is unacceptable to supply discrete contour lines or sparse elevation points. In most civil packages a 3D surface is represented as a continuous triangle mesh. This may be referred to by names such as 'triangles', 'DTM' (Digital Terrain Model), 'TIN' (Triangulated Irregular Network), or 'triangle mesh'. Line work is usually derived from this mesh, so it is almost always present in the 3rd party data set.

There are other items that can and should be delivered as part of the machine control file package. Things that are highly useful to machine operators include:

1. A continuous natural elevation surface and/or a continuous cut/fill map
    a. The ability to understand the location and extents of cuts and fills within the jobsite is highly beneficial for operators.
2. One or more digital benchmarks within (or closely adjacent to) the work area that correspond to real world, physical benchmarks.
    a. These should be machine accessible such that a machine operator can park their equipment directly on top of the benchmark in order to reference against it. For instance, a benchmark on a fence line or on a walkway bridge will not suffice. If a peg, that peg should be flush with the ground surface or only protruding slightly (<20cm/8in).

3. One or more real-world benchmarks that are situated so that the machine control operator can securely locate their RTK GPS base station antenna directly above the benchmark.
    a. The horizontal and vertical coordinates of this benchmark must be supplied
    b. The benchmark must be placed in a position such that it is feasible for an operator to access the benchmark and install a GPS antenna directly above it.
4. Linework
    a. Any supplied linework should be specific to the machine operator's needs. It is normally a subset of the linework present on construction plans designed for human interpretation. For instance, isoheight contour lines are usually not helpful as the height information is already encoded in the DTM.
    b. Particular emphasis should be placed on linework that helps guide an operator's pattern of travel. For instance, centerlines of drains can be beneficial. Depending on the machine, these may also be used as part of automated steering systems. Extents of certain features, positions of grade breaks, and delineations of prohibited work areas may all be useful.

Coordinate systems

The coordinate systems used by civil engineers vary greatly. This is not a problem *if* the used coordinate system and/or projection is clearly specified and advertised. It is best practice to supply this information separately to the files containing the land surface meshes (as file formats such as DXF often do not explicitly include this information).

Units

The units used by civil engineers vary greatly. This is not a problem *if* the used units system is clearly specified and advertised. It is best practice to supply this information separately to the files containing the land surface meshes. Both horizontal and vertical units must be supplied (as file formats such as DXF often do not explicitly include this information).

Standard file package required for T3RRA Design

The below is a general guide for successful design transfer. T3RRA Design can handle certain file types outside of this specification (for instance LandXML, or a DXF of gridded elevations) however this is the most common method we have seen for data transfer from the widest range of civil packages.

Mandatory

Triangulated mesh surfaces in DXF format.

DXF version: **AutoCAD 2013**

DXF layer type: **3D Faces** (this is the DXF term for data in a 3D mesh of triangles)

Layers per file: **1**

Required layers: **2** (Natural surface, and design surface)

Required files: **2** (one each for natural surface, and design surface)

Coordinate system: Can be **global**, or **local**

NOTE: DXF files do not normally include information relating to the coordinate system of the contained design. This information *must* be supplied separately.

If global: The coordinate system name *must* be supplied separately to the DXF files.

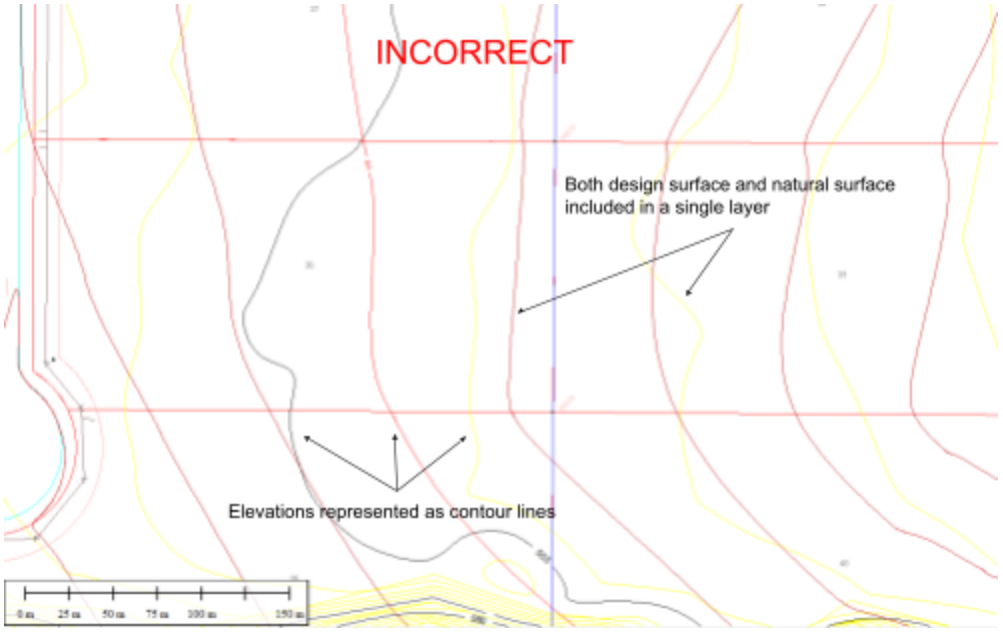
If local:

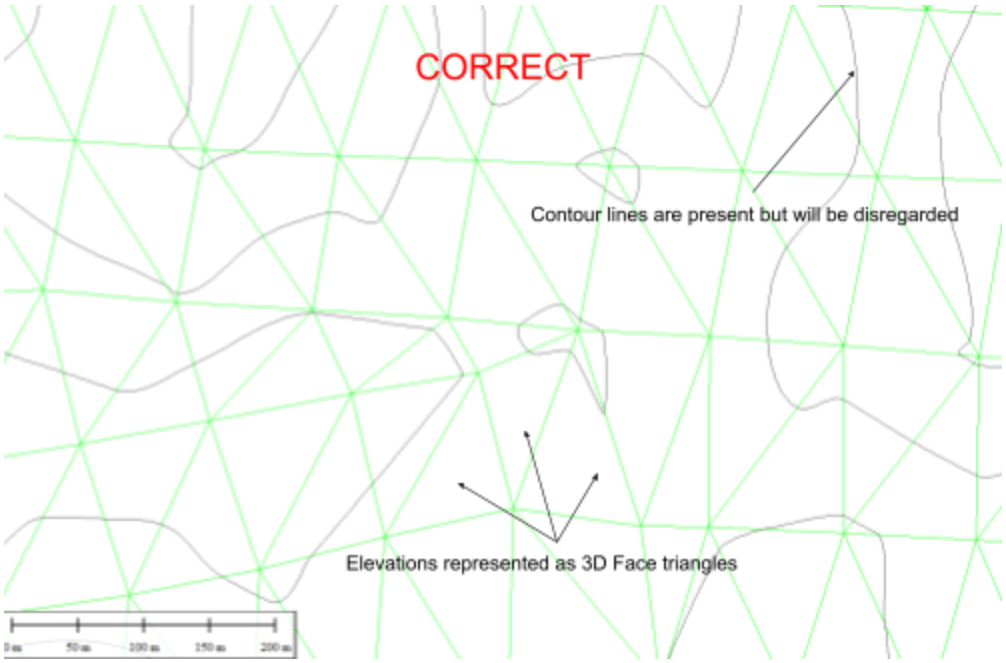
1. A benchmark must be included with the files. This must have:
    a. Coordinates (X,Y,Z) of the Benchmark in the local coordinate system and units.
    b. Coordinates (Long, Lat, Alt) of the Benchmark in WGS84 in degrees and meters.
    c. Horizontal units of the local coordinate system.

    d. Vertical units of the local coordinate system.
2. The projection of the local coordinate system must be specified.
    a. If easting and northings the projection should be specified (ie., orthographic, transverse mercator, etc).

Optional

Linework layers may also be included. These can be points, lines, polylines, or polygons. These must be in separate DXF files.





T3RRA DOCUMENT CONTROL

UNRESTRICTED (Suitable for external publication)