FDM 9-65-1 Introduction

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1.1 When Used

Projects that need earth volume quantities, profiles, drainage information, or other elevation dependant views for original design and final quantities will employ either cross sections or digital terrain models (DTMs). Cross sectioning is the process of determining elevations of the ground along lines at right angles to a reference line.

A digital terrain model (DTM) is a mathematical model of the earth's surface. Three dimensional coordinates (X,Y,Z) of ground points are obtained by field surveying or photogrammetrically digitizing the points. By connecting the coordinates of these ground points with its closest "neighbor," a triangulated irregular network (TIN) is developed. Software then interpolates this TIN to generate contours, cross sections, and volumetric computations.

1.2 Standards and Specifications

The end product of cross sections or DTMs, whether by field or photogrammetric methods, is a plot of the original ground surface. The minimum accuracy of cross sections and DTMs is plus or minus 0.3 feet (90 mm) of the true ground elevation for final plans. DTMs may also be created for corridor studies but to a lesser accuracy. The proposed scope of the improvement and the character of the terrain will determine the width of the cross section of DTM.

FDM 9-65-5 Field Procedures

October 28, 1994

5.1 Cross Sections

Cross sections, either aerial or field derived, are produced by determining ground elevations at breaklines along a line that is at right angles to the reference line. Typically, the project manager will specify the interval and width of cross sections. Normal field procedure is to take a cross section at 100 foot (40 m) intervals in rural areas and 50 feet (20 m) in urban areas. The field crew should also take special sections at sudden changes in terrain, private entrances, existing drainage facilities, and drainage scales for cross drains. These drainage sections may be skewed, if necessary, to follow the bottom of the drainage channel. All such sections should be noted on the cross section notes.

5.2 Digital Terrain Models (DTMs)

Whether using field or aerial methods, the objective is to acquire sufficient three dimensional coordinates (X,Y,Z) of ground points throughout the project area. Ample ground coordinates will ensure a cross section can be developed at any location desired. Within areas of possible relocation of center line, additional widespread coverage may be needed. Three dimensional coordinates need to be determined on all lines of discontinuity and at random locations, generally not exceeding 25 foot (10 meter) spacings. In flat or even slope terrain the spacings may be increased, but use an occasional check shot to make sure of an even slope. Through the use of DTMs and an engineering work station, the designer will have the flexibility to change center line locations and obtain new cross sections wherever necessary.

Although DTMs are desirable, they take approximately 30% more effort to create compared with normal cross sections. Therefore, their use should be confined to projects, or portions of projects, for which the preferred alignment has not been established. When requesting DTMs on a particular portion of a project, the project manager should define these areas by marking the limits on a mosaic or like exhibit. When splitting a project between normal cross sections and DTMs it is advisable to request DTM areas first due to the time factor. Also, the designer can be resolving the DTM area for final alignment while the remainder of the cross sections are being produced.

DTMs for final plan cross sections should not be generated from normal cross section data. Although each shot may be accurate, there is generally 100 feet (40 meters) between each section and significant elevation changes could occur within that distance which would result in inaccurate DTMs and subsequent cross sections.

When accurate elevations cannot be determined photogrammetrically because of dense vegetation, a polygon will be used to identify an obscured area. Points inside this polygon are then coded "OBS," for obscure area, in the ASCII file that is turned over to the project manager. If an obscured area is in a critical zone, a field survey crew should supplement the data with field shots to ensure reliable results from the DTM. When doing a field

DTM, the project manager should use some sort of grid layout to assure complete coverage of the area desired.

5.3 Computations

Cross section notes taken by hand need to be adjusted and elevations computed. Information gathered radially by total station and data collector will need to be computed and adjusted to the appropriate coordinated system.

FDM 9-65-10 Monumentation Required

October 28, 1994

For horizontal locations, cross Sections will be tied to a survey reference line (see FDM 9-50-5). DTMs will be tied to a project coordinate system for horizontal location.

In most cases, project bench marks will establish vertical control. Some Resurface and Recondition 1 projects may not require a vertical datum if only typical sections and quantity computations are necessary.