Topographic Survey

Introduction

- **Topography** - defined as the shape or configuration or relief or three-dimensional quality of a surface
- Topography maps are very useful for engineers when planning and locating a structure

Topographic Survey

- U.S. Geological Survey (USGS) has developed maps for a large part of the US
- Napoleon Bonaparte received his first promotion because of ability to make and use maps

USGS Topographic Map of Mt. Shasta, CA - 1883

Typical USGS Topographic Map

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Contours

The most common method of representing the topography of an area is to use **contour lines**

A contour line is an imaginary level line that connects points of equal elevation
There are several rules to note when viewing topographic maps:

- **The rule of Vs**: sharp-pointed V usually are in stream valleys, with the drainage channel passing through the point of the V, with the V pointing upstream.

- **The rule of Os**: closed loops are normally uphill on the inside and downhill on the outside, and the innermost loop is the highest area.

- **Spacing of contours**: close contours indicate a steep slope; distant contours a shallow slope. Two or more contour lines merging indicates a cliff.

Imagine a hill that has its top sliced off with a really big knife.

The selection of the contour is important:

- The contour interval should be small enough to give the desired topographic detail while remaining economic.

- Usually every fifth contour line is shown in a heavy, wider line, this is called an index line.
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Characteristics of Contours
- Closely spaced contours indicate steep slopes
- Widely spaced contours indicate moderate slopes
- Contours should be labeled to the elevation value
- Contours are not shown going through buildings
- Contour line do not cross

Characteristics of Contours
- Depression and hill look the same; note the contour value to distinguish the terrain
- Important points can be further defined by including a "spot" elevation
- Contour lines tend to parallel each other on uniform slopes

Construction of Contours
- The first step in developing a contour map is measuring the elevations of a group of points
- It will be easier for us to establish a rectangular grid of points (marked with flags) and measure the elevation
- The location of the flag points can be established by taping and checked by pacing or the odometer

Group Work
What is the elevation of point A?

What is the elevation of point C?
What is the approximate slope between points A and C?

\[
\text{slope} = \frac{\Delta \text{elevation}}{\text{length}} = \frac{53 \text{ ft.} - 64 \text{ ft.}}{300 \text{ ft.}} = -0.037 = -3.7\%
\]

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**Construction of Contours**

- For our project, the spacing of the grid is established by requiring that no more than 1-foot contour elevation change in each grid cell.
- To compute that spacing consider the slope along each edge of your site:

\[
\text{slope} = \frac{\Delta \text{elevation}}{\text{length}} = \frac{102 - 98}{100} = 0.04 \text{ ft.}
\]

grid spacing = \frac{1}{4} \text{slope} = \frac{100}{4} = 25 \text{ ft.}

**U-Turns**

Repeat this calculation for each side of your site and use the smallest value for your grid spacing.

If the grid spacing value is problematic to use or set-up, round down to a convenient value - probably a multiple of 10 would be convenient.

<table>
<thead>
<tr>
<th>Side</th>
<th>Length (ft.)</th>
<th>ΔElevation</th>
<th>Grid Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>DA</td>
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</tbody>
</table>

**Surveying - Introduction to Topographic Modeling**

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Once your contour grid is established, measure the elevation of each grid point. We want a contour map on 5 ft. intervals. The grid is rectangular, the dimensions of the sides are 80 ft. (north) and 100 ft. (east).

The basic method for estimating contours is applied to each grid cell individually. Use linear interpolation to find the location of the desired contour interval. Let consider the cell in the upper left-hand corner - remember the contour interval is 5 ft.

Let's look at the top edge of the grid cell.

Let's look at the bottom edge of the grid cell.
Let's look at the left edge of the grid cell

\[ x = \frac{2(80)}{3} = \frac{160}{3} = 53.33 \text{ ft} \]

Let's look at the right edge of the grid cell

\[ x = \frac{3(80)}{6} = \frac{240}{6} = 40 \text{ ft} \]

Locate the contour intervals locations on the grid cell

- Next, simply connect points of equal contour intervals
- One grid cell down, eight to go . . .

Repeating the linear interpolation for each of the remaining grid cell gives:

TopHat Questions

End of Topographic Surveying