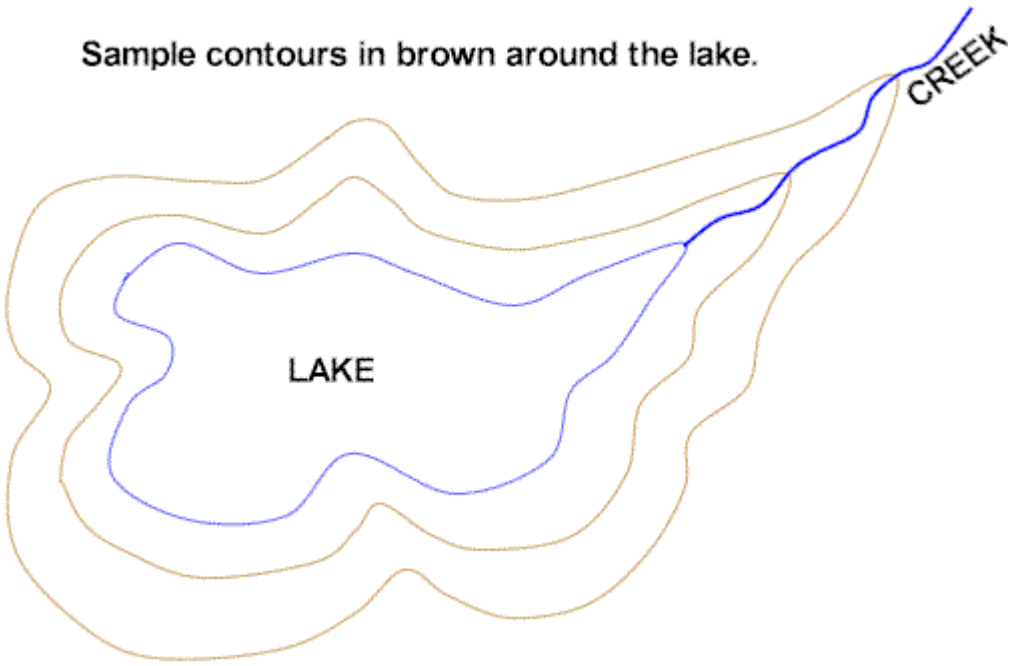
Topographic Maps and Contours

Definitions

- Contour lines are lines of equal elevation
- They can also be called "isolines" with "iso-" meaning equal
- On weather maps one can see isobar lines which represent equal barometric pressure (iso = equal; bar for barometric pressure)
- There are other kinds of isolines for depth of water, etc.

Examples

- If one thinks of a small lake on a calm day and the water's edge, they would have an image of a contour line
- The lake will be assumed to have equal elevation across the water and thus if one would walk the edge with one foot dry and one wet, they may need to climb over tree branches but would not have to go uphill or downhill.
- For a valley or creek, the slices will cut into the hillside and look like a "V" shape when viewed from above.

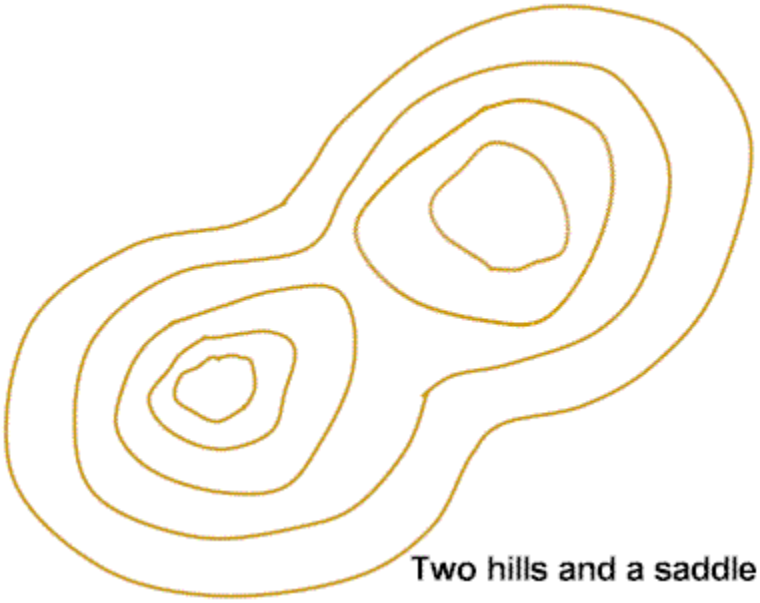


Hilltops and Saddles

- Contours which represent hilltops will look somewhat like concentric circles or concentric ovals
- If one thinks of slicing an apple or orange, the edges where the knife cuts will be the contour lines
- As the cuts are deeper into the hill, other hill tops may also be cut at the same

elevation

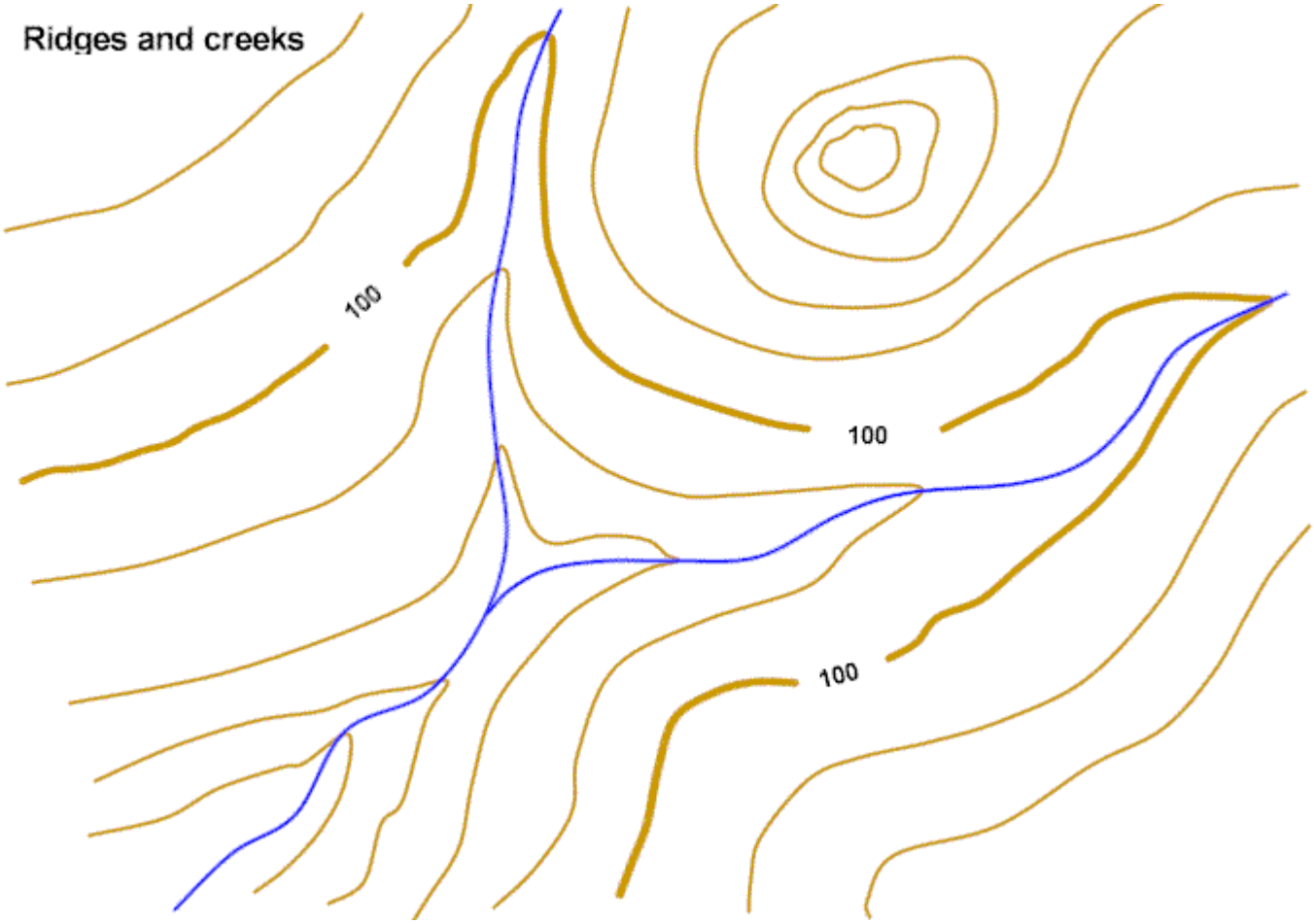
- The area between two hilltops becomes what is called a "saddle."
- If one thinks of the hills as the raised portions of the saddle in the front and the rear, it is easier to understand this name.



Two hills and a saddle

Ridges

- The areas between creeks can become ridges.
- The contours have a "U" shape as they go around the nose of the ridge
- They are somewhat parallel to the ridge line or the creek below when they are halfway up the side of the ridge.
- Where the creek merges at the base of the ridge, the contours have an "M" shape
- Every 5th line will be darker and labeled



Variations in contours

- Elevation difference is larger as the terrain is more rugged or the map scale is smaller
- Contours are closer when the terrain is steeper
- Chart below gives typical values for contour intervals

English Contour Interval	Map Scale	Metric Contour Interval	Map Scale
1 ft	50 ft / in	.5 m	1:500
2 ft	100 ft / in	1 m	1:1,000
5 ft	200 ft / in	2 m	1:2,000
10 ft	500 ft / in	5 m	1:5,000
20 ft	1,000 ft / in	10 m	1:10,000

Field Data

- Typically the data for the elevations on a topographic map are collected with a total station.
- The instrument is located where a large portion of the area to be mapped can be seen.
- From the instrument, a backsite is take to a reference point and then the horizontal angle, zenith angle and slope distance to each point is recorded
- If the total station is set to record this raw field data, it is then converted to 3D coordinates of Northing, Easting and Elevation
- These values are usually displayed in a CAD system.
- Some software is programmed to interpolate the contour values and some is not.
- It is critical that students understand how to determine contours from the 3D coordinate values

Interpolation Sequence

- Determine the breaklines along creeks, valleys and ridge lines first
  - Interpolation will be somewhat parallel to the breaklines
  - If you connect point of equal elevation on two sides of a breakline for a valley, the contour becomes a bridge
  - If you connect points of equal elevation on two sides of a breakline for a ridge, the contour becomes a tunnel
- Locations along creeks and in valleys in the breakline are determined first
- Locations along breaklines for ridges are next
- Locations between creeks and ridges are next. These should be somewhat perpendicular to the breaklines as much as possible.
- Locations along the edges of the map area are last

Basic Interpolation

- Two points which have different elevations are selected
- For this example, one has an elevation of 134 ft and the second is 152 ft
- If the map is using 10 ft contours, the 140 and 150 ft contours are between these two places
- By assuming a smooth slope between these elevation and by measuring the map distance between the 134 and 152 elevations, a ratio can be established

$$\frac{\text{Partial elevation}}{\text{Total elevation}} = \frac{\text{Partial distance (x)}}{\text{Total distance}}$$

$$\frac{140 - 134}{152 - 134} = \frac{(x)}{25 \text{ units map dist}}$$

$$x = 8.3 \text{ map units}$$

- By measuring 8.3 map units from the 134 elevation the position of 140 ft elevation is marked.
- Similarly the partial elevation for the 150 elevation is 150-134 and solving for x this time one gets (x = 22.2 map units)
- Thus even contour points can be found according to the list above

Index Contours

- When an area of the map has been interpolated, the contours are connected as free hand lines among all the points of equal elevation
- Every 5th line is plotted slightly darker and wider and is marked with the elevation of that line as was shown by the lines marked 100 ft above.

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