Contours

Lines joining points of equal value

Examples of Values

- Elevation
- Thickness, (Isopach, or Isopachyte)
- Pressure, (Isobar)
- Population
- Etc

Advantages of Contours

- Contours provide a picture of a data set, which humans find easier to understand than a table of values.

  also,

- Trends in the data set, (e.g. surface gradients), can be seen easily.

Table of Values

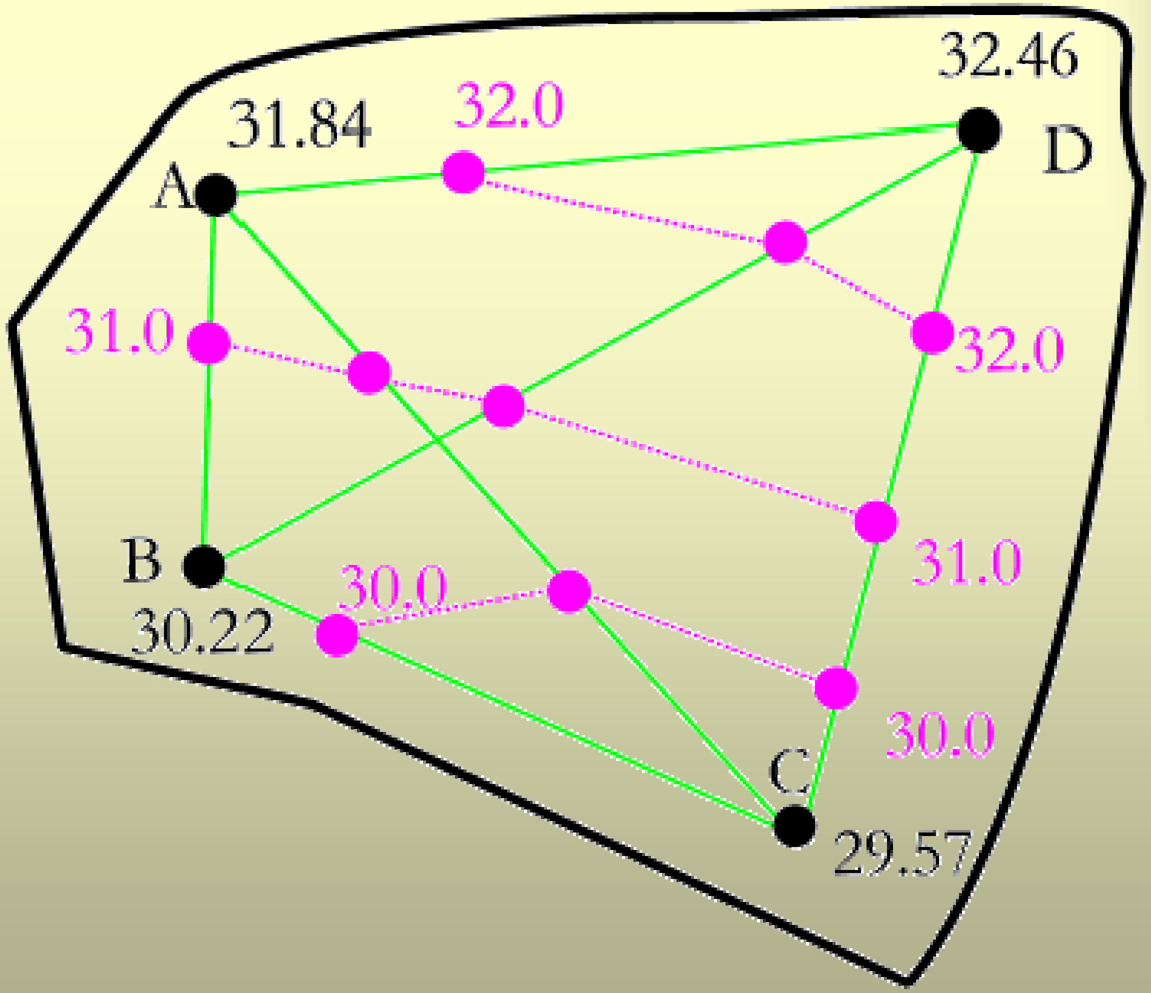
Consider the data set A, B, C, D.

Point	X	Y	Z
A	525.17	912.62	31.84
B	520.16	801.55	30.22
C	710.39	721.88	29.57
D	799.81	981.25	32.46

These are three dimensional co-ordinates of four trial pits on a construction site.

While it is obvious to the observer that the values in the table have centimetre precision, it is not obvious what the spatial relationship is.

Contours of Values



Now we can see the shape of the site, and the slope of the ground.

Disadvantages of Contours

- As contours are derived, (interpolated), from the original data set, they are not as accurate as the original values.
- Also contours can be drawn in different places if there are anomalies in the data set.

Interpolation

- Intermediate values are obtained from a data set by a method called interpolation.
- Interpolation can be done: -.
    - By calculation.
    - Graphically.
    - By computer.
- It is important not to extrapolate, i.e.
- to stay within the data set.

Calculate contours

Manual calculation suffers from: -

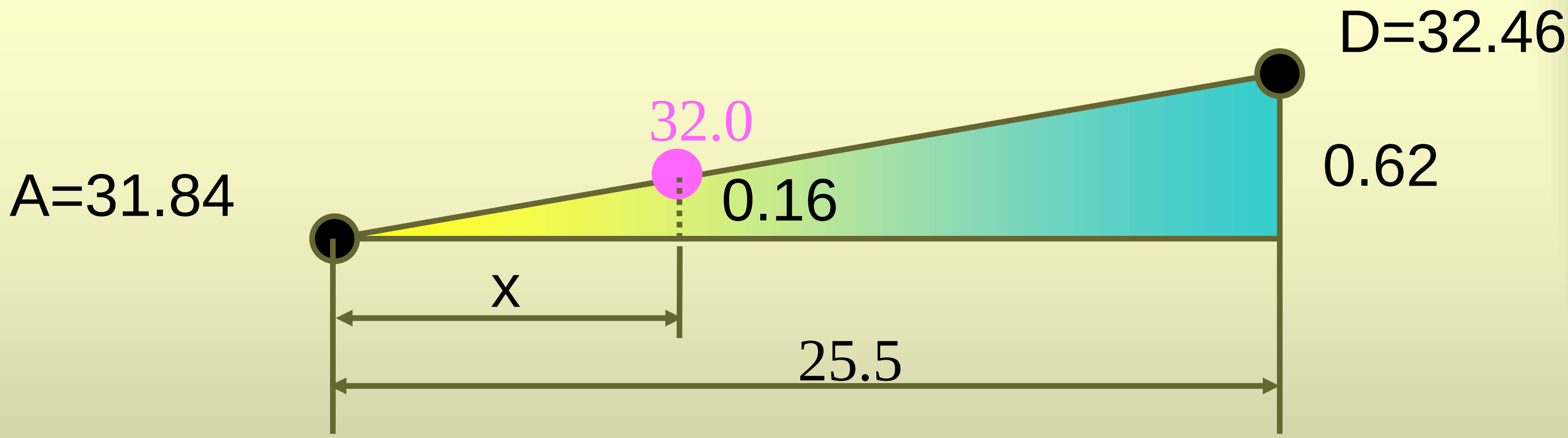
a. Tedious repetition of calculation and

b. The calculations are error prone

The calculation finds the horizontal positions of the interpolated values in proportion to the differences between the values being considered.

Calculated Interpolation

Consider the line A to D, (in section)

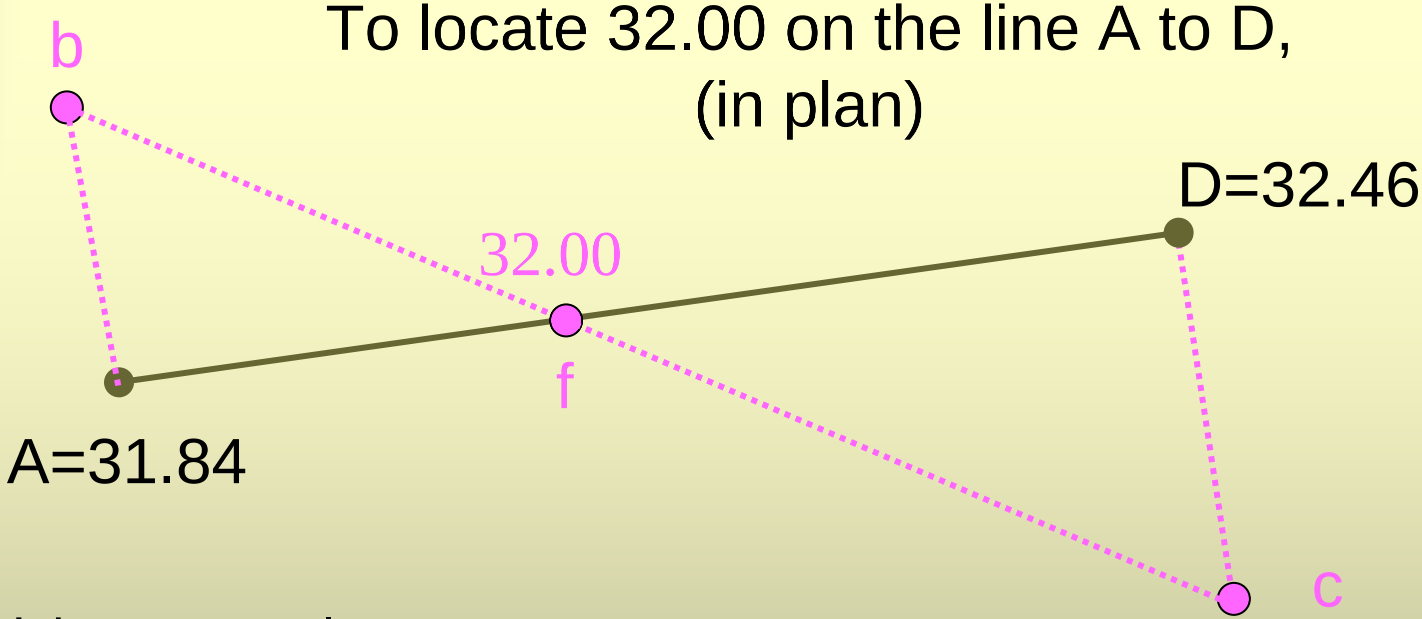


By the principle of similar triangles;

- The distance X = 0.16/0.62x25.5
- The distance 25.5 is scaled, and can be in <u>any</u> units.
- X is in the same units.

Graphic Interpolation

To locate 32.00 on the line A to D,
(in plan)



Using any scale,

1. Draw a line from A to b 0.16 long, (32.00 – 31.84)
2. Draw a line from D to c 0.46 long, (32.46 – 32.00).
3. A to b and D to c must be square to A to D.
4. Join b to c. Point f is 32.00.

Interpolation by Computer

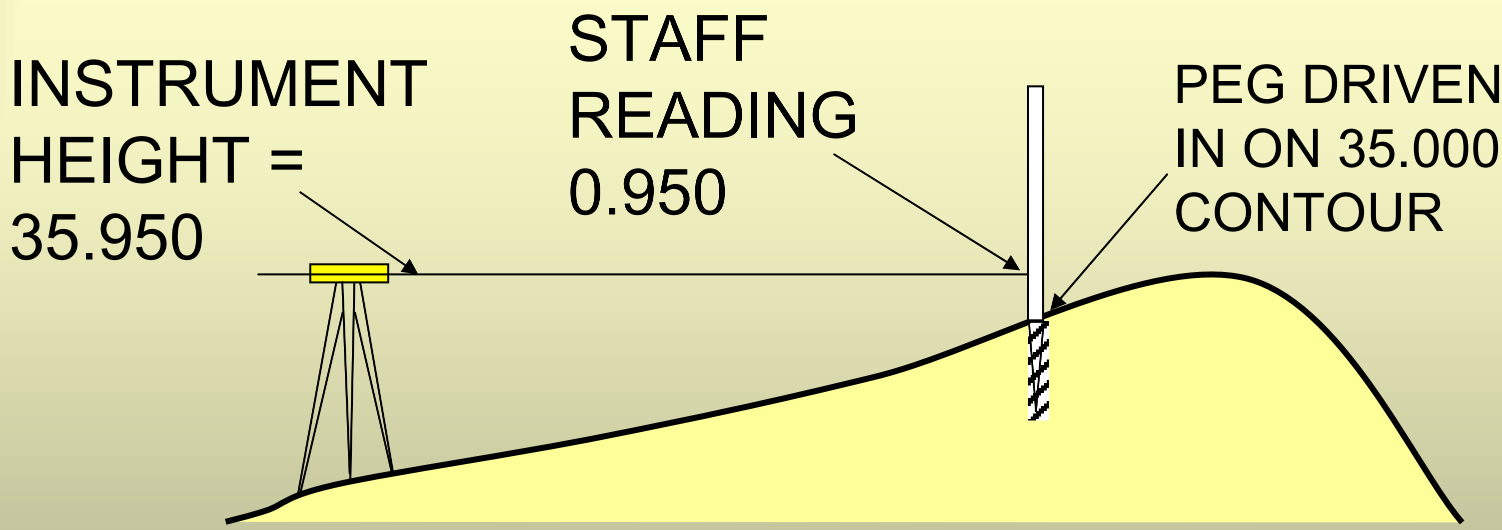
- It is now obvious that manual calculation or plotting is both tedious and error prone.
- Computer software is available which will both calculate and plot contours.
- The display of weather forecast isobars on the television is a good example of this.

Computer Input

- The computer software requires an input similar to the table on slide four.
- The data is normally collected electronically and sent directly to the computer.
- Thus there is no human intervention at any stage.

Direct Setting Out (1)

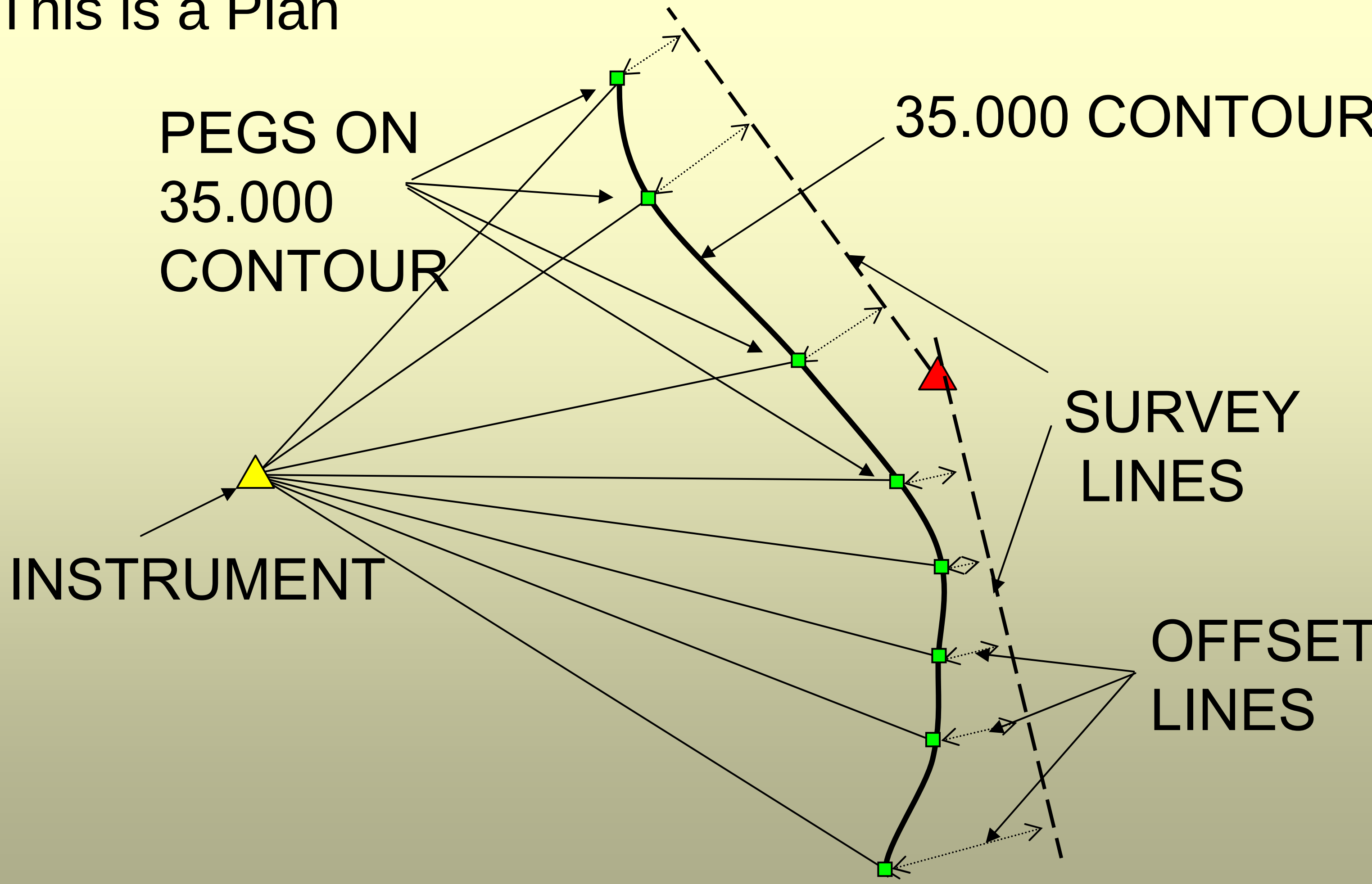
This is an Elevation



Determine the instrument height, calculate the required staff reading, then wherever the staff reading agrees with the calculated value is marked as the required contour

Direct Setting Out (2)

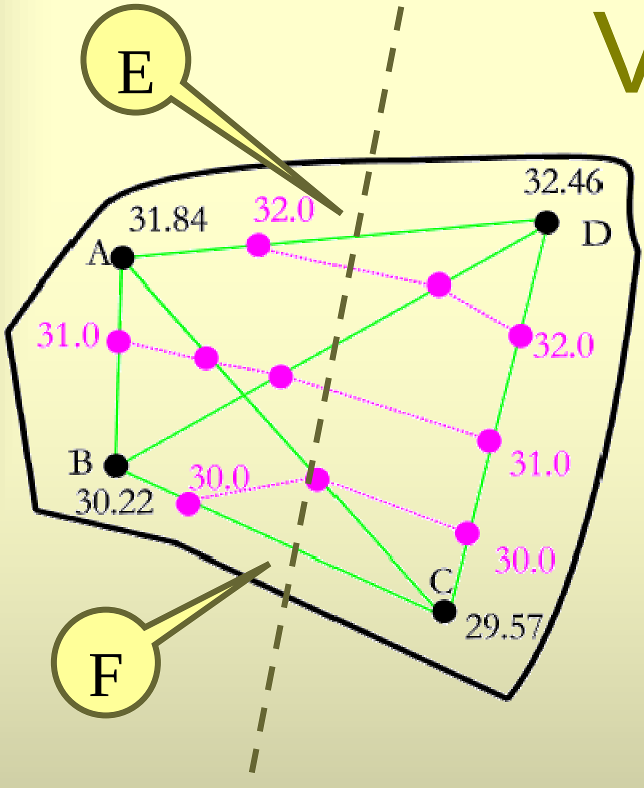
This is a Plan



Auto Data Collection

- Survey data can also be collected and processed in an identical manner.
- The only problem is the cost of the data collection equipment and the processing software.

Volumes 1



Volumes can be calculated by a variety of methods.

The areas of the cross sections, e.g. **A-B, E-F, D-C**, are used to calculate volumes by the *prismoidal* rule, i.e. if A and B are the end areas, M is the middle area and L is the total length, then

Volume = *(L/6) (A+B+4M)*

(B must be measured, not averaged from A and C). This method tends to be used for roads, canals, railways, generally long thin items.

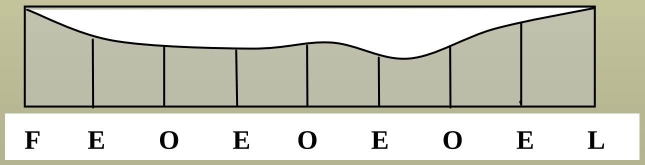
Volumes 1a

The areas of multiple cross sections can be used to calculate volumes by *Simpson's* rule,

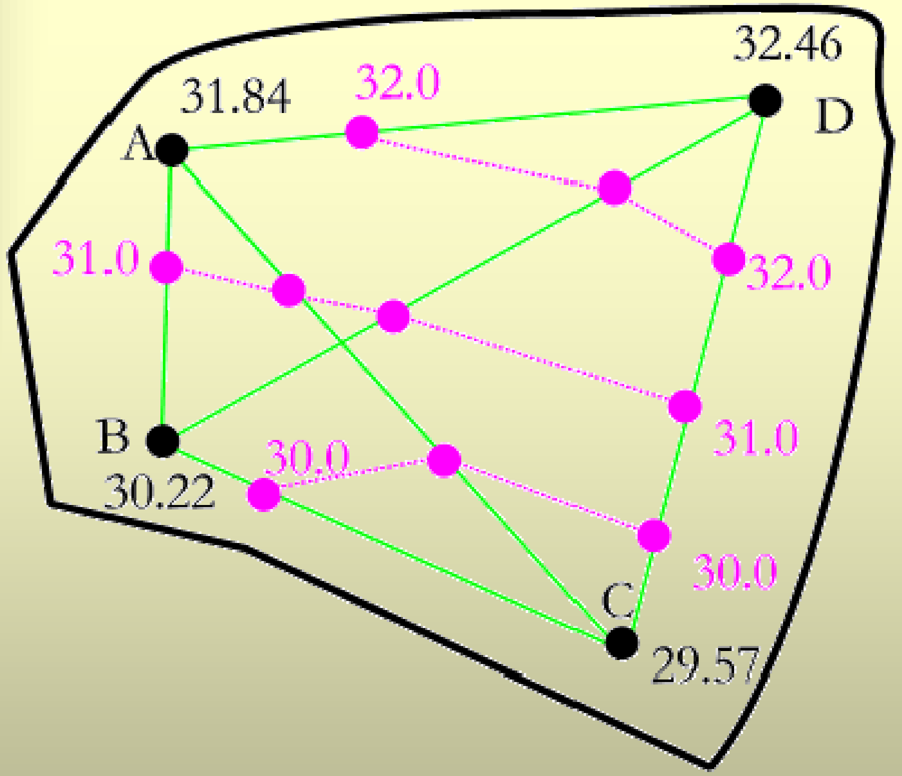
Volume = *W/3[(F+L) +4E+2O],*

where ***W*** is the spacing between cross sections, ***F*** is the first cross section, ***L*** is the last, and ***O*** and ***E*** are odd and even cross sections respectively.

There *must* be an odd number of cross sections.

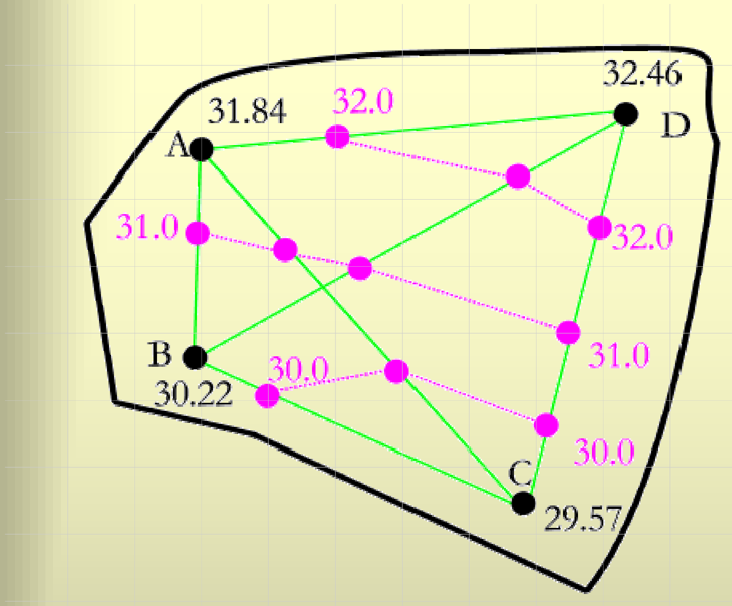


Volumes 2



The areas of plotted contours can be measured by a *planimeter*, multiplied by the contour interval, and summed as a series of horizontal slices.

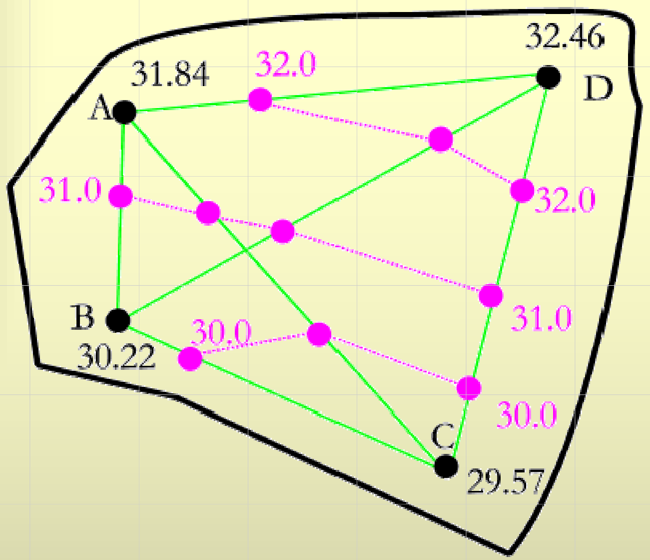
Volumes 3



The area is covered by a grid and the volume calculated as the sum of the square prisms within the site boundary. The average of the corner heights of each square at top and bottom is multiplied by the area of the square to produce the volume of each prism.

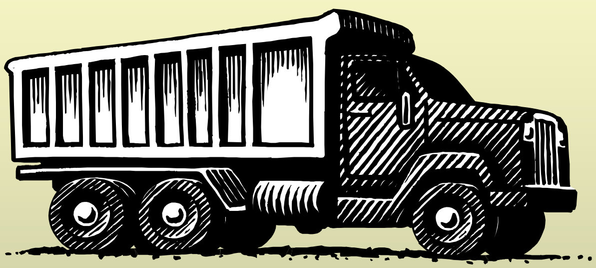
The grid can be set out on site, calculated from a topographical survey, (either manually or by computer.), or superimposed graphically.

Volumes 3a



The partial areas outside the whole squares are wedges except at the corners, (where they are cones), and must be calculated separately.

Bulking/Shrinkage



Six cubic metres of earth when excavated occupy a greater volume, (due to voids), than can be carried by a six cubic metre vehicle. Conversely the load of a six cubic metre vehicle occupies less than six cubic metres when compacted on site.

This bulking/shrinkage factor suffers from a measure of uncertainty – sand and gravel being more predictable than demolition rubble for instance. When importing material to site, suitability can also be an issue.

THE END