INVICTA EDUCATION

THEODOLITE

MEASURING
UNDERSTANDING SURVEYING

PRODUCT GUIDE

IP 129259

Involving children in a geometric survey takes them away from the desk–bound practice of measurement, into the outside world of buildings and trees.

This is where Invicta metric survey equipment makes measurement both simple and rewarding.

SURVEYING IN SCHOOLS

Many schools include some survey work in their curriculum.

A few base a large part of the geometry syllabus on the practical work done in surveying.

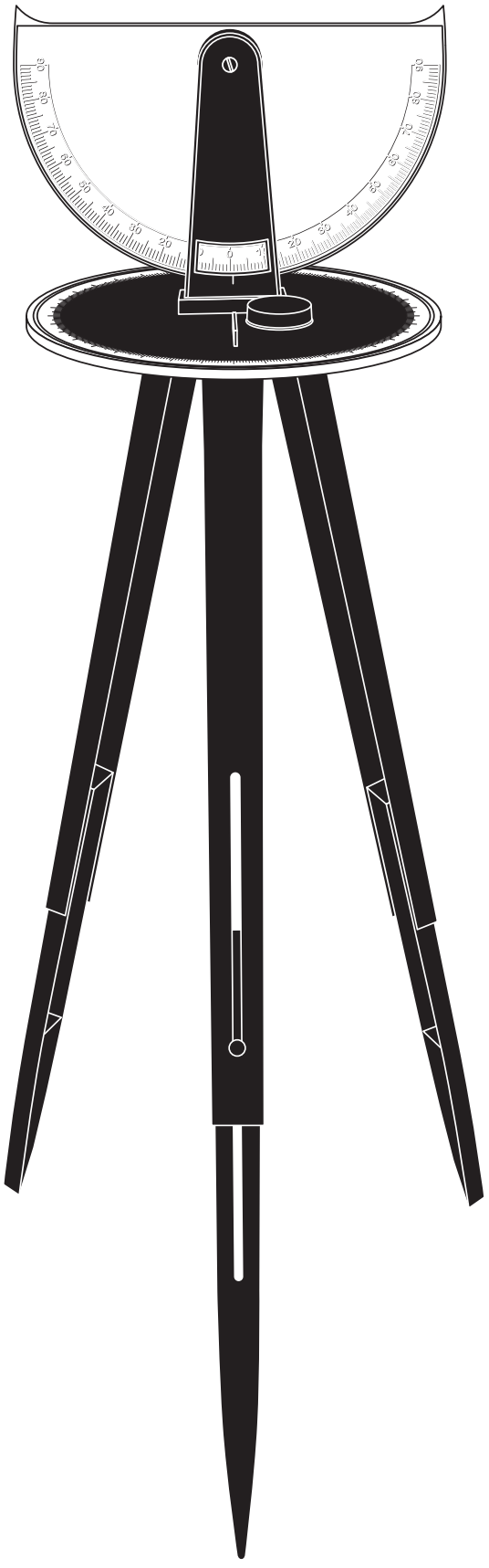
The teaching of surveying should be directed so that pupils grasp the fundamental mathematics by being faced with many small practical problems so that they acquire competence in techniques.

Invicta surveying aids have been designed to teach surveying as an introduction to geometrical ideas so that later deductive stages of geometrical properties develop from real experiences.

The exercises are suitable for many junior pupils, middle school pupils and secondary pupils.

No attempt has been made to introduce trigonometrical calculations, but these can be introduced if the pupils are sufficiently advanced.

Emphasis has been made on the practical work in geometry, geography and environmental studies.



The Invicta Theodolite is a free standing, sturdy instrument made of tough attractively coloured plastics.

It has:-

- **32cm diameter, 360° base protractor**
- **Swiveling angle sights, mounted to move in a vertical plane to give inclination angles**
- **A mounted 180° protractor**
- **Leveling device**

BEARINGS

There are three bearings: true bearing, magnetic bearing and grid bearing, which are respectively the angle between a line pointing true north, Magnetic North and grid north, and a line pointing in another direction.

To find magnetic bearings:-

1. Set the Theodolite up level in a central position of a playground, field, village, park etc, with the zero of the base protractor pointing to magnetic north with a compass.
2. Turn the sights of the Theodolite CLOCKWISE to distant objects, a tree, chimney, corner of a building etc, and record the bearing of each in degrees.
3. The distances to the objects can be measured with a 10 metre chain or trundle wheel and the details entered in a field note-book.

An angle thus becomes a measure of change of direction or rotation. Right-angle rotations from the magnetic north give the cardinal points of the compass and pupils should become accustomed to starting directions in terms of a clockwise angle from the north.

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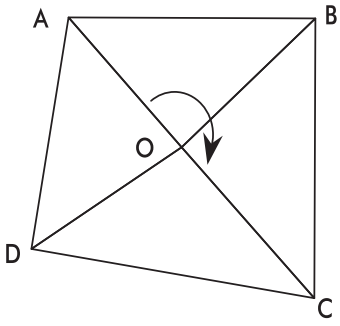
THEODOLITE

AREA



The plotting of bearing leads to the plotting of areas. For example, the area of the quadrilateral-shaped field (right) can be plotted as follows:

1) Point O, is taken somewhere in the centre of the field. The distances OA, OB, OC and OD are measured, and the directions of A, B, C, D from O are found with the Theodolite, first set so that its zero points at A.

   Alternatively, the Theodolite may be positioned with the help of a magnetic compass so that the zero line points to Magnetic North. The bearings of A, B, C and D relative to Magnetic North are then read as before. The drawing demands the construction of triangles, given two sides and the included angle.

2) The directions of A, B, C and D may be found by sighting lines drawn on paper and the distances OA, OB etc. marked off to some convenient scale.

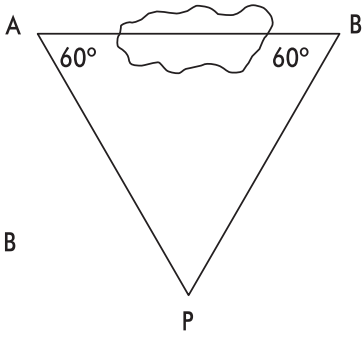
3) The distances OA, OB, OC, OD, AB, BC, CD and DA are measured. The plan now requires the construction of triangles given three sides.

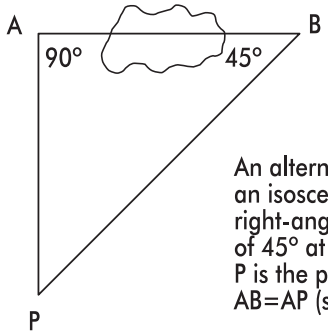
All methods of determining rectilineal and polygonal shapes depend on dividing them into triangles and/or trapeziums and their drawing invariably demands one or other forms of triangle or trapezium construction.

INDIRECT MEASUREMENT

It is often necessary to measure distance which cannot be found directly by chain or tape because of the presence of an obstacle on its length. Finding heights of buildings or trees, finding the distance across a lake or a river, are examples of indirect measurement.

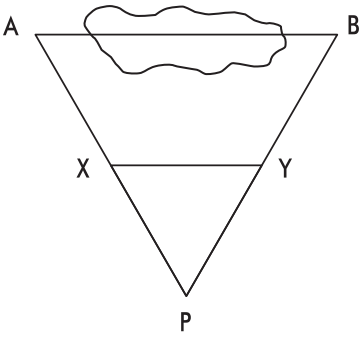
In the first method (right), angles of 60° are set out at A and B with the Theodolite, and the point of intersection P, is marked with a Ranging Pole. AB=AP (sides of an equilateral triangle).





An alternative method (left) makes use of an isosceles right-angled triangle. A right-angle is set out at A, and an angle of 45° at B.
P is the point of intersection.
AB=AP (sides of an equilateral triangle).

These two methods demand that A and B be intervisible. If A cannot be seen from B, the following method can be used (right).
Any point P, is chosen from which A and B can be seen. AP and BP are measured and the midpoint, X, Y, of AP and BP are found.
AB=2XY (the line joining the midpoints of a triangle is half the third side).
XY also gives the direction of AB.



FINDING HEIGHTS

Measuring Heights with a Shadow Stick

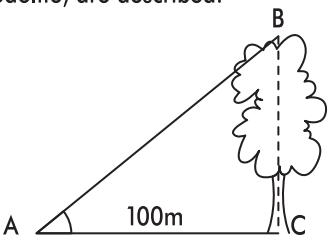
Measure the length of the shadow of the shadow stick.
Measure the length of the shadow of a tree, building etc.
The height of the object is:

$$\frac{\text{The length of the object's shadow}}{\text{The length of the stick's shadow}} \times \text{the length of the stick}$$

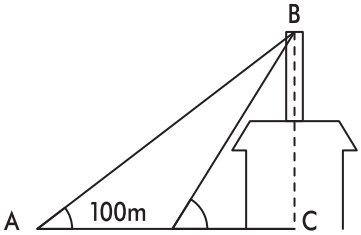
Measuring Heights with the Theodolite

Two methods, using the Theodolite, are described.

Shown right, the angle of elevation, CAB, is measured from the end of a measured base line, AC. The height is found by drawing to scale and measuring.



When the base of the object is inaccessible, it is possible to measure a base from two sighting positions and measure the two angles, CAB, CDB, with the Theodolite.
The height is found by scale drawing.



TRAVERSING

Traversing means taking a series of forward bearings with a Theodolite and measuring the distances between successive stations of observation.

This method is great value in mapping roads and rivers, and drawing maps of a district.

The positions of other features visable from the traverse line (a farm building, a church, corner of a wood etc) can be mapped by taking their bearings from two stations on the traverse.

A map is drawn by drawing bearings and distances to scale.

OTHER INVICTA PRODUCTS THAT YOU MAY FIND USEFUL *(please see web site* ***www.invictaeducation.com*** *for more details)*

050059 Trundle Wheel	146459 Metrilog	025059 Clinometer - Mk1
050159 Trundle Wheel Counter	108659 Acetate Area Measuring Grids	050659 Clinometer - Mk2

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