STRUCTURE OF SURVEYING INSTRUMENTS

Spring Term

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THEODOLITE

- **What is Theodolite?**
  - Use of Theodoite
  - Theodolite Terminology

THEODOLITE

- **Types of Theodolites (Construction)**
  - Optical-Mechanical Theodolites
  - Electronic Theodolites
- **Types of Theodolites (Accuracy)**
  - Constraction Theodolite (1’)
  - Takeometry (1”)
  - Precise Theodolite (0.2”)

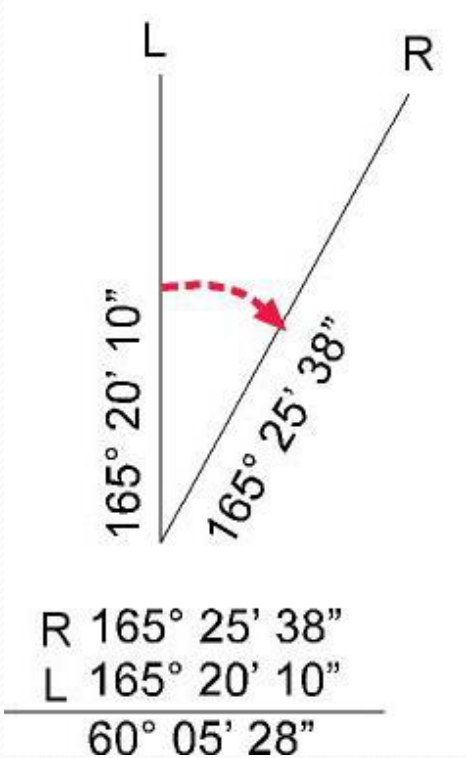
THEODOLİTE

- **Errors in Theodolite**

- **Testing and Adjustment of a Theodolite**

What is Theodolite?

A surveying instrument and precision instrument for measuring angles in the horizontal and vertical planes.

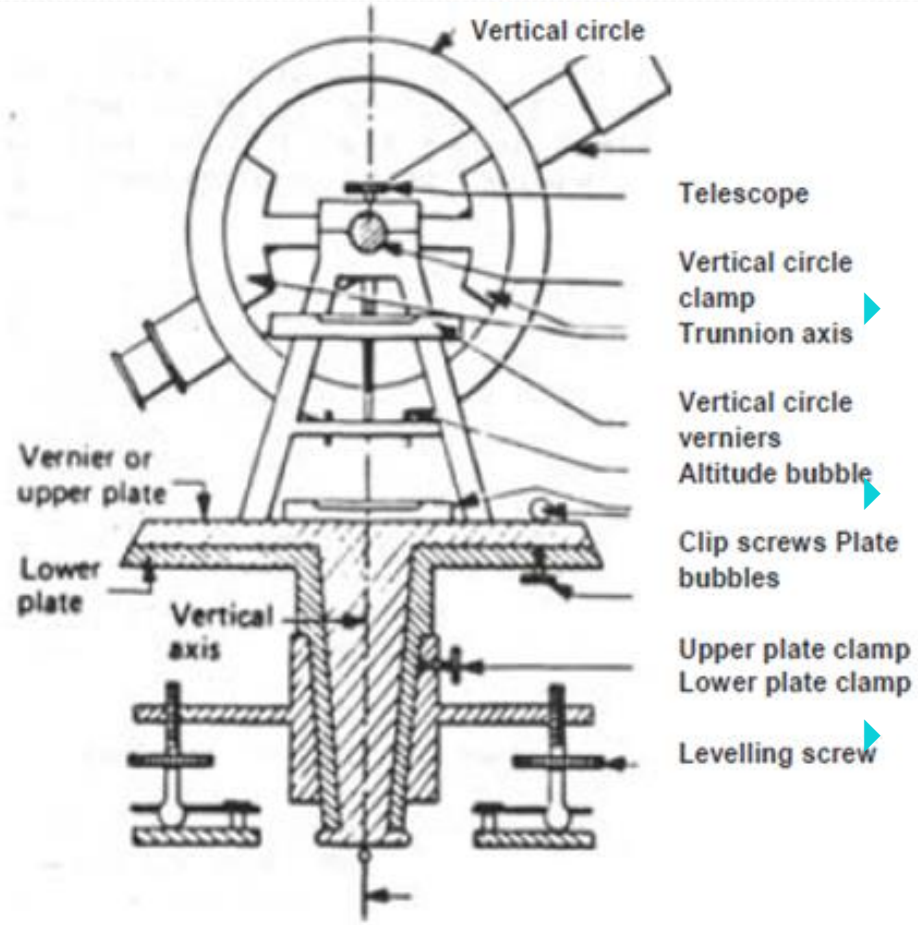


Uses of Theodolite

Use of theodolite;

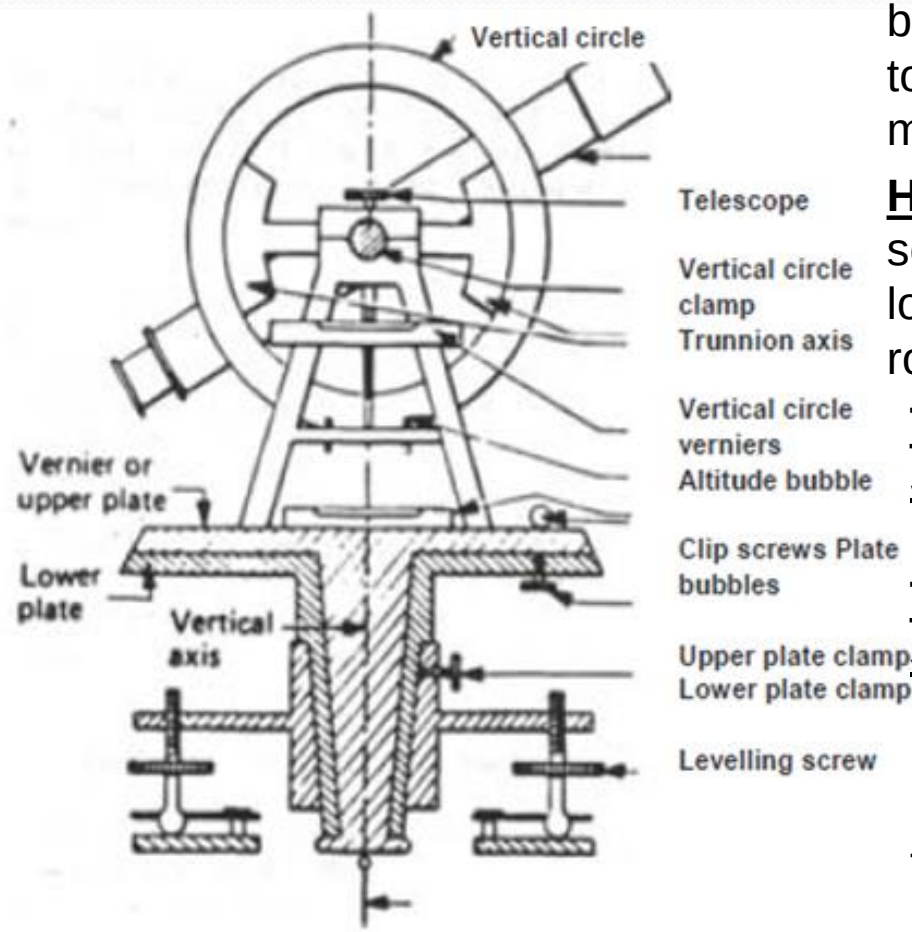
- Mapping applications and in the construction industry…
- Measurement of Horizontal and vertical angle
- Measurement of magnetic bearing of lines
- Locating points on line
- Prolonging survey lines
- Determining difference in elevation
- Setting out curves
- Aligning tunnels
- Mining works etc.

Main Components



- **<u>Upper Plate</u>**: It is the base on which the standards and vertical circle are placed. For the instrument to be in corrent adjustment it is necessary that the upper plate must be perpendicular to the alidade axis and parallel to the trunnion axis.
- **<u>Telescope</u>:** It has the same features as in a level graticule with eyepiece and internal focussing for the telescope itself.
- **<u>Vertical Scale (Circle)</u>: I**t is a full 400g scale. It is used to measure the angle between the line of sight (collimation axis) of the telescope and the vertical axis.
- **<u>Vertical Clamp and Tangent Screw</u>** : This allow free transiting of the telescope. When clamped, the telescope can be slowly transited using vertical tangent screw.

Main Components



The Lower Plate: It is the base of the whole instrument. It houses the foot screws and the bearing for the vertical axis. It is rigidly attached to the tripod mounting assembly and does not move.

Horizontal Scale (Circle): It is a full 400g scale. It is often placed between the upper and lower plates It is capable of full independent rotation about the trunnion axis.

The Upper Horizontal Clamp and Tangent Screw: used during a sequence or “round” of horizontal angle measurements.

The Lower Horizontal Clamp and Tangent Screw: These must only be used at the start of horizontal angle measurements to set the first reading to zero

Circle Reading and Optical Micrometer: The vertical and horizontal circles require illumination in order to read them. This is usually provided by small circular mirrors

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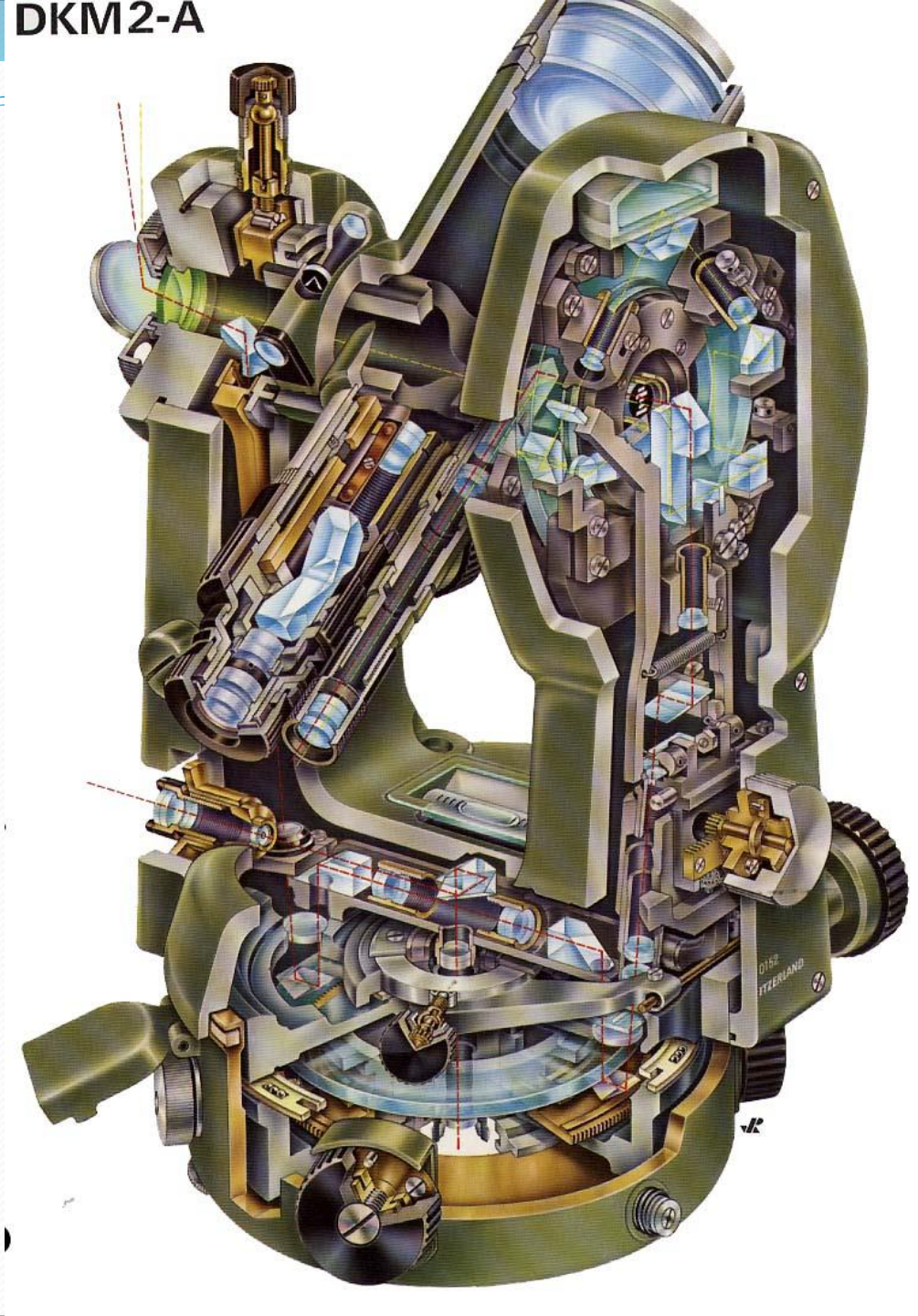
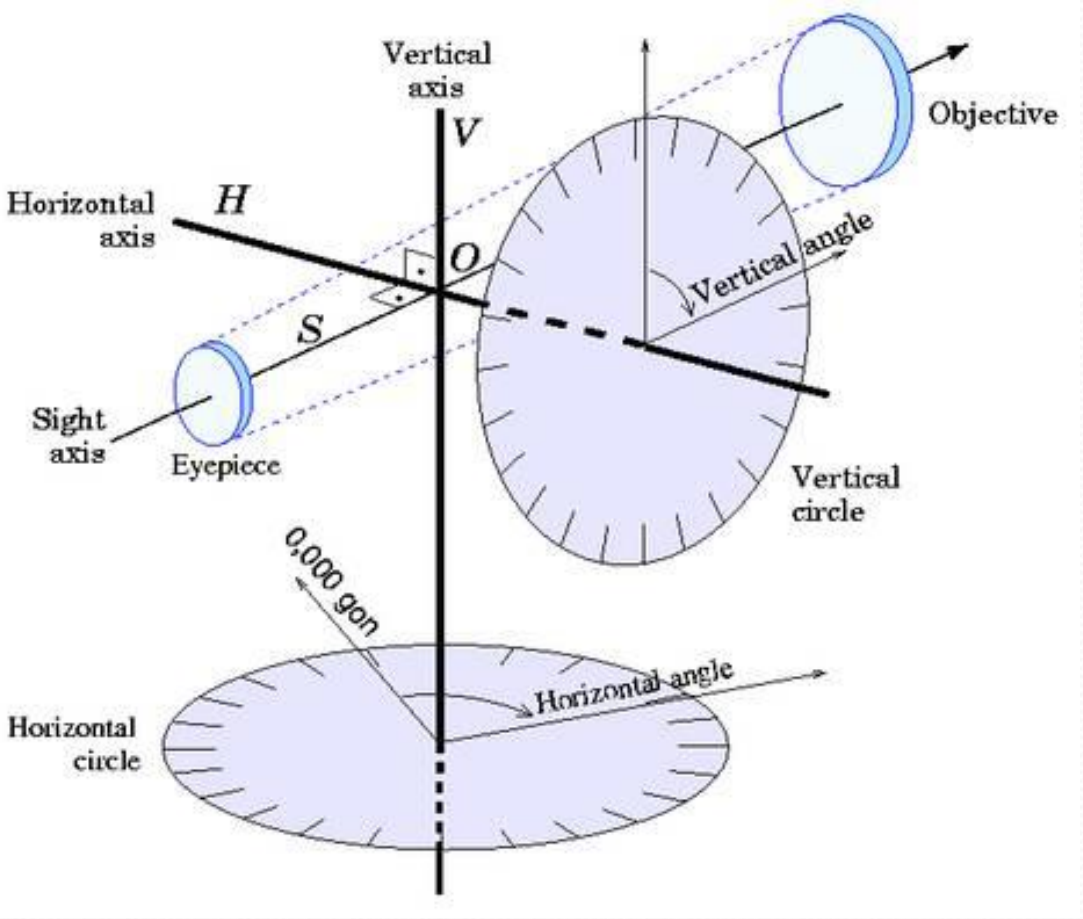


Axes of Theodolite



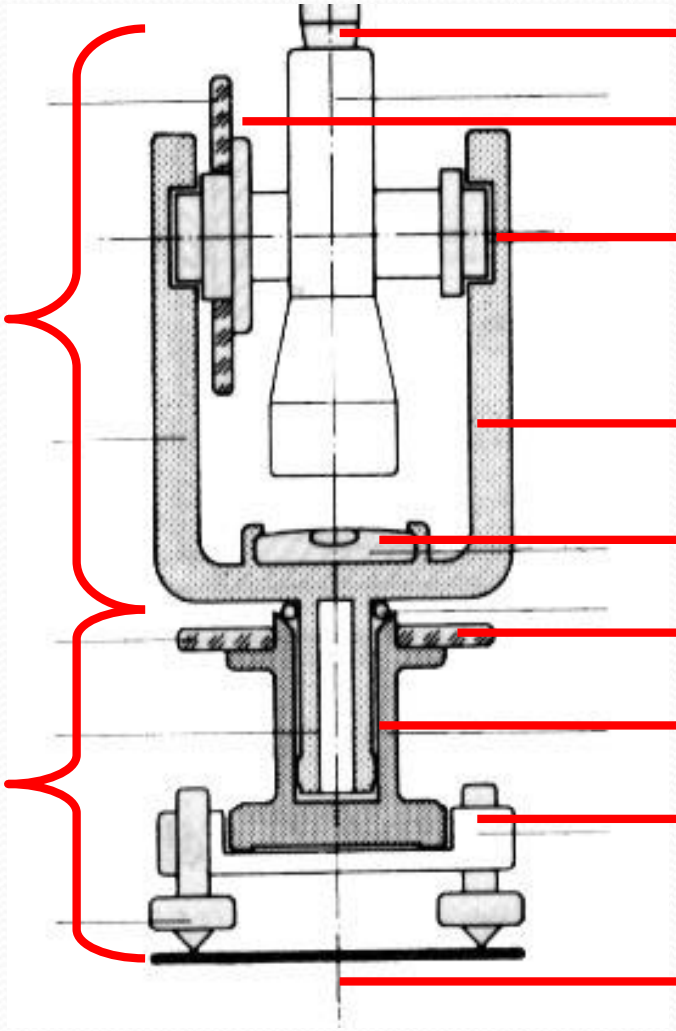
V - Vertical axis

S – Sight axis, collimation axis

H – horizontal axis (telescope rotary axis)

L – level axis (the alidade axis)

Axes of Theodolite



Upper Plate
Üst yapı

LowerPlate
Alt yapı

Dürbün Telescope

Düşey açı dairesi vertical circle

Muylu ekseni

Gövde

Silindirik düzeç

Yatay açı dairesi horizontal circle

Düşey eksen yuvası

Üç ayak tribrach

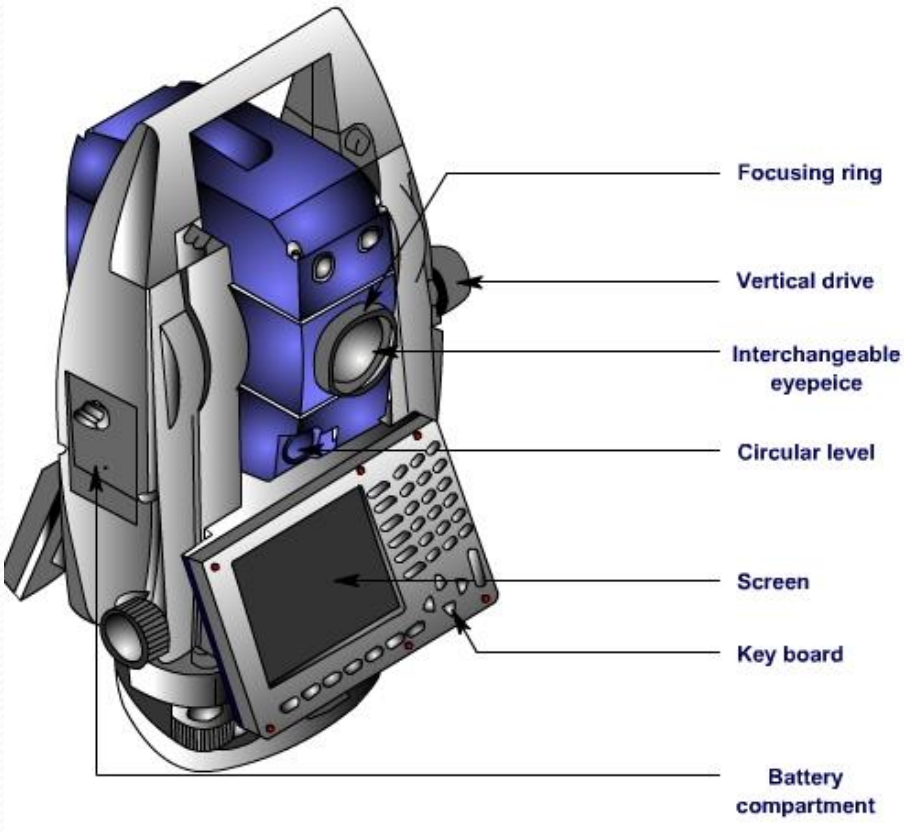
Düşey eksen Vertical axis

Digital Theodolite

- Provides the value of observation directly in viewing panel.
- The precision of this type of instrument varies in the order of 1" to 10".

Digital Theodolite

- All the parameters required to be observed during surveying can be obtained.
- The value of observation gets displayed in a viewing panel.
- The precision of this type of instrument varies in the order of 0.1" to 10".



Digital Theodolite

- The important features of total station are:
  - **Key-board**: Control all the functions are controlled by operating key board.
  - **Digital panel:** Displays the values of distance, angle, height and the co-ordinates of the observed point, where the reflector (target) is kept.
  - **Remote height object:** The heights of some inaccessible objects such as towers can be read directly. The micro-processor provided in the instrument applies the correction for earth's curvature and mean refraction, automatically.
  - **Traversing program:** The co-ordinates of the reflector and the angle or bearing on the reflector can be stored and can be recalled for next set up of instrument.
  - **Setting out for distance, direction and height** : Whenever a particular direction and horizontal distance is to be entered for the purpose of locating the point on the ground using a target, then the instrument displays the angle through which the theodolite has to be turned and the distance by which the reflector should move.

Comparision of theodolite and Total Station

- Both the total station and theodolite are devices for the measurement of vertical and horizontal angles during engineering projects and surveying.

- Each has specific characteristics due to which they are used.

- The factors of time, expertise available, and cost will determine the use of either of these instruments.

Modern Surveying Instruments

- **Electronic Distance Measurement (EDM) Instruments**:

  Direct measurement of distances and their directions can be obtained by using electronic instruments that rely on propagation, reflection and reception of either light waves or radio waves.

Electronic Distance Measurements (EDM)

- Infrared wave instruments
- Light wave instruments
- Micro wave instruments

Infrared Wave Instruments

- These instruments measure distances by using amplitude modulated infrared waves. (prisms mounted on target are used to reflect the waves.)
- These instruments are light and economical and can be mounted on theodolites for angular measurements.
- The range of such an instrument will be 3 km and the accuracy achieved is ± 10 mm.

Light Wave Instruments

- These are the instruments which measures distances based on propagation of modulated light waves.
- The accuracy of such an instrument varies from 0.5 to 5 mm / km distance and has a range of nearly 3 km.

Microwave Instruments

- These instruments make use of high frequency radio waves.
- Thee instruments were invented as early as 1950 in South Africa by Dr. T.L. Wadley.
- The range of these instruments is up to 100 km and can be used both during day and might.

Total Stations

It is a light weight, compact and fully integrated electronic instrument combining the capability of an EDM and an angular measuring instrument such as wild theodolite.

It can perform the following functions.

- Distance measurement
- Angular measurement
- Data processing
- Digital display of point details
- Storing data is an electronic field book

Modern Surveying Instruments

There are four basic types of this surveying equipment :

Robotic Total Station

Imaging
Total Station

Construction
Total Station

Optical Total Station

References

1. Volland, C., I.U.M Centre the Villeurbanne, 2001.
2. Dennison, K, Thedolite presentation, 2000.
3. Mitchell, M., Jolley, J., Survey Methods Overview, 2009.