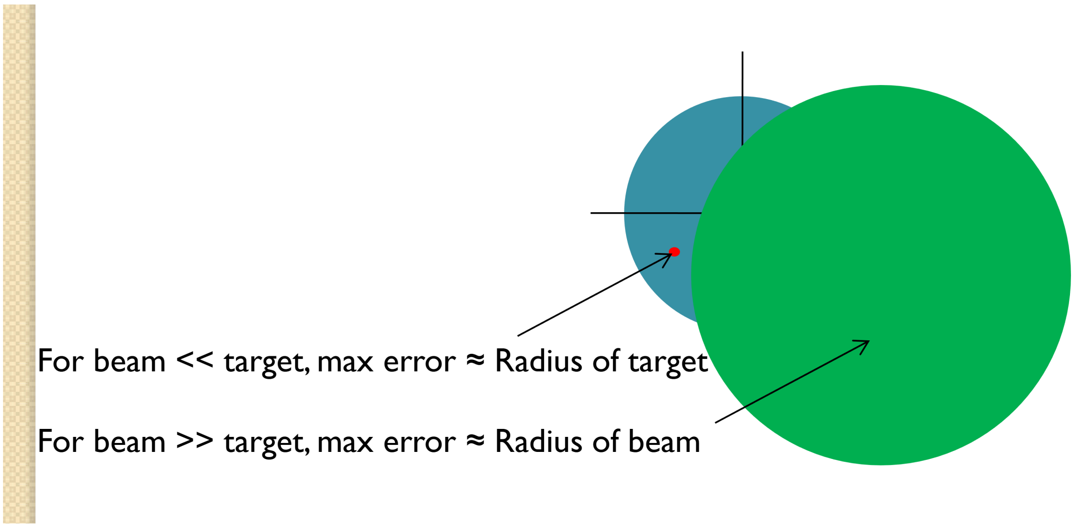
edm

- What are some technical specifications to consider for reflectorless EDM (rEDM)?
  - Phase vs pulsed (traditionally pulsed), higher signal return rates, typically phase.
  - Laser class
  - Wavelength
  - Spot size: the longer the distance, the wider the beam
  - Range
  - Precision
- How can rEDM be calibrated?
  - Different values from when using prisms, but using multi-pillar baseline.
    - Use flat target boards (e.g laser scanning targets)
  - Reducing to horizontal,
    - Solve for AC and scale factor.
  - **NOTE**: the wavelength of the instrument may be different for prism and reflectorless mode. Two separate calibrations on a baseline must be conducted.
- What are some examples of rEDM?
  - Typically have different lasers for reflectorless and prism mode
    - Still two when same wavelength for each mode, but atmospheric parameters will be the same
  - Different lasers for prism, reflectorless, auto target recognition, and laser pointer/plummet.
  - e.g Sokkia Set530 Total station (= 690nm, Class 3R in reflectorless, Class 1 in prism), Leica TS60, Leica 1200+ Total Station.
- What are some considerations for rEDM?
  - **Instrument specs & errors?**
    - Laser class, wavelength, spot size and range
    - Alignment of beam (check: shoot beam, mark w/tape, change face, check if aligned)
    - Accuracy and precision of instrument?
  - **Type of surface?**
    - Texture and colour of surface?
    - Target type (e.g corner of wall)?
      - Get a card, shoot towards, then shoot towards the corner to see if they are the same
      - Measuring the intensity (angle of incidence different)
  - **Pointing issues?**
    - Angle of incidence of beam to target? (may need a offset, take a distance shot to an offset and then wind back the cross hairs)
    - Objects online (foliage in the way, out of focus)
  - **Potential atmospheric effects, dependent on distance?**
    - Wavelength of rEDM laser (defines C, and D); beam refraction
    - Typical spot size/beam width? *Beam divergence* over longer distances, increases laser spot size.

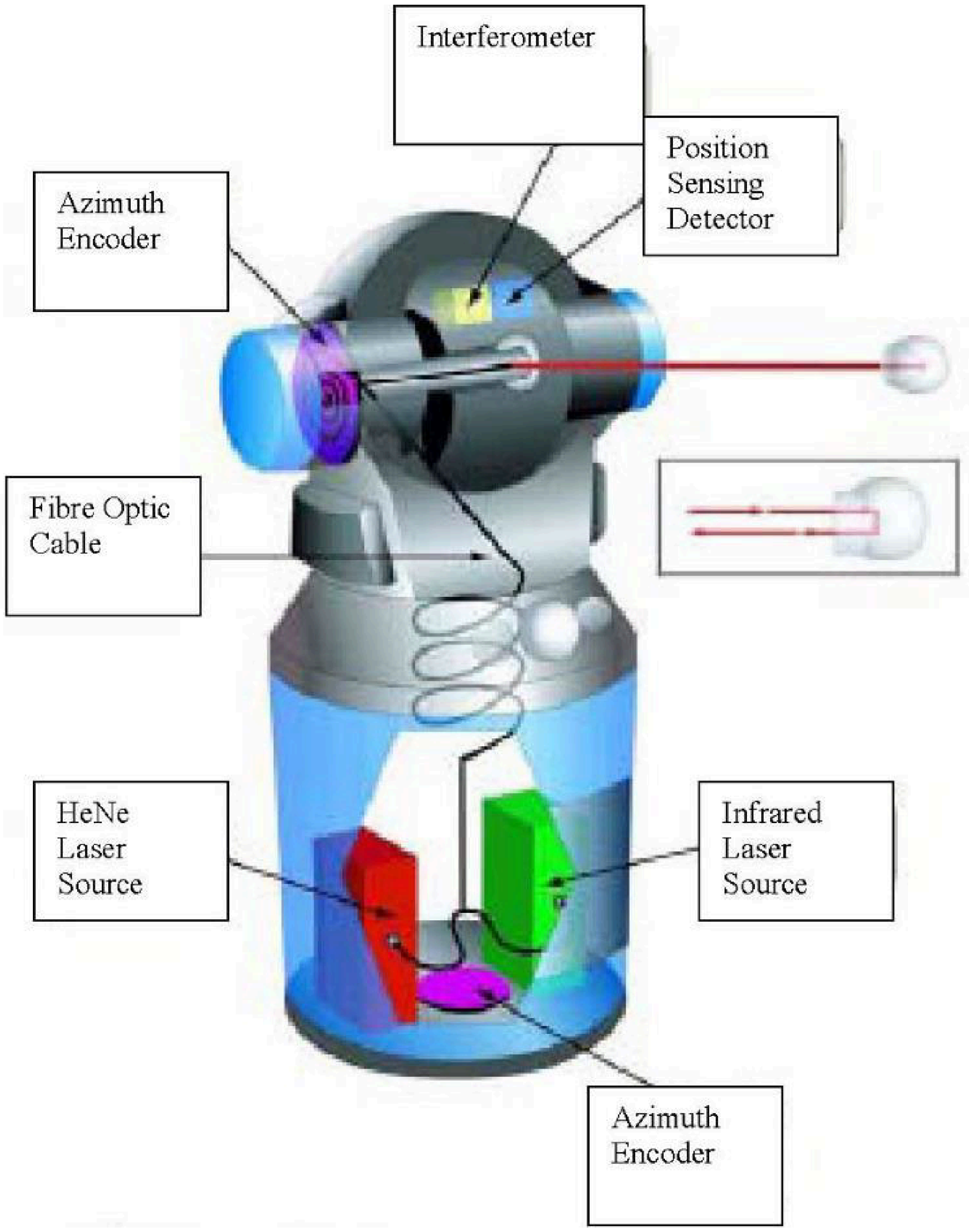
- **Reduction of calculations?**
    - From grid to ellipsoidal/ground/ distance?
    - Applying appropriate scale factor (multiply with ellipsoidal to get grid, divide with grid to get ellipsoidal)
- What are some applications of motorised total stations?
  - Remote control for detail, control surveys or setouts
  - Kinematic tracking of targets
  - Deformation surveys with ATR; measuring sets of angles, sweeps to wall targets.
    - Data sent at specific times, compares if there is significant movement
- What are some ATR pointing problems?
  - **Losing the target/aiming to target centre**, need ways of searching (e.g Power Search, Spiral Search)
    - Scanning line by line.
    - **Solution**: Using a CCD array to measure prism position. Measuring intensity back. Aiming offsets used to correct horizontal and vertical angles, controls motors
      - Crosshairs may not be moved to the exact centre (minimise time for measuring)
  - **Prism issues** such as:
    - **Multiple prisms found**: prisms in LoS, raindrops on prism or objective lens of telescope
      - Ensure only 1 prism in LoS.
    - **No prism found or bad conditions** (i.e heat shimmer, measurement distance too great)
      - Reduce distance, cover reflections, measure without ATR.
    - Prism unstable due to fast movement, or oscillation of prism
      - Measure without ATR
  - **Reduced range** due to hot weather, strong heat shimmer, bright reflections:
    - Solution: Reduce measurement distance, measure w/o ATR
  - **Loss of accuracy**
    - About $\pm$ 1mm pointing accuracy regardless of distance, thus closer lines lose accuracy with ATR.
    - 1'' = 1mm / 200m
    - ATR collimation error
- What are some manual pointing considerations?
  - Manually pointing to fat and thin targets
    - Fat: take left and right and split the distance,
    - Thin: double cross-hairs
  - Digital level reading barcode:
    - Takes photo of barcode, shifts and scales to match with digital image (**correlation**)
  - Original EDMs w/o telescope:
    - Using signal strength, intensity,
    - Sweep randomly or in a pattern (pointing accurately not too much of an issue if getting a distance)
  - Photogrammetry coordinating targets:

    - Similar to linear arrays/level sensors, measuring signal intensity of pixels
  - TLS pointing at targets:
    - Target centre: 1000s of points fitted to centre
  - Automations
    - Centre of target from single obs; potential errors

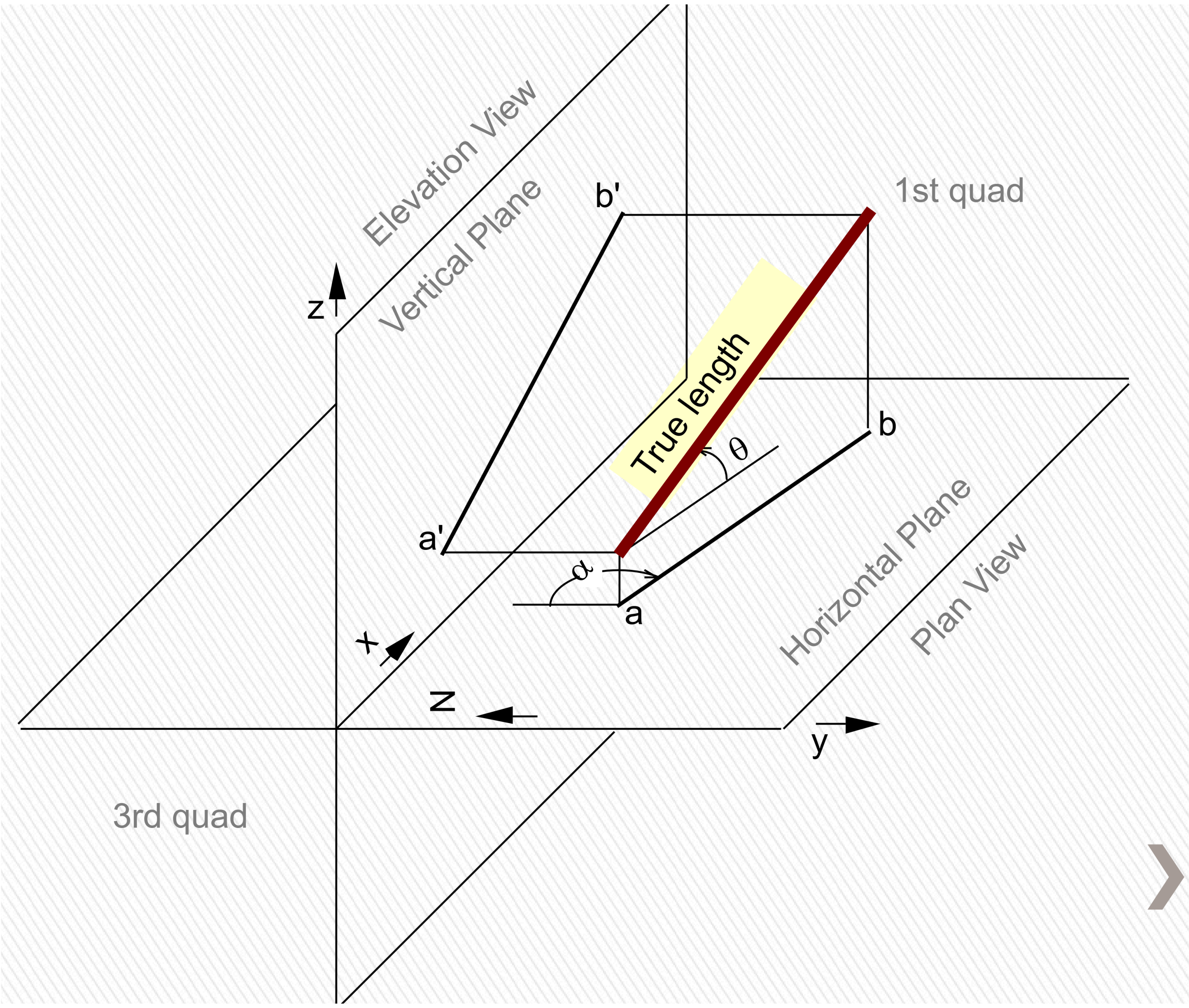


    - Calculation from multiple obs (point cloud, course and fine scans)
      - Centroid calculations.
      - Weighted **means** (using signal strength / reflected intensity or distance)
      - Edge detection: scanning in at least two directions
        - Consider beam width, mean of two edges = centre.
- What is a disto? What uses does it have?
  - Hand held distance meters.
  - Used for strata surveys, recovery mark sketches, or mine detail surveys. Can be used to form trilateration networks.
  - Considerations:
    - Horizontal or slope distance
    - Indoors or daylight conditions
    - Improving range or precision?
    - Is the laser pointed to the desired target?
- What are laser trackers?
  - High-precision trackers that measure a change in distance using interferometry (change of phase)
    - More accurate than measuring the time of flight typically used in laser scanning.
  - As it uses a laser, still susceptible to atmospheric refraction (i.e refractive index of air)
  - t Some applications include: high-precision surveys, production assurance (i.e A380 wings, tolerances of 0.25mm), BlueScope project, Australian Synchrotron.
    - Cannot be setup over a mark, requires micrometer accuracy. Hence a resection to existing control is done.
    - Calibration done on the Absolute Distance Meter (ADM) and interferometer (IFM, dynamic distance measurement) on baselines.
  - Examples of laser trackers include:
    - Faro Laser Tracker: angular accuracy of 18 1µ µ. and a distance accuracy of 10µ 0µ.

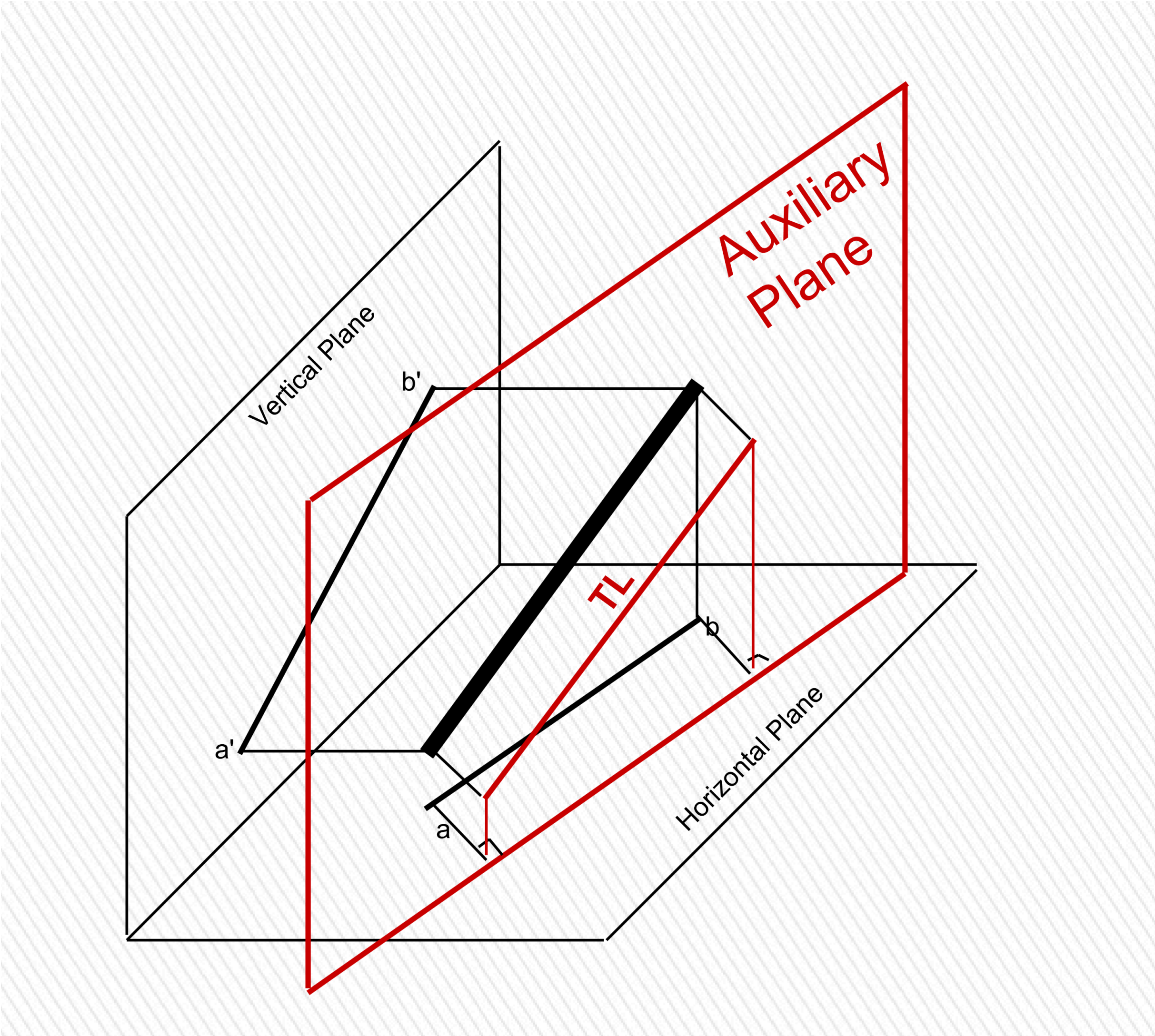
- Interferometer tracking/EDM style point positioning.

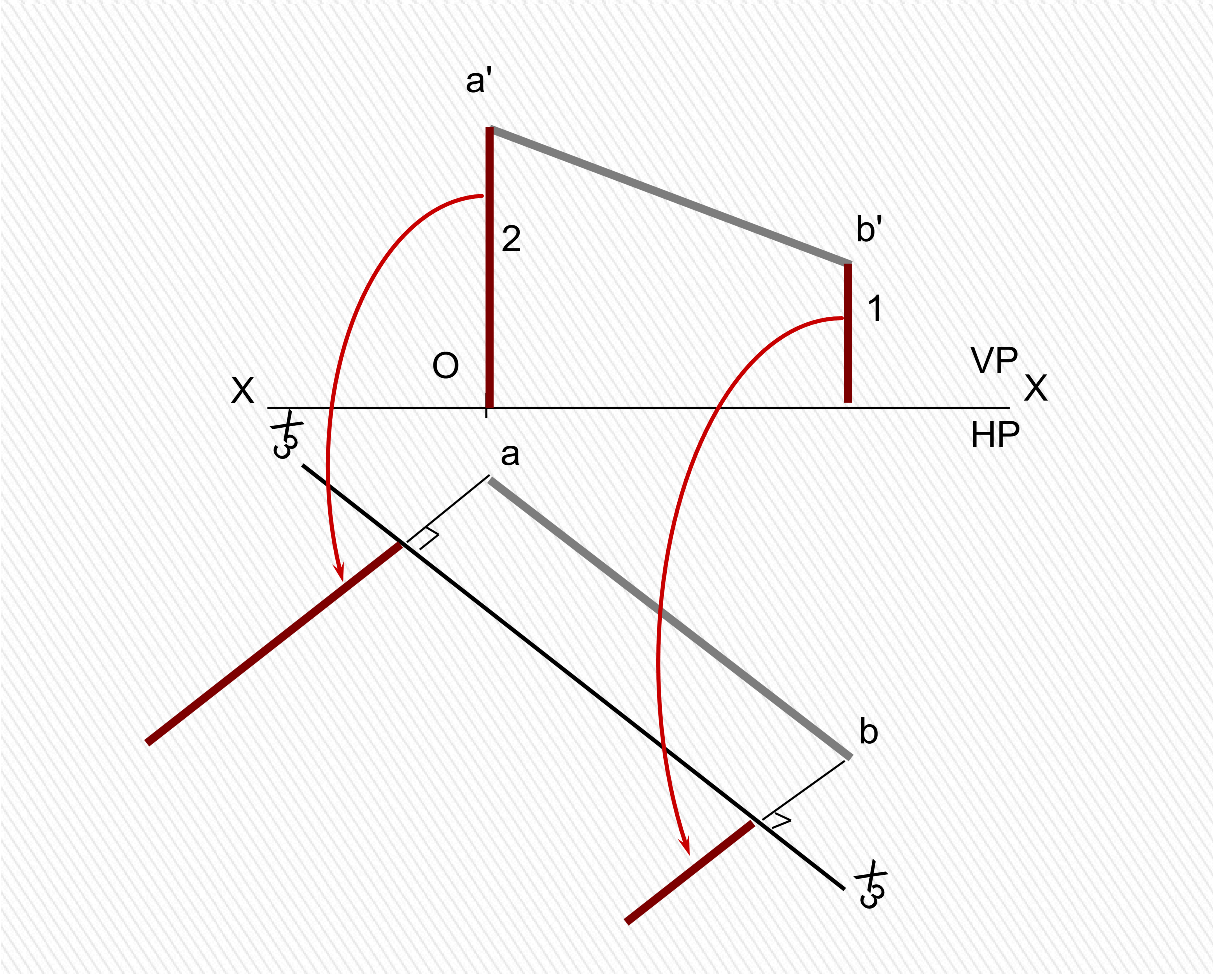


- What are some considerations for 3D lines?
  - Also called descriptive geometry, this is important for 3D orientation of the centrelines of tunnels, mines, or axles. Calculations could involve:
    - Coordinate calculations of the shortest distance between 2 lines.
    - Shortest distance from a line to a point and between two lines.
  - The length of projection of a line in an orthographic projection is not the true length unless the line is parallel to the plane on which it is projected.
  - Plotting Lines: on vertical and horizontal plan view. Finding True Length, bearing, slope, etc.

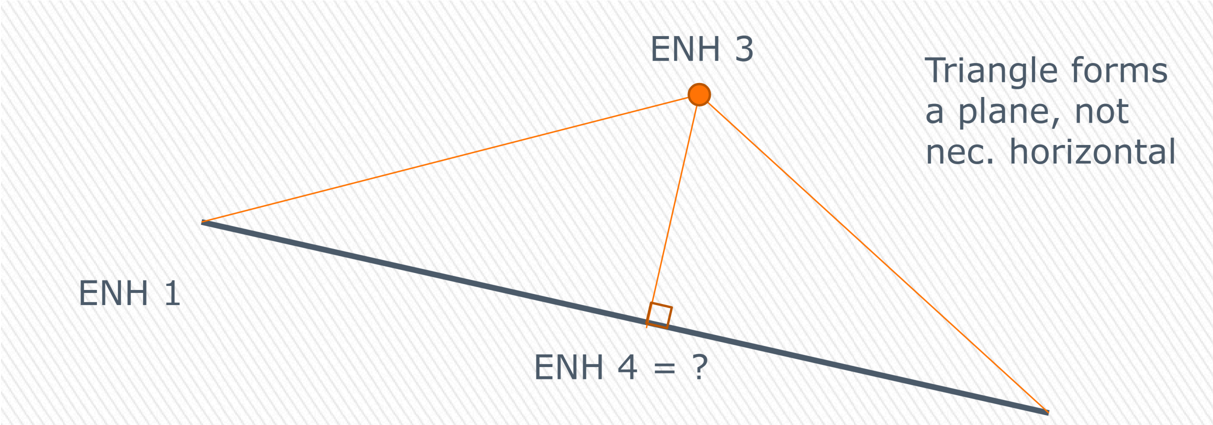


- Auxiliary Planes


Auxiliary
Plane
Vertical Plane
b'
TL
b
a'
a
Horizontal Plane


a'
2
b'
1
O
VP
X
X
HP
a
b

- Shortest Distance: the common perpendicular line between two skew lines i the shortest distance. Calculated through



  - Slope distances from coords (reverse scale factors if coords on MGA)
  - Solve triangle 1 2 3 in incline plane
  - Cosine rule -> angles
  - Right angle triangle 1 3 4 solution