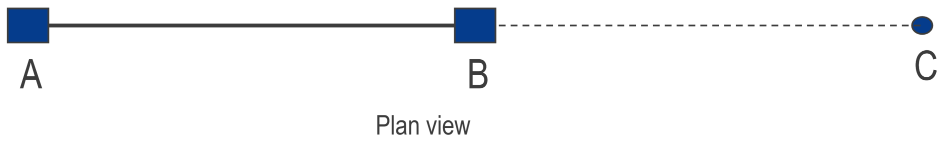
alignment & high precision surveys

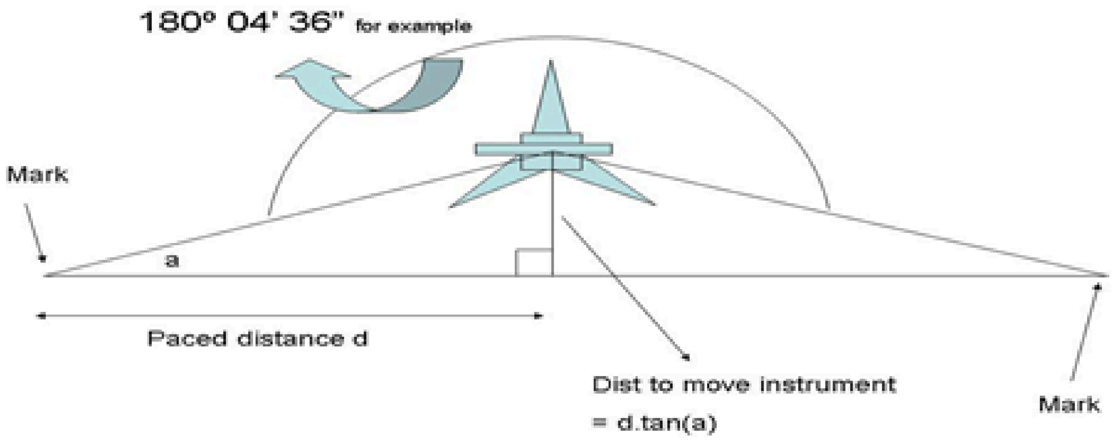
- What are some direct survey methods for alignment surveys?
  - Typically used in industrial & construction surveys, these involve:
    - Prolonging a straight line: plunging in 2 faces



Which is best method & why?

1. Setup beside line, radiate A & B, calculate, setout C by radiation
2. Setup at A sight to B then to C
3. Setup at B sight to A turn 180 in FL & FR, mark mean
4. Setup at B sight to A “plunge” in FL & FR, mark mean

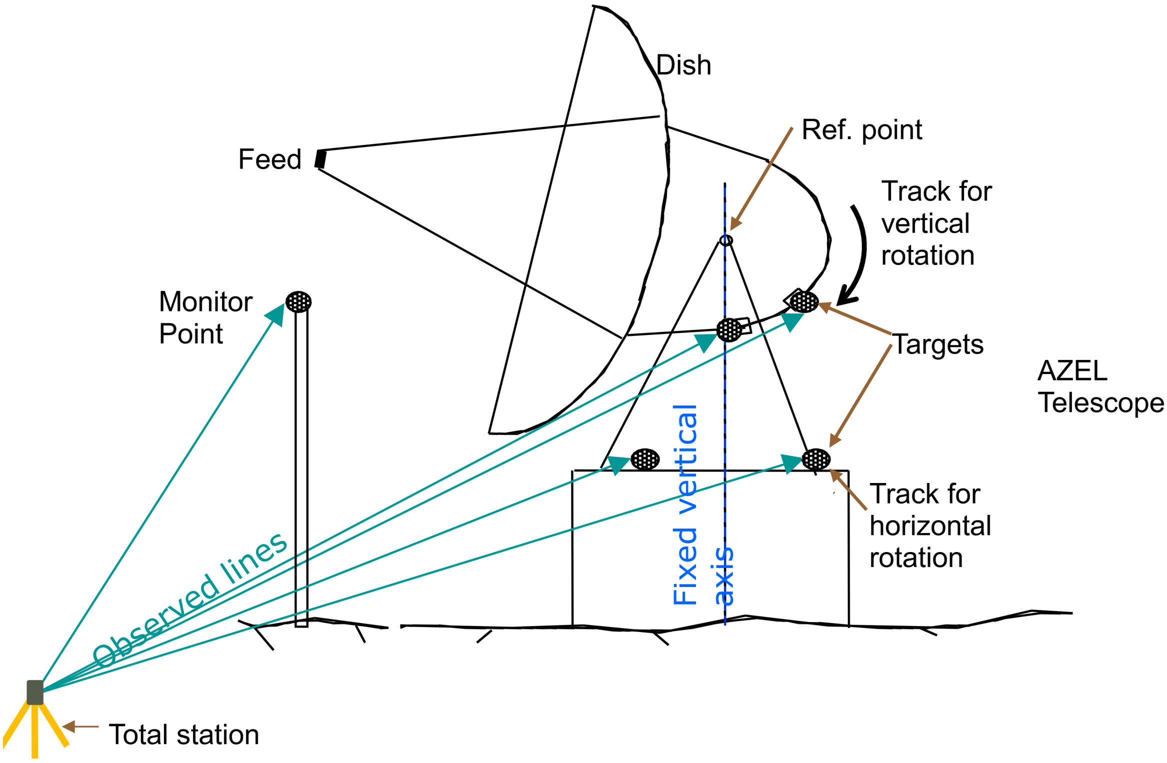
    - Setting up on a line (middling in): where you can't see from one end to the other or can't set up on end marks.
      - Only works by assuming that the distance from each mark is equal.



    - Intersection of two lines
    - Parallel lines
      - e.g Cadastral party wall
    - Shifting line of sight/collimation through a parallel plate micrometer
      - A PPM can shift the LoS by 5mm of each side w/o moving the isntrument. Reading accuracy can be as good as 0.01mm. Advantages include
        - Targets do not need to be shifted during obs, but are required within 10mm range.
        - Able to use normal traversing targets
        - Could also be used for vertical alginments. However, coefficient of refraction seriously affects any vertical alignment. Earth curvature must also be considered.
    - Laser alignment without occupation of terminal of alignment axis
      - Measure offsets and solve with linear regression

- Measuring to existing marks is usually more accurate than setting out.

- What are some high precision survey techniques?
  - These are typically applied to unique survey projects, like observing the radio telescope dish surface and determining the shape of the dish panels.
    - **'Indirect' survey**: The centre of the axes cannot be sighted to. Place marks at some distance and rotate.
      - Get a best circle in 3D coords in both vertical and horizontal. Intersect circles to get a centre of the axes.
    - **Checks**: Stable monitor point away from traget to ensure setup point is correct



  - Consider **high precision** for: (most due to centring errors):
    - **Instrument**: electronic data recording, faster observations/more observations in limited time.
      - Calibrate frequently and test.
    - **Angles**: Theodolite intersections can be used to get very accurate 3D coords in small scale industrial jobs. Directions very accurate over short distances IF centring errors removed
      - 1" = 0.1 mm over 20m lines.
    - **Distances**: Distance measurement with EDM is often not as accurate for lines less than 30m, unless using special laser trackers.
    - **Heights**: For < 1mm, use ZA and staff obs to nearby BMs.
      - Utilise simultaneous reciprocal observations due to refraction <- reciprocal observations <- precision levelling (still highly accurate, easy)
      - Take care when steep sights are required.
    - **Traversing**: For **azimuth transfer** with short traverse legs, use long backsights to avoid centring errors.
    - **Marks**: Clear centre, stable.
      - Setting up over a mark gives small error, avoided by resection observations to close recovery marks.

    - **Environmental conditions:** structures may move due to solar heating. Observe at night for little change, or same time of the day.
- **CASE STUDY** (e.g CSIRO, Narrabri Radio Telescope Dish).
    - Environmental conditions: 4 hour survey at night for constant temp and no moving cloud shadow effects.
    - Accuracy required: Need high accuracy for high radio frequency (< 1/4 mm)
    - Instrument was fixed to a moving platform attached to the dish itself, with compensator removed.
        - 640 targets were used,
        - LS adjustment.