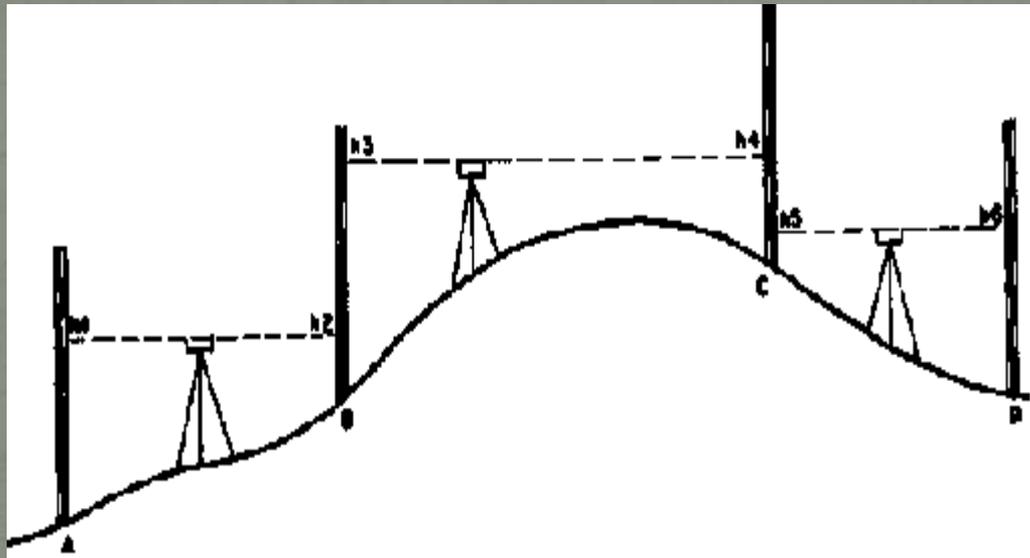


# Leveling



# What is “Leveling?”

- Levelling is the process by which differences in height between two or more points can be determined.
- Leveling is a branch of surveying, the object of which is to find or establish the elevation of a given point with respect to the given or assumed Datum (reference point).
- Common leveling instruments include the spirit level, the dumpy level, the digital level, and the laser level.



# Tools For Leveling

- Spirit Level - or **bubble level** is an instrument designed to indicate whether a surface is level or plumb



# Spirit Level

- Varying Lengths 8in to 16ft
- Can also be magnetic
- Quality of Levels vary markedly

## Non Magnetic



## Magnetic



## Masonry



## Digital Levels



## Torpedoes

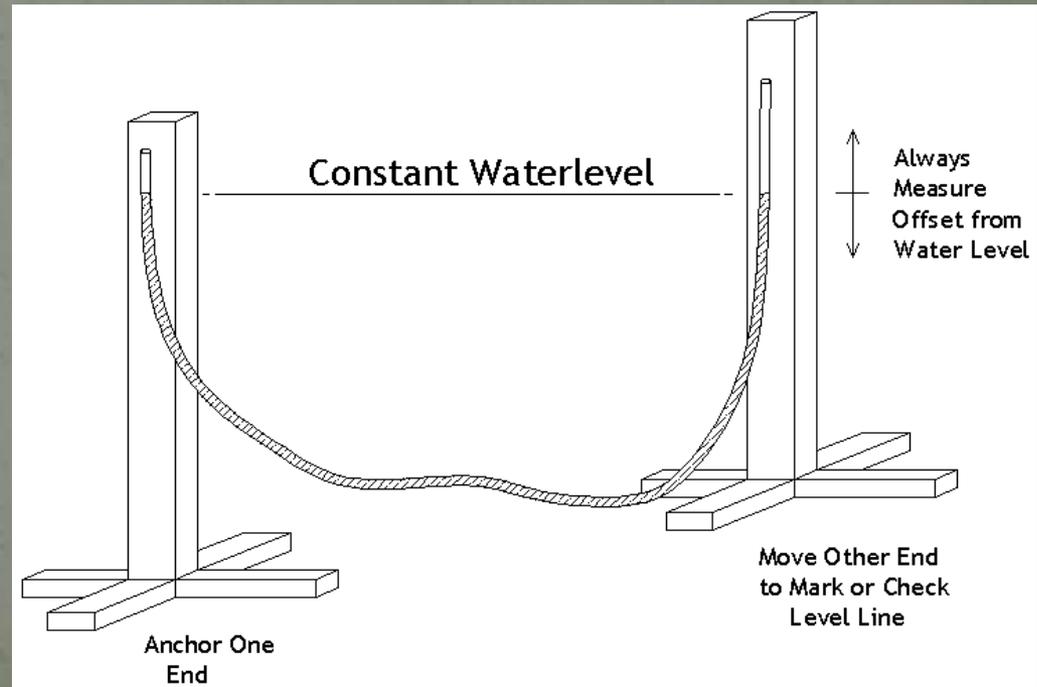


A line level is a level designed to hang on a builders string line. The body of the level incorporates small hooks to allow it to attach and hang from the string line. The body is lightweight, so as not to weigh down the string line, it is also small in size as the string line in effect *becomes* the body; when the level is hung in the centre of the string, each *leg* of the string line extends the levels plane



# Water Level

- The tube is filled with water so that the water level is about 3 ft high in each of the tube ends. It is essential that no air bubbles be trapped in the tube. Air bubbles can be removed by tapping the tube with the finger.



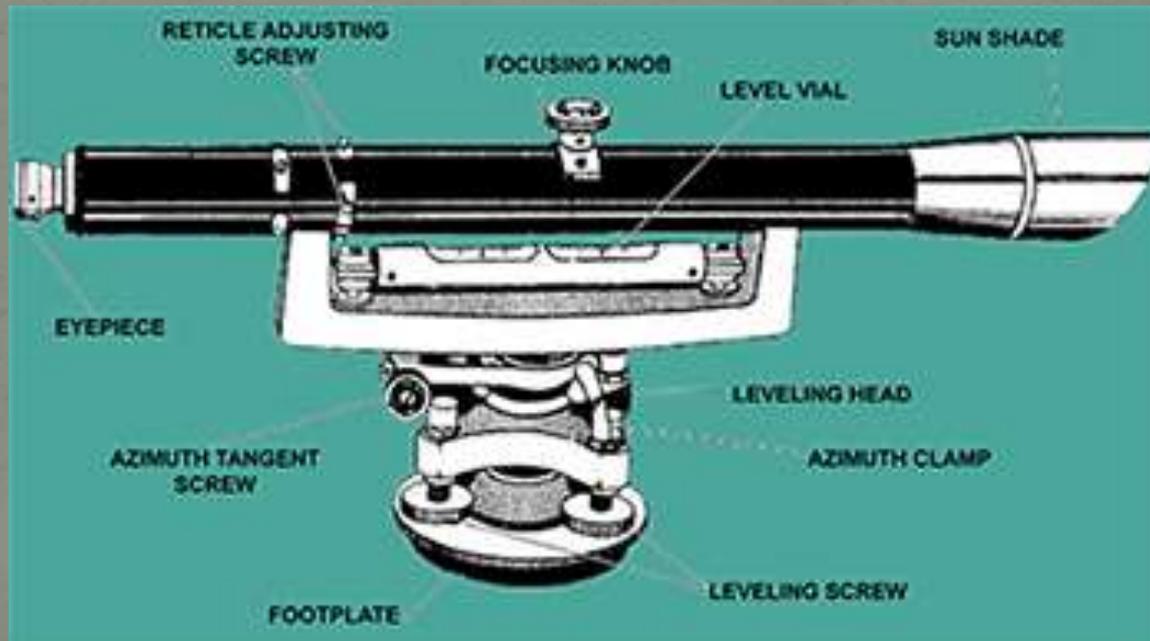
# Dumpy Level

It is simple compact and stable. The telescope is rigidly fixed to its support therefore cannot be rotated about its longitudinal axis. A long bubble tube is attached to the top of telescope. Dumpy literally means short and thick.

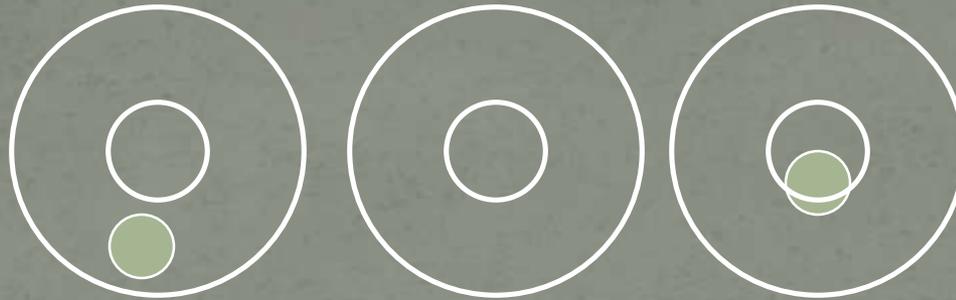


# Builders Level

A **builders level** is an optical instrument used to establish or check points in the same horizontal plane. It is used in surveying and building to transfer, measure, or set horizontal levels



# Bubble



When bubble is centred the instrument's standing axis is approximately vertical. The compensators in the instrument take over and adjust the optical Line of Collimation so that it is horizontal (hopefully)

# Tilting (Transit) level

It consists of a telescope attached with a level tube which can be tilted within few degrees in vertical plane by a tilting screw.

Very Accurate

Very Difficult to Set Up

Can also set grades

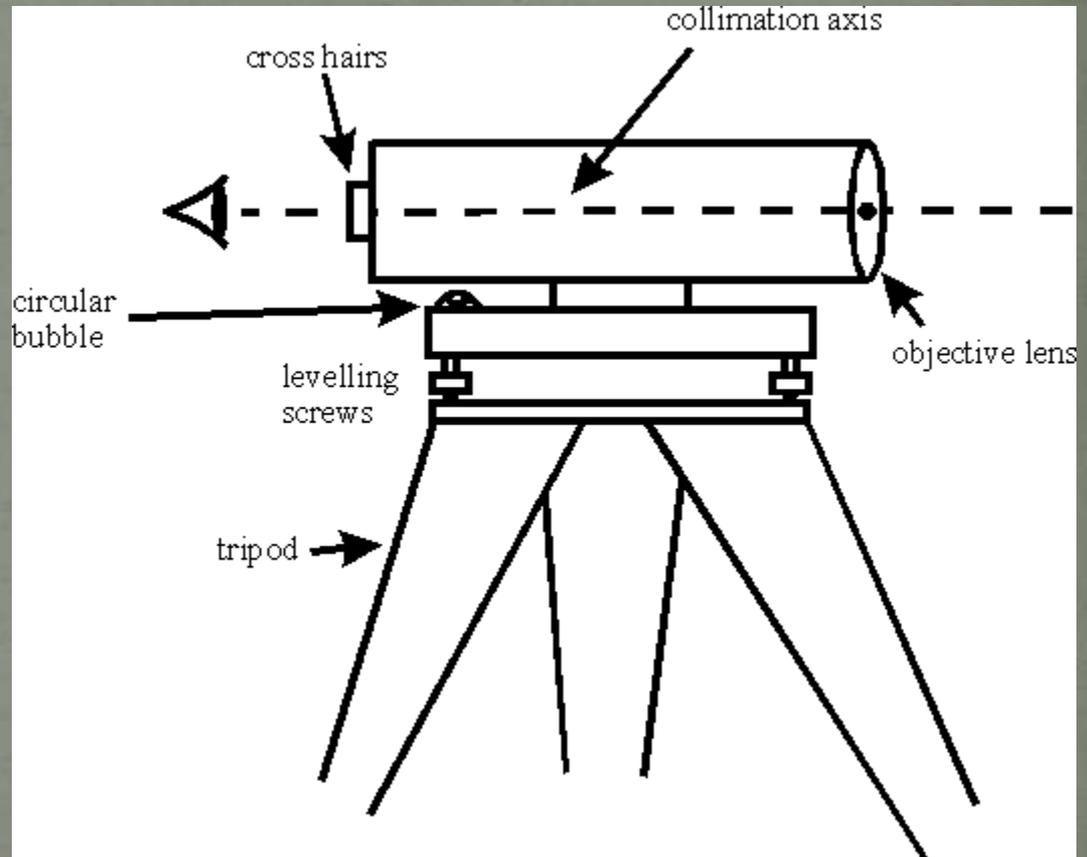
Works similar to a plumbers pipe level

Have been replaced by Total Stations



# Definition

- **Line of Collimation** – Imaginary line that passes through leveling instrument at Cross Hairs



# Automatic Level

- The Automatic Level is an easy to use surveying Instrument
- Instrument needs only to be setup level within its circular level bubble
- Has a damping compensator which adjusts line of colimation
- Generally accurate to  $\pm 2\text{mm}$

# Automatic Level

1. Base Plate
2. Horizontal Circle
3. Eyepiece
4. Circular Bubble
5. Sighting Pointer
6. Objective Lens
7. Focusing Knob
8. Fine Motion Drive
9. Footscrew
10. Bubble Mirror



# Laser Level

- Has a compensator similar to Automatic Level
- Radiates a Laser Beam 360 through line of collimation
- Laser is then picked by a receiver to indicate line of collimation
- Some lasers are self leveling
- Survey quality laser levels are designed with two features:
  - ❖ Visible or non-visible
  - ❖ Rotating or non-rotating

# Total Station

- A total station is an electronic transit and an EDM combined into one instrument.
- Add in a microprocessor, laser plummet and other options and you have the instrument of choice for ground based surveying.
- Some may require a prism, but others are reflectorless.



# Errors particular to Lasers

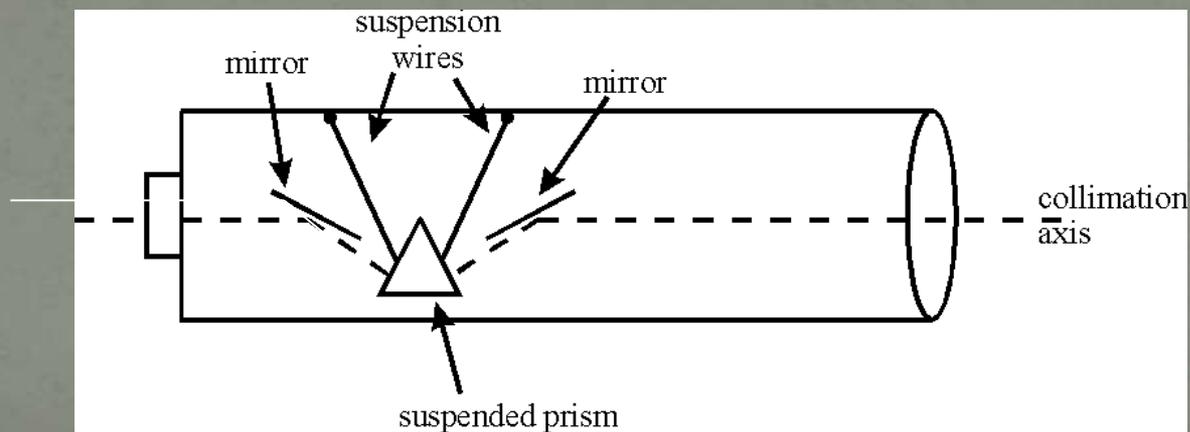
- Reflections from other glass objects ie car windscreens
- Rotating Beacons
- Lasers being used at other sites, typically lasers have range of 900ft.

# Leveling Errors

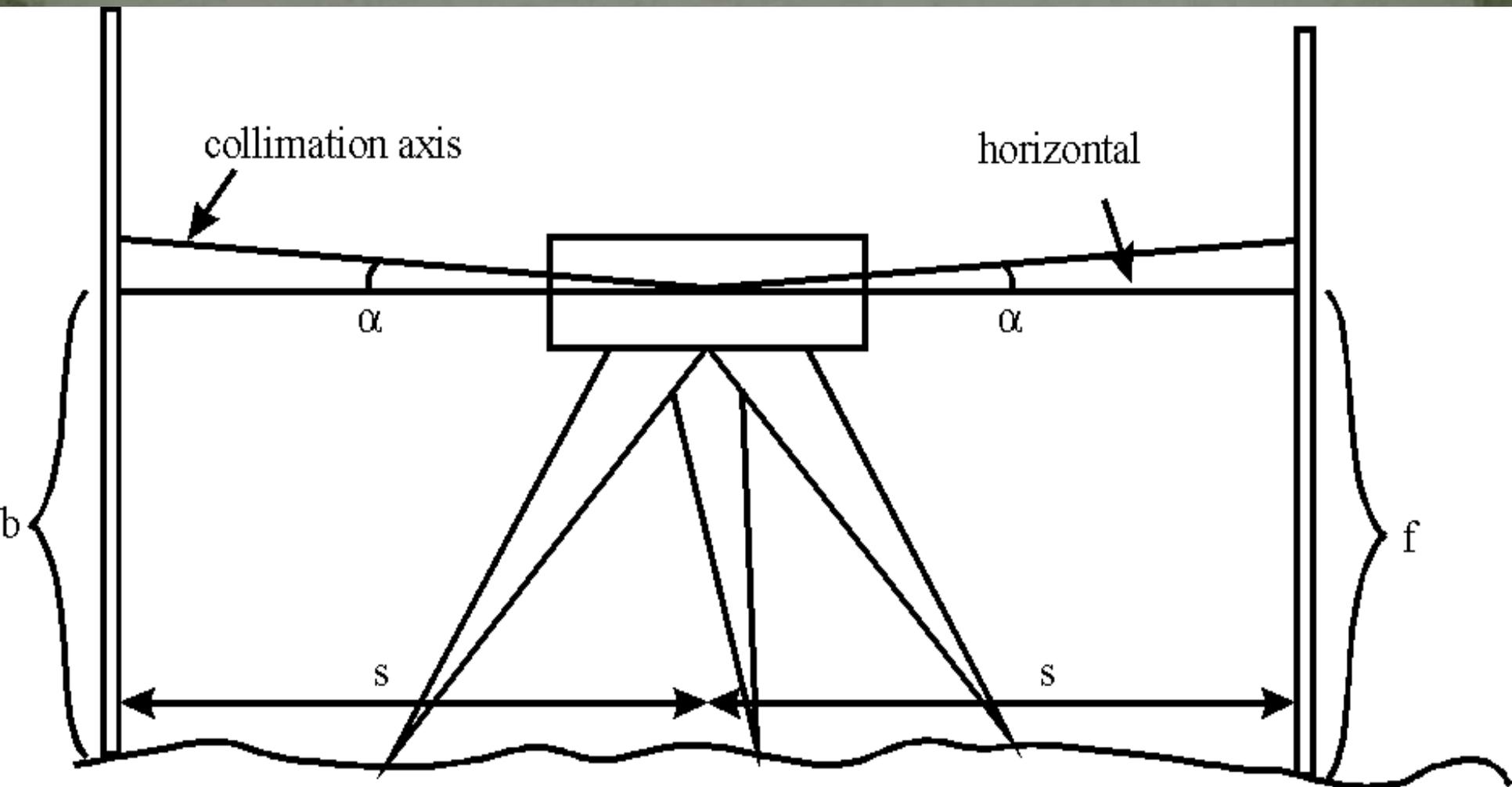
- There are a large number of potential sources of errors in leveling. Many of these are only significant for precise leveling over long distances. For the short segments of leveling that will occur in connecting a TGBM to nearby benchmarks there are only four worth mentioning:
  - ● Collimation Error
  - ● Error due to Earth Curvature
  - ● Error due to Parallax Error
  - ● Error due to Refraction

# Collimation Error

- The Automatic Prism compensator goes out of alignment.
- The level provides readings outside of its specification

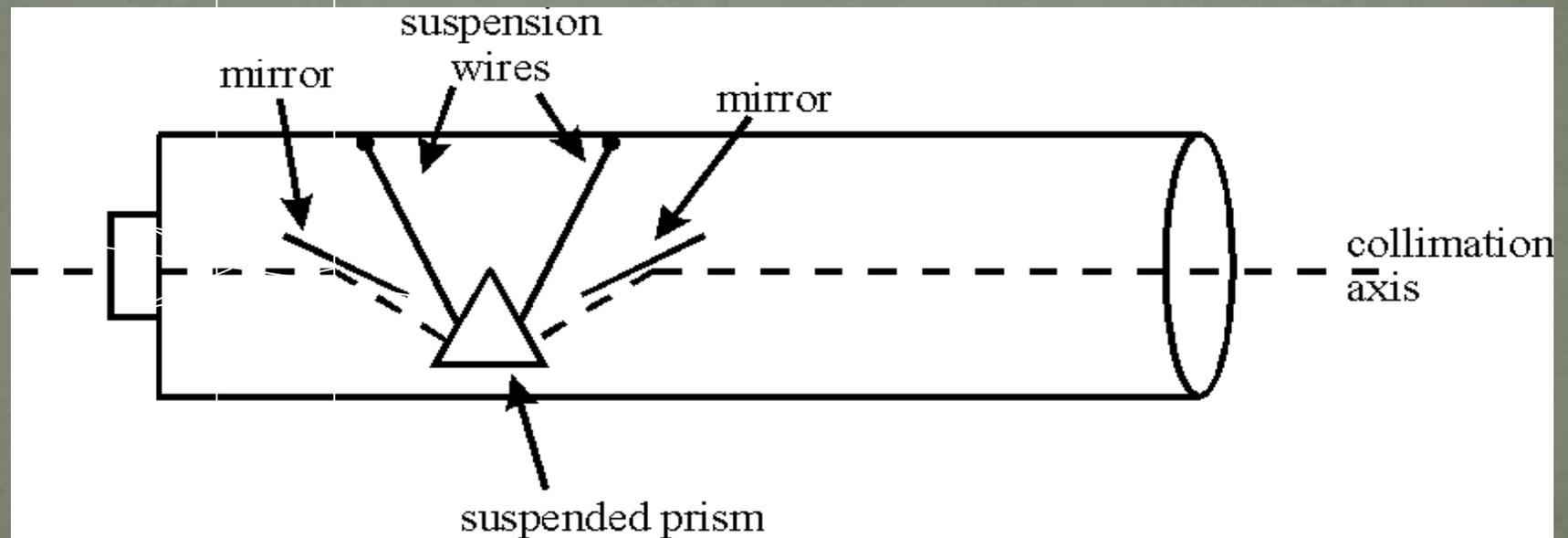


# Collimation Error

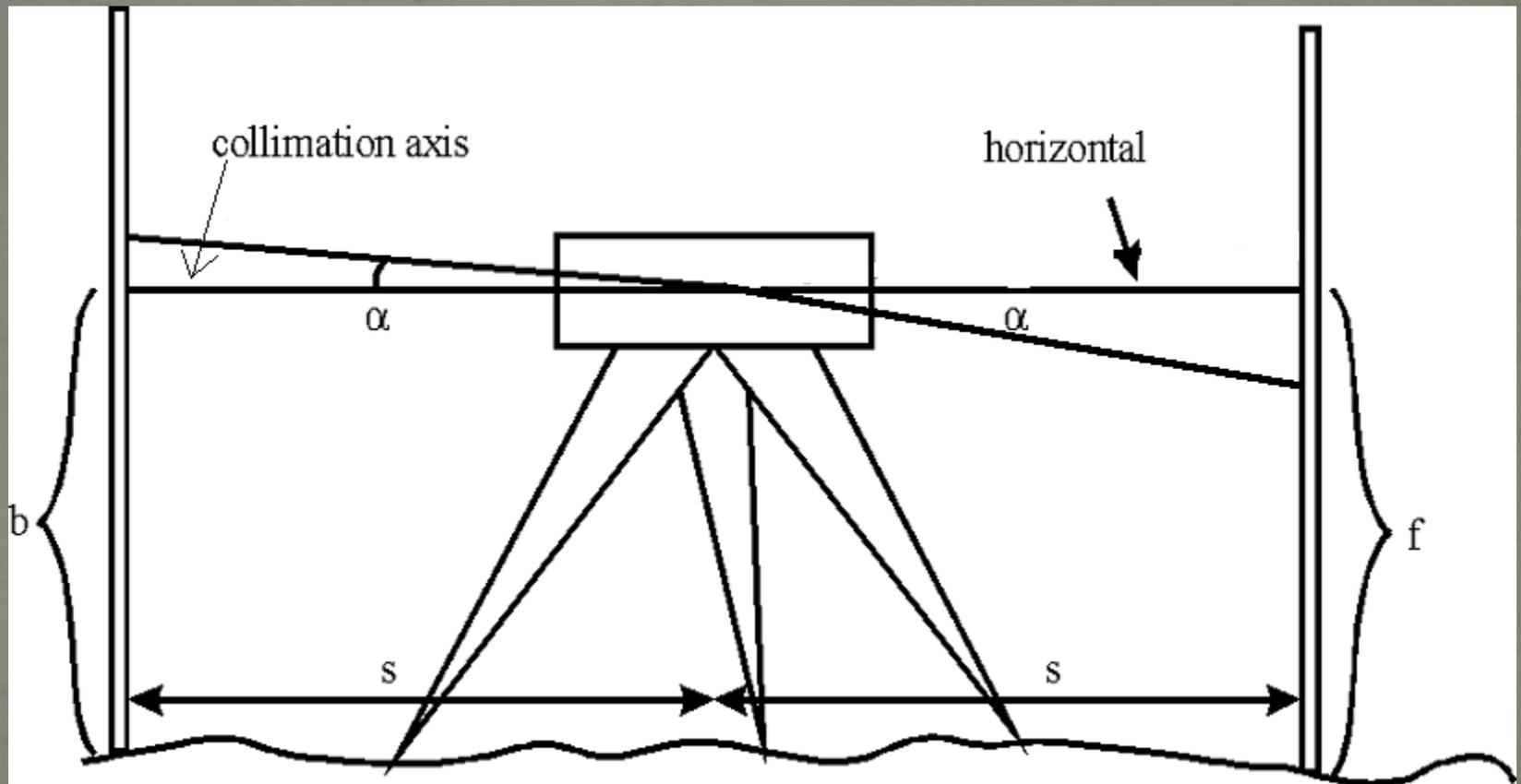


# Parallax Error

- When using an optical instrument — both the image and cross hairs can be focused- if either is imprecisely focused, the cross hairs will appear to move with respect to the object focused, if one moves one's head horizontally in front of the eyepiece.

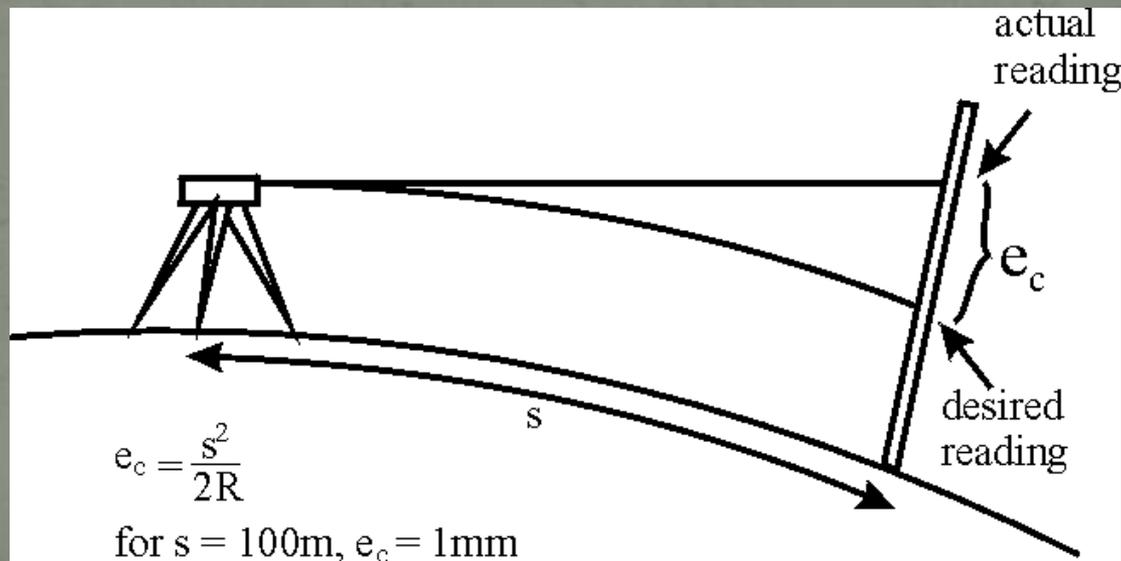


# Parallax Error



# Curvature of the Earth

- Due to the curvature of the Earth, the line of sight at the instrument will deviate from a horizontal line as one moves away from the level



# Correction of Curvature Error

- For a sight length of 300 ft the effect is only 1mm.
- Keep Sight lengths under 150 ft
- the effect is eliminated by using equal sight lengths for fore- and backsights.