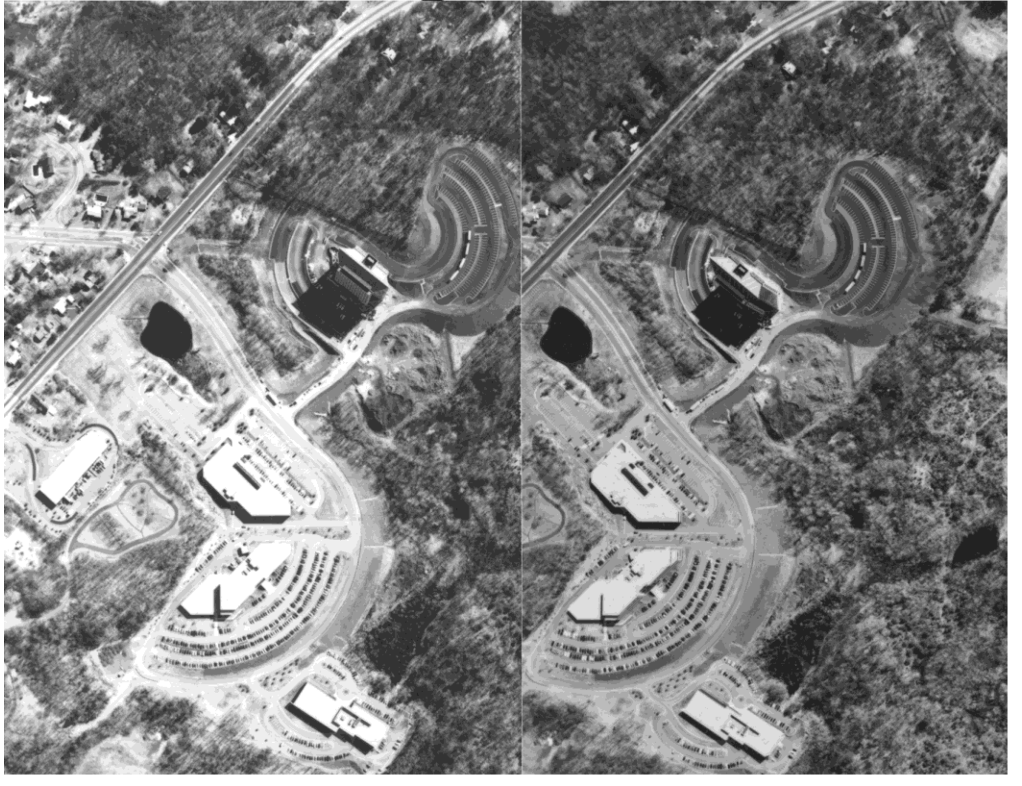
# GEO 4120c – Air Photo Interpretation



23 February 2009: **Parallax and Vertical Measurements: Stereo Parallax**

# Last Time

- Geometry and Photo Measurements 2:
- Principles of Stereoscopic Vision
- Vertical Measurements – Single Photo Parallax

# Today

- **Parallax, Vertical Measurements II: Stereo-pair measurements**
- **Parallax equations**
- **The Floating Red Dot Device: The Parallax Bar**
- **Play with Parallax Bar**
- **No workshop today – calculations on exam**
- **EXAM posted at 1:45 PM**

# HEIGHT MEASUREMENTS
## using stereoscopic parallax

- **Relief displacement on photos allows height measurement;**
  - **if no displacement, no *stereoscopic parallax*...**

- **Parallax:**
  - apparent displacement of an object caused by a change in point of observation
  - e.g. same object viewed from each of a stereo pair of photos (stereoscopic parallax)

# Parallax Height Equation

$$h = \frac{H\,dP}{P_b + dP}$$

Where:

*h* = height of object being measured

*H* = flying height above base of object

*dP* = difference in absolute parallax between top and bottom of the object

*P* = average absolute parallax of the two ends of the baseline (measured as the distance between the principal points of the two photos minus the distance between the images of the base of the object on the two photos when they are properly aligned for the measurement of *dP*).

$P_b$ = absolute parallax at the base of the object (measured as the distance between the principal points of the two photos minus the distance between the the images of the base of the object on the two photos when they are properly aligned for measurement of *dP).*

# Parallax Height Equation

**$h=(H)*[dp/(P + dp)]$**

**H = the flying height above the ground** (also indicated as $(H-h)$)

**dp = differential parallax**

a)measure (in mm) from the top of the object in question on one photo to the same place on the other photo

b)measure (in mm) from the base of the object in question on one photo to the same place on the other

c)subtract the two values found in a and b to find the dp

**P = average photo base length**

a)measure the photo distance between the principal point and the corresponding principal point on each photo and divide by two)

**h = the height of the object.**

# HEIGHT MEASUREMENTS

## using stereoscopic parallax

**The parallax-height equation:**

$$h_o = \frac{(H-h)*dP}{P_b + dP}$$

$h_o$ = height of displaced object

$P_b$ = *absolute stereoscopic parallax: Photo Base*

$dP$ = *differential parallax*

$(H-h)$ = flying height above the base of the object

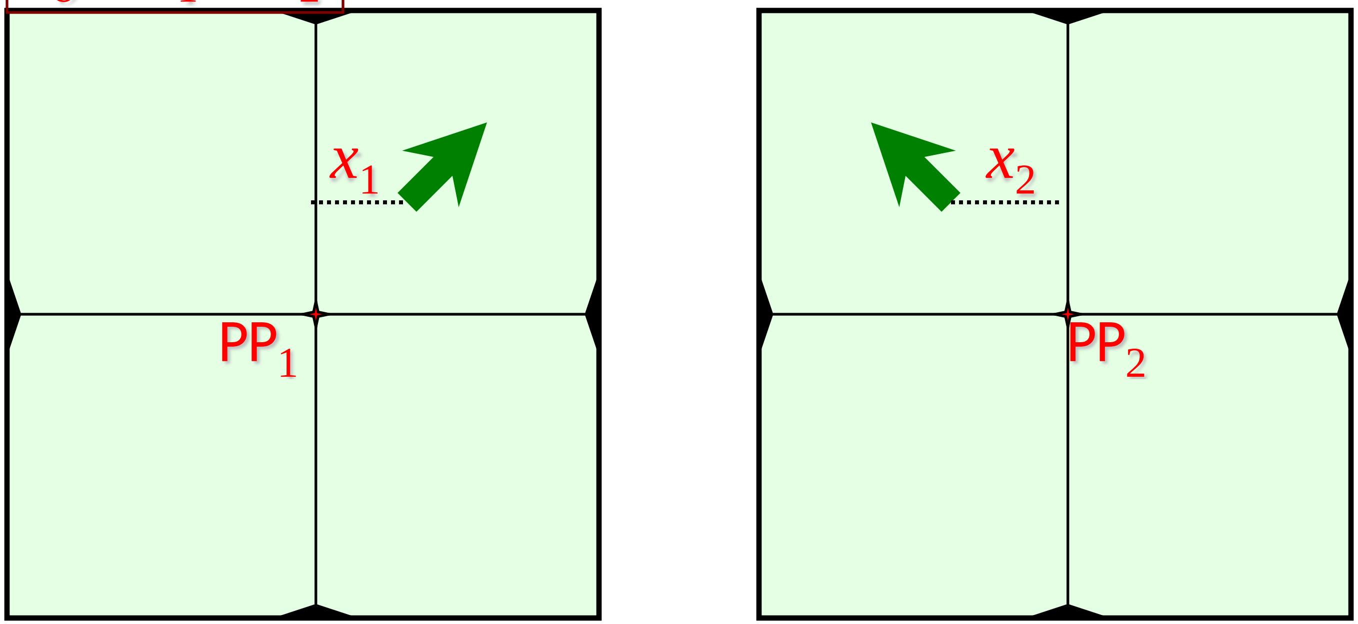
* measure *P* and *dp* on the photo
(e.g., with an engineer's scale, parallax wedge, or parallax bar)
using the ***same*** units (e.g. mm, inches)

# HEIGHT MEASUREMENTS
## using stereoscopic parallax

- **absolute stereoscopic parallax (*$P_b$*)**
  - sum of the distance of corresponding image objects from their respective nadirs (PPs) to the base of the object
  - always measured parallel to the flight line

$$P_b = x_1 + x_2$$

*a difficult measurement...



# HEIGHT MEASUREMENTS

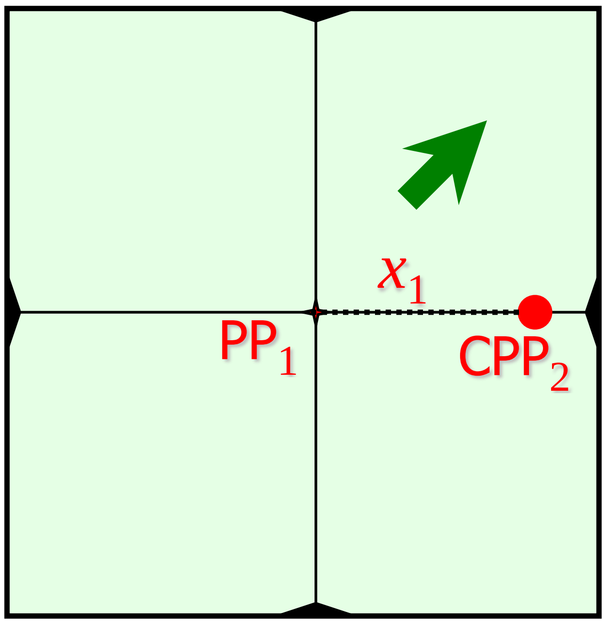
## using stereoscopic parallax

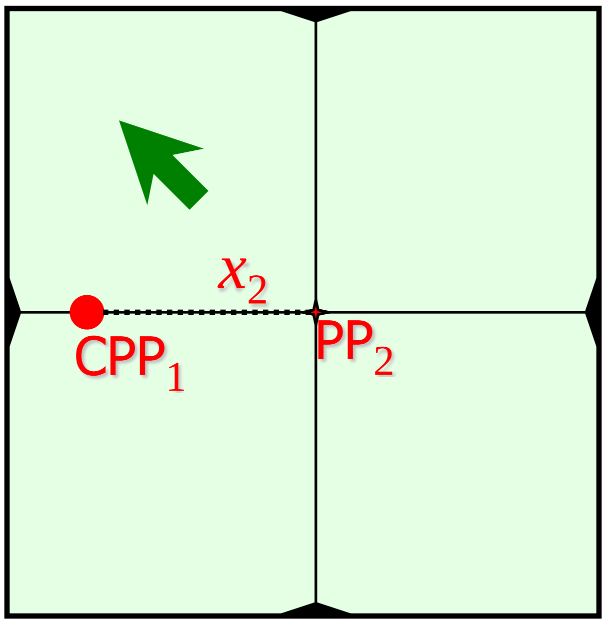
- **Average photo base ( *P* )**
  - can be substituted for $P_b$ in level terrain
  - the mean distance between PP and CPP on each photo

(when PP1, PP2, and the base of the object are all at approximately the same elevation)

$$P = (x_1 + x_2) / 2$$

$$h_o = \frac{(H - h) * dP}{P + dP}$$



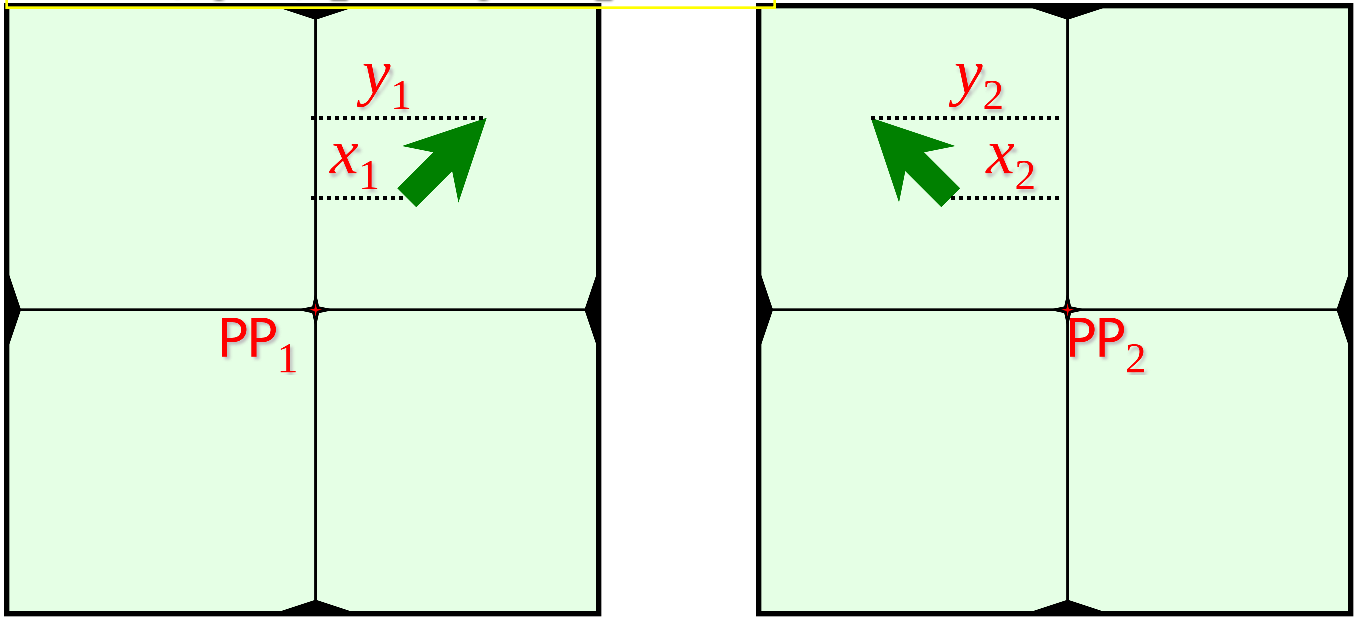



# HEIGHT MEASUREMENTS
## using stereoscopic parallax

- **differential parallax (*dP*)**
  - the difference in the absolute stereoscopic parallax at the top and the base of the object
  - always measured parallel to the flight line

$$dP = (y_1 + y_2) - (x_1 + x_2)$$

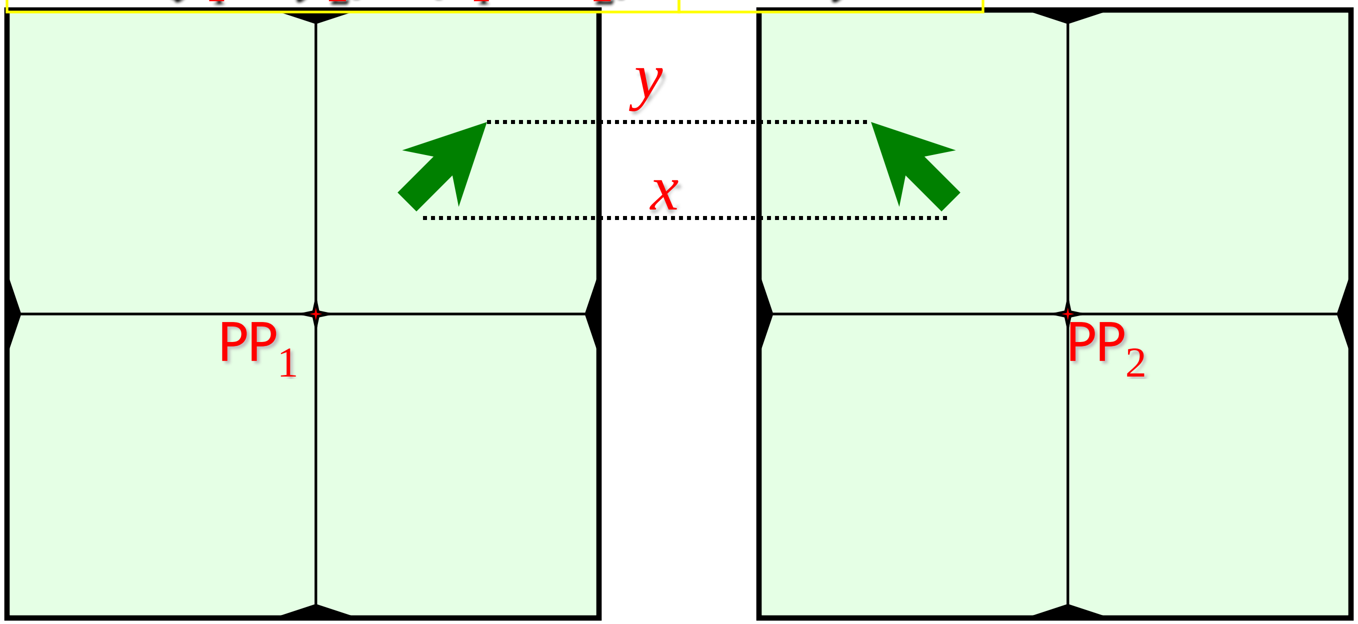
*OR...



# HEIGHT MEASUREMENTS
## using stereoscopic parallax

- **differential parallax (*dP*)**
  - the difference in the absolute stereoscopic parallax at the top and the base of the object
  - always measured parallel to the flight line

$$dP = (y_1 + y_2) - (x_1 + x_2) \quad = x - y$$

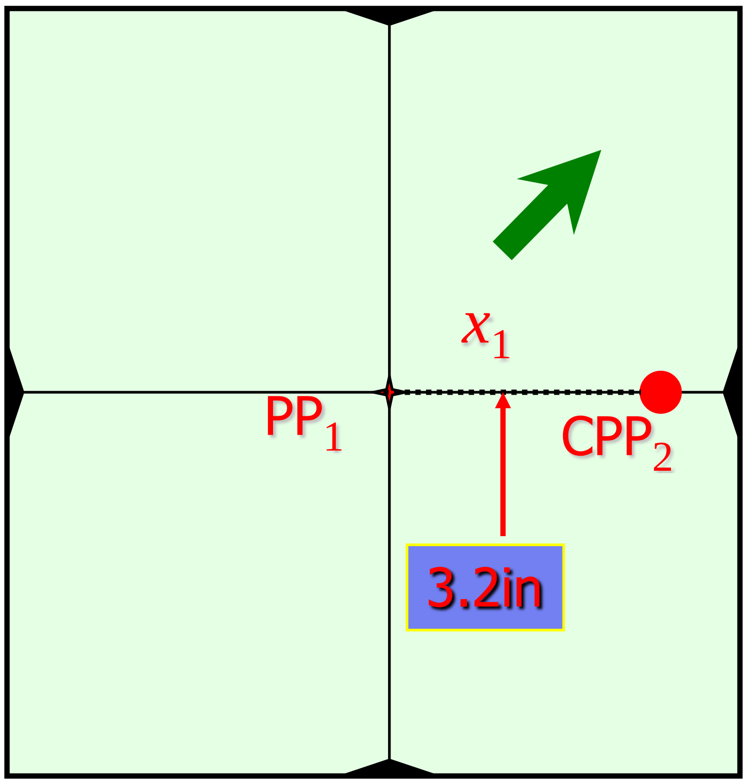


# HEIGHT MEASUREMENTS

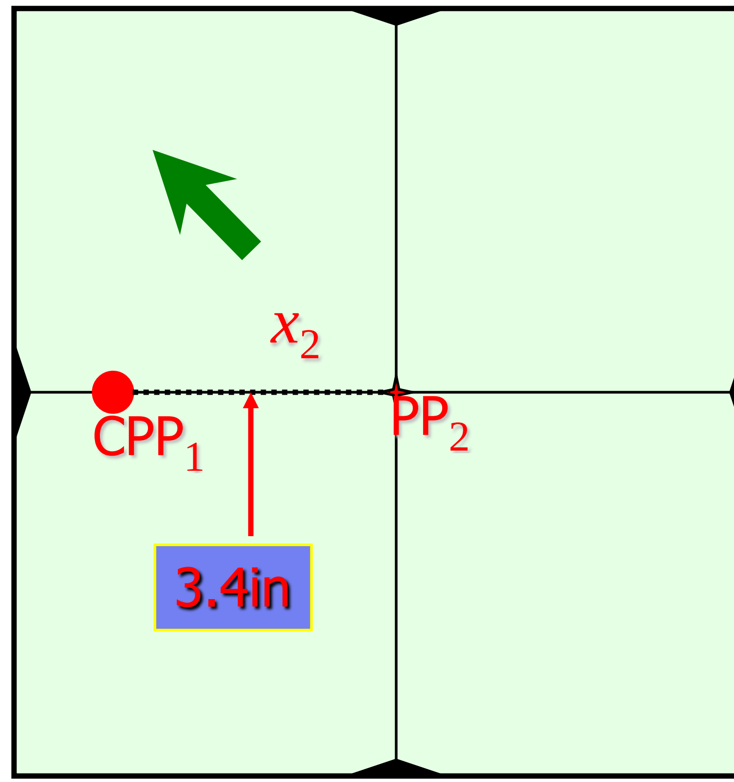
## average photo base (*P*)

use an engineer's scale

$P = (x_1 + x_2) / 2$




$P = (3.2\text{in} + 3.4\text{in}) / 2 = 3.3\text{in}$

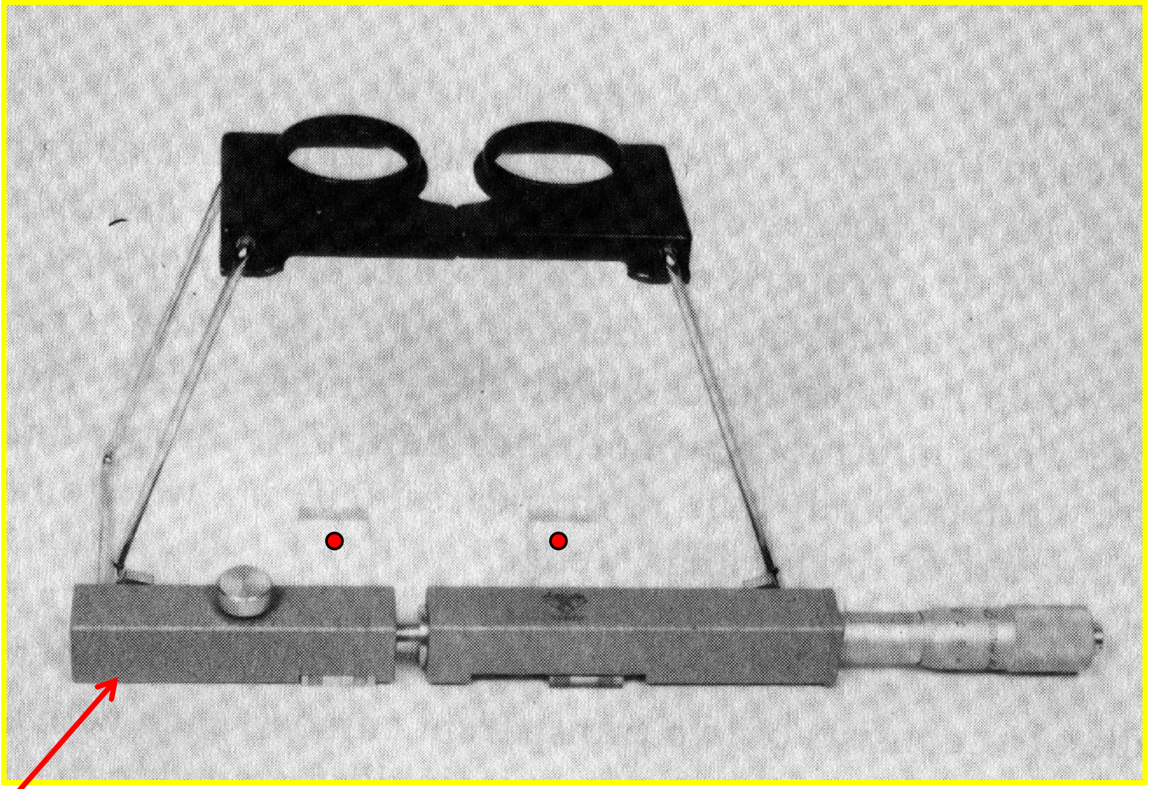


# Parallax Wedge

- See P. 220 in Arnold

# HEIGHT MEASUREMENTS

differential parallax (*dP*)

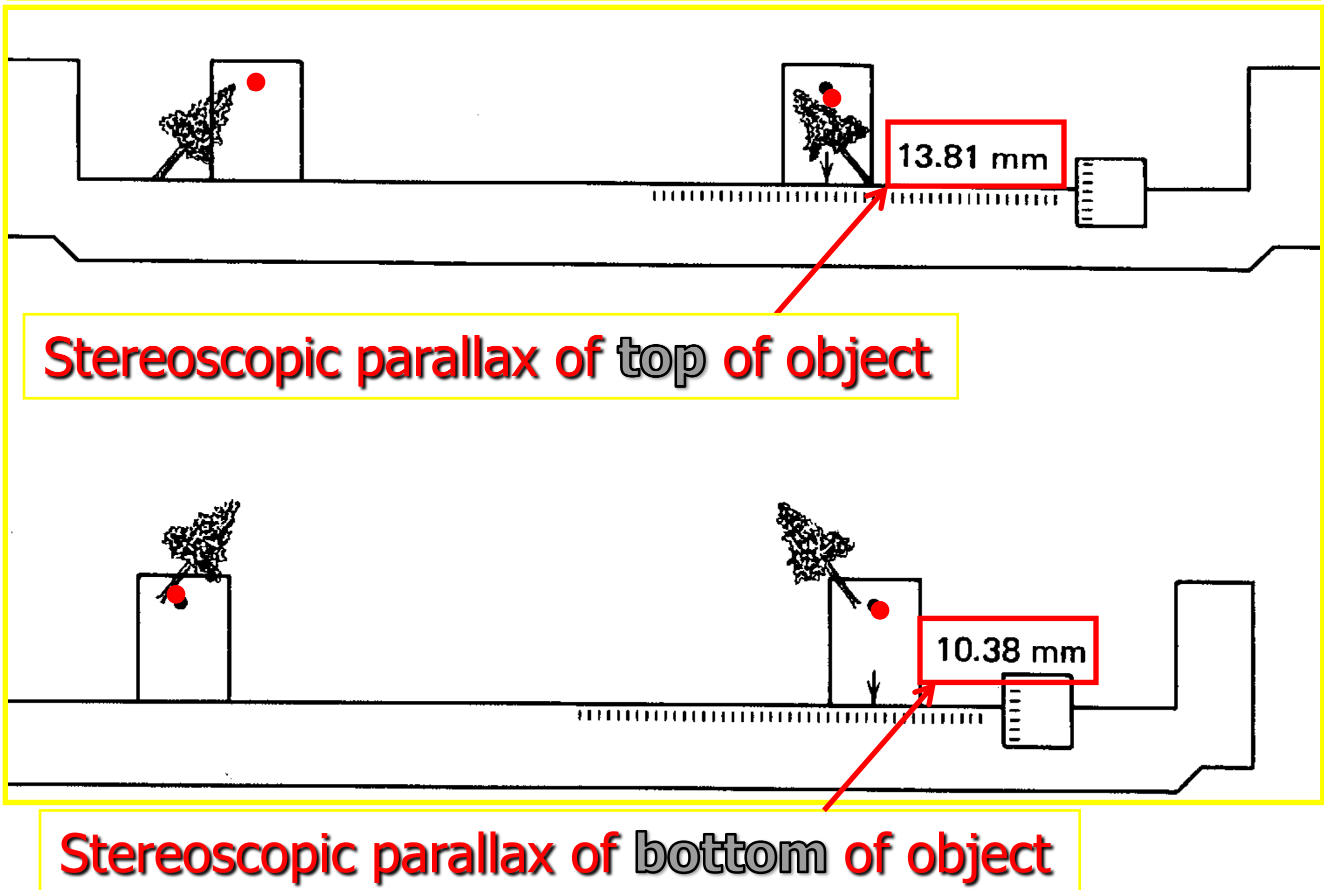


parallax bar (attached to pocket/lens stereoscope)

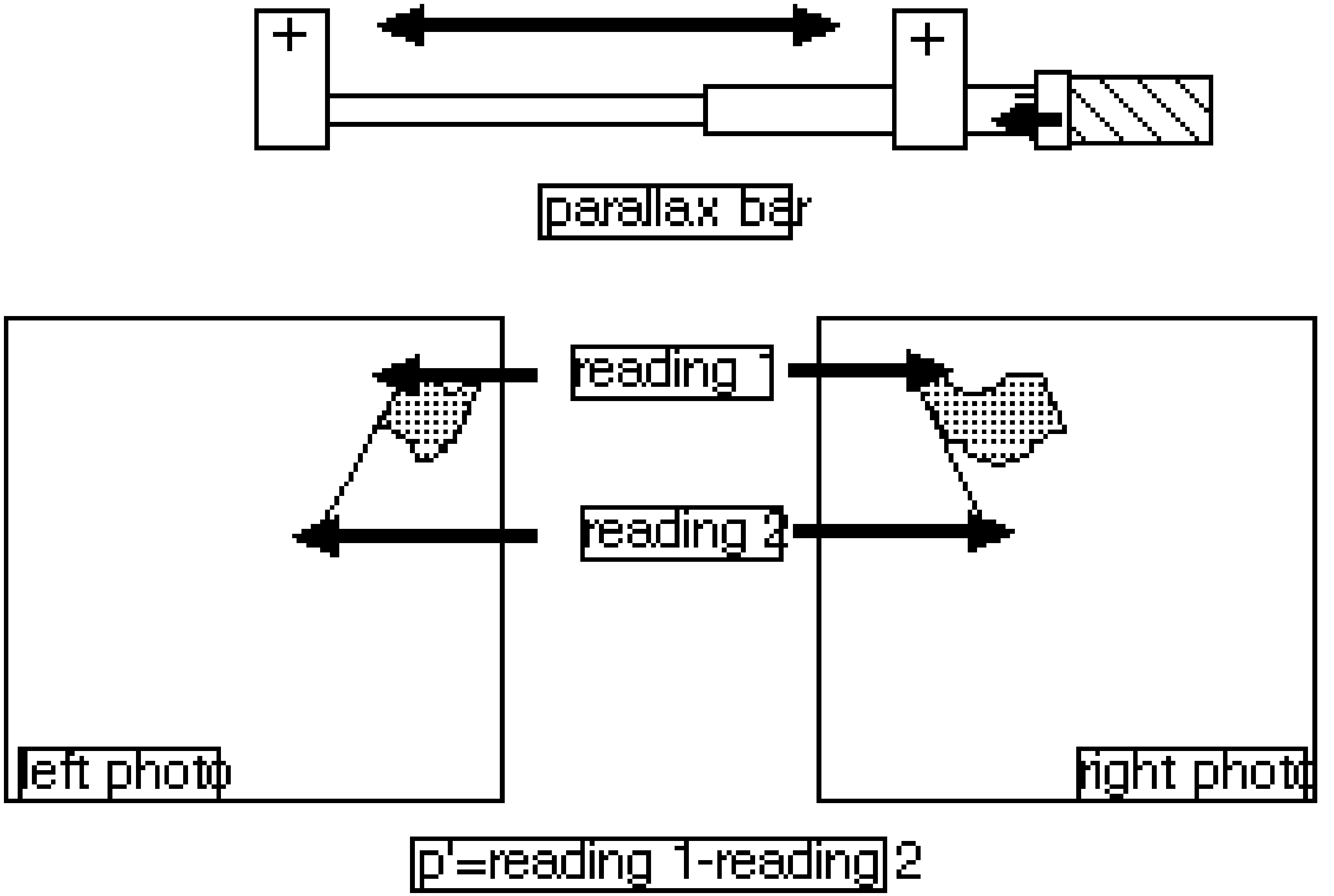
# HEIGHT MEASUREMENTS

## differential parallax (*dP*)

$dP$ = 13.81mm - 10.38mm = 3.43mm



# Parallax Bar




Read by two measurement on knob (reading 1, reading 2) – leveling marker with object bottom and top

# HEIGHT MEASUREMENTS

## using stereoscopic parallax

**The parallax-height equation:**

$$h_o = \frac{(H-h)*dP}{P+dP}$$

$h_o$ = height of displaced object

$P$ = average photo base $= 3.3\,in$ = 84 $mm$

$dP$ = differential parallax $= 3.4\,mm$

$(H-h)$ = flying height above the base of the object $= 1{,}000\,m$

same units!

# HEIGHT MEASUREMENTS

## using stereoscopic parallax

**The parallax-height equation:**

$$h_o = \frac{(H-h)*dP}{P+dP}$$

$$h_o = \frac{(1000m)*3.4\not{mm}}{84\not{mm}+3.4\not{mm}} = \boxed{38.9m}$$

Remember that $(H-h)$ is the altitude above ground, when $h$ is the elevation of the ground and $H$ is the altitude above "sea level."

# Next Time

- Exam posted at 1:45 Today
- Turn in Exam by 4:00 PM 27 February (Friday)
- USE YOUR OWN WORDS. DOWNLOADED, CUT AND PASTE, TEXT WILL NOT BE ACCEPTED
- Digital Air Photo Interpretation
  - Introduction to ERDAS Imagine