

Rough object creation

Casting

Low Precision

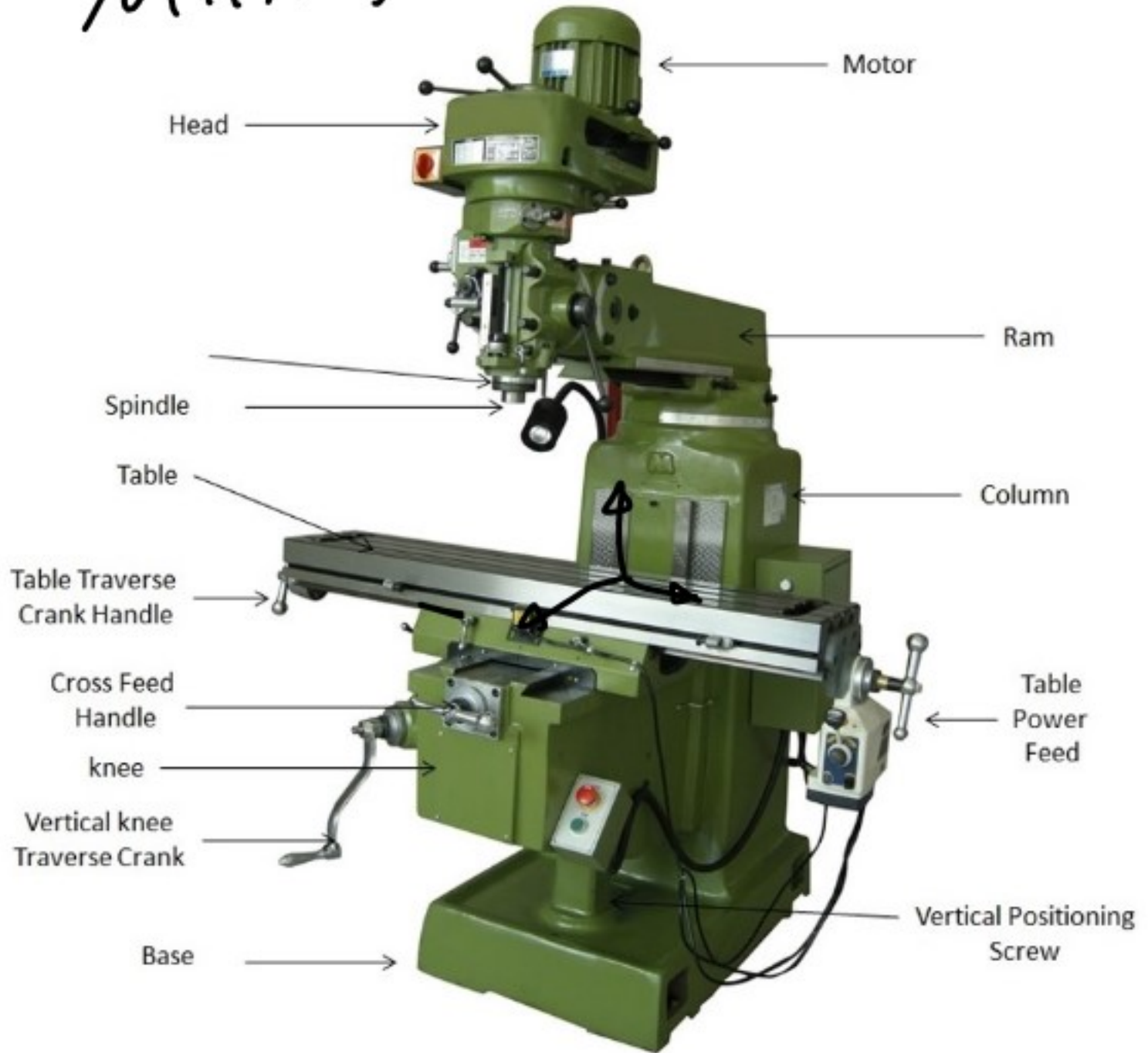
Forging

High Tolerances

Welding

More Precise Parts

# Milling Machine



# Lathe

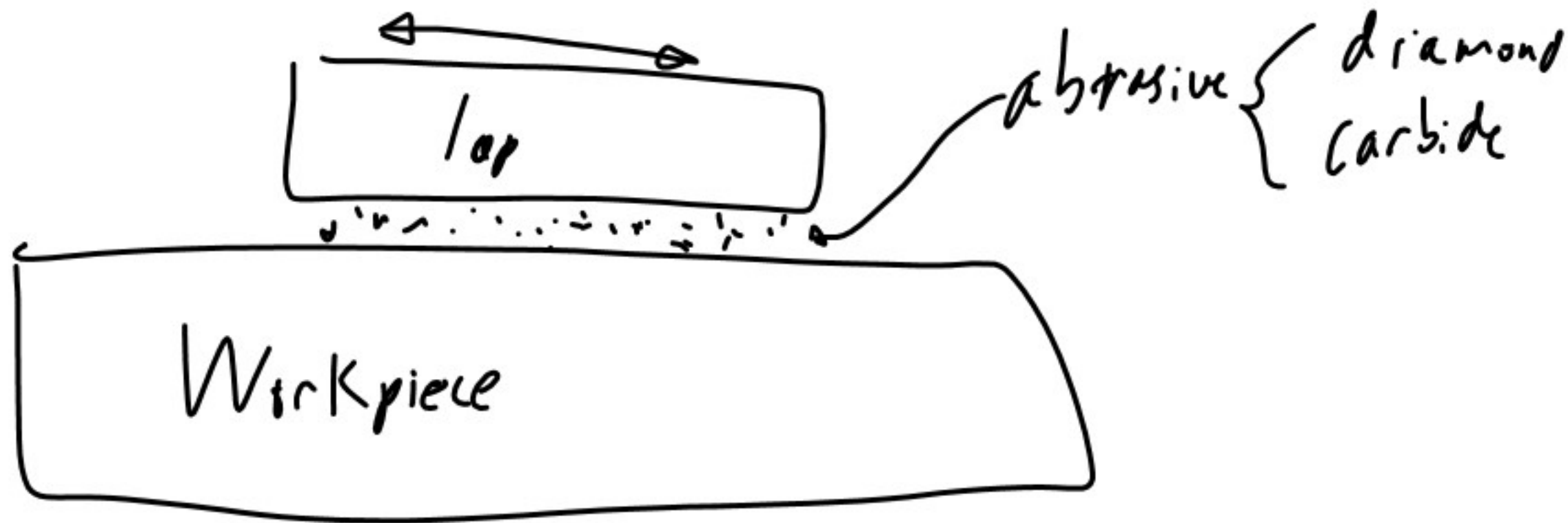


How to create a flat surface

how to check it

How to make a square

# Lapping



Lap and  
Workpiece  
Same material  
Material removed  
from both

Lap is softer  
Material removed  
from workpiece



Scraping

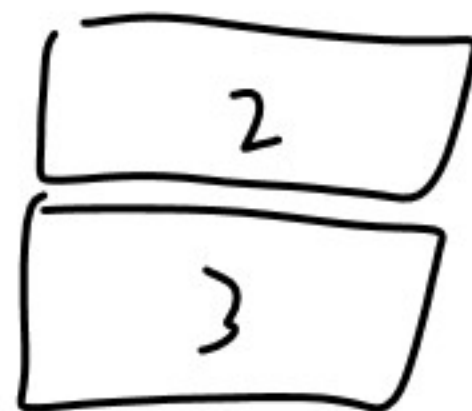
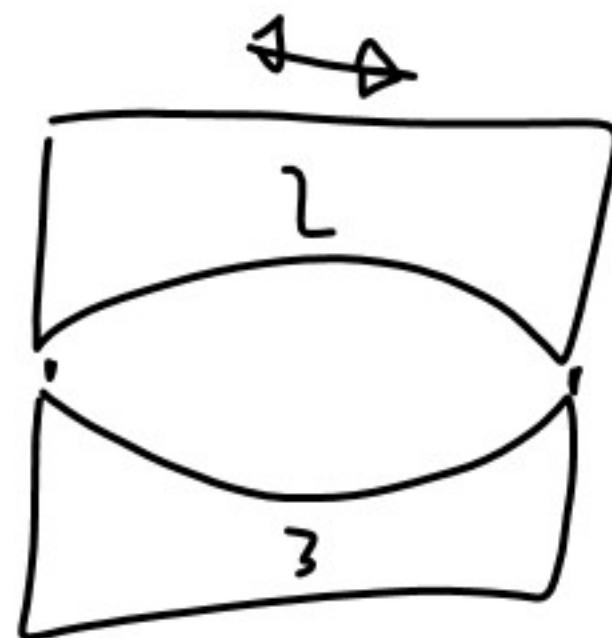
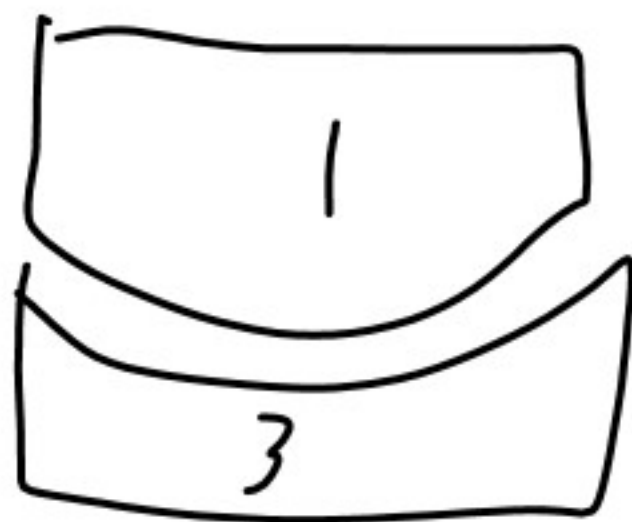
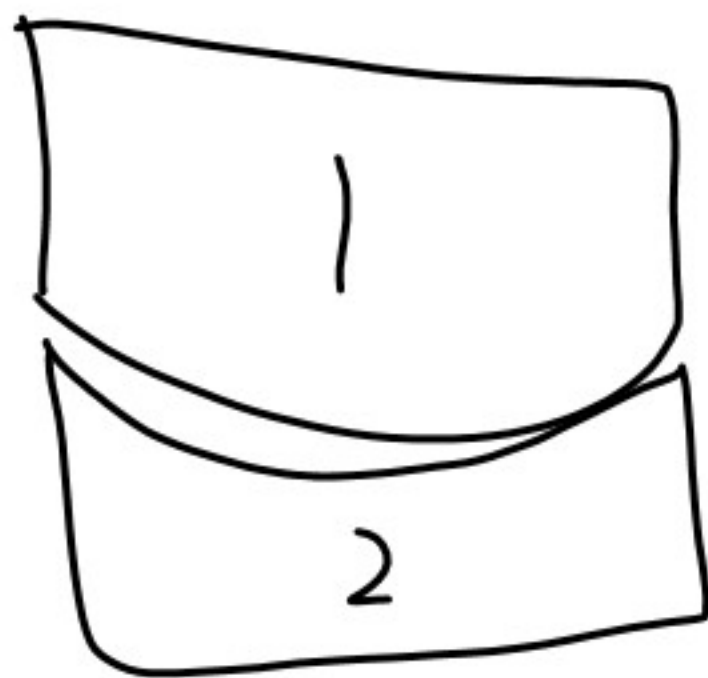
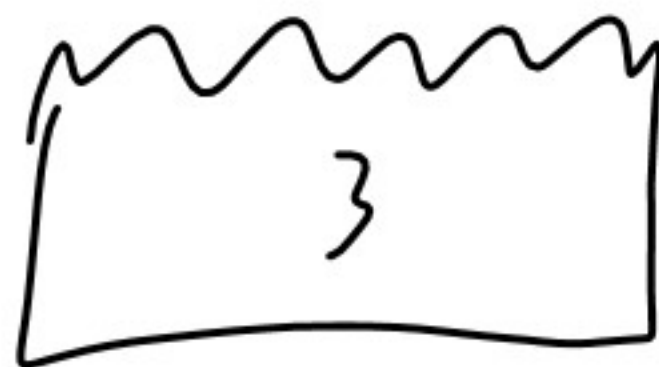
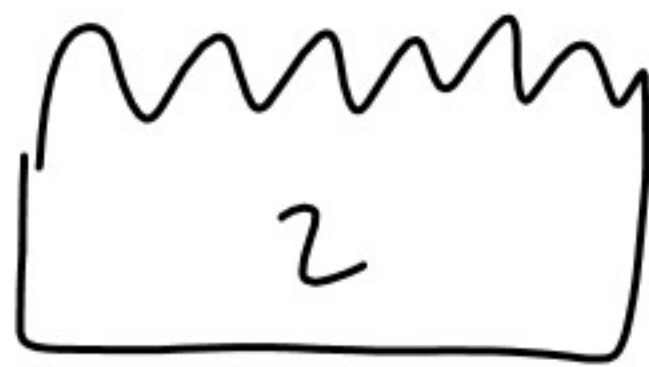


Scraper

High Spot

PayCNC.COM

# Three plate method





Surfact plate



Thermal expansion

Cast Iron

Granite

Same

Lower

Drop something

Dent

Chip

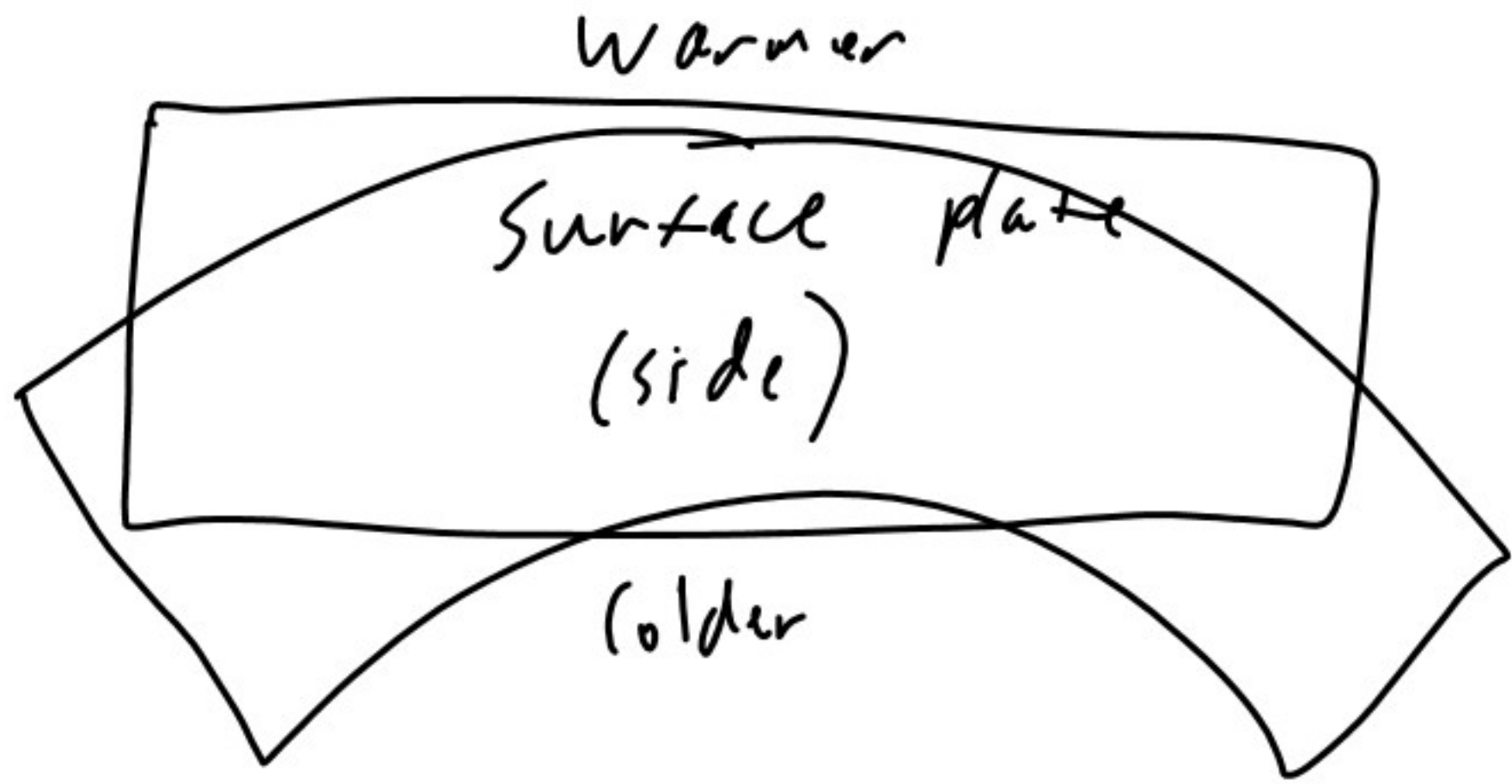


Cost

Expensive

Cheaper





Rectangular Surface Plate		Flatness Tolerances ( $\mu\text{in.}$ )					
		Grade AA		Grade A		Grade B	
Width (in.)	Length (in.)	Local Flatness	Overall Flatness	Local Flatness	Overall Flatness	Local Flatness	Overall Flatness
12	12	35	50	60	100	110	200
12	18	35	50	60	100	110	200
18	18	35	50	60	100	110	200
18	24	35	80	60	160	110	320
24	24	45	80	70	160	120	320
24	36	45	100	70	200	120	400
24	48	45	150	70	300	120	600
30	48	45	180	70	360	120	720
36	36	45	150	70	300	120	600
36	48	45	200	70	400	120	800
36	60	60	250	80	500	160	1000
36	72	60	300	80	600	160	1200
48	48	60	200	80	400	160	800
48	60	60	300	80	600	160	1200
48	72	60	350	80	700	160	1400
48	96	75	500	100	1000	200	2000
48	120	90	700	120	1400	240	2800
60	120	90	750	120	1500	240	3000
72	96	90	600	120	1200	240	2400
72	144	100	1100	140	2200	280	4400

100  $\mu\text{in}$   
0.0001 in

45  $\mu\text{in}$   
0.000045 in

Machinists Level

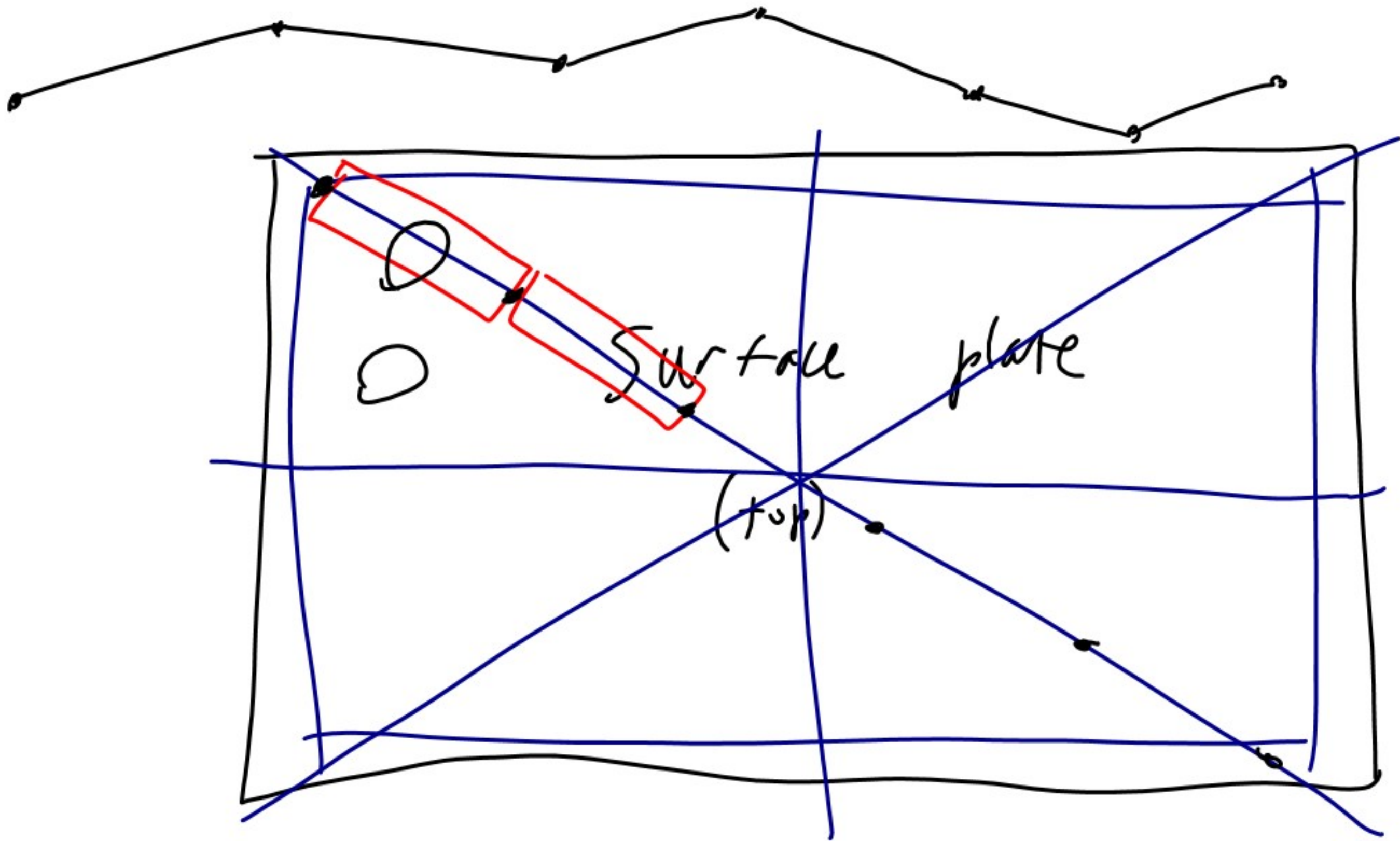


12 in

0.005 in

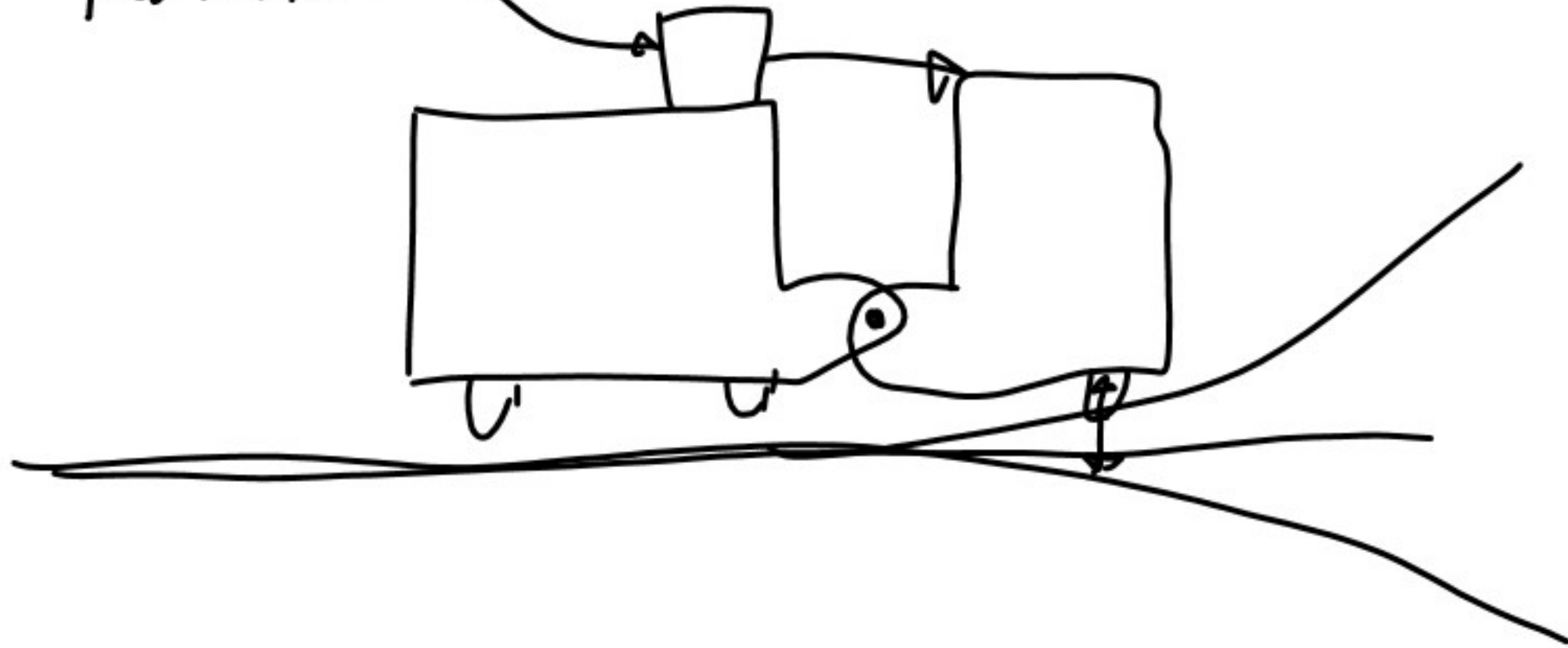
Electronic Levels





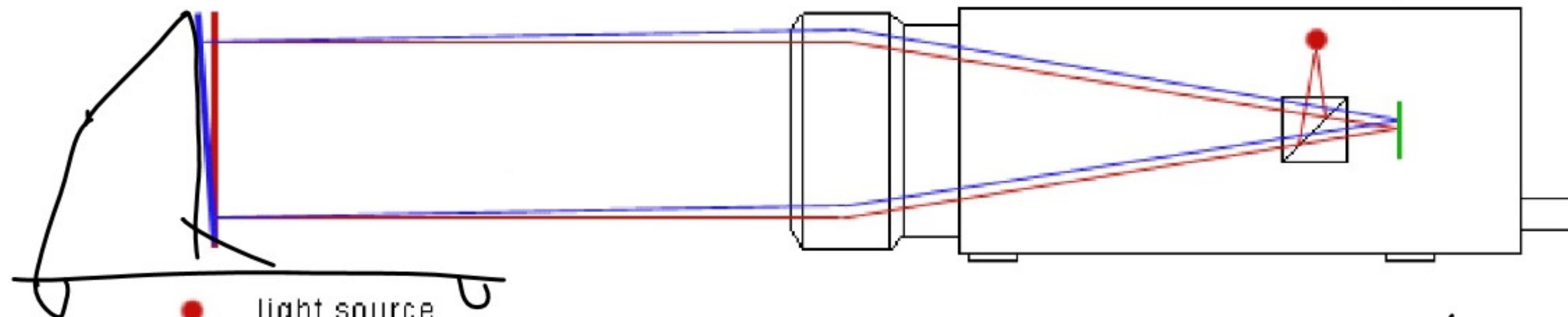
# Local Flatness

Repeat - 0 - Meter  
indicator



# Autocollimator

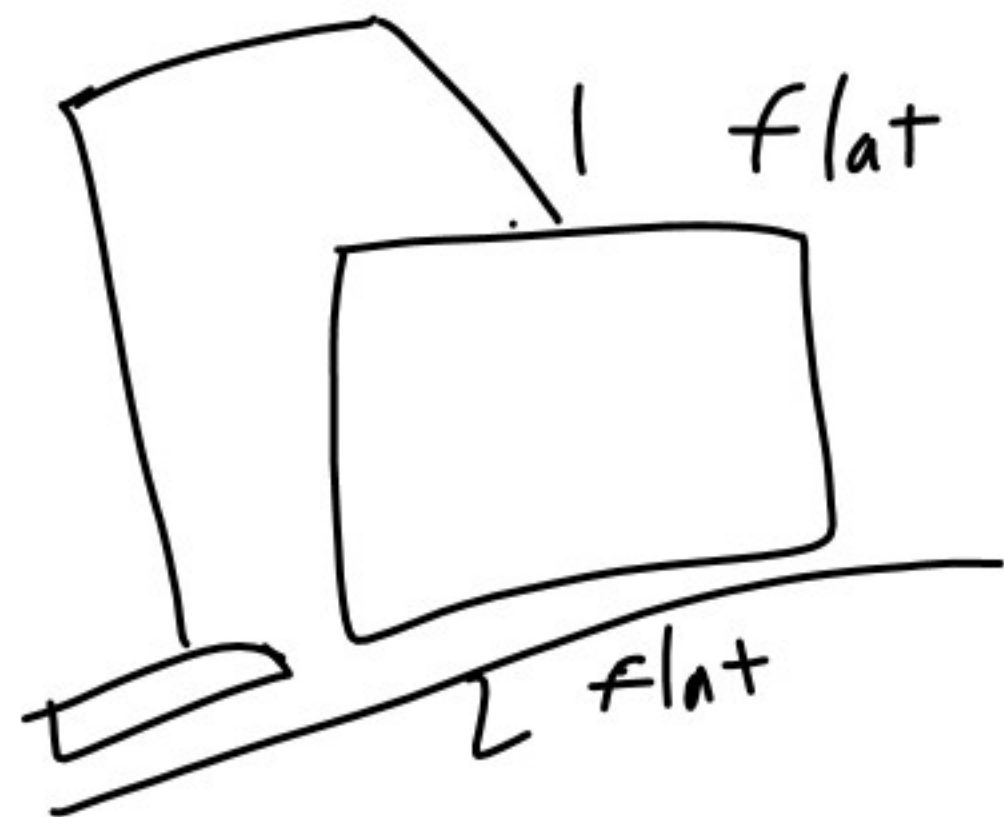
$$4 \text{ arc-second} = 0.0011^\circ$$

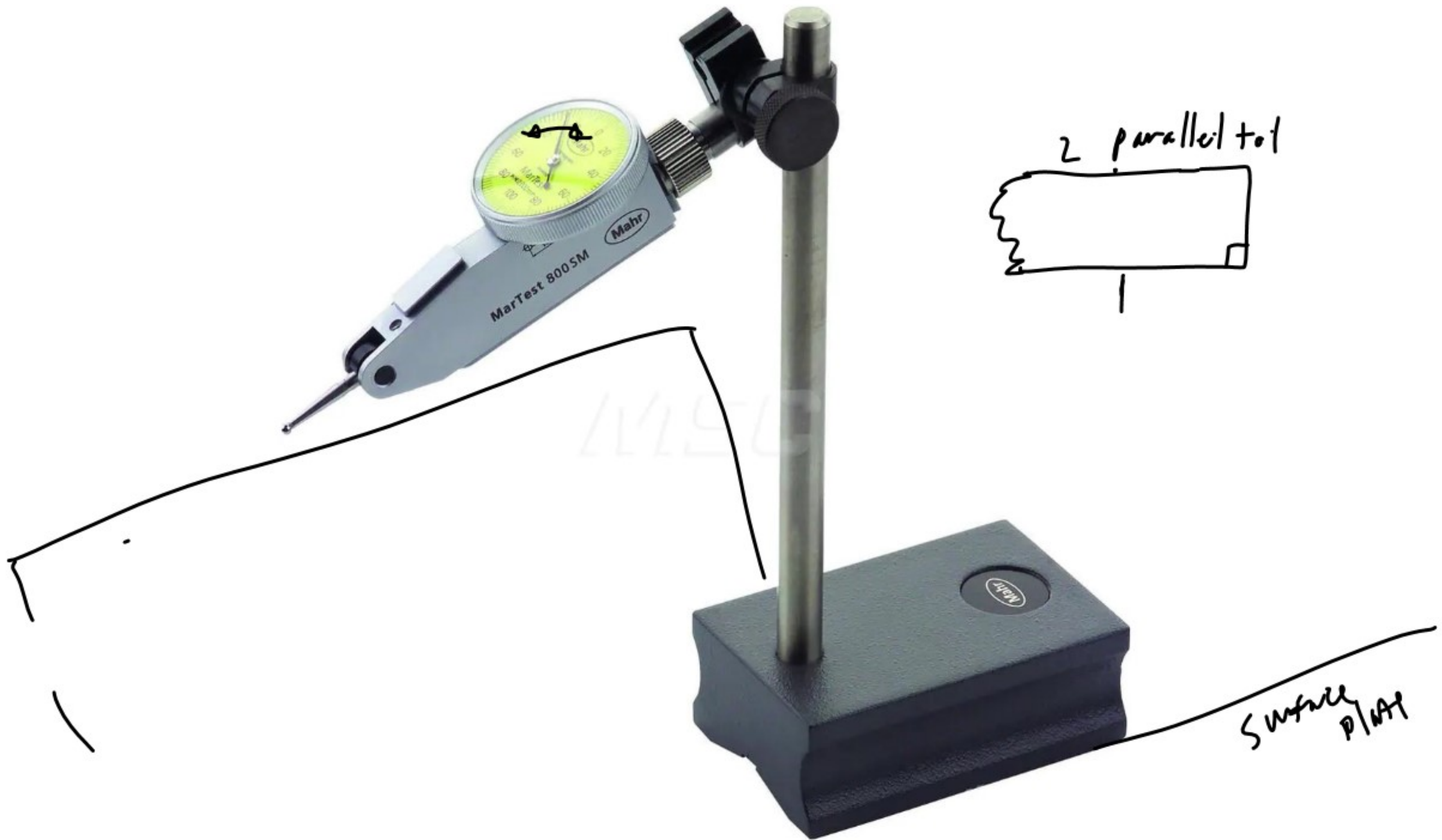


- light source
- reflected beam when mirror is perpendicular to autocollimator
- reflected beam when mirror is tilted
- detecting surface

$$1^\circ = 60'$$
$$1' = 60''$$







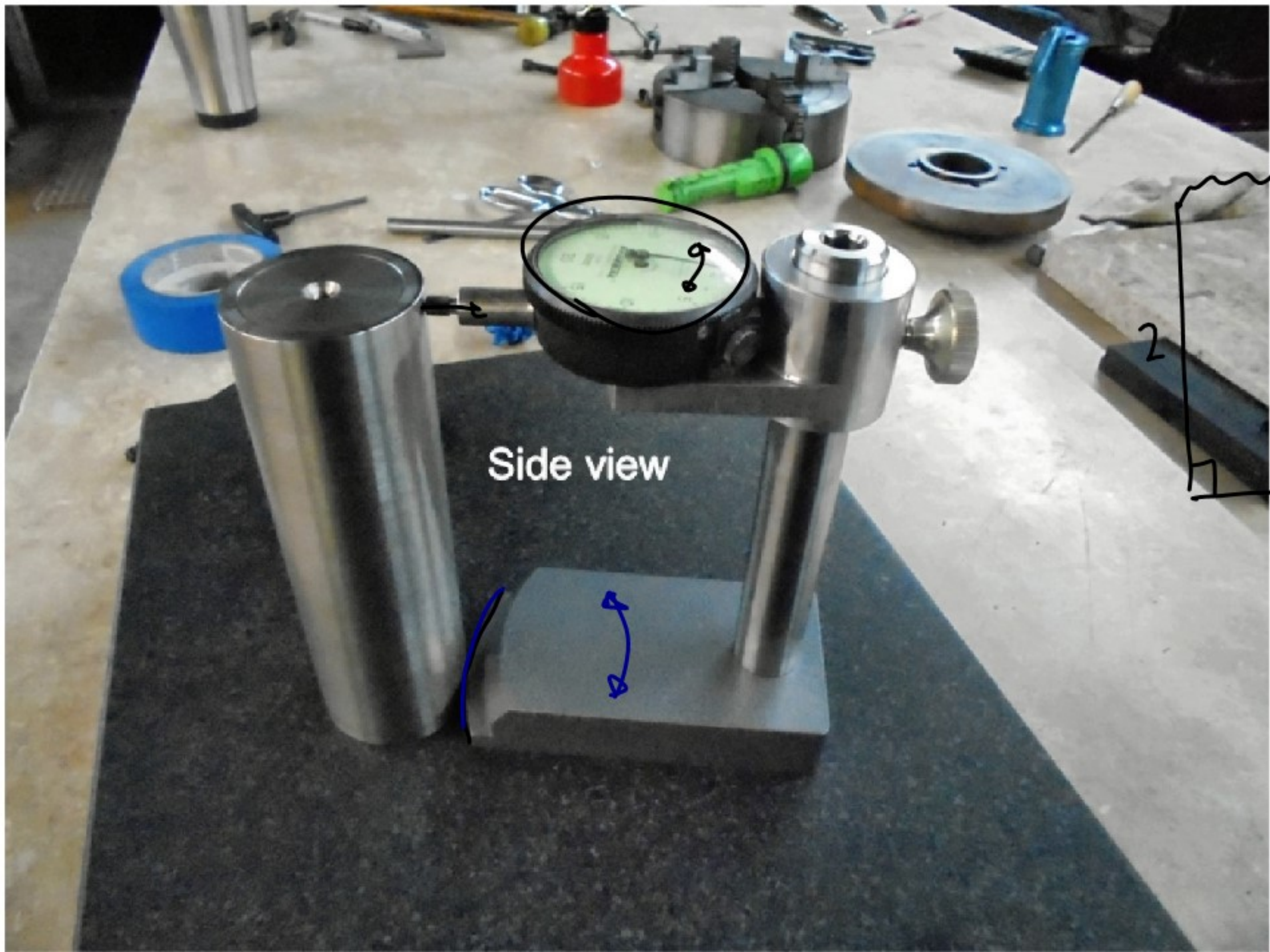
MarTest 800SM

Mahr

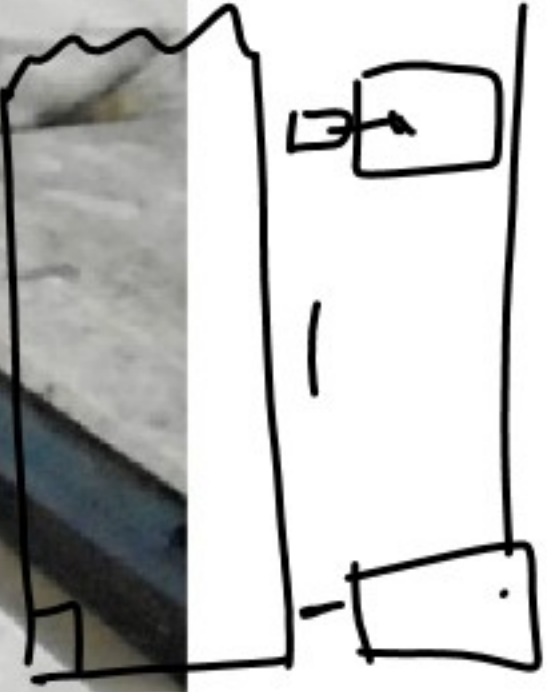
2 parallel to

Surface  
PLATE





Side view







Foundations of  
Mechanical  
Accuracy  
by Wayne Moore