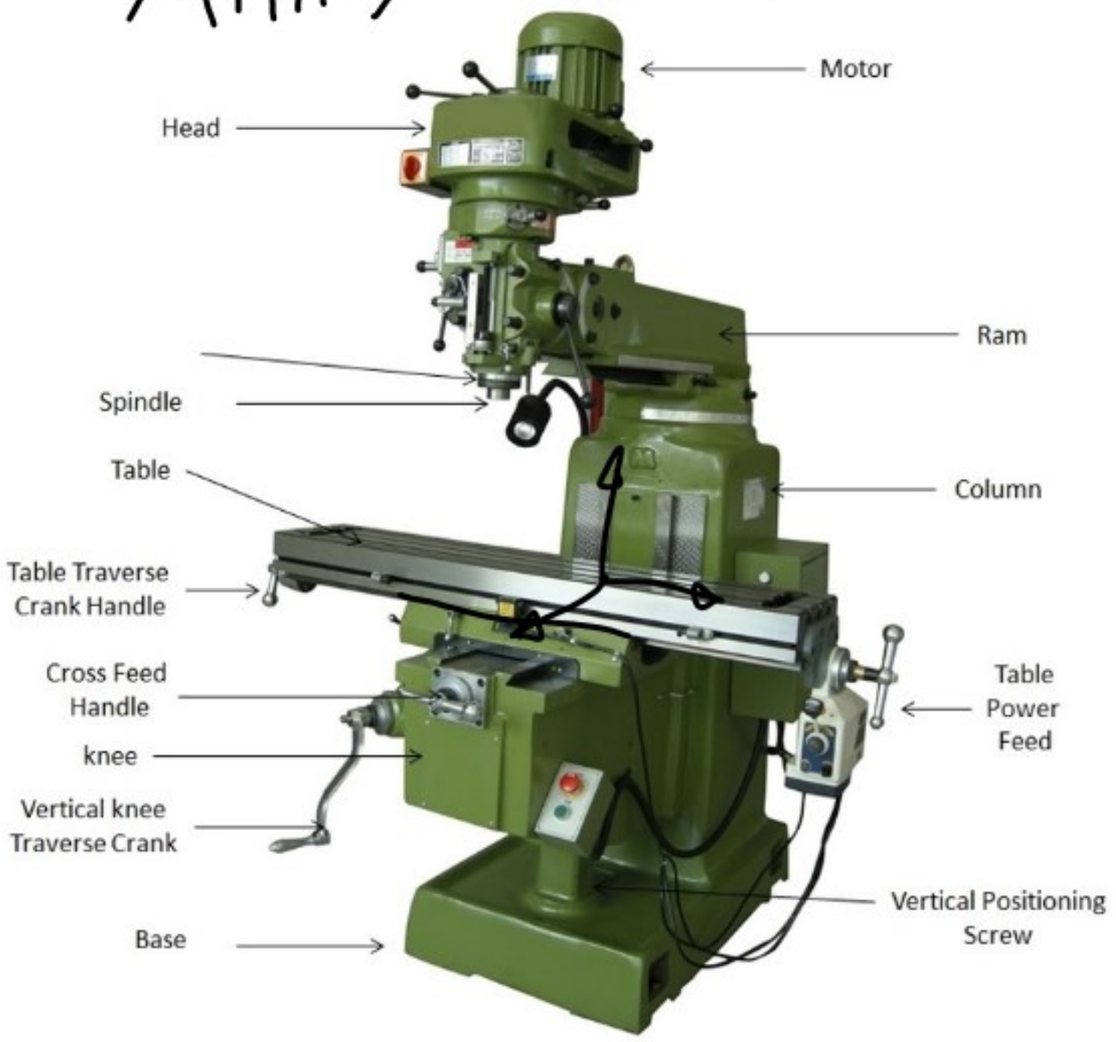
How roughly shaped objects are made

- Casting
- Forging
- Welding

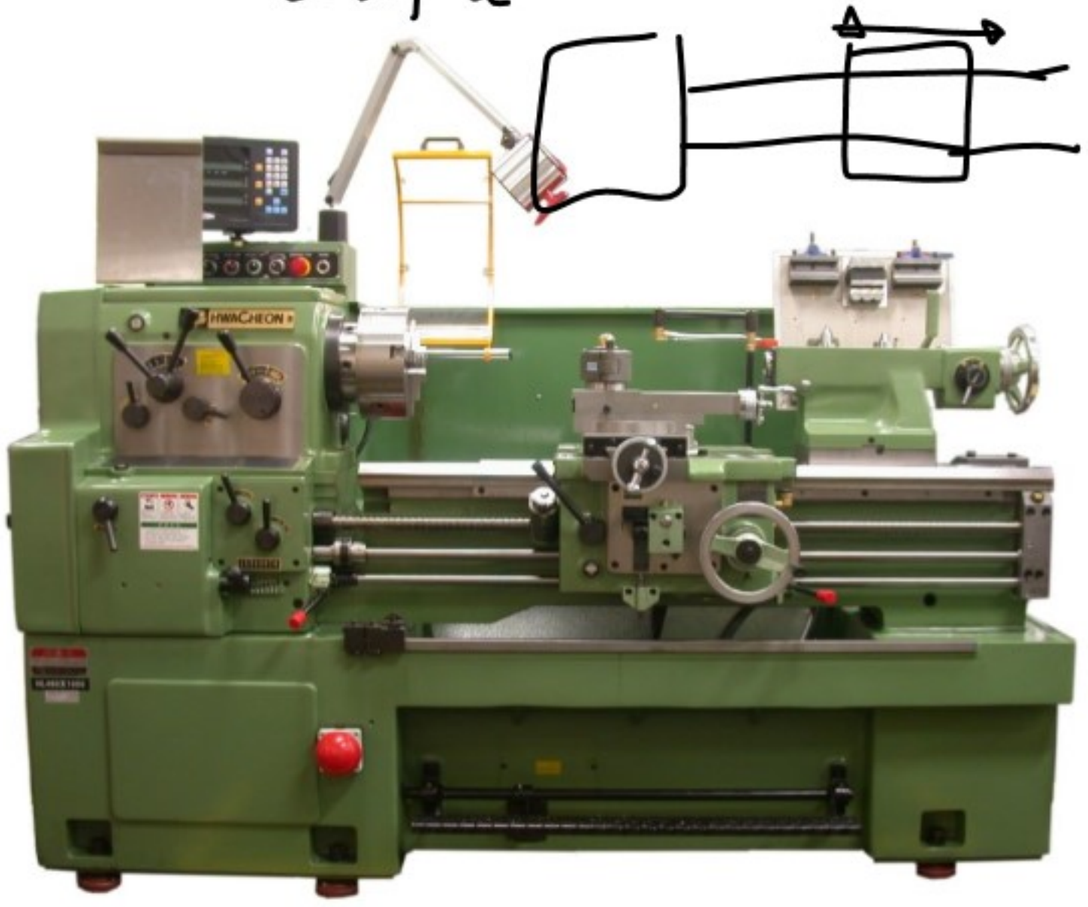
Low precision

Large Tolerances

Milling Machine

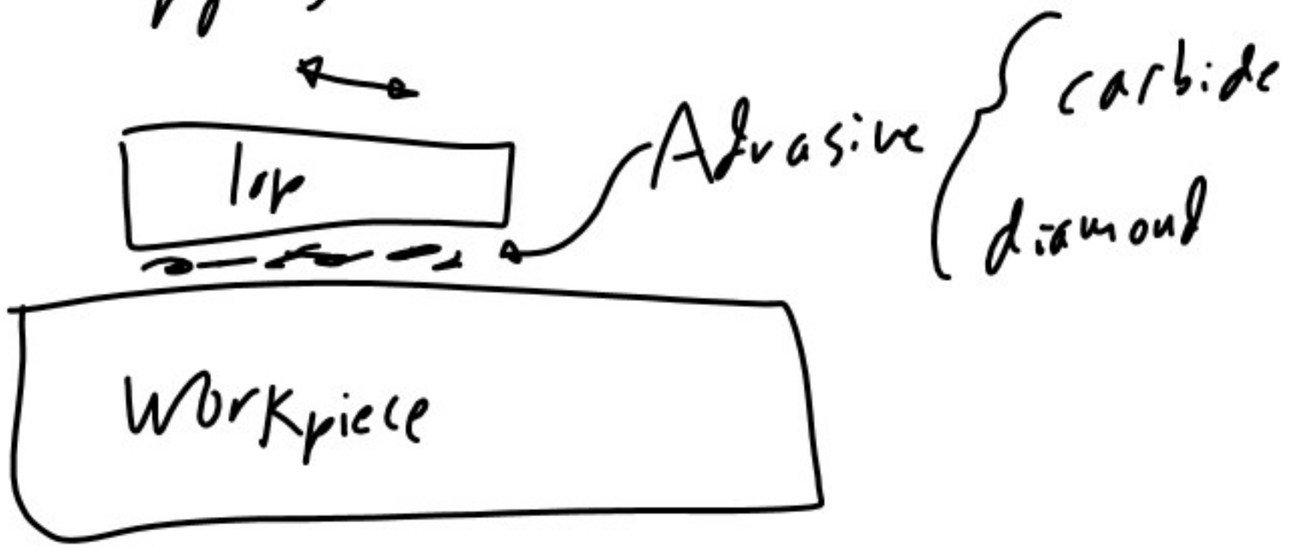


Lathe



Reference surface flat

Lapping



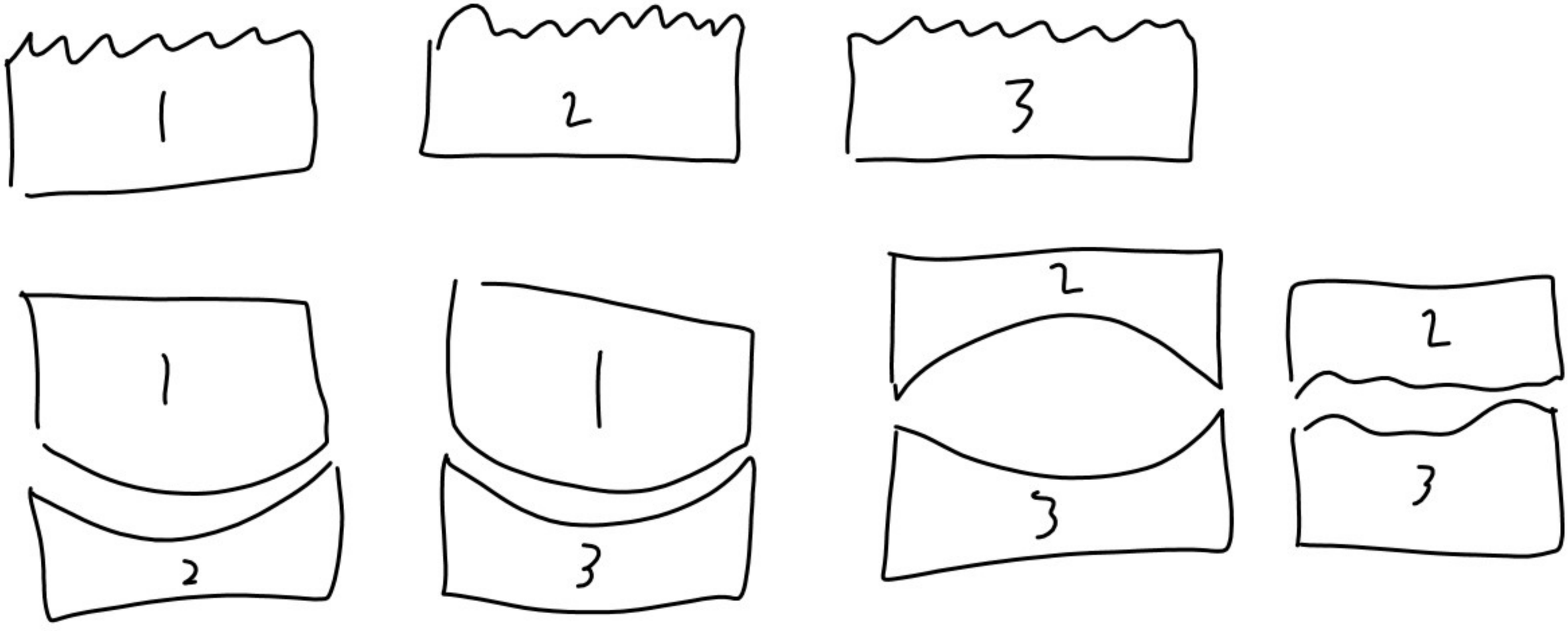
Same Material
Removes from Both

Lap softer

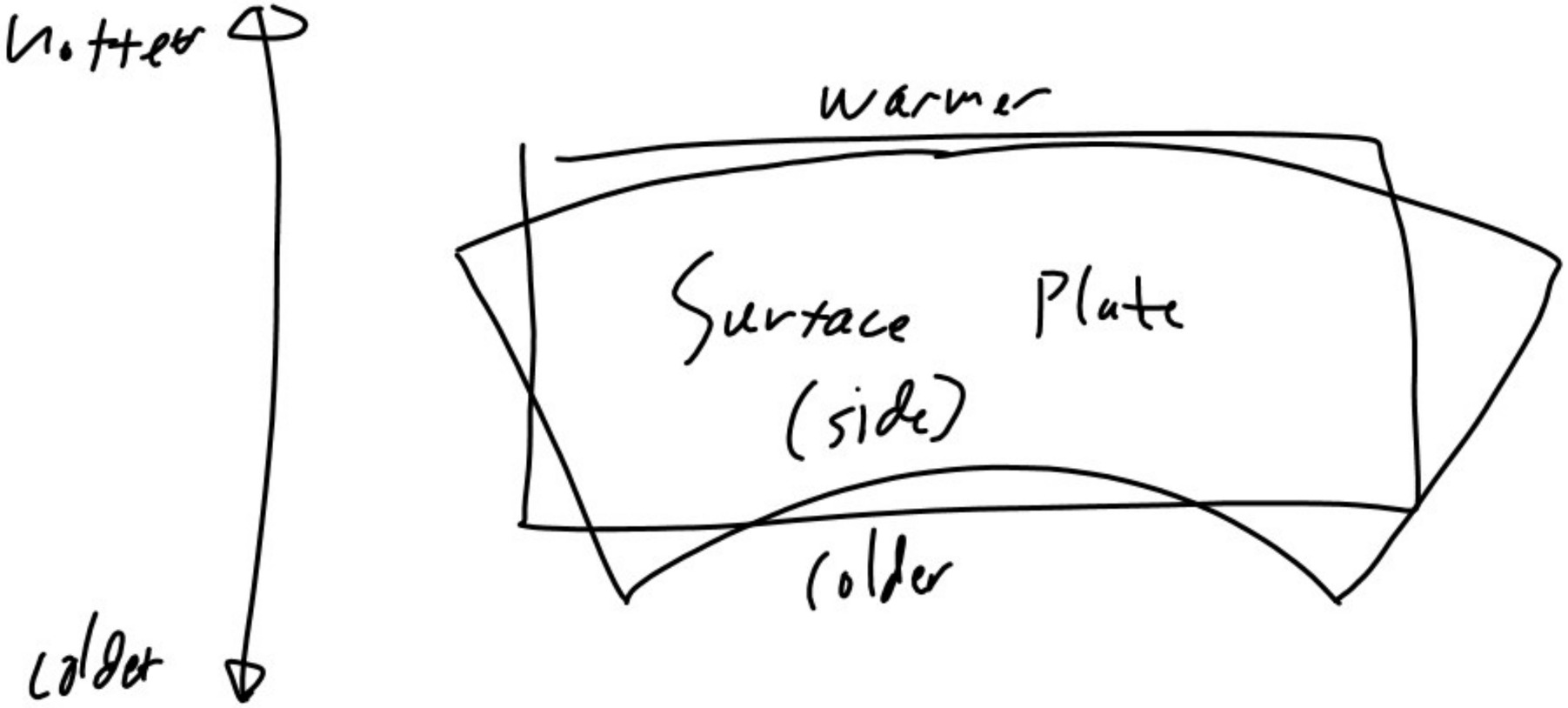
Remove from workpiece


Scraping
Scraper
Workpiece
High Point
PayCNC.COM

Three plate method



	Cast Iron	Granite
temperature	Similar to workpieces	Lower
drop a part	dent 	chip 
cost	expensive	cheaper
Weight	heavier	lighter


Warmer
Surface
Plate
(side)
colder
Warmer
colder

Rectangular Surface Plate		Flatness Tolerances (µin.)					
		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 µ in

0.0001 in

45 µin

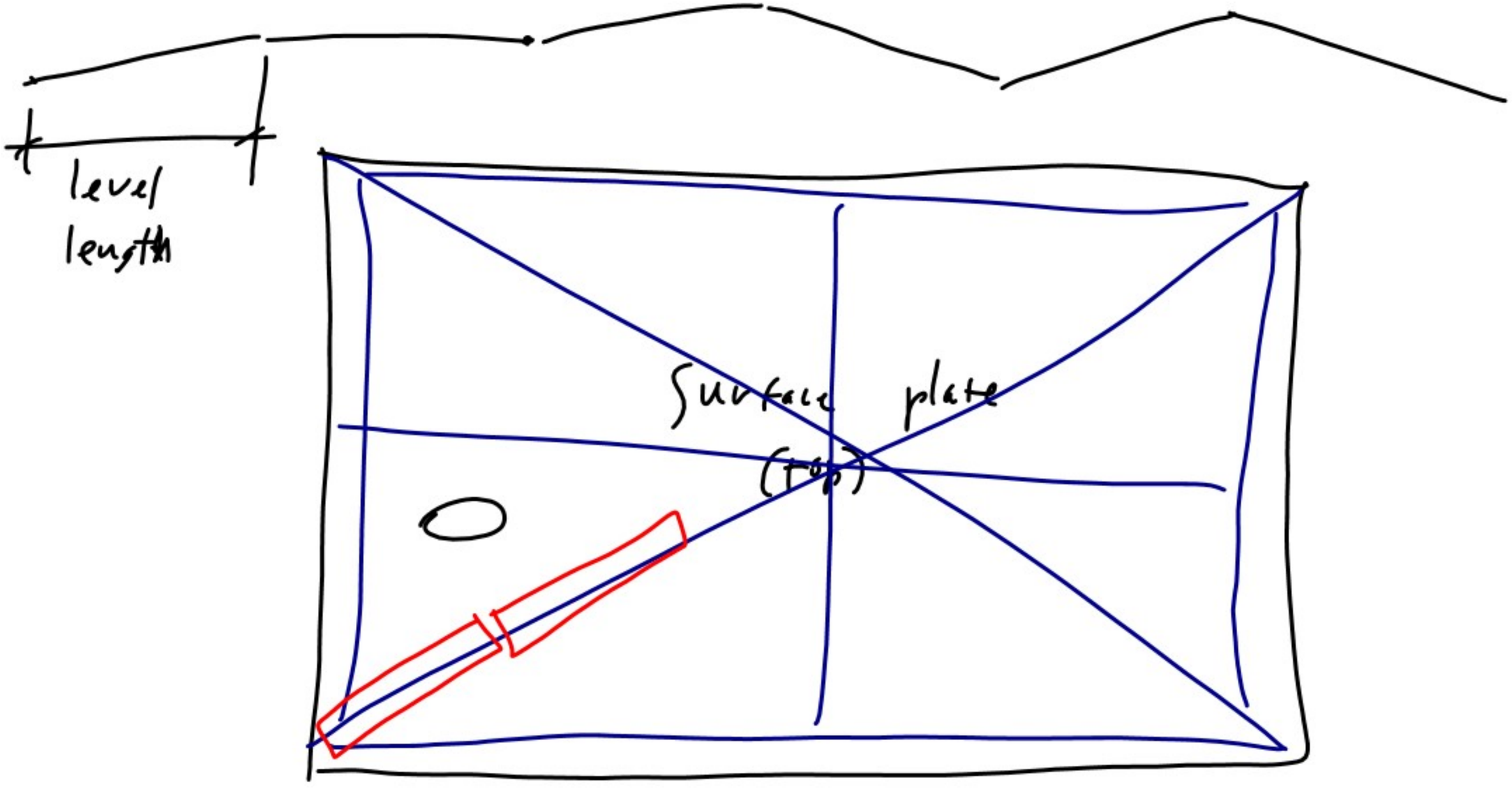
0.000045"

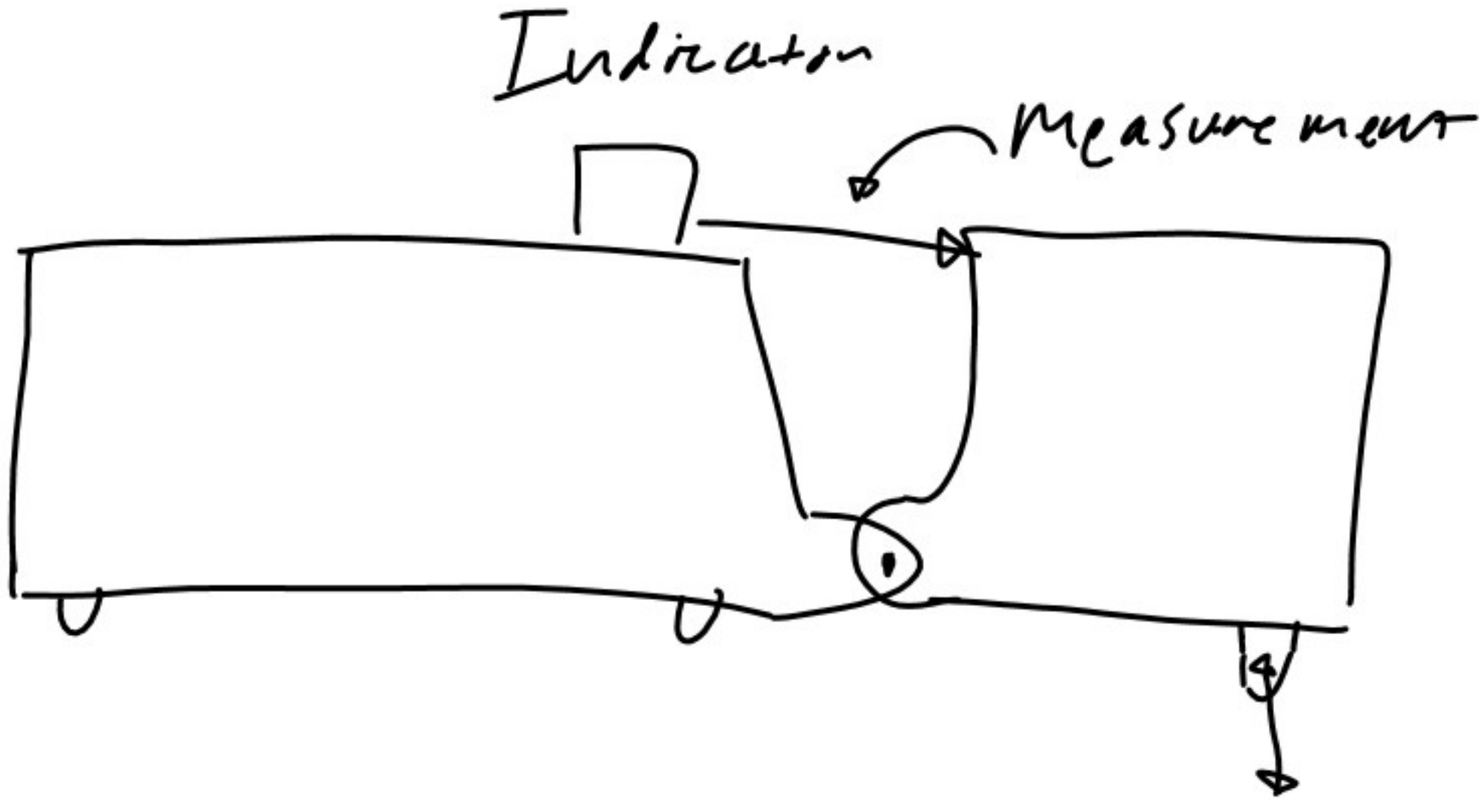
Machinists Level

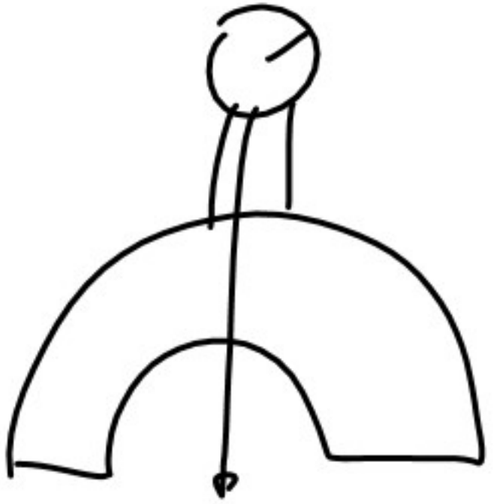
12 in

0.005 in

Electronic Levels

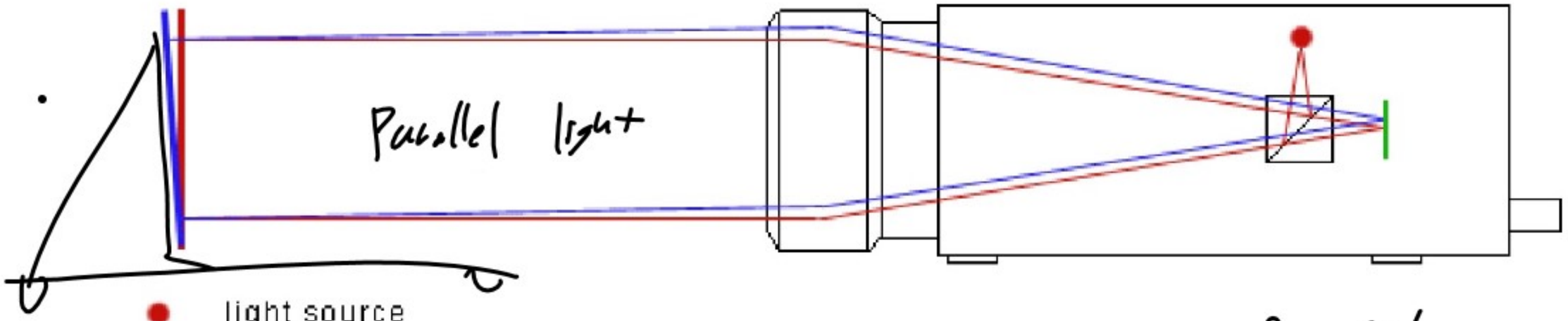

level
length
surface plate
(Top)


Indicator
Measurement



Autocollimator

4 arc-seconds = 0.001°



light source

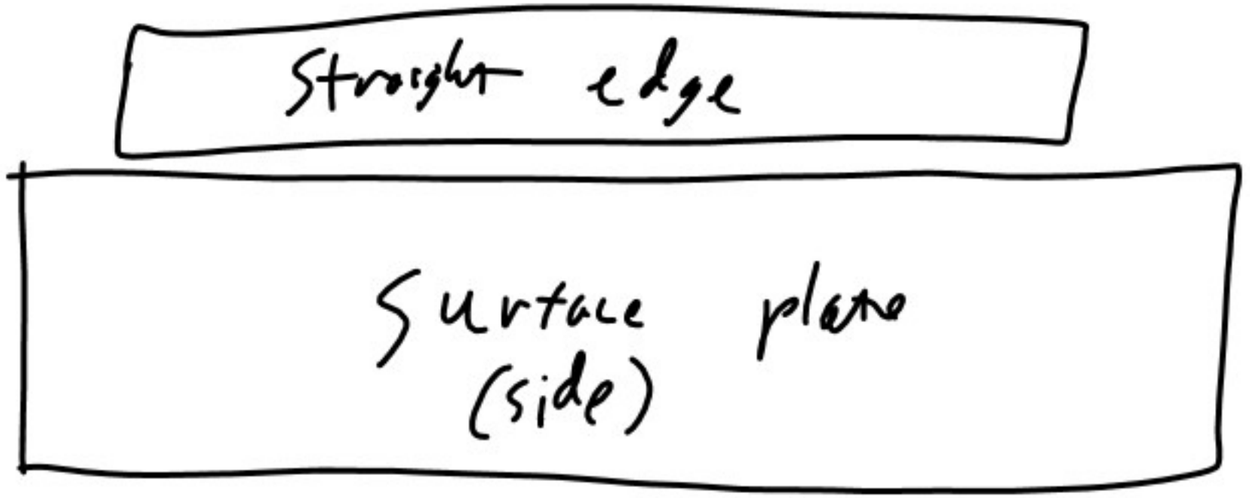
reflected beam when mirror is perpendicular to autocollimator

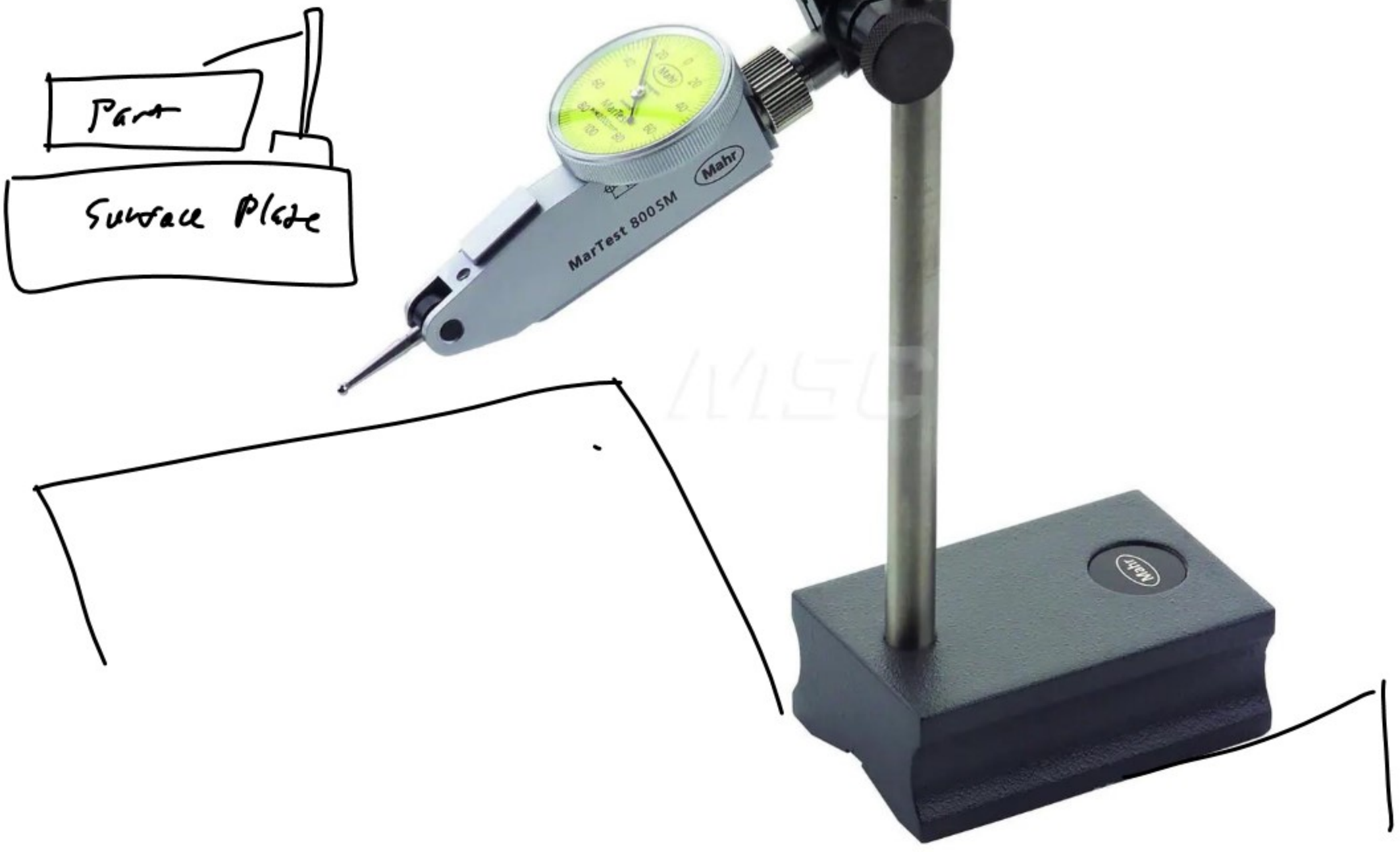
reflected beam when mirror is tilted

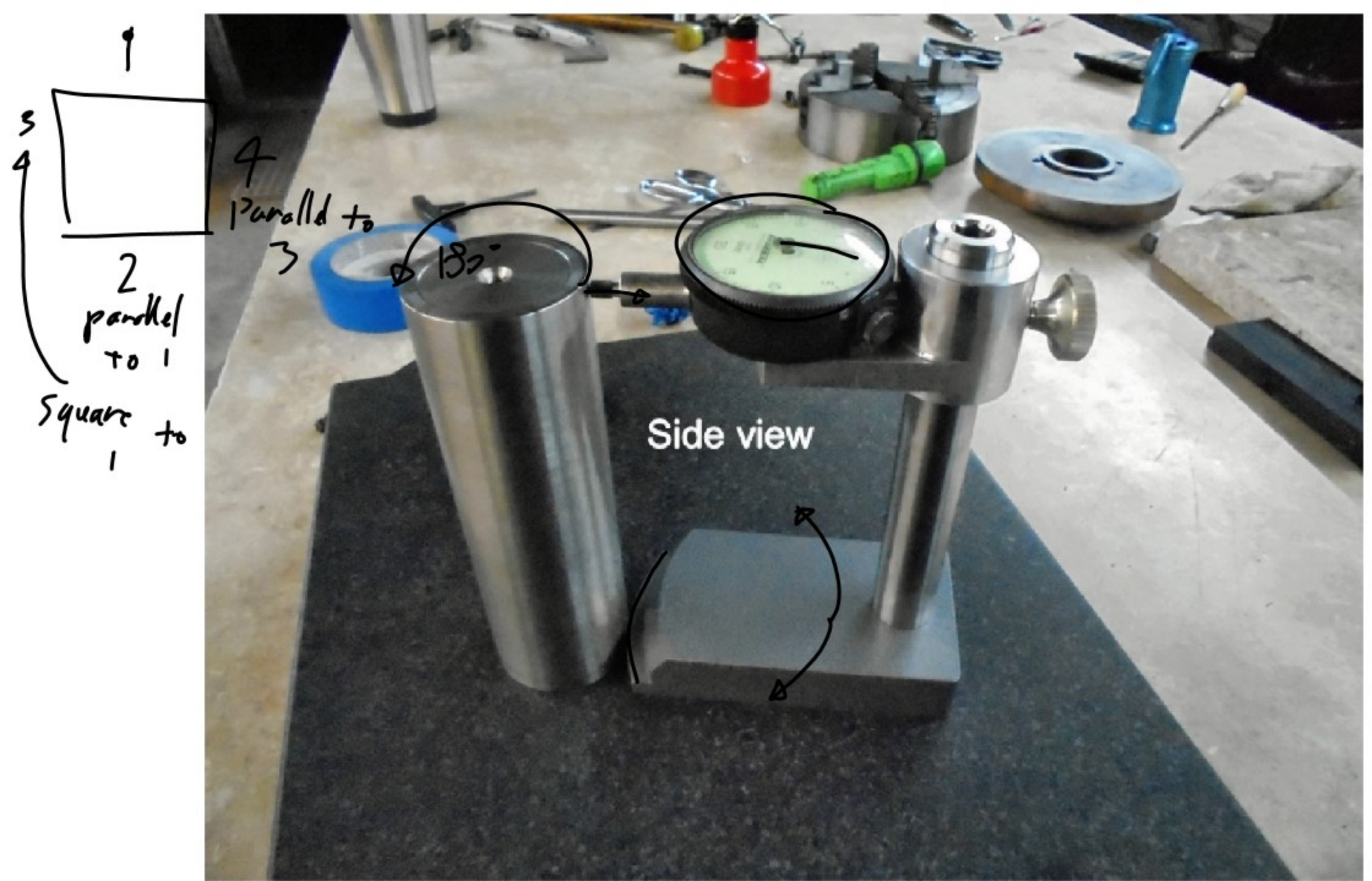
detecting surface

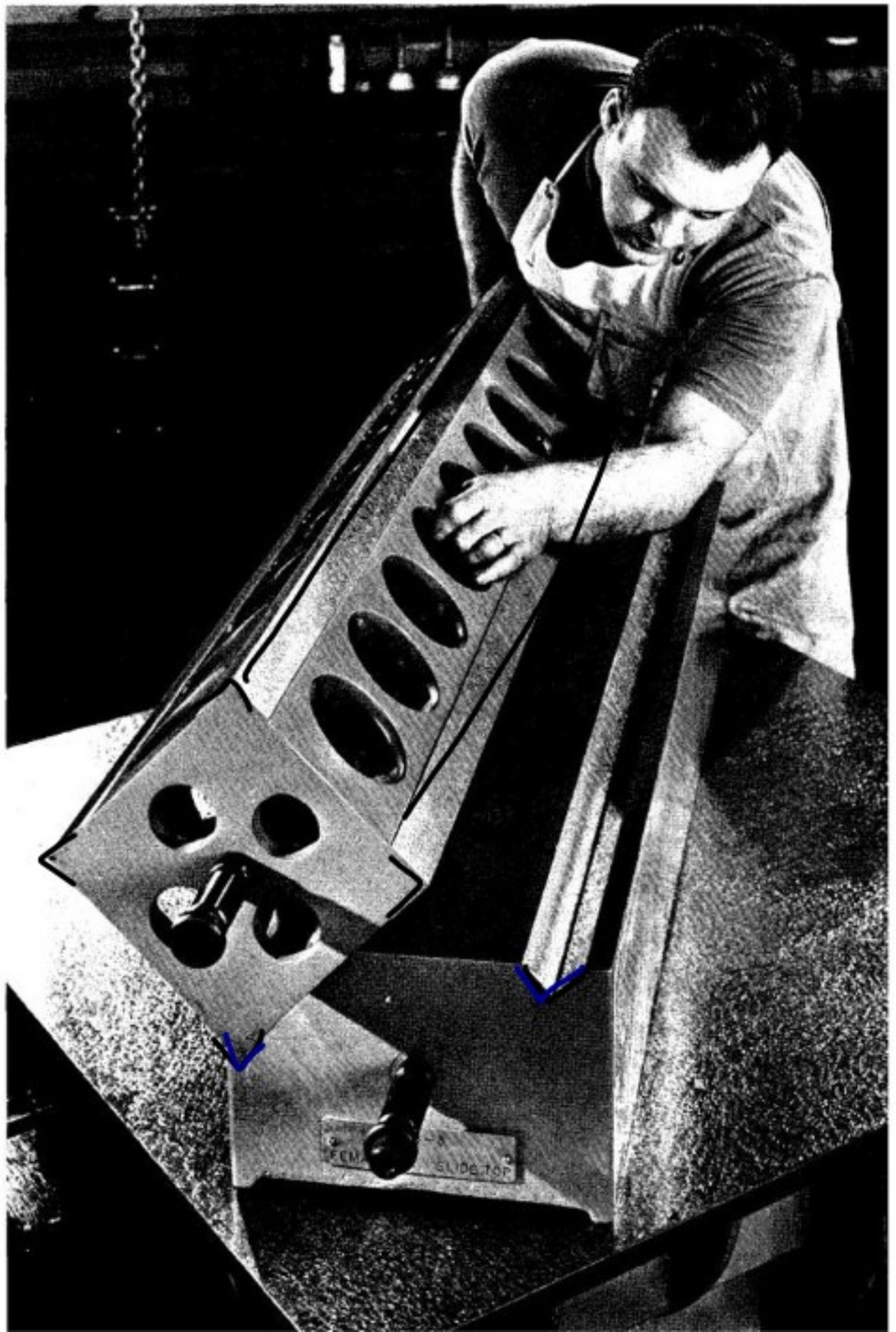
$1^\circ = 60'$

$1' = 60''$


Straight edge
Surface plate
(side)


Part
Surface Plate
Mahr
MarTest 800 SM
Mahr


1
4
Parallel to 3
2
parallel to 1
Square to 1
Side view



Foundations of mechanical Accuracy

by Wayne Moore