Abstract:

In this experiment, surface texture of a sample was investigated and determined in terms of its micro scale property: roughness.

There are two simple means for comparing surfaces roughness ;namely ,human feeling by touching and light scattering technique ;however in this experiment the Taly surt consisting of stylus ,skidder shoe and a probe piezoelectric transducer was used for accurate measurement of surface roughness.

Four different methods of roughness calculation was used :peak to valley height giving the least accurate result of roughness value of: 7.928 μm ,eight point average method giving:4.928 μm ,the RMS and the area methods giving the results respectively:1.636 μm and 1.33μm which represents the most accurate roughness values.

Objective:

To measure the roughness of given surface.

Engineering Measurement Lab

List of symbols

A_{above}: Area above the center line.

A_{below}: Area below the center line.

A-H: triangles name.

h: distance from the point on the center line to the surface curve.

HM: Horizontal magnification.

H_p: Highest peak.

H_v: Lowest valley.

L: Sample length.

R_a: Area method.

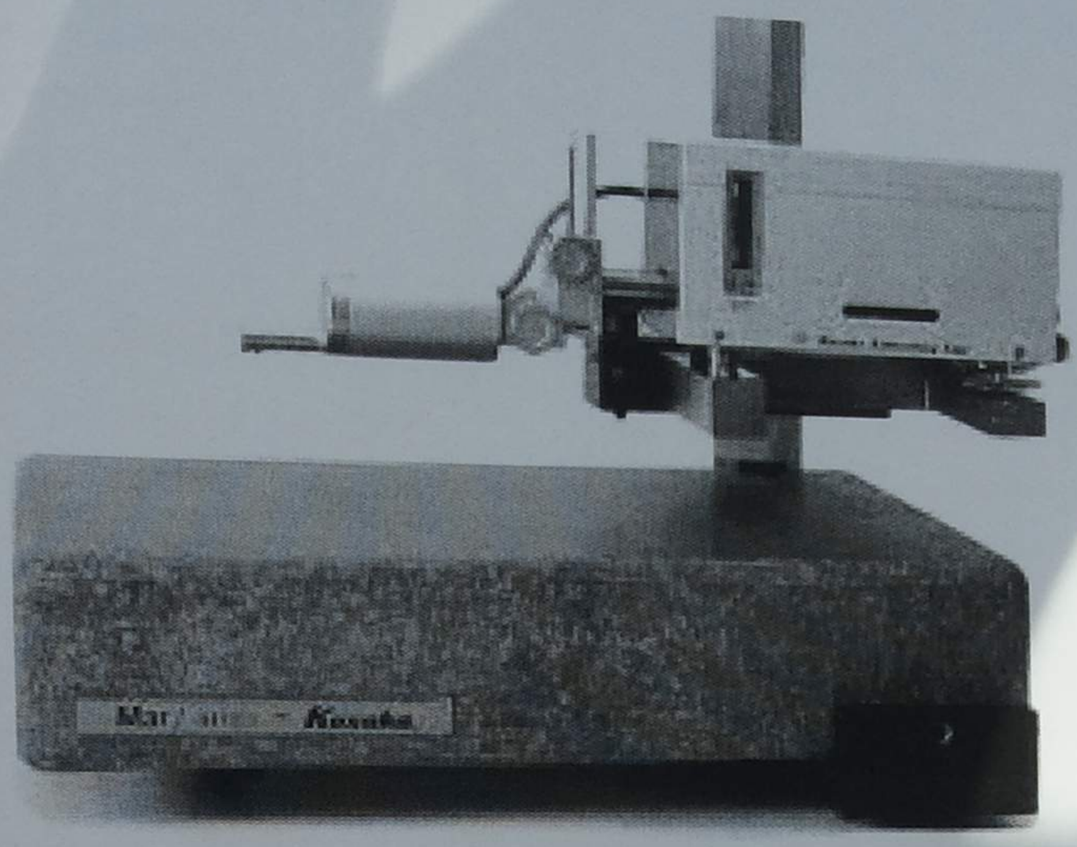
R_{cr}: RMS value.

R_p: Peak to valley height.

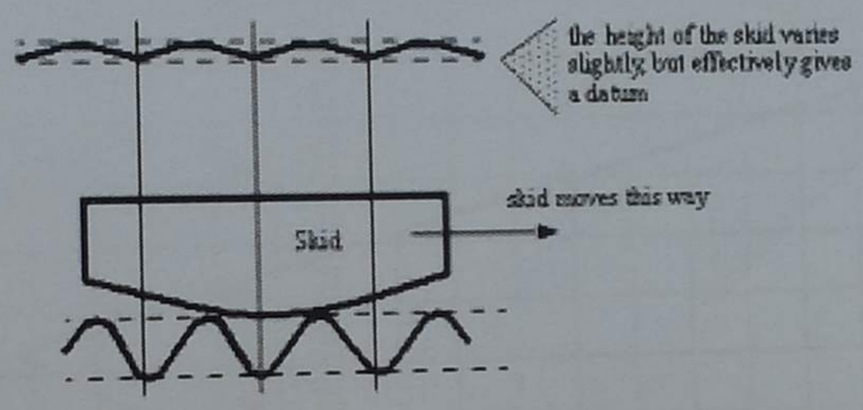
R_z:Eight-point average.

VM: Vertical magnification.

Apparatus:



Skid - used for regular frequencies, and very common.



Procedure:

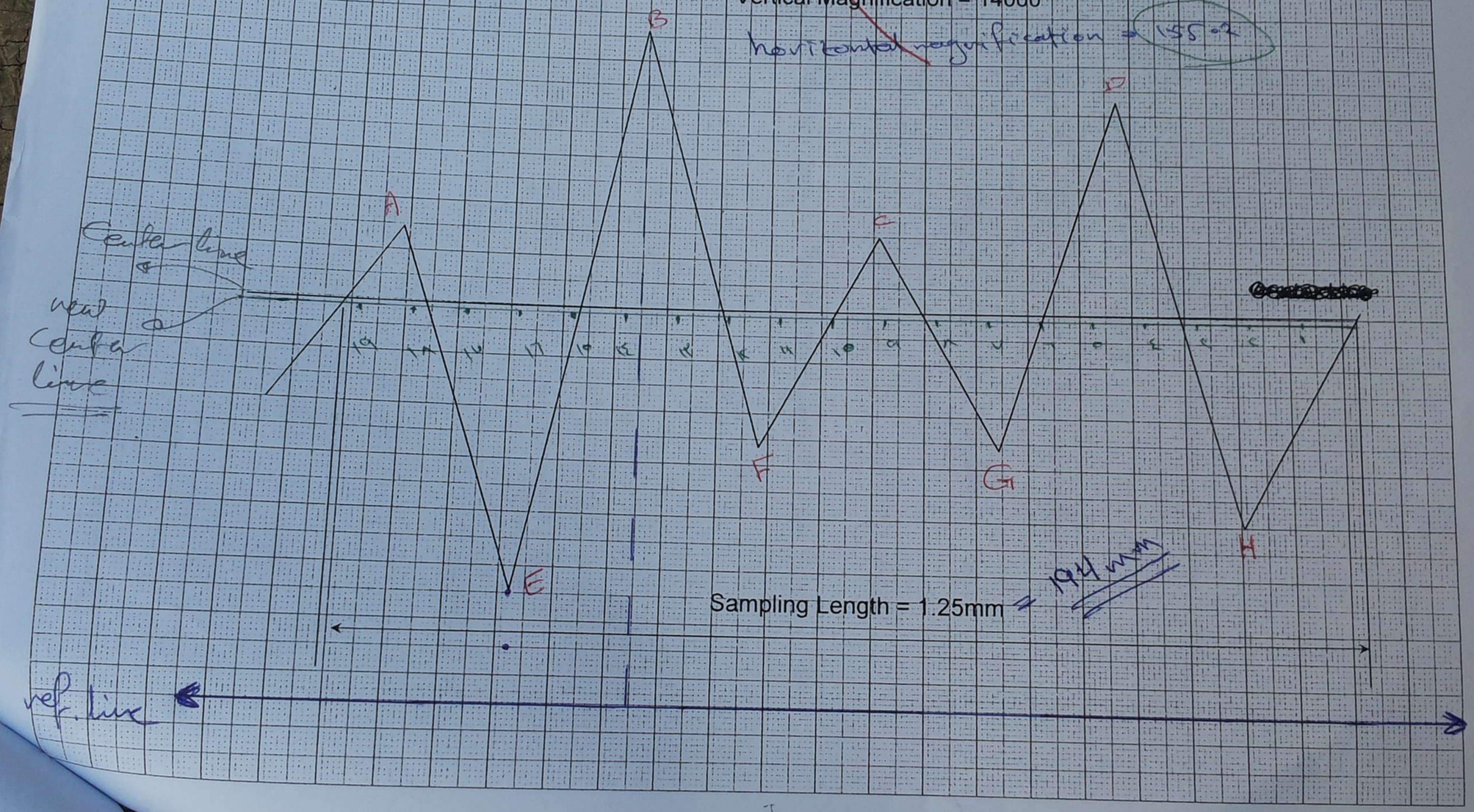
1. Define sampling length.
2. Pass the styles probe of the device on the surface.

(sample)

Date:- 21/7/2014

Vertical Magnification = 14000

horizontal magnification = 155·2



Sample Calculations:

* Finding the horizontal magnification:

$$H.M = \frac{\text{measured length}}{\text{Sampling length}}$$

$$H.M = \frac{19.4 \times 10^{-2}}{1.25 \times 10^{-3}} = 155.2$$

* Finding the roughness using the peak to valley (R_p) method:

the height of the highest point is $(H_P) = 131$ mm

the height of the lowest point is $(H_V) = 20$ mm

the roughness: $R_p = \frac{(H_P - H_V)}{V.M}$

$$R_p = \frac{131 - 20}{14000} \times 1000 = 7.928\ \mu m.$$

* Finding the roughness using eight-point average(R_z) method:

the height of (4) peaks: 90, 131, 90, 118

the sum of them = 429 mm

the height of (4) valleys: 20, 49, 49, 35

the sum of them = 153 mm

the roughness: $R_z = \frac{\Sigma Peak - \Sigma valley}{4} \cdot \frac{1000}{V.M}$

$$R_z = \frac{429 - 153}{4} \cdot \frac{1000}{14000} = 4.928\ \mu m.$$

* Finding the roughness using RMS and Area methods (R_{cv}) & (R_a):

→ Center Line has been located on the graph paper

→ Finding the triangles area : (A - H)

using Area = $\frac{1}{2}$ x height x Base.

triangles above the center line.

A = $\frac{1}{2}$ x 15 x 15 = 112.5 mm^2

B = $\frac{1}{2}$ x 27 x 56 = 756 mm^2

C = $\frac{1}{2}$ x 16 x 15 = 120 mm^2

D = $\frac{1}{2}$ x 26 x 43 = 559 mm^2

triangles below the center line.

E = $\frac{1}{2}$ x 29 x 55 = 797.5 mm^2

F = $\frac{1}{2}$ x 22 x 26 = 286 mm^2

G = $\frac{1}{2}$ x 24 x 26 = 312 mm^2

H = $\frac{1}{2}$ x 34 x 40 = 680 mm^2

Sum of area above : 1547.5 mm^2

Sum of area below : 2075.5 mm^2

center line location correction : $\frac{\Sigma Area_{above} - \Sigma Area_{below}}{2L}$

where „L" is measured length on the graph: (194 mm)

$$Correction = \frac{1547.5 - 2075.5}{2 \times 194} = -1.36 \text{ mm}$$

the negative sign means that move it downward.

* The area method (R_a):

the roughness $Ra = \frac{\Sigma A}{L} \times \frac{1000}{V.M}$

$$Ra = \frac{1547.5 + 2075.5}{194} \times \frac{1000}{14000}$$

$Ra = 1.33 \mu m$.

* The (RMS) (R_{cr}) method:

→ divide the center line into (19) points

→ measure the height of each point from the surface.

→ Find the sum of the squre of the heights.

$$\Sigma h^2 = [19^2 + 36^2 + 9^2 + 26^2 + 27^2 + 0^2 + 22^2 + 3^2 + 14^2 + 0^2 + 18^2 + 2^2 + 31^2 + 41^2 + 5^2 + 51^2 + 21^2 + 9^2 + 5^2] = 9975 \text{ mm}^2$$

, then the roughness $(R_{cr}) = \sqrt{\frac{\Sigma h^2}{19}} \times \frac{1000}{U.M}$

$$R_{cr} = \sqrt{\frac{9975}{19}} \times \frac{1000}{14000}$$

$$R_{cr} = 1.636 \mu m.$$

Discussion:

1. Roughness is desired in many applications such as brakes, pulleys, pens, shoes and to increase the heat transfer by increasing the surface area.
2. Roughness may not be desired in other applications, friction power for example.
3. Roughness is a function of: the manufacturing process type, material of the surface, cutting speed, temperature, vibration and lubricant used.
4. Grinding and milling processes are the best processes regarding roughness.
5. Casting and welding processes are the worst processes regarding roughness.
6. Rubert gauge give a quick indication of surface roughness qualitatively, while using the stylus gives the exact value of surface roughness quantitatively.

Source of error:

1- The existence of dust on the surface.
2- Vibrations in the surface.

Summery and conclusion:

Surface roughness is an important factor when dealing with issues such as friction, lubrication, and wear.

Surface roughness was measured using three methods:

1-comparing the roughness of surfaces by touching the surfaces with your fingernail.

2-ligth scattering method.

3-using stylus probe: this method gave quantitative results.