PR311 MECHANICAL PROPERTIES OF MATERIALS

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SUBJECT	:	PR311
GROUP	:	ME03
DATE	:	13/02/2020

PROCEDURE

- Two inches(a) apart on the specimen was marked.
- Initial length(a), width(b) and thikness(t) were measured.
- The specimen was fixed approximately on the Hounsfield Tensometer
- Specimen was loaded gradually & corresponding extension of the specimen was obtained until it breaks.
- Specimen length, width & thikness of the neck were measured.

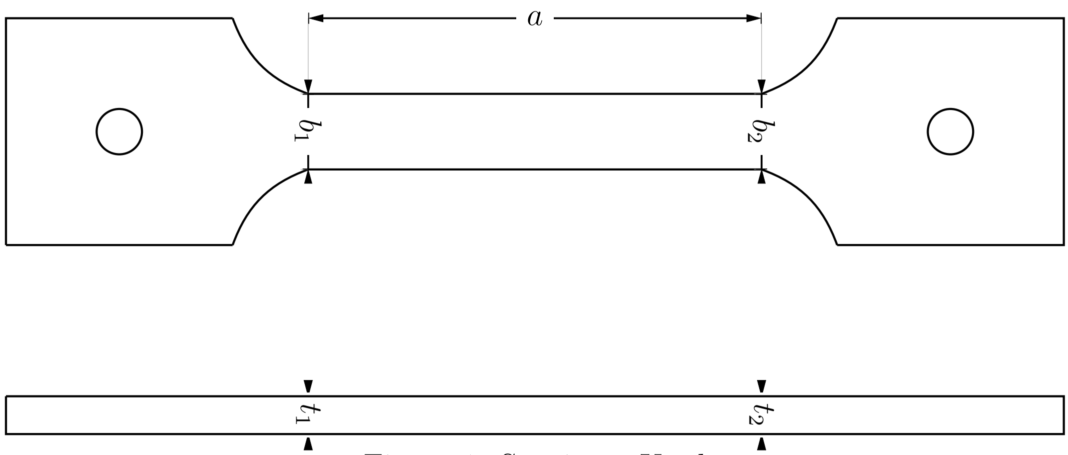

Figure 1: Specimen Used

Table 2: Load Variation with the Extension

Extension(mm)	Load(kN)		
	0°C	R.T	100°C
0	0.000	0.000	0.000
0.5	1.800	1.800	1.600
1.0	2.125	2.100	2.050
1.5	2.200	2.200	2.160
2.0	2.160	2.250	2.225
2.5	2.080	2.080	2.200
3.0	1.950	1.950	2.000
3.5	1.750	1.650	1.700
4.0	1.800	-	-

Considering 2^{nd} set of reading from the table 02 (at room temperature condition)

$$\text{Engineering Stress(S)} = 1.8\text{kN} \times 21.44 \times 10^{-6}\text{m}^2 \tag{1}$$

$$= \underline{83.96\text{MPa}} \tag{2}$$

$$\text{Engineering Strain(n)} = 0.5\text{mm} \div 84.5\text{mm} \tag{3}$$

$$= \underline{5.92 \times 10^{-3}} \tag{4}$$

$$\text{True Stress}(\sigma) = 1.8\text{kN} \times 19.95 \times 10^{-6}\text{m}^2 \tag{5}$$

$$= \underline{90.22\text{MPa}} \tag{6}$$

$$\text{True Strain}(\epsilon) = \ln(\frac{84.5 + 0.5}{84.5}) \tag{7}$$

$$= \underline{5.9 \times 10^{-3}} \tag{8}$$

$$\ln(\sigma) = \underline{4.50} \tag{9}$$

$$\ln(\epsilon) = \underline{-5.13} \tag{10}$$

SPECIMEN CALCULATION

- Initial Readings

$$a = \underline{84.5\text{mm}} \tag{11}$$

$$b = \frac{b_1 + b_2}{2} \tag{12}$$

$$= \frac{13.4 + 13.4}{2} \tag{13}$$

$$b = \underline{13.4\text{mm}} \tag{14}$$

$$t = \frac{t_1 + t_2}{2} \tag{15}$$

$$= \frac{1.6 + 1.6}{2} \tag{16}$$

$$t = \underline{1.6\text{mm}} \tag{17}$$

$$\tag{18}$$

- Final Readings
  (at room temp)

$$b_f = \frac{13.4 + 13.2}{2} \tag{19}$$

$$b_f = \underline{13.3\text{mm}} \tag{20}$$

$$t_f = \frac{1.4 + 1.6}{2} \tag{21}$$

$$t_f = \underline{1.5\text{mm}} \tag{22}$$

$$t = \underline{1.6\text{mm}} \tag{23}$$

$$\tag{24}$$

- Initial average cross section (A)

$$A = b \times t \tag{25}$$

$$= 13.4 \times 1.6 \tag{26}$$

$$A = \underline{21.44\text{mm}} \tag{27}$$

$$\tag{28}$$

RESULTS

Table : Experimental Calculated Data

Parameter	Value
l_r	4.18%
A_r	6.95%
S_y	70MPa
σ_y	70MPa
S_u	106MPa
σ_u	113MPa
S_f	58MPa
σ_f	58MPa
n_f	0.040
ϵ_f	0.039

DATE : 19/02/2020

TITLE : MECHANICAL PROPERTIES OF MATERIALS

AIM :
1. To obtain the stress strain relationship
2. To obtain the behaviour of Aluminum under loading conditions

INTRODUCTION

If a metallic or ceramic specimen is elongated beyond the elastic limit, the stress increases & the material is said to be starin harden. This strengthening mechanism is related to an increase in the dislocation density, which occurs during plastic deformation. The increase in the external stress is due to the interaction of the moving dislocation with existing dislocations.

During the plastic deformation of the test specimen, there are two opposing factors that determine the load required for a given extension on deformation. First is the strain hardening which evidently leads to an increase of the load and second is the decrease in area of cross section extensions. Strain hardening dominates & load increases. However, at larger and thus the load passes through a maximum and then begins to decrease at this stage the "Engineering Stress" which is defined as the ratio of the load on the specimen to the original cross sectional area reaches maximum value. This value of stress is known as "Ultimate Strength"

Under the applied load the weaker portion of the specimen will elongate to a greater extent thtan the rest of the specimen. This will tend to decrease the area and thus increase the stress on the specimen in that region so that further elongation will occur in the thinner portion resulting in a "neck" in the specimen.

Strain hardening continues up to the point of rupture but ordinary stress strain curves for ductile materials do not exibit beyond this ultimate tensile strength. This shortcoming arises from the fact that in the ordinary stress-strain determinations the stress is calculated by dividing the load by initial cross section. The true stress can be found by dividing the load by the actual area of the cross section existing at the moment of load measurement. Thus a true stress Vs true strain curve can be plotted from the tensile data and it will normally demonstrate that the metal gets stronger up to the point of rupture.

TABULATION

Table : Stress & Strain for Engineering & True

Engineering		True	
S(MPa)	$n \times 10^{-3}$	σ(MPa)	$\epsilon \times 10^{-3}$
0	0	0	0
83.96	5.92	90.22	5.90
97.95	11.83	105.26	5.90
102.61	17.75	110.28	17.60
104.94	23.67	112.78	23.40
97.02	29.59	104.26	29.16
90.95	35.50	97.74	34.89
76.96	41.42	82.71	40.59

DISCUSSION

The stress plotted in stress-strain diagrams is obtained by diving the load, P by the cross sectional area, A_0 of the specimen measured before any deformation has taken place. Since the cross-sectional area of the specimen decrease as P increases, the stress plotted in the diagram may not represent the actual stress in the specimen.

True stress i sobtained by dividing P by th e cross-sectional area A of the deformed specimen becomes apparent in ductile materials after yeild has started. While the engineering stress σwhich is directly proportional to the load, P, decreases with P during the necking phase, the true stress(σ_t), which is proportionaltp $($P) & inversely proportional to A, is observed to keep increasing untill rupture of the specimen occurs.

According to the result; ultimate strength given by engineering stress-strain curve is less than the one given by the true stress-strain curve. Because we use initial area for engineering stress and instantaneous area (changing area with respect to time) for true stress. But other values are quite similar.

REFERENCES

- https://en.m.wikipedia.org/wiki/stress-strain-curve on 22/02/2020 at 6.00am
- https://www.engineeringarchives.com/les_mom_truestresstruestrainengstressengstrain.html on 22/02/2020 at 7.00am

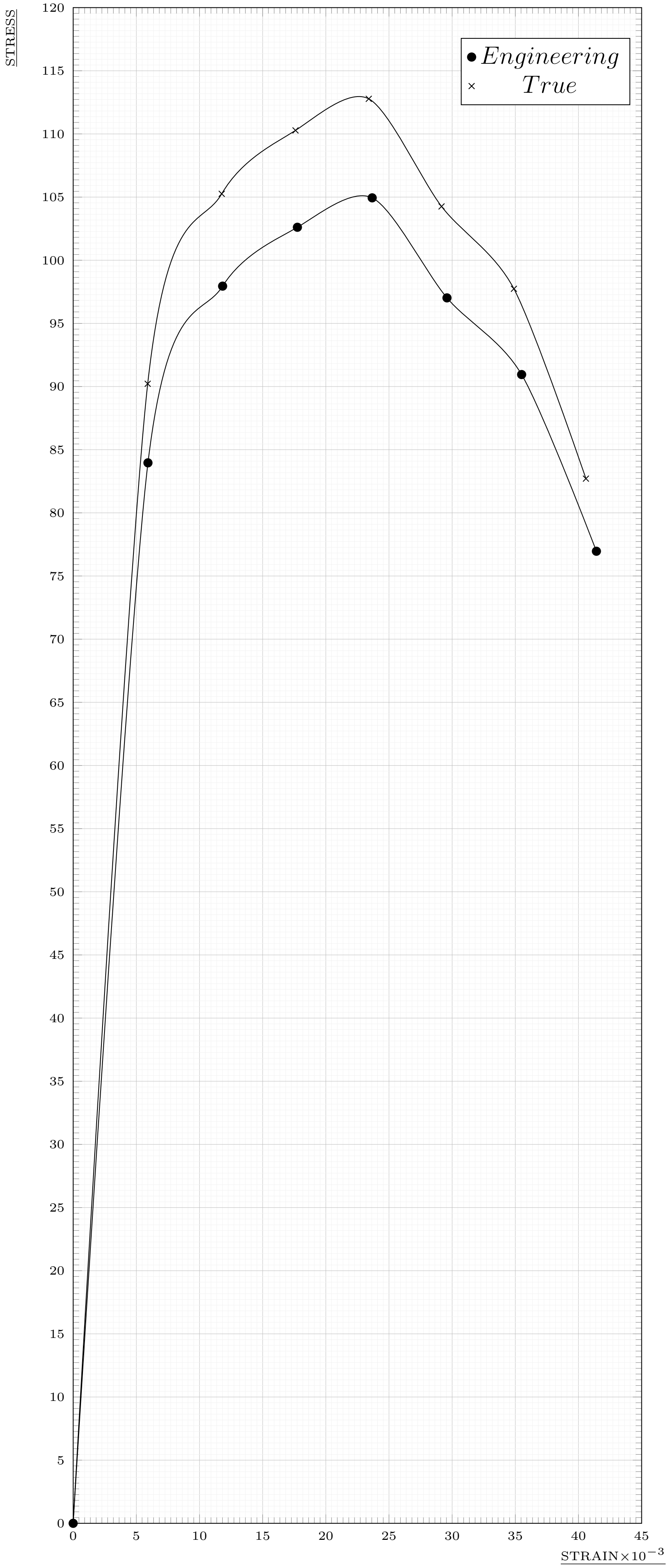

FIGURE 1:VARIATION OF STRESS AGAINST STRAIN