Lab Experiment

Beam Bending

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Section A

In this section, the Young's modulus of two materials (mild steel and aluminium) can be calculated from experimental data.

A total of six groups of data were obtained from the experiment. (See Table 1)

Analysis

By plotting these 6 groups of data on a scatter plot and performing regression analysis, a total of 6 groups of graphs were obtained.

No.	Material	Final load (N)	R-square
1	Steel	50	0.9999
2	Steel	100	0.9998
3	Steel	150	0.9989
4	Aluminium	50	0.9999
5	Aluminium	100	0.9999
6	Aluminium	150	0.9987

Table 1: result of A1 regression analysis

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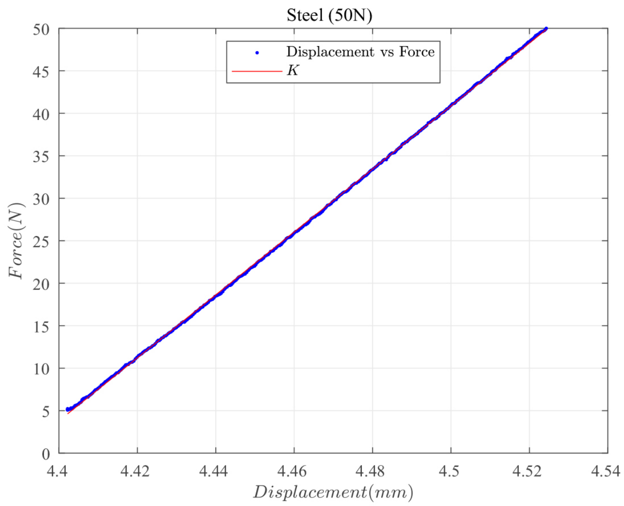
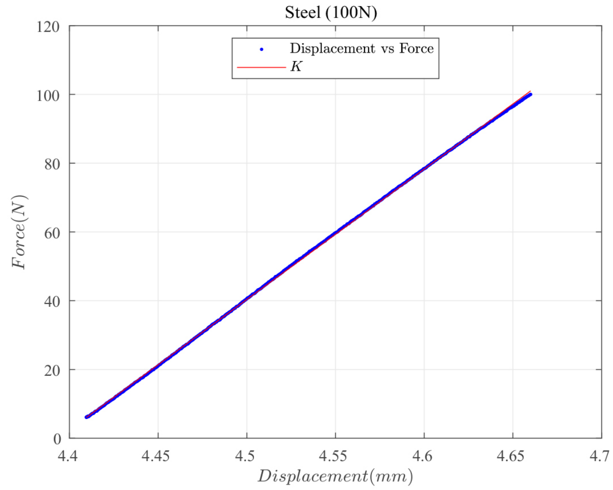
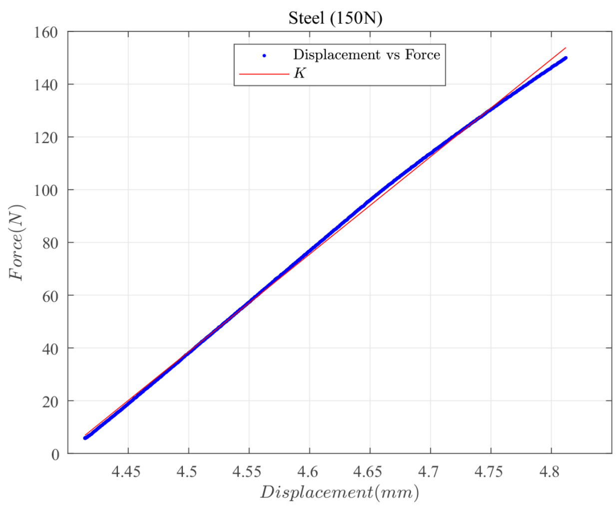
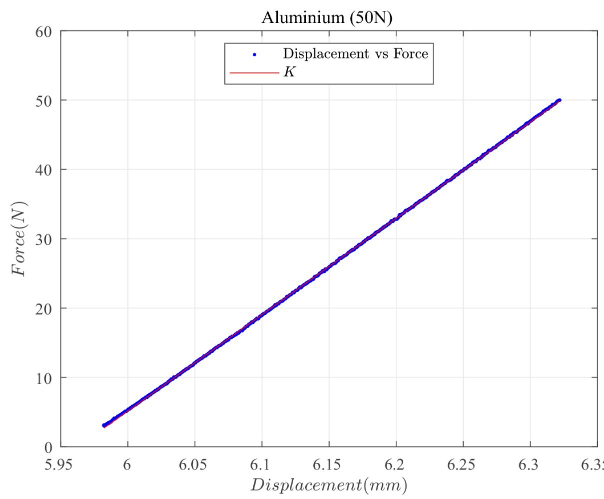
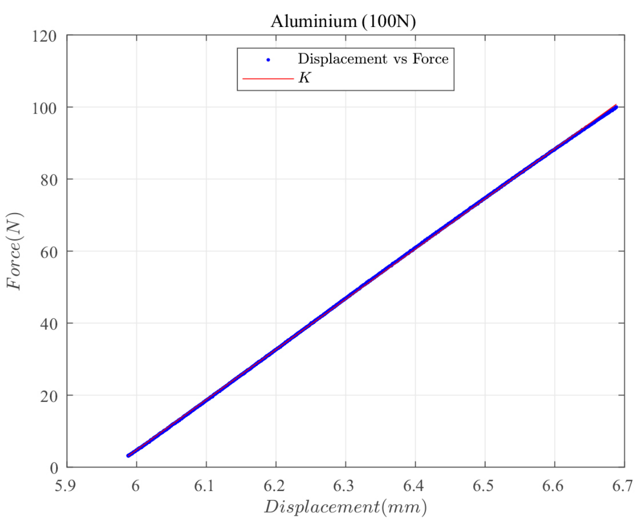
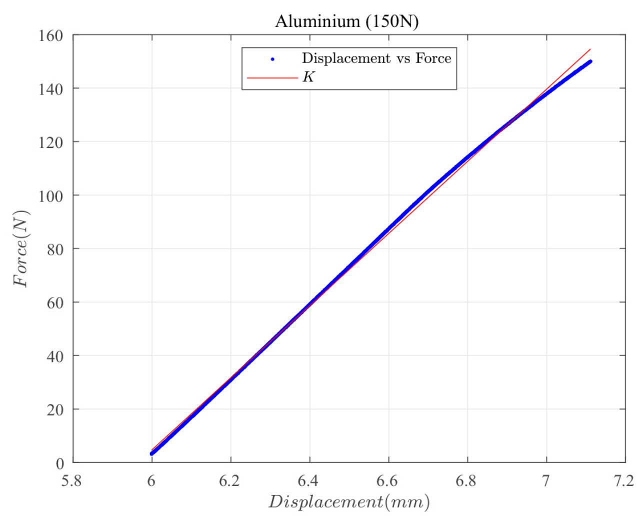

Steel (50N)
Displacement vs Force
K
$Force(N)$
$Displacement(mm)$


Steel (100N)
Displacement vs Force
K
$Force(N)$
$Displacement(mm)$


Steel (150N)
Displacement vs Force
K
$Force(N)$
$Displacement(mm)$


Aluminium (50N)
Displacement vs Force
K
$Force(N)$
$Displacement(mm)$


Aluminium (100N)
Displacement vs Force
K
$Force(N)$
$Displacement(mm)$


Aluminium (150N)
Displacement vs Force
K
$Force(N)$
$Displacement(mm)$

In order to calculate E, the moment of inertia I needs to be calculated first.

$$I = \frac{bh^3}{12} = \frac{20 * 3^3}{12} * 10^{-12} = 4.5 * 10^{-11}(mm^4) \tag{1}$$

We know

$$\delta_{max} = \frac{PL^3}{48EI} \tag{2}$$

And the slope of the regression analysis

$$K = \frac{P}{\delta} = \frac{48EI}{L^3} \tag{3}$$

So

$$E = (\frac{P}{\delta}) * \frac{L^3}{48} = K * \frac{L^3}{48} \tag{4}$$

Modulus of Elasticity	Mild Steel	Aluminium
$E_1(P = 50N)$	171.482	64.3056
$E_2(P = 50N)$	175.509	64.5370
$E_3(P = 50N)$	171.019	62.4074
$E_{exp} = (E_1 + E_2 + E_3)/3$	172.670	63.75

(Unit: GPa)

Table 2: result of A1 regression analysis

Summary

Section B

Results

Summarise

Section C

Results

Summarise

Section D

Results

Summarise