YTÜ Mechanical Engineering Departmant

Mechanic Division General Laboratory Course

Bending Test Reports

Laboratory location: B Blok– Mechanic Laboratory
Laboratory name: Bending Test
Topic: Deflection of simply supported beam

Equipment and Material needed:

- Load cell
- One digital indicator
- One weight hanger
- Set of weights
- Beam

Figure 1.Bending Test

Theoretical Information (Pure Bending):

The theory of pure bending of a beam shows that when a beam is loaded in such a way that it bends only in the plane of the applied moment, the theory of pure bending shows that the stress distribution and the curvature of the beam are related by

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

M: The bending moment occurs in the beam section

I: Moment of Inertia

E: Elasticity modulus

R: Radius of curvature

σ : Bending stress

y: Vertical distance from the neutral axis

Bending of beams and their deflactions formulation are shown ing figure 2 :

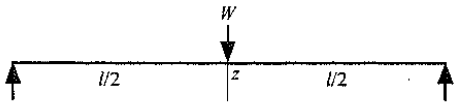
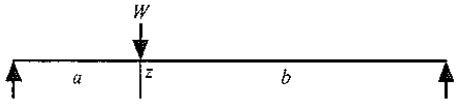
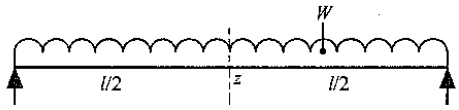
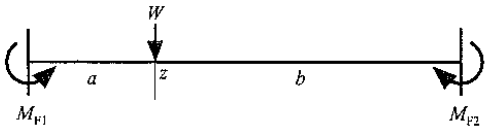
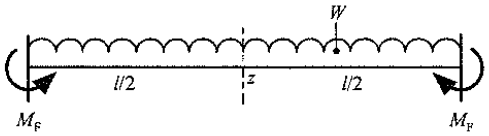
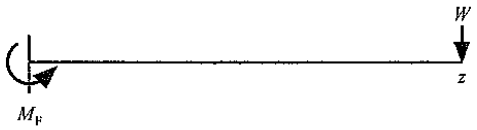
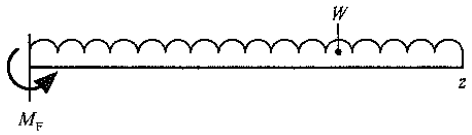
	Deflection at z	End slope	Reaction moment M_F
	$\frac{Wl^3}{48EI}$	$\frac{Wl^3}{16EI}$	
	$\frac{Wa^2b^2}{3EIl}$	$\frac{Wab(l+b)}{6EIl}$ at the left end	
	$\frac{5Wl^4}{384EIl}$	$\frac{Wl^4}{24EIl}$	
	$\frac{Wa^3b^3}{3EIl^3}$		$M_{F1}=\frac{Wab^2}{l^2}$ $M_{F2}=\frac{Wa^2b}{l^2}$
	$\frac{Wl^4}{384EIl}$		$\frac{Wl^2}{12}$
	$\frac{Wl^3}{3EI}$	$\frac{Wl^2}{2EI}$	Wl
	$\frac{Wl^4}{8EI}$	$\frac{Wl^3}{6EI}$	$\frac{Wl^2}{2}$

Figure 2 Bending beams

Aims of Experiments

- To familiarize student with the apparatus
- To prove the overall relationship between stiffness, material property and the beam dimensions

Procedure of the experiment

a) Set up the two different beams (stainless stell, brass) and a load cell so that the load cells are at your pencil marks that are equal distance from the midpoint. Measure the thickness and width of the beam.

b) Make sure that the load cell have their locking pins fitted.

c) Hang one weight hangerat the midpoint of the beam.

d) Put the digital indicator on the upper cross member so that its contact rest directly above the weight hanger.

e) Apply the loads to the hanger in increaments written in Table 1.Each time you add a load, tap the apparatus very gently and take the readings of the deflection.

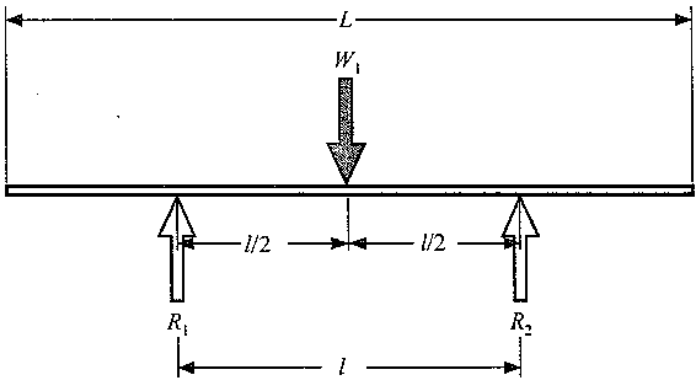


Figure 3 Force diagram for variation of deflection experiment.

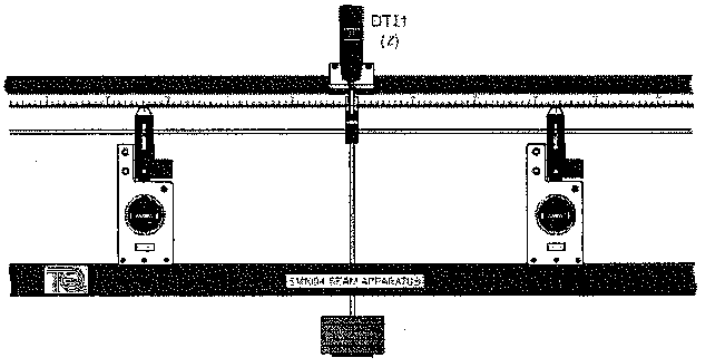


Figure 4 Set up for the variation of deflection experiment

Table 1 Load and deflection for simply supported beam

Load *W* (N)	Deflection *z* (mm)			
	Steel 6.4 mm	Steel 4.8 mm	Steel 3.2 mm	Brass 6.4 mm
5				
10				
15				
20				
25				
30				

Result Analysis:

For each beam,plot a chart of load (N) and deflection (mm) and find the gradient of each graph. The gradient should give the stiffness of th material. Finally, compare the calculated stifness value with the given one**.** Make the error analysis

Table 2. Elasticity modulus of materials

MALZEME	ELASTİKLİK MODÜLÜ
Stainless steel	210 GPa
Brass	105 GPa
Aluminium	76 GPa

Material	Thickness (mm)	Stiffness (N/mm)
Steel	6.4	
Steel	4.8	
Steel	3.2	
Brass	6.4	