OBJECTIVE 1 :

STUDY OF THE STRESS-STRAIN BEHAVIOR OF STEEL UNDER TENSILE LOADING

MATERIALS REQUIRED :

Mild steel specimen
Universal testing Machine (UTM)
Vernier caliper
Computer system with graph plotting software

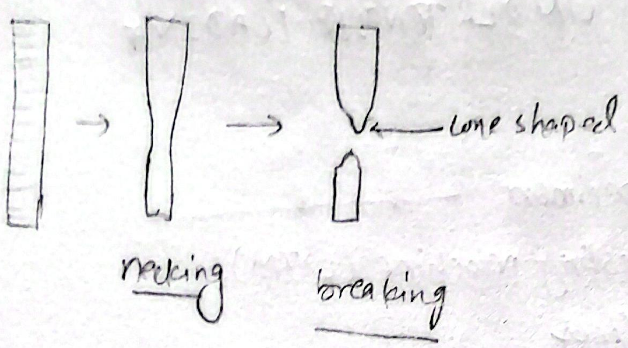
THEORY :

When a material is subjected to a gradually increasing tensile force, it undergoes deformation. The relationship between the applied stress & the corresponding strain is plotted as stress-strain curve.

For steel, the stress-strain curve consists of several key points:

- Proportional limit: Stress is directly proportional to strain (Hooke's law is applicable)
- Elastic limit: Beyond this, permanent deformation begins
- Yield point: sudden elongation with little to no increase in stress.
- Ultimate Tensile Strength (UTS): Maximum stress the material can withstand
- Breaking point: The point where the specimen fractures.

This curve is crucial for understanding a material's mechanical behaviour & designing structures that can withstand loads safely.



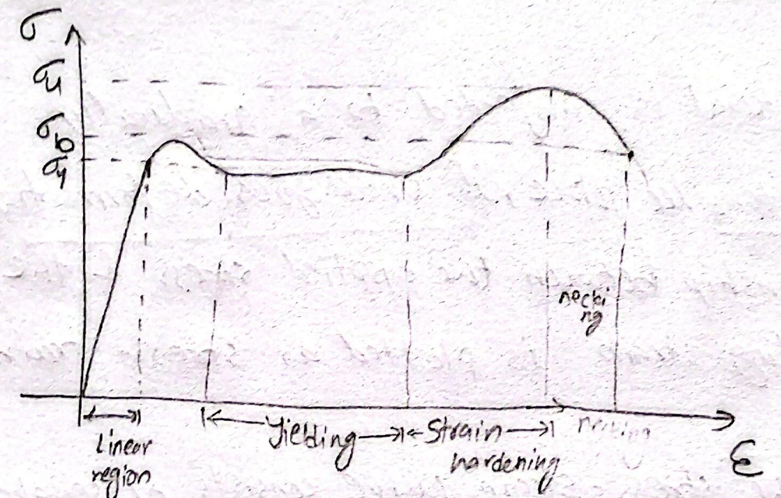


fig. stress-strain curve

OBSERVATION :

diameter of specimen :

Length of specimen :

Load at yield point :

Load at ultimate strength :

Breaking load :

RESULTS :

Yield strength :

Ultimate Tensile strength :

PRECAUTION :

→ Zero the load & displacement reading befor starting.

→ Ensure the specimen is properly centered & gripped in the machine.

→ Wear safety goggles & keep a safe distance during test.

OBJECTIVE 2 | EXPERIMENTAL DETERMINATION OF BEAM DEFLECTION USING DIAL GAUGE

INSTRUMENTS REQUIRED

(I) Simply supported beam setup
(II) Dial Gauge
(III) Vernier caliper
(IV) Loads

THEORY

When a beam is subjected to external loading, it undergoes deformation known as deflection. For a simply supported beam, deflection depends on the type of load, span length, material properties (Young's modulus) and the moment of inertia of cross section. The maximum deflection occurs at the centre of beam for symmetric loading cases.

In experiments, a dial gauge is commonly used to measure the deflection of beam. It consists of a circular dial with a needle that indicates displacement with high precision, allowing accurate observation of beam behaviour under load.

Theoretical deflection that a load 'W' cause in beam is given by ~~Wl~~

$$\Delta_{th} = \frac{WL^3}{48EI}$$

where W = load (N)
L = Length of beam (m)
E = Young's Modulus of Elasticity (N/mm²)
I = Moment of inertia (mm⁴)

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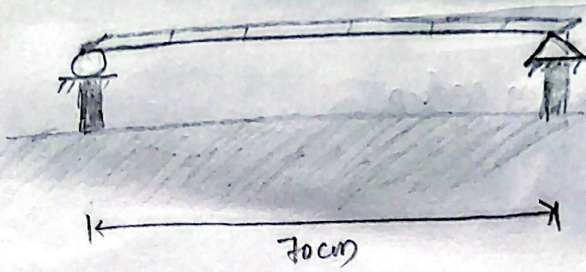

fig.(1) simply supported beam

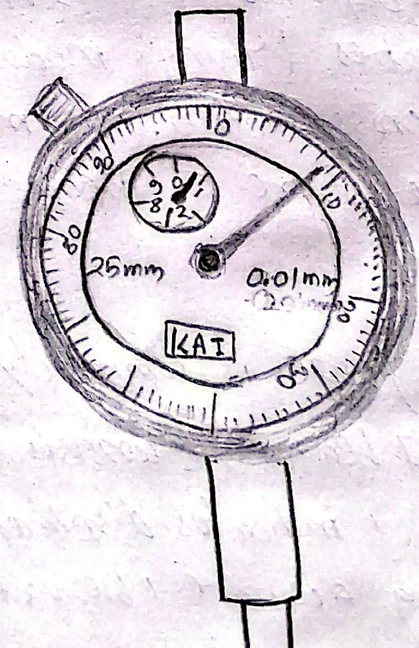

fig. Dial Gauge

OBSERVATION & CALCULATION

$b = 2.561\ cm = 25.61\,mm$

$d = 0.592\ cm = 5.92\ mm$

$L = 70\,cm = 700\,mm$

$E = 210 \times 10^3\ N/mm^2$

$I = \frac{b \times d^3}{12} = 442.79\ mm^4$

$W = m \times g\ ;\ g = 9.81\ ms^{-2}$

Observation table

S.N.	Loading (kg)	Reading Initial (mm)	Reading Final (mm)	Δ (mm)	$\Delta_{th} = \frac{WL^3}{48EI}$	Error
(1)	1.037	7.00	8.05	1.05	0.78	0.27
(2)	2.151	7.00	10.53	3.53	1.62	1.91
(3)	2.749	7.00	11.42	4.42	2.07	2.35
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RESULTS:

The error in the calculation of deflection with respect to theoretical value was found to be 0.27mm, 1.91mm and 2.35mm

PRECAUTION:

(i) Reading should be taken carefully.

(ii) External loading except the required one should be avoided, e.g. touchings.

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