5. PRACTICAL BASED LEARNING - DEMONSTRATION IN LABORATORY

TENSION TEST ON MILD STEEL SPECIMEN

Date of experiment conducted: 14.12.2024

Semester:3rd sem

The primary objectives of conducting a tension test on a mild steel specimen are as follows:

1. **Determine Mechanical Properties**:
   - **Yield Strength**: To find the stress at which the material begins to deform plastically.
   - **Ultimate Tensile Strength (UTS)**: To measure the maximum stress the material can withstand before failure.
   - **Young's Modulus**: To calculate the elasticity of the material, which is the ratio of stress to strain in the elastic region.
   - **Ductility**: To assess the extent to which the material can be stretched or elongated before fracture, typically expressed as percentage elongation.
   - **Toughness**: To evaluate the energy absorbed by the specimen before fracture.
2. **Analyze Material Behavior**:
   - **Elastic Deformation**: To observe the behavior of the material within its elastic limit, where it returns to its original shape upon unloading.
   - **Plastic Deformation**: To understand the behavior beyond the elastic limit, where permanent deformation occurs.
   - **Fracture Point**: To study the point at which the material ultimately breaks.
3. **Establish Stress-Strain Relationship**:
   - To generate a stress-strain curve, which provides valuable insights into the material's behavior under tensile load and helps in identifying the elastic and plastic regions.
4. **Quality Control and Material Specification**:
   - To ensure the material meets required mechanical properties for specific engineering applications.
   - To validate the material's compliance with standards and specifications (e.g., ASTM, ISO).
5. **Design and Engineering Insights**:
   - To aid in designing components and structures by understanding the material's capacity to withstand applied forces.
   - To determine the factor of safety for various applications.
6. **Compare Materials**:
   - To evaluate the performance of mild steel relative to other materials under similar loading conditions.

7. **Research and Development**:
    - To study the effects of manufacturing processes (e.g., heat treatment, alloying) on the material's tensile properties.

By conducting this test, engineers and researchers can obtain critical data for designing safe and efficient structures and systems.

OUTPUT:

The output of conducting a tension test on a mild steel specimen typically includes the following key results and observations:

1. Stress-Strain Curve:

- A graph showing the relationship between stress (force per unit area) and strain (deformation per unit length) of the specimen.
- This curve provides valuable insights into the elastic and plastic behavior of the material.

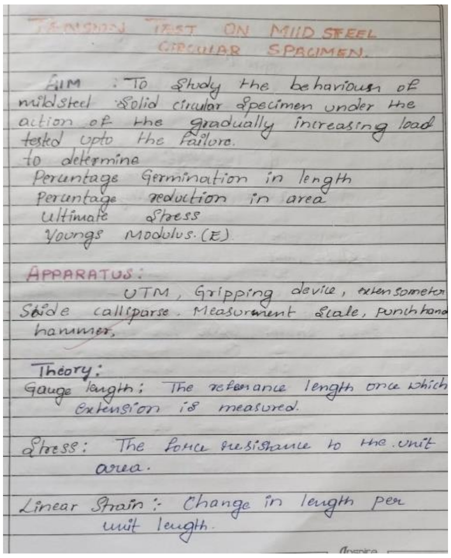
2. Key Mechanical Properties:

- **Elastic Limit**: The maximum stress that the material can withstand without permanent deformation.
- **Proportional Limit**: The point up to which stress and strain are directly proportional.
- **Yield Strength**: The stress at which the material starts to exhibit significant plastic deformation.
- **Ultimate Tensile Strength (UTS)**: The maximum stress the material can withstand before necking begins.
- **Fracture Stress**: The stress at which the material ultimately breaks.
- **Young's Modulus (E)**: The ratio of stress to strain in the elastic region, indicating the stiffness of the material.
- **Ductility**: Typically expressed as percentage elongation or reduction in the cross-sectional area.
- **Poisson's Ratio** (if transverse strain is measured): The ratio of lateral strain to longitudinal strain.

3. Material Behaviour Observations:

- **Elastic Deformation**: Region where the material returns to its original shape after unloading.
- **Plastic Deformation**: Region where permanent deformation occurs.
- **Necking**: Reduction in the cross-sectional area just before fracture.
- **Fracture Point**: The point at which the material breaks.

4.Numerical Results:



TENSION TEST ON MILD STEEL CIRCULAR SPECIMEN.

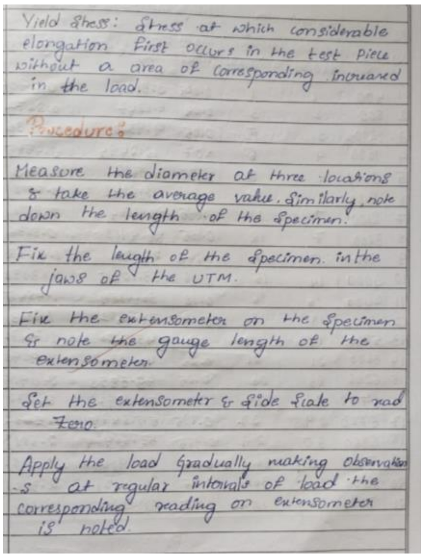
AIM : To study the behaviour of mild steel solid circular specimen under the action of the gradually increasing load tested upto the failure.
to determine
Percentage Germination in length
Percentage reduction in area
Ultimate stress
Youngs Modulus. (E)

APPARATUS:
UTM, Gripping device, extensometer Slide calliparse. Measurement scale, punch hand hammer,

Theory:
Gauge length: The referance length once which extension is measured.

Stress: The force resistance to the unit area.

Linear Strain :- Change in length per unit length.



Yield Stress: Stress at which considerable elongation first occurs in the test piece without a area of corresponding increased in the load.

Procedure:

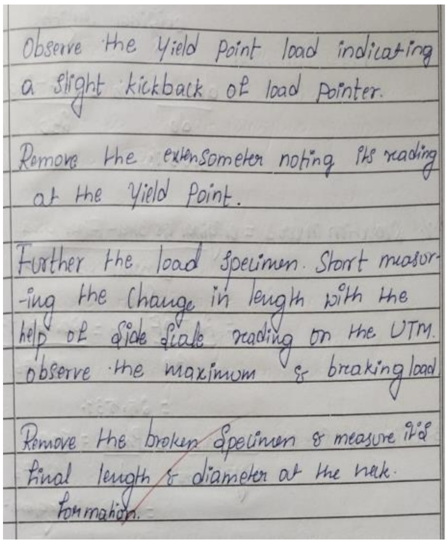
Measure the diameter at three locations & take the average value. Similarly note down the length of the specimen.

Fix the length of the specimen in the jaws of the UTM.

Fix the extensometer on the specimen & note the gauge length of the extensometer.

Set the extensometer & slide scale to read zero.

Apply the load gradually making observations at regular intervals of load the corresponding reading on extensometer is noted.

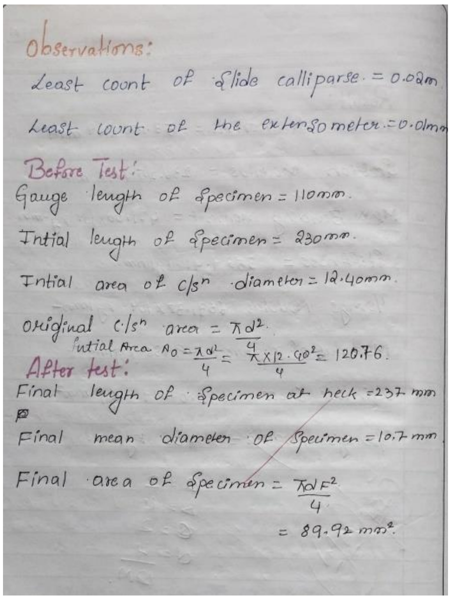


Observe the yield point load indicating a slight kickback of load pointer.

Remove the extensometer noting its reading at the yield point.

Further the load specimen. Start measuring the change in length with the help of slide scale reading on the UTM. observe the maximum & braking load

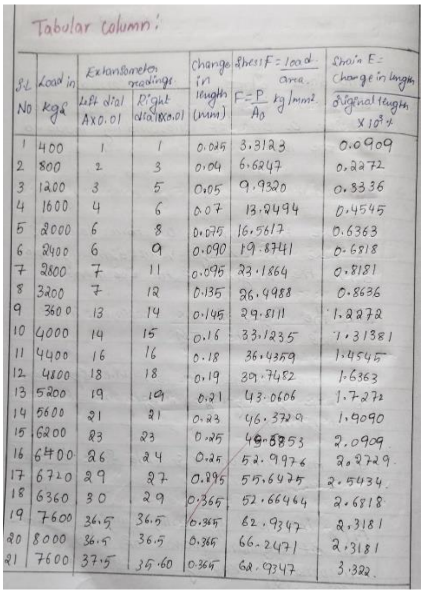
Remove the broken specimen & measure its final length & diameter at the neck formation.



Observations:
Least count of slide calliparse = 0.02m
Least count of the extensometer = 0.01mm

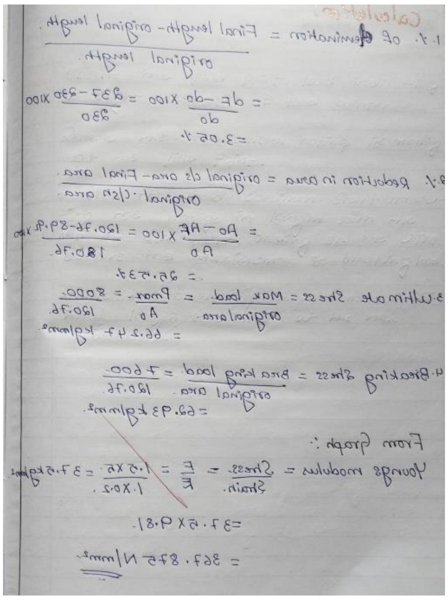
Before Test:
Gauge length of specimen = 110mm.
Intial length of specimen = 230mm.
Intial area of c/sn diameter = 12.40mm.
original c/sn area = $\frac{\pi d^2}{4}$
Intial Area $A_0 = \frac{\pi d^2}{4} = \frac{\pi \times 12.40^2}{4} = 120.76$.

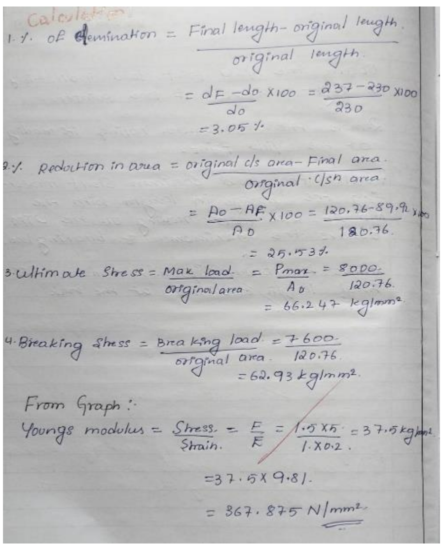
After test:
Final length of specimen at neck = 237 mm
Final mean diameter of specimen = 10.7 mm
Final area of specimen = $\frac{\pi d_F^2}{4}$
= 89.92 mm².



Tabular column:

Sl No	Load in kgs	Extensometer readings: Left dial A×0.01	Extensometer readings: Right dial B×0.01	Change in length (mm)	Stress F = load/area, F = P/A0 kg/mm²	Strain E = Change in length / Original length ×10³ %
1	400	1	1	0.025	3.3123	0.0909
2	800	2	3	0.04	6.6247	0.2272
3	1200	3	5	0.05	9.9320	0.3336
4	1600	4	6	0.07	13.2494	0.4545
5	2000	6	8	0.075	16.5617	0.6363
6	2400	6	9	0.090	19.8741	0.6818
7	2800	7	11	0.095	23.1864	0.8181
8	3200	7	12	0.135	26.4988	0.8636
9	3600	13	14	0.145	29.8111	1.2272
10	4000	14	15	0.16	33.1235	1.31381
11	4400	16	16	0.18	36.4359	1.4545
12	4800	18	18	0.19	39.7482	1.6363
13	5200	19	19	0.21	43.0606	1.7272
14	5600	21	21	0.23	46.3729	1.9090
15	6200	23	23	0.25	49.5853	2.0909
16	6400	26	24	0.25	52.9976	2.2729
17	6720	29	27	0.295	55.6475	2.5434
18	6360	30	29	0.365	52.66464	2.6818
19	7600	36.5	36.5	0.365	62.9347	2.3181
20	8000	36.5	36.5	0.365	66.2471	2.3181
21	7600	37.5	35.60	0.365	62.9347	3.322





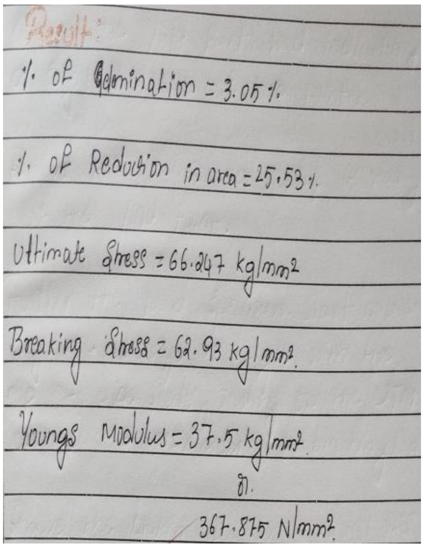
Calculation:
1. % of Germination = $\frac{\text{Final length} - \text{original length}}{\text{original length}}$
$= \frac{d_F - d_0}{d_0} \times 100 = \frac{237 - 230}{230} \times 100$
= 3.05 %

2. % Reduction in area = $\frac{\text{original c/s area} - \text{Final area}}{\text{original c/sn area}}$
$= \frac{A_0 - A_F}{A_0} \times 100 = \frac{120.76 - 89.92}{120.76} \times 100$
= 25.53 %

3. Ultimate Stress = $\frac{\text{Max load}}{\text{original area}} = \frac{P_{max}}{A_0} = \frac{8000}{120.76}$
= 66.247 kg/mm²

4. Breaking Stress = $\frac{\text{Breaking load}}{\text{original area}} = \frac{7600}{120.76}$
= 62.93 kg/mm².

From Graph:
Youngs modulus = $\frac{\text{Stress}}{\text{Strain}} = \frac{F}{E} = \frac{1.5 \times 5}{1 \times 0.2} = 37.5$ kg/mm²
= 37.5 × 9.81
= 367.875 N/mm²



Result:

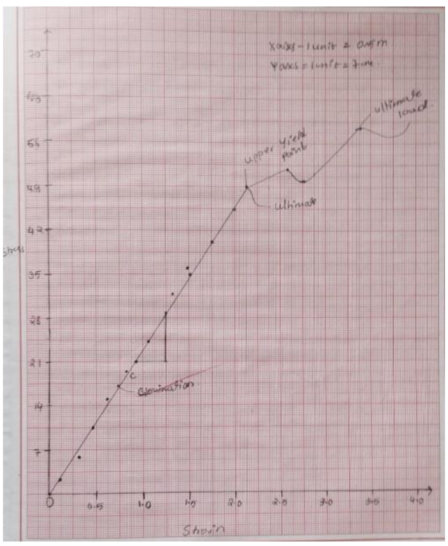
% of Germination = 3.05 %

% of Reduction in area = 25.53 %

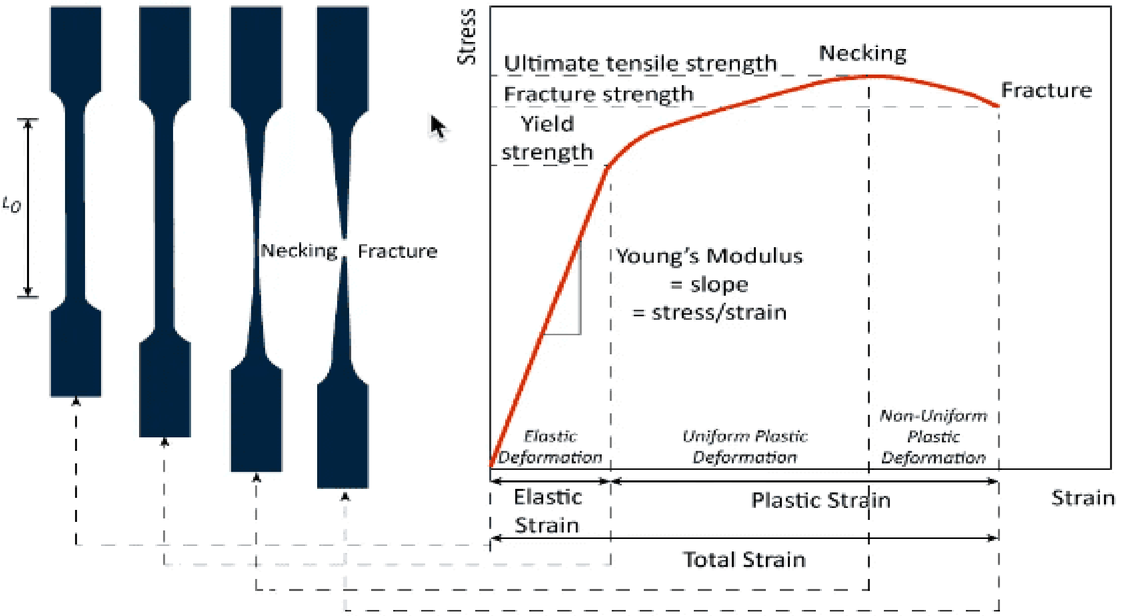
Ultimate Stress = 66.247 kg/mm²

Breaking Stress = 62.93 kg/mm².

Youngs Modulus = 37.5 kg/mm²
or
367.875 N/mm².



5. Fracture Appearance:



- **Cup-and-Cone Fracture**: Typical for ductile materials like mild steel, indicating good ductility.

6. Toughness:

- Area under the stress-strain curve, indicating the energy absorbed by the material before failure.

7. Strain Hardening:

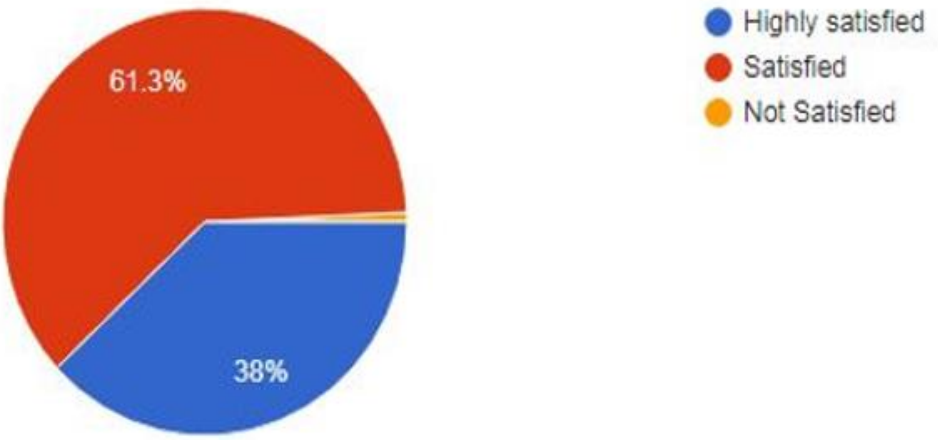
- Observations of how the material strengthens as it undergoes plastic deformation (between the yield point and UTS).

These outputs provide critical data for evaluating the material's suitability for engineering applications and are often used for quality control, design validation, and research purposes.

PHOTOGALLARY OF TENSION TEST CONDUCTION ON MILD STEEL SPECIMEN

FEEDBACK RESPONSES

4.Overall, how satisfied were you with all the activities conducted?
36 responses



Course coordinator

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