AIRCRAFT STRUCTURES

A PROJECT REPORT

submitted to

SRM INSTITUTE OF SCIENCE & TECHNOLOGY

by

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ABSTRACT:

This study explores the photo elastic behaviour of epoxy resin models in I-section and elliptical section geometries under various loading conditions. Using a photo elastic material provided for experimental analysis, strain contours, visualized as fringe patterns, were examined through photoelasticity tests. The models were designed to specified dimensions: for 2-point compression testing, I-section models with a flange width of 150 mm, web height of 150 mm, and thickness of 5 mm; and for elliptical sections(65 mm diameter, 5 mm thickness) was utilized. Additionally, models for 3-point and 4-point bending followed ASTM D790 and D6272 standards, respectively, while end-notched samples adhered to ASTM D7905. This setup enabled detailed observations of stress distribution across the sections, facilitating an understanding of the stress concentration zones and the overall material response. The experiment's results demonstrate the efficacy of photo elastic techniques in capturing strain distribution, offering insights into structural integrity relevant to aircraft design.

Keywords: photoelasticity, epoxy, I-section, elliptical

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Introduction To Aircraft Structural Components

Aircraft are complex engineering marvels, composed of numerous structural components, each designed to fulfill specific roles in maintaining the aircraft's integrity and functionality. These components must withstand various stresses encountered during flight, such as aerodynamic forces, pressure changes, and operational loads. Below is an overview of the primary components in an aircraft's structure:

- **Fuselage**

The fuselage is the central body of the aircraft, serving as the main framework that holds the cockpit, passenger cabin, and cargo areas. It is typically constructed in either a "monocoque" or "semi-monocoque" design:

  - "Monocoque" relies mainly on its outer skin for strength.

  "Semi-monocoque" combines skin with internal frames and stringers, providing added strength while minimizing weight.

- **Wings**

  Wings are the primary lift-generating surfaces, tailored to balance efficiency and stability. They consist of:

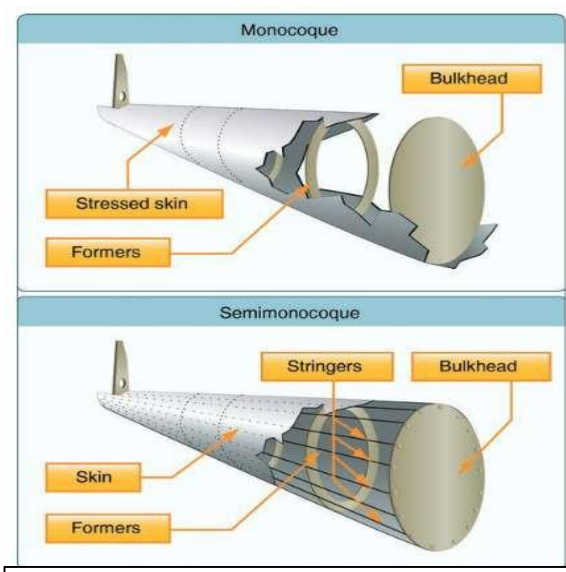


Fig no.1-FUSELAGE

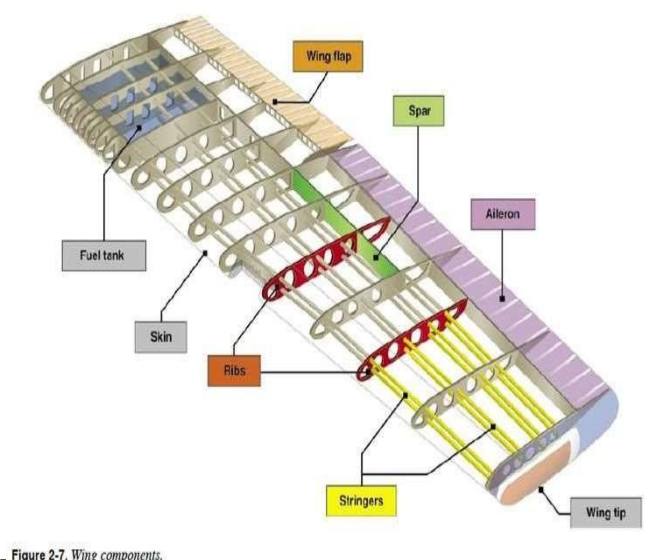


Fig no.2-WING

- **Spars** (primary load-bearing elements running along the wing length),
- **Ribs** (structural elements giving the wing its airfoil shape),
- **Skin** (outer covering that also contributes to strength). Wing designs vary, including straight, swept, and delta configurations, each suited to different flight characteristics.

- **Empennage(TailSection)**

  The empennage stabilizes the aircraft, especially during maneuvers. It includes:

  - **Horizontal Stabilizer** and **Elevators** to control pitch,
  - **Vertical Stabilizer** and **Rudder** to control yaw. These parts help maintain a stable flight path and respond to pilot inputs effectively.

- **LandingGear**

  Essential for ground operations, the landing gear supports the aircraft during takeoff, landing, and taxiing. It includes **wheels**, **shock absorbers**, and **brakes** to handle the impact and weight distribution. The most common configurations are tricycle and tailwheel types, each suited to different aircraft designs.

- **EngineMounts**

  Engine mounts secure the engines to the aircraft's structure, absorbing vibrations and providing a stable platform for engine thrust. They must be

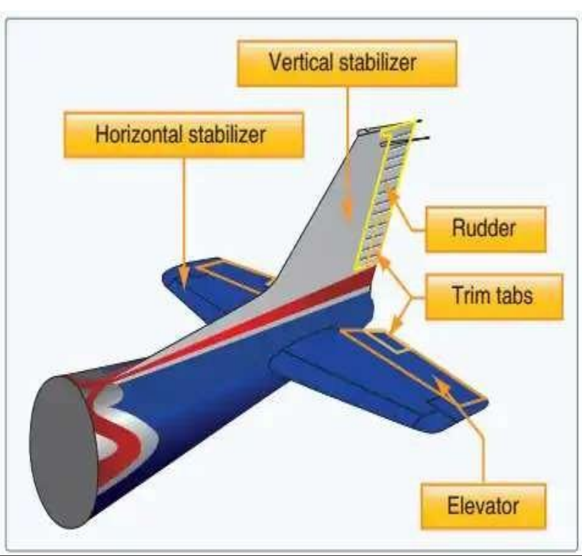


Fig no.3-TAIL

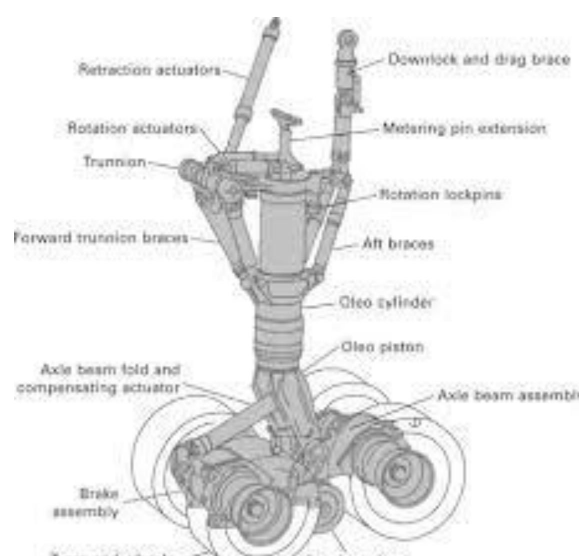


Fig no.4-LANDING GEAR

strong enough to handle high temperatures and stresses, often crafted from high-strength alloys.

- **ControlSurfaces**

  Control surfaces enable maneuvering and stability:

  - **Ailerons** control roll,
  - **Elevators** adjust pitch,
  - **Rudder** controls yaw. Additional devices like **flaps**, **slats**, and **spoilers** are used to modify lift during various flight phases, particularly during takeoff and landing.

- **Spars,Ribs, Stringers**

  These internal structures reinforce both the fuselage and wings:

  - **Spars** are the primary load-bearing elements in wings,
  - **Ribs** shape the wings and distribute stresses,
  - **Stringers** support the fuselage and wing skin, adding to overall strength and stiffness.

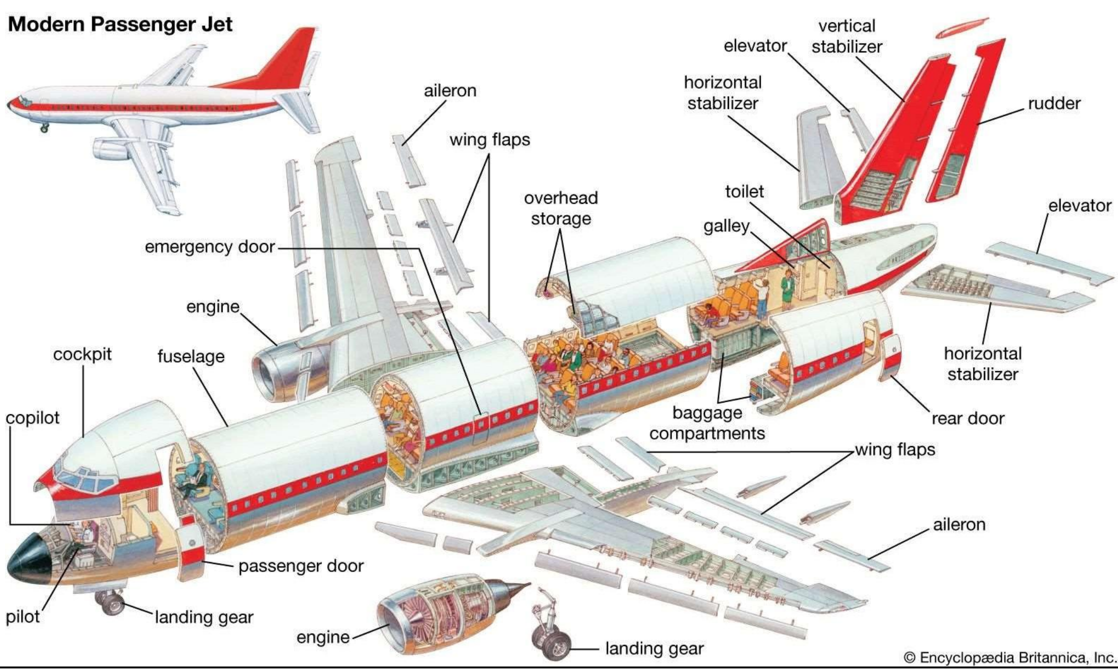


Fig no.5-AIRCRAFT COMPONENTS

Each of these components contributes to the aircraft's overall performance and safety, ensuring it can withstand the demands of flight. This structural framework allows for effective load distribution and stability under various operational conditions.

STRESS

Stress at a Point refers to the internal forces that develop within a material at a specific location in response to external forces. This concept helps engineers understand how materials resist deformation and potential failure under various loading conditions.

At any given point within a material, stress can be thought of as the force exerted per unit area, providing a measure of how much internal pressure is acting on that small region. Stress at a point is a vector quantity and varies depending on the direction and orientation of the surface through which it is observed.

Types of Stress at a Point

Stress at a point is generally divided into two main types based on how the force interacts with the material surface:

1. **Normal Stress**
   - Normal stress acts perpendicular to the surface. It can either stretch the material (tensile stress) or compress it (compressive stress).
   - Tensile stress pulls atoms or molecules in the material apart, whereas compressive stress pushes them together, impacting the material's shape and potentially causing it to deform.
2. **Shear Stress**
   - Shear stress acts parallel to the surface, attempting to cause adjacent layers within the material to slide past each other.
   - This type of stress is significant in scenarios where there are forces causing twisting or sliding, like in beams subjected to torsion or in fasteners holding materials together.

Stress Tensor Representation

At any point, stress can be represented as a set of components acting along different directions. This full set of stress components forms a **stress tensor**, which describes the stress state in a material by including both normal and shear stress components. By considering stress in three dimensions, engineers can understand the combined effects of various forces acting within a structure.

Principal Stresses

Through mathematical transformation, it is possible to find special orientations at which the stress at a point is purely normal, with no shear stress acting on those planes. These are called **principal stresses**, and they represent the maximum and minimum normal stresses at that point. Principal stresses are critical in design because they highlight the maximum stress that a material experiences in any direction.

Importance of Stress at a Point

Understanding stress at a point is crucial for assessing:

- **Material performance**: Helps predict how materials will respond to external forces, determining their suitability for various applications.
- **Failure prevention**: Stress analysis at specific points allows engineers to identify stress concentrations, which are areas more likely to experience failure under load.
- **Structural safety**: Ensures that structures can safely withstand expected loads without yielding or fracturing, which is essential for structural integrity.

In summary, stress at a point provides insight into how materials internally resist forces, helping engineers design structures that are both strong and reliable.

STRAIN

Strain is a measure of deformation representing the change in shape or size of a material under applied stress. Unlike stress, which describes the force per unit area, strain is a dimensionless quantity that describes the relative change in the material's dimensions.

When an external force is applied to a material, the internal structure of the material responds by either elongating, compressing, or distorting, depending on the nature of the force. Strain quantifies this change by comparing the original dimensions of the material to its deformed state.

Types of Strain

1. **Normal Strain**
   - Normal strain occurs when the material is stretched or compressed along a specific direction.
   - It measures the change in length of the material relative to its original length.
   - Normal strain can be **tensile** (positive strain, where the material is stretched) or **compressive** (negative strain, where the material is shortened).
2. **Shear Strain**
   - Shear strain arises when forces cause one layer of the material to slide relative to an adjacent layer.
   - This type of strain does not change the volume but alters the shape, often resulting in angular distortion.
   - It is commonly observed in cases of torsion or when forces act parallel to the surfaces of the material.
3. **Volumetric Strain**
   - Volumetric strain measures the change in volume of a material under stress, which can occur in cases where the material is subjected to pressure from all directions.
   - This is common in materials subjected to compressive forces, such as in fluids or compressible solids.

Importance of Strain

Strain provides valuable insight into how a material will respond to loading conditions:

- **Predicting Deformation**: By analyzing strain, engineers can predict how much a material will deform under certain loads, helping to ensure designs are functional and safe.
- **Determining Material Limits**: Understanding strain helps identify the limits of elasticity in materials. Up to a certain point (the elastic limit), materials can return to their original shape after the load is removed. Beyond this point, materials undergo permanent deformation.
- **Evaluating Structural Safety**: Excessive strain can lead to structural failure. By understanding strain distributions, engineers can design structures that avoid high strain concentrations, thus preventing deformation and potential failure.

Strain analysis is essential for material science, mechanical engineering, and structural analysis, as it directly influences the design and durability of materials and structures.

STRESS-STRAIN RELATIONSHIP

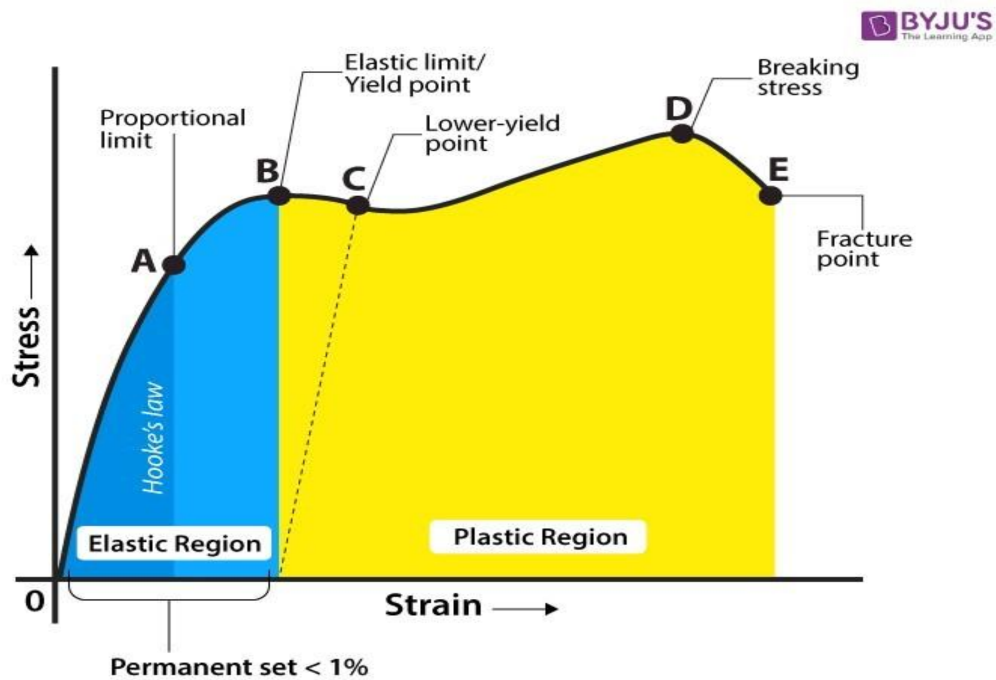


Fig no.6-STRESS-STRAIN RELATIONSHIP

The **stress-strain relationship** describes how a material deforms in response to an applied load. This relationship provides essential insights into the mechanical properties of materials, such as their strength, elasticity, and ductility, and is crucial for designing structures that can withstand forces without permanent deformation or failure.

The Elastic Region

In the initial stage of loading, many materials exhibit **elastic behavior**, where they return to their original shape once the applied force is removed. The relationship between stress and strain in this region is **linear** for most materials and follows **Hooke's Law**. This linearity is characterized by the **Young's Modulus** (or modulus of elasticity), a constant that indicates the stiffness of a material. Materials with a high Young's Modulus are stiffer and require more force to produce the same amount of strain compared to less stiff materials.

Yield Point

When the applied stress reaches a certain level, called the **yield point**, the material begins to deform plastically. Beyond this point, even if the stress is removed, the material will not fully return to its original shape. This marks the beginning of the **plastic region** of the stress-strain curve.

Plastic Region

In the plastic region, materials undergo **permanent deformation**. This nonlinear section of the stress-strain curve shows how the material continues to deform under stress but does not return to its original dimensions. For many ductile materials, the curve will display a significant amount of strain before failure, indicating a period of **strain hardening** where the material can withstand more stress as it is deformed.

Ultimate Strength and Fracture

As the material reaches its **ultimate tensile strength (UTS)**, the maximum stress it can withstand, any additional stress will lead to a reduction in the cross-sectional area (necking) until the material eventually fractures. The point of fracture represents the material's **breaking point**.

Types of Stress-Strain Curves

Different materials display characteristic stress-strain behaviors, allowing them to be classified based on their responses:

1. **Brittle Materials**: Show little to no plastic deformation, fracturing soon after the elastic limit (e.g., glass, ceramics).
2. **Ductile Materials**: Exhibit a significant plastic region, with substantial deformation before fracture (e.g., metals like steel and aluminum).
3. **Elastomers**: Have a nonlinear stress-strain relationship in the elastic region, capable of large strains (e.g., rubber).

Importance of the Stress-Strain Relationship

Understanding the stress-strain relationship is vital for:

- **Material Selection**: Choosing materials that can handle expected loads without excessive deformation.

- **Predicting Failure**: Assessing how materials will behave under extreme conditions to prevent failures.
- **Engineering Design**: Ensuring structures and components are capable of elastic deformation while staying within safe limits.

The stress-strain relationship is foundational in materials science and structural engineering, enabling designs that balance flexibility, strength, and durability according to specific requirements.

INTRODUCTION TO PHOTOELASTICITY

Photoelasticity is an experimental technique used to measure stress distribution within transparent materials. This method is based on the property of birefringence, where certain materials exhibit different refractive indices when subjected to stress, allowing internal stresses to be visualized.

Basic Principle

In photoelasticity, when a birefringent material is placed under stress, it exhibits temporary double refraction, splitting an incident light beam into two polarized components. By placing this stressed material between polarized light filters, interference patterns, called *isochromatic fringes*, become visible. These patterns represent contours of equal principal stress difference in the material.

Applications

Photoelasticity is widely used in engineering and materials science for:

- Identifying stress concentrations in structural components.
- Validating computational models by comparing predicted and experimental stress fields.
- Examining components that are difficult to analyze through analytical methods, especially complex shapes or regions with high stress concentrations.

Types of Photoelasticity

There are two main types of photoelasticity:

1. Two-dimensional photoelasticity: Used with flat, thin models where stresses are in the plane of the material.
2. Three-dimensional photoelasticity: Used for real objects, though more complex due to stress distribution through the volume.

Advantages and Disadvantages

Advantages

- Non-destructive and highly visual.

- Allows observation of stress concentrations, helping in design optimization.

Disadvantages

- Limited to transparent materials.
- Calibration and interpretation of fringe patterns require expertise.

Photoelasticity thus provides a powerful visualization of stress fields, making it invaluable for experimental stress analysis in structural engineering and materials science.

STRESS-OPTIC LAW

The **stress-optic law** is the fundamental principle underlying the technique of photoelasticity, which relates the optical effects in a birefringent material to the internal stresses it experiences. This law describes how the change in refractive index (birefringence) in a stressed material is proportional to the difference in principal stresses.

Stress-Optic Law Equation

The stress-optic law can be mathematically represented as:

$$\Delta n = C \cdot (\sigma 1 - \sigma 2)$$

where:

- Δn is the change in refractive index, or birefringence, due to stress.
- CCC is the **stress-optic coefficient** (a material constant that depends on the wavelength of light and the material).
- $\sigma 1$ and $\sigma 2$ are the **principal stresses** at a point in the material.

In photoelastic experiments, the relative phase difference introduced by this birefringence leads to the formation of interference fringes, also known as **isochromatic fringes**, which are visible in polarized light.

Application of Stress-Optic Law in Photoelasticity

In practical applications, the **fringe order N** (an integer or fractional value representing the fringe's position) is related to the difference in principal stresses. This relationship is given by:

$$\sigma 1 - \sigma 2 = N \cdot \lambda \ /(t.C)$$

where:

- N is the fringe order observed in the photoelastic material.
- λ is the wavelength of the light used.
- t is the thickness of the material being analyzed.

Significance of the Stress-Optic Law

The stress-optic law enables engineers and researchers to:

- Quantitatively measure stress distribution within transparent materials.
- Identify high-stress regions by analyzing the fringe patterns.
- Validate theoretical stress models and finite element analyses through experimental methods.

This law forms the basis of stress analysis in photoelasticity, making it a key tool in assessing structural integrity and optimizing designs in engineering applications.

FRINGE PATTERNS

Fringe patterns are key to understanding stress distributions in photoelastic analysis, offering a visual representation of stresses within transparent materials under polarized light. These patterns appear as alternating light and dark bands (or colors with white light) and result from the interference of light as it passes through a birefringent material under stress.

Types of Fringe Patterns

1. **Isochromatic Fringes**: These represent lines of equal *principal stress difference* ($\sigma 1 - \sigma 2$) and show where stress levels are the same. Using monochromatic light, they appear as alternating light and dark bands, while with white light, they display in colors. Isochromatic fringes help identify high-stress areas and quantify stress differences.

2. **Isoclinic Fringes**: These indicate lines of equal *principal stress direction*, showing where the angle of the principal stresses remains constant. Observed by rotating a polarizer to match the stress direction, they help identify stress orientation rather than magnitude.

Formation and Interpretation of Fringe Patterns

Fringe patterns arise due to **stress-induced birefringence**. When polarized light enters a stressed material, it splits into two rays moving at different speeds due to the stress difference. When these rays recombine, they interfere, creating the fringe pattern.

- **Fringe Order N**: The order relates to the number of complete light cycles of interference and thus to the principal stress difference. Higher fringe orders indicate greater stress differences.

- **Fringe Density**: Closely spaced fringes mark high-stress gradients, while widely spaced ones denote lower stress regions.

Applications of Fringe Patterns

Fringe patterns are essential in experimental stress analysis, enabling engineers to:

- Visualize stress concentrations, making them ideal for analyzing complex geometries.

- Confirm and validate computational stress models by comparing experimental fringe patterns.

- Test and optimize design modifications by observing fringe changes before and after adjustments.

Fringe patterns offer a powerful tool in structural analysis, providing a direct, intuitive understanding of stress distribution, which aids in optimizing designs for improved safety and durability.

PHOTOELASTIC MATERIALS

Photoelastic materials exhibit birefringence when subjected to mechanical stress, crucial for stress analysis using photoelasticity. They allow visualization of internal stress distributions through polarized light.

Key Characteristics

- **Birefringence**: Two different refractive indices based on stress direction, causing fringe patterns.
- **Transparency**: Essential for observing stress patterns.
- **Predictable Elastic Properties**: Ensures accurate stress analysis.

Types

- **Polymer Resins**: Commonly used like epoxy and polycarbonate.
- **Glass**: Certain types provide high optical clarity.
- **Crystals**: Materials like quartz for specialized applications.
- **Natural Materials**: Such as calcite, less commonly used.

Applications

- **Structural Analysis**: Visualizing stress distributions to improve design.
- **Experimental Validation**: Models for validating predictions and analyses.
- **Education**: Teaching stress analysis and optics concepts.

Photoelastic materials are essential in mechanics and engineering, providing valuable insights into material behavior and enhancing design safety.

REQUIREMENTS OF PHOTOELASTIC MATERIALS

For materials to be effective in photoelastic applications, they must meet several key requirements:

1. Birefringence

- **Ability to Exhibit Birefringence**: The material should demonstrate a significant difference in refractive indices when subjected to stress, allowing for clear fringe patterns to be observed.

2. Transparency

- **Optical Clarity**: The material must be transparent to permit polarized light to pass through without significant absorption or scattering, ensuring effective visualization of stress patterns.

3. Mechanical Properties

- **Linear Elasticity**: The material should exhibit a linear elastic response under applied loads, meaning that stress and strain are proportional within the working range to ensure accurate stress analysis.
- **Uniformity**: The material should have consistent properties throughout to avoid variations in birefringence that could affect measurements.

4. Durability

- **Resistance to Environmental Factors**: Photoelastic materials should be resistant to environmental factors (e.g., humidity, temperature changes) that could affect their optical and mechanical properties.

5. Thickness

- **Appropriate Thickness**: The material should be of sufficient thickness to create observable fringe patterns but not so thick that it hinders light transmission or complicates the analysis.

6. Availability and Ease of Fabrication

- **Ease of Manufacture**: The material should be readily available and easy to mold or shape into desired forms for experimentation and analysis.

Meeting these requirements ensures that photoelastic materials can be effectively used for stress analysis, enabling accurate visualization and measurement of stress distributions in various applications.

EPOXY RESIN

Epoxy resin, particularly art epoxy resin, is a versatile and commonly used photoelastic material. It possesses optical properties that make it suitable for stress analysis through photoelasticity, a technique where stress patterns in transparent materials can be visualized under polarized light. Here are some detailed characteristics and properties of epoxy resin in this context:

1. Material Composition and Structure

- **Base Composition**: Art epoxy resin typically consists of two main components: a resin and a hardener. The curing process involves a chemical reaction that results in a durable, solid plastic.
- **Clarity**: High-grade art epoxy resin is optically clear and often designed to be bubble-free, making it ideal for photoelastic applications.

2. Advantages for Photoelasticity

- **Ease of Use**: Art epoxy resins can be easily cast into different shapes and forms, making them suitable for creating models for stress testing.
- **Cost-Effectiveness**: They are generally more affordable compared to other specialized photoelastic materials.
- **Customizable**: The refractive index and clarity can be adjusted by using different formulations or additives.

3. Limitations

- **Time to Cure**: Epoxy resins require a curing period that varies with temperature and formulation.
- **Sensitivity to UV Light**: Some epoxy resins may yellow over time if not formulated with UV stabilizers.

PHOTOELASTIC PROPERTIES

- **Optical Transparency**: Epoxy resins exhibit high transparency, which is essential for analyzing stress patterns with polarized light.
- **Birefringence**: Under stress, epoxy resin shows birefringence, meaning it has different refractive indices in different directions. This property creates a pattern of colored fringes when observed under polarized light, revealing stress distribution.
- **Fringe Order**: The number and spacing of the fringes are related to the magnitude of stress. Epoxy resins are sensitive enough to display distinct fringe patterns.

MECHANICAL AND THERMAL PROPERTIES

- **Elastic Modulus**: Art epoxy resins typically have a moderate elastic modulus, which contributes to their responsiveness in stress analysis.
- **Hardness and Toughness**: These resins cure to a rigid and hard state, which allows them to maintain shape under stress without significant deformation.
- **Temperature Sensitivity**: Epoxy resins can be affected by changes in temperature, which might alter their stress patterns and birefringence properties.

AVAILABILITY DETAILS OF THE MATERIAL

1. Retail and Online Stores

- **Art/Craft Stores**: Found in art supply and hardware stores.
- **Online Platforms**: Available on Amazon, eBay, Etsy, and specialized art retailer sites.
- **Direct from Manufacturers**: Options for bulk purchases.

2. Regional Availability

- **Common**: Easily found near City
- **Shipping**: Some restrictions may apply due to hazardous material classifications.

COST DETAILS OF THE MATERIAL

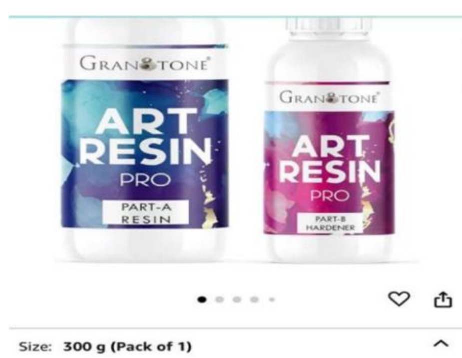
❖ **Sizes and Pricing**

- **Small Kits**: 340. RS-12800.RS for hobby use.
- **Bulk Options**: $100+ for professional projects.

❖ **Considerations**

- **Shipping Fees**: May vary, especially internationally.
- **Regulations**: Check local import rules for chemicals.

❖ **Epoxy Used In Project:**Buyed from Amazon



FABRICATION DETAILS

1. Design Phase (SolidWorks)

- **I-Section Mold**: Design an I-section mold with:
  - **Flange Width**: 150 mm
  - **Web Height**: 150 mm
  - **Thickness**: 5 mm for both the flange and web.
- **Elliptical Section Mold**:
  - **Major Diameter**: 65 mm
  - **Thickness**: 5 mm

2. 3D Printing

- Export the designed models from SolidWorks in a format suitable for 3D printing (e.g., STL file).
- Print the molds using a 3D printer with a suitable material like PLA or ABS for rigidity.

3. Preparation for Casting

- **Surface Treatment**: Apply a release agent to the interior surfaces of the printed mold to prevent the epoxy from sticking.
- **Assembly**: Ensure the molds are sealed properly to avoid leaks.

4. Epoxy Resin Casting

- **Mixing**: Prepare the epoxy resin by mixing the resin and hardener according to the manufacturer's instructions.
- **Pouring**: Carefully pour the mixed epoxy resin into the molds, ensuring even distribution.
- **Curing**: Allow the epoxy to dry and cure for the specified time, ensuring minimal air bubbles.

5. Demolding

- Once the resin has fully cured, gently remove the cast pieces from the molds.
- **Finishing**: Sand or trim any excess edges for a smooth finish.

CHALLENGES FACED

1. Buying Epoxy Resin

- **Availability Issues**: Sourcing high-quality, clear epoxy resin may be challenging, especially if specific properties (e.g., UV resistance, clarity) are required.
- **Cost**: Good-quality resin can be expensive, potentially straining the project budget.
- **Shipping Restrictions**: Epoxy resins may be classified as hazardous materials, affecting shipping options and delivery times.

2. Mold Fabrication

- **3D Printing Limitations**: Ensuring the 3D printer's capacity to produce high-quality, defect-free molds is essential. Issues like warping or uneven surfaces can affect the final casting.
- **Material Selection**: Choosing the right material for printing molds can be tricky. Some materials may not withstand the epoxy curing process or may be difficult to seal properly.
- **Surface Finishing**: Achieving a smooth finish on 3D-printed molds may require additional work, such as sanding or applying a release agent, to avoid imperfections in the final cast.

PHOTOGRAPHS OF THE FABRICATED MODELS

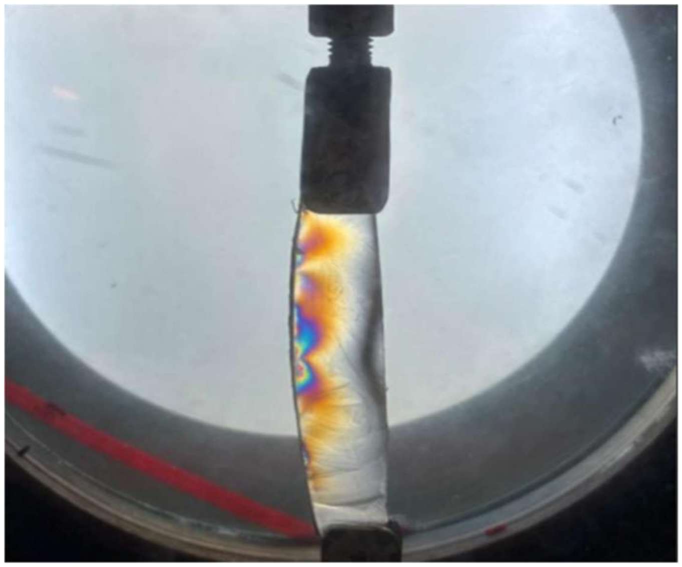


Fig no.7-ELLIPSE

Fig No.8-I-SECTION

SCHEMATIC OF PHOTOELASTIC SETUP

AND PHOTOGRAPH

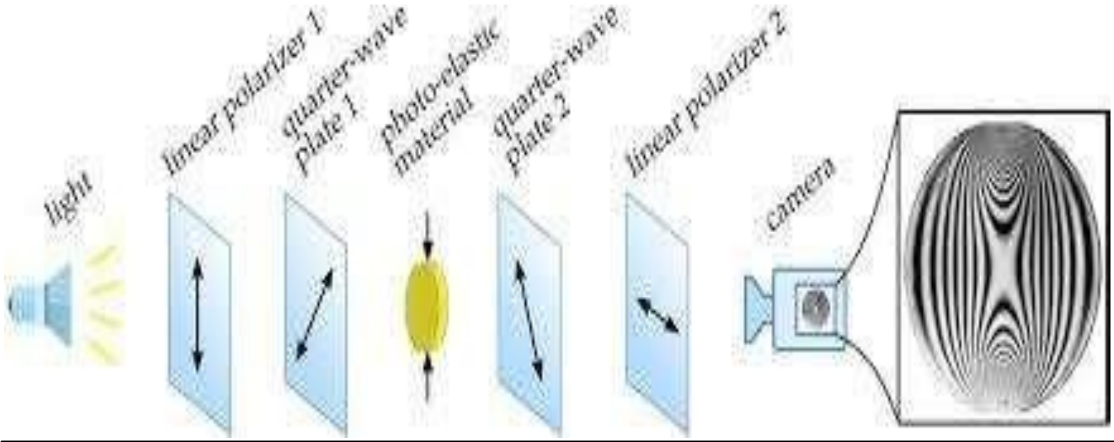


Fig No.9-SCHEMATIC OF PHOTOELASTIC SETUP

Fig No.10-I SECTION SETUP

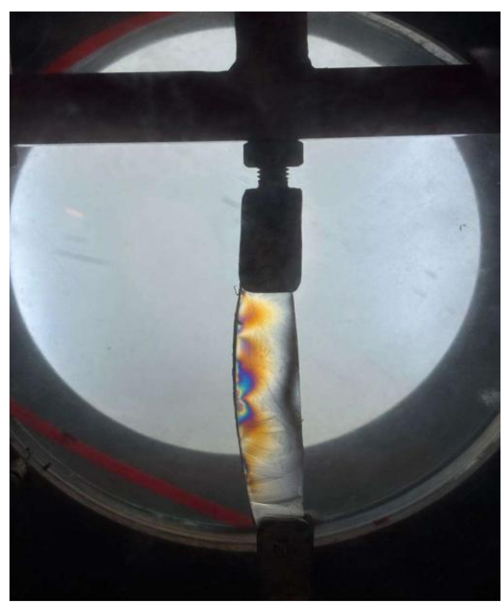
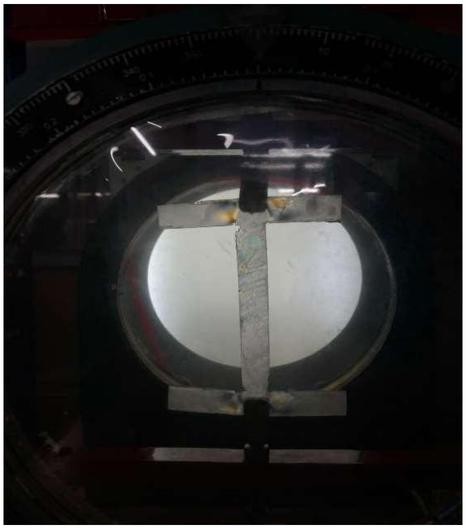


Fig No.11-ELLIPTICAL SECTION SETUP

STRAIN CONTOUR PLOTS OF I -SECTION



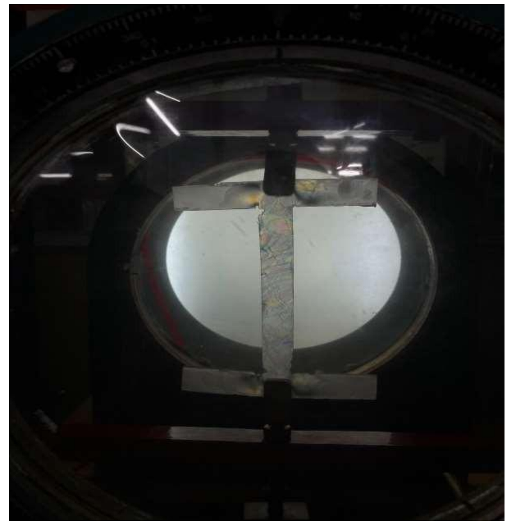
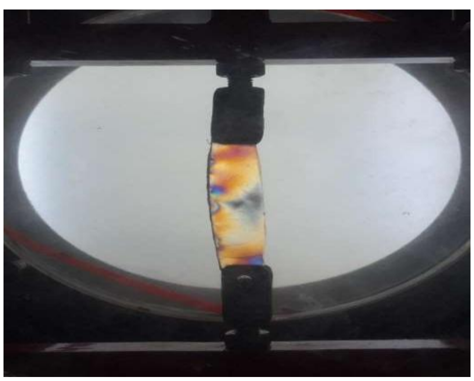
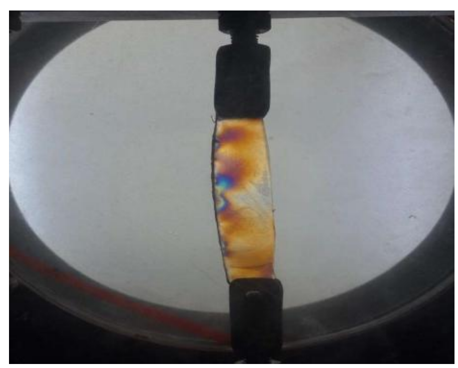
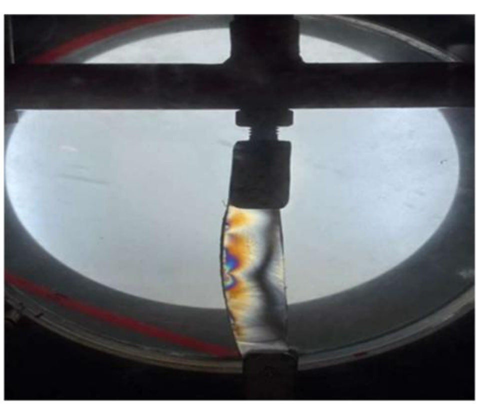


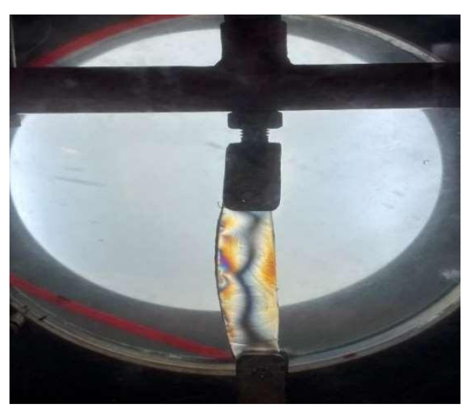
Fig No.12 – FRINGE PATTERN ON I-SECTIONS

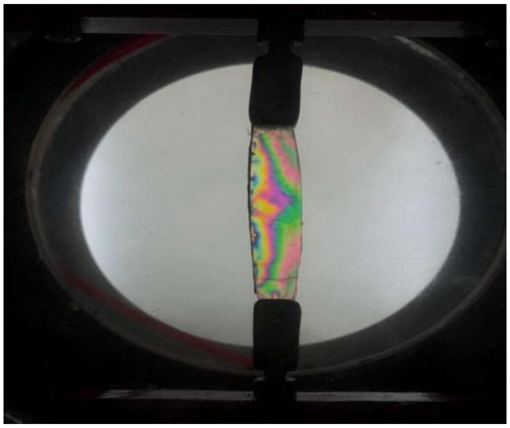
STRAIN CONTOUR PLOTS OF ELLIPSE











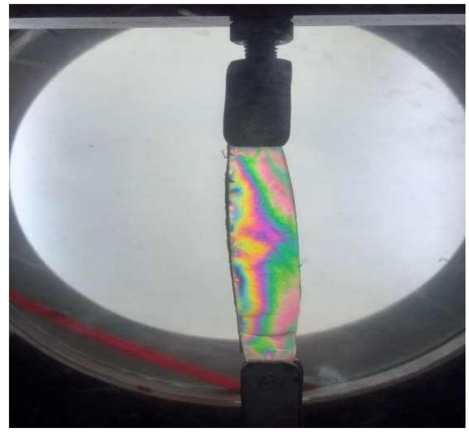


Fig No.13 – FRINGE PATTERN ON ELLIPTICAL SECTIONS

RESULTS AND DISCUSSION

The fringe pattern obtained by 2 point bending is applied, the fringe pattern for I -section has not been obtained as accepted due to manufacturing errors and less curing time of epoxy. The fringe pattern for the ellipse has been obtained but due to some initial stress, while removing it from the mould, there is quite a distortion in it. It signifies that manufacturing plays a vital role, a well-manufactured section would give better results. It also signifies that a photoelastic effect would be used to observe the already undergone stress object respond when additional load is applied.

CONCLUSION

The photoelastic test of epoxy resin demonstrated that it is an effective material for visualizing stress distribution in structural models. The clear and transparent nature of the epoxy allowed for the successful observation of birefringence patterns under polarized light, indicating its suitability for photoelastic analysis. Despite minor challenges such as bubble formation and surface imperfections, the overall process yielded dimensionally accurate and functional models.

Improvements in mold-making techniques and casting procedures could further enhance the quality of future models. The study confirmed that epoxy resin is a reliable and versatile material for stress analysis, making it a valuable tool for engineering research and educational purposes.

CONTRIBUTION OF EACH TEAM MEMBER

- Krisha (Team Lead): Making Mould, 3D printing, Experiment
- Riddhi: Report and Experiment

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