A

PROJECT REPORT

ON

STRESS MEASUREMENT USING POLARISED LIGHT

SUBMITTED BY

NAME	G.R. NO.	ROLL NO.	MOBILE NUMBER
Atharva Dhamse	21810865	153060	8208373206
Ameya Malwadkar	21810901	153063	8552922267
Aniket Rane	21810904	153064	7263864941
Vedangini Thakare	21810632	153046	9359921649
Kapil Khanke	21810712	153052	7083395905
Saurabh Kulkarni	21810910	153065	9423860845
Sumeet Raisoni	21810794	153056	9673970585
Gargee Lagad	21810803	153057	9011934433
Dhruba Jyoti Divya	21810985	153069	9765495839
Sushant Bhange	21810700	153051	9665526506
Vikas Rathod	21810649	153048	9130817494
Mitesh Godse	21810812	153066	8983026653
Rohan Raskar	21810748	153053	9623534227
Rohan Fugate	21810613	153045	8793202838
Omkar Kulkarni	21810933	153067	8421144938
Nazar Bekinalkar	21810940	153068	8983963960
Atharva Chandne	21810894	153062	9689583737
Shaikh Mohammad Owais	21810775	153055	9860397373
Hasan Mohammed	21810863	153059	9359961366
Yugal Jain	21810841	153058	7030181766
Shreyash Kochat	21810636	153061	9765726852

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PROF. DIPTI PANDIT

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ABSTRACT

The experiment is about stress measurement using polarised light. The process of measuring stress by using polarised light is commonly known as photoelasticity. As polarised light passes through the narrowest possible gap it is the best way to minimise stress in a specimen.

In photoelasticity we measure the residual stress generated automatically or manually in a transparent hard material such as plastic plate, glass slide etc. We here used a French curve which is a plane plastic plate. A polarizer and an analyser on either side of the object was used to polarise the unpolarised light and view the creation of fringe pattern due the stress in the object. The conclusion from this experiment is derived that when stress in the object is created manually in one direction the respective colour pattern gets shifted in opposite direction.

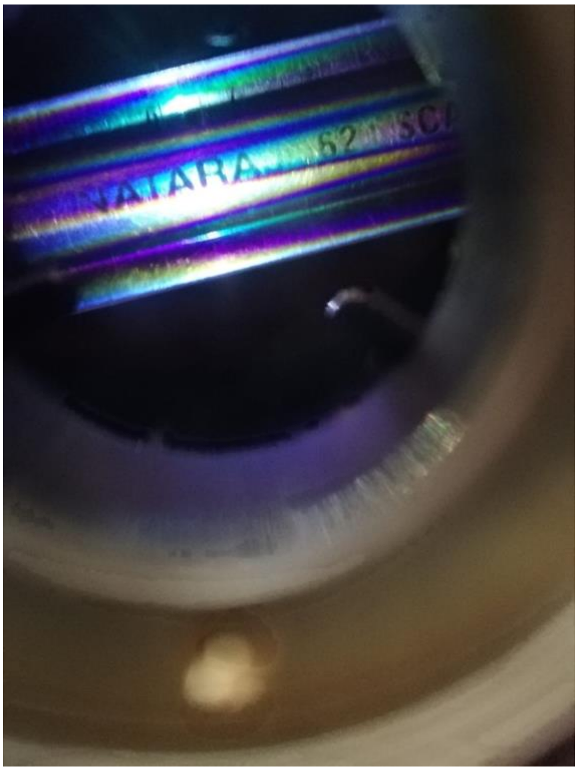
There are many applications of this method to quantify and rectify the stress in objects like glass cups, glass plates etc. Today there are automated mechanisms to quantify stress by photoelasticity and rectify them to the greatest extent.

Introduction

The experiment of calculating stress is a widely used full-field technique for accurately measuring surface strains to determine the stresses in a part or structure during static or dynamic testing.

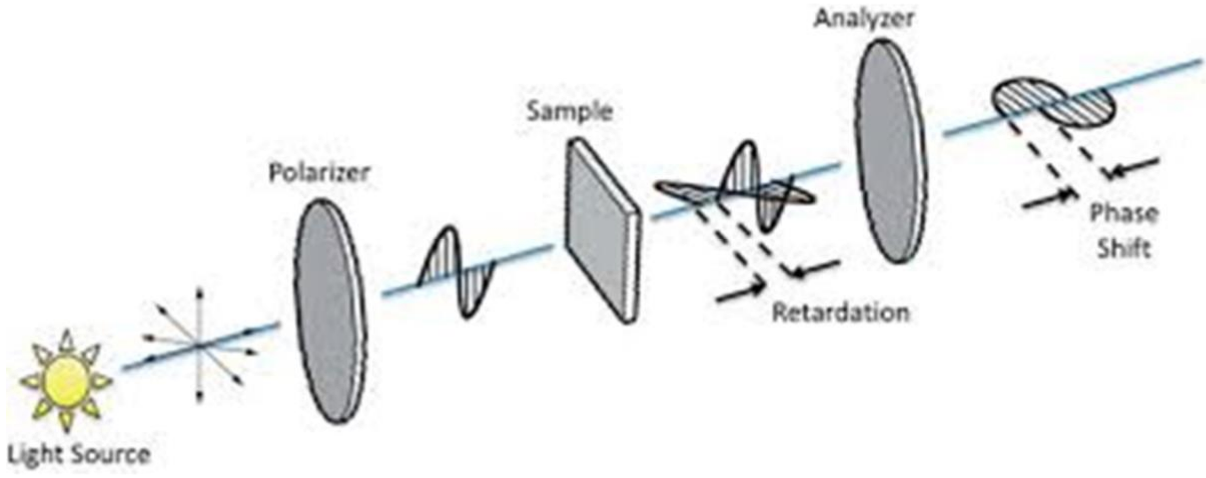
With the Photoelasticity method, a special strain-sensitive plastic coating is first bonded to the test part. Then, as test or service loads are applied to the part, the coating is illuminated by polarized light from a reflection polariscope. When viewed through the polariscope, the coating displays the strains in a colorful, informative pattern which immediately reveals the overall strain distribution and pinpoints highly strain areas.

With an optical transducer (compensator) attached to the polariscope, quantitative stress analysis can be quickly and easily performed. Permanent records of the overall strain distribution can be made by photography or by video recording.



Object under load and stress pattern as visible.

Block Diagram



Work Carried Out

In this experiment following steps were taken to complete the model,

- We started our project by searching for a polarizer through which we could polarize the torch light.
- We also enquired for the car polarising sheet which was perfect for our experiment. But it was not in our budget hence we dropped the idea.
- Later professor Garde gave us a example of working model by using a polarizer and an analyser were we got the exact idea how the stress is seen and how the colour fringes looks.
- Then using the polarizer and analyser we did many trials for the proper distance between the specimen , polarizer and analyser.
- Finally we formulated the accurate distance. Then we framed a box and made the working model.
- After this was the trying of new objects to analyse the stress and selecting the best object which could show us the maximum stress with clear view.
- Finally we selected french curve which is a plastic plate and observed the colour pattern due to the stress and got various conclusions.

Components

1. Box(Frame of the structure)

2. Polariser

3. Analyser

4. Object (French Curve)

5. Binding threads

Final Structure

Observation

After the object was viewed from the analyser, stress patterns were visible. This is due to the phenomenon of birefringence and phase retardation which a polarised light undergoes on passing through a stressed object. The unpolarised light on passing through source undergoes polarisation on passing through the polariser.

This polarised light then passes through subject under stress When a ray of light passes through a photoelastic material, its electromagnetic wave components are resolved along the two principal stress direction (, ɫ1ɫ2) and each component experiences a different refractive index due to the birefringence. This results in different velocity of light wavefronts in the material and perpendicular to each other taking slightly different paths.

This results in the stressed material having two different indices of refraction (n_1, n_2) i.e., displaying the phenomenon of double refraction where by incident light is split into two rays taking slightly different paths. The difference in the refractive indices leads to a relative phase retardation between the two components.

From this experiment it can be concluded that when stress in the object is created manually in one direction the respective colour pattern gets shifted in opposite direction. Also, the fringe width increases as stress is induced in the object.

Object under unstressed state

Object under stressed state

Future Scope

We have conducted a set of analyses to evaluate the performance of coir fibre reinforced natural rubber composites. However there is ample scope for future studies in this topic and the work would be more fruitful if the following fields are explored.

- Non-destructive Testing of Composites :
  The knowledge of damage behaviour and the transition of damage from a subcritical stage to a critical stage is of considerable interest in material development and application. This method involves the detection of surface movements caused by stress waves of the fracture processes on a microscopic scale. Exploration of this method will provide a clear understanding of the composite performance.

- Analysis to Study Environmental Friendliness:
  It is known that petroleum based polymers cause harm to our environment due the lack of biodegradability. In the present study, both of the constituents in the composite are of natural origin. A complete idea about the biodegradation can be obtained only from a systematic study. Hence the biodegradation characteristics have to be analyzed.

- Product Manufacturing and Testing:
  These composites can be used for the production of belts, oil seals, gaskets etc. The present work will be successful only if useful articles are produced based on the material that has been developed in the study. Hence various articles based on these composites are to be produced and their service performance is to be judged using standard tests. This will open up new avenues for coir fibre reinforced natural rubber.

Conclusion

Although it is not possible to calculate exact stress using a polariscope, we can analyse stress in object using this experiment and locate places with maximum and minimum stress.