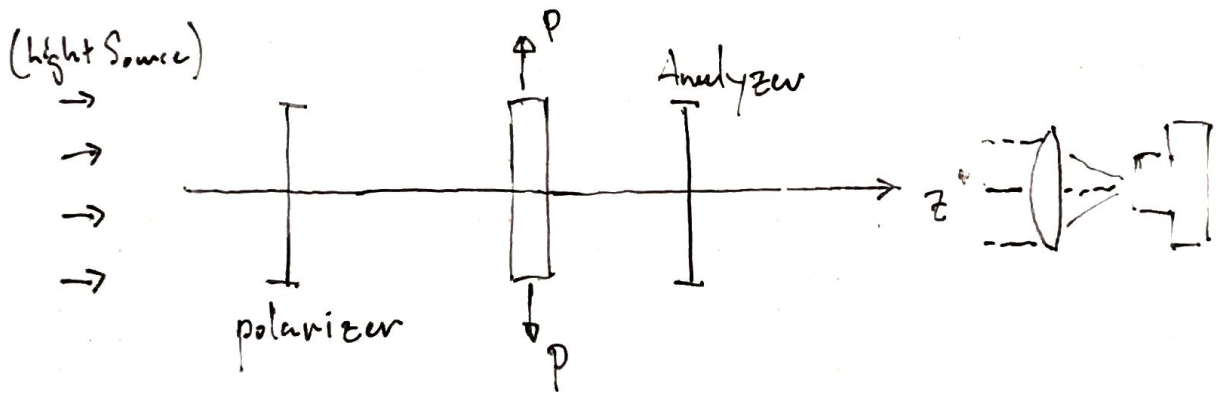
Experimental Mechanics : 9 October 2018

- Lecture #11 : Photoelasticity ; Fringes (Isoclinic vs. Isochromatic)
  - Photoelastic Materials
  - Analysis of Fringe Patterns
- Linear Polariscope



$$I = K \sin^2\left(\frac{\Delta}{2}\right) \sin^2(2\alpha) = 0$$

$$\underbrace{\quad}_{0} \quad \underbrace{\quad}_{0}$$

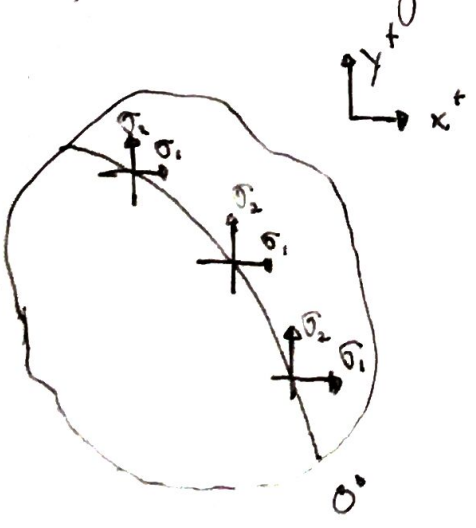
or

- if $\sin^2 2\alpha$: Isoclinic ; or principal stress inline w/pol.
- " $\sin^2 \frac{\Delta}{2}$: Isochromatic ; $\frac{\Delta}{2}$

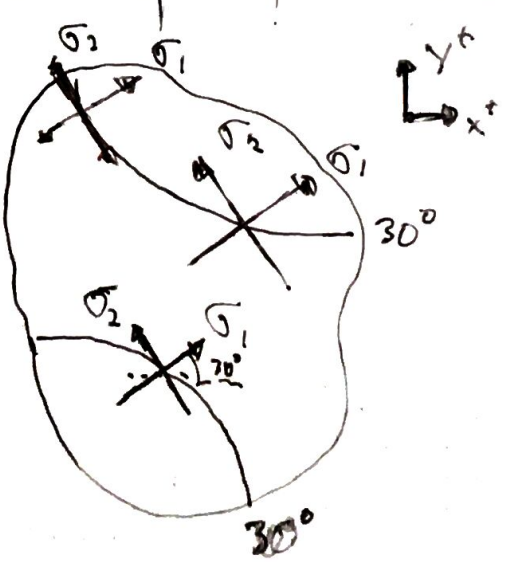
- Isoclinic : $I = 0$ because $\sin^2 2\alpha = 0$

$$2\alpha = n\pi, \quad n = 1, 2, 3 \ldots$$

- Principal stress in axis of polarizer
- Isoclinic parameter: rotate polarizer to varied orientation to create a full field map of stress
- Overlay of outline of isoclinic fringe create 2D stress direction
- Isoclinics must pass through isotropic or singular point; $\sigma_1 = \sigma_2$
- Isoclinic of atleast one parameter will have coincided with axis of symmetry.
- Stress / bonded as singular : . isoclinic of all parameters



a) Polarizer set to 0°



b) Polarizer set to 30°

- Isochromatic: $I = 0$ because $\sin^2 \frac{\Delta}{2} = 1$

$$\Delta/2 = n\pi \; ; \; n = 1, 2, 3 \ldots$$

$$n = \frac{\Delta}{2\pi} = \frac{hc}{\lambda}(\sigma_1 - \sigma_2)$$

  - n = fringe order
  - Δ = relative retardation ($\alpha[\sigma_1 - \sigma_2]$) if is an integer multiple of λ of light
  - Given lines of principal stress difference $\sigma_1 - \sigma_2$, we know $\tau_{max} = \frac{\sigma_1 - \sigma_2}{2}$ by Mohr's Circle

Quarter Wave Plates before & after model mounted @ ±45° isoclinics will be removed

- Ultimately, want to know n^{th} order of fringe order
  - Might be done by tracking boundary lines
  - Through movement of line under loading.
  - With white light, 0^{th} order is black with successive one λ
  - Isotropic ($\sigma_1 = \sigma_2$) will always be black

- Sample Pieces has been "model material", as few materials are isotropic and stress induced birefringence.
- Still, can be loaded to see a full field stress distribution by applying stressed geometries.

· Generally a polycarbonate:

+ Homolite 100
+ Polycarbonate

} For Creep

+ Epoxy Resin
+ Urethane Rubber

} Older Materials