Center of Excellence in Structural Health Monitoring
Inaugural meeting - April 12, 2007

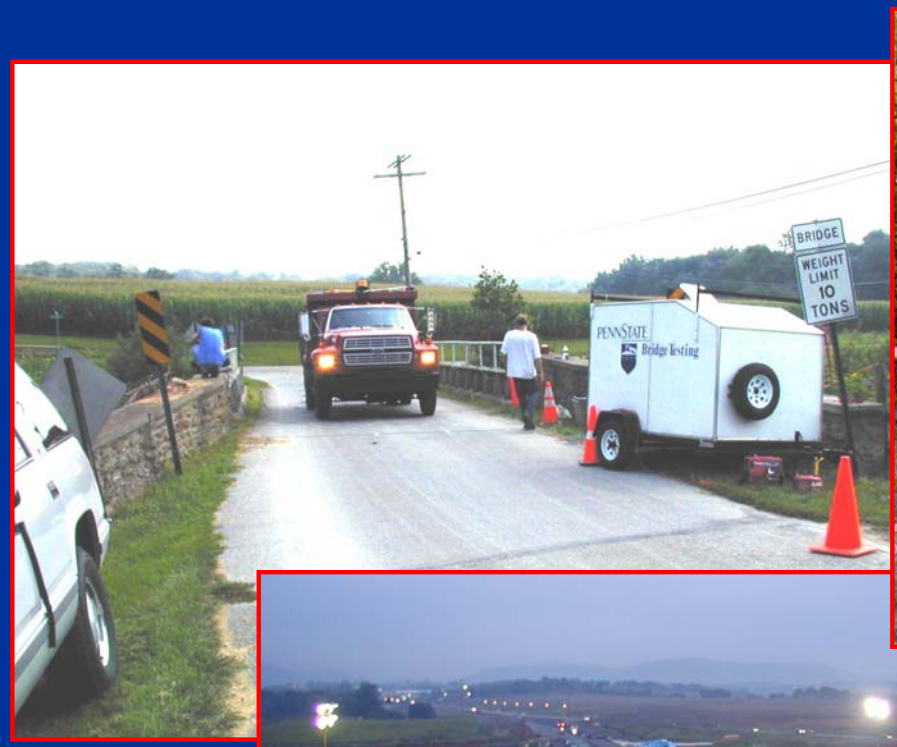
Structural Health Monitoring of Civil Infrastructure

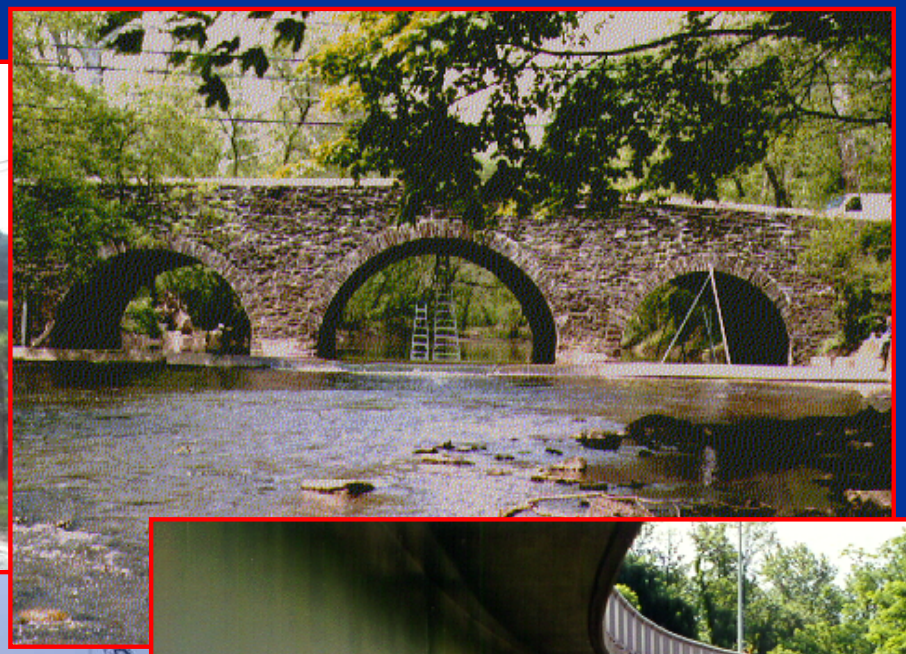
Long Term Monitoring of 4 Integral Abutment Bridges – *J. Laman*

- **4 MONITORED BRIDGES**
- **64 to 80 CHANNELS/PER BRIDGE**
- **REMOTE DATA COLLECTION**

Continuous, Remote Environmental Load Monitoring

Field Evaluation and Health Assessment of Bridges





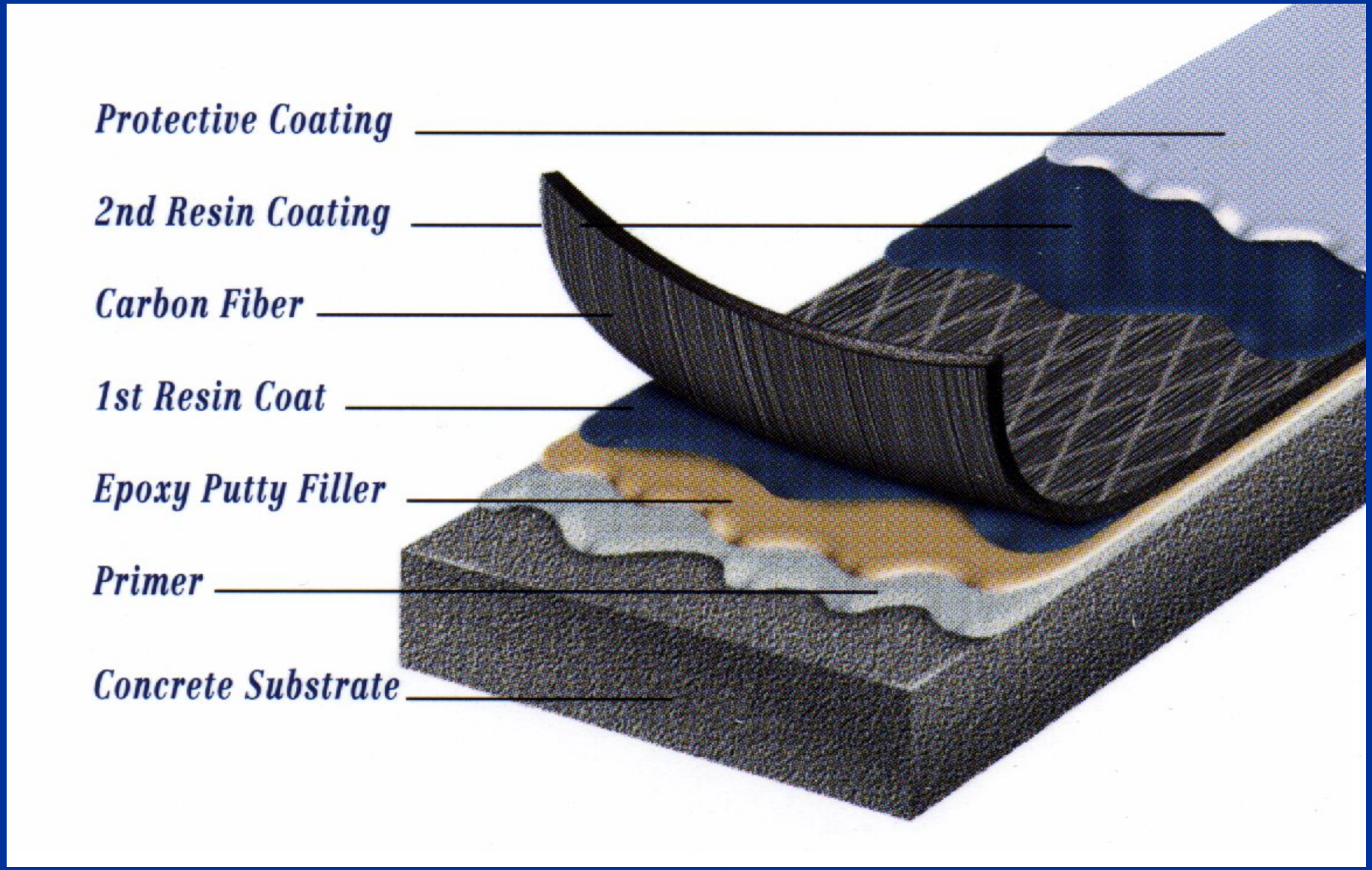
Evaluation of FRP Composite Repairs for Concrete Structures

Maria Lopez de Murphy, *Ph.D.*
Assistant Professor and Will Development Professor

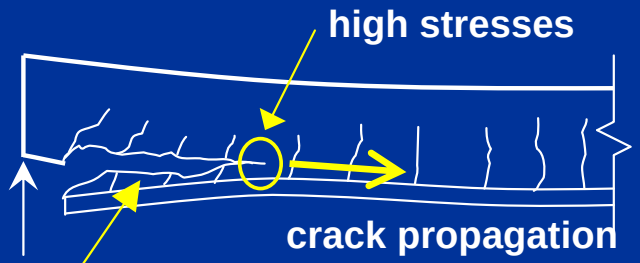
Repair/Strengthening Applications

(Wabo®MBrace)

FRP Bonded Repairs

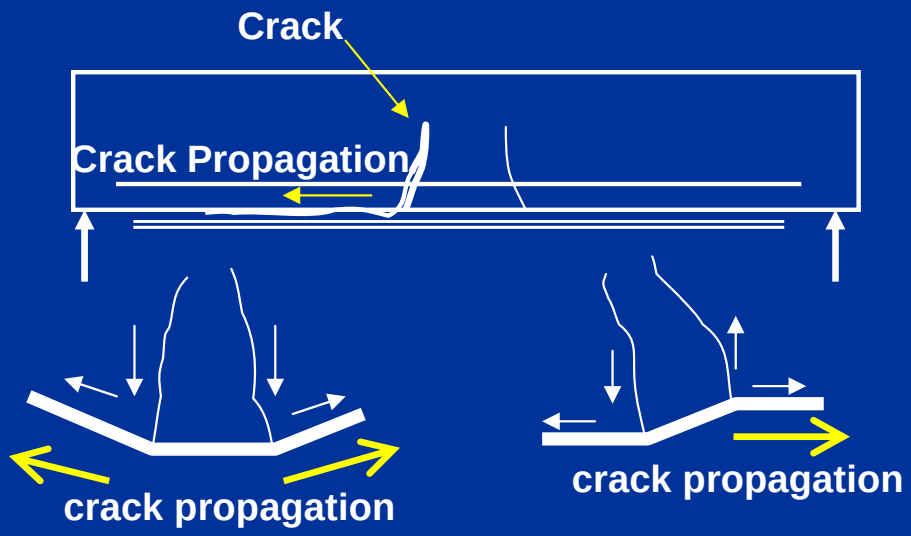


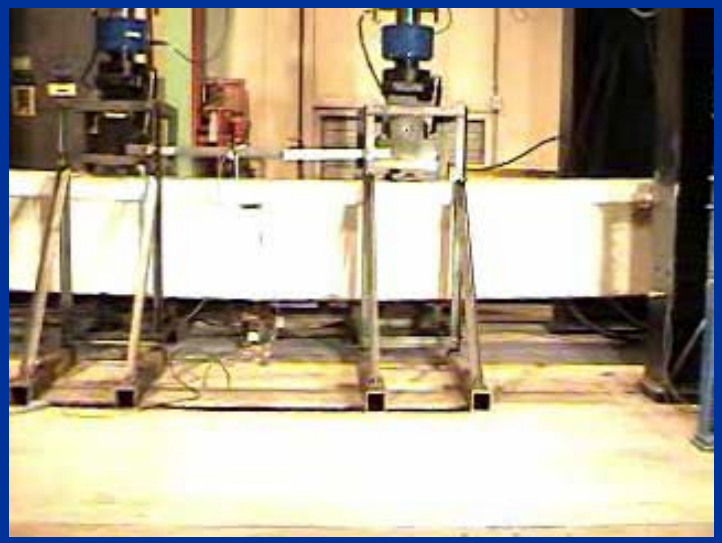
Debonding Failures of FRP Strengthened RC Beams.



Failure of concrete cover along rebar

Delamination of FRP from end

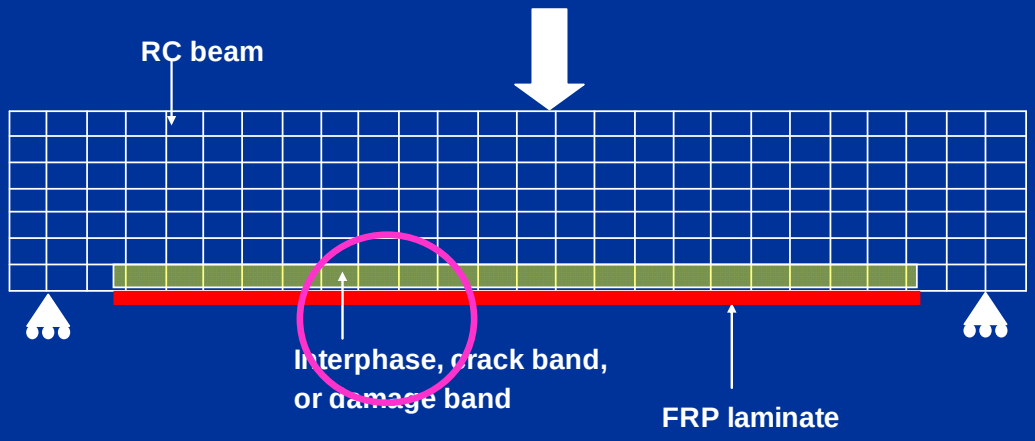


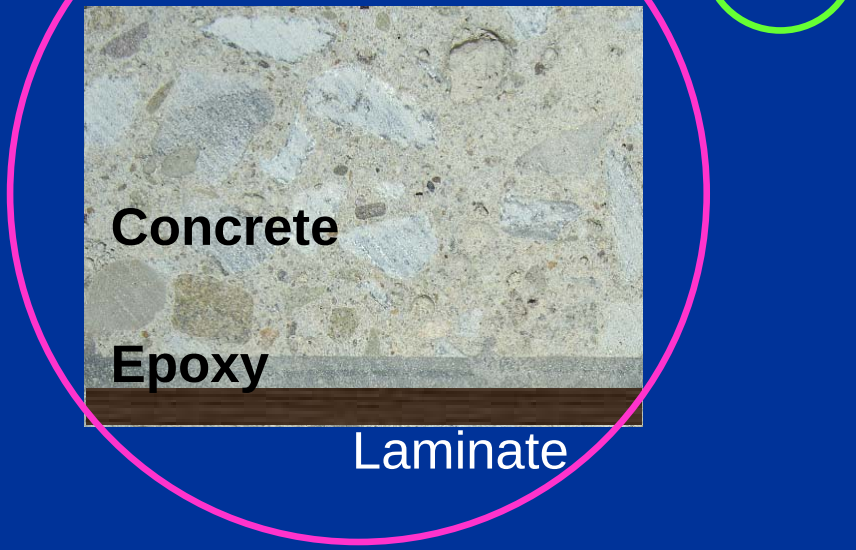


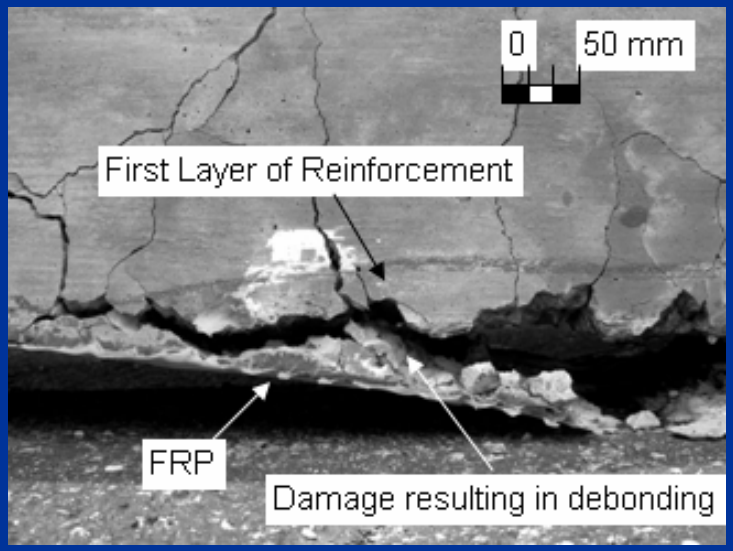
Delamination from an interior crack

Adapted from: Buyukozturk & Hearing (1998); Smith and Teng (2002).

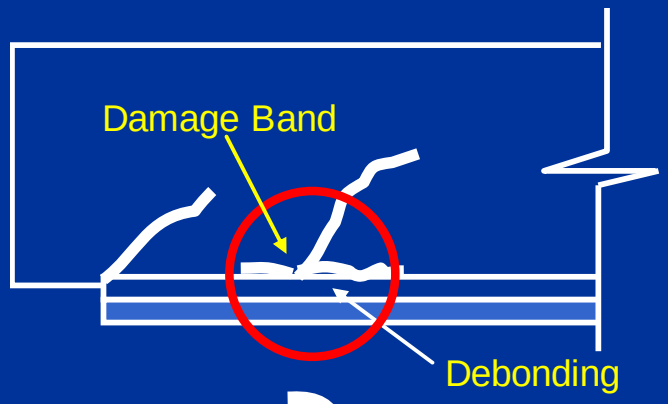
Evaluation of Bond Behavior using a Damage Approach

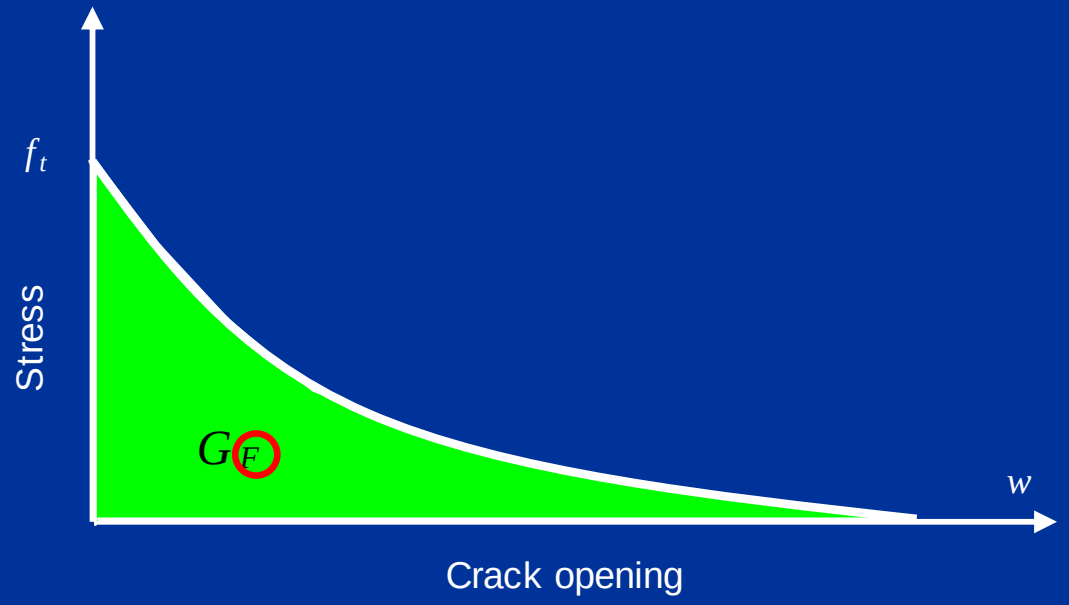


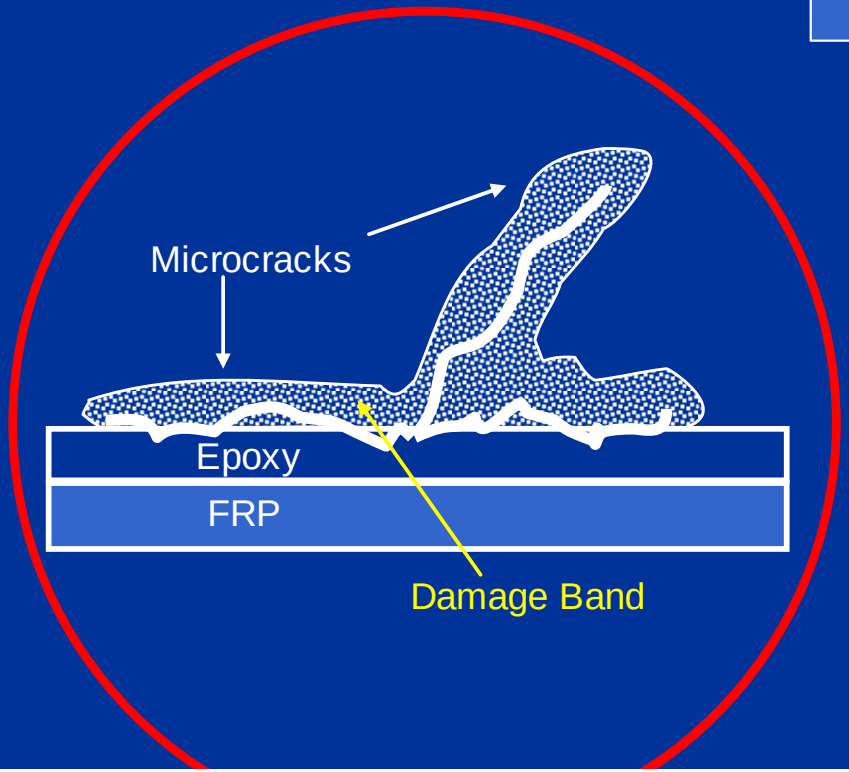




Analytical Approach using Damage Mechanics







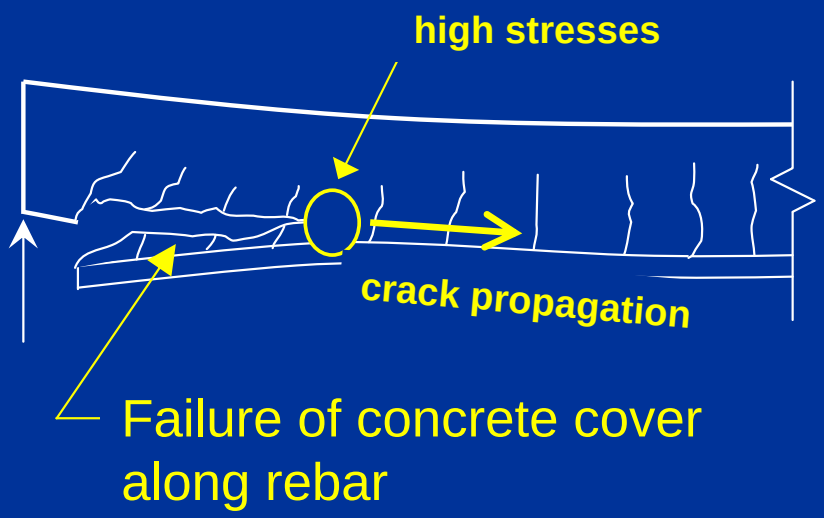
Onset of Cracking

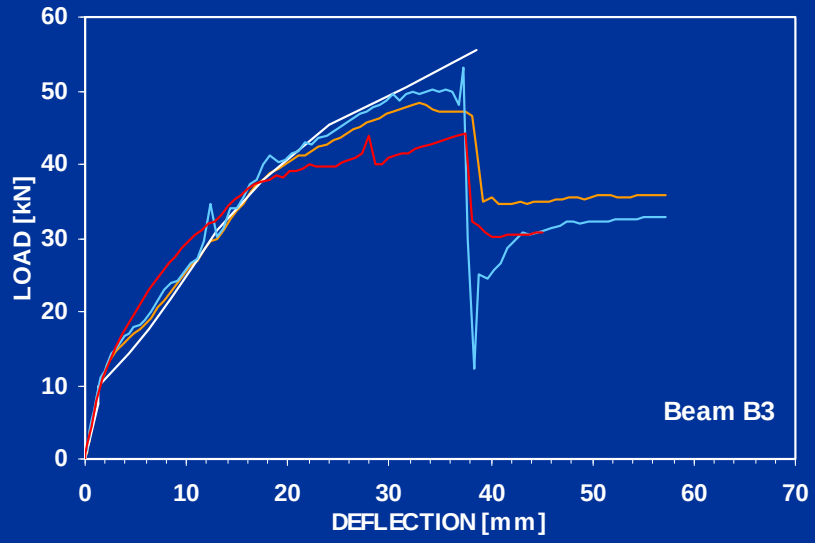
$$\sigma_1 = f_t$$

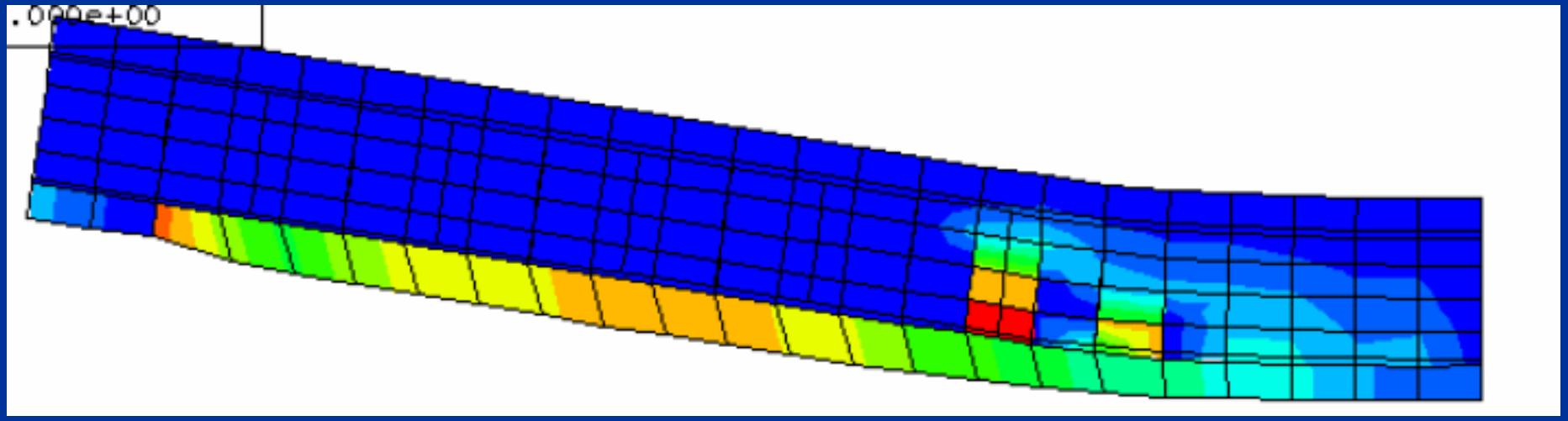
Damage evolution

$$d = \frac{1}{G_F}\int_0^w \sigma(w)dw = \frac{\alpha}{G_F}\int_0^{\varepsilon^P} \sigma(\varepsilon^P)d\varepsilon^P$$

Beams failing by Plate Debonding



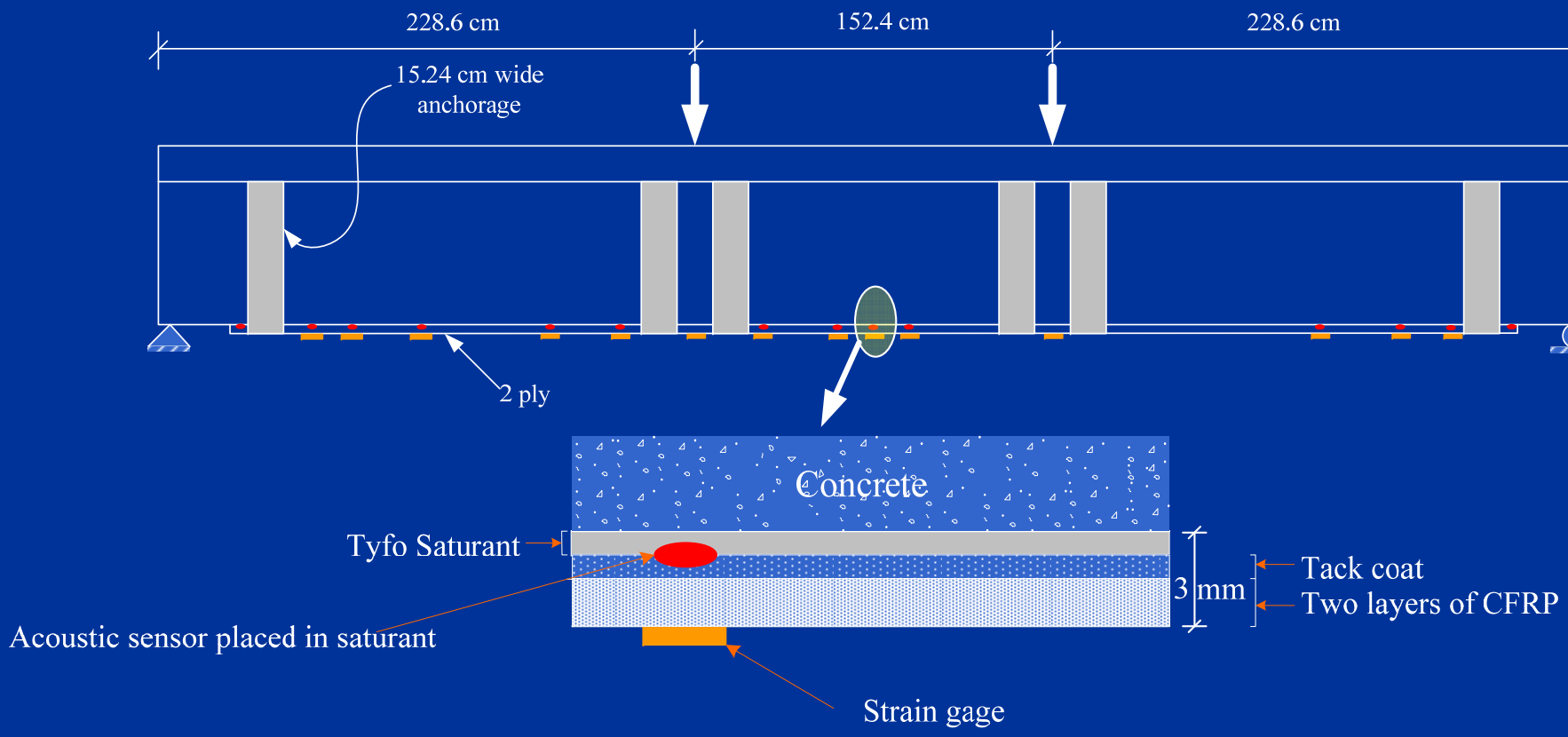




SHM of FRP Composite Repairs

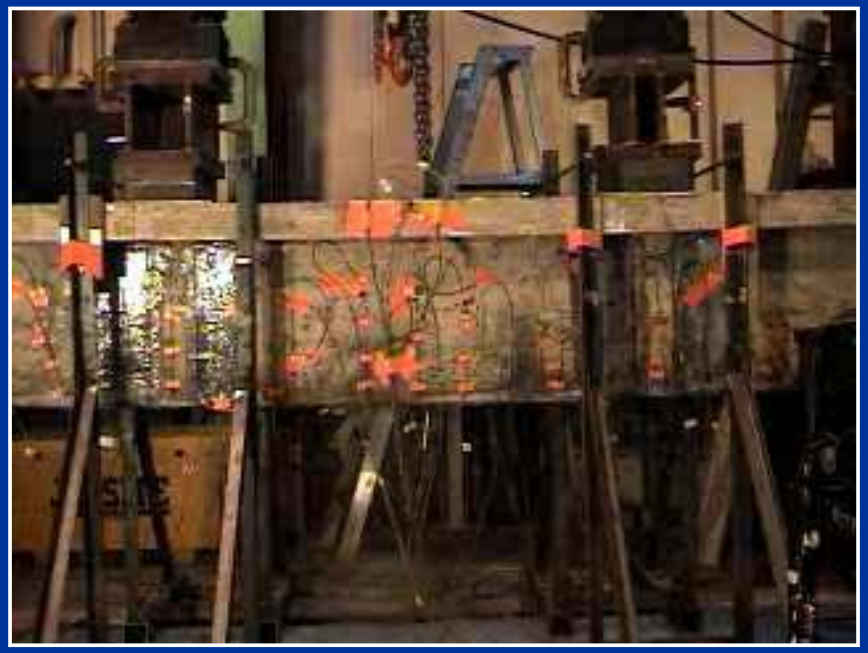
- Array of strain gages
- Fiber optics
- Digital Imaging
- Acoustic sensors
- Photoelastic coatings

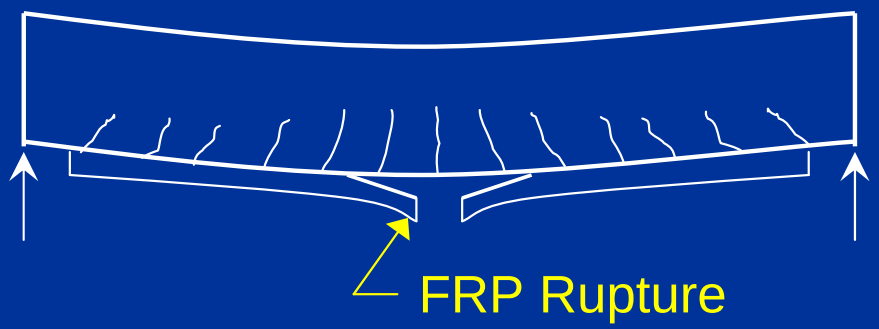
Evaluation of Performance using Acoustic Sensors and Strain Gages



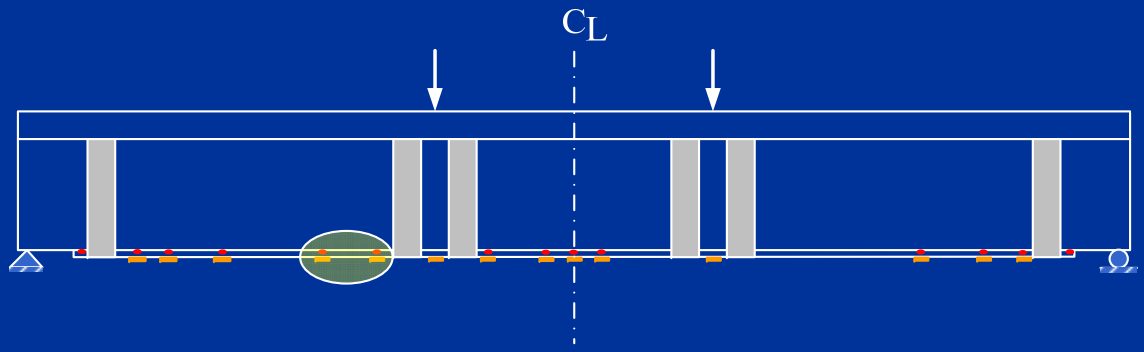
Ultrasonic Guided Wave Sensor

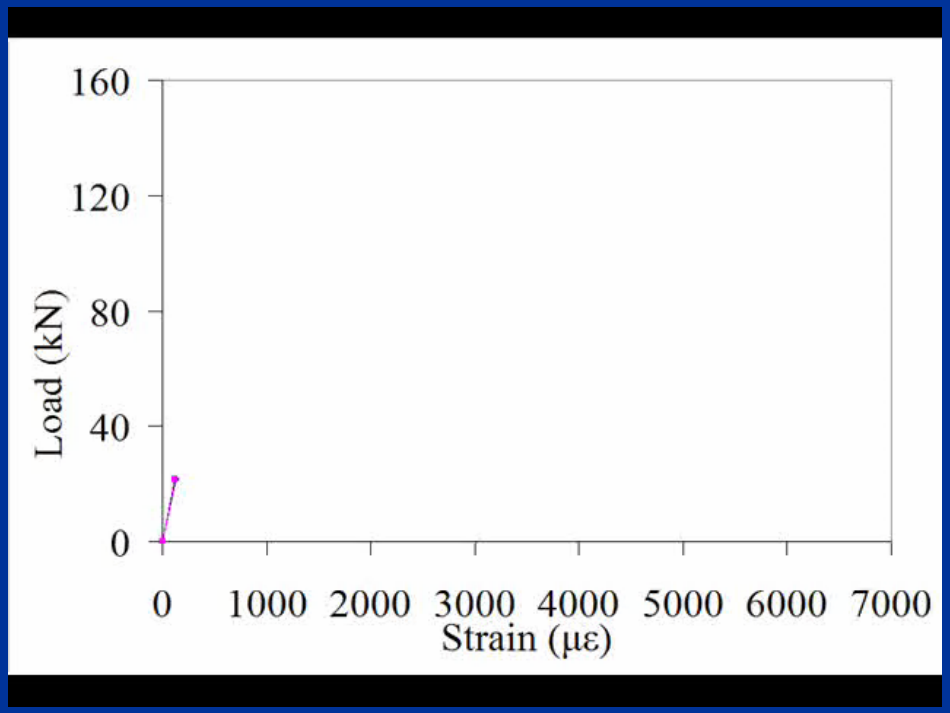
- PZT disk sensor
  - Diameter - 0.25 in (6.35 mm)
  - Thickness – 0.01 in (2.54 mm)
  - Radial vibration at 350 kHz
  - Placed in the epoxy bonding layer

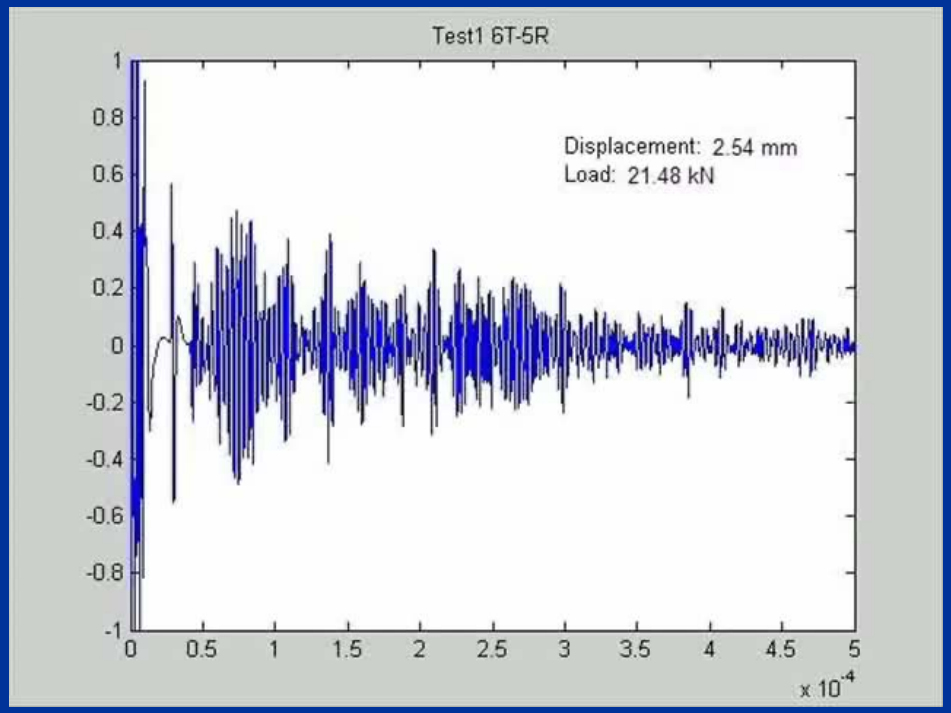



FRP Rupture

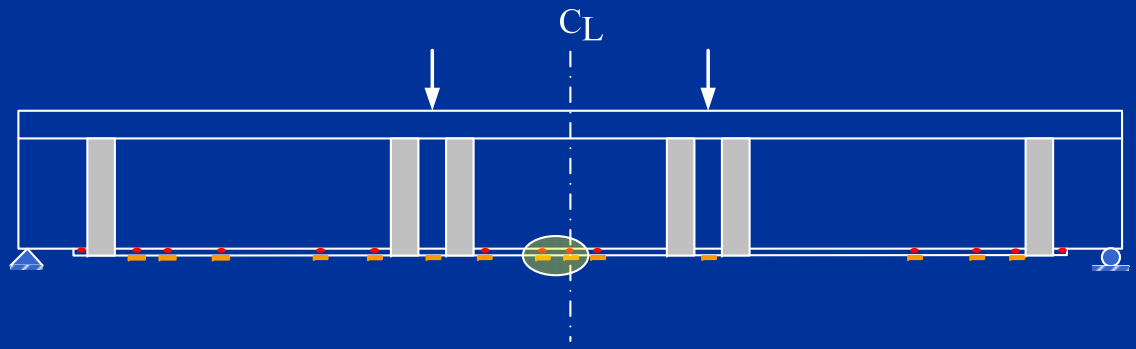
Sensors near anchorage region

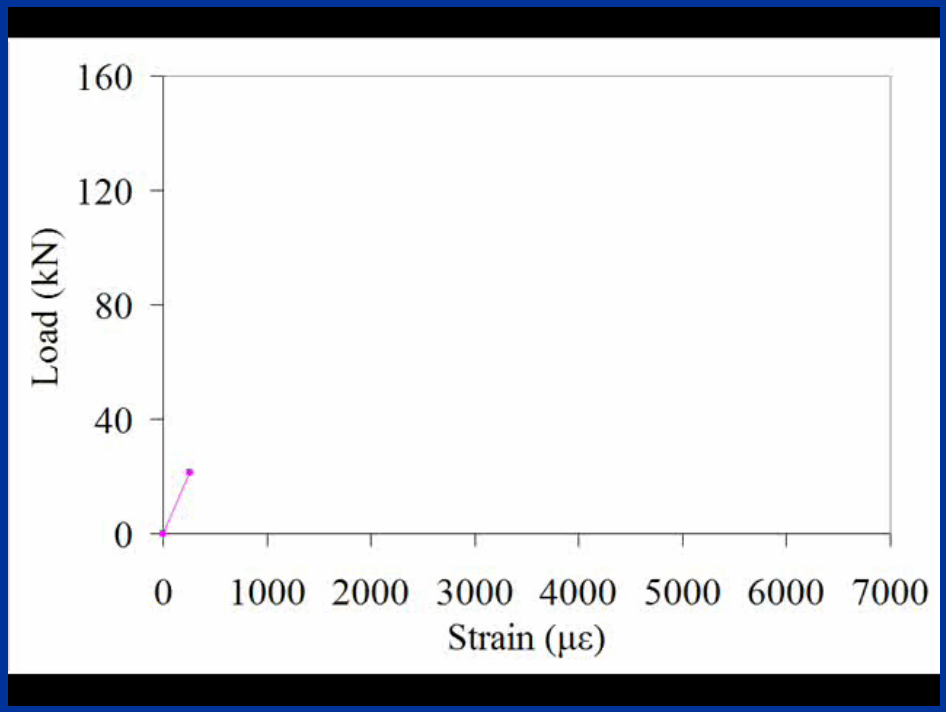


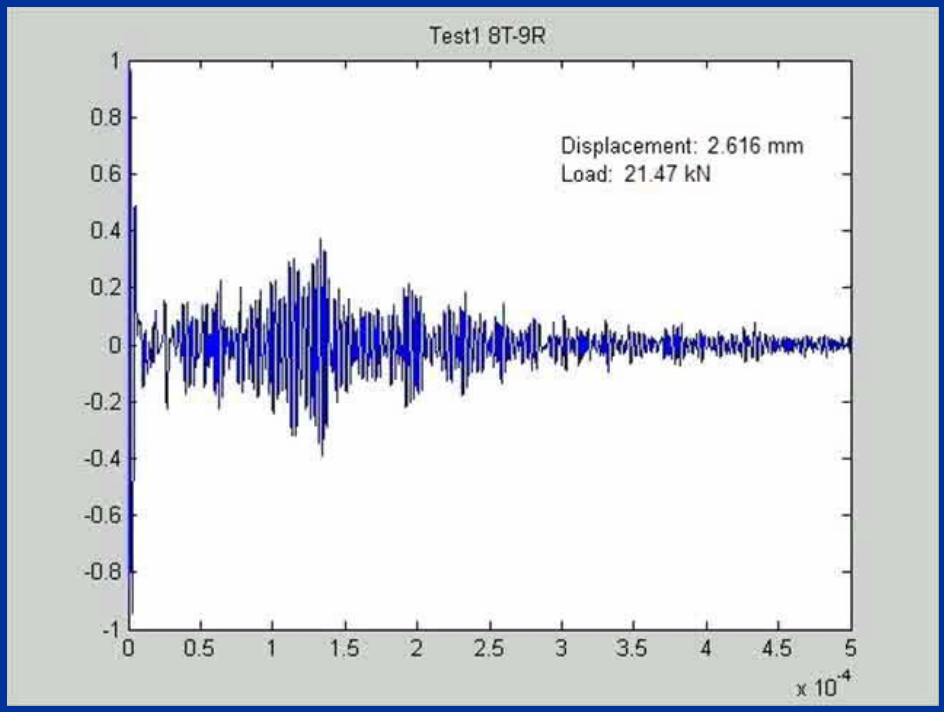




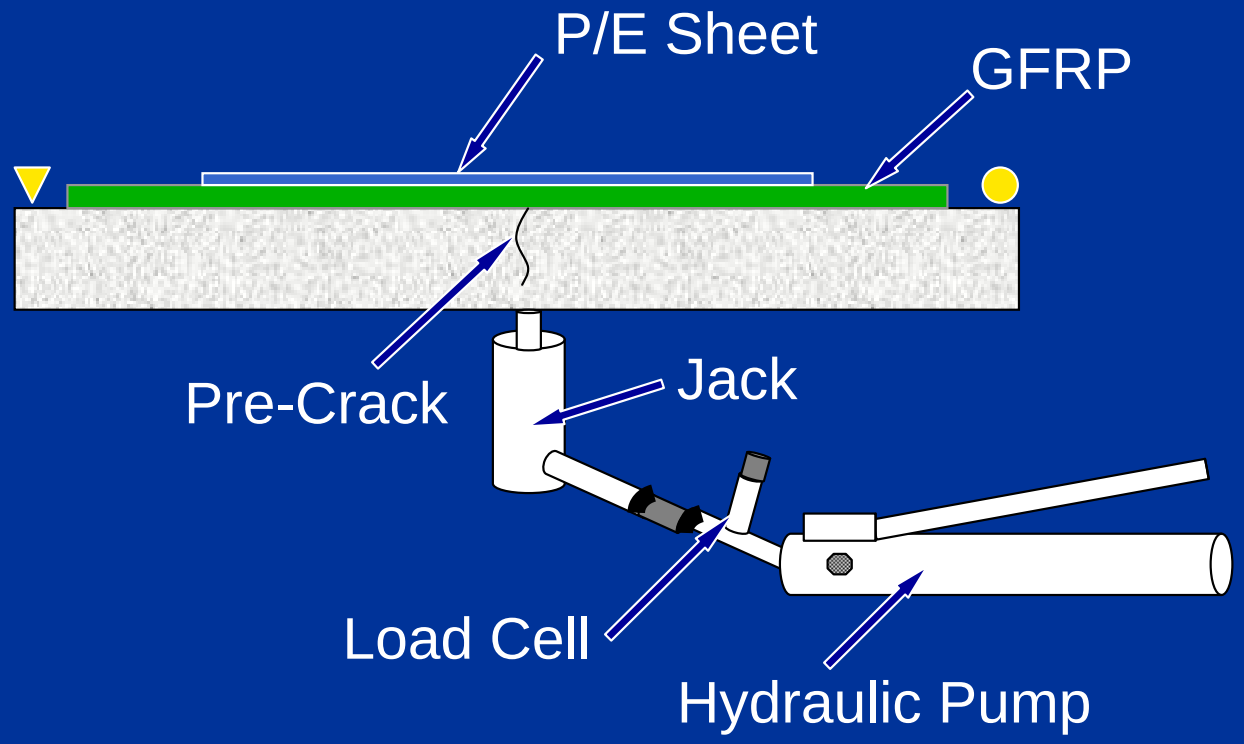
Sensors near region of FRP rupture





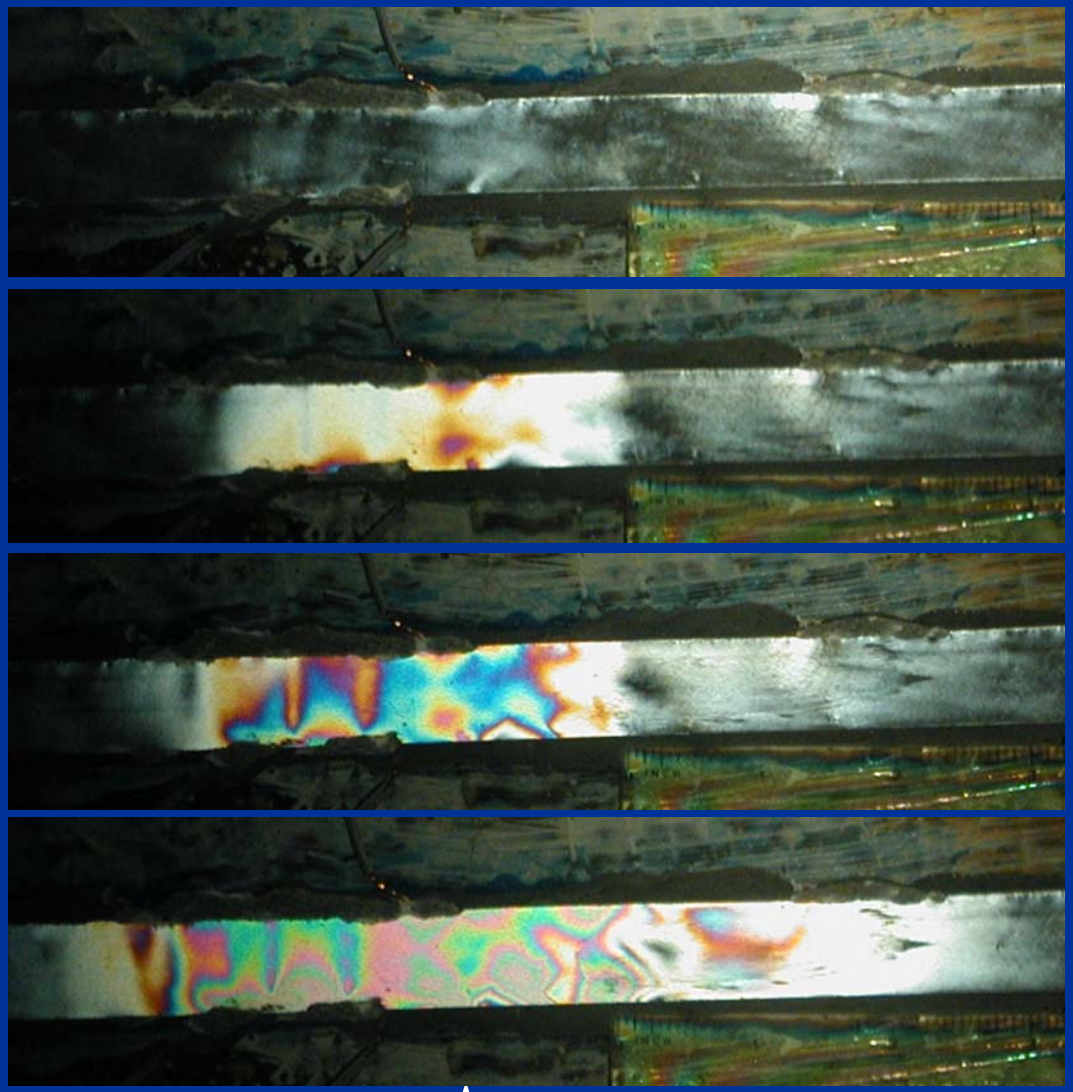


Evaluation of GFRP-Concrete Bond using Photoelastic Coatings *Boothby & Bakis*



Full-field strains in GFRP sheet measured with photoelastic (PE) coating applied to tensile surface

PE Fringes During Test



239 psi

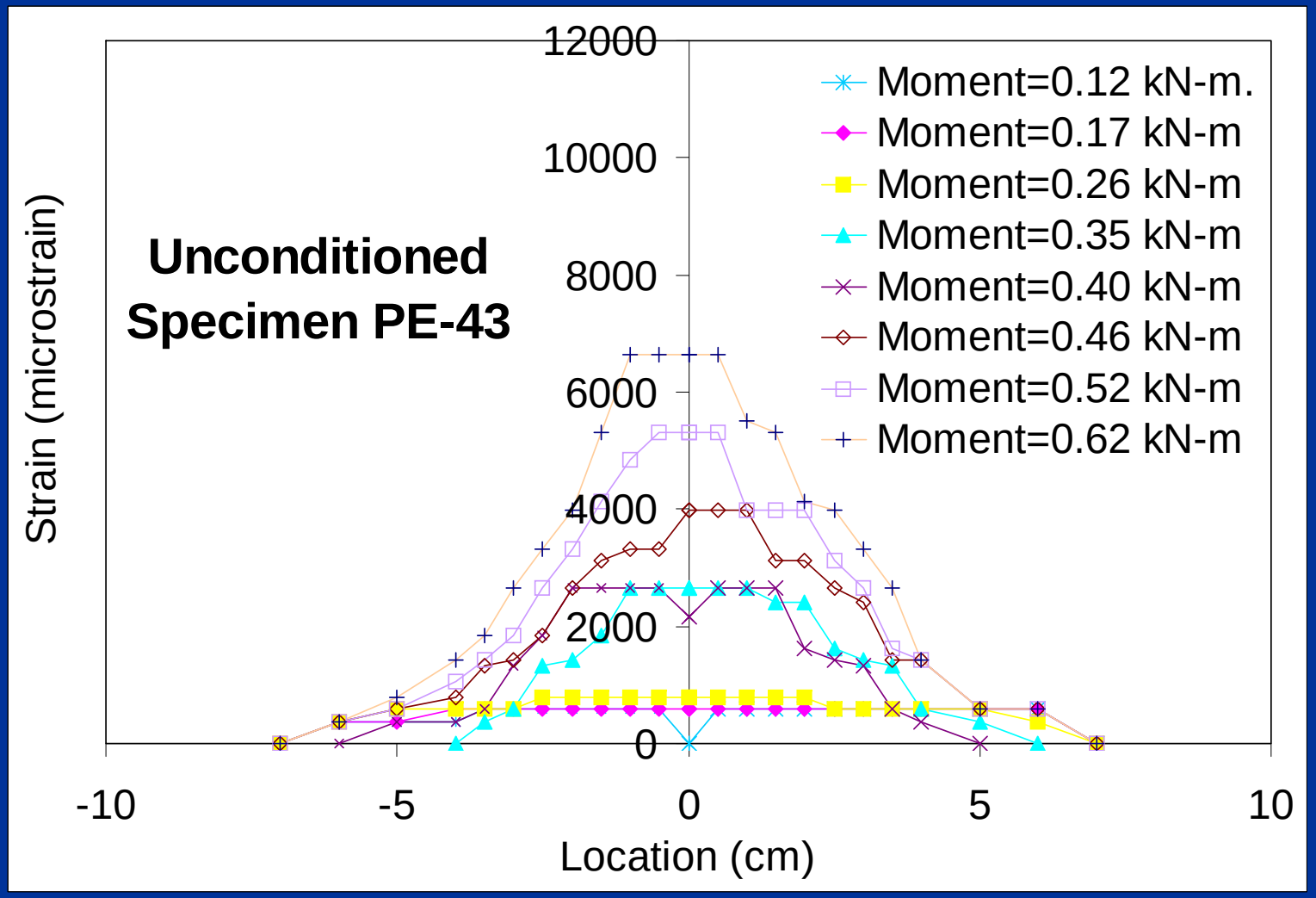
533 psi

658 psi

901 psi

Flexural Crack

Strain Distribution



Thank You