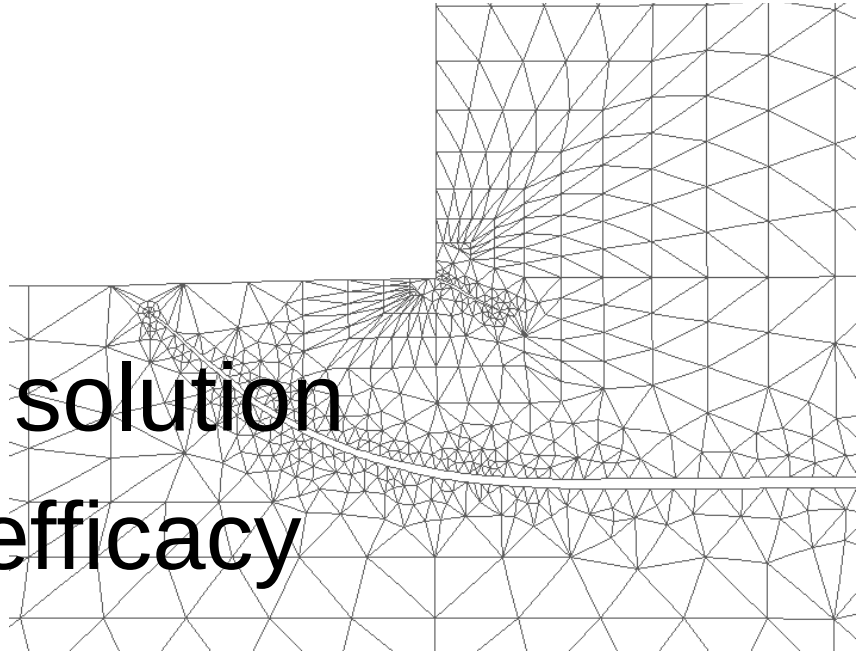
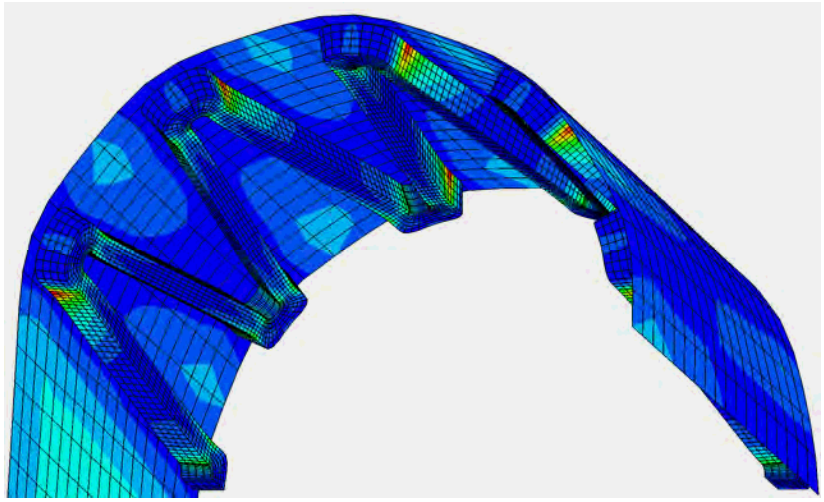
FEA of Composites: The Fundamentals and Beyond…

Paul E. Labossiere

Role of FEA in Design

- Gain understanding
- Explore feasibility
- Optimize a particular solution
- Evaluate safety and efficacy





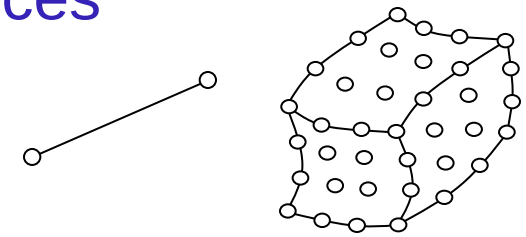
"The purpose of computing is insight, not numbers"

R. W. Hamming

List of Proposed Topics

1 Review of FEA Principles and Practices

- Governing Equations
- 1-D-to 3-D elements
- Plate and Shell Formulations



2 Modeling Techniques

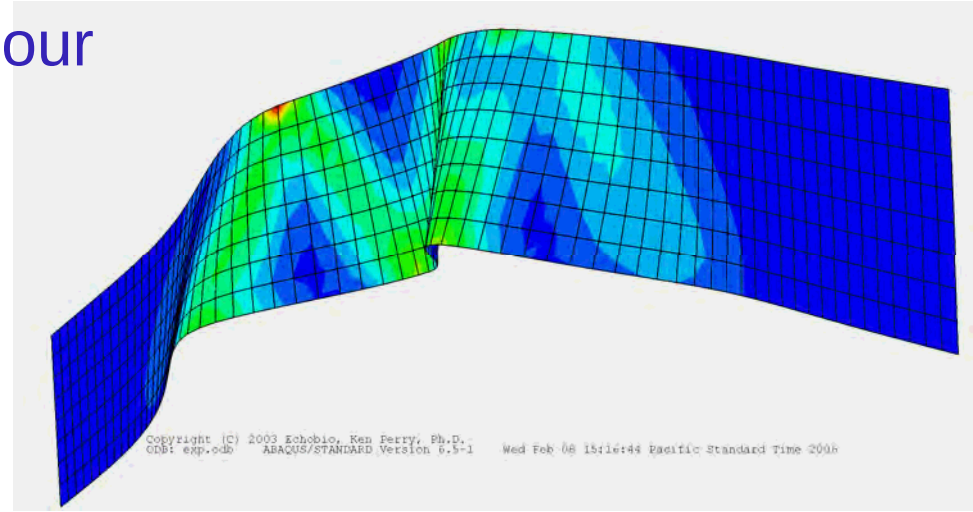
- Mesh Refinement
- Submodeling
- Boundary Condition Interpretation

$$\mathbf{D}_{ep} = \mathbf{D} - \frac{1}{\mathbf{H}_p + \mathbf{n}:\mathbf{D}:\mathbf{m}}(\mathbf{D}:\mathbf{m}\otimes\mathbf{n}:\mathbf{D})$$

$$\mathbf{K}_L = \iiint_V \left(\mathbf{B}_O^T\mathbf{D}\mathbf{B}_L + \mathbf{B}_L^T\mathbf{D}\mathbf{B}_L + \mathbf{B}_L^T\mathbf{D}\mathbf{B}_O\right)dV$$

3 Sources of Nonlinear Behaviour

- Plasticity
- Large Deformations
- Finite Strains
- Buckling



4 Convergence Criteria

- Tolerances and Residual Forces
- Restarts

5 Composites

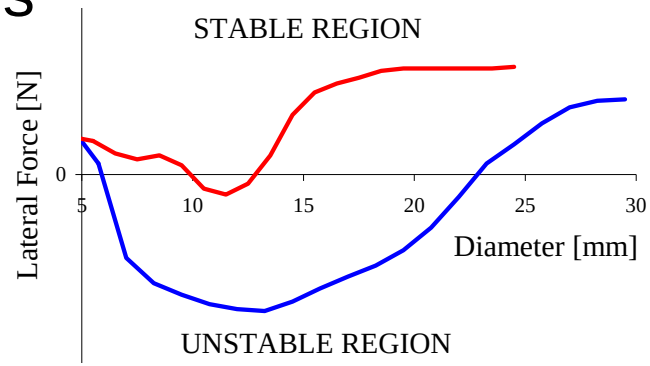
- Anisotropic Materials
- Layered Elements
- Ply Drop-Offs
- Cores

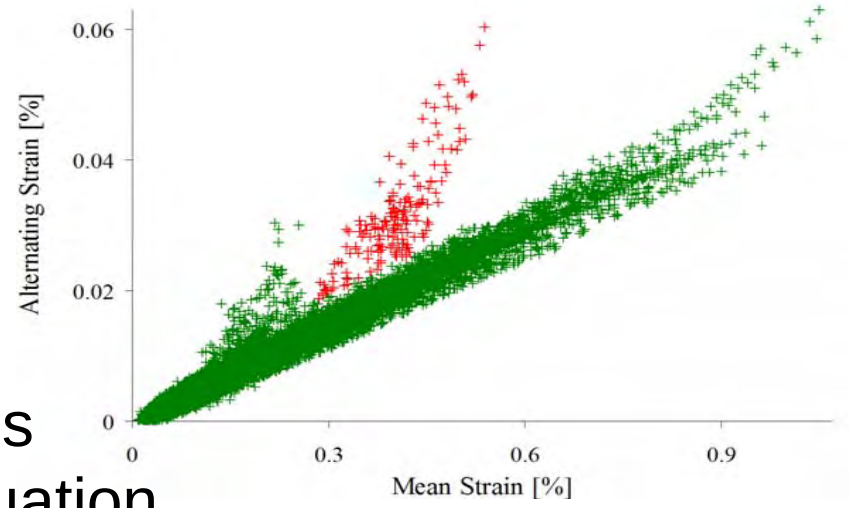
6 User Subroutines

- Constitutive models
- Field Variables

7 Reliability

- Damage and Delaminations
- Fatigue Performance Evaluation





Goals

- Provide the composite specialists with the basic understanding of FEA methodology and solution interpretation

- Provide the FEA jockey with the basic understanding of additional complexities associated with modeling composites

Proposed Format

Day 1

- 4-hour class (topics 1, 2, 3)
- 1 hour class (topics 4,5)
- 2 hour computer lab (review topics 1-5)
- 1 hour class (good fea practices)

Day 2

- 4-hour class (topics 5-7)
- 2-hour computer lab (composites applications)
- 1 hour class (good fea practices)
- 1 hour round table???

Feedback Needed

Additional topics and format

- Define audience and select instructors/lab assistants

Appropriate platform (ABAQUS, Ansys, other??)

Workshop format (computer laboratory setting??)

- demonstrate key concepts through selected examples

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