Development of an Interactive Self-Teaching Package in Failure Analysis

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Outline

Talk will address:

- Background to development – drivers in choosing the interactive internet route
- Format chosen for the package
- Interactive elements – what can they do?
- Demonstration of package
Background

Author's experience:

- Applied engineering best assimilated in laboratory setting
- Particularly true for analytical skills in the synthesis of mechanical properties and metallurgy/materials science
  - Failure analysis and fractography
  - Design for fatigue and fracture
- Subtle interactions between composition, processing, structure and properties need laboratory case study development
Background

Author's experience:

- Want to develop expertise in
  - Mechanical property testing
  - Use of optical microscope and SEM
  - Metallographic interpretation
  - Fractography
- Difficult to do except in laboratory-intensive modules
- Availability of such resources diminishing due to cost, staff shortages, timetable constraints, larger cohorts
Background

Drivers:

• Industrial failure case studies highly successful
  ➢ Raise students interest and link disparate modules
  ➢ Ground modules firmly in practice of 'real' engineering
  ➢ Introduce 'social consciousness' aspects
  ✓ Ethics & litigation
  ✓ Legal responsibility & culpability
  ✓ Insurance & loss adjusting
  ➢ Team experience
Background

Rationale for interactive case studies:

- Achieve aspects of the ‘reflective practitioner’ in engineering failure analysis
- Improve core specialist knowledge in the field of materials and failure
- Key aim to promote student motivation
  - Illustrate breadth of engineering practice and failure
  - Promote depth in analytical skills
  - Available in 'digestive' packet sizes over internet
Format of package

• Internet-based
  ➢ Multimedia capability
  ➢ Hyperlinks to focussed high-level resources
  ➢ 24/7 access
• Easy navigation
  ➢ Size not a daunting issue
  ➢ Choice of entry points
• Each case study is 'stand-alone'
• Powerful associated resources in fractography and metallography
Format of package

- Introductory front page states learning from each case
- Navigation for whole case study laid out
- Case studies partitioned into stages of real solution
- Interactive elements:
  - Allow reflection on critical synthesis
  - Introduce engineering estimation techniques
Interactive elements

• Example – fracture stress of undercarriage brackets: give theory/information + test learning

\[
K_I = \sqrt{\frac{m}{\pi}}
\]

\[
C = \left[ C_0 \cdot \left( \frac{a}{w} \right)^4 \cdot \left( \frac{2c}{B} \right)^2 \right] C_1
\]

\[
C_0 = 1.13 - 0.06 \left( \frac{a}{w} \right)
\]

\[
C_1 = -0.54 + 0.95 \left( \frac{2c}{B} \right)
\]

\[
C_2 = 0.5 \left( \frac{10}{0.47 - \left( \frac{a}{w} \right)^3} \right) - 10 \left( 1 - \left( \frac{a}{w} \right)^3 \right) C_1
\]

\[
C_3 = 1 + 0.1 \left( \frac{2c}{B} \right)
\]
Interactive elements

- Example – fracture stress of undercarriage brackets:- allow sensitivity analysis

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Demonstration

• Package hyperlinked below:
  Run Interactive Failure Package