



Course E-2/R-9

Structural Engineering for Composite Repair

Course Summary

This 5-day course is specifically aimed at engineers who are responsible for the design development of both temporary and permanent repairs to primary and secondary composite structures.

Introduction

Many composite repair courses have been provided for technical personnel with respect to the fabrication and application of the repair scheme. But what of the repair schemes design? The majority of repair schemes called out in repair instructions are minor in nature and damage limits are very conservative. Damage beyond such size limitations require specific engineering design disposition. Engineers associated with operations generally do not possess the required skills to conduct such repair development, although they are not overly difficult. This course in the design of repairs for composite and bonded structures will provide the participating engineers with skills in repair design development that will improve the structural integrity of repairs and significantly reduce repair re-work. The instruction follows the basic repair methodology covering the assessment of damage based on NDI results, the determination of structural integrity loss, which in turn leads to the type of repair design required, the analysis of a repair joint and the repair scheme instructions application. During the course examples and exercises of damage analysis and repair design will utilize PC based software and will culminate in the actual repair of a damaged composite component. Numerical analysis and stress calculations are performed on PC based programs. Optimizations of repair design parameters to meet structural and geometric limitations are quickly identified and discussed.

Key Lecture Topics:

- Overview of composite and adhesive bonding technology.
- Review the mechanics of composite materials; laminate stiffness matrices [A], [B] & [D], hygrothermal effects, and laminate strength criteria.
- Design requirements of composite structures leading to repair.
- Review of defect types in composite structures.
- Damage assessment – review of NDI methods.
- Damage stress analysis methodology; intralaminar matrix cracks, delaminations and disbonds, holes and fractured fibers, inclusions, and heat damage.
- Environmental effects and damage tolerance.
- Management of repairs; QC/QA, certification, health and safety.

Workshop Exercises:

- Computer (PC) application to determine laminate properties.
- Repair instruction drafting guidelines.
- Repair design and application to actual structure.
- Throughout the course extensive use will be made of computers to conduct: (1) laminate properties of existing structures; (2) degraded component stress analysis with respect to holes, delaminations and matrix cracking; (3) repair scheme development; (4) bonded repair load and size calculations and (5) bolted repair loads and sizing.
- An actual damaged component will be analyzed for structural integrity loss and a repair scheme will then be designed to restore the load carrying capacity of the component. This will lead the participants into the removal of damage, fabricate the repair scheme and apply and cure the repair patch.

Course Benefits

Engineers will learn key repair design requirements for providing proficient repair instructions for composite structures.

Prerequisites

M-1/R-1 Composite Structures: Fabrication and Damage Repair-Phase 1 course, or

E-1 Essentials of Composite Materials for Engineers and Technical Managers course, or

Equivalent experience with composite materials and processes.

Teaching Method

Active classroom lecture and workshop exercises

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