Improved Composite Repair Using a Pressurized Repair Clave

A Research Proposal

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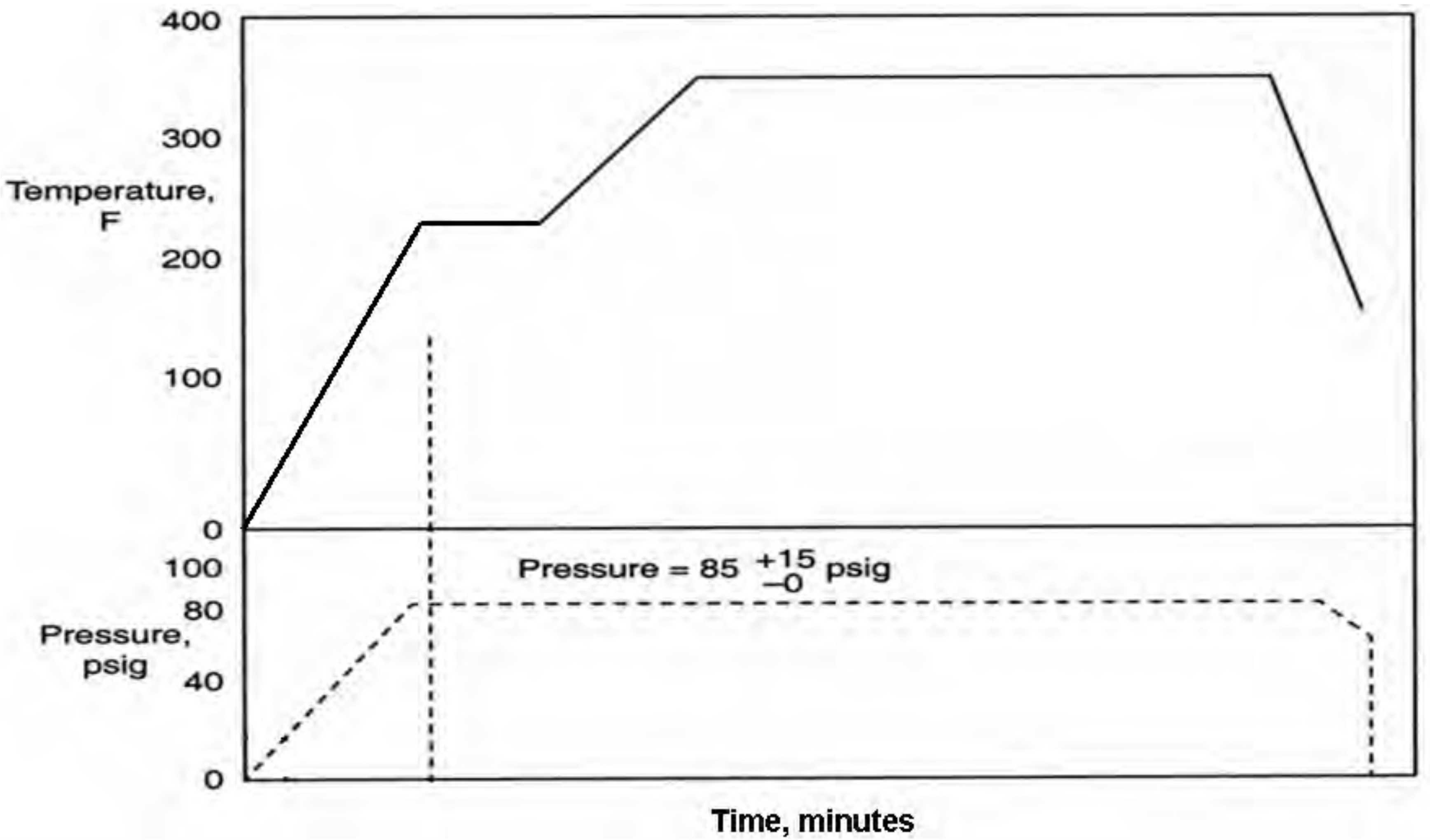
Background

- Aircraft composite parts are fabricated with an autoclave pressure of 85psi in addition to a vacuum pressure of 14.7 psi.
- Such autoclave pressure is required to consolidate fibers onto matrix to reduce void content.
- However, current composite repair practice utilizes only a vacuum pressure which generally results in a larger void content.
- The matrix dominated properties, such as in-plane and interlaminar shear strengths are significantly reduced by the void content.
- To overcome such problems, a pressurized Repair Clave has been developed recently by Heatcon to improve the repair quality.
- Research is needed to quantitatively assess the effect of Repair Clave pressure on void content and mechanical property improvement.

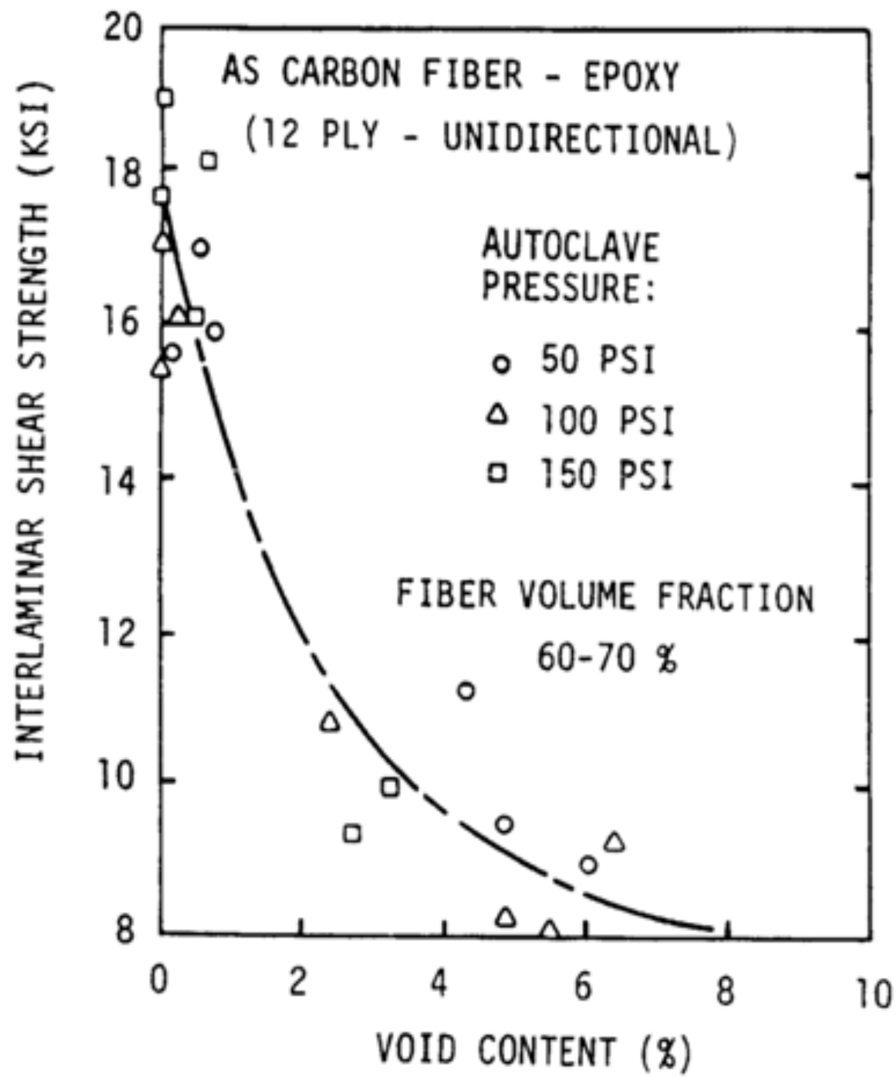
Typical Autoclave Cure Cycle



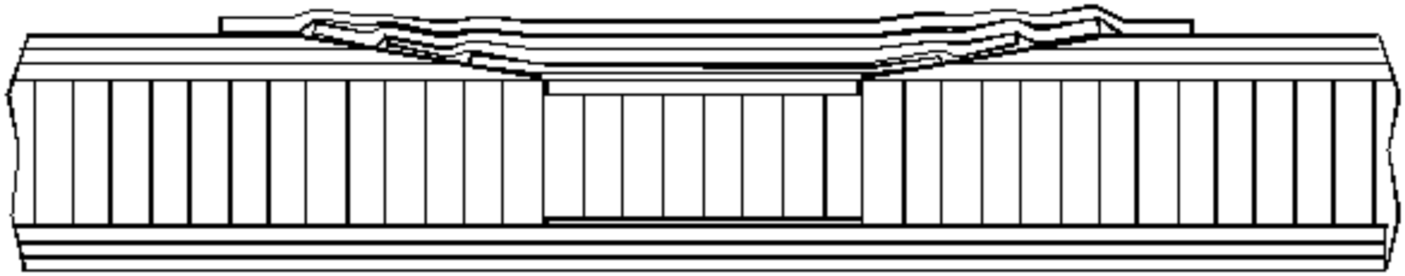
Effects of Voids on Interlaminar Shear Strength

Large reductions in interlaminar shear strength are observed when void content is only 2 – 3% by volume.

Voids generally increase the rate and amount of moisture absorption in a humid environment.



Bonded Scarf Repair



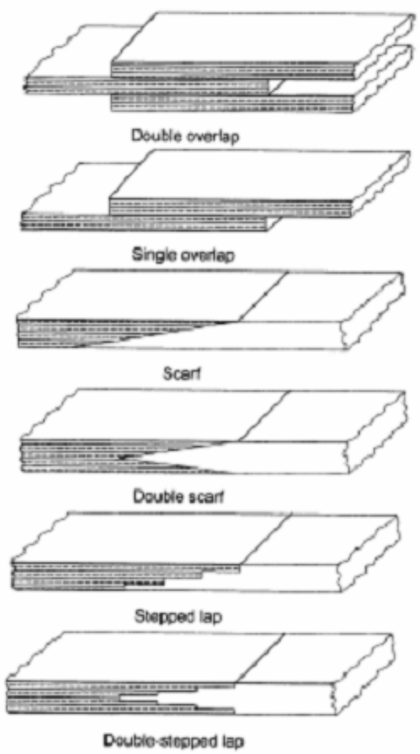


Fig. 9.2 Schematic illustration of several types of bonded joint.

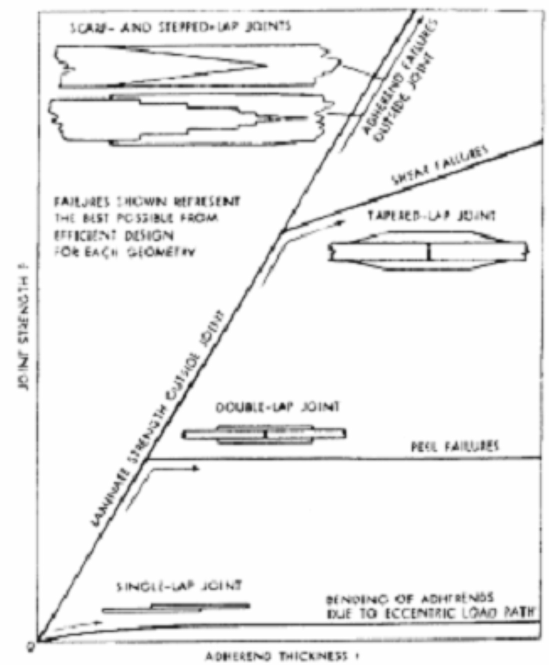
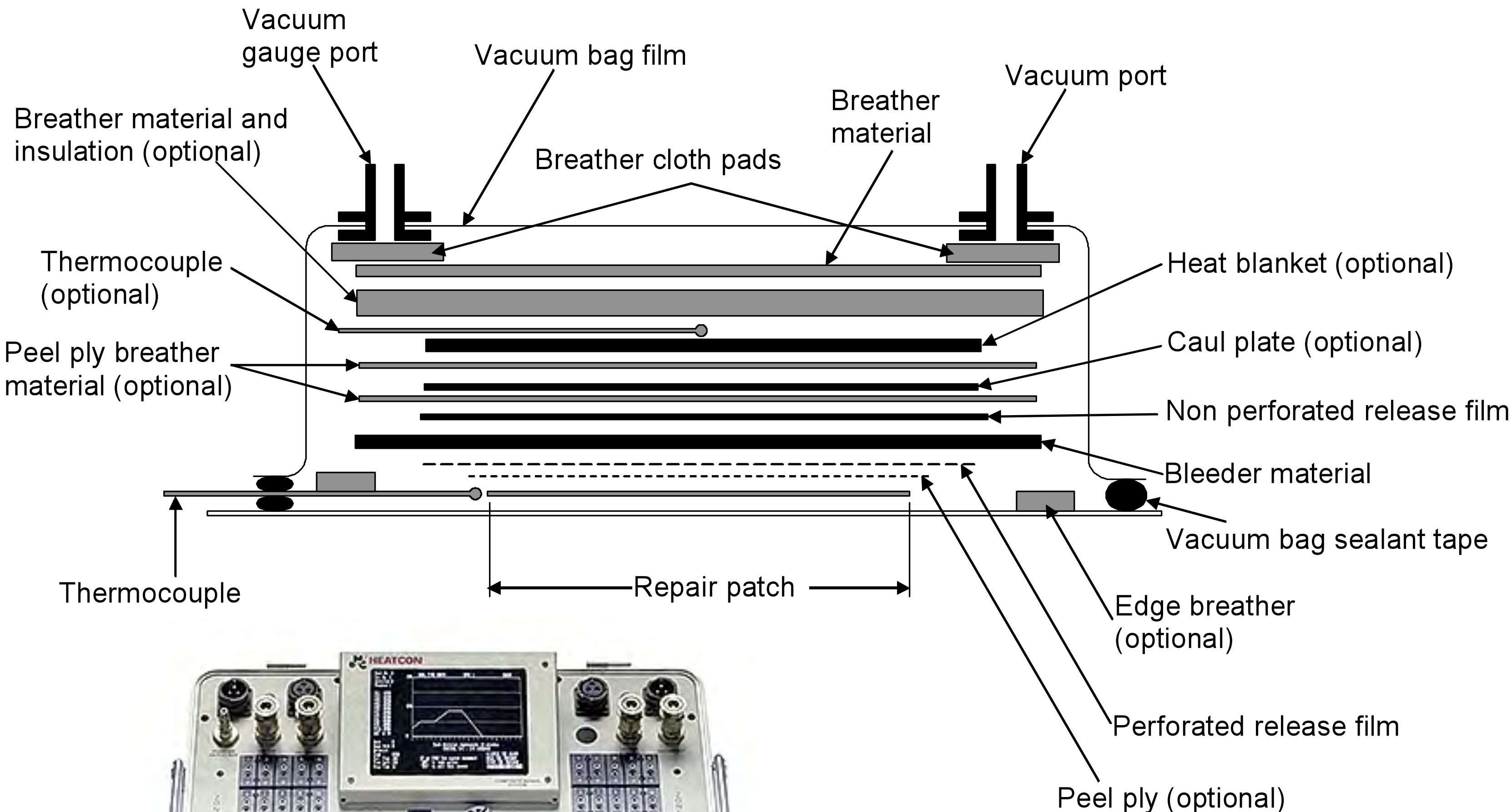


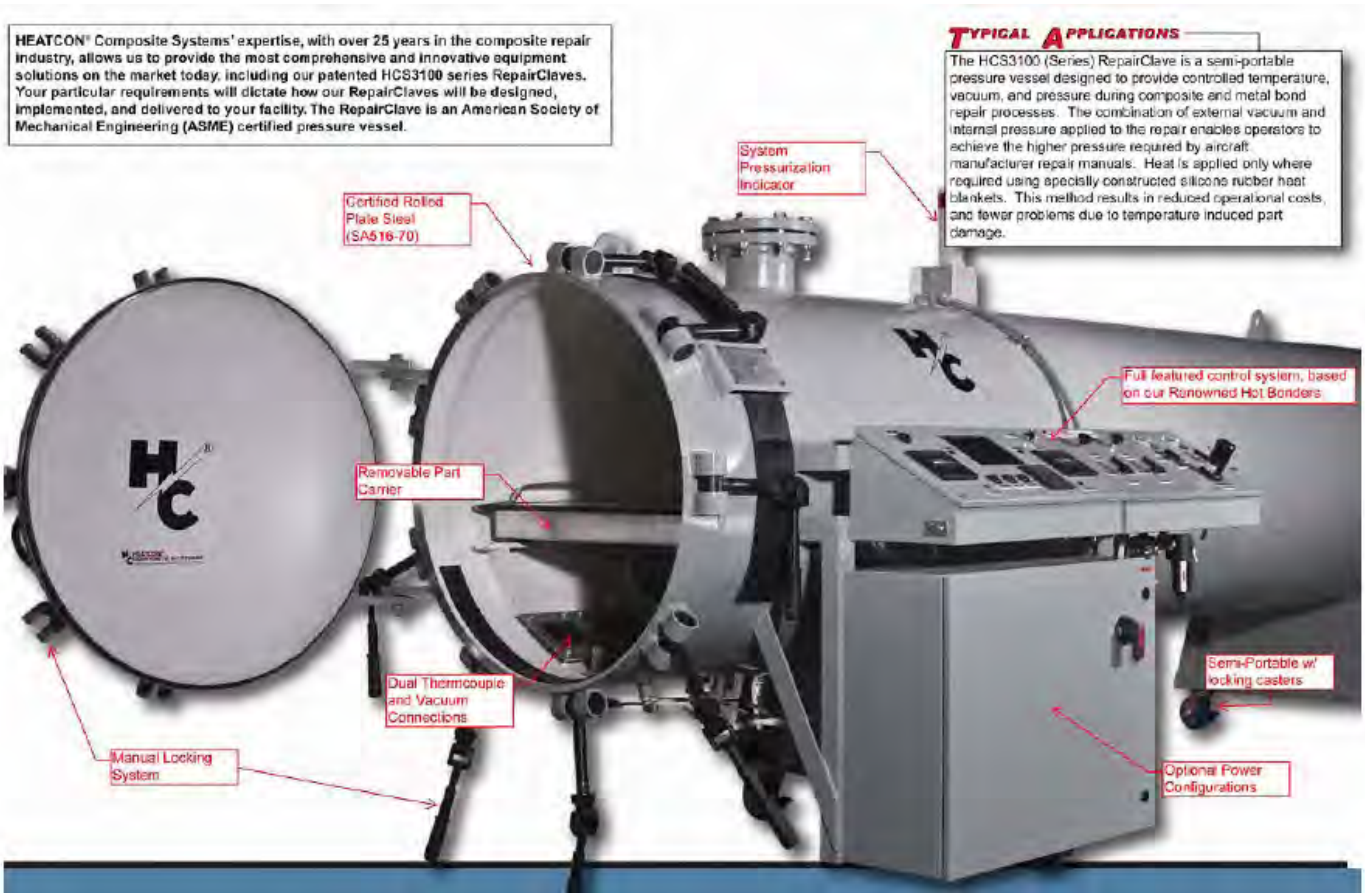
Fig. 9.3 Load-carrying capacity of adhesive joints. Taken from Ref. 3.

Bag Molding and Hot Bonder

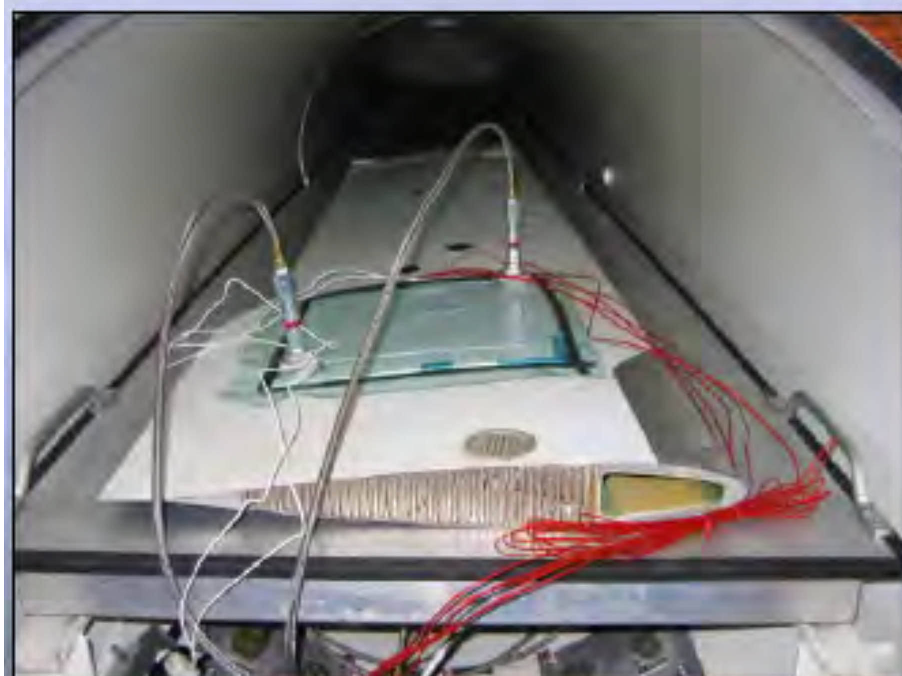


Heatcon HCS9200 Hot Bonder

HCS3100 Repair Clave



Multiple Zone Repair Using Repair Clave*



* HEATCON® COMPOSITE SYSTEMS
COMPOSITE REPAIR SOLUTIONS

Objectives of Proposed Research

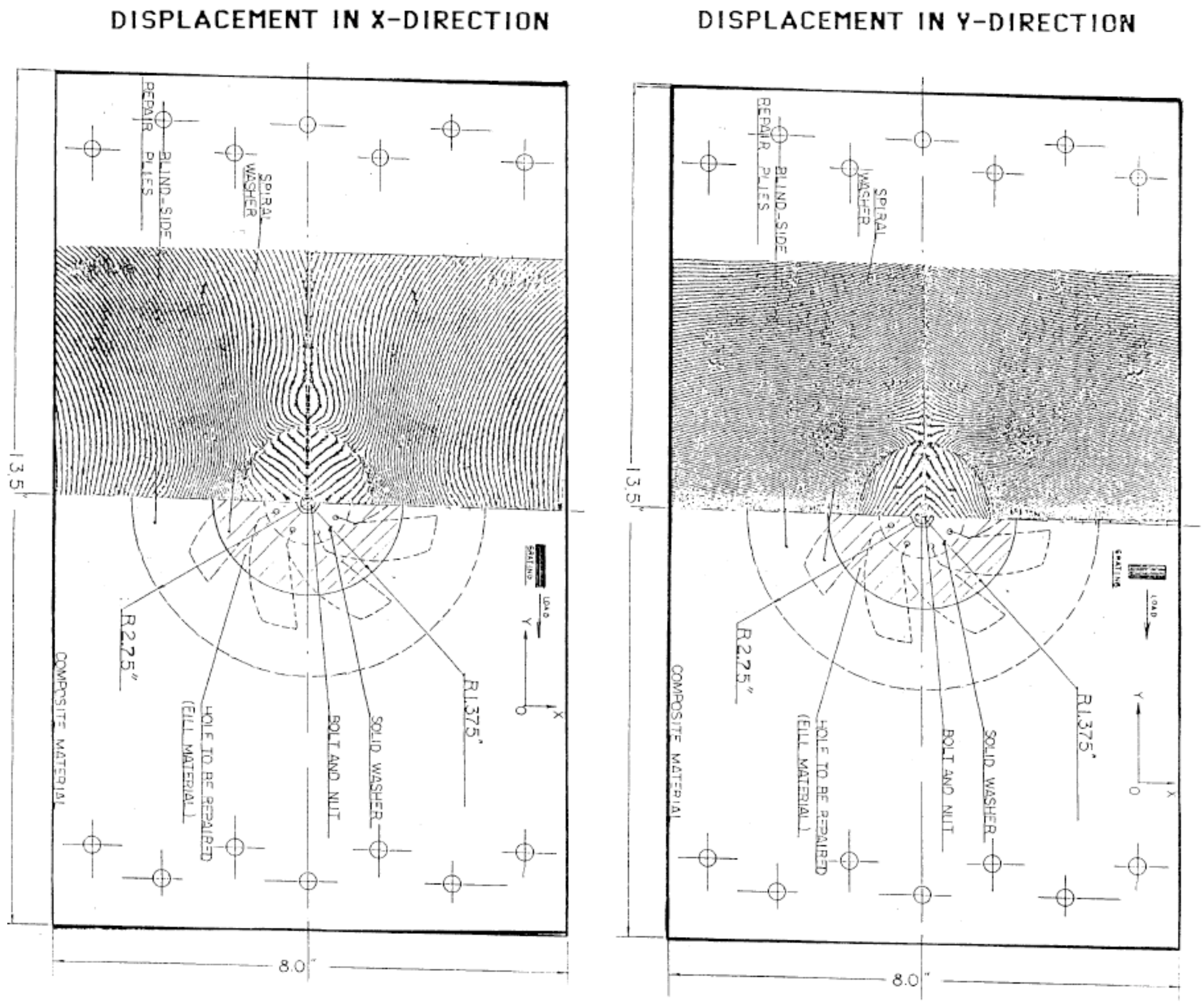
- To investigate the effect of Repair Clave pressure on the repair quality:
  - Void Content
  - Resin/fiber uniformity
  - Matrix dominated properties
- To analytically predict the compressive strength as a function of the quality of repaired parts.
- To develop improved repair techniques to support Structural Repair Manual (SRM) developments.

Technical Approach

- To fabricate the following three types of specimens:
  1). An undamaged autoclave cured control sample
  2). Samples repaired using only a hot bonder
  3). Samples repaired using both a Repair Clave and a hot bonder.
- To test matrix dominated properties of the above three types of samples.
- To conduct Non-Destructive and Destructive assessments of repair quality, e.g. void content, resin starve/rich, etc.
- To perform analysis to study the effect of repair quality on the compressive strength of repaired specimens.

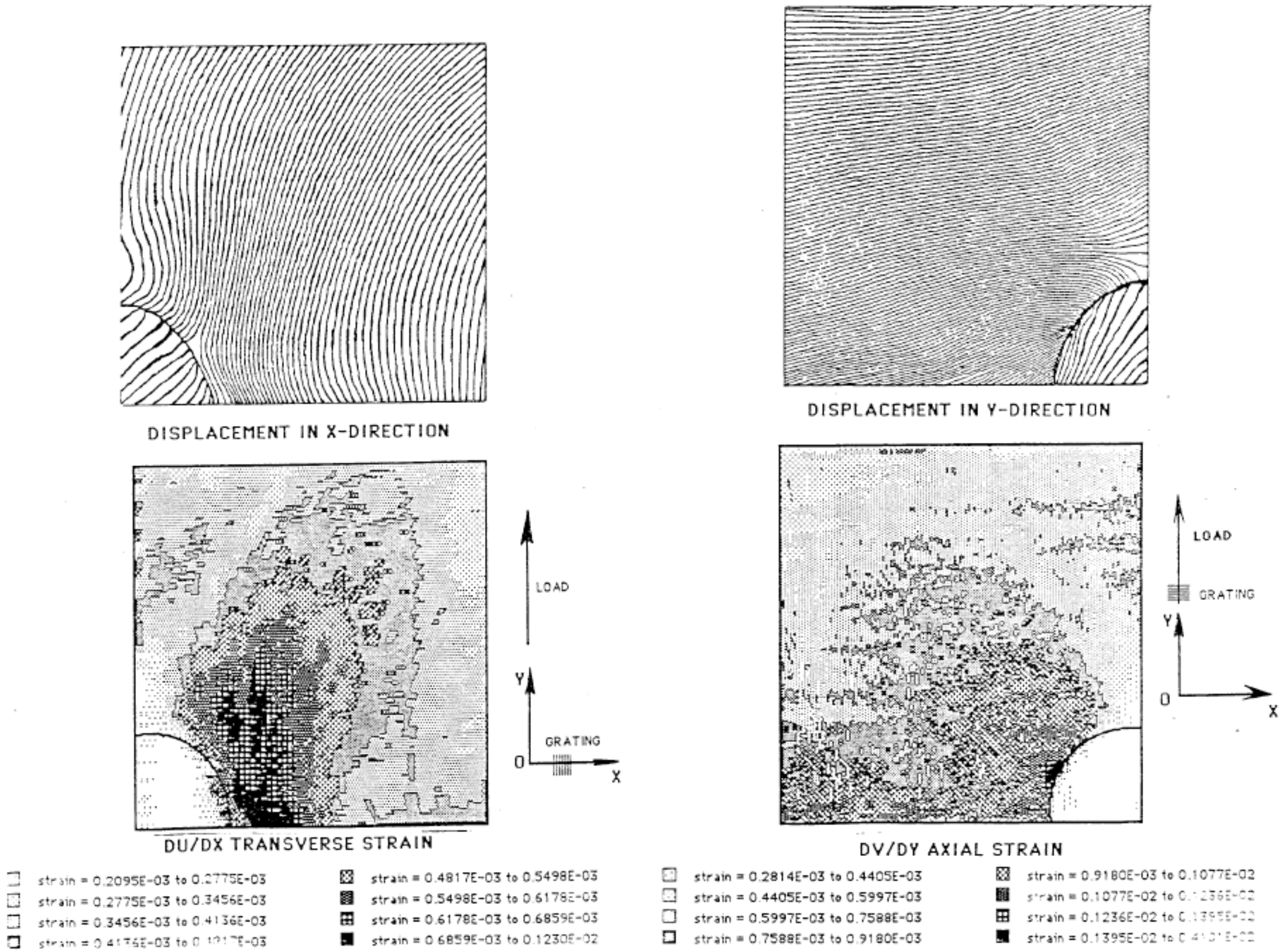
Measured Displacement Fields in Blind Side Repair Specimen

(K.Y. Lin, et al 1987, Sponsored by Boeing Military)



Strain Fields in Blind Side Repair Specimen

(K.Y. Lin, et al 1987)



Predicted Displacement Fields in Blind Side Repair Specimen

(K.Y. Lin, et al 1987)

BLIND-SIDE SPECIMEN 2133 LB

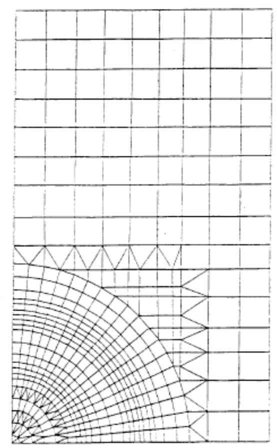
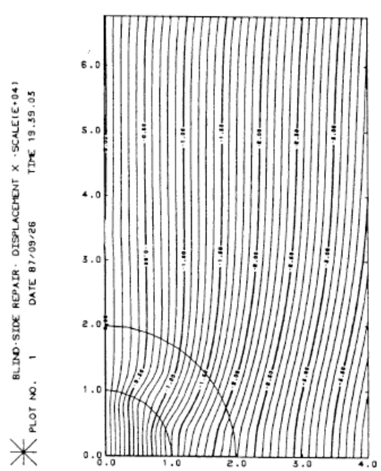
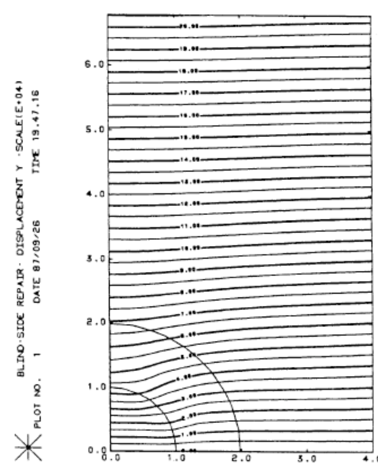


Fig 6. Typical mesh pattern for the case of a circular shape of damage repaired by the blind-side methed.





Project Team

- P.I.: Prof. Kuen Y. Lin, University of Washington
- Confirmed Sponsor: Heatcon Composites
- Potential Sponsors: Boeing, FAA