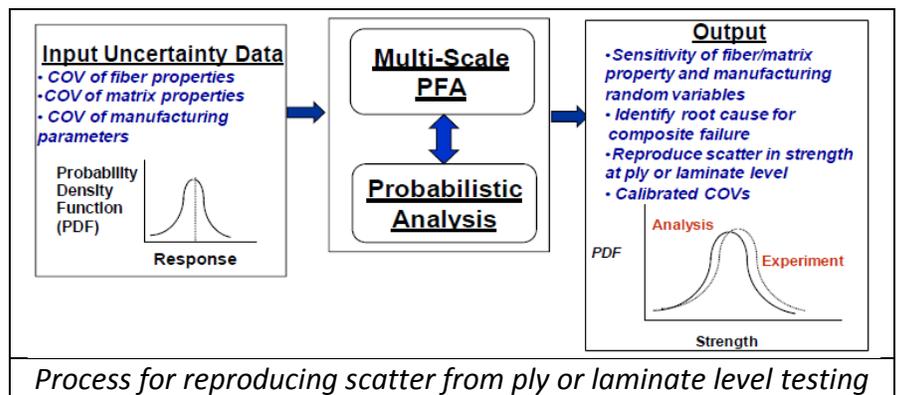


A-B Basis Allowable Test Reduction Approach

Challenge

Traditionally engineers have tested materials and coupons in various forms in order to obtain the necessary “material allowable”, consider scatter in composite material laminates, and support scale up according to the “Building Block Testing Approach”. The key challenge is to determine strength allowable by means of testing, even if the material is produced at one facility, is costly and time consuming, as a large number of samples needs to be tested at different environments. “Virtual testing” is proposed method to try new materials in structures earlier in an applications timeline. Virtual testing is made possible by conducting progressive failure analysis and combining those results to predict structure/component safety based on the physics and micro/macro mechanics of materials, manufacturing processes, available data, and service environments. The methodology combines probabilistic methods with advanced multi-scale multi-physics progressive failure analysis and Bayesian statistics to reduce the number of tests needed for determination of strength allowables. The test reduction analysis process produces random variable vectors of fiber/matrix/lamina properties and fabrication variables such as fiber content, void, and ply thickness. The random variables are then fitted to normal distribution and distribution parameters are computed. In this case study cumulative distribution functions, probabilistic sensitivities, and A & B Basis Allowables for unidirectional and several soft, quasi, and hard mixed layups in tension and compression are validated with physical testing for HEXCEL 8552 IM7 tape.

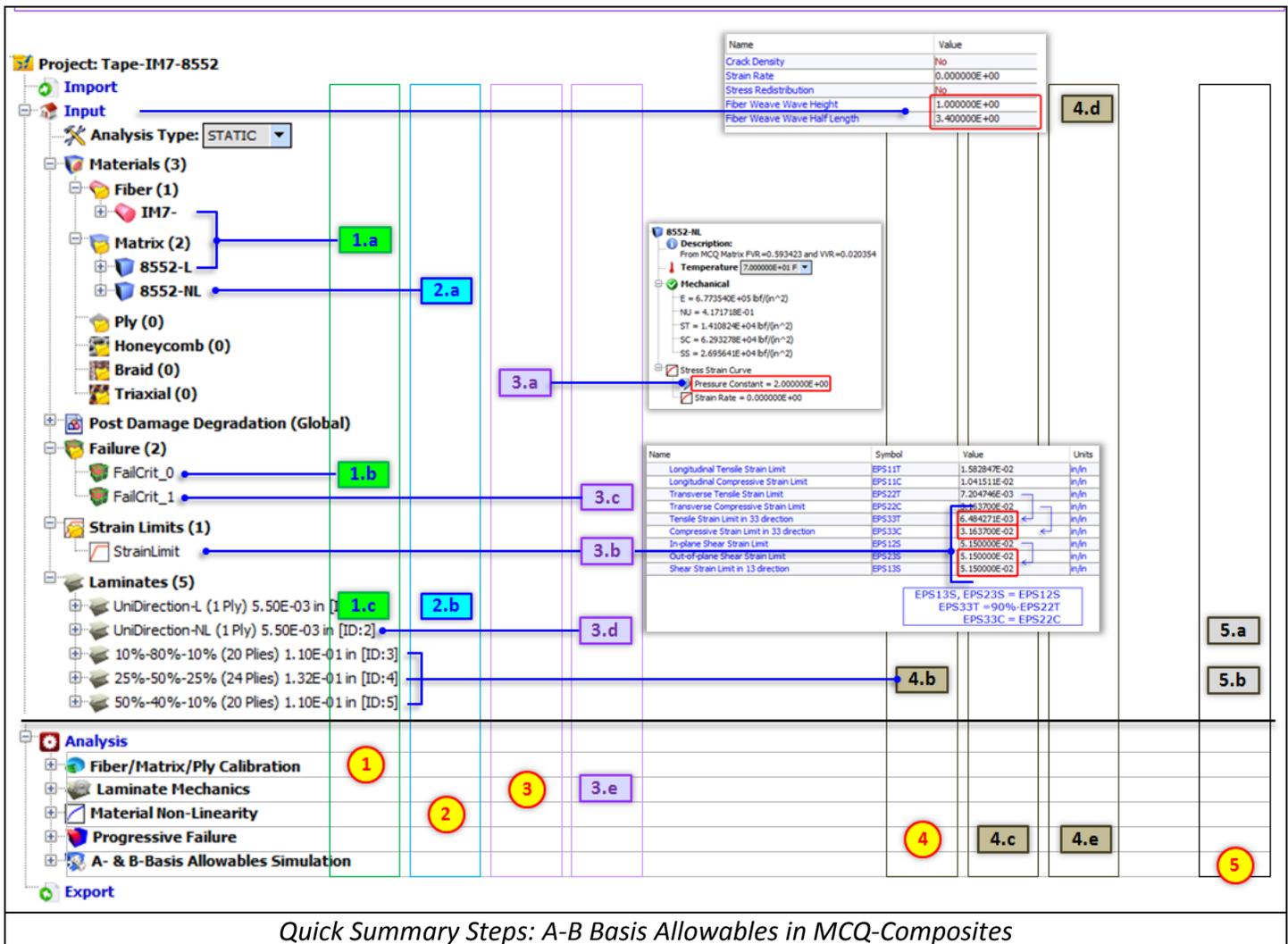


Solution

Classical Laminate Theory (Analytical) and Micro-Mechanics are employed methodology. The step by step process is shown next:

- **Step-1:** Fiber/Matrix/ Ply Calibration
- **Step-2:** Material Non-Linearity Analysis
- **Step-3:** Laminate Mechanics Analysis
- **Step-4:** Progressive Failure Analysis
- **Step-5:** A-&B-Basis Allowables Simulations

The following chart provides a visual description of the work-flow for this case study



Results & Conclusion

- Generate fiber and matrix in-situ properties, as well as the matrix non-linear stress-strain curve.
- Predict the elastic and mechanical properties of the given laminates and their A&B-basis allowable.

Key Highlights & Benefits

Product: MCQ-Composites

Industry: Aerospace and Automotive

Application: A-B Basis Allowable

Benefits: Offers test reduction analysis process

Related Publication

AB Basis Allowable Test Reduction Approach and Composite Generic Basis Strength Values. AIAA SciTech, 4-8.