

# Guidelines and Parameter Selection for the Simulation of Progressive Delamination

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**Abstract:** Turon's methodology for determining optimal analysis parameters for the simulation of progressive delamination is reviewed. Recommended procedures for determining analysis parameters for efficient delamination growth predictions using the Abaqus/Standard cohesive element and relatively coarse meshes are provided for single and mixed-mode loading. The Abaqus cohesive element, COH3D8, and a user-defined cohesive element are used to develop finite element models of the double cantilever beam specimen, the end-notched flexure specimen, and the mixed-mode bending specimen to simulate progressive delamination growth in Mode I, Mode II, and mixed-mode fracture, respectively. The predicted responses are compared with their analytical solutions. The results show that for single-mode fracture, the predicted responses obtained with the Abaqus cohesive element correlate well with the analytical solutions. For mixed-mode fracture, it was found that the response predicted using COH3D8 elements depends on the damage evolution criterion that is used. The energy-based criterion overpredicts the peak loads and load-deflection response. The results predicted using a tabulated form of the BK criterion correlate well with the analytical solution and with the results predicted with the user-written element.

**Keywords:** Damage, Composites, Progressive Delamination, Virtual Crack Closure Technique (VCCT), Cohesive Elements, Fracture Mechanics.

## 1. Introduction

Delaminations in laminated composite structures usually initiate from discontinuities such as matrix cracks and free edges or from embedded defects due to the manufacturing processes. Delaminations can reduce the stiffness and strength of a composite structure. In other cases, delamination can provide stress relief and delay the final failure of the composite structure. Therefore, it is important to analyze the progressive growth of delamination in order to predict the performance of a composite structure and to develop reliable and safe designs.