Energy-release rate and mode mixity of face/core debonds in sandwich beams

Closed-form algebraic expressions for the energy-release rate and the mode mixity are obtained for a debonded sandwich (trimaterial). The most general case of an "asymmetric" sandwich is considered (i.e., the bottom face sheet not necessarily of the same material or thickness as the top facesheet). The energy-release rate is obtained by use of the J-integral, and the expression is derived in terms of the forces and moments at the debond section. Regarding the mode mixity, a closed-form expression is derived in terms of the geometry, material, and applied loading, and it is proven that, in the trimaterial case, just as in the bimaterial case, the mode mixity can be obtained in terms of a single scalar quantity ω, which is independent of loading; the ω value for a particular geometry and material can be extracted from a numerical solution for one loading combination. Thus, this analysis extends the existing formulas in the literature, which are for either a delamination in a homogeneous composite or an interface crack in a bimaterial. These new "trimaterial with a crack" formulas are also proven to yield the formulas for the limits of a bimaterial or for a homogeneous section with a crack. © 2012 by the American Institute of Aeronautics and Astronautics, Inc. All rights reserved.