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SHEAR AND FOUNDATION EFFECTS IN SCB SANDWICH SPECIMEN

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1. INTRODUCTION

Failure of the face/core interface in a sandwich structure needs consideration in design of damage-tolerant sandwich structures. The large elastic stiffness mismatch between the face sheets and core leads to mixed mode (combined opening and shear) loading. Experimental studies have shown that the face/core fracture resistance and the tendency of the crack to kink into the core depend on the mode mixity. Li et al. [1] and Andrews and Massabo [2] conducted finite element analysis of a beam-like element under axial a transverse forces and pure bending moments Li et al. [1] found that shear may greatly influence energy release rate and mode mixity and that these quantities depend on localized deformation in the crack tip region termed "root rotation", see Fig. 1.

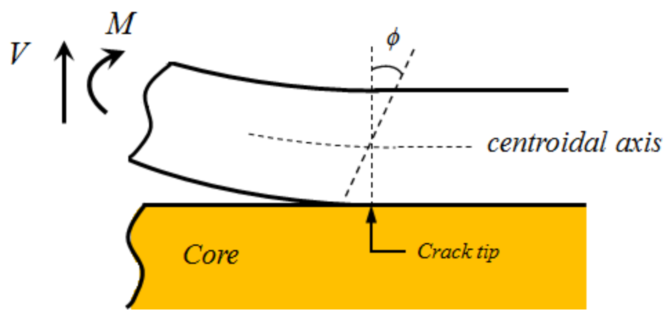

Fig. 1: Illustration of crack root rotation.

Analysis of crack root rotation in the SCB test specimen, Fig.2, has recently been conducted by Saseendran et al. [3].

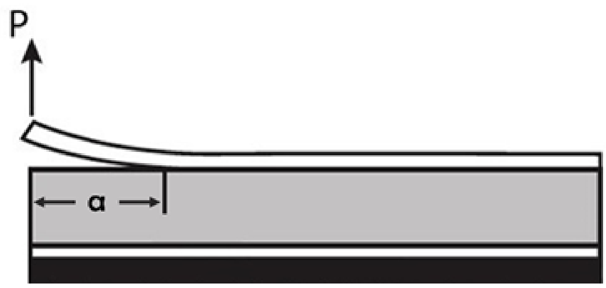

Fig. 2: Schematic representation of SCB test for face/core disbanding characterization.

Notice that for this test, the crack tip shear force and moment (both per unit width) are defined in Eqs.1a and 1b:

$$V = P / b \quad (1a)$$
$$M = Pa / b \quad (1b)$$

where P is the load applied, b is the specimen width and a is the crack length (Fig. 2). Hence, for short crack lengths, shear will dominate the loading, while at long crack lengths, we can neglect the influence of shear, and consider only the applied moment.

In this presentation, we will extend the results by Saseendran et al.[3] to show how they apply to SCB specimens with a range of foam and honeycomb cores. The conditions when shear becomes a significant factor influencing energy release rate and mode mixity will be discussed.

2. RESULTS

A symmetrical SCB sandwich specimen with aluminum face sheets $(E_f = 68.9\ GPa, h_f = 6.35mm)$ and a PVC H100 foam core $(E_c = 130\ MPa, h_c = 25.4\ mm)$ was initially considered. Total length of specimen was L = 305mm, and the crack length was varied in the range: a = 1-50 mm. The foundation model was used to analyze crack root rotation. In addition, a 2D plane stress finite element model of the SCB specimen was constructed. The model utilized 4-node parabolic elements in the crack tip region.

Results for the crack root rotation for this specific SCB specimen are presented in Fig. 3. The FEA results agree very well with analytical results from the foundation model. Notice that the pure shear effect can be determined by extrapolation of the results to a = 0. It is noted that shear dominates the rotation for crack lengths less than about 15 mm $(\frac{a}{h_f} \leq 2.4)$.

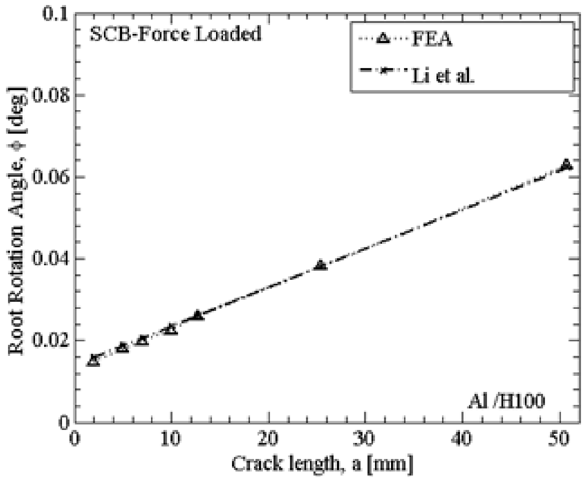

Fig. 3: Crack root rotation angle (ϕ) for SCB sandwich specimen (P = 1N/mm) calculated from FEA and Li et al. [1] approach.

Results for a wide range of face, core materials, and thickness will be presented.

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