



Notched behavior of HexMC discontinuous composite Materials

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ABSTRACT

Recent composite technology research and development efforts have focused on discontinuous carbon fiber/epoxy molding systems derived from chopped aerospace-grade unidirectional tape prepreg. The focus of this research is on HexMC AS4/ 8552, supplied by Hexcel. The notch sensitivity of specimens made with HexMC is studied. Specimens with small holes, typical of fasteners (0.125, 0.25, 0.375 and 0.5 in. diameter) and large holes, typical of lightening holes (0.5, 1.0, 1.5 and 2.0 in. diameter) are tested under tension. The specimen dimensions are varied for the two different hole sizes, and include a narrow specimen (12 in. x 1.5 in.) and a wide specimen (12 in. x 4 in.). The specimen thickness is also varied between thin and thick panels (0.09, 0.13, 0.17, 0.33 in.), thus enabling the generation of plots as a function of d/w and d/t ratios. Purpose of the tests is to evaluate the notch sensitivity of the material to both small and large holes, and therefore provide methods or guidance to account for holes during analysis of HexMC parts. A total of over 120 specimens are tested. Results show that for small hole sizes failure transitions from gross section (away from the hole) to net section progressively, and therefore for large holes failure always occurs at the hole location. The material behaves as a notch-insensitive material throughout the spectrum of hole sizes. The plot of normalized strength vs. d/w however shows a different behavior, which is yet to be understood. The variation in test data is between 2 and 15%, with a grand total average of 9.7%, but there are no correlations or trend between CoV and geometries. Lastly, a deep beam is loaded as cantilever in bending using a dedicated test fixture. The beam has 4 fastener holes at the root, and an optional large lightening hole in the middle. It is loaded with a concentrated vertical force at the tip. This setup induces a complex load state into the specimen. Results show that for hole sizes [0, 0.5, 1.0 in.] failure occurs at the root, either at the fasteners or in the net section close to them, while for hole sizes [1.5, 2.0 in.] it occurs at the lightning hole. Nonetheless, the failure loads are nearly identical for both failure locations, thus confirming the relative notch-insensitivity of this material.