Strain rate effects in the indentation behavior of foam-based sandwich structures

Abstract :

Indentation tests have been undertaken at quasi-static and impact rates of strain on sandwich structures based on six different types of polymer foam core and two types of composite skin. Initially, the influence of strain rate on the compression properties of the sandwich structures has been investigated, where it has been shown that the plastic collapse strength of the foam cores is rate sensitive, increasing by approximately 100% over the range of strain rates considered. The indentation behavior of the sandwich structures was characterized using a Meyer indentation law of the form P = Can, where P is the applied force, a is the resulting indentation, and C, the contact stiffness and n, the indentation exponent, are constants for a given system. It has been shown that the value of the exponent, n, does not vary significantly with the properties of the core or the skin, typically being close to unity for all tests. The contact stiffness C varied greatly and was found to depend on the plastic collapse strength of the foam and the properties of the skin. It has been shown that a plot of C vs. plastic collapse strength containing all of the quasi-static and dynamic data appears to yield a unique relationship for the systems considered here. Tests have also shown that C varies with indentor radius, with the greatest sensitivity to indentor radius being observed in the higher modulus foams.These results highlight the importance of using the appropriate dynamic contact properties when modeling the impact response of foam-based sandwich structures.