BALLISTIC GLASS HAZARD STUDY

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Ballistic resistant glazing is often used in building windows to protect important personnel. However, when a bullet impacts ballistic glazing and is successfully stopped, the glass layer on the protected side of the glazing layup can spall, breaking into shards that are ejected at high velocity towards the protected personnel. The objective of this study was to understand and characterize the spall debris, quantify the spall hazard to personnel in terms of eye and skin injury risk and to develop an improved surrogate witness material for inexpensive standardized testing. This effort sought to answer these questions by using a combination of tests and modeling. The testing components of the evaluation included ballistic tests on glazing samples for debris characterization and injury tests using porcine eye and skin surrogates as targets to characterize type and risk of injury. The test data was then fitted with mathematical curves and probabilistic distributions so that generalized behavior could be observed for fragment size, shape and velocity for various layups and terminating layer glass types as well as severity of injury. The injury and debris characterization data were then used to develop an inexpensive surrogate witness panel that is correlated to actual human injury data. This new witness panel is an improvement over witness panels recommended under the current ASTM, NIC and UL test standards which are not correlated to particular injury levels and due to differences in the standards can lead to dissimilar performance ratings. Finally, a limited risk prediction model for eye and skin injury was developed to demonstrate the potential use of this data for real world applications. In basic form, the model illustrates the way the data developed during this effort could be used to calculate the likelihood of various levels of injury based on a given window geometry and setback. Ultimately the results of this effort could be used to improve standards for performance of “low spall glass” in UL, NIJ, ASTM, etc., providing performance ratings that are directly correlated with probability of injury.