RESPONSE OF DUCTILE STEEL STUD WALLS TO DYNAMIC LOADS

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Key words: Blast – Steel Studs – Cold-Formed Steel – Load-Tree– Tensile Membrane

Energy absorption is an important concept when considering structural response to extreme loading conditions. Strain energy for a structural component can be defined as the area under the resistance-deflection curve. To achieve large energy absorption, a blast-loaded component must respond either with a large ultimate deflection or a large ultimate resistance. Steel stud walls absorb strain energy with a large ultimate deflection, which limits the forces acting on the connections. As a result, conventional construction methods can be used to fasten studs to the track and still achieve a ductile response to a blast load. Many United States government guidelines restrict the use of steel stud walls by imposing response limits that are overly conservative. Response limits are correlated to a component's ductility, which is the ratio of the ultimate deflection to the yield deflection. Currently, a ductility of 3 is assumed to correlate with complete failure of a steel stud wall built using conventional methods. Research done by the Air Force Research Laboratory (AFRL) has shown that conventionally constructed steel stud walls can achieve much higher ductility ratios (greater than 8) than those suggested by the current guidance documents. Existing response limits have been incorporated into an automated single-degree-of-freedom (SDOF) spreadsheet workbook that computes resistance functions using theoretical shape functions and the assumption that no tensile membrane capacity is available when conventional construction methods are used. For the current study, static resistance functions were developed from more than 70 wall segments tested at AFRL. From these static resistance functions, SDOF response predictions were carried out and compared with existing methods of analysis. A full-scale blast validation test of seven different steel stud walls was performed, and the measured response closely matched the predictions made using the resistance functions developed during the current study. This paper provides an overview of the research program. Pertinent findings are described, and recommendations regarding the use of steel stud wall systems against blast loads are given.