

Dynamics Modeling of the Vertical Impulse Measurement Fixture

Cadet Richard Hutchison

Department of Civil & Mechanical Engineering
United States Military Academy
West Point, New York

ARL Sponsor: Dr. Patrick Baker

Chief, Explosives Technology Branch
Terminal Effects Division
Weapons and Materials Research Directorate
U.S. Army Research Laboratory
Aberdeen Proving Ground, Maryland

ABSTRACT:

The Vertical Impulse Measurement Fixture (VIMF) at Aberdeen Proving Grounds is a facility that is designed to measure the vertical displacement of a rigid surface subjected to land mine detonation. This facility will allow engineers and scientists to better characterize the impulse generated by a buried land mine on solid bodies of various shapes and sizes and thus help engineers to design better armored vehicles. This project numerically analyzes the response to the VIMF to various blast scenarios using both hand calculations and computer simulations. Initially a Computer Aided Design (CAD) model of the facility was created using existing design drawings and metal shop work orders. Changes to the design during construction were incorporated in the model. The model was confirmed by comparing the model's measurements with measurements of the actual facility, and by comparing the calculated weight of its parts to their measured weights. Using pressure time history data from CONWEP, hand calculations using principles of rigid-body dynamics were performed to predict the motion of the main moving part of the facility, the guide rail. That prediction was used as a check for computer simulations. Using similar blast data and the CAD model, the behavior of the facility when subjected to a mine blast was simulated. In addition to displacements, this numerical model can be used in finite element analyses of the facility in order to ensure there will be no structural failure of the facility.

KEY WORDS: Land Mine, Computer Aided Design (CAD), Vertical Impulse

CONTACT: Cadet Richard Hutchison, USMA, West Point, NY 10996
Tel: (845)-515-4661 email: Richard.Hutchison@usma.edu

Dr. Christopher Conley, DCME, USMA, West Point, NY 10996
Tel: (845) 938-4092 email: ic7188@exmail.usma.army.mil

Dr. Patrick Baker, ATTN: AMSRL-WM-TB (Baker),
Aberdeen Proving Ground, MD 21005-5006
Tel: (410) 278-0204 (DSN 298-0204) Email: pbaker@arl.army.mil