COMPUTATIONAL STUDY OF HIGI-I-SPEED EXIT JET FLOW FROM THE LARGE BLAST/THERMAL SIMULATOR

SCHRAML,S.J.

The U.S. Army has recently expressed an interest in testing full scale military vehicles in transient, high dynamic pressure flows. To address this need, the Defense Special Weapons Agency (DSWA) and the U.S. Army Research Laboratory (ARL) initiated a cooperative program to explore methods of generating the desired environment at reasonable cost. The program has focused its efforts on using the Large Blast/Thermal Simulator (LB/TS) as the facility for generating the transient flow environment. The LB/TS is a large shock tube that was originally designed to expose equipment to exponentially decaying blast waves inside its expansion section. The concept of using the LB/TS to generate the transient, high dynamic pressure environment is based on the formation of a coherent, high speed exit j et at the downstream end of the expansion tunnel. This technique has been demonstrated on small scale at ARL and is considered applicable to the LB/TS.

A computational study was performed to assess the dominant characteristics of the LB/TS exit jet and evaluate its performance in producing the desired flow environment. The computational study consisted of three distinct elements. First, a series of two-dimensional (2D), axisymmetric calculations were performed to provide an initial indication of the changes in peak pressures, peak velocities. and energy delivery at various distances from the exit plane of the expansion tunnel as a function of initial driver gas conditions. This phase of the study provided the range of driver initial conditions and measurement positions that would produce the desired flow histories. Next. a set of 2-D planar symmetry calculations was performed to provide an initial indication of the effect of the ground plane on the primary shock. Finally, a three-dimensional (3-D) computational model was constructed and used to obtain a detailed description of the flow characteristics and complete the overall assessment of the exit jet as a technique for generating the desired transient flow environment.

The computational study showed that the exit jet of the LB/TS is capable of producing flow histories with peak velocities as great as 600 m/s. A peak dynamic pressure of approximately 200 kPa and an associated dynamic pressure impulse of 60 kpa-s were obtained from a simulation in which the maximum driver overpressure of 15.5 MPa was used. This paper presents descriptions of the computational methods used in the study, details of the 2-D and 3-D computational models, the assumptions that went into the construction of those models, and the overall findings of the computational study.