Novel Approach to Conducting Blast Load Analyses Using Abaqus/Explicit-CEL

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Abstract: A new method is introduced for conducting blast load analyses using the new Coupled-Eulerian-Lagrangian (CEL) capability of Abaqus/Explicit. In the past, either a 1-D blast code or tabular data was used to determine a pressure vs. time curve that would be applied to the exterior surfaces that were assumed to interact with the blast wave. These pressure curves were generated using knowledge of the amount/type of explosive and line-of-sight distance away from the explosion. While this method remains valid, with increasingly complex structural geometry, oblique surfaces, and with corners facing the blast, the amount of overhead required to analytically determine the necessary pressure loading for each of the various surfaces becomes exhaustive. This new approach involves surrounding the structure with a body of air (Eulerian), imparting a blast (pressure) wave as a boundary condition into the body of air, and then having it propagate into the Lagrangian structure. The Lagrangian structure can be positioned arbitrarily within the Eulerian domain to achieve any angle of incidence that is desired. This new method negates the need to determine reflected pressures for oblique surfaces a priori. This approach remains to be validated against test data (impulse-momentum traps) but thus far the results look promising.

Keywords: CEL, Coupled Analysis, Explosive, Shock

1. Introduction

A significant amount of energy is contained within a blast wave. Considerable damage can occur should it impact a structure. However, it is difficult to assess the loading experienced by the structure because of the large number of variables at play: cased explosive versus uncased, effects of afterburning, angle of incidence with respect to incoming shock, nearby geometry/barriers interacting with the shock, possible mach reflection due to air burst, etc, etc.

During the design phase of new armor systems, for example, it is valuable to understand how the armor system will respond to blast loading even if only in an approximate sense. This procedure can be extended to any structure that may experience blast loading, be it explosive test facility or buildings in high risk areas**.** What follows is first an overview on the characteristics of explosive shock waves, then a discussion of some of the historical modeling techniques and how these models provide the inputs to a new analysis technique.

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