

ANALYSIS OF BLAST LOADS ON COMMERCIAL BUILDINGS

BIRNBAUM,N.K.; HAYHURST,C.J.; FAIRLIE,G.E.

Analytic techniques and computational fluid dynamics (CFD) software programs are currently in use for assessing the blast loads on military structures for a variety of situations. These approaches, of necessity, are now being extended to the calculation of explosion-structure interaction problems where the loadings are not upon hardened military targets but rather on civilian structures. This has become of great importance as high explosive bomb attacks have been increasingly directed against many commercial, financial and civic centers consisting of buildings of conventional, "soft" construction.

One aspect in the protection of such structures is the accurate prediction of the blast loadings on structural components using analytic or advanced numerical tools taking into account the complexity of the buildings, its geometry and the surrounding environment. Such an understanding of the loads can help define building protection options such as selection of materials, relocation of building services, siting, and construction techniques.

The advantages and disadvantages of different numerical and analytic techniques are discussed and illustrated by example. Applications discussed include:

Idealized one and two dimensional problems.

- Blast propagation over multiple structures in two dimensions .
- Blast in a three dimensional urban setting due to a Terrorist bomb including multiple interactions with buildings and roads.
- Blast within a three dimensional underground garage and resultant loadings on concrete panels and columns.

Important effects such as multiple blast wave reflections, rarefactions, and the negative phase of the blast wave can be readily modeled in CFD codes. Simplified analytic and semi-empirical techniques many times ignore such phenomena. Thus, modeling modern buildings set in congested city centers usually requires the use of sophisticated CFD numerical calculations. The use of both analytic techniques and CFD calculations can provide a cost-efficient and accurate approach to determining blast loads. Such information is critical in any effort to effectively harden commercial structures.