BLASTEX

PC Windows Software for Rapid Evaluation of Explosion Blast and Missile Effects on Building Structures, Vehicles and Surrounding People

The BLASTEX software package code is formed by five computer codes called PRESEX, MISSEX, DISTEX, FLYEX and PENEX. BLATEX is used for a rapid simplified evaluation of the blast wave and missile effects on building structures. All five programs run on PC under a Windows XP environment. The programs are fast, user friendly and easy to use.

Although the mathematical formulation of the treated problems is quite complex, including integrations of nonlinear differential equations, solution to nonlinear algebraic systems, multidimensional nonlinear interpolation schemes, etc., the user has not to worry about the number of points for blast and missile load definition, number of solution integration points to ensure numerical stability and accuracy, crushing length and time steps, mesh refinement for multidimensional interpolation schemes. All these important input parameters are handled internally by the programs to ensure accuracy and numerical efficiency consistent with the solution method used. The user is required only to input a minimum of input data related to the physical aspects of the investigated problem.

The structures of the programs were thought to be convenient to the user, but also to help him in interpreting the computed results. In this idea, the PRESEX, MISSEX and DISTEX programs compute the solution for a set of parameter values, not only for a single parameter value. This offers to the user the possibility of forming expedient engineering judgments on the structure behavior under the blast or missile loads.

The five computer programs addressed the following issues:

1. PRESEX computes equivalent static pressures and damage for target structures subjected to a blast wave from an explosion

2. MISSEX computes equivalent static pressures and damage for target structures subjected to a missile impact

3. DISTEX computes stand-off distances for different level of accepted damage levels on target structures and given charge weights

4. FLYEX evaluates the stability and appurtenance speed of unconstrained objects subjected to blast waves from explosions

5. PENEX computes the local damages and required minimum thicknesses for the target structure walls subjected to missile impact

The next sections describe in more detail the above programs and show how to use them. For each program an example is included.

PRESEX Program: The PRESEX program computes the equivalent static pressure on a building structure subjected to blast wave from an explosion. The input data are the equivalent TNT charge weight, the distance from explosion location, and damping of the structure. PRESEX initially computes the blast parameters including the shock wave pressure impulses on reflective and side-on surfaces, arrival time, wind pressure and wave front velocity. For structural evaluation the pressure impulses are idealized as triangular impulsive loads. The effect of dynamic wind pressure on reflective surfaces is neglected (small in comparison with reflected pressure).

MISSEX Program: The MISSEX program computes the equivalent static force on a target structure subjected to a missile impact force. The equivalent force computed with MISSEX is based on the dynamic elasto-plastic analysis of the target structure. The local damage effects produced by a missile to the target (penetration, perforation) are determined using the PENEX program. MISSEX considers both non-deformable and deformable missiles based on the procedures recommended by the Report ASCE Committee on Impact and Impulsive Loads, 1980. The basic assumptions are that the missile is rigid for non-deformable missiles and ideally plastic for deformable missiles and that the target is rigid. For deformable missiles the crushing strength distribution and mass distribution along the missile can be defined as uniform distributions or more realistically by inputting the crushing strength and mass distribution diagrams that are functions of crushed length.

DISTEX Program: The DISTEX program computes stand-off distances for given TNT charge weight and different levels of equivalent static pressure on building. The DISTEX program should be run in conjunction with the PRESEX program. DISTEX uses as an input file the file C:\BLAST\FILE2 (ductility solution) computed by PRESEX. The structural damping is read from this file. The TNT weight can be different than that used in PRESEX. Stand-off distances are computed for both reflective and side-on surfaces and output in files C:\BLAST\DISTR and C:\BLAST\DISTS. The user must input, in addition to charge weight, the elastic frequency and the ductility of target structure.

FLYEX Program: FLYEX determines the stability of unconstrained objects subjected to explosion blast waves. The program can be used either to compute the appurtenance speed for unconstrained objects or to check the overturning stability (toppling analysis) of unconstrained objects under explosion pressure waves. The TNT charge weight and the distance from explosion location, object weight and object frontal area must be input. FLYEX determines the appurtenance speed using impulse momentum conservation and Baker-Kulesz approach. Minimum transverse size of the object and the distance from the front to location of maximum cross-sectional area are needed for the input in the BK approach. Appurtenance option on the ground or in air has to be specified. For toppling analysis the geometric characteristics of the object must be input. Tracks, buses, mobile homes, missiles on the launch pad, are objects that can be damaged due to overturning (toppling) when enveloped by a blast wave from an accidental explosion.

PENEX Program: The PENEX program computes the local damage effects produced by a non-deformable missile impact on a target structure. For concrete target the penetration depth, perforation and scabbing thicknesses are computed. For perforated targets the residual velocity of the missile is also determined. For steel targets (steel plate with or without stiffeners) the threshold (perforation) thickness is determined. All computations performed by PENEX are based on empirical formulas which were calibrated based on limited experiments and parameter ranges for missile weight and velocity. The implemented formulas are those recommended by the Report of ASCE Committee for Impulsive and Impact Loads, 1980, for nuclear facilities.