

Structural Response Prediction and Criteria

EXPLOSION RESEARCH COOPERATIVE



Structural response prediction tools have been developed through theoretical methods, empirical data observed at accident sites, and experimental testing. These tools use either pressure-impulse curves or component response criteria to predict how building components will respond to explosive loads.

For more information about dynamic structural response research, please contact:

Dr. Raymond Bennett
rbennett@bakerrisk.com

ACCOMPLISHMENTS

- Building Evaluation and Screening Tool (BEAST) software was developed as a facility siting screening tool. The program predicts building damage to blast loads, based in large part on several years of component failure limit testing in the BakerRisk shock tube and observations made at explosion accident sites.
- Component failure criteria have been determined for a wide range of structural components including:
 - Metal Structures
 - Masonry Structures
 - Reinforced Concrete Structures
 - Doors
 - Windows

A Joint Industry Research Program
by BakerRisk

Baker Engineering & Risk Consultants, Inc.
3330 Oakwell Court, Suite 100
San Antonio, TX 78218-3024
Phone: (210) 824-5960
www.BakerRisk.com





Structural Response Prediction Criteria

EXPLOSION RESEARCH COOPERATIVE

PREVIOUS STUDIES:

Enhancement of the Building Evaluation and Screening Tool (BEAST) (2000) An enhanced version of the BEAST computer program was developed for use by Cooperative participants as a screening tool for facility siting studies. This program predicts the blast damage level to buildings based on the input blast load and building type.

Blast Resistant Design Criteria (1998) Criteria were developed that identified levels of plastic deflection for many different structural component types consistent with each of the four component damage levels used in the BEAST building and component blast damage evaluation methodology. The purpose of this project was to identify quantitative criteria for each BEAST damage level that could be used in analyses of components with parameters outside the range of those that can be analyzed with BEAST.

Door Performance (1997) The objective of this study was to determine blast capacities of conventional steel personnel doors common to petrochemical plants. There are large numbers of steel personnel doors in a petrochemical plant of greatly differing design. Fire rated doors are the strongest of the conventional doors while non-fire rated with large windows tend to be the weakest. No data existed on the blast performance of conventional doors prior to this study. The technical approach was to develop a database through blast testing of door performance under varying blast load conditions.

Siting Tools for Evaluating Blast Response of Conventional Buildings (1995) This study developed a method for assessing blast capacities of conventional buildings using empirically based methods. The result was a Microsoft® Windows-based software package called BEAST (Building Evaluation and Structural Assessment Tool) that is capable of making quick evaluations of potential building damage using documented procedures. This software allows for automated application of the damage assessment methods developed in the study. It includes a "Quick Assessment" feature, which predicts an overall building damage with minimal user input and a "Detailed Evaluation" feature, which evaluates component damage and allows a review of the technical database. The software also provides an on-screen photograph display of building damage from the accident photo library compiled under the study.

Building Component Failure Criteria Study (1994) This study defined building component failure limits in terms of critical deformations and involved the development of conventional building blast failure criteria. This study was undertaken to better understand the true response of buildings exposed to blast loads. This required defining structural response criteria different from that presented in blast design manuals and documents, which include conservatisms intended to ensure that the designed or predicted responses are well below the actual response that would occur in practice. Structural performance and the ability to resist blast loading are measured in terms of member deformation and/or ductility ratio. This 1994 study compiled a summary of failure criteria for various conventional building components based on previously published criteria, published test data, and explosion accident measurements.



Baker Engineering & Risk Consultants, Inc.
3330 Oakwell Court, Suite 100
San Antonio, TX 78218-3024
Phone: (210) 824-5960
www.BakerRisk.com

For additional information on participating in the Explosion Research Cooperative, visit www.BakerRisk.com or email us at Co-op@BakerRisk.com