Modeling and Simulation for Force Protection

ERDC/CERL TN-02-4 rev. September 2003

Problem

Military threats have significantly changed since the end of the Cold War. The recent attacks on U.S. interests home and abroad have fundamentally changed the perception of terrorist risk to Army installations. Installations are prominent targets of aggressors as both symbolic targets and because of their key role in combating terrorism. As a result, force protection will be a high priority of DoD installations, and the need for effective force protection planning will increase.

Army Installation personnel, mission operations, and facilities are vulnerable to various aggressor threats, including explosives and releases of chemical, biological and radiological (CBR) agents. Facility planners, designers, and O&M personnel need improved capabilities to determine the vulnerabilities of new and existing facilities, and to identify the most cost-effective countermeasures for reducing risk.

Approach

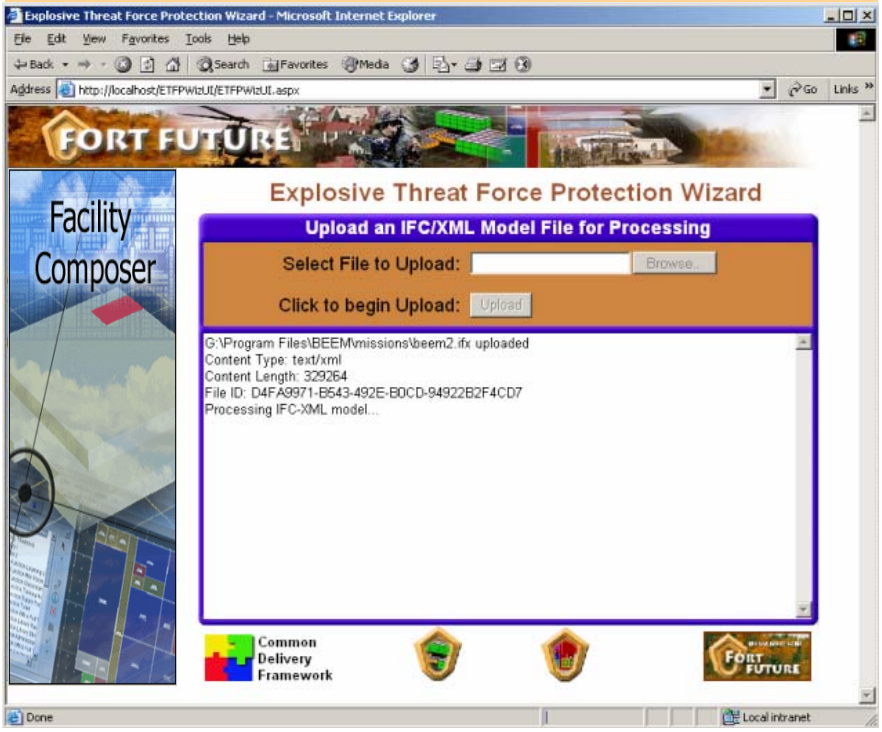
To provide a Force Protection capability for Fort Future, researchers will develop decision support tools to help reduce the vulnerability of an installation's operations and personnel. The initial focus will be on the integration of existing software tools to evaluate the effects of terrorist explosive and airborne chemical/biological attacks on buildings. This capability will be extended to the overall installation infrastructure and will consider physical security to ensure mission accomplishment. These integrated software tools will assist designers, planners, operators, owners, and users in assessing their level of readiness for attacks against the infrastructure and personnel and for determining and evaluating alternative options for minimizing vulnerability.

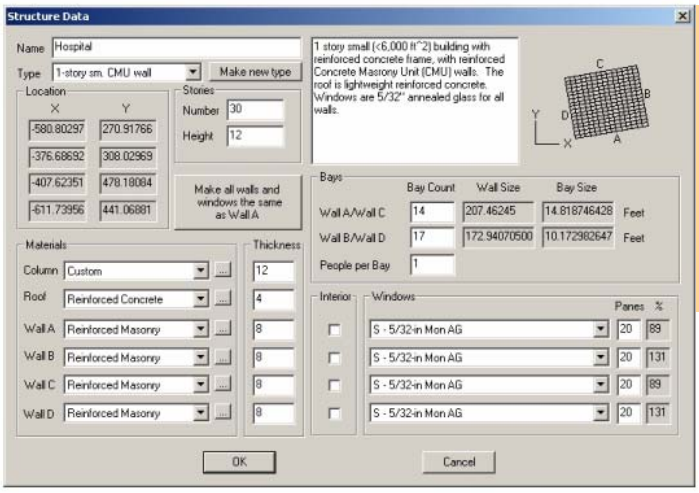
Tools

Explosive Threat Force Protection Wizard

The Explosive Threat Force Protection Wizard provides safety and master planners the ability to generate building and installation models for explosive threat analysis. The wizard automatically extracts information about the building and site from the Fort Future installation model. The planner then uses the Blast Effects Estimation Model (BEEM) to define threats and analyze the resulting damage in a 3-D view. This allows the planner to establish stand-off distances, evaluate various protective strategies, and then use Facility Composer's cost estimation

The web-based Explosive Threat Protection Wizard will provide automated capabilities to determine the a facility's vulnerabilities and to identify cost-effective countermeasures to reduce risk.





Data is imported from *Facility Composer* into BEEM to generate building and installation models for explosive threat analysis.

capability to make intelligent countermeasure selections.

This tool leverages the Blast Effects Estimation Model (BEEM), which provides the front-end for established and validated modeling codes including the blast effects analysis of the Army's Antiterrorism Planner (AT-Planner) and the ballistic effects of the Navy's Force Protection Tool (FPT). BEEM is being developed for the Counter Terrorism Technical Support Office (CTTSO) Technical Support Working Group (TSWG).

Minimum AT Standards for Buildings Wizard

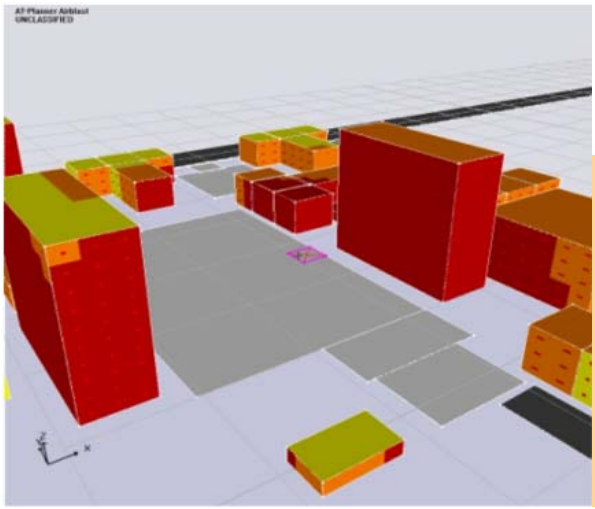
The Minimum AT Standards for Buildings (MATSB) Wizard will aid facility planners and designers in ensuring that all of the applicable minimum antiterrorism/force protection standards that are addressed in Unified Facility Criteria (UFC) 4-010-01, DoD Minimum Antiterrorism Standards for Buildings, are properly identified and included in the project requirements. Initially, the wizard will prompt the User for project-specific input and then walk the User through a decision tree process to determine and identify the project's applicable minimum antiterrorism/force protection requirements. Ultimately, the wizard will extract data directly from Facility Composer and output protection requirements with minimal User input.

The wizard will be extended to interface with the Installation Planning Workbench to provide standoff distance requirements for planned buildings and recommended requirements for existing buildings. Spatial representation of standoff zones for buildings and conflicts with controlled perimeter, parking lots, roadways, and adjacent buildings will be displayed on the installation map. This functionality will aid designers and master planners in siting proposed facilities and determine compliance with standoff requirements of UFC 4-010-01.

CBR Modeling and Simulation Tool

The CBR Modeling and Simulation Tool will be a secure web-based tool that will aid facility planners and designers, emergency responders, and force protection planners to identify potential vulnerabilities of planned and existing facilities and installations to the threat from chemical, biological, or radiological (CBR) attacks. The CBR Wizard will address scenarios in which contaminants are released external to a facility, either inside or outside of an installation's perimeter.

Users will import an existing installation model from a GIS data base, create CBR threat scenarios, and select the specific chemical or biological or radiological threat (e.g., chlorine, anthrax, cesium-137) for which an external release to buildings is simulated. The CBR modeling and simulation tool will utilize information about the amount of hazardous material released, release rate, location, and duration of the release event, in addition to local



Sample BEEM blast-damage assessment: blast located at ground level "x"; colors differentiate degree of damage.

meteorological information to simulate the transport of the chemical-biological contaminant plume throughout the installation. Plume transport simulation will utilize the air dispersion model from the Defense Threat Reduction Agency (DTRA) Hazardous Prediction and Assessment Capability (HPAC) Tool. The concentration of the chemical or biological contaminant will be shown on the installation map as dosage contours or percent probability of injury to personnel.

The level of contamination infiltrating specific buildings, at any time, can be determined based on air exchange rates, and other building specific information, with the aid of a "leaky box" model. The simulation will indicate when buildings are unsafe or safe for use again during Force Projection Simulations. Affected areas and facilities will be represented visually.

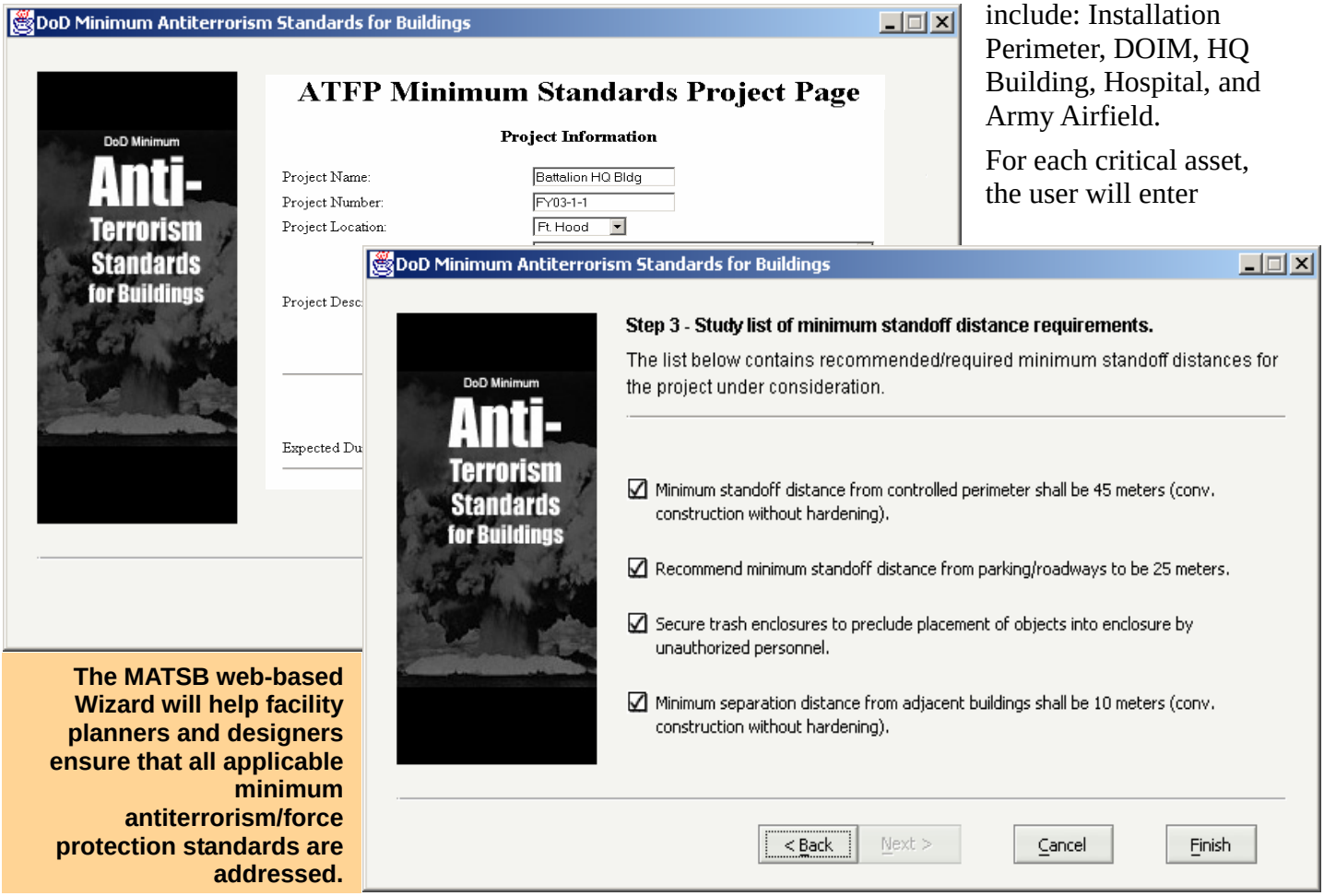
Facility-specific information on buildings in the affected area (e.g., type of CBR protection employed, if any; number of occupants; unit activity type; scheduled hours of operation, etc.) will be extracted from existing installation databases to allow emergency responders and force protection planners to identify type and extent of vulnerabilities and develop plans to mitigate impacts.

Integrated Anti-Terrorism Force Protection Rating Tool

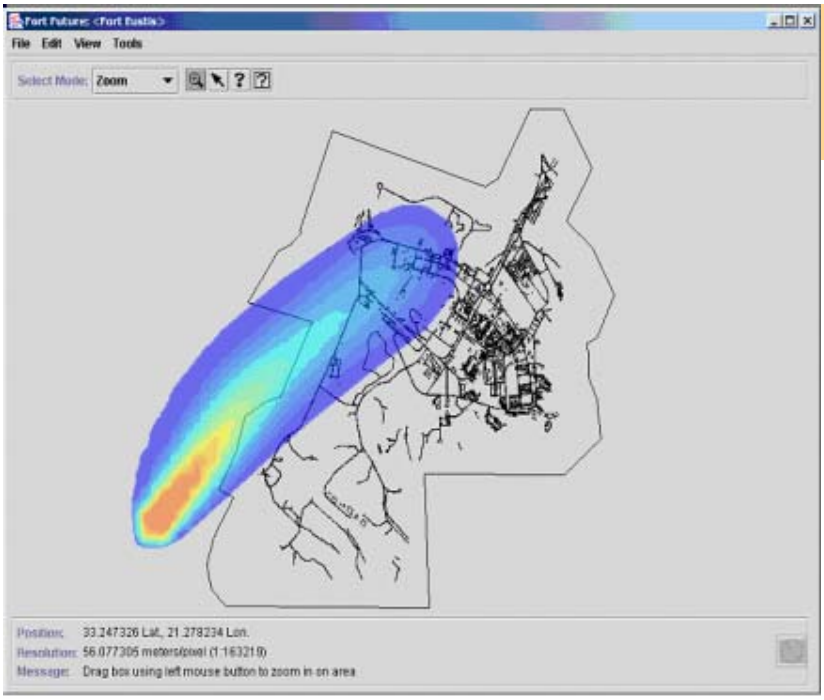
The Integrated Anti-Terrorism/Force Protection (AT/FP) Rating Tool will assist Installation Master Planners and Force Protection Officers in the evaluation of Army Installation Force Protection needs and requirements for existing or planned facilities.

The tool will be in the form of a matrix that will provide a risk rating for critical Mission Essential Vulnerability Areas and High Risk Targets (MEVAs/HRTs) or Single Points of Failure (SPF) on an Army Installation. The matrix will be based on risk weighting factors and strategies developed for the Navy's Risk Analysis and Vulnerability Assessment Tool (RAVA) and the Joint Chiefs of Staff Joint Anti-Terrorism (JAT) Guide. Some examples of these critical assets include: Installation Perimeter, DOIM, HQ Building, Hospital, and Army Airfield.

For each critical asset, the user will enter



The MATSB web-based Wizard will help facility planners and designers ensure that all applicable minimum antiterrorism/force protection standards are addressed.



The CBR wizard will enable users to model the dispersion of contaminants and the extent of their impact on facilities in the contaminated area.

The Asset Force Protection Rating quantifies the risk or probability (between 0 and 1) of suffering damage or loss to a specific critical asset if a projected terrorist threat occurs, and is the product of the asset value, vulnerability rating, and threat likelihood. The matrix cells in which these ratings fall will be color-coded red, amber, or green, to provide the user with an easy recognition of whether risks are high, medium, or low.

Asset Values and Threat Likelihood values. Asset Value Tools and Threat Likelihood Tools are available in the JAT/FP Guide to help users determine these values. Each column of the matrix will address terrorist tactics and weapons, including explosive threats, forced and covert entry and chemical, biological, and radiological (CBR) weapons. Along each row of the matrix, the user will answers 65 questions regarding proposed designs to mitigate the effects of those terrorist tactics. The questions will address attributes of the asset perimeter, asset exterior design and asset interior design, such as stand-off distances, barriers, design of windows and doors, and electronic security.

The output to the user will be in the form of a matrix display that will list the critical assets in rows and tactics in columns. An Asset Force Protection Rating will be given in the each matrix cell for each asset, tactic pair.

US Army Corps of Engineers®
Engineer Research and Development Center

Contacts

U.S. Army Engineer Research and Development Center

Dr. Ashok Kumar, Project Leader
Phone: (217) 373-7235
Email: Ashok.Kumar@erdc.usace.army.mil

David Bailey, Minimum AT Standards for Buildings
Phone: (217) 352-6511, x7480
Email: David.M.Bailey@erdc.usace.army.mil

Kirk McGraw, Explosive Threat Force Protection
Phone: (217) 352-6511, x3328
Email: Kirk.D.McGraw@erdc.usace.army.mil

James Miller, Chemical, Biological, and Radiological Attack
Phone: (217) 352-6511, x7302
Email: James.P.Miller@erdc.usace.army.mil

Dr. David Stephenson, Integrated Anti-Terrorism/Force Protection Screening
Email: Larry.D.Stephenson@erdc.usace.army.mil

FAX: (217) 373-7222

Fort Future web site: http://ff.cecer.army.mil/