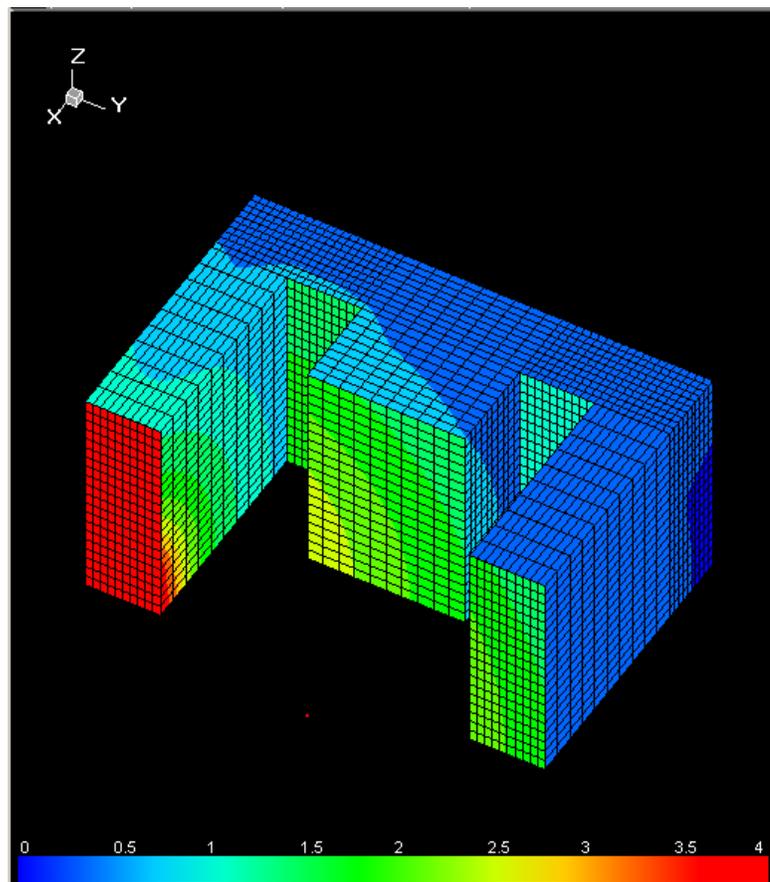


# **3D-BLAST**

## USER GUIDE



August 2010



**3-D BLAST**  
*USER GUIDE*

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## INTRODUCTION

**3D-Blast** is a computer program that provides quick calculation and visualization of the effects of an open-air explosion on a variety of building shapes. Given the dimensions of the building and the size and location of an explosive charge, the program will estimate the pressure and impulse distribution on the building and map them as contours on a 3D representation of the structure. After an analysis is complete, the program contains an automated report writer which can prepare a concise technical report highlighting the results.

**3D-Blast** uses a special purpose software program that estimates the path the shock wave will follow from an explosion to a grid of points on the building. The range to each of these nodes on the 3D model is determined using the shortest path around the exterior of the facility. The software then uses an airblast driver to determine the appropriate pressure and impulse magnitudes for the range and orientation of each element. A non-cased, hemispherical detonation is assumed. The airblast equations documented in the U.S. Department of Energy's "A Manual for the Prediction of Blast and Fragment Loading on Structures", DOE/TIC 11268 (1992) is the basis for the loading algorithms.

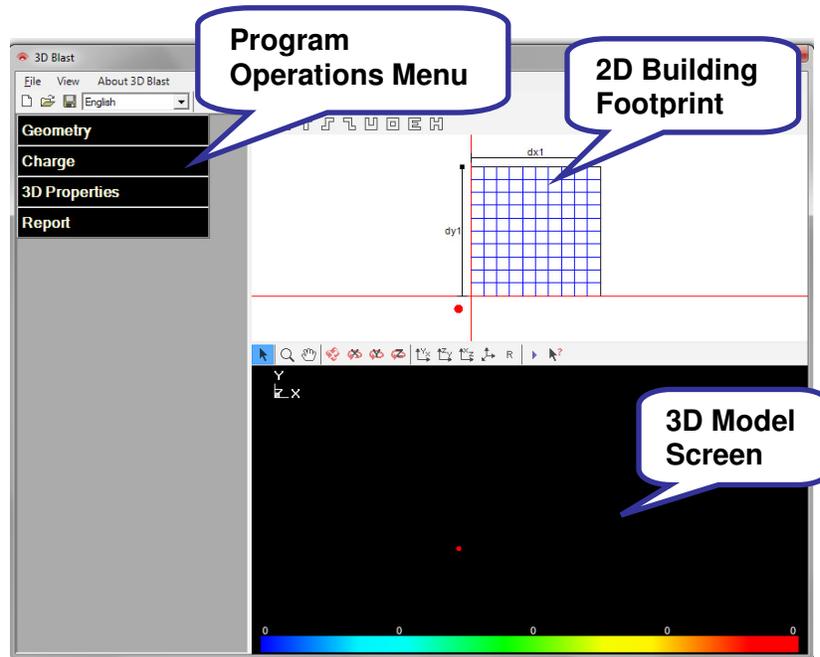
The program provides a simple, quick approximation of the 3D engulfment of a structure. A significant feature of this program is the ability to manipulate the building dimensions and explosive location by clicking and dragging the building dimensions or target with the computer mouse. Once the 3D model is built, the user may rotate the structure, zoom in for detail and zoom out for perspective. These features allow the user to approximate parameters and quickly experiment with various options while visualizing their effects on the structure. The program currently contains nine building footprints for analysis: a Box, an L-Shape, a T-Shape, an S-Shape, a Z-Shape, a U-Shape, an O-Shape, an E-Shape, and an H-Shape.

**3D-Blast** provides two different forms of output:

- Full color 3D engulfment models
- A report detailing the technical parameters and results including 3D engulfment models

This User Guide contains an index of Toolbar Features and provides guidance for screen input.

## OPENING SCREEN



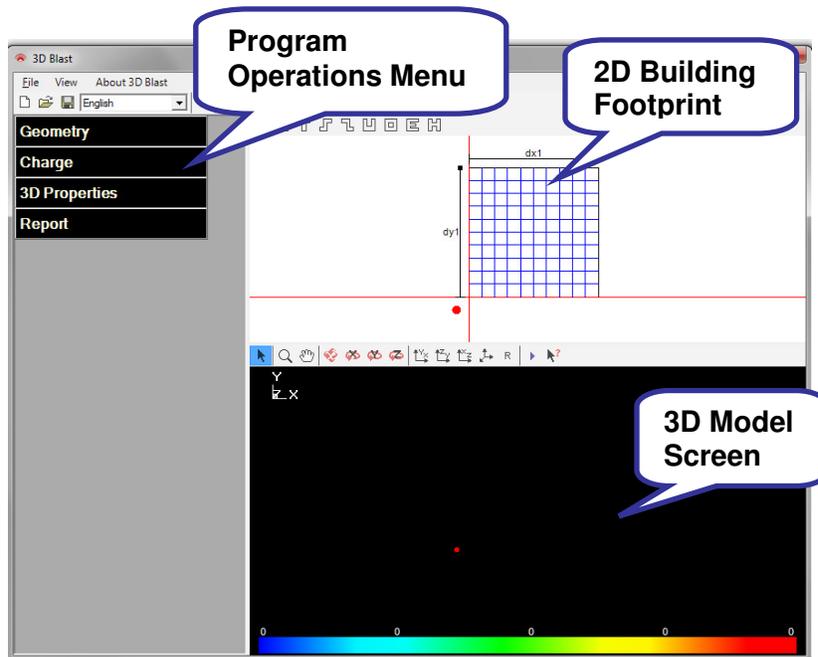
### **Initial Screen**

The 3D-Blast Program opens with a screen that contains three components: a program operations menu on the left, a 2D building footprint screen in the upper right portion of the screen, and a black background in the lower portion of the screen where the 3D building and explosive device will be drawn.

The size of each component may be changed by clicking and dragging the dividers between each.

## BEGIN ANALYSIS

### Start a New File or Open a Previously Saved File



**New File** Select “New” from the File menu.

**Open a Previously Saved File** Select “Open” from the File menu to access your computer directory; the default file extension for 3D-Blast is .tdb.

**Import Old File** Select “Import” from the File menu to access files created in Version 1.0 or earlier of 3D-Blast.

## PROGRAM TOOLBAR



The screenshot shows the top toolbar of the 3-D BLAST application. From left to right, it contains: a 'New File' icon (a blank document), an 'Open File' icon (a folder with a document), a 'Save File' icon (a floppy disk), a 'Units' dropdown menu currently set to 'English', a 'Run Analysis' button (a right-pointing triangle), and a 'View 3D Model' icon (a 3D model of a molecule).

**New File**  
 Click this icon to start a “new” problem.

**Open File**  
 Click this icon to access previously saved files. Files created in version 1.0 or earlier must be imported using “import” in the File menu.

**Save File**  
 Click this icon to save your file.

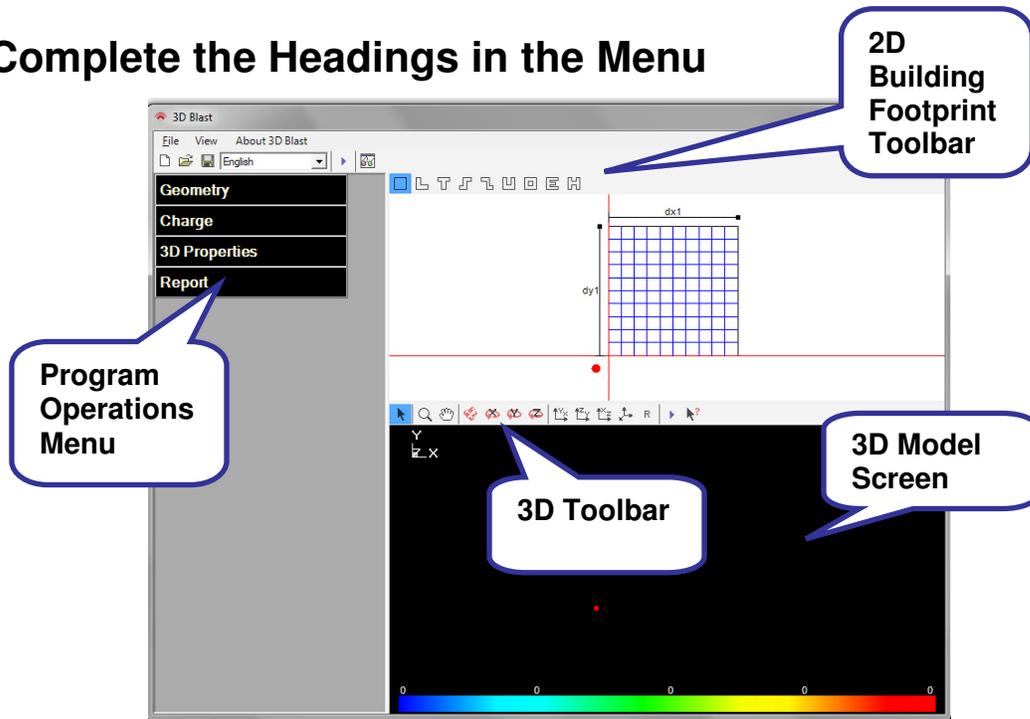
**Units**  
  
Click this drop down box on the Toolbar to select English or Metric units for the analysis.

**Run Analysis**  
 Click this button on the Toolbar to run the analysis.

**View 3D Model in a separate window**  
 Click this icon on the Toolbar to open a new window containing the 3D Model.

## NAVIGATING IN THE PROGRAM

### Complete the Headings in the Menu



#### **Program Operations Menu**

The operations menu on the left side of the screen is a tree. Click one of the main headings and a table expands below it. After expanding a heading, an additional click will collapse it.

#### **2D Building Footprint Screen**

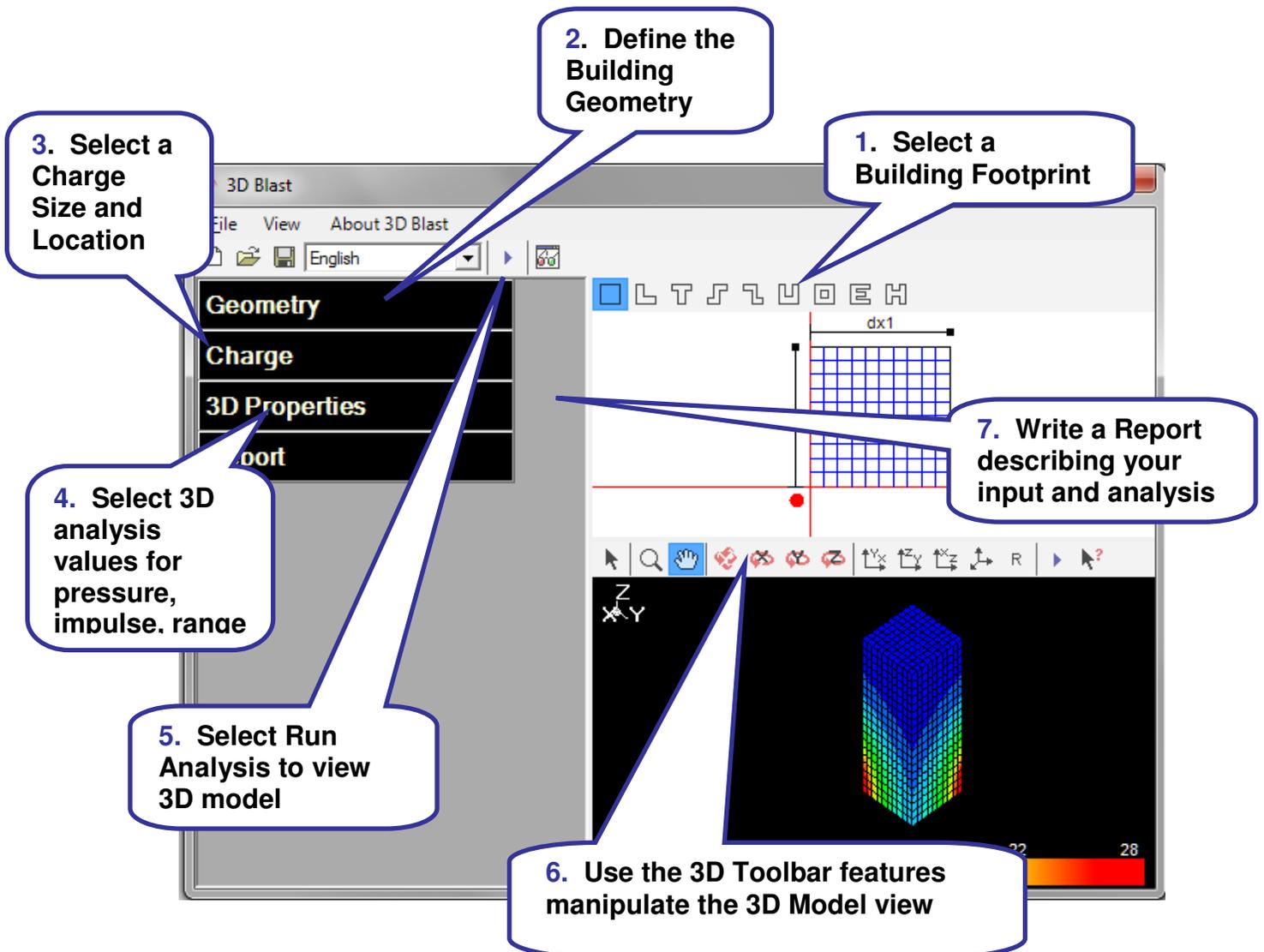
Select a building footprint on the 2D Toolbar at the top, and the footprint will be drawn with line segments along the x- and y-axes. Many model variables may be adjusted by dragging objects in this window.

#### **3-D Model Screen**

After selecting the Geometry, Charge, and 3D Properties for the building, select Run Analysis to see the 3D results for the building.

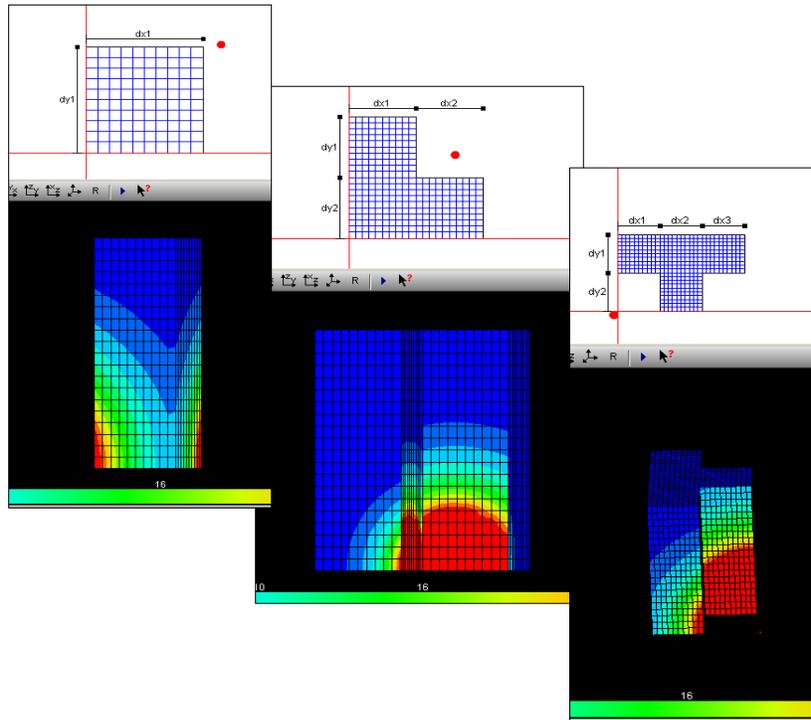
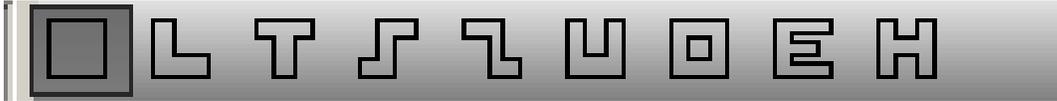
## PROGRAM STEPS

**Complete the following steps to obtain a 3D Model and Write a Report**



## STEP 1 BUILDING FOOTPRINTS

Select a Building Footprint on the 2D Toolbar

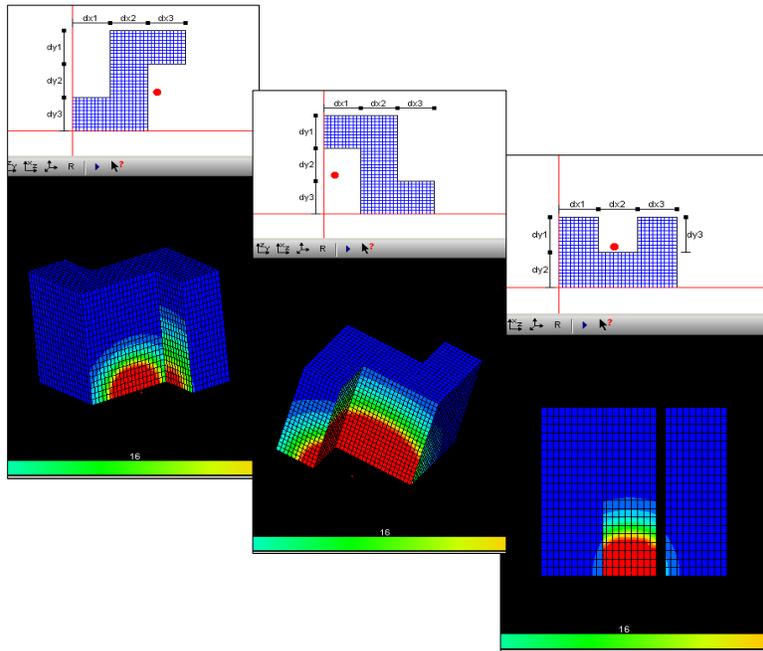


Box, L-Shape, and T-Shape Building Footprints

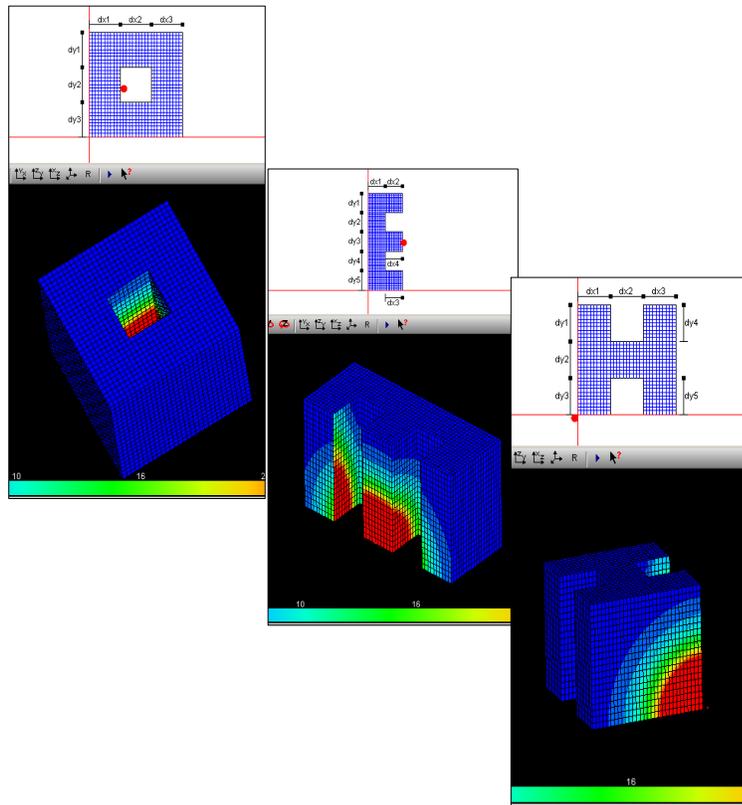
### Select a Building Footprint

Click one of the nine shapes on the 2D Toolbar and the program will plot the building footprint selected in the upper-right portion of the screen.

## Step 1 BUILDING FOOTPRINTS (cont)



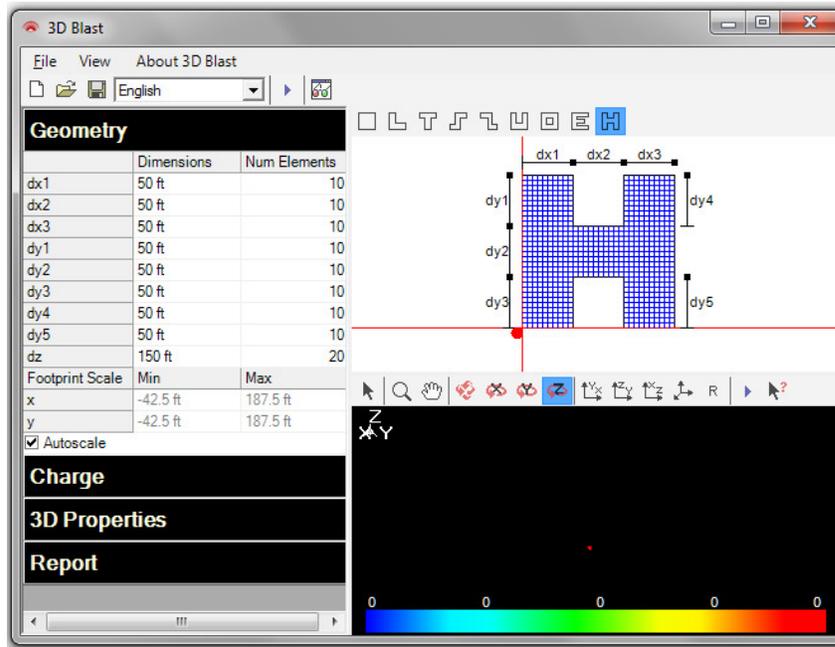
S-Shape, Z-Shape, and U-Shape Building Footprints



O-Shape, E-Shape, and H-Shape Building Footprints

## STEP 2 GEOMETRY

### Setting Units and Dimensions of the Building



### Setting Dimensions

#### Geometry Tree

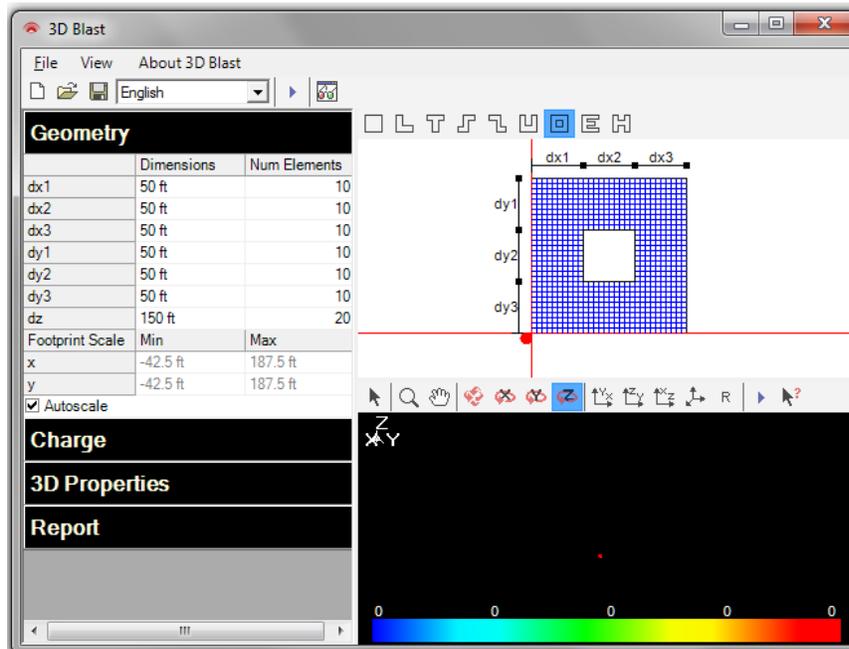
Open the Geometry tree on the left and enter specific dimensions for length, width and height. More complex shapes may consist of several fields in each direction. These fields are labeled and match the dimension lines on the 2D Building Footprint.

#### 2D Building Footprint

After entering a dimension, press enter or Tab on the computer keyboard to exit the table cell and the 2D building footprint will update to match the revised dimensions. The dimensions may also be altered by dragging the endpoints for each dimension line in the 2D view (upper right). As you drag an endpoint, the new dimension will be displayed directly on the 2D view.

## STEP 2 GEOMETRY (cont)

### Selecting the Number of Elements and Scale



### Scale and Number of Elements

#### Set the scale to obtain the best view of the footprint

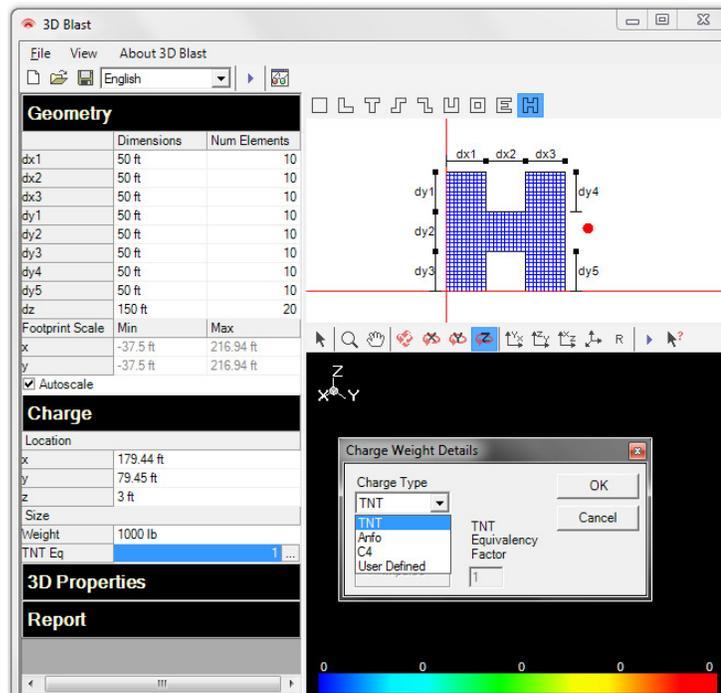
Scale defines the maximum and minimum values on the footprint display axes. Autoscale provides the scale that best displays the entire building in the available viewing area.

#### Assign the number of elements in each dimension

In the Geometry tree, enter the number of segments (elements) associated with each dimension. The model is divided into a grid of nodes and elements. Blast loads are calculated at each node based on the orientation of the associated elements. A finer grid results in a higher resolution but takes longer to run.

## STEP 3 CHARGE

### Select the Charge Location and Explosive Weight



### Charge Location and Explosive Weight

#### Enter a Charge Weight and Type

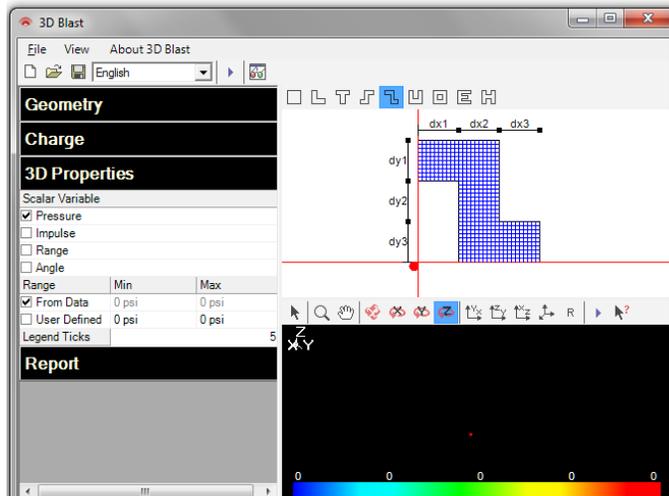
Open the Charge tree on the left and fill in the “Weight” and click the button on the right of the TNT Eq field to select the explosive type (TNT, Anfo, C4, or User Defined). If Anfo or C4 is selected, the program converts them into equivalent pounds of TNT. The user can selected either pressure or impulse equivalence.

#### Size and position the explosive charge

The charge location may also be entered in the Charge tree or located by dragging the red circle (explosive charge) around the 2D Footprint.

## STEP 4 3D PROPERTIES

### Determine the Scalar Variable and Scalar Range



### Scalar Variable and Scalar Range

Select one of four analysis options for viewing the blast effects on the 3D model. Open the 3D Properties tree and select a variable to display.

Four options are available.

- Pressure
- Impulse
- Range
- Angle

### Set the Range for the Legend

From Data The program determines the range based on the minimum and maximum value in the output.

User Defined The minimum and maximum range can be entered manually.

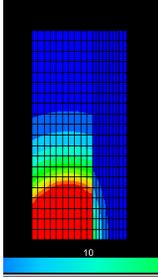
### Set Legend Ticks

Change the number in this field to alter the number of divisions for the legend.

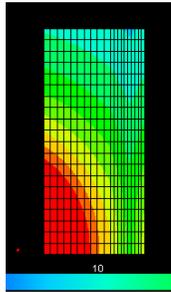
## STEP 4 3D PROPERTIES (cont)

### Scalar Variables

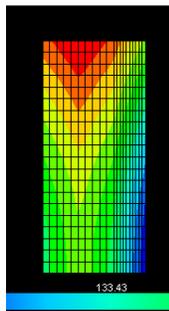
Pressure displays the peak positive phase pressure of each element due to the specified charge.



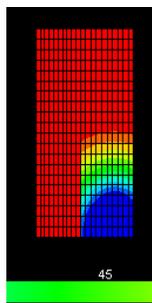
Impulse plots the impulse of each element due to the specified charge.



Range displays the distance between the charge and each element.



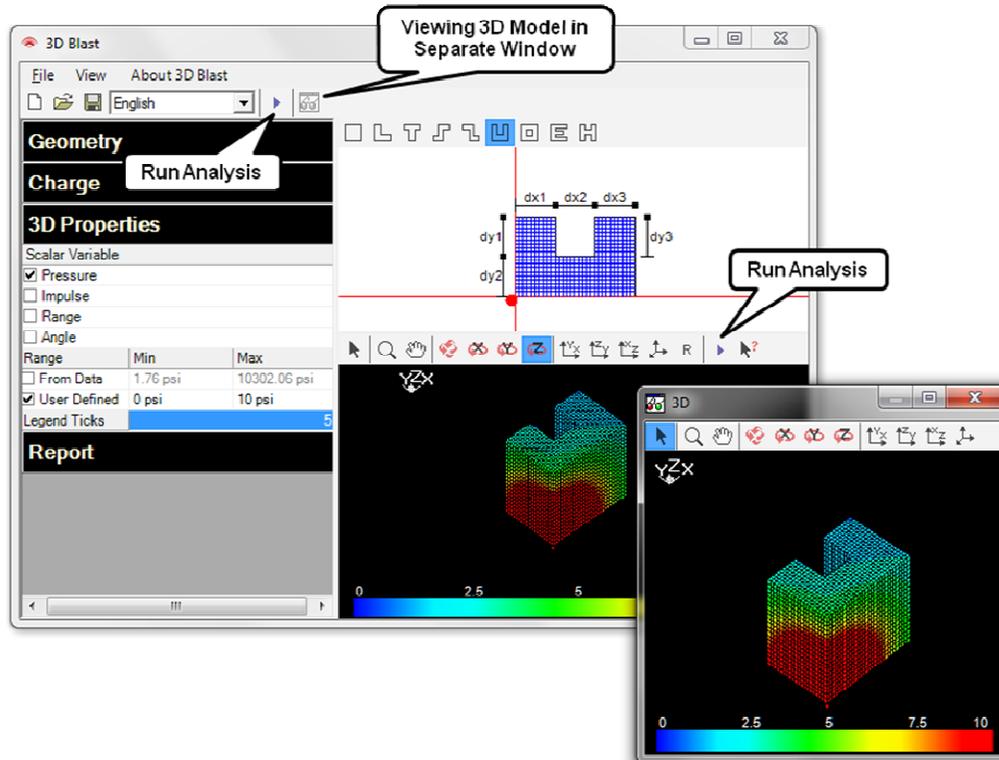
Angle plots the angle between the shock wave travel direction and a vector normal to the building surface.



## STEP 5 RUN ANALYSIS

### Run and View the Analysis Results

#### Viewing 3D Model in Separate Window



### Transforming 2D footprint into 3D Model

Click the Run Analysis button  on the program Toolbar or on the 3D Toolbar.

### Viewing 3D Model in Separate Window

Click the Viewing 3D Model in Separate Window icon  on the program Toolbar to obtain a larger window to view the model.

## STEP 6 3D TOOLBAR

### Viewing the 3D Model - Zooming, Panning, Rotating, and X,Y, Z planes



#### Zooming Tool



#### Panning Tool



#### Rotating Tools



## STEP 6 3D TOOLBAR (cont)

### Viewing the 3D Model - Zooming, Panning, Rotating, and X,Y, Z planes



#### Viewing in the X,Y, Z Plane



View the model in the X-Y plane



View the model in the Y-Z plane



View the model in the X-Z plane



View the model in an isometric plane

#### Reset the 3D Model to the original view



Reset view and return the model to its original plane after rotating, panning, or zooming.

#### To Obtain Data on a Specific Point

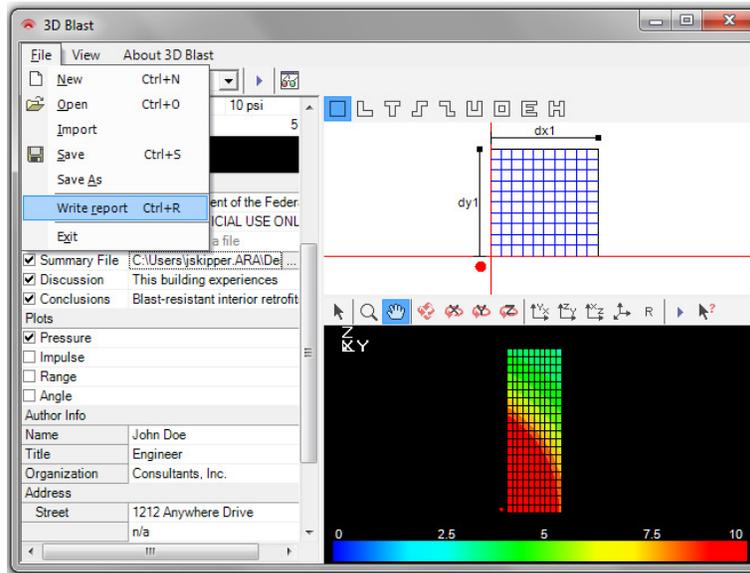


Select a point on the 3D Model to display a table of the pressure, impulse, range and angle at the cursor location. The four nodes of the element selected on the 3D Model are highlighted in blue in the table.

X (ft)	y (ft)	z (ft)	pressure (psi)	impulse (psi-msec)	range (ft)	angle (deg)
150.0	70.0	22.5	2.50	38.40	225.94	90.00
150.0	65.0	22.5	2.58	39.23	220.98	90.00
150.0	65.0	22.5	2.58	39.23	220.98	90.00
150.0	70.0	22.5	2.50	38.40	225.94	90.00
150.0	70.0	30.0	2.49	38.28	226.70	90.00
150.0	65.0	30.0	2.57	39.10	221.73	90.00
150.0	65.0	30.0	2.57	39.10	221.73	90.00
150.0	70.0	30.0	2.49	38.28	226.70	90.00
150.0	70.0	37.5	2.47	38.10	227.81	90.00
150.0	65.0	37.5	2.55	38.91	222.84	90.00
150.0	65.0	37.5	2.55	38.91	222.84	90.00
150.0	70.0	37.5	2.47	38.10	227.81	90.00
150.0	70.0	45.0	2.46	37.91	229.00	90.00
150.0	65.0	45.0	2.53	38.70	224.12	90.00
150.0	65.0	45.0	2.53	38.70	224.12	90.00
150.0	70.0	45.0	2.46	37.91	229.00	90.00
150.0	70.0	52.5	2.43	37.68	230.46	90.00
150.0	65.0	52.5	2.51	38.46	225.58	90.00
150.0	65.0	52.5	2.51	38.46	225.58	90.00
150.0	70.0	52.5	2.43	37.68	230.46	90.00
150.0	70.0	60.0	2.41	37.40	232.26	90.00
150.0	65.0	60.0	2.48	38.17	227.38	90.00
150.0	65.0	60.0	2.48	38.17	227.38	90.00

## STEP 7 REPORT

### Write a Report Summarizing Analysis



#### **Define Report Components**

Click the Report heading on the left screen. Enter the key components listed below, then select Write Report from the File menu.

**Logo** Import an image file from your computer to use as a logo on the cover of the report (3D-Blast will remember this logo between subsequent runs).

**Cover Page** Enter a Report Title, select a Footer from the drop down menu, import a Summary file from your computer, enter any Discussion and a Conclusions in the text boxes provided.

**Plots** Choose one or more plot views of the 3D model to include in the report.

**Author Information** Enter all contact information for the author.