



**NAVFAC**  
Naval Facilities Engineering Command

**ENGINEERING SERVICE CENTER**  
Port Hueneme, California 93043-4370

# **USER'S GUIDE**

## **UG-2065-SHR**

### **SHOCK USER'S MANUAL VERSIONN 1.0**

by

Philip Wager

April 2005

---

Approved for public release; distribution is unlimited.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                         |                            |                                                             |                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------------|----------------------------|-------------------------------------------------------------|-------------------------------------------|
| <b>REPORT DOCUMENTATION PAGE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |                         |                            | <i>Form Approved</i><br><i>OMB No. 0704-0811</i>            |                                           |
| <p>The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information, if it does not display a currently valid OMB control number.</p> <p><b>PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</b></p> |             |                         |                            |                                                             |                                           |
| 1. REPORT DATE (DD-MM-YYYY)<br>April 2005                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             | 2. REPORT TYPE<br>Final |                            | 3. DATES COVERED (From – To)                                |                                           |
| 4. TITLE AND SUBTITLE<br><b>SHOCK USER'S MANUAL VERSION 1.0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                         |                            | 5a. CONTRACT NUMBER                                         |                                           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                         |                            | 5b. GRANT NUMBER                                            |                                           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                         |                            | 5c. PROGRAM ELEMENT NUMBER                                  |                                           |
| 6. AUTHOR(S)<br>Phil Wager                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                         |                            | 5d. PROJECT NUMBER                                          |                                           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                         |                            | 5e. TASK NUMBER                                             |                                           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                         |                            | 5f. WORK UNIT NUMBER                                        |                                           |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESSES<br>Commanding Officer<br>Naval Facilities Engineering Service Center<br>1100 23 <sup>rd</sup> Ave<br>Port Hueneme, CA 93043-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |                         |                            | 8. PERFORMING ORGANIZATION REPORT NUMBER<br><br>UG-2065-SHR |                                           |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)<br>Commanding Officer<br>Naval Facilities Engineering Service Center<br>1100 23 <sup>rd</sup> Ave<br>Port Hueneme, CA 93043-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |                         |                            | 10. SPONSOR/MONITORS ACRONYM(S)                             |                                           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                         |                            | 11. SPONSOR/MONITOR'S REPORT NUMBER(S)                      |                                           |
| 12. DISTRIBUTION/AVAILABILITY STATEMENT<br>Approved for public release; distribution is unlimited.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |                         |                            |                                                             |                                           |
| 13. SUPPLEMENTARY NOTES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                         |                            |                                                             |                                           |
| 14. ABSTRACT<br><p>SHOCK is a blast load analysis program, which will calculate the impulse and pressure on all or part of a blast surface, which is bounded by 1 to 4 reflecting surfaces.</p> <p>SHOCK will read input from a program data file or a Blast Library Database. The input can also be entered interactively. The required input is the length and width of the blast surface, the number and location of the reflecting surfaces and the weight and location of the charge.</p> <p>SHOCK calculates the impulse and pressure on either all or part of the blast surface from the incident blast wave and from the waves reflecting off of each adjacent surface. SHOCK uses these results to calculate the maximum average pressure on the blast surface from each incident and reflected wave, and the total average impulse from the sum of all the waves. SHOCK also calculates the impulse duration on the blast surface.</p>                           |             |                         |                            |                                                             |                                           |
| 15. SUBJECT TERMS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |                         |                            |                                                             |                                           |
| 16. SECURITY CLASSIFICATION OF:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                         | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES                                         | 19a. NAME OF RESPONSIBLE PERSON           |
| a. REPORT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | b. ABSTRACT | c. THIS PAGE            |                            |                                                             | 19b. TELEPHONE NUMBER (include area code) |
| U                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | U           | U                       | U                          | 52                                                          |                                           |

## **EXECUTIVE SUMMARY**

SHOCK is a blast load analysis program, which will calculate the impulse and pressure on all or part of a blast surface which is bounded by 1 to 4 reflecting surfaces.

SHOCK will read input from a program data file or a Blast Library Database. The input can also be entered interactively. The required input is the length and width of the blast surface, the number and location of the reflecting surfaces and the weight and location of the charge.

SHOCK calculates the impulse and pressure on either all or part of the blast surface from the incident blast wave and from the waves reflecting off of each adjacent surface. SHOCK uses these results to calculate the maximum average pressure on the blast surface from each incident and reflected wave, and the total average impulse from the sum of all the waves. SHOCK also calculates the impulse duration on the blast surface.

## TABLE OF CONTENTS

|                                      | Page |
|--------------------------------------|------|
| <b>1.0 INTRODUCTION</b> .....        | 1    |
| <b>2.0 PROGRAM DESCRIPTION</b> ..... | 1    |
| 2.1 Theory 1 .....                   |      |
| 2.2 Features .....                   | 1    |
| 2.3 Limitations .....                | 1    |
| <b>3.0 PROGRAM OPERATION</b> .....   | 2    |
| 3.1 Program Execution.....           | 2    |
| 3.2 Program Input .....              | 2    |
| 3.2.1 Interactive Input.....         | 3    |
| 3.2.2 Database Inpu.....             | 4    |
| 3.2.3 SHOCK Data File Input.....     | 4    |
| 3.3 Output .....                     | 6    |
| <b>4.0 REFERENCES</b> .....          | 8    |
| <b>5.0 SAMPLE PROBLEMS</b> .....     | 8    |

## **1.0 INTRODUCTION**

SHOCK is a blast load analysis program, which will calculate the impulse and pressure on all or part of a blast surface which is bounded by 1 to 4 reflecting surfaces.

SHOCK will read input from a program data file or a Blast Library Database. The input can also be entered interactively. The required input is the length and width of the blast surface, the number and location of the reflecting surfaces and the weight and location of the charge.

SHOCK calculates the impulse and pressure on either all or part of the blast surface from the incident blast wave and from the waves reflecting off of each adjacent surface. SHOCK uses these results to calculate the maximum average pressure on the blast surface from each incident and reflected wave, and the total average impulse from the sum of all the waves. SHOCK also calculates the impulse duration on the blast surface.

## **2.0 PROGRAM DESCRIPTION**

### **2.1 Theory**

The initial version of SHOCK is PAIMPRES, developed by Ammonn and Whitney Consulting Engineers to generate the design curves in section 2-14.2 of Reference 1.

SHOCK develops a grid of approximately 1089 points on the blast surface. Shock impulse and pressure is calculated for each grid point on the blast surface for the incident blast wave, and for the shock reflecting off each adjacent surface. The grid point values are averaged and used to calculate the output results.

### **2.2 Features**

SHOCK has the ability to calculate the impulses and pressures on a portion of the blast surface such as a window or doorway. The reduced surface can be either an area or a point. The input coordinates for either the point or the corners of the area will be compared with the coordinates of the blast surface grid. The grid points closest to the specified coordinates will be used to define the reduced surface.

The SHOCK output includes a printout of the total (incident + reflected) impulse at points on the blast surface grid. The grid printout can be compressed or full or omitted. In full grid printout, the impulse at each grid point is printed. In compressed printout, the impulse is printed at a limited number of equally spaced grid points. The spacing is chosen such that only nine columns of impulse values will be printed, and the output for grid values and analysis results will be limited to one page.

Whether or not the full grid is requested, it will be printed if it can fit on the same page as the analysis results. If the full grid is printed, it will be identified as such even if a compressed grid was specified.

The choice of grid printout only affects the output. It has no effect on the analysis results.

### **2.3 Limitations**

The names of the input data file and the database file are limited to 12 characters.

### 3.0 PROGRAM OPERATION

#### 3.1 Program Execution

SHOCK is written in FORTRAN and can be executed through keyboard input on computers ranging from personal computers to main-frames. After the program is initiated, the following will be displayed:

```
PROGRAM SHOCK  
VERSION 1.0
```

```
ENTER SOURCE OF INPUT DATA, OR "X" TO EXIT PROGRAM
```

- A. INTERACTIVE ENTRY
- B. DATABASE FILE
- C. SHOCK DATA FILE

Typing A, B or C, and then the RETURN or ENTER key will cause execution to resume.

#### 3.2 Program Input

The input parameters for SHOCK are shown in Figure 1 and Figure 2, and are described below.

##### VARIABLE DESCRIPTION AND UNITS

|    |                                                                                                                                                                              |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| W  | Charge weight, lbs                                                                                                                                                           |
| RA | Normal distance from charge to blast surface, ft                                                                                                                             |
| RL | Width of blast surface, ft                                                                                                                                                   |
| H  | Height of blast surface, ft                                                                                                                                                  |
| SL | Normal distance from charge to reflecting surface 2, ft                                                                                                                      |
| SH | Normal distance from charge to reflecting surface 1, ft                                                                                                                      |
| X1 | Normal distance from reflecting surface 2 to the upper left corner of the reduced surface, or the normal distance from reflecting surface 2 to the reduced surface point, ft |
| Y1 | Normal distance from reflecting surface 1 to the upper left corner of the reduced surface, or the normal distance from reflecting surface 1 to the reduced surface point, ft |
| X2 | Normal distance from reflecting surface 2 to the lower right corner of the reduced surface, ft                                                                               |
| Y2 | Normal distance from reflecting surface 1 to the lower right corner of the reduced surface, ft                                                                               |

In addition to these parameters, the input includes variables to indicate which of the reflecting surfaces exist, and to indicate the extent of printout for the impulse grid.

In the program input and output, the use of "vertical" and "horizontal" to describe certain

variables, as well as the description of the various reflecting surfaces as walls, ceilings, or floors, are aids to help the user visualize the relationship of the variables. The descriptions assume that the reflecting surface is a wall. If SHOCK is used to calculate the loads on a surface other than a wall, the interrelationship of the reflecting surfaces and the variables RL, H, SL, SH, and RA will remain the same as shown in Figure 1.

**3.2.1 Interactive Input.** If interactive input is chosen, the next prompts will be for the run title, the output file name, and the extent of output for the impulse grid. SHOCK will then display the following menu:

```

SELECT LETTER TO INPUT/MODIFY PARAMETERS
A. CHARGE WEIGHT, LBS ..... 0.00
B. DISTANCE TO BLAST SURFACE, FT ..... 0.00
C. HEIGHT OF BLAST SURFACE, FT ..... 0.00
D. WIDTH OF BLAST SURFACE, FT ..... 0.00
E. VERTICAL (Y) DISTANCE TO CHARGE
   FROM REFLECTING SURFACE NQ. 1, FT..... 0.00
F. HORIZONTAL (X) DISTANCE TO CHARGE
   FROM REFLECTING SURFACE NO. 2, FT..... 0.00
G. REFLECTING SURFACES
   "1" IF SURFACE EXISTS, "0" IF IT DOESN'T
   SURFACE 1 (FLOOR) ..... 0
   SURFACE 2 (LEFT SIDEWALL) ..... 0
   SURFACE 3 (CEILING) ..... 0
   SURFACE 4 (RIGHT SIDEWALL) ..... 0
H. REDUCED SURFACE CALCULATION ..... NO
I. WRITE PARAMETERS TO EXISTING DATABASE
J. NO CHANGES

```

The values for each input parameter can be changed by typing the corresponding letter on the menu and entering the new parameter value. The changes will be made and the menu will be redisplayed after each change until 'J' is typed.

Choice 'I' can be used to write the parameter values to an existing Blast Library database.

If 'H' is typed, the following prompt will be displayed

```

ENTER "A" FOR AN AREA, "P" FOR A POINT, OR "N" TO CANCEL

```

If 'A' is chosen, SHOCK will display prompts for the coordinates of the upper left and lower right corners of the surface. If 'P' is chosen, shock will display a prompt for the coordinates of the point.

Typing 'J' in response to the menu will halt the input and start the problem solution. Once the solution is complete, the following prompt will be displayed:

```

TYPE "Y" TO RUN ANOTHER PROBLEM OR
TYPE ANY OTHER KEY TO EXIT PROGRAM

```

If 'Y' is typed, the input menu will be displayed with the parameters from the problem which was just completed. If any other key is typed, the program will close all files and stop.

**3.2.2 Database Input.** Database input requires an existing Blast Design Software Library Database file. The database file is designed to minimize user input to the programs in the Blast Design Software Library. This file can be accessed by all programs in the library to read from and write to, key parameters that were generated or will be required by other library programs. Any data that is lacking for a particular computer run can then be supplied by the user. The required format for this file is given in the Blast Design Software Library Database Manual.

If database input is chosen, SHOCK will display prompts for the name of the database file, the title of the run, the name of the output file, and the extent of the output grid. The database parameter values will then be read and displayed in the same menu that was displayed for interactive input. Any required changes can be made to the parameters in this menu.

The Blast Library database does not store reduced surface parameters. Therefore, if a reduced surface is required, it will have to be entered interactively.

Once any required changes have been made, the problem solution can be started by selecting 'J' in the menu. After the solution has been completed, the following prompt will appear:

TYPE "Y" TO RUN ANOTHER PROBLEM OR  
TYPE ANY OTHER KEY TO EXIT PROGRAM

If 'Y' is typed, SHOCK will display a prompts for another database input problem. If any other key is typed, the program will close all files and stop.

**3.2.3 SHOCK Data File Input.** The SHOCK data file will consist of 3 or 4 types of data cards. The title card, data card, and termination card must be included. The reduced surface card is only required if 'A' or 'P' is entered in column 75 of the data card. The card formats are shown below.

Card 1: Title Card (1I5, 75A1)

| COLUMN | VARIABLE | DESCRIPTION       |
|--------|----------|-------------------|
| 4-5    | ICN      | the numerals '01' |
| 6-80   | TITLE    | problem title     |

Card 2: Data Card (1I5, 6F10.0, 4I1, 3X, 1A1, 1x, 1A1)

| COLUMN | VARIABLE | DESCRIPTION                                      |
|--------|----------|--------------------------------------------------|
| 4-5    | ICN      | the numerals '02'                                |
| 6-15   | W        | charge weight                                    |
| 16-25  | RA       | horizontal distance to charge from blast surface |
| 26-35  | RL       | length of blast surface                          |
| 36-45  | H        | height of blast surface                          |



|       |        |                                                                                                                                                                |
|-------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 46-55 | SL     | horizontal distance to charge from reflecting surface 2                                                                                                        |
| 56-65 | SH     | vertical distance to charge from reflecting surface 1                                                                                                          |
| 66    | NR(1)  | existence code for reflecting surface 1<br>'1' if the surface exists,<br>'0' if it doesn't                                                                     |
| 67    | NR (2) | existence code for reflecting surface 2                                                                                                                        |
| 68    | NR (3) | existence code for reflecting surface 3                                                                                                                        |
| 69    | NR (4) | existence code for reflecting surface 4                                                                                                                        |
| 73    | GRID   | impulse grid printout code<br>'F' print full impulse grid<br>'C' print compressed impulse grid<br>suppress impulse grid (default)                              |
| 75    | REDRSF | reduced surface code<br>'A' if the reduced surface is an area<br>'P' if the reduced surface is a point<br>if the whole load wall is to be considered (default) |

Card 3: Reduced Surface Card (1I5, 4F10.0)

Required only if REDSRF .eq. 'A' or 'P'

| COLUMN | VARIABLE | DESCRIPTION                                                                                                              |
|--------|----------|--------------------------------------------------------------------------------------------------------------------------|
| 4-5    | ICN      | the numerals '03'                                                                                                        |
| 6-15   | X1       | the X-coordinate of the upper left corner of the reduced surface area , or the X-coordinate of the reduced surface point |
| 16-25  | Y1       | the Y-coordinate of the upper left corner of the reduced surface area, or the Y-coordinate of the reduced surface point  |
| 26-35  | X2       | the X coordinate of the lower right corner of reduced surface area                                                       |
| 36-45  | Y2       | the Y coordinate of the lower right corner of reduced surface area                                                       |

Card 4: Termination Card (1I5)

| COLUMN | VARIABLE | DESCRIPTION       |
|--------|----------|-------------------|
| 4-5    | ICN      | the numerals '99' |

One set of type 1, 2, and 3 (if required) cards should be included in the input deck for each problem. The last card in the deck should be a type 4 card. The arrangement of the deck is shown below:

| COLUMNS | CARD DESCRIPTION                                 |    |                                                                               |
|---------|--------------------------------------------------|----|-------------------------------------------------------------------------------|
| 12345   |                                                  |    |                                                                               |
| 01      | Card                                             | 1: | Title card                                                                    |
| 02      | Card                                             | 2: | Data card                                                                     |
| 03      | Card                                             | 3: | Reduced surface card - only if column<br>75 of the previous card is not blank |
| 01      | Include a set of type 1, 2, and 3 cards for each |    |                                                                               |
| 02      | additional problems                              |    |                                                                               |
| 03      |                                                  |    |                                                                               |
| 99      | Card D: Termination card                         |    |                                                                               |

### 3.3 Output

The program output is independent of the method of data input. If a compressed output impulse grid is specified in the input, or if the full grid is small enough, the output will consist of two pages.

The program identification and a table listing of the input data will be printed on the first page. The impulse grid and analysis results will be printed on the second page.

If a full grid is specified, it will be printed on as many pages as are required, and the analysis results will be printed on the final page.

The analysis results include the average pressure and impulse on the blast surface due to the incident wave and the reflected wave off each existing adjacent surface. The final pressure result is the maximum of the average pressures on the blast surface from the incident wave or any of the reflected waves. The final impulse result is the sum of the average impulses on the blast surface from the incident wave and all reflected waves. The results conclude with the impulse duration on the blast surface.

The output for three example problems is included in Section 5.

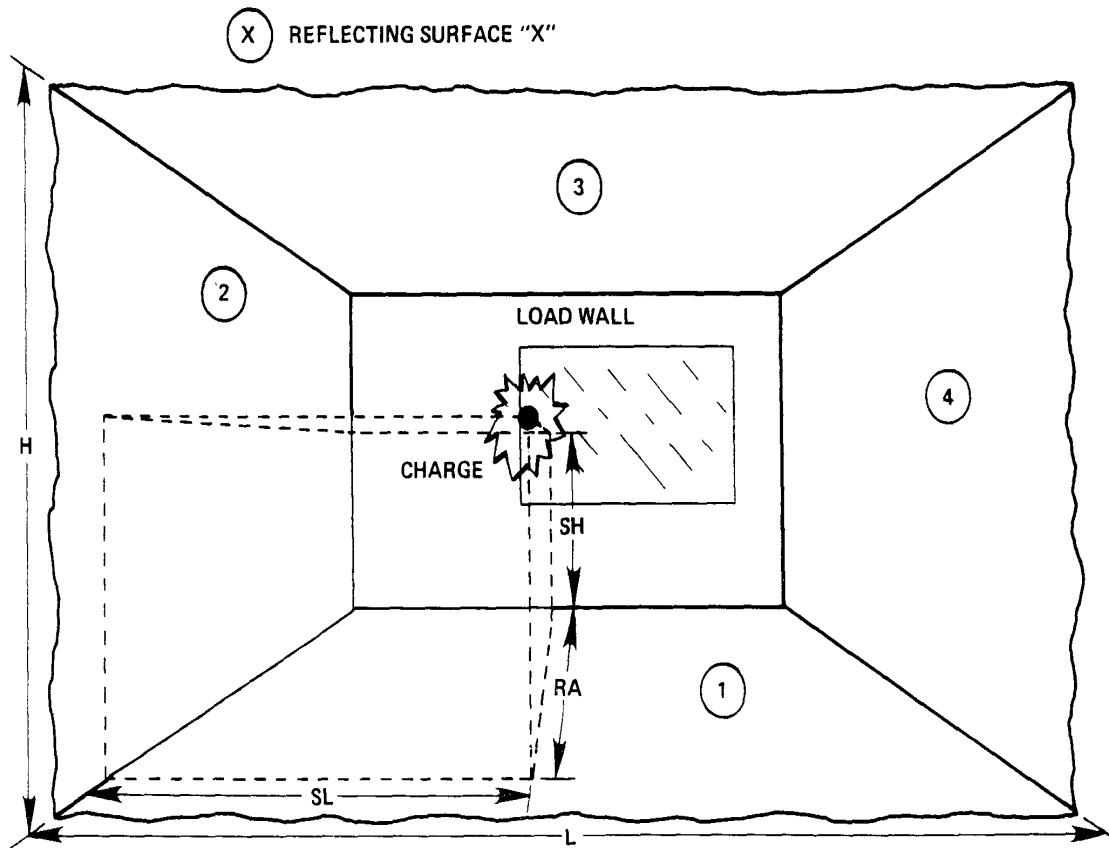


Figure 1.

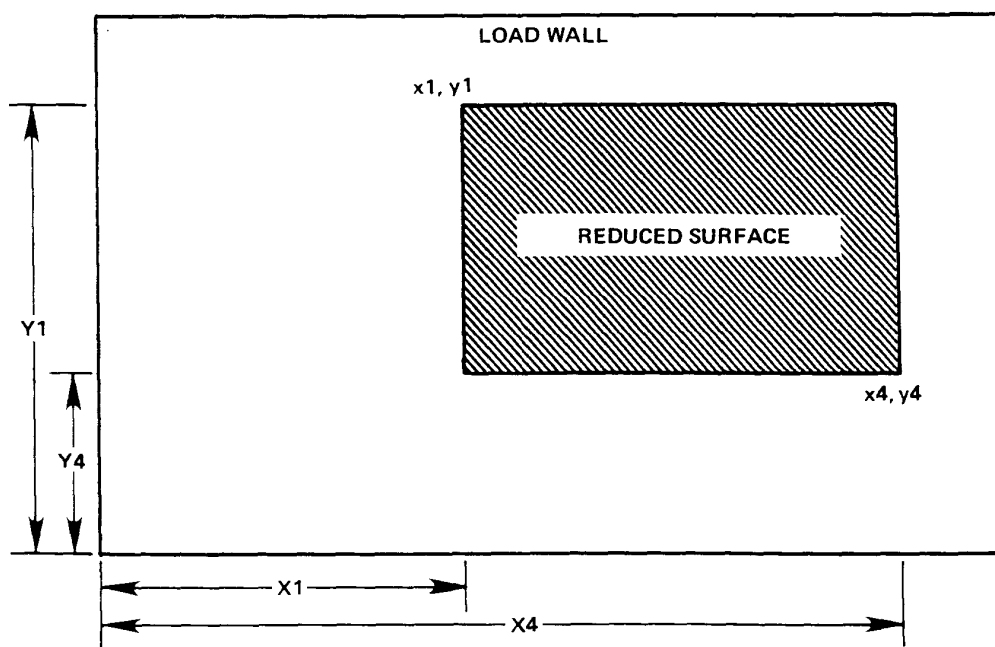


Figure 2.



## 4.0 REFERENCES

1. U.S. Army Armament Research, Development and Engineering Center.  
Structures to Resist the Effects of Accidental Explosions, Volume II:  
Blast, Fragment, and Shock Loads. Special Publication ARLCD-SP-84001.  
Dec 1986.

## 5.0 SAMPLE PROBLEMS

The output for three sample problems is include in this section. The first problem has no reduced surface and a full impulse grid printout. The second problem has an area reduced surface and a compressed impulse grid printout. The third problem has a point reduced surface and a full grid printout. The input for the example problems was read from a shock data file, but the output would be identical for any other input method.

### Input Deck

|    |                 |     |   |                                              |     |    |    |      |    |   |  |  |  |
|----|-----------------|-----|---|----------------------------------------------|-----|----|----|------|----|---|--|--|--|
| 01 | EXAMPLE PROBLEM | 1   | - | ENTIRE SURFACE, FULL GRID PRINTOUT           |     |    |    |      |    |   |  |  |  |
| 02 | 100.            | 5.  |   | 20.                                          | 16. | 5. | 5. | 1    | 11 | F |  |  |  |
| 01 | EXAMPLE PROBLEM | 2   | - | AREA REDUCED SURFACE, COMPRESSED GRID OUTPUT |     |    |    |      |    |   |  |  |  |
| 02 | 100.            | 5.  |   | 16.                                          | 10. | 5. | 5. | 1111 | C  | A |  |  |  |
| 03 | 4.              | 12. |   | 12.                                          | 4.  |    |    |      |    |   |  |  |  |
| 01 | EXAMPLE PROBLEM | 3   | - | POINT REDUCED SURFACE, FULL GRID OUTPUT      |     |    |    |      |    |   |  |  |  |
| 02 | 100.            | 5.  |   | 16.                                          | 16. | 5. | 5. | 1    | F  | P |  |  |  |
| 03 | 6.              | 10. |   | 10.                                          | 6.  |    |    |      |    |   |  |  |  |
| 99 |                 |     |   |                                              |     |    |    |      |    |   |  |  |  |

# PROGRAM SHOCK VERSION 1.0

\*\*\*\*\*

PROGRAM FOR CALCULATION OF AVERAGE BARRIER REFLECTED  
SHOCK PRESSURES AND IMPULSES DUE TO AN INCIDENT WAVE AND  
REFLECTED WAVES FROM ONE TO FOUR REFLECTION SURFACES.  
ORIGINAL PROGRAM "PAIMPRES" DEVELOPED BY AMMANN AND WHITNEY  
MODIFIED TO "SHOCK" BY NAVAL CIVIL ENGINEERING LAB

## INPUT DATA

DATA SET TITLE:

EXAMPLE PROBLEM 1 - ENTIRE SURFACE, FULL GRID PRINTOUT

|                                                                                 |        |
|---------------------------------------------------------------------------------|--------|
| A. CHARGE WEIGHT, LBS .....                                                     | 100.00 |
| B. DISTANCE TO BLAST SURFACE, FT .....                                          | 5.00   |
| C. WIDTH OF BLAST SURFACE FT .....                                              | 20.00  |
| D. HEIGHT OF BLAST SURFACE, FT .....                                            | 16.00  |
| E. HORIZONTAL (X) DISTANCE TO CHARGE<br>FROM REFLECTING SURFACE NO. 2, FT ..... | 5.00   |
| F. VERTICAL (Y) DISTANCE TO CHARGE<br>FROM REFLECTING SURFACE NO. 1, FT .....   | 5.00   |
| G. REFLECTING SURFACES<br>"1" FOR FULL REFLECTION, "0" FOR NONE                 |        |
| SURFACE 1 (FLOOR).....                                                          | 1      |
| SURFACE 2 (LEFT SIDEUALL).....                                                  | 0      |
| SURFACE 3 (CEILING).....                                                        | 1      |
| SURFACE 4 (RIGHT SIDEWALL) .....                                                | 1      |
| H. REDUCED SURFACE CALCULATION .....                                            | NO     |

# IMPULSE GRID

|                                                  |    |
|--------------------------------------------------|----|
| NUMBER OF VERTICAL GRID LINES ON BLAST SURFACE   | 33 |
| NUMBER OF HORIZONTAL GRID LINES ON BLAST SURFACE | 33 |

DISTANCE BETWEEN VERTICAL GRID LINES= 0.62 FT

DISTANCE BETWEEN HORIZONTAL GRID LINES = 0.50 FT

## FULL IMPULSE GRID IN PSI-MS/LBS\*\*1/3

| Y GRID<br>COORDS | X GRID COORDINATES |       |       |       |       |       |       |       |       |
|------------------|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|
|                  | 0.00               | 0.62  | 1.25  | 1.87  | 2.50  | 3.12  | 3.75  | 4.37  | 5.00  |
| 16.00            | 20.9               | 42.2  | 42.8  | 43.3  | 43.6  | 43.9  | 44.1  | 44.3  | 43.5  |
| 15.50            | 42.1               | 85.0  | 85.7  | 86.6  | 87.4  | 88.1  | 88.6  | 89.0  | 87.5  |
| 15.00            | 42.4               | 85.9  | 86.8  | 87.6  | 88.2  | 88.8  | 89.3  | 89.6  | 88.2  |
| 14.50            | 42.9               | 87.0  | 88.0  | 88.9  | 89.7  | 90.3  | 90.9  | 91.3  | 89.9  |
| 14.00            | 43.5               | 88.2  | 89.4  | 90.4  | 91.3  | 92.1  | 92.7  | 93.2  | 91.8  |
| 13.50            | 44.1               | 89.6  | 91.0  | 92.2  | 93.2  | 94.1  | 94.7  | 95.2  | 93.8  |
| 13.00            | 44.8               | 91.2  | 92.7  | 94.1  | 95.2  | 96.2  | 97.0  | 97.6  | 95.8  |
| 12.50            | 45.6               | 93.3  | 94.9  | 96.4  | 97.9  | 99.1  | 100.1 | 100.9 | 98.7  |
| 12.00            | 46.7               | 95.4  | 97.4  | 99.3  | 101.2 | 102.8 | 104.1 | 105.0 | 102.4 |
| 11.50            | 47.7               | 97.9  | 100.4 | 102.9 | 105.2 | 107.2 | 108.8 | 109.9 | 107.0 |
| 11.00            | 48.9               | 100.9 | 104.0 | 107.0 | 109.9 | 112.4 | 114.4 | 115.8 | 112.4 |
| 10.50            | 50.3               | 104.3 | 108.1 | 111.9 | 115.4 | 118.4 | 120.9 | 122.5 | 118.9 |
| 10.00            | 52.0               | 108.1 | 112.5 | 117.0 | 121.3 | 125.7 | 129.5 | 132.0 | 128.5 |
| 9.50             | 53.7               | 112.3 | 117.5 | 122.9 | 129.4 | 135.2 | 140.0 | 143.2 | 139.7 |
| 9.00             | 55.5               | 116.8 | 123.0 | 131.2 | 139.0 | 146.3 | 152.2 | 156.1 | 152.5 |
| 8.50             | 57.4               | 121.6 | 130.4 | 140.0 | 149.6 | 158.4 | 165.6 | 170.5 | 166.8 |
| 8.00             | 59.4               | 127.2 | 138.0 | 149.4 | 160.8 | 171.4 | 180.4 | 186.5 | 182.7 |
| 7.50             | 61.3               | 133.3 | 145.7 | 158.8 | 172.2 | 185.1 | 195.7 | 202.2 | 198.0 |
| 7.00             | 63.4               | 139.2 | 153.0 | 167.8 | 183.9 | 198.9 | 210.6 | 219.0 | 213.3 |
| 6.50             | 65.5               | 144.6 | 160.6 | 177.6 | 195.2 | 210.4 | 224.0 | 235.0 | 230.7 |
| 6.00             | 67.8               | 150.2 | 166.1 | 183.9 | 202.5 | 219.5 | 236.5 | 249.4 | 246.8 |
| 5.50             | 69.2               | 153.0 | 169.7 | 188.7 | 207.9 | 226.5 | 245.7 | 260.4 | 257.3 |
| 5.00             | 69.9               | 154.7 | 171.9 | 191.4 | 211.0 | 230.3 | 250.5 | 265.1 | 264.3 |
| 4.50             | 70.2               | 155.5 | 172.7 | 192.1 | 211.8 | 230.9 | 250.8 | 265.9 | 261.3 |
| 4.00             | 70.2               | 155.3 | 172.3 | 191.8 | 212.0 | 230.5 | 248.5 | 262.1 | 254.7 |
| 3.50             | 70.0               | 155.1 | 172.6 | 191.5 | 211.5 | 229.4 | 245.3 | 257.5 | 242.6 |
| 3.00             | 70.2               | 155.7 | 173.0 | 192.2 | 212.4 | 231.9 | 247.1 | 257.8 | 229.0 |
| 2.50             | 70.9               | 157.5 | 176.2 | 197.3 | 218.5 | 238.7 | 255.8 | 267.2 | 217.2 |
| 2.00             | 72.8               | 162.9 | 184.4 | 207.4 | 233.3 | 257.1 | 276.5 | 289.5 | 206.2 |
| 1.50             | 76.5               | 173.0 | 199.2 | 229.5 | 259.4 | 287.8 | 311.9 | 324.8 | 195.2 |
| 1.00             | 82.0               | 191.5 | 224.0 | 261.4 | 297.4 | 330.2 | 360.5 | 384.3 | 186.6 |
| 0.50             | 91.0               | 217.8 | 262.2 | 301.8 | 356.2 | 433.9 | 489.8 | 527.4 | 180.4 |
| 0.00             | 61.5               | 158.3 | 202.0 | 266.3 | 361.5 | 456.8 | 544.4 | 608.2 | 89.4  |

| Y GRID<br>COORDS | X GRID COORDINATES |       |       |       |       |       |       |       |       |
|------------------|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|
|                  | 5.62               | 6.25  | 6.87  | 7.50  | 8.12  | 8.75  | 9.37  | 10.00 | 10.62 |
| 16.00            | 44.6               | 44.6  | 44.7  | 44.7  | 44.5  | 44.3  | 44.1  | 43.8  | 43.9  |
| 15.50            | 89.5               | 89.6  | 89.6  | 89.4  | 89.1  | 88.8  | 88.6  | 88.3  | 88.0  |
| 15.00            | 90.1               | 90.3  | 90.3  | 90.3  | 90.1  | 89.8  | 89.4  | 89.1  | 88.7  |
| 14.50            | 91.8               | 91.9  | 91.8  | 91.7  | 91.4  | 91.0  | 90.5  | 90.0  | 89.5  |
| 14.00            | 93.6               | 93.7  | 93.6  | 93.3  | 92.9  | 92.3  | 91.7  | 91.1  | 90.4  |
| 13.50            | 95.6               | 95.7  | 95.5  | 95.1  | 94.6  | 93.9  | 93.1  | 92.3  | 91.4  |
| 13.00            | 98.1               | 97.9  | 97.6  | 97.1  | 96.5  | 95.6  | 94.6  | 93.7  | 92.6  |
| 12.50            | 101.3              | 101.1 | 100.5 | 99.8  | 98.8  | 97.7  | 96.7  | 95.3  | 93.9  |
| 12.00            | 105.4              | 105.0 | 104.2 | 103.0 | 101.7 | 100.2 | 98.8  | 97.5  | 95.8  |
| 11.50            | 110.4              | 109.7 | 108.6 | 107.0 | 105.2 | 103.2 | 101.3 | 99.5  | 97.8  |
| 11.00            | 116.3              | 115.3 | 113.8 | 111.7 | 109.3 | 106.8 | 104.3 | 101.9 | 99.7  |
| 10.50            | 123.0              | 121.8 | 119.8 | 117.1 | 114.1 | 110.9 | 107.7 | 104.7 | 101.8 |
| 10.00            | 132.4              | 130.3 | 127.0 | 123.0 | 119.2 | 115.3 | 111.5 | 107.9 | 104.5 |
| 9.50             | 143.6              | 140.9 | 136.5 | 131.1 | 125.0 | 120.2 | 115.6 | 111.3 | 107.4 |
| 9.00             | 156.5              | 153.1 | 147.6 | 140.8 | 133.2 | 125.7 | 120.1 | 114.9 | 110.3 |
| 8.50             | 170.9              | 166.5 | 159.7 | 151.3 | 142.1 | 133.1 | 124.8 | 118.7 | 113.2 |
| 8.00             | 186.9              | 181.2 | 172.7 | 162.4 | 151.5 | 140.7 | 130.5 | 122.6 | 116.3 |
| 7.50             | 202.6              | 196.5 | 186.3 | 173.8 | 160.9 | 148.3 | 136.6 | 126.5 | 119.3 |
| 7.00             | 219.4              | 211.5 | 200.2 | 185.5 | 169.9 | 155.6 | 142.4 | 130.7 | 122.3 |
| 6.50             | 235.4              | 224.9 | 211.6 | 196.9 | 179.7 | 163.2 | 147.8 | 134.8 | 125.0 |
| 6.00             | 249.8              | 237.3 | 220.7 | 204.1 | 186.0 | 168.8 | 153.4 | 139.3 | 127.5 |
| 5.50             | 260.8              | 246.5 | 227.7 | 209.5 | 190.7 | 172.3 | 156.2 | 142.1 | 130.9 |
| 5.00             | 265.5              | 251.3 | 231.5 | 212.6 | 193.5 | 174.6 | 157.9 | 143.4 | 131.8 |
| 4.50             | 266.3              | 251.6 | 232.2 | 213.4 | 194.2 | 175.3 | 158.7 | 144.1 | 132.4 |
| 4.00             | 262.5              | 249.3 | 231.7 | 213.6 | 193.9 | 175.0 | 158.5 | 144.1 | 132.8 |
| 3.50             | 258.0              | 246.1 | 230.6 | 213.1 | 193.6 | 175.2 | 158.3 | 143.7 | 133.0 |
| 3.00             | 258.2              | 247.9 | 233.1 | 214.0 | 194.3 | 175.6 | 158.9 | 144.1 | 133.1 |
| 2.50             | 267.6              | 256.6 | 239.9 | 220.1 | 199.4 | 178.9 | 160.7 | 145.6 | 134.6 |
| 2.00             | 289.9              | 277.3 | 258.3 | 234.9 | 209.5 | 187.0 | 166.1 | 149.4 | 136.8 |
| 1.50             | 325.2              | 312.8 | 289.0 | 261.1 | 231.7 | 201.9 | 176.3 | 156.8 | 140.9 |
| 1.00             | 384.7              | 361.3 | 331.4 | 299.1 | 263.5 | 226.7 | 194.8 | 168.0 | 148.1 |
| 0.50             | 527.8              | 490.6 | 435.2 | 358.0 | 304.0 | 264.9 | 221.1 | 185.9 | 158.4 |
| 0.00             | 608.5              | 544.8 | 457.5 | 362.4 | 267.4 | 203.3 | 159.9 | 124.9 | 97.9  |

| Y GRID<br>COORDS | X GRID COORDINATES |       |       |       |       |       |       |       |       |
|------------------|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|
|                  | 11.25              | 11.87 | 12.50 | 13.12 | 13.75 | 14.37 | 15.00 | 15.62 | 16.25 |
| 16.00            | 44.0               | 44.1  | 44.1  | 44.0  | 43.9  | 43.7  | 47.3  | 46.2  | 45.0  |
| 15.50            | 88.0               | 88.0  | 87.9  | 87.8  | 87.5  | 87.1  | 87.6  | 87.2  | 85.1  |
| 15.00            | 88.2               | 87.9  | 87.8  | 87.6  | 87.3  | 86.9  | 88.3  | 86.4  | 84.2  |
| 14.50            | 88.9               | 88.2  | 87.6  | 87.4  | 87.1  | 86.6  | 87.7  | 85.5  | 83.4  |
| 14.00            | 89.6               | 88.8  | 87.9  | 87.2  | 86.8  | 86.4  | 86.7  | 84.6  | 82.7  |
| 13.50            | 90.5               | 89.5  | 88.5  | 87.4  | 86.6  | 86.1  | 85.8  | 83.9  | 82.0  |
| 13.00            | 91.4               | 90.3  | 89.1  | 87.8  | 86.6  | 85.8  | 85.0  | 83.2  | 81.8  |
| 12.50            | 92.5               | 91.1  | 89.7  | 88.3  | 86.9  | 85.6  | 84.3  | 82.9  | 81.7  |
| 12.00            | 93.9               | 92.1  | 90.5  | 88.9  | 87.3  | 85.8  | 84.1  | 82.8  | 81.6  |
| 11.50            | 95.7               | 93.6  | 91.5  | 89.5  | 87.9  | 86.4  | 84.2  | 82.8  | 81.6  |
| 11.00            | 97.7               | 95.2  | 92.9  | 90.8  | 88.7  | 87.0  | 84.6  | 82.7  | 81.5  |
| 10.50            | 99.3               | 97.1  | 94.6  | 92.2  | 90.0  | 87.9  | 85.0  | 82.7  | 81.4  |
| 10.00            | 101.6              | 99.1  | 96.5  | 93.8  | 91.3  | 89.0  | 85.8  | 83.1  | 81.3  |
| 9.50             | 104.0              | 101.0 | 98.3  | 95.4  | 92.6  | 90.1  | 86.7  | 83.8  | 81.3  |
| 9.00             | 106.2              | 102.9 | 100.0 | 97.0  | 94.0  | 91.2  | 87.6  | 84.6  | 81.8  |
| 8.50             | 108.5              | 104.6 | 101.4 | 98.6  | 95.4  | 92.3  | 88.6  | 85.4  | 82.5  |
| 8.00             | 110.9              | 106.4 | 102.7 | 99.8  | 96.6  | 93.5  | 89.5  | 86.3  | 83.2  |
| 7.50             | 113.2              | 108.1 | 104.0 | 100.8 | 97.5  | 94.4  | 90.5  | 87.1  | 83.9  |
| 7.00             | 115.5              | 109.9 | 105.3 | 101.7 | 98.4  | 95.1  | 91.3  | 87.9  | 84.7  |
| 6.50             | 117.7              | 111.6 | 106.6 | 102.6 | 99.2  | 95.8  | 91.9  | 88.7  | 85.4  |
| 6.00             | 119.6              | 113.1 | 107.8 | 103.6 | 100.0 | 96.4  | 92.5  | 89.1  | 85.9  |
| 5.50             | 121.8              | 114.5 | 109.0 | 104.5 | 100.8 | 97.0  | 93.0  | 89.4  | 86.2  |
| 5.00             | 123.9              | 116.5 | 109.9 | 105.3 | 101.5 | 97.5  | 93.3  | 89.7  | 86.4  |
| 4.50             | 124.3              | 117.8 | 111.7 | 106.0 | 102.1 | 98.0  | 93.6  | 90.0  | 86.6  |
| 4.00             | 124.6              | 111.9 | 112.6 | 107.5 | 102.6 | 98.5  | 94.0  | 90.3  | 86.9  |
| 3.50             | 124.8              | 118.1 | 112.7 | 108.5 | 103.6 | 98.9  | 94.4  | 90.6  | 87.2  |
| 3.00             | 124.9              | 118.2 | 112.8 | 108.5 | 104.8 | 99.3  | 94.8  | 90.9  | 87.4  |
| 2.50             | 125.2              | 118.4 | 112.9 | 108.6 | 104.7 | 100.8 | 95.0  | 91.2  | 87.6  |
| 2.00             | 126.9              | 118.8 | 113.2 | 108.8 | 104.5 | 100.8 | 95.8  | 91.3  | 87.7  |
| 1.50             | 129.2              | 120.3 | 113.6 | 108.9 | 104.4 | 100.5 | 96.9  | 91.4  | 87.8  |
| 1.00             | 132.9              | 122.5 | 114.7 | 109.0 | 104.4 | 100.4 | 96.6  | 92.2  | 88.1  |
| 0.50             | 139.0              | 125.4 | 116.6 | 109.3 | 109.3 | 103.8 | 98.9  | 94.3  | 89.5  |
| 0.00             | 81.1               | 69.9  | 62.8  | 57.5  | 54.1  | 51.4  | 49.1  | 46.8  | 44.6  |



| Y GRID<br>COORDS | X GRID COORDINATES |       |       |       |       |       |
|------------------|--------------------|-------|-------|-------|-------|-------|
|                  | 16.87              | 17.50 | 18.12 | 18.75 | 19.37 | 20.00 |
| 16.00            | 43.3               | 41.9  | 40.6  | 39.6  | 39.1  | 19.4  |
| 15.50            | 82.9               | 80.9  | 79.0  | 77.6  | 76.8  | 38.1  |
| 15.00            | 82.1               | 80.2  | 78.6  | 77.6  | 76.7  | 38.0  |
| 14.50            | 81.4               | 79.7  | 78.5  | 77.5  | 76.6  | 37.9  |
| 14.00            | 80.8               | 79.5  | 78.5  | 77.5  | 76.6  | 37.9  |
| 13.50            | 80.6               | 79.5  | 78.4  | 77.4  | 76.5  | 38.0  |
| 13.00            | 80.6               | 79.4  | 78.3  | 77.3  | 76.4  | 38.0  |
| 12.50            | 80.6               | 79.4  | 78.3  | 77.2  | 76.5  | 38.0  |
| 12.00            | 80.5               | 79.4  | 78.2  | 77.2  | 76.6  | 38.0  |
| 11.50            | 80.4               | 79.2  | 78.2  | 77.2  | 76.6  | 38.1  |
| 11.00            | 80.2               | 79.1  | 78.0  | 77.3  | 76.7  | 38.1  |
| 10.50            | 80.1               | 79.0  | 77.9  | 77.2  | 76.7  | 38.1  |
| 10.00            | 80.1               | 78.9  | 77.8  | 77.2  | 76.7  | 38.1  |
| 9.50             | 80.0               | 78.8  | 77.8  | 77.1  | 76.6  | 38.1  |
| 9.00             | 80.0               | 78.7  | 77.7  | 77.1  | 76.5  | 38.0  |
| 8.50             | 80.3               | 78.6  | 77.7  | 77.0  | 76.4  | 37.9  |
| 8.00             | 80.7               | 78.9  | 77.7  | 76.9  | 76.2  | 37.7  |
| 7.50             | 81.2               | 79.3  | 77.9  | 76.8  | 75.9  | 37.6  |
| 7.00             | 81.7               | 79.7  | 78.1  | 76.7  | 75.7  | 37.5  |
| 6.50             | 82.2               | 80.0  | 78.3  | 76.9  | 75.6  | 37.5  |
| 6.00             | 82.6               | 80.3  | 78.7  | 77.1  | 75.8  | 37.4  |
| 5.50             | 83.1               | 80.7  | 79.0  | 77.4  | 76.0  | 37.4  |
| 5.00             | 83.3               | 81.2  | 79.4  | 77.8  | 76.3  | 37.5  |
| 4.50             | 83.6               | 81.6  | 79.8  | 78.1  | 76.6  | 37.6  |
| 4.00             | 83.8               | 81.8  | 80.3  | 78.5  | 76.9  | 37.7  |
| 3.50             | 84.0               | 82.0  | 80.5  | 78.9  | 77.2  | 37.9  |
| 3.00             | 84.2               | 82.2  | 80.7  | 79.2  | 77.6  | 38.1  |
| 2.50             | 84.5               | 82.4  | 80.9  | 79.6  | 78.1  | 38.4  |
| 2.00             | 84.8               | 82.7  | 81.2  | 79.9  | 78.6  | 38.6  |
| 1.50             | 85.1               | 83.0  | 81.4  | 80.1  | 79.7  | 39.0  |
| 1.00             | 85.6               | 84.4  | 82.4  | 80.9  | 79.6  | 39.0  |
| 0.50             | 86.7               | 84.2  | 82.2  | 80.7  | 79.4  | 38.9  |
| 0.00             | 43.2               | 42.0  | 41.0  | 40.2  | 39.6  | 19.4  |

## ANALYSIS RESULTS

### AVERAGE SHOCK PRESSURE AND SCALED SHOCK IMPULSE ON BLAST SURFACE DUE TO WAVES OFF REFLECTING SURFACES DUE TO INCIDENT WAVE

|          |       |     |      |      |        |
|----------|-------|-----|------|------|--------|
| SURFACE  | 1     | 2   | 3    | 4    |        |
| IMPULSE  | 38.0  | 0.0 | 17.3 | 13.0 | 55.5   |
| PRESSURE | 929.3 | 0.0 | 76.4 | 36.9 | 1392.2 |

### MAXIMUM AVERAGE SHOCK PRESSURE AND TOTAL AVERAGE SHOCK IMPULSE ON BLAST SURFACE

|                |        |
|----------------|--------|
| SCALED IMPULSE | 123.8  |
| IMPULSE        | 574.5  |
| PRESSURE       | 1392.2 |

IMPULSE DURATION ON BLAST SURFACE = 0.83 MS

SCALED IMPULSES HAVE BEEN DIVIDED BY  $W^{1/3}$  = 4.64

SCALED IMPULSES ARE PSI-MS/LBS<sup>1/3</sup>, IMPULSES ARE PSI-MS, PRESSURES ARE PSI

PROGRAM SHOCK  
VERSION 1.0

\*\*\*\*\*  
PROGRAM FOR CALCULATION OF AVERAGE BARRIER REFLECTED  
SHOCK PRESSURES AND IMPULSES DUE TO AN INCIDENT WAVE AND  
REFLECTED WAVES FROM ONE TO FOUR REFLECTION SURFACES.  
ORIGINAL PROGRAM "PAIMPRES" DEVELOPED BY AMMANN AND WHITNEY  
MODIFIED TO "SHOCK" BY NAVAL CIVIL ENGINEERING LAB

INPUT DATA

DATA SET TITLE:

EXAMPLE PROBLEM 2 - AREA REDUCED SURFACE, COMPRESSED GRID OUTPUT

|                                                                                 |        |       |
|---------------------------------------------------------------------------------|--------|-------|
| A. CHARGE WEIGHT, LBS .....                                                     | 100.00 |       |
| B. DISTANCE TO BLAST SURFACE, FT.....                                           | 5.00   |       |
| C. WIDTH OF BLAST SURFACE, FT .....                                             | 16.00  |       |
| D. HEIGHT OF BLAST SURFACE, FT.....                                             | 10.00  |       |
| E. HORIZONTAL CX) DISTANCE TO CHARGE<br>FROM REFLECTING SURFACE NO. 2, FT ..... | 5.00   |       |
| F. VERTICAL (Y) DISTANCE TO CHARGE<br>FROM REFLECTING SURFACE NO. 1, FT .....   | 5.00   |       |
| G. REFLECTING SURFACES<br>"1" FOR FULL REFLECTION, "0" FOR NONE                 |        |       |
| SURFACE 1 (FLOOR) .....                                                         | 1      |       |
| SURFACE 2 (LEFT SIDEWALL).....                                                  | 1      |       |
| SURFACE 3 (CEILING).....                                                        | 1      |       |
| SURFACE 4 (RIGHT SIDEWALL).....                                                 | 1      |       |
| H. REDUCED SURFACE CALCULATION.....                                             | YES    |       |
| CORNERS OF REDUCED AREA; X, Y; FT                                               |        |       |
| UPPER LEFT CORNER .....                                                         | 4.00   | 12.00 |
| UPPER RIGHT CORNER .....                                                        | 12.00  | 12.00 |
| LOWER LEFT CORNER .....                                                         | 4.00   | 4.00  |
| LOWER RIGHT CORNER.....                                                         | 2.00   | 4.00  |

## IMPULSE GRID

NUMBER OF VERTICAL GRID LINES ON BLAST SURFACE 33  
 NUMBER OF HORIZONTAL GRID LINES ON BLAST SURFACE 33  
 NUMBER OF VERTICAL LINES ON REDUCED SURFACE 17  
 NUMBER OF HORIZONTAL LINES ON REDUCED SURFACE 26

DISTANCE BETWEEN VERTICAL GRID LINES = 0.50 FT  
 DISTANCE BETWEEN HORIZONTAL GRID LINES = 0.31 FT

|                         |   | SPECIFIED<br>COORDINATE (FT) | CLOSEST<br>GRID POINT | GRID POINT<br>COORDINATE (FT) |
|-------------------------|---|------------------------------|-----------------------|-------------------------------|
| AREA UPPER LEFT CORNER  | X | 4.00                         | 9                     | 4.00                          |
|                         | Y | 12.00                        | 39                    | 11.87                         |
| AREA LOWER RIGHT CORNER | X | 12.00                        | 25                    | 12.00                         |
|                         | Y | 4.00                         | 14                    | 4.06                          |

## COMPRESSED IMPULSE GRID IN PSI-MS/LBS\*\*1/3

| Y GRID<br>COORDS | X GRID COORDINATES |        |       |       |       |       |
|------------------|--------------------|--------|-------|-------|-------|-------|
|                  | 4.00               | 5.50   | 7.00  | 8.50  | 10.00 | 11.50 |
| 11.87            | 1172.3             | 1257.9 | 897.9 | 475.8 | 278.4 | 179.9 |
| 10.94            | 1185.8             | 1272.6 | 909.6 | 484.7 | 285.0 | 185.5 |
| 10.00            | 601.9              | 645.4  | 462.0 | 247.6 | 146.4 | 95.4  |
| 9.06             | 447.8              | 465.2  | 384.3 | 293.2 | 214.1 | 169.8 |
| 8.12             | 357.7              | 359.7  | 315.1 | 249.1 | 196.9 | 166.3 |
| 7.19             | 327.9              | 325.9  | 290.3 | 236.5 | 192.5 | 166.1 |
| 6.25             | 331.3              | 329.5  | 290.4 | 238.9 | 194.4 | 167.5 |
| 5.31             | 340.8              | 339.0  | 294.3 | 241.0 | 197.5 | 169.6 |
| 4.37             | 338.7              | 337.6  | 293.3 | 240.3 | 197.2 | 168.5 |

## ANALYSIS RESULTS

AVERAGE SHOCK PRESSURE AND SCALED SHOCK IMPULSE ON REDUCED SURFACE DUE TO WAVES OFF REFLECTING SURFACES DUE TO INCIDENT WAVE

| SURFACE  | 1     | 2     | 3      | 4    |        |
|----------|-------|-------|--------|------|--------|
| IMPULSE  | 29.8  | 29.9  | 190.0  | 17.0 | 91.4   |
| PRESSURE | 320.3 | 332.2 | 6607.2 | 60.3 | 2779.1 |

MAXIMUM AVERAGE SHOCK PRES. AND TOTAL AVERAGE SHOCK IMPULSE ON REDUCED SURFACE

|                |        |
|----------------|--------|
| SCALED IMPULSE | 358.1  |
| IMPULSE        | 1662.1 |
| PRESSURE       | 6607.2 |

IMPULSE DURATION ON BLAST SURFACE = 0.50 MS

SCALED IMPULSES HAVE BEEN DIVIDED BY  $W^{**}(1/3) = 4.64$

SCALED IMPULSES ARE PSI-MS/LBS\*\*1/3, IMPULSES ARE PSI-MS, PRESSURES ARE PSI

PROGRAM SHOCK  
VERSION 1.0

PROGRAM FOR CALCULATION OF AVERAGE BARRIER REFLECTED  
SHOCK PRESSURES AND IMPULSES DUE TO AN INCIDENT WAVE AND  
REFLECTED WAVES FROM ONE TO FOUR REFLECTION SURFACES.  
ORIGINAL PROGRAM "PAIMPRES" DEVELOPED BY AMMANN AND WHITNEY  
MODIFIED TO "SHOCK" BY NAVAL CIVIL ENGINEERING LAB

INPUT DATA

DATA SET TITLE:

EXAMPLE PROBLEM 3 - POINT REDUCED SURFACE, FULL GRID OUTPUT

|                                                                                 |        |
|---------------------------------------------------------------------------------|--------|
| A. CHARGE WEIGHT, LBS.....                                                      | 100.00 |
| B. DISTANCE TO BLAST SURFACE, FT.....                                           | 5.00   |
| C. WIDTH OF BLAST SURFACE, FT .....                                             | 16.00  |
| D. HEIGHT OF BLAST SURFACE, FT.....                                             | 16.00  |
| E. HORIZONTAL (X) DISTANCE TO CHARGE<br>FROM REFLECTING SURFACE NO. 2, FT ..... | 5.00   |
| F. VERTICAL (Y) DISTANCE TO CHARGE<br>FROM REFLECTING SURFACE NO. 1, FT .....   | 5.00   |
| G. REFLECTING SURFACES<br>"1" FOR FULL REFLECTION, "0" FOR NONE                 |        |
| SURFACE 1 (FLOOR) .....                                                         | 1      |
| SURFACE 2 (LEFT SIDEWALL).....                                                  | 0      |
| SURFACE 3 (CEILING).....                                                        | 0      |
| SURFACE 4 (RIGHT SIDEWALL).....                                                 | 0      |
| H. REDUCED SURFACE CALCULATION.....                                             | YES    |
| LOCATION OF POINT                                                               |        |
| X DISTANCE FROM SURFACE 2, FT.....                                              | 6.00   |
| Y DISTANCE FROM SURFACE 1, FT.....                                              | 10.00  |

## IMPULSE GRID

NUMBER OF VERTICAL GRID LINES ON BLAST SURFACE 33  
 NUMBER OF HORIZONTAL GRID LINES ON BLAST SURFACE 33

DISTANCE BETWEEN VERTICAL GRID LINES = 0.50 FT  
 DISTANCE BETWEEN HORIZONTAL GRID LINES = 0.50 FT

|                          |       | SPECIFIED<br>COORDINATE<br>(FT) | CLOSEST<br>GRID<br>POINT | GRID POINT<br>COORDINATE<br>(FT) |
|--------------------------|-------|---------------------------------|--------------------------|----------------------------------|
| DISTANCE FROM<br>SURFACE | 2 (X) | 6.00                            | 13                       | 6.00                             |
| DISTANCE FROM<br>SURFACE | 1 (Y) | 10.00                           | 21                       | 10.00                            |

## FULL IMPULSE GRID IN PSI-MS/LBS\*\*1/3

| Y GRID<br>COORDS | X GRID COORDINATES |
|------------------|--------------------|
|                  | 6.00               |
| 10.00            | 102.0              |

## ANALYSIS RESULTS

AVERAGE SHOCK PRESSURE AND SCALED SHOCK IMPULSE ON REDUCED  
SURFACE DUE TO WAVES OFF REFLECTING SURFACES DUE TO INCIDENT WAVE

|          |       |     |     |     |        |
|----------|-------|-----|-----|-----|--------|
| SURFACE  | 1     | 2   | 3   | 4   |        |
| IMPULSE  | 25.6  | 0.0 | 0.0 | 0.0 | 76.4   |
| PRESSURE | 179.6 | 0.0 | 0.0 | 0.0 | 2975.8 |

MAXIMUN AVERAGE SHOCK PRES. AND TOTAL AVERAGE SHOCK IMPULSE ON  
REDUCED SURFACE

|          |        |
|----------|--------|
| SCALED   | 102.0  |
| IMPULSE  |        |
| IMPULSE  | 473.7  |
| PRESSURE | 2975.8 |

IMPULSE DURATION ON BLAST SURFACE = 0.32 MS

SCALED IMPULSES HAVE BEEN DIVIDED BY  $W^{**}(1/3)$  = 4.64

SCALED IMPULSES ARE PSI-MS/LBS\*\*1/3, IMPULSES ARE PSI-MS, PRESSURES ARE  
PSI