

Daystar Masonry

User Manual

LICENSE & COPYRIGHT

Daystar Masonry is copyrighted and all rights are reserved. The license for use is granted to the purchaser by Daystar Software, Inc. as a single user license and does not permit the program to be used by more than one person at one time. Copying of the program to other media is permitted for back-up purposes as long as all copies remain in the possession of the purchaser.

All rights reserved. No part of this publication may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language in any form or by any means, without the written permission of Daystar Software, Inc. Daystar Software, Inc., reserves the right to revise this publication from time to time and to make changes to the contents without obligation to notify any person or organization of such changes.

Neither Daystar Software, Inc., nor the author of this program and documentation are liable or responsible to the purchaser or user for loss or damage caused, or alleged to be caused, directly or indirectly by the software and its attendant documentation, including (but not limited to) interruption on service, loss of business, or anticipatory profits. No Daystar Software, Inc. distributor, or agent, or employee is authorized to make any modification, extension, or addition to this warranty.

© 1995-99 Daystar Software, Inc. - All rights reserved.

Daystar Masonry is a trademark of Daystar Software, Inc.

Windows is a registered trademark and Windows NT is a trademark of Microsoft Corporation.

INTRODUCTION

Daystar Masonry calculates a complete concrete masonry wall analysis and design based on your choice of the UBC, BOCA, SBCCI, or ACI building codes. Shear, axial, moment, combined stress, steel stress, and shear stress diagrams are calculated and displayed. Stresses levels are color coded, allowing quick and easy changes to be made to the wall.

Any number of axial, horizontal point, and horizontal distributed loads can be applied to the wall. In addition, a seismic load factor can be input that will calculate the seismic load based on the wall weight. Loads are assignable to any one of six types (dead, floor live, roof live, wind, snow, or seismic). Daystar Masonry has incorporated seven standard load cases. You can use these load cases, turn some or all of them off and/or create your own. This gives you unmatched flexibility in combining your loads.

All input and output values can be viewed and printed as graphics or text. In addition, graphics can be saved in Windows Metafile format for use in virtually any graphics program. Text values can be saved as a text file for easy export to spreadsheet or word processing programs.

Daystar Masonry is a structural design aid and is not to be used as a substitute for experienced engineering judgment. This program should only be used by professional engineers experienced in the field of masonry wall design. The final decision as to the applicability of the information produced by this program is strictly up to the user of this program.

TABLE OF CONTENTS

Getting Started.....	1
Basics	3
Menus.....	5
Example.....	17
Technical Discussion.....	19
Definitions	28
Index.....	30

GETTING STARTED

System Requirements

Daystar Masonry is a 32-bit application designed to work with the Windows® 3.1, Windows® 95, and Windows NT™ operating systems. Because Windows 3.1 is a 16-bit operating system, additional files must be installed to upgrade it to Win32s and allow 32-bit applications to run. If Win32s has previously been installed these files will not be needed and will not be installed.

You will need one of the following setups and operating systems to use Masonry:

Windows 3.1 running in enhanced mode.
0.8 megabytes of free hard disk space if Win32s is already installed or
2.7 megabytes if not.

Windows 95
0.8 megabytes of free hard disk space.

Windows NT
0.8 megabytes of free hard disk space.

Installation

Before beginning installation exit all running programs. If you use a virus protection program on your computer, override it or turn it off. The setup program may not run properly with virus protection turned on or with other programs running. After running Setup, be sure to restart your virus protection program.

To install Masonry for Windows 3.1 using floppy disks:

1. Insert the disk labeled "Disk 1" into drive A.
2. From the File menu in Program Manager, choose Run.
3. Type **a:\setup**
4. Press ENTER.

To install Masonry for Windows 95/98/NT using floppy disks:

1. Insert the disk floppy disk into drive A.
2. Choose Run from the Start Menu
3. Type **a:\setup**
4. Press ENTER.

To install Masonry using the CD-ROM:

1. Insert the CD-ROM into the CD-ROM drive.
2. If the CD-ROM does not automatically start, choose Run from the Start Menu
3. Type **d:\setup** where **d:** is the CD-ROM drive letter.
4. Press ENTER.

Files

Masonry installs the following files depending on which operating system you are using:

All operating systems:

Masonry directory
 masonry.hlp
 masonry.exe
 example.wal

Windows 3.1:

Windows\System\Win32s directory

win32s.exe	p_037.nls	p_10000.nls	p_10006.nls
p_10007.nls	p_10029.nls	p_10079.nls	p_1026.nls
p_500.nls	p_875.nls	l_intl.nls	p_10081.nls
p_1250.nls	p_1251.nls	p_1252.nls	p_1253.nls
p_1254.nls	p_737.nls	p_855.nls	p_866.nls
p_869.nls	comdlg32.dll	lz32.dll	shell32.dll
version.dll	p_437.nls	p_850.nls	p_852.nls
p_857.nls	p_860.nls	p_861.nls	p_863.nls
p_865.nls	sorttbls.nls	winspool.drv	w32scomb.dll
ctype.nls	netapi32.dll	olesvr32.dll	wsock32.dll
sck16thk.dll	olecli32.dll	unicode.nls	locale.nls
w32s.386	winmm.dll	ntmsg.dll	p_936.nls
p_949.nls	w32skrn1.dll	p_10001.nls	p_932.nls
crtdll.dll	p_950.nls	sortkey.nls	

Windows\System directory

w32sys.dll	winmm16.dll	ctl3d32.dll
olecli.dll	win32s16.dll	

BASICS

Toolbar

The toolbar displayed under the menu allows quick one button access to change the wall geometry, add loads, print, etc. If you are unsure what each button does, simply move the cursor over the button and wait about a half second. A small window will appear displaying the menu item associated with the button and a longer description will appear in the status bar at the bottom of the application window.

The combo box allows you to change the currently displayed load case. Click on it and a list of all available load cases will drop down. Select the load case you want to display.

The toolbar can be attached to the top or bottom of the application window or float free. To cause the toolbar to float free click on it anywhere but on a button or the combo box and drag it to where you want it to be. To attach it to the bottom or top of the application window, click on it anywhere but on a button or the combo box and drag it to the top or bottom. When you release the toolbar it will reattach to the window.

Wherever you decide to put the toolbar, the program will remember and place it there every time you start the program.

Current Load Case

The load case title displayed in the toolbar combo box and the upper left corner of the Structure view is the currently selected load case. All loads associated with this load case are displayed on the wall diagram. You may change the current load case by selecting a new one from the toolbar combo box or from the Case menu.

Views

The graphical Structure view displays the wall, physical properties, building code, and loads associated with the currently selected load case. After selecting Calculate Now under the Case menu, the controlling load case and stresses for both the wall and the parapet are displayed to the right of the wall. Shear, axial, moment, and stress diagrams, as well as, numeric stresses for the currently selected load case are displayed below the wall diagram.

The Text view displays the wall, physical properties, building code, and all loads and load cases for the wall and parapet. In addition, stresses and stress ratios are displayed for all load cases.

Double-clicking

Anywhere that the cursor turns into a magnifying glass is a place that you can double-click to either make changes or view data. The status bar at the bottom of the application window will display a message describing what will happen if you double-click. Double-clicking on most objects will bring up a dialog box that allows you to change or delete the object.

Shear, Axial, Moment, and Stress Diagrams

Double-clicking on the shear, axial, moment, and stress diagrams will bring up a dialog box displaying the loads and stresses of the point that you double-clicked on.

Editing and Deleting Loads

Double-clicking on the load arrows or text in the Structure view will present a dialog box that allows you to change the load or delete it. Change the load by entering new magnitudes and/or locations and clicking the OK button. Delete the load by clicking the Delete button.

Dialog Box Graphical Buttons

The Add Axial Point Load, Add Horiz. Distributed Load, and Add Horiz. Point Load dialog boxes each have graphical buttons used to indicate the direction of the input loads. These buttons act just like standard radio buttons. Tabbing into a group of buttons or clicking on a button in the group will cause the selected button to show a dotted outline indicating it is the active button. You can use the arrow keys to move from button to button in the group and the TAB key to move out of the group. As you select a button the load diagram will change to indicate the direction of the load.

Help

You can access on-line help at anytime by pressing the F1 button.

MENUS

This chapter describes the various menu commands available to you. The bold face item is the menu command and the item in parenthesis is the keyboard short cut. Not all menu items have keyboard short cuts.

Please see the TECHNICAL DISCUSSION and DEFINITIONS sections for further information about information contained in the dialog boxes.

FILE MENU

New (Ctrl+N)

Use this command to create a new document.

Open (Ctrl+O)

Use this command to open an existing document in a new window. You can open multiple documents at once. Use the Window menu to switch among the multiple open documents.

The following options allow you to specify which file to open:

File Name

Type or select the filename you want to open. This box lists files with the extension you select in the List Files of Type box.

List Files of Type

Select the type of file you want to open:

Drives

Select the drive in which Masonry stores the file that you want to open.

Directories

Select the directory in which Masonry stores the file that you want to open.

Network...

Choose this button to connect to a network location, assigning it a new drive letter.

Close

Use this command to close the window containing the active document. Masonry suggests that you save changes to your document before you close it. If you close a document without saving, you lose all changes made since the last time you saved it. Before closing an untitled document, Masonry displays the Save As dialog box and suggests that you name and save the document.

Save (Ctrl+S)

Use this command to save the active document to its current name and directory. When you save a document for the first time, Masonry displays the Save As dialog box so you can name your document. If you want to change the name and directory of an existing document before you save it, choose the Save As command.

Save As

Use this command to save and name the active document. Masonry displays the Save As dialog box so you can name your document.

To save a document with its existing name and directory, use the Save command.

The following options allow you to specify the name and location of the file you're about to save:

File Name

Type a new filename to save a document with a different name. A filename can contain up to eight characters and an extension of up to three characters. Masonry adds the extension you specify in the Save File As Type box.

Drives

Select the drive in which you want to store the document.

Directories

Select the directory in which you want to store the document.

Network...

Choose this button to connect to a network location, assigning it a new drive letter.

Export As Metafile

Use this command to export the contents of the Structure view to a Windows Metafile. This file can be opened by any program that recognizes metafiles. Masonry displays the Save As dialog box so you can name the metafile. Please see Save As above for your options.

Some graphics programs are better at accepting images from the clipboard than importing images from a metafile. You may need to experiment with importation verses pasting to get the results you need. In addition, Windows places restrictions on the size of metafiles. Large walls and/or large scales may cause the metafile to be distorted when exported or copied to the clipboard.

Export As Text

Use this command to export the contents of the Text view to a text file. This file can be opened by any program that recognizes text files. Masonry displays the Save As dialog box so you can name the text file. Please see Save As above for your options.

Print (Ctrl+P)

Use this command to print a document. This command presents a Print dialog box, where you may specify the range of pages to be printed, the number of copies, the destination printer, and other printer setup options.

The following options allow you to specify how the document should be printed:

Printer

This is the active printer and printer connection. Choose the Setup option to change the printer and printer connection.

Setup

Displays a Print Setup dialog box, so you can select a printer and printer connection.

Print Range

Specify the pages you want to print:

- All** Prints the entire document.
- Selection** Prints the currently selected text.
- Pages** Prints the range of pages you specify in the From and To boxes.

Copies

Specify the number of copies you want to print for the above page range.

Collate Copies

Prints copies in page number order, instead of separated multiple copies of each page.

Print Quality

Select the quality of the printing. Generally, lower quality printing takes less time to produce.

Print Preview

Use this command to display the active document as it would appear when printed. When you choose this command, the main window will be replaced with a print preview window in which one or two pages will be displayed in their printed format. The print preview toolbar offers you options to view either one or two pages at a time; move back and forth through the document; zoom in and out of pages; and initiate a print job.

The print preview toolbar offers you the following options:

Print

Bring up the print dialog box, to start a print job.

Next Page

Preview the next printed page.

Prev Page

Preview the previous printed page.

One Page / Two Page

Preview one or two printed pages at a time.

Zoom In

Take a closer look at the printed page.

Zoom Out

Take a larger look at the printed page.

Close

Return from print preview to the editing window.

Print Setup

Use this command to select a printer and a printer connection. This command presents a Print Setup dialog box, where you specify the printer and its connection.

The following options allow you to select the destination printer and its connection.

Printer

Select the printer you want to use. Choose the Default Printer; or choose the Specific Printer option and select one of the current installed printers shown in the box. You install printers and configure ports using the Windows Control Panel.

Orientation

Choose Portrait or Landscape.

Paper Size

Select the size of paper that the document is to be printed on.

Paper Source

Some printers offer multiple trays for different paper sources. Specify the tray here.

Options

Displays a dialog box where you can make additional choices about printing, specific to the type of printer you have selected.

Network...

Choose this button to connect to a network location, assigning it a new drive letter.

1, 2, 3, 4 command (File menu)

Use the numbers and filenames listed at the bottom of the File menu to open the last four documents you closed. Choose the number that corresponds with the document you want to open.

Exit (Alt+F4)

Use this command to end your Masonry session. You can also use the Close command on the application Control menu. Masonry prompts you to save documents with unsaved changes.

EDIT MENU

Undo (Ctrl+Z)

Use this command to reverse the last editing action, if possible. The Undo command is grayed out on the menu if you cannot reverse your last action.

Copy (Ctrl+C)

Use this command to copy whatever is displayed in the view onto the clipboard. In the Structure view the data is copied as a graphic. In the Text view the data is copied as text.

Copying data to the clipboard replaces the contents previously stored there.

Some graphics programs are better at accepting images from the clipboard than importing images from a metafile. You may need to experiment with importation verses pasting to get the results you need. In addition, Windows places restrictions on the size of metafiles. Large walls and/or large scales may cause the metafile to be distorted when exported or copied to the clipboard.

WALL MENU

Change Wall (Ctrl+W)

Use this command to make changes to the wall. This command presents a Wall Dimensions dialog box, where you may specify the wall and parapet heights, thickness, rebar spacing, and other options.

The following options allow you to specify the wall and parapet geometry:

Parapet Ht

This is the distance from the top support to the top of the parapet.

Parapet Rebar

This is the size and spacing of the parapet rebar. If you choose Calc in the rebar size list box, Masonry will calculate the required size based on the input loads and building code.

Parapet Rebar d

This is the distance from the inside face of the parapet to the centerline of the rebar. You may choose Center or Edge or Other and enter a dimension. Whatever you choose, the dimension will be displayed in the Other edit box.

Wall Ht

This is the distance from the bottom support to the top support.

Wall Rebar

This is the size and spacing of the wall rebar. If you choose Calc in the rebar size list box, Masonry will calculate the required size based on the input loads and building code.

Wall Rebar d

This is the distance from the outside face of the wall to the centerline of the rebar. You may choose Center or Edge or Other and enter a dimension. Whatever you choose, the dimension will be displayed in the Other edit box.

Block Wt

This is the weight of the masonry block used in seismic and axial calculations. Please see the tables in the TECHNICAL DISCUSSION for the block weight.

Nominal Thickness

This is the nominal thickness of the wall. Please see the tables in the TECHNICAL DISCUSSION for section properties.

Match parapet and wall rebar sizes.

Check this option if you have chosen Calc for both the parapet and wall rebar sizes and want Masonry to use the same size rebar in the parapet and wall.

Grout Solid

Check this option to if you want the calculations to reflect that all cells are filled with grout.

In addition to typing in a dimension for the wall and parapet rebar d, you can also move the rebar itself by clicking and dragging on the rebar in the wall diagram. When you move the cursor over

the rebar, it will turn into an east-west arrow. Clicking and dragging will move the rebar and change the value in the Other edit box.

Physical Properties

Use this command to make changes to the physical properties of the wall. This command presents a Physical Properties dialog box, where you may specify the wall and parapet $f'm$, f_s , and whether it will have special inspection.

The following options allow you to specify the physical properties:

f'm

This is the compressive strength of the masonry.

f_s

This is the allowable tensile stress of the reinforcing steel.

Special Inspection

Check this option to indicate that the wall will have special inspection during construction. This item will not be enabled if the building code is BOCA '93 or SBCCI '91 because these codes do not have a provision for special inspection.

Heading

Use this command to add a descriptive heading to the document. You are allowed up to four lines for the heading.

Title Block

Use this command to add a title block to the document. Anything entered in this dialog will be saved in the masonry.ini file and will be used in all documents. You are allowed up to four lines for the title block.

LOADS MENU

Add Axial Point Load (Ctrl+A)

Use this command to add axial point loads to the wall. This command presents an Add Axial Point Load dialog box, where you may specify load magnitude, location, eccentricity, and other options.

The following options allow you to specify the axial point load information:

Point Load

This is the magnitude of the axial point load.

Location

This is the vertical distance from the base of the wall to the application point of the axial point load.

Eccentricity

This is the horizontal distance from the centerline of the wall to the centerline of the axial point load.

Direction

This is the direction of the axial point load and which side of the wall the eccentricity is measured from.

Load Type

This is the type of load that this axial point load represents.

In addition to typing in a dimension for the location of the axial point load, you can also move the axial point load arrow itself by clicking and dragging on the arrow in the wall diagram. When you move the cursor over the point of the arrow, it will turn into a north-south arrow. Clicking and dragging will move the arrow and change the value in the Location edit box.

Loads are represented in the Structure view by an arrow, identifier text next to the arrow, and text displaying the load magnitude, location, and eccentricity. The identifier text begins with the letters AP for axial point and then a one or two letter load type as described in the DEFINITIONS section. The identifier text ends with a number to make the load identifier unique.

This newly added load may not appear in the Structure view if the Load Type selected is not included in the Current Load Case. To see the load, change the Current Load Case to one that includes this Load Type.

Add Horiz. Distributed Load (Ctrl+D)

Use this command to add horizontal distributed loads to the wall. This command presents an Add Horizontal Distributed Load dialog box, where you may specify load magnitude, location, and other options.

The following options allow you to specify the horizontal distributed load information:

Top Load

This is the magnitude of the upper horizontal distributed load.

Bottom Load

This is the magnitude of the lower horizontal distributed load.

Top Location

This is the vertical distance from the base of the wall to the application point of the upper horizontal distributed load.

Bottom Location

This is the vertical distance from the base of the wall to the application point of the lower horizontal distributed load.

Direction

This is the direction of the horizontal distributed load.

Load Type

This is the type of load that this horizontal distributed load represents.

In addition to typing in a dimension for the top and bottom location of the horizontal distributed load, you can also move the horizontal distributed load arrows themselves by clicking and

dragging on the arrows in the wall diagram. When you move the cursor over the centerline of the arrow, it will turn into a north-south arrow. Clicking and dragging will move the arrow and change the value in the Location edit boxes.

Loads are represented in the Structure view by an arrows, identifier text next to the arrows, and text displaying the load magnitude and location. The identifier text begins with the letters HD for horizontal distributed and then a one or two letter load type as described in the DEFINITIONS section. The identifier text ends with a number to make the load identifier unique.

This newly added load may not appear in the Structure view if the Load Type selected is not included in the Current Load Case. To see the load, change the Current Load Case to one that includes this Load Type.

Add Horiz. Point Load (Ctrl+H)

Use this command add horizontal point loads to the wall. This command presents an Add Horizontal Point Load dialog box, where you may specify load magnitude, location, and other options.

The following options allow you to specify the horizontal point load information:

Point Load

This is the magnitude of the horizontal point load.

Location

This is the vertical distance from the base of the wall to the application point of the horizontal point load.

Direction

This is the direction of the horizontal point load.

Load Type

This is the type of load that this horizontal point load represents.

In addition to typing in a dimension for the location of the horizontal point load, you can also move the horizontal point load arrow itself by clicking and dragging on the arrow in the wall diagram. When you move the cursor over the centerline of the arrow, it will turn into a north-south arrow. Clicking and dragging will move the arrow and change the value in the Location edit box.

Loads are represented in the Structure view by an arrow, identifier text next to the arrow, and text displaying the load magnitude and location. The identifier text begins with the letters HP for horizontal point and then a one or two letter load type as described in the DEFINITIONS section. The identifier text ends with a number to make the load identifier unique.

This newly added load may not appear in the Structure view if the Load Type selected is not included in the Current Load Case. To see the load, change the Current Load Case to one that includes this Load Type.

Include Self Weight

Use this command to include the weight of the wall in the axial stress calculations. A check mark appears next to the menu item when the self weight is to be included.

This command affects only the axial load and does not affect any seismic factors that may have been entered.

Seismic Load Factor

Use this command to enter the factor that the wall weight will be multiplied by to determine the horizontal seismic force on the wall. This command presents a Seismic Load Factor dialog box, where you may specify the factor.

This newly added load may not appear in the Structure view if the Current Load Case does not include Seismic Loading. To see the load, change the Current Load Case to one that includes Seismic Loading.

CASE MENU***Calculate Now*** (F9)

Use this command to immediately analyze and design the masonry wall. You can calculate at any time.

Building Code (Ctrl+B)

Use this command to select the appropriate building code for this wall design. This command presents a Building Code dialog box, where you may specify the building code.

Select Standard Load Cases

Use this command to selectively turn on and off the standard load cases built into Masonry. This command presents a Select Standard Load Cases dialog box, where you may check which load cases you want to include in this wall design.

These standard load cases are not necessarily applicable to all the building codes available in Masonry. They are included as a convenience to aid you in your design.

Add Load Case (Ctrl+L)

Use this command to create load cases that you want to use in your design. This command presents an Add Load Case dialog box, where you may enter the load case name and load multipliers.

The following options allow you to specify the load case information:

Load Case Name

This is the name that will be used for the load case.

Dead, Floor Live, Roof Live, Snow, Wind, Seismic

These are the load types that are to be included in the load case. Enter the multiplier for each in the edit box to the left. Any multipliers that are left blank are considered zero.

After entering the load case name and multipliers, click the Add button to add the load case to the design. After clicking the Add button the load case name will be blanked and the multipliers will be zeroed so that you can add another load case. When you are finished adding load cases, click the Close button to close the dialog box.

The Cancel button will blank the load case name and zero the multipliers and may be used to clear entries you have made in the name and multiplier edit boxes but do not want to keep. This button will not affect any load cases that have already been added by clicking the Add button.

Change Load Case

Use this command to change load cases that you previously entered using the Add Load Case command. This command presents a Change Load Case dialog box, where you may select an existing load case from the Load Case list box and change the load case name and load type multipliers. Please see the Add Load Case command for a description of the load case name and multipliers options.

After selecting a load case from the Load Case list box, the load case name and multiplier edit boxes will be filled in with the information from the selected load case. After changing the load case information, click the Change button to change the load case. You may then continue selecting load cases and making changes. When you are finished changing load cases, click the Close button to close the dialog box.

The Cancel button will blank the load case name and zero the multipliers and may be used to clear entries you have made in the name and multiplier edit boxes but do not want to keep. This button will not affect any load cases that have already been added by clicking the Change button.

Delete Load Case

Use this command to delete load cases that you previously entered using the Add Load Case command. This command presents a Delete Load Case dialog box, where you may select an existing load case from the Load Case list box and delete it.

After selecting a load case from the Load Case list box, click the Delete button to delete the load case. You may continue selecting load cases and deleting. When you are finished deleting load cases, click the Close button to close the dialog box.

Current Load Cases

Use the load case names listed at the bottom of the Case menu to select the load case that you want to make current. This can also be accomplished by selecting a load case in the toolbar combo box.

VIEW MENU

Display Text/Display Structure

Use this command to change the document view from the Structure view to the Text view and back. The command title will change each time you select it.

Toolbar

Use this command to display and hide the Toolbar, which includes buttons for some of the most common commands in Masonry, such as File Open. A check mark appears next to the menu item when the Toolbar is displayed.

Status Bar

Use this command to display and hide the Status Bar, which describes the action to be executed by the selected menu item or depressed toolbar button, and keyboard latch state. A check mark appears next to the menu item when the Status Bar is displayed.

Options

Use this command to select the units, numeric format, scale, and display parameters of the document. This command presents a tabbed Options dialog box, where you may set all display parameters for the document.

WINDOW MENU

Cascade

Use this command to arrange multiple opened windows in an overlapped fashion.

Tile

Use this command to arrange multiple opened windows in a non-overlapped fashion.

Arrange Icons

Use this command to arrange the icons for minimized windows at the bottom of the main window. If there is an open document window at the bottom of the main window, then some or all of the icons may not be visible because they will be underneath this document window.

#1, 2, ... command (Window menu)

Masonry displays a list of currently open document windows at the bottom of the Window menu. A check mark appears in front of the document name of the active window. Choose a document from this list to make its window active.

HELP MENU

Index

Use this command to display the opening screen of Help. From the opening screen, you can jump to step-by-step instructions for using Masonry and various types of reference information.

Once you open Help, you can click the Contents button whenever you want to return to the opening screen.

Using Help

Use this command for instructions about using Help.

About Daystar Masonry

Use this command to display the copyright notice and version number of your copy of Masonry.

EXAMPLE

This example will show you some of the features of Masonry and how to use them. The design criteria are as follows:

Building Code = UBC' 94

$f_s = 20,000$ psi

$f'_m = 1,350$ psi

No Special Inspection

Wall Ht = 16'-0"

Parapet Ht = 3'-0"

Thickness = 12"

Wall and Parapet Rebar $d = 9$ "

Axial Roof Dead Load = 75 lbs/ft @ 6" ecc.

Axial Snow Load = 150 lbs/ft @ 6" ecc.

Wind Load = 25 psf

Seismic Load Factor = 0.3

Start up Masonry and select the Physical Properties menu item under the Wall menu. When the Physical Properties dialog box appears, enter 1350 in the f'_m edit box and 20000 in the f_s edit box. Click the OK button.

Double-click the wall diagram or select the Change Wall menu item under the Wall menu. When the Wall Dimensions dialog box appears, enter 3 in the Parapet Ht edit box and select Calc in the Parapet Rebar list box. Enter 16 in the Wall Ht edit box and select Calc in the Wall Rebar list box. Select 12 in the Thickness list box and click the Edge radio button for both the Parapet and Wall Rebar d . Now click the OK button.

Click the Add Axial Point Load toolbar button or select the Add Axial Point Load menu item under the Loads menu. When the Add Axial Point Load dialog box appears, enter 75 in the Point Load edit box, 16 in the Location edit box, and 6 in the Eccentricity edit box. Now click the OK button.

Click the Add Axial Point Load toolbar button or select the Add Axial Point Load menu item under the Loads menu. When the Add Axial Point Load dialog box appears, enter 150 in the Point Load edit box, 16 in the Location edit box, and 6 in the Eccentricity edit box. Click the Snow radio button for the Load Type and then click the OK button.

Click the Add Horiz. Distributed Load toolbar button or select the Add Horiz. Distributed Load menu item under the Loads menu. When the Add Horizontal Distributed Load dialog box

appears, enter 25 in the Top Load and Bottom Load edit boxes, 19 in the Top Location edit box, and 0 in the Bottom Location edit box. Click the Wind radio button for the Load Type and then click the OK button.

Select the Seismic Load Factor menu item under the Loads menu and when the Seismic Load Factor dialog box appears, enter 0.3 in the Seismic Load Factor edit box. Click the OK button.

Select the Building Code menu item under the Case menu and when the Building Code dialog box appears, select the UBC '94 radio button. Click the OK button.

Select the Calculate Now menu item under the Case menu to design the wall. Note that the wall rebar could not be adequately sized because under seismic loading the d value is only 2 5/8". To take care of this problem we will move the rebar to the center of the wall. Double-click the wall diagram and when the Wall Dimensions dialog box appears, click the Center radio buttons on both the Parapet and Wall Rebar d . Click the OK button and then select Calculate Now again.

This example is in the directory where you installed Masonry and also accessible from the Daystar program group. Open it and experiment with the wide variety of tools at your disposal.

TECHNICAL DISCUSSION

General

All designs are based on concrete masonry.

The analysis and design are based on working stress design.

All tensile stresses are taken by the reinforcing steel.

During analysis and design, the wall is then broken down into 12 sections per foot and the internal shear, moment, axial loads and stresses are determined at each section. The controlling wall and parapet locations are then determined based on these stresses. This is done for each load case and the controlling load case is chosen from the highest stress load case.

Masonry also takes stress reversals into account when calculating stresses. Therefore, when tensile stresses move from one side of the wall to the other, a new d is calculated based on the distance from the rebar to the tension face of the wall. Depending on the location of the rebar, this new d may control the design because this distance may be much smaller than the input value.

The sign conventions are as follows:

Axial Point Load	down and to the right of the wall are positive.
Horiz. Point Load	to the right is positive.
Horiz. Distributed Load	to the right is positive.

All rebar sizes are based on ASTM standard bar size designations (i.e. #3 is a 0.375" diameter bar).

Masonry does **not** check minimum area of steel or required embedment lengths.

Masonry uses the following equations from the referenced code books to perform the design.

UBC '91

wall $h' = \text{wall ht}$

parapet $h' = 2 * \text{parapet ht}$

The h'/t ratio for both the wall and the parapet is calculated. If it exceeds 30, this condition is indicated in both the structure and text views. Although calculations are completed based on this h'/t , the code book should be consulted for possible slender wall design requirements.

$$F_a = 0.20 f'_m [1 - (h'/42t)^3]$$

$$F_b = f'_m / 3 \quad 2,000 \text{ psi max.}$$

$$F_s = \text{input } f_s \quad 24,000 \text{ psi max.}$$

$$F_v = 1.0 (f'_m)^{(1/2)} \quad 50 \text{ psi max.}$$

$$b=12 \text{ inches}$$

$$p=As/bd$$

$$n=Es/Em$$

$$k=[(np)^2+2np]^{(1/2)}-np$$

$$j=1-k/3$$

$$Em=750f_m \quad 3,000,000 \text{ psi max.}$$

$$Es=29,000,000 \text{ psi}$$

The design is controlled by one of the following:

$$f_a/F_a+f_b/F_b$$

$$f_v/F_v$$

$$f_s/F_s$$

BOCA '93

$$\text{wall } h'=\text{wall ht}$$

$$\text{parapet } h'=2*\text{parapet ht}$$

$$F_a=0.25f'_m[1-(h'/140r)^2] \quad \text{for } h'/r \leq 99$$

$$F_a=0.25f'_m(70r/h')^2 \quad \text{for } h'/r > 99$$

$$F_b=f'_m/3 \quad 2,000 \text{ psi max.}$$

$$F_s=\text{input } f_s \quad 24,000 \text{ psi max.}$$

$$F_v=1.0(f'_m)^{(1/2)} \quad 50 \text{ psi max.}$$

All of the above are increased by 4/3 if the load case includes a wind or seismic load.

$$f_a=\text{Axial/Effective Area}$$

$$f_v=\text{Shear/Effective Area}$$

$$f_b=M(2/jk)/bd^2$$

$$f_s=M/Asjd$$

$$b=12 \text{ inches}$$

$$p=As/bd$$

$$n=Es/Em$$

$$k=[(np)^2+2np]^{(1/2)}-np$$

$$j=1-k/3$$

$Em =$ The compressive strength of masonry units is found in the following “Compressive Strength of Masonry Units” table based on f'_m and the Em is found in the following “ Em for ACI, SBCCI, and BOCA Building Codes” table.

$$Es=29,000,000 \text{ psi}$$

The design is controlled by one of the following:

$$f_a/F_a + f_b/F_b$$

$$f_v/F_v$$

$$f_s/F_s$$

SBCCI '91

wall $h' = \text{wall ht}$

parapet $h' = 2 * \text{parapet ht}$

$$F_a = 0.25 f' m [1 - (h'/140r)^2] \quad \text{for } h'/r \leq 99$$

$$F_a = 0.25 f' m (70r/h')^2 \quad \text{for } h'/r > 99$$

$$F_b = f' m / 3 \quad 2,000 \text{ psi max.}$$

$$F_s = \text{input } f_s \quad 24,000 \text{ psi max.}$$

$$F_v = 1.0 (f' m)^{(1/2)} \quad 50 \text{ psi max.}$$

All of the above are increased by 4/3 if the load case includes a wind or seismic load.

$f_a = \text{Axial/Effective Area}$

$f_v = \text{Shear/Effective Area}$

$$f_b = M(2/jk) / b d^2$$

$$f_s = M / A_s j d$$

$$b = 12 \text{ inches}$$

$$p = A_s / b d$$

$$n = E_s / E_m$$

$$k = [(np)^2 + 2np]^{(1/2)} - np$$

$$j = 1 - k/3$$

$E_m =$ The compressive strength of masonry units is found in the following “Compressive Strength of Masonry Units” table based on $f' m$ and the E_m is found in the following “ E_m for ACI, SBCCI, and BOCA Building Codes” table.

$$E_s = 29,000,000 \text{ psi}$$

The design is controlled by one of the following:

$$f_a/F_a + f_b/F_b$$

$$f_v/F_v$$

$$f_s/F_s$$

SBCCI '94

wall $h' = \text{wall ht}$

parapet $h' = 2 * \text{parapet ht}$

$$\begin{aligned} F_a &= 0.25f'_m [1 - (h'/140r)^2] && \text{for } h'/r \leq 99 \\ F_a &= 0.25f'_m (70r/h')^2 && \text{for } h'/r > 99 \\ F_b &= f'_m / 3 && 2,000 \text{ psi max.} \\ F_s &= \text{input } f_s && 24,000 \text{ psi max.} \\ F_v &= 1.0(f'_m)^{(1/2)} && 50 \text{ psi max.} \end{aligned}$$

All of the above are increased by 4/3 if the load case includes a wind or seismic load.

$f_a = \text{Axial/Effective Area}$

$f_v = \text{Shear/Effective Area}$

$$\begin{aligned} f_b &= M(2/jk) / bd^2 \\ f_s &= M / Asj \end{aligned}$$

$b = 12 \text{ inches}$

$p = A_s / bd$

$n = E_s / E_m$

$k = [(np)^2 + 2np]^{(1/2)} - np$

$j = 1 - k/3$

$E_m =$ The compressive strength of masonry units is found in the following “Compressive Strength of Masonry Units” table based on f'_m and the E_m is found in the following “ E_m for ACI, SBCCI, and BOCA Building Codes” table.

$E_s = 29,000,000 \text{ psi}$

The design is controlled by one of the following:

$f_a / F_a + f_b / F_b$

f_v / F_v

f_s / F_s

ACI 530-92

wall $h' = \text{wall ht}$

parapet $h' = 2 * \text{parapet ht}$

$$\begin{aligned} F_a &= 0.25f'_m [1 - (h'/140r)^2] && \text{for } h'/r \leq 99 \\ F_a &= 0.25f'_m (70r/h')^2 && \text{for } h'/r > 99 \\ F_b &= f'_m / 3 && 2,000 \text{ psi max.} \\ F_s &= \text{input } f_s && 24,000 \text{ psi max.} \\ F_v &= 1.0(f'_m)^{(1/2)} && 50 \text{ psi max.} \end{aligned}$$

All of the above are increased by 4/3 if the load case includes a wind or seismic load.

$f_a = \text{Axial/Effective Area}$
 $f_v = \text{Shear/Effective Area}$

$f_b = M(2/jk)/bd^2$
 $f_s = M/Asjd$

$b = 12 \text{ inches}$
 $p = As/bd$
 $n = E_s/E_m$
 $k = [(np)^2 + 2np]^{(1/2)} - np$
 $j = 1 - k/3$

$E_m =$ The compressive strength of masonry units is found in the following “Compressive Strength of Masonry Units” table based on f'_m and the E_m is found in the following “ E_m for ACI, SBCCI, and BOCA Building Codes” table.

$E_s = 29,000,000 \text{ psi}$

The design is controlled by one of the following:

$f_a/F_a + f_b/F_b$
 f_v/F_v
 f_s/F_s

Effective Area (in²)

Grout spacing	Nominal unit thickness (inch)			
	6	8	10	12
Solid Grout	5.6	7.6	9.6	11.6
Grout @ 16" oc	4.5	5.8	7.2	8.5
24" oc	4.1	5.2	6.3	7.5
32" oc	3.9	4.9	5.9	7.0
40" oc	3.8	4.7	5.7	6.7
48" oc	3.7	4.6	5.5	6.5

Radius of Gyration (inch)

Grout spacing	Nominal unit thickness (inch)			
	6	8	10	12
Solid Grout	1.62	2.19	2.77	3.34
Grout @ 16" oc	1.79	2.43	3.04	3.67
24" oc	1.87	2.53	3.17	3.82
32" oc	1.91	2.59	3.25	3.91
40" oc	1.94	2.63	3.30	3.97
48" oc	1.96	2.66	3.33	4.02

Rebar Depth

Nominal thickness (in)	Center (in)	Edge (in)
6	2.8125	3.50
8	3.8125	5.25
10	4.8125	7.25
12	5.8125	9.00

Light Weight Block (lbs/ft)

Grout spacing	Nominal unit thickness (inch)			
	6	8	10	12
Solid Grout	52	75	93	118
Grout @ 16" oc	41	60	69	88
24" oc	37	55	61	79
32" oc	36	52	57	74
40" oc	35	50	55	71
48" oc	34	45	53	69

Medium Weight Block (lbs/ft)

Grout spacing	Nominal unit thickness (inch)			
	6	8	10	12
Solid Grout	58	78	98	124
Grout @ 16" oc	47	63	80	94
24" oc	43	58	72	85
32" oc	42	55	68	80
40" oc	41	53	66	78
48" oc	40	49	64	75

Normal Weight Block (lbs/ft)

Grout spacing	Nominal unit thickness (inch)			
	6	8	10	12
Solid Grout	63	84	104	133
Grout @ 16" oc	52	66	86	103
24" oc	48	61	78	94
32" oc	47	58	74	89
40" oc	46	56	72	86
48" oc	45	55	70	83

Compressive Strength of Masonry Units

Compressive Strength of Masonry f'm (psi)	Compressive Strength of Masonry Units (psi)
1,000	1,250
1,500	1,900
2,000	2,800
2,500	3,750
3,000	4,800

Em for ACI, SBCCI, and BOCA Building Codes

Compressive Strength of Masonry Units (psi)	Em (psi x 10⁶)
6,000 and greater	3.5
5,000	3.2
4,000	2.9
3,000	2.5
2,500	2.4
2,000	2.2
1,500	1.6

DEFINITIONS

AP	Axial Point Load.
b	Effective width of rectangular member. Always equal to 12”.
d	Distance from the compression face of the element to the centerline of the tension reinforcement.
D	Dead Load
DL	Dead Load
Em	Modulus of elasticity of masonry.
Es	Modulus of elasticity of reinforcing steel.
fa	Actual axial stress calculated as shown in the TECHNICAL DISCUSSION section.
Fa	Allowable axial stress calculated as shown in the TECHNICAL DISCUSSION section.
fb	Actual bending stress calculated as shown in the TECHNICAL DISCUSSION section.
Fb	Allowable bending stress calculated as shown in the TECHNICAL DISCUSSION section.
FL	Floor Live Load
FLL	Floor Live Load
f'm	Compressive strength of masonry.
fs	Input allowable tensile stress of masonry reinforcing steel. Also, actual tensile stress in masonry rebar calculated as shown in the TECHNICAL DISCUSSION section.
Fs	Allowable tensile stress of the masonry reinforcing steel.
fv	Actual shear stress calculated as shown in the TECHNICAL DISCUSSION section.

Fv	Allowable shear stress calculated as shown in the TECHNICAL DISCUSSION section.
h'	Effective height of the wall or parapet.
HD	Horizontal Distributed Load.
HP	Horizontal Point Load.
j	The ratio of the distance between the centroid of the flexural compressive forces and the centroid of the tensile forces to depth.
k	The ratio of depth of the compressive stress in a flexural member to the depth.
n	Modular ratio.
p	Ratio of the area of flexural tensile reinforcement to the area.
RL	Roof Live Load
RLL	Roof Live Load
SEL	Seismic Load
SN	Snow Load
SNL	Snow Load
W	Wind Load
WL	Wind Load

- #1, 2, ... command (Window menu), 15
- 1, 2, 3, 4 command (File menu), 8
- About Daystar Masonry, 16
- ACI 530-92, 24
- Add Axial Point Load, 10
- Add Horiz. Distributed Load, 11
- Add Horiz. Point Load, 12
- Add Load Case, 13
- AP, 28
- Arrange Icons, 15
- b, 28
- BOCA '93, 22
- Building Code, 13
- Calculate Now, 13
- Cascade, 15
- CASE MENU, 13
- Change Load Case, 14
- Change Wall, 9
- Close, 5
- Compressive Strength of Masonry Units, 27
- Copy, 8
- Current Load Case, 3, 14
- d, 28
- D, 28
- Delete Load Case, 14
- Display Structure, 15
- Display Text, 15
- DL, 28
- Double-clicking, 3
- EDIT MENU, 8
- Effective Area, 25
- Em, 27, 28
- Es, 28
- Exit, 8
- Export As Metafile, 6
- Export As Text, 6
- fa, 28
- Fa, 28
- fb, 28
- Fb, 28
- FILE MENU, 5
- Files, 2
- FL, 28
- FLL, 28
- f'm, 28
- fs, 28
- Fs, 28
- fv, 28
- Fv, 29
- h', 29
- HD, 29
- Heading, 10
- Help, 4
- HELP MENU, 16
- HP, 29
- Include Self Weight, 13
- Index, 16
- Installation, 1
- j, 29
- k, 29
- Light Weight Block, 26
- Load Cases, 14
- LOADS MENU, 10
- magnifying glass, 3
- Medium Weight Block, 26
- n, 29
- New, 5
- Normal Weight Block, 27
- Open, 5
- Options, 15

- p, 29
- Physical Properties, 10
- Print, 6
- Print Preview, 7
- Print Setup, 7

- Radius of Gyration, 26
- Rebar Depth, 26
- RL, 29
- RLL, 29

- Save, 5
- Save As, 6
- SBCCI '91, 23
- SBCCI '94, 24
- Seismic Load Factor, 13
- SEL, 29
- Select Standard Load Cases, 13
- Shear, Axial, Moment, and Stress Diagrams,
4
- SN, 29

- SNL, 29
- Status Bar, 15
- System Requirements, 1

- Tile, 15
- Title Block, 10
- Toolbar, 3, 15

- UBC '91, 19
- UBC '94, 20
- UBC '97, 21
- Undo, 8
- Using Help, 16

- VIEW MENU, 15
- Views, 3

- W, 29
- WALL MENU, 9
- WINDOW MENU, 15
- Windows Metafile, 6
- WL, 29