SE INSIGHTS

FOR MASONRY DESIGN

Component-Based Masonry Design Software

Software programs that design masonry using finite element analysis (FEA) are beneficial to structural engineers because they analyze the structure as a whole—the lintels, jambs, walls, etc. all work together. They also allow engineers to understand complex problems and find reasonable, approximate solutions. But FEA software is not necessarily the best tool for every project; sometimes simpler is better. This is where component design programs come in.

Component design programs, as one might think, analyze individual components of construction — an engineer can design a masonry lintel, then apply loads from the lintel supports to a jamb in order to design the jambs. The programs look at each component as isolated, simply supported, determinate members. This simpler design may not represent actual conditions quite like FEA can, but it can save time if FEA is not needed to deal with complicated geometry. This paper will cover some of the options available to engineers when designing masonry with component design programs.

IMI Masonry Partition Wall

The International Masonry Institute has a free web-based software program for the design of masonry partition walls. Partition walls are a textbook case of a component that doesn't need FEA in order to get an efficient design, yet they are often over-designed. Many times, engineers have a general note stating that the maximum reinforcing spacing in masonry walls shall not exceed 48 inches or something similar. But a partition wall, by definition, carries no structural loads at all, and therefore doesn't need much (or sometimes any) reinforcing. The IMI partition wall software allows the engineer to input the design code, block thickness and weight, wall height and support conditions, and loads (if they differ from the default 5 psf interior partition load). The program will automatically calculate properties such as wall thickness, net area, section modulus, and weight. The user can set seismic design criteria to check the wall for lateral loads based on this weight. These properties can be manually overridden if it is necessary to do so. One thing to watch out for is that if the engineer allows the program to calculate the masonry assembly strength (f'm) automatically, it will use the minimum value per the selected design code (2000 psi for IBC 2015; 1500 psi for previous codes). To use a value other than the minimum, uncheck the "automatic" box after f'm and enter a different value. The program only uses ASD design.

Structural Masonry Design System (SMDS)

The National Concrete Masonry Association has produced this program that is capable of designing lintels, walls (both for in-plane and out-of-plane loading), columns, and pilasters. The program has the capability to use ASD design or strength design. One can either enter f'm (if "prism method" is the method selected for masonry strength) or enter the block compressive strength (f'cmu) and mortar type (select "unit strength method") and have the program calculate f'm. SMDS offers quite a bit of flexibility with design parameters. For instance, with lintel design, the program offers the option to enter the forces acting on the lintel (shear, moment) or to enter the loads and let the program calculate the forces. The engineer can also tell the program whether to use arching action when calculating the forces. The out-of-plane wall design module allows the user to select the support conditions, grout spacing, and whether the wall is running bond or stack bond.

IES QuickMasonry

This program is similar to SMDS in that it can design multiple components (bearing wall, shear wall, pilaster, column, beam) under either ASD or Strength provisions. This program allows the user a good amount of flexibility, like the ability to enter any block sizes that may not come preloaded with the software, and the option to design in-wall pilasters and pilasters that are thicker than the wall.

TEDDS

TEDDS is a program that can design with many different materials, so it doesn't have as many options for working with masonry as the previous programs. It is still capable of performing some basic designs, however. It can design wall panels, lintels, columns, and masonry retaining walls. One drawback of this program is that there are only a few preprogrammed block strengths that the engineer can input to calculate the f'm; the program does not have the capability to process any value that might be entered.

The following tables show comparisons of these different component-based design programs which can give engineers an idea of which one has the capabilities they require.

component design	materials	wall thickness	shear walls	unreinf	reinf	wall opening	lintels	parapet & multi-story	columns or pilasters
IMI Masonry Partition Wall Design v2	specify assembly, f'm / specify mortar	4" - 12"	-	yes	vertical, allows bar spacing up to 120" o.c.	-	-	-	-
ENERCALC cloud version build 6.17.2.28	specify assembly, f'm / specify Modulus Rupture, fr	6" - 16"	-	-	vertical limited, only allows bar spacing up to 48" o.c.	-	yes, and arching action	parapet & multi-story	columns
NCMA - Structural Masonry Design System v7.1	specify block f'cmu / assembly, f'm / specify mortar	6" - 16"	yes	yes	vertical, allows bar spacing up to 120" o.c.	-	yes, and arching action	-	column & pilasters
QuickMasonry v5	specify assembly, f'm / specify mortar	6" - 12" but other thicknesses can be added	yes	yes	Vertical at any spacing	-	vert & horiz, and arching action	parapet	column & pilasters
TEDDS 2017	specify block, f'cmu (1900, 2800, 3750, 4800) / specify mortar	wall: 4" - 12" / lintel: 6" - 16"	yes	yes	Vertical (8" to 96") and horiz (8" to 48")	-	yes, and arching action (with checklist)	parapet	columns

component design	support conditions				loading conditions				
	pinned base & top	horiz simple span	fixed base & pinned top	fixed base	vertical load	horiz pressure	point load	horiz tapered load	horiz line load
IMI Masonry Partition Wall Design v2	X	X	X	X		X			
ENERCALC cloud version build 6.17.2.28		X (lintels)							
NCMA - Structural Masonry Design System v7.1	X		X	X	X	X	X	X	X
QuickMasonry v5	X	X (lintels)	X	Quick RWall	X	X	X	X	X
TEDDS 2017	X		X	Separate Retaining Wall Tool	X	X			

component design	ASD 2005	ASD 2008	ASD 2011	ASD 2013	SD 2005	SD 2008	SD 2011	SD 2013
IMI Masonry Partition Wall Design v2		X	X	X				
ENERCALC cloud version build 6.17.2.28					X	X	X	X
NCMA - Structural Masonry Design System v7.1	X	X	X		X	X	X	
QuickMasonry v5	X	X	X	X	X	X	X	X
TEDDS 2017	X	X	X	lintels and retaining walls	X	X	X	