



# SE **INSIGHTS**

## FOR MASONRY DESIGN

### Technical Review of Structural Masonry Design Software

FEA software is indispensable when dealing with masonry structures subject to significant loading conditions, or those featuring complex configurations, such as large openings, shear walls with discontinuities, or multi-story constructions. These programs facilitate a more sophisticated analysis of load distributions, stress concentrations, and deformation characteristics across masonry components. Below is a summary of key FEA tools suitable for masonry applications:

#### List of Finite Element Analysis/Design Software Reviewed by FORSE

We recommend using FEA programs for walls that are either complicated or have a reasonably high load demand, which includes: walls with relatively large openings, shear walls with openings, masonry wall groups used with stair and elevator shafts, exterior walls with high loads, multistory masonry walls, and storm shelter walls. FEA programs are required for understanding the true load on all masonry lintels.

1. **RAM Elements** - Masonry Wall module

Quick start guide: [RAM Elements Manual for Masonry Analysis and Design \(pdf\)](#) Suitable for analyzing masonry walls under various loading scenarios. The software integrates analysis and design functions, supporting code checks and detailed output reports.

2. **RISA Floor/ RISA 3D**

Quick start guide: [RISA-3D Workflow Manual for Masonry Analysis and Design \(pdf\)](#)

Facilitates three-dimensional modeling and analysis of masonry walls, accounting for both in-plane and out-of-plane loading. Appropriate for designs requiring an integrated approach to structural systems.

3. **ETABS** - Masonry walls are all modeled as grouted solid. When the actual wall being modeled is solid, ETABS can be used without issue; if it is partially grouted, modification factors need to be used. Utilizes grouted solid models for masonry walls. When walls are partially grouted, engineers must apply correction factors to accurately represent stiffness and load-bearing capacity.

4. **Tekla Structural Designer / TEDDS (new)** - Masonry walls are modeled in Tekla Structural Designer to be analyzed in the 3D model - to design the walls, analysis information can be linked to TEDDS. Allows for Masonry walls to modeled and analyze within a comprehensive 3D environment. Tekla's link with TEDDS supports detailed design verifications based on FEA results."

Masonry software quick start guides are found at: [masonrystructure.com/technical/](http://masonrystructure.com/technical/)

Below are examples for modifying FEA elements to properly model masonry:

- How to account for partial grouting in masonry
- Incorporating masonry control joints (CJ)
- How to account for cracking in masonry

## Component Based Design Software Reviewed by FORSE

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Component-based masonry design tools are ideal for simpler structural elements where detailed FEA may not be necessary. These tools streamline the design process for non-load-bearing partition walls, single-story structures with light loads, or walls with minimal openings. Here is an overview of the main software for component design:

1. **IMI Partition Wall** - Provides designers with the opportunity to engineer masonry partitions with simple input, simple non-FEA analysis, and with code checks for analysis results. Code checks are based on 2009-2015 IBC ASD; including appropriate references to TMS 402.

- [imiweb.org/partition\\_wall/](http://imiweb.org/partition_wall/)

2. **DIRECT DESIGN 3.1** (NCMA) - Software that enables the design of an entire masonry structure in one model. Simply enter design criteria, specify the plan layout and opening locations, and the software fragments the model into individual components for design checks. Every wall is detailed simultaneously. The software is based on the TMS Direct Design Handbook (TMS 403).

- [ncma.org/software/direct-design/](http://ncma.org/software/direct-design/)

3. **EleMasonry** (NCMA) - Software for structural designs of masonry elements one component at a time. Design walls for in-plane (shear walls) and out-of-plane loads, columns, pilasters, and lintels including code-prescribed detailing requirements for seismic loading, second order analysis, lap splicing, shear reinforcement, and more. Code available for 2002-2016 ASCE 7 ASD or SD; including appropriate references to the masonry design provisions of TMS 402 and corresponding loading criteria from ASCE 7. This program is a sister software to QuickMasonry (through IES).

- 4. [ncma.org/software/elemasonry-design-software/](http://ncma.org/software/elemasonry-design-software/)

5. **QuickMasonry** (Integrated Engineering Software, Inc.) - Software for structural designs of masonry elements one component at a time. Design walls for in-plane (shear walls) and out-of-plane loads, columns, pilasters, and lintels. Codes available for MSJC 2013, MSJC 2011, MSJC-08.

- [iesweb.com/quick/#qm](http://iesweb.com/quick/#qm)

6. **TEDDS** (Tekla/Trimble) - Software for structural designs of masonry elements one component at a time. Design walls for in-plane (shear walls) and out-of-plane loads, columns, and lintels. Codes available for MSJC 2013, MSJC 2011, MSJC-08, MSJC-05.

- [tekla.com/products/tekla-tedds](http://tekla.com/products/tekla-tedds)

Engineers should integrate knowledge of masonry-specific behaviors, such as anisotropy, material nonlinearity, and reinforcement interaction, into the selection and use of software tools. FEA models must incorporate realistic boundary conditions and load cases to yield accurate representations of structural performance.

Furthermore, component-based designs must account for local code requirements and ensure adequate detailing to maintain structural integrity under expected service loads.

The proper selection of software depends on the complexity of the structure, the loading conditions, and the level of detail required in the analysis. For more advanced applications, incorporating FEA software will be necessary to understand the true distribution of stresses and optimize design decisions.