INTERNATIONAL MASONRY INSTITUTE

RAM Elements V16 Manual for Masonry Analysis and Design

Preface: The importance of good structural software cannot be underestimated as a tool for today's structural engineer. During the last few years, the software options available to structural engineers for masonry design have grown and the use of structural masonry has become more prevalent and sophisticated. To support the engineering community, FORSE Consulting, LLC created this manual.

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About RAM Elements V16 for Masonry Design (from International Masonry Institute)

RAM Elements V16 is one of the few commercially available, finite element analysis-based, structural analysis and design programs that provide tools for effective modeling and design of masonry structures.

RAM Elements V16 can be used to create an entire building that includes masonry or simply model and design an individual masonry wall panel. It provides code checks for masonry load bearing walls, masonry shear walls, masonry wall lintels, and masonry columns at the end of wall panels. The code check options are as follows:

- TMS 402-16 SD (Strength Design)
- TMS 402-16 ASD
- TMS 402-13 SD
- TMS 402-13 ASD
- TMS 402-11 SD
- TMS 402-11 ASD
- TMS 402-08 SD
- TMS 402-08 ASD
- ACI 530-05 ASD

It also can design hybrid masonry/frame structures and handles both reinforced and unreinforced masonry using concrete masonry units or clay brick units in a variety of compressive strengths and unit configurations. RAM Elements V16 is one of the software packages recommended by the International Masonry Institute for masonry wall design.

About RAM Elements V16 (from Bentley Systems, Inc.)

RAM Elements V16 provides quick, reliable tools for specific structural tasks. RAM Elements V16 is the only structural engineering software system that offers finite element analysis plus stand-alone or integrated design tools all in one package.

When you are designing masonry walls, or performing many other everyday design tasks, RAM Elements V16 delivers the industry's most productive and easy-to-use engineering analysis and design toolkit.

About International Masonry Institute (IMI)

The International Masonry Institute offers quality training for craftworkers, professional education for masonry contractors and free technical assistance to the design and construction communities. IMI is a strategic alliance between the International Union of Bricklayers and Allied Craftworkers (BAC) and their signatory contractors to promote quality masonry construction.

Team IMI consists of architects, engineers, construction managers, skilled craftworkers and instructors, offering what no other group can: expertise in training, craftsmanship, design, installation and marketing. That means buildings built by union craftworkers and contractors get built the right way.

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This document is intended for the use of industry professionals who are competent to evaluate the significance and limitations of the information provided herein. This publication should not be used as the sole guide for masonry design and construction.

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Section 1: Workflow for Masonry Building in RAM Elements V16

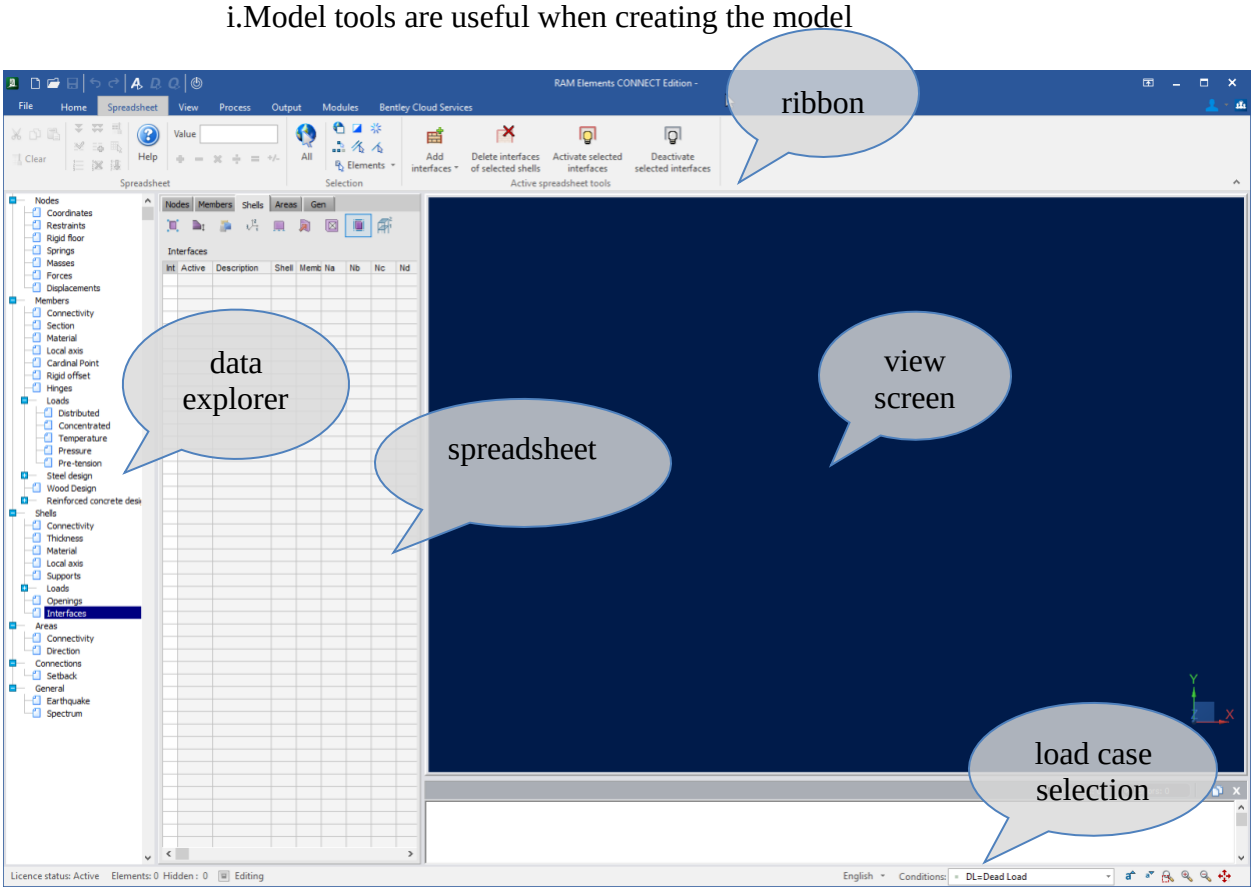
1. Open RE (RAM Elements)

2. Learn about the GUI (Graphic User Interface)

a. Home Ribbon
   i. Data Explorer for navigation and model status
      - will highlight in blue throughout the manual
   ii. Data Spreadsheet for model creation, information
      - nodes
      - beam, column, brace elements
      - shells
      - areas
      - general
   iii. Selection tools

b. Spreadsheet Ribbon
   i. Spreadsheet tools
   ii. Selection tools (repeat from Home Ribbon)
   iii. Active spreadsheet tools
      - notice how these change depending on Data Spreadsheet selection

c. View Ribbon
   i. Model tools are useful when creating the model



Screen shot 1 – RE screen layout

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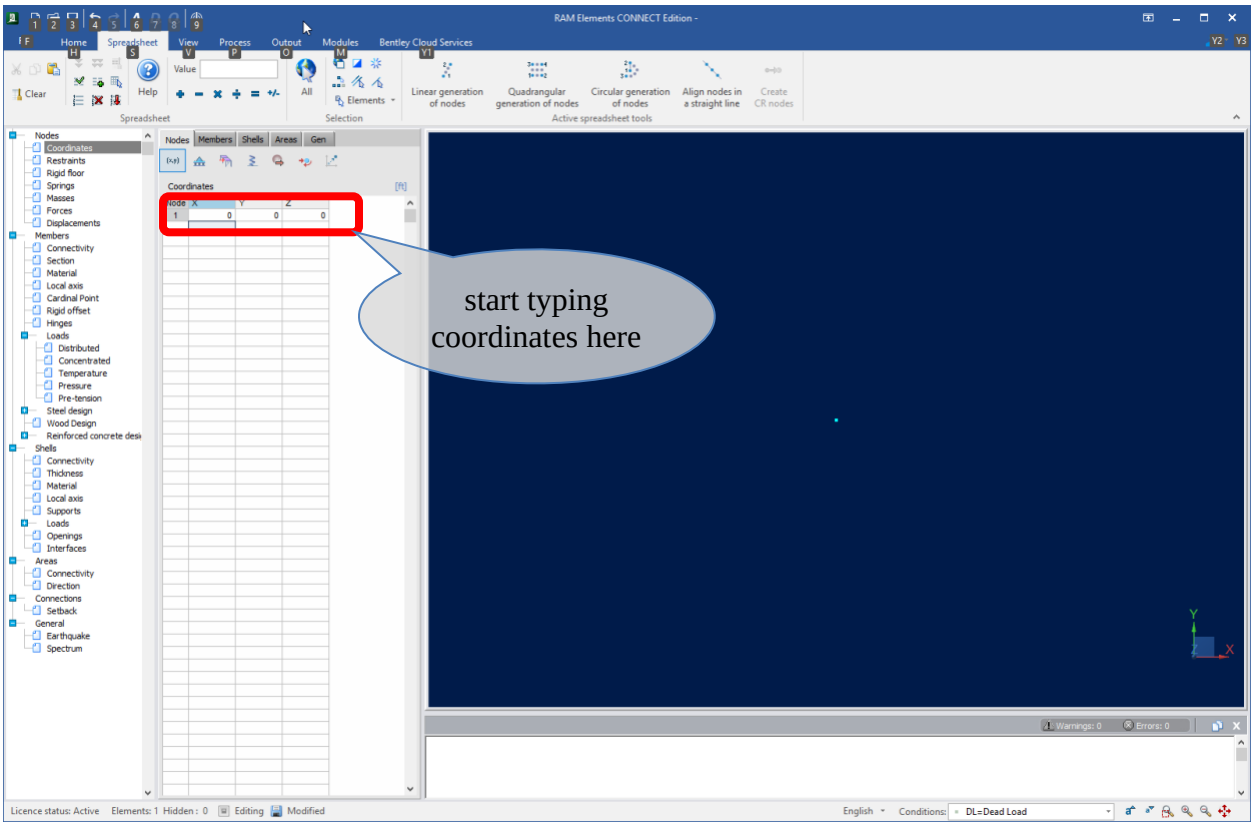
Modeling Tip: right click on the view screen to see a quick way to get to these tools

3. Begin by adding nodes using spreadsheet

a. Start with one masonry wall elevation, enter node coordinates for corners of the wall (Data Explorer: Nodes > Coordinates) – see screen shot 2 below.
   i. For multiple story buildings, start by working on the first level only at this time.

b. Define support conditions (Data Explorer: Nodes > Restraints)
   i. Another option is to define spring supports, here you will find compression-only spring supports – see screen shot 3 below.



Screen shot 2 – where to type to enter node coordinates

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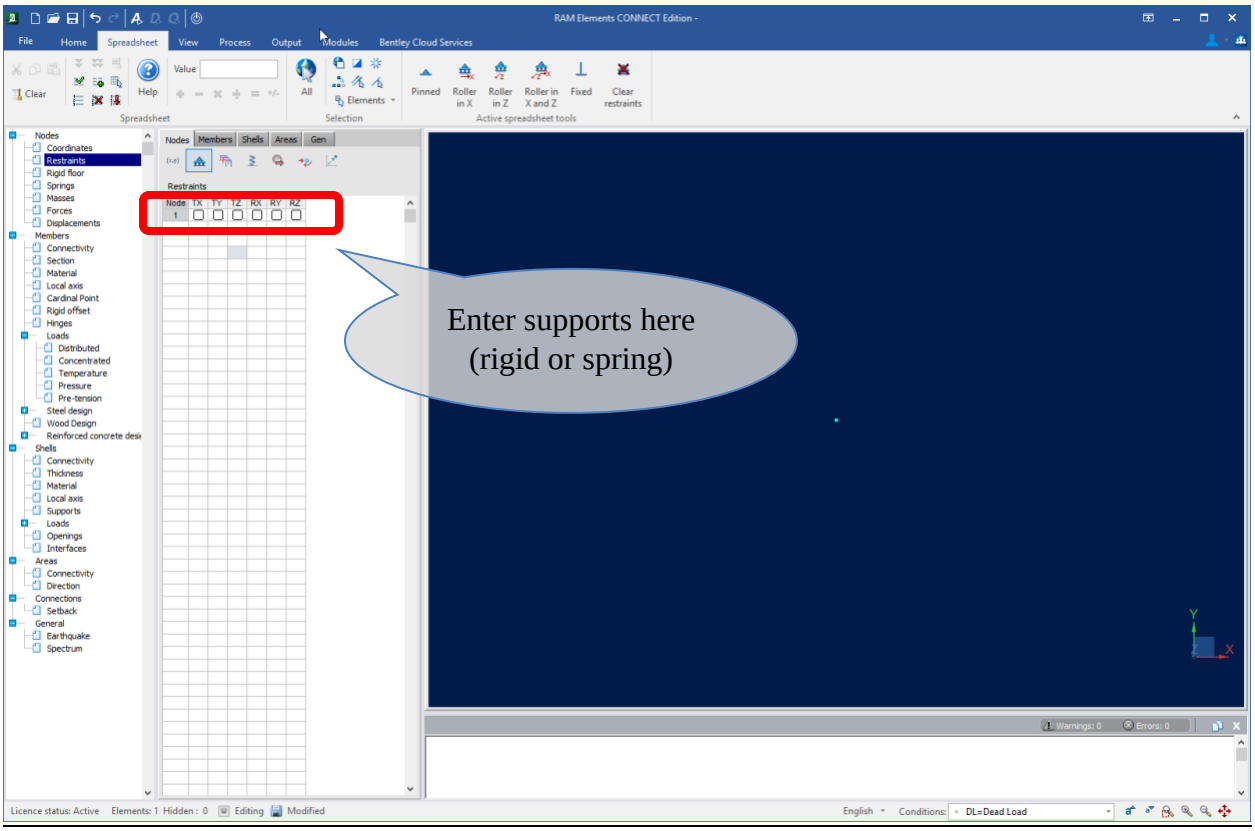

Screen Shot 3 – where to define supports

4. Add wall panels to that elevation

a. Select nodes, click Create quadrangular shell (Data Explorer: Shells > Connectivity) – see screen shot 4 below.
b. Define unique wall description, useful for selecting similar walls later
c. Define thickness (Data Explorer: Shells > Thickness) – see screen shot 5 below.
d. Define masonry material (Data Explorer: Shells > Material)- see screen 6 shot below.
    i. Create custom masonry material if necessary
        - Go to Home>Databases>Materials – see screen shot 6 below.
e. Verify that all walls in a plane have the same orientation of the local axis
f. Segment wall where there will be control joints
g. Create gap between walls
    i. Allows walls between control joints to act independently
h. Define any openings (Data Explorer: Shells > Openings)

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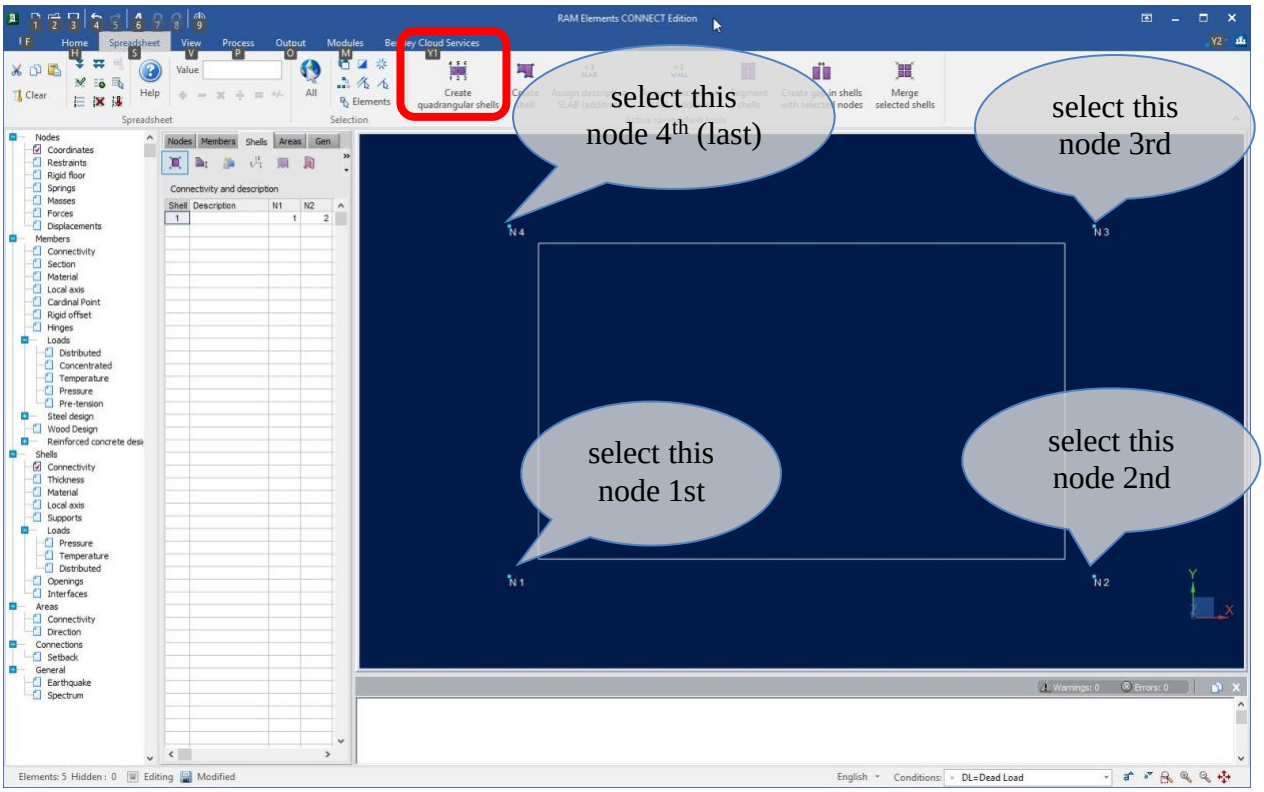

Screen shot 4 – select nodes in this order to use quadrangular shell tool

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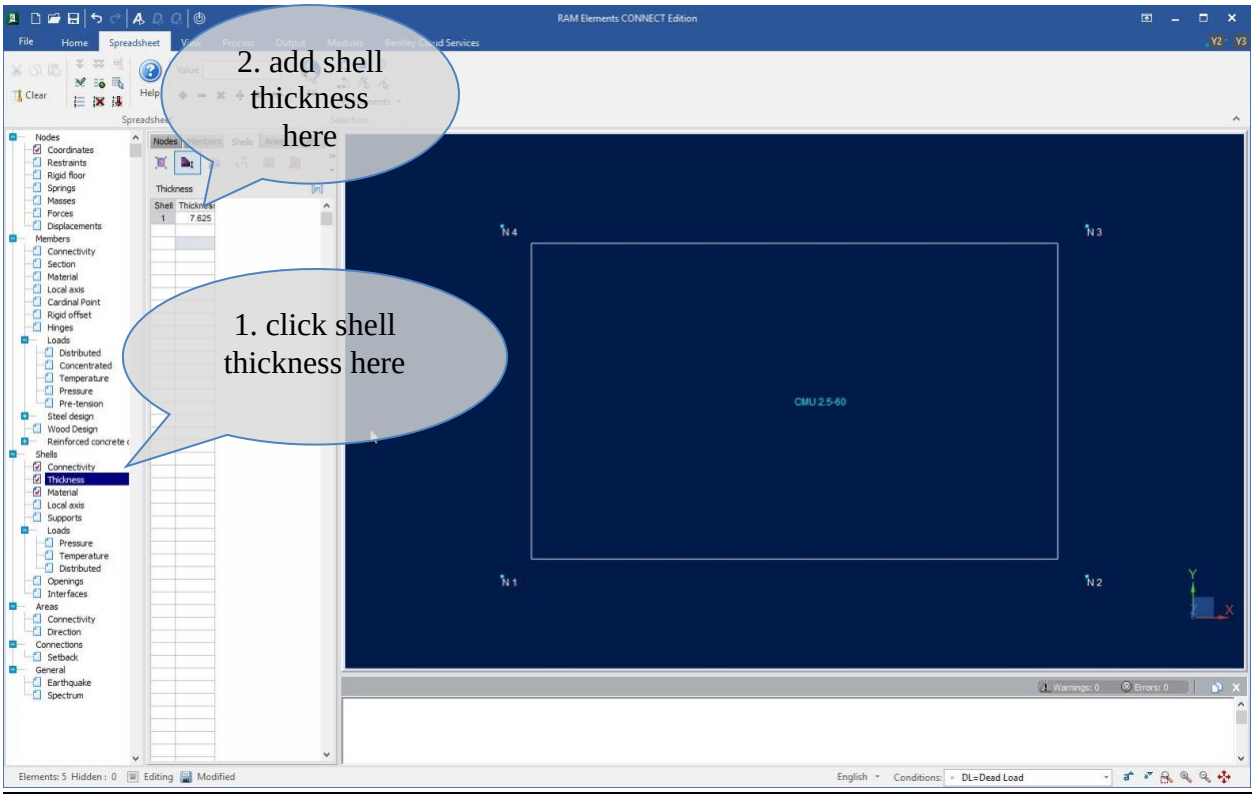
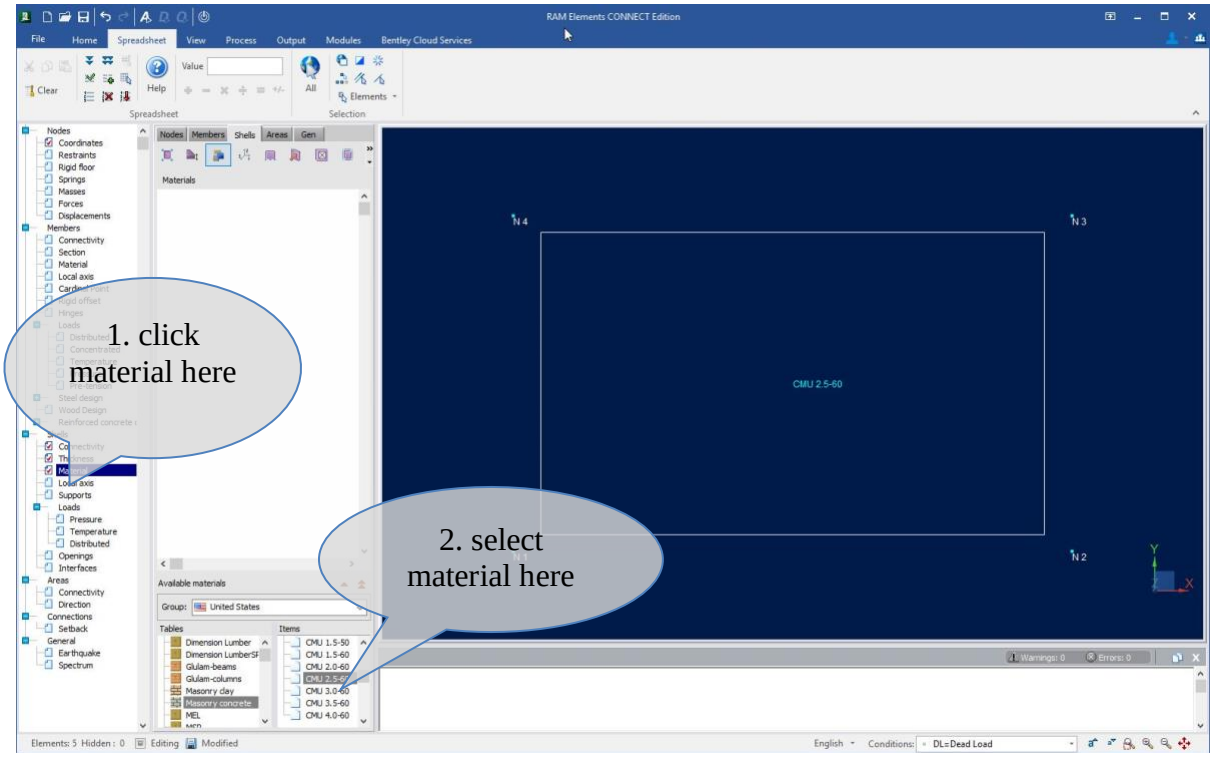


Screen Shot 5 – where to define material



Screen Shot 6 – where to define material

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5. Copy wall properties to other similar walls in the building at that level

a. Go to Home>Modeling>Copy

6. Add additional walls following steps above

7. Add additional support elements (columns)

a. Define nodes similar to **step 3** above
b. Select the nodes just created, click Connect nodes with members (Data Explorer: Members > Connectivity)
c. Define unique column member description--useful for selecting similar columns later
d. Define section (Data Explorer: Members > Section)
e. Define material (Data Explorer: Members > Material)
    i. Create custom material if necessary
f. Verify that all column members have similar orientation for axis 1 of the local axis

8. Create floor elements (beams)

a. Create girders first, secondary beams afterwards
    i. Define nodes similar to **step 3** above
    ii. Select the nodes just created, click Connect nodes with members
        - (Data Explorer: Members > Connectivity)
    iii. Define unique beam member description--useful for selecting similar beams later
    iv. Define section (Data Explorer: Members > Section)
    v. Define material (Data Explorer: Members > Material)
        - create custom material if necessary
    vi. Verify that all column members have similar orientation for axis 1 of the local axis
    vii. Verify floor element end boundary conditions
        - (Data Explorer: Members > Hinges)
    viii. Define support eccentricity by defining rigid end offsets
        - (Data Explorer: Members > Rigid Offsets)
        - especially where members are supported at the masonry wall, verify that the rigid end offset reflects the eccentric wall loading condition if that exists
b. Create beams by adding nodes along girders
    i. Under Data Explorer: Members > Connectivity, go to Spreadsheet > Active spreadsheet tools > Segmentation > Create nodes (on the ribbon) and segment member
        - Define the number of segments, select Create nodes only
    ii. Add beams similar to **step 8a** above

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9. Add floor loading: DL, LL, and SL (if applicable)

a. Go to Home > Load Conditions > Add/Edit
    i. Add Cases for Dead Load, Live Load, and Snow Load
b. Define Areas (referred to sometimes as Deck areas) for distributing area loads
    ii. Must be defined between members that form planar area
        - If an Area is defined by a wall edge, use a trivial member to allow the use of an Area here as well
    iii. Select members that define edges of the Area, and click: (Data Explorer: Areas > Connectivity)
        - Assign load areas direction parallel to X
        - Assign load areas direction parallel to Z
    iv. Verify the direction is correct (Data Explorer: Areas > Direction)
    v. Define Surface load
        - See lower right corner for current load condition
        - Enter pressure value for each load condition (notice units are KIPS/ft^2)
        - Define Y Dir. as -1 for all Pressures representing gravity loads
c. Add loads to members (Data Explorer: Members > Loads)
d. Add loads to nodes (Data Explorer: Nodes > Forces)

10. Copy to create multiple story buildings (skip this step for single story buildings)

11. Add unique elements that are not able to be modeled in elevation or plan views

a. One example would be masonry wall parapets
    i. Copy the wall or walls for the uppermost story
        - Copy distance should be the height of the wall
    ii. Modify the parapet height by changing the node coordinates

12. Add any additional floor loads as required following step 9b, step 9c, or step 9d

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13. Answer the question: Are wind loads on wall panels C&C or MWFRS?

a. See steps below and figure 1 for decision tree.

Modeling Tip: Careful consideration must be made when applying wind loads to building interior and exterior masonry elements within RAM Elements v16. Particular consideration is needed for applying out-of-plane pressure loads to the walls and whether to use MWFRS or C&C wind loads, dependent on the size of the masonry wall panels.

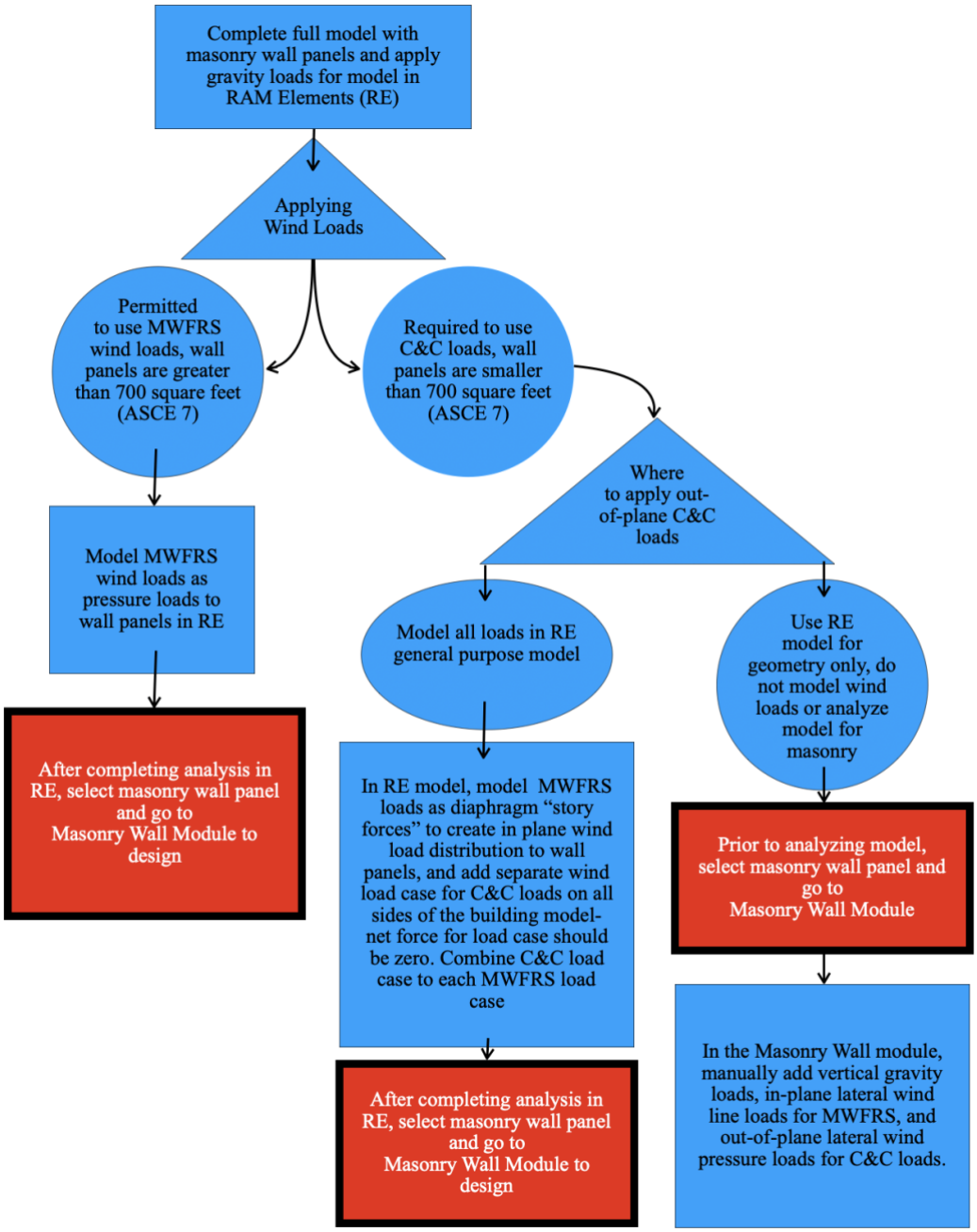

Figure 1 - RAM Elements - Decision Tree for wind loading options on masonry wall panels

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b. If C&C, consider going directly to stand-alone masonry wall module before adding load combinations and analyzing
    i. Select walls and import to Masonry Wall module (more than one shell element can be selected as long as the shells are in the same plane, shells are connected, and the shells form a rectangular area). Once in the Wall module:
        - Add vertical loading
        - Add lateral loading
        - Assign load combinations
        - Define design criteria
        - Complete wall design
        - Save individual wall design files
    ii. Once wall designs are complete, return to RE model to finish designing other elements
    iii. Save and END
c. If MWFRS, add lateral loads to masonry walls and parapets

14. Define load combinations

a. Go to Home > Load Conditions > Add/Edit
    i. To manually define load combinations
        1. Be sure to define the Type as Service or Design as applicable
        2. There must be at least one service and one design load combination–see screen shot 7 below.
b. Go to Home > Load Conditions > Generate
    i. Select a template
        1. Remember to add Service AND Design load combinations

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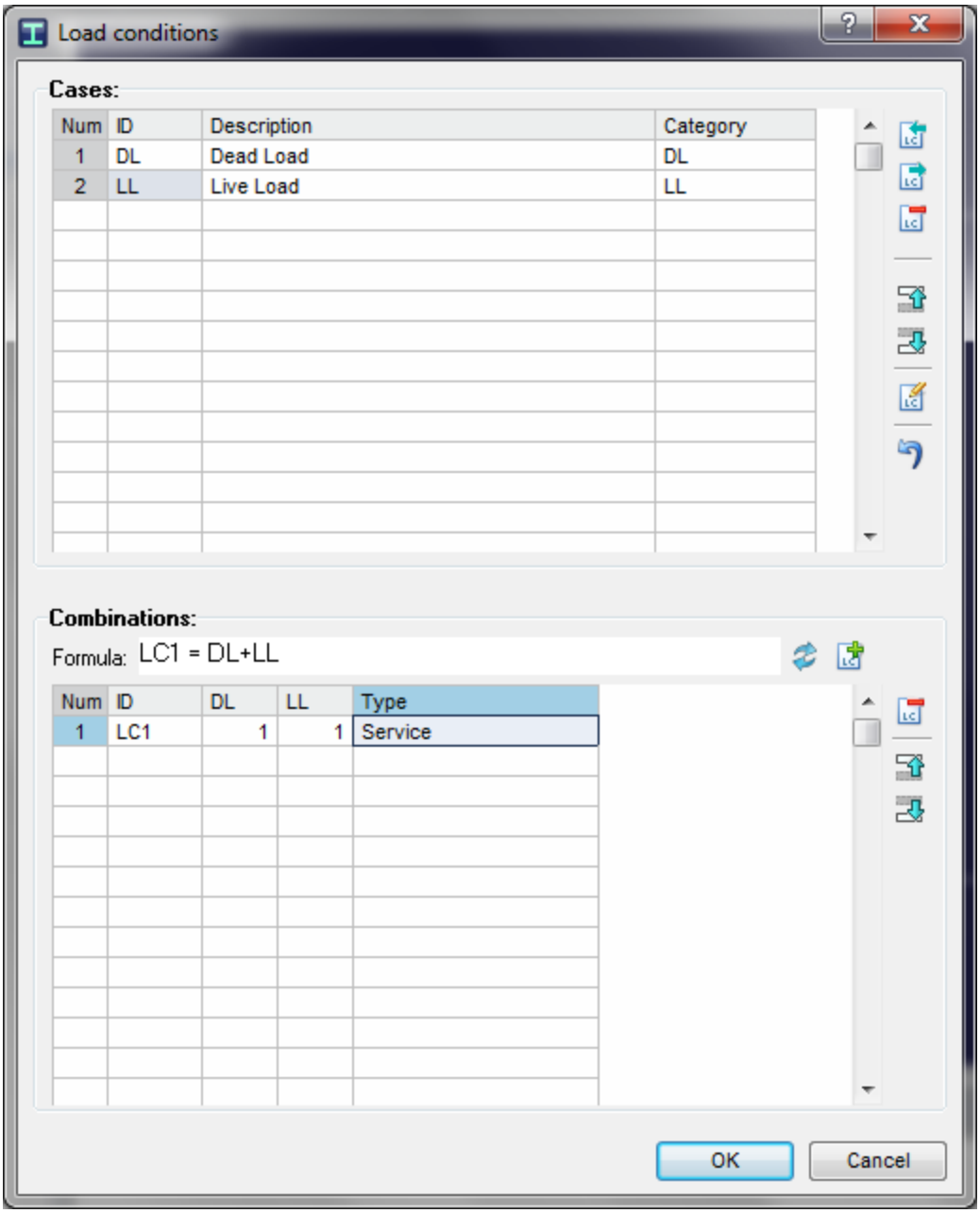

Screen Shot 7 – Load case and load combination input

15. Analyze model

a. Go to Process > Analyze model
   i. Verify “Analysis,” “Condition,” “Finite element model,” “Model DOF”

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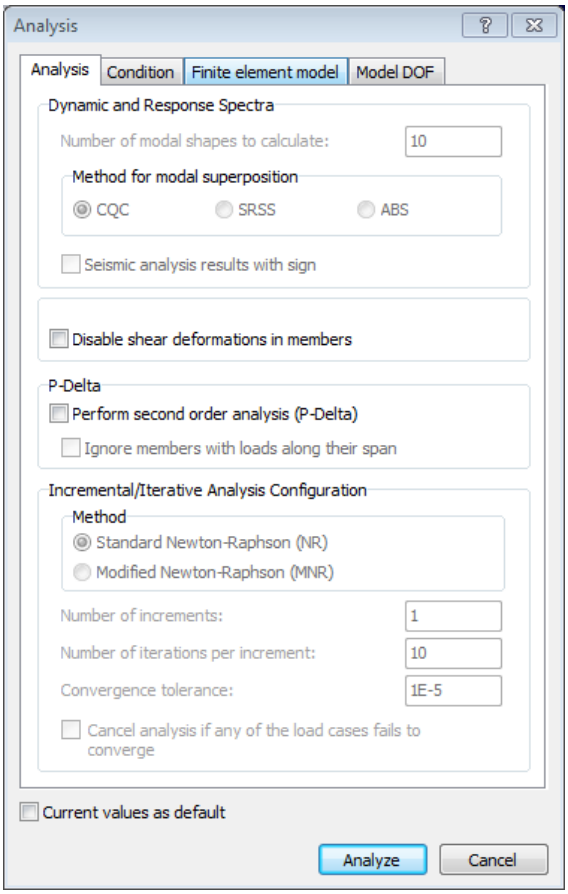

Screen Shot 8 – Analysis options

16. Design wall panels in Masonry Wall module

a. All the analysis results for the wall will come from the main RE model
   i. No additional load can be added
   ii. No load combinations can be defined
   iii. Define design criteria
   iv. Complete wall design
   v. Save individual wall designs back to the main model

17. Save model and END

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Section 2: Using Hybrid Masonry Tools within RE

1. Define nodes and members to create simple examples of hybrid masonry:
    a. Steel frame
    b. Concrete frame
2. Add masonry wall
3. Define hybrid masonry Interface using tools from RE
    a. Type I
    b. Type IIa
    c. Type IIb
    d. Type IIIa
    e. Type IIIb
    f. Out -of- plane only
4. Analyze the model
5. Design wall in RAM Masonry Wall module

Section 3: More Information about Masonry in RAM Elements

- Masonry Parapets
    - To create masonry parapet walls, simply add a shell element above the wall
    - Select both the main wall and the added parapet before going to the masonry wall module
    - Parapets must be 4 feet or less

- Hybrid masonry
    - All sides of hybrid masonry walls must have concrete or steel framing
    - The hybrid masonry tools offset masonry from steel member centerlines

- Non-load bearing walls
    - Non-load bearing walls can be modeled
        - Care must be used to make sure other members above don't connect to the top of the non-load bearing wall
- Load bearing
    - Members supported on walls will transfer load to the walls as point loads
    - Rigid end offsets should be used to represent eccentricity

- Masonry stiffness limitations
    - There are no tools for modifying stiffness of masonry based on cracking
        - Work-around: modify the elastic modulus to account for cracking
    - In the general FEM, there is no modification for partially grouted masonry
        - Work-around: use equivalent thickness to reduce the stiffness

Note: both of these stiffness modifications are especially necessary when multiple systems (i.e. steel frame and masonry walls) are both used to resist lateral loads

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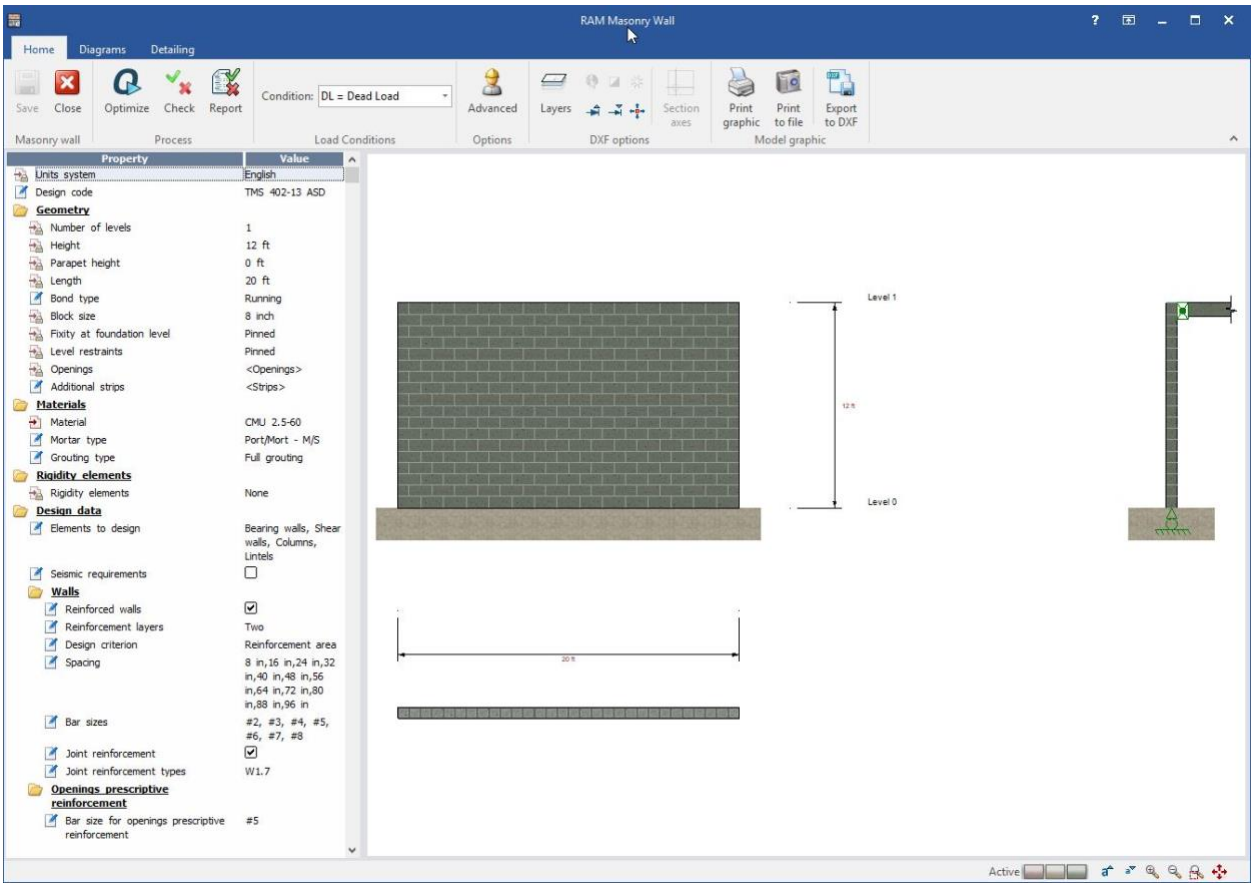
Section 4: Using RAM Masonry Wall as a Stand-Alone Program

1. It is not required to use the main RE program for modeling, and analysis of masonry walls; you can simply open RAM Masonry Wall module and enter data for the wall design manually
    a. From the Module Ribbon, Go to Wall > Standalone > Masonry
        i. Select Unit System
        ii. Enter Design Code
        iii. Define Geometry
        iv. Define Materials
        v. Add Rigidity elements (if applicable)
        vi. Add Loads
        vii. Verify the settings in Advanced Options
        viii. Go to Optimize
            1. Once designed, review Diagrams, FEM, Detailing, and Report



Screen Shot 9 – Masonry Module

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Section 5: Brief Workflow for Importing a REVIT Structure Model

1. Review REVIT Structure model prior to export
2. Create New ISM Repository from REVIT Structure model by using Bentley Structural Synchronizer (ISM)
    a. Modify export tables to enable unmatched sections
3. Create New model in RE from ISM repository
4. Revise and connect model (as necessary)
    a. Verify the model is valid for analysis
        i. Verify masonry wall material is valid
    b. Revise shell elements so masonry walls can be designed
        i. Segmented to create rectangular shells that can be imported to the wall module
        ii. Add openings that weren't included in REVIT model
    c. Create gravity loading
        i. Modeled deck areas as required for vertical loading
        ii. Apply line and point loads for members, and loads at nodes
    d. Create lateral loads
        i. Apply lateral loads at nodes to represent story forces
            1. Define rigid floor numbers for rigid floor constraint
        ii. Lateral pressure loads
            1. Wind load dependent on wall panel tributary area:
                a. Components and cladding, or
                b. MWFRS
            2. Seismic
            3. Soil or other lateral load
5. Complete analysis in RE general FEA program
6. Complete individual wall designs in RAM Masonry Wall module

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Section 6 (short): Brief Workflow for Importing an RSS Model

1. Create model in RSS-RAM Modeler with beams, columns, walls, and one-way deck
    a. Assign Concrete and Other member section labels so they will be recognized in RE
2. Perform RAM Gravity analysis with:
    a. RSS-RAM Steel Beam,
    b. RSS-RAM Steel Column, or
    c. RSS-RAM Frame
3. Complete RSS-RAM Steel Beam and Column designs if sizes are not already assigned in RSS-RAM Modeler
4. Create lateral wind and or seismic load cases in RSS-RAM Frame
5. Complete RAM Frame analysis to get wind and seismic Story forces
6. Open RE
    a. Go to File, Import > RAM SS (Full Model)
7. Edit model in RE as necessary
    a. Revise nodes, membersm and shells
        i. Assign Masonry material to walls
    b. Verify loading
        i. Gravity loads from RAM Steel (RAM Gravity) analysis
        ii. Surface, snow, line and point loads on slab/deck in RSS distributed prior to import (only loads on members are imported)
        iii. Lateral loads from RAM Frame
        iv. Wind and seismic story forces are available for import
    c. Apply additional loading
        i. Lateral pressure loads
            1. Wind load dependent on wall panel tributary area:
                a. Components and cladding, or
                b. MWFRS
            2. Seismic
            3. Soil or other lateral load
8. Complete analysis in RE general FEA program
9. Complete individual wall designs in RAM Masonry Wall module

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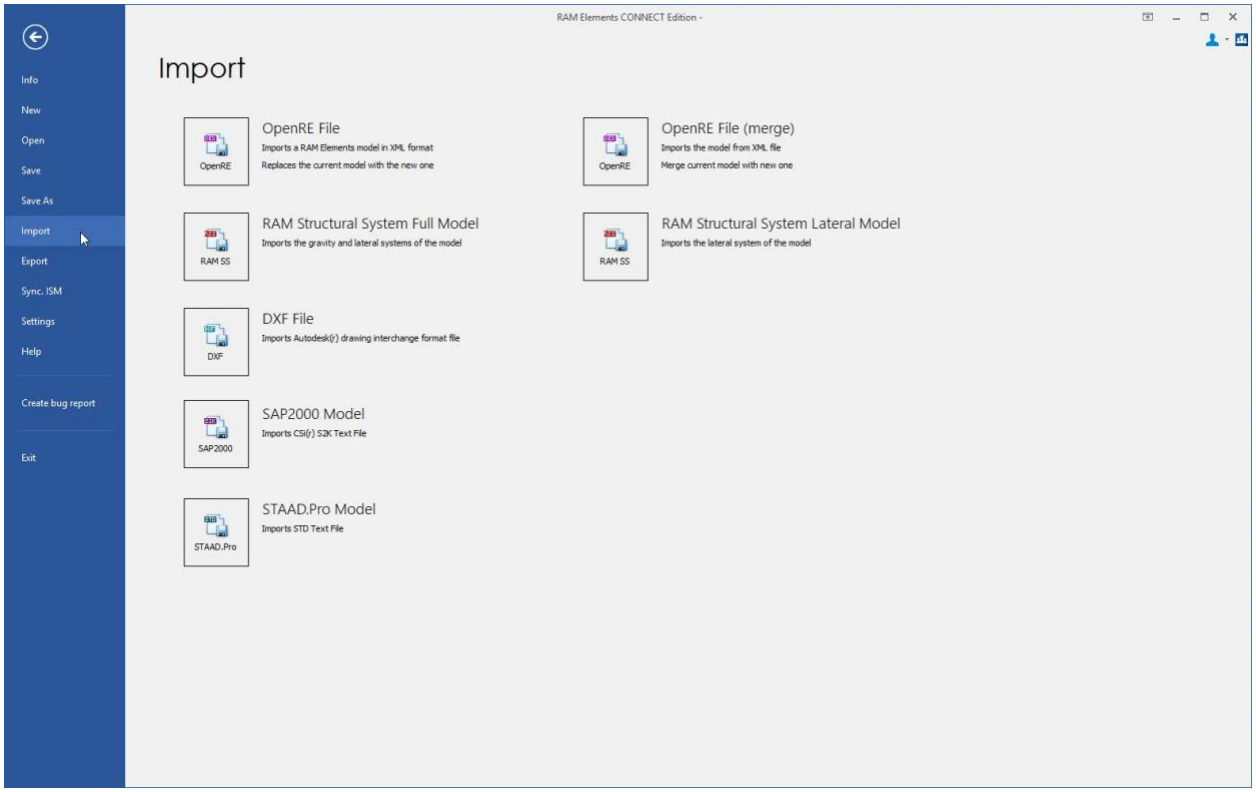
Section 6 (long): Complete Guide for RAM Elements Import of a RAM Structural System Masonry Model

Import RSS file into RE

Importing a RSS file into RE

- Open RE
    - Go to File > Import >



Screen Shot 10 – Import Options

- RAM SS (full model)
    - All the members in the RSS file will be imported
- RAM SS (lateral model)
    - Only the lateral members in the RSS file will be imported
    - The members that were defined as lateral are loaded based on the RSS-RAM Gravity analysis (see below)
    - The model will be similar (not exactly the same) as the model used in RAM Frame because of member setting differences
- NOTE: any floor types not used in the Story data in RSS-RAM Modeler will be ignored when you import

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Preparing the RSS model for import

It's important to realize what's imported before going through the steps of the actual import of the RSS model into RE.

Basic differences between RSS and RE

- RSS models are built in 2D planes (floor plan and elevation); once floor plans are created, they are "stacked" to create a full model. RSS floor plans may contain sloping within a plane, but floor members cannot connect to multiple floor plans.
- RE models are 3D and are not limited in geometry.
- RSS divides the model into gravity members and lateral members.
- RSS-RAM Steel treats all members as gravity member type.
- RSS-RAM Frame is for analyzing and checking lateral members and ignores gravity members in the analysis. The reactions from gravity members are recognized when they are supported by a lateral member.
- In RE there is no separation of gravity and lateral members; the structure is analyzed all together.
- It is also worth noting that both programs (RSS-RAM Frame and RE) use the RAM FE finite element analysis engine.

Information about the RSS model when importing

Since the model to be imported may contain materials other than masonry, such as roof beams, trusses, columns, etc., the information is inclusive of all materials, not just masonry.

1. **Concrete and other walls are imported as shells in RE**
    a. Concrete wall materials are used as RE will create a custom material table based on the properties in RSS
    b. The most common way to model masonry is RSS is as Other material. Other material walls will have the material left blank when the RSS model is imported to RE (custom material table not created)
        i. There is no advantage to defining masonry walls as concrete--they will have to be reassigned as masonry in RE
    c. Wall openings are imported
    d. Cracked section factors for walls can be assigned for concrete walls, but this property is not imported to RE. Possible options would be to consider a reduced thickness or reduced E value of the walls in RE. This is not a limitation of the import, but a limitation of the RE program in general
    e. Note: the overall wall from RSS is imported to RE and will be discretized during the analysis. RE does its own wall meshing and while it uses the same meshing engine as RSS, different wall meshes may result.
2. **Beam members and column members are imported into RE**
    a. Member sizes are recognized when section labels exist in RE Section tables
    b. Member will be imported but member section labels will not be recognized when the size from RSS doesn't exist in RE Section tables
        i.Common members imported with unrecognized sections
            1. Special joists (for example: "xxKSP")
            2. Smart beams

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3. Concrete members--it is not based on the size, it is based on the Section Label (from Concrete Beam Section Properties) used in RAM Modeler
4. Other members--same as for Concrete members

c. Only steel and concrete member materials from RSS are used as RE will create custom Material tables based on the properties in RSS
   i. Common members imported with the material left blank (custom material table not created):
      1. Steel joist members
      2. Smartbeam members
      3. Other beam or column members
d. Member fixity for members defined in RSS as Lateral will be recognized in RE
e. All column and beam members defined in RSS as Gravity are pinned at each end in RE
   i. Member fixity for gravity concrete or other members--assumed to be pinned at each end regardless of whether they are assigned within RSS as fixed or pinned
      1. When partial floors are modeled in RSS, gravity columns that are continuous through the partial floor where no beams exist (two story columns) will be segmented with a node at the floor level. These members need to be un-segmented or the end releases changed to fixed at that internal node segmenting the column at the partial floor level – otherwise this will lead to a local instability
      2. Gravity member fixity at the free end of cantilevers will be pinned and may need to be changed to fixed - otherwise this may lead to a local instability
f. Cracked section factors can be assigned in RSS, but this property isn't available in RE and therefore it is not imported
g. Design parameters from RSS-RAM Frame such as un-braced length and K factors are not imported to RE.
h. Rigid end zones can be automatically considered in RSS, but are manually assigned in RE as rigid end offsets or cardinal point properties
   i. Nothing is imported from RSS-RAM Frame to RE for this property

3. **No decking will be imported**
   a. One-way deck will not be imported
      i. One-way decking will be used by RAM Gravity to distribute the loads to beam members and walls, and those line loads and point loads on members and walls will be imported to RE
         1. Line loads on walls are further lumped as point loads at the ends of the walls, since line loads are not allowed to be applied to the edge of shell elements in RE
   b. Two-way slabs will not be imported
      i. Two-way slabs are not imported to RE, and two-way slabs are not recognized by RAM Gravity; therefore, loads applied to two-way slabs will not be distributed to members and walls imported to RE

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        1. NOTE: consider not using two-way slabs in an RSS model if you plan to import the model to RE
4. **Horizontal rigid diaphragms are recognized as the nodes at the ends of beams and columns, and edges of walls are assigned a Rigid Floor # in RE based on Story data from RSS**
    a. Multiple diaphragms on a single story in the RSS model will be imported to RE with the same Rigid Floor number and will need to be separated to individual rigid floors by manually assigning a different rigid floor number to the nodes in the separate areas
    b. Horizontal diaphragm constraints can be assigned to sloping floor areas with sloping beams, however rigid floor numbers in RE are only allowed to be assigned to nodes with the same y-coordinate. Therefore, the rigid floor number will need to be removed or all nodes must be modified to have the same y-coordinate

Information about the RSS model and gravity loads

1. Point loads and line loads directly applied to members with RSS-RAM Modeler are imported to RE
2. Point loads and line loads directly applied to walls with RSS-RAM Modeler are not imported to RE, but instead are replaced with resultant point loads applied to the nodes at the upper corners of the wall
3. Surface and snow loads are not directly imported. Surface and snow loads are distributed to members based on RSS-RAM Gravity Analysis, which calculates the tributary areas and attributes gravity loads to each member based on the deck orientation, and surface load applied to the deck area. This also applies to point and line loads on decking
    a. Similarly, the loads that would have been distributed to the walls are replaced with equivalent point loads applied to the nodes at the upper corners of the wall
4. Self-weight
    a. If the self-weight is indicated to be included with the gravity dead loads in RSS, then the self-weight gets applied as:
    b. Additional uniform dead load on beams
    c. Resultant point loads applied to the nodes at the upper corners of the wall
    d. Point loads at the top of columns
5. All live loads (reducible, unreducible, storage, roof) or snow loads get imported to RE as a single load case defined as Live Load
    a. Negative live load is a result of load applied to the cantilever and not to the back span within RSS-RAM Gravity
    b. In RSS all the live loads are analyzed. Then, when performing a code check on a member the live load results (axial, bending, shear) are reduced based on the LL reduction percent for that specific member. If the live load is reducible, and if the tributary area of the directly loaded member is large enough, then a reduction will be made prior to loading the beam member only. No additional reduction can be made to the columns supporting these beams.
    c. If you have Roof LL or Snow Load in RSS and want them separated in RE:

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i. LL at the roof was defined to be Roof LL in RSS [RSS-RAM Manager > Criteria > Member Loads: "Consider Roof Live Load, Ignore Snow Loads"]
- Add Roof LL category in RE, then loads at the roof members would have to be cut/paste to this new category

or

ii. LL at the roof was defined to be SL in RSS [RSS-RAM Manager > Criteria > Member Loads: "Consider Snow Loads, Ignore Roof Live Loads"]
- Add Snow Load category in RE, then loads at the roof members would have to be cut/paste to this new category

Information about the RSS model and lateral story forces for rigid diaphragms

1. Lateral wind and seismic story forces are imported into RE
    a. As stated above, wind and seismic are imported using Wind: User Defined Story Forces, and Seismic: User Defined Story Forces
2. Other story forces (not wind or seismic) for rigid diaphragms are not imported to RE
    a. Dynamic Load Cases are not imported
    b. Notional Load Cases are not imported
    c. User Defined Story Force Load Cases are not imported
    d. Center of Rigidity Load Case is not imported
    e. Virtual Workload Cases are not imported
3. Lateral forces from Semi-rigid and Pseudo Flexible Diaphragms in RAM Frame are not imported as distributed loads into RE
    a. Instead of the distributed loads, the original lateral story force is imported
4. Lateral nodal loads applied in RSS-RAM Modeler are not imported into RE
5. NOTE: nowhere in RSS are pressure forces applied to wall panels or any other member between diaphragms. Therefore, when the model is imported into RE, no shell elements (walls) will have lateral pressure loads applied for wind, seismic, or any other loading.

Summary: recommended workflow

1. Create model in RSS-RAM Modeler with beams, columns, masonry walls (as "other" material), and one-way deck
    a. Assign Concrete and Other member section labels that will be recognized in RE
2. Perform RAM Gravity analysis with:
    a. RSS-RAM Steel Beam, RSS-RAM Steel Column, and/or RSS-RAM Frame
3. Complete RSS-RAM Steel Beam and Column designs if sizes are not already assigned in RSS-RAM Modeler
4. Create lateral Wind and/or Seismic load cases in RSS-RAM Frame
5. Complete RAM Frame analysis to get Wind and Seismic Story forces
6. Open RE
    a. Go to RE button, Import > RAM SS (Full Model)
7. Edit model in RE as necessary
    a. Revise members and shells
        i. Assign Masonry material to walls
    b. Verify loading

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i. Gravity loads from RAM Steel (RAM Gravity) analysis
ii. Surface, snow, line and point loads on slab/deck in RSS distributed prior to import (only loads on members are imported)
iii. Lateral loads from RAM Frame
iv. Wind and Seismic story forces are available for import

c. Apply additional loading
   i. Lateral pressure loads
      1. Wind based on components and cladding
      2. Seismic
      3. Soil or other load acting on the building

8. In RE, complete analysis and designs

Commentary: RSS-RAM Gravity analysis and how it relates to RE import of an RSS file

Notes relevant to RE import of RSS model:

1. *results used by RE for loading members and walls*

When a model is designed using either of the RAM Steel modules (Steel Beam or Steel Column), the program performs a simple tributary analysis which is referred to as the "framing tables." To determine the loads, the program calculates the tributary areas and attributes gravity loads to each member based on the applied surface, snow, line and point loads in the model. The reactions of a beam framing to another beam, or a beam framing to a column are calculated based on the assumption that all members are simply supported, determinate members with exactly two supports. Live loads are reduced according to the code rules and the particular member tributary area. Specifically, the things that are not considered in this type of analysis are:

- No end fixity considered; all members considered to be pinned.
- No braces.
- No skip loading (except the live load on cantilever beams).

Commentary: RSS-RAM Frame analysis and how it relates to RE import of an RSS file

Notes relevant to RE import of RSS model:

1. *Loading for members in RE will be the same as described below if Lateral Only model is imported to RE*
2. *Lateral load story forces (not semi-rigid or pseudo flexible) used by RE, for both Full Model and Lateral Only Model imports to RE*
3. *results from RSS-RAM Frame analysis are <u>not</u> used in any way by RE*

Here the program performs a full 3-dimensional analysis. The reactions of gravity members being supported by lateral members are calculated in the RSS-RAM Gravity Analysis, then these reactions are applied to the lateral members as point loads. Gravity members also define brace points (joists brace top flange, w-sections brace top and bottom flanges) for the lateral members. Otherwise, the gravity members are completely ignored in the RAM Frame analysis. Rigid or semi-rigid diaphragms are assumed to connect the vertical frame together, with some options for customization. Lateral loads can be applied in addition to the gravity loads. These lateral loads can be applied as diaphragm forces when rigid diaphragms are used, or they may be applied as nodal loads.

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