MASONRY INSIGHTS
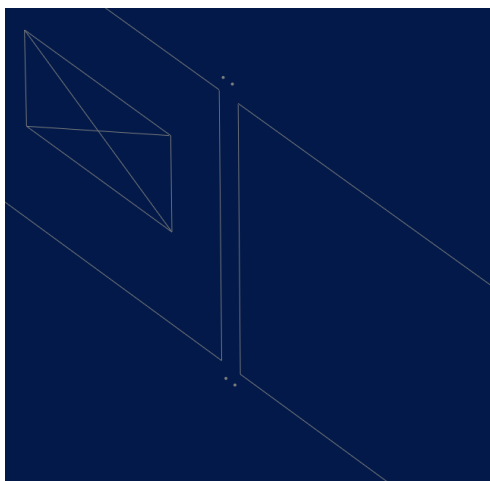
Masonry -

The best way to incorporate CJ locations

Modeling Control Joints in Masonry Walls

It is important to incorporate control joint locations in the analysis and design of structural masonry walls. Control joint locations directly impact how loads are distributed throughout the wall shell elements, and are to be located and shown on the design documents to match the structural analysis. The NCMA Tek 10-2c provides guidance on how to control cracking in masonry walls, including control joint spacing requirements.

This example shows systematically how to model control joints in RAM Structural System / RAM Elements Software and RISA 3D. In both software programs, the nodes at the end of wall panels are effectively attached to each panel. Therefore, to create a control joint gap, the wall segments on either side of a joint need to be modeled as separate wall segments with no shared nodes, to ensure full-height discontinuity between wall panels. In addition, in both software tools, the wall panels would need to be initially modeled as segments with a gap between them to represent the control joints. Existing wall panels cannot be split once modeled.

Figure a. Control Joint in RAM Elements
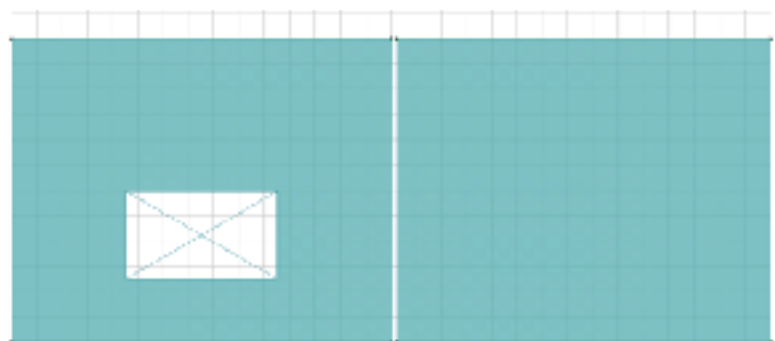
Figure b. Control Joint in RISA 3D

Modeling Control Joints in a RE Model as imported from RSS

For a RAM Structural Systems (RSS) model with masonry walls modeled in RSS, the control joints can be modeled within RSS prior to importing to RAM Elements (RE) for the design of the masonry wall. In some respects, this is advantageous to do this in order to retain loading and floor framing reactions. This example focuses only on the modeling of control joints in masonry walls.

In a model containing masonry walls (modeled as "other" material in RSS-RAM Modeler):

1. In RSS-RAM Modeler, model masonry walls as individual wall segments separated by a full-height gap at control joint locations.
   a. The gap should be a minimum of 3 inches to avoid merging of the nodes in the finite element mesh in RAM Elements.
   b. The Move Wall command can be utilized to manipulate the location of the ends of the walls as needed.

2. Insert a dummy beam between the ends of adjacent wall segments at the control joint location to provide continuous support for floor elements.
   a. Model the dummy beam as "other" material with negligible self-weight, modulus of elasticity, and area properties.

3. Open RAM Elements (RE) > File > Import > RAM SS (Full Model)

4. The wall panels will import as shell elements with nodes at each of its four corners. At the control joint gap, there should be no shared nodes.

5. Refer to the following section to continue wall design and to modify control joint locations in RAM Elements.

Modifying Control Joints in RAM Elements

1. Once you have wall shell elements modeled in RAM Elements FEM, control joint locations can be modified:
   a. View > Properties > Numbering > Turn on Nodes to show node numbers
   b. Select wall panel adjacent to the control joint you wish to modify
   c. Under the Nodes tab, modify the X, Y, Z, coordinates accordingly to change the end of the shell element location

2. Go to Process > Analyze Model > Finite Element model to confirm the node merge tolerance is less than the gap provided at the control joint. This is to avoid node merging in the finite element mesh.
   a. Modeling a 3 in gap and utilizing the default of 0.1 in merge tolerance will ensure the control joint gap is maintained in the finite element mesh.

3. Analyze model.

4. Select shell elements to open the Masonry Wall Module and perform wall design > Modules > Under walls > Assign > Masonry. You may select more than one shell element at a time (Shift + click) to

assign the same wall design as long as the shells are in the same plane, the shells are connected, and the shells form a rectangular area. Note you will not be able to select shell elements separated by a control joint due to lack of connectivity.
   a. It is recommended that if you have a FEM model in RAM Elements, it is ideal to use the Masonry Wall Module (not the Standalone Module) to design the masonry walls in order to retain FEM wall material properties and forces.

Modeling Control Joints in RISA 3D

1. Create new wall panels in RISA 3D using the 'Draw Wall Panels' button. This lets you draw wall panels graphically 'dot to dot' using a drawing grid.

2. Model wall panels separately so as to create a control joint gap.

3. Under Global Settings > Solution > Advanced > Merge Tolerance. Ensure the merge tolerance is less than the gap provided at the control joint to avoid merging of the gap nodes in the finite element mesh.
   a. Modeling a 3 in gap and utilizing the default of 0.12 in merge tolerance will ensure the control joint gap is maintained in the finite element mesh.

3. To modify control joint locations, change wall panel node coordinates in the Joint Coordinates table.

4. If there is area loading assigned, a dummy beam can be modeled at the top of the adjacent walls to allow area loading at the gap to distribute to the walls.