Discretization

Discretization refers to the process of translating the material domain of an object-based model into an analytical model suitable for analysis. In structural analysis, discretization may involve either of two basic analytical-model types, including:

- **Node-element model**, in which structural elements are represented by individual lines connected by nodes. In a 3D system, each node has six degrees of freedom, each either constrained or free. The geometric and material properties of structural elements are then characterized by line elements which simulate their physical behavior by following mathematical relationships. Through application of the direct stiffness method, loading at node locations translates into displacement and stress fields which indicate structural performance.

- **Finite-element model**, in which a meshing procedure creates a network of line elements connected by nodes within a material continuum. Each line element simulates the geometric and physical properties of the local material. Given the loading and boundary conditions of the whole system, numerical formulation of structural response may advance through the computational model. The discretization of a finite-element model will have some degree of refinement, producing either a coarse or fine mesh. A node-element model is technically a finite-element model in which a single line element represents the structural element. Node-element modeling, however, follows the direct stiffness method, whereas finite-element modeling follows the finite-element method (FEM). The SAPFire ® Analysis Engine implements an efficient finite-element approach when performing structural analysis.

Division of frame elements

While the discretization of an object-based model is always critical (in that discretization facilitates analysis), there are conditions in which it is also important to **divide frame elements** into multiple segments such that accurate results are generated.

It is useful to subdivide frame elements for the following analysis types:

- Buckling analysis - To capture higher modes.

- Dynamic analysis - To better capture mass distribution, since mass is assembled at joint locations.

- P-Delta (P-) effect - To better capture local column deformation for assessment of equilibrium conditions about displaced configuration.

- Displacement accuracy - To create joints at locations where accurate displacements are needed, otherwise values are interpolated from the nodes at either end of the frame element.

Discretization tips

- For shell elements, discretization may be refined through auto meshing (Assign > Area > Automatic Area Mesh) or area dividing (Edit > Areas > Divide Areas).

- For frame elements, auto meshing at intermediate points is specified by default. Frame discretization is then connected to that of shell elements at each applicable joint.