Chapter 3

ELEMENT SELECTION
There are several types of structural and non structural elements in LS-DYNA

The structural elements consists of:

- Beam
- Shell
- Tshell
- Soild

There exists other elements in LS-DYNA such as discrete, concentrate mass, seatbelt, etc.

Each element needs *SECTION in which different formulations and other parameters are defined
Shells

Solids

Beams/Trusses

Discrete Elements
*ELEMENT_DISCRETE

- Need: element ID, part ID
- 2 nodal point ID’s, orientation, scale factor on force
- force vs. displacement is defined by *MAT_SPRING
- force vs. velocity is defined by *MAT_DAMPER

*SECTION_DISCRETE

- transitional or rotational
- dynamic magnification factor
- tension/compression limits
**MAT_SPRING_option**

- Elastic
- Elastic-plastic (E, Et, SGMY)
- Nonlinear elastic
- Inelastic (allow tension or compression only)
- General nonlinear (negative or zero slope allowed in the F vs. D curve)
- Maxwell (exponential decay of stiffness)
- Etc.

**MAT_DAMPER_option**

- Viscous
- Nonlinear viscous
- Etc.
**ELEMENT_BEAM**

- Need: element ID, part ID, 3 nodal point ID’s

**SECTION_BEAM**

- Truss (axial deformation only)
- Beam (axial, bending, torsional deformations)
- Different beam formulation
- Different cross-sections
  - Rectangular, tubular, arbitrary
  - Area and inertia’s
- Warping is also included
**ELEMENT_BEAM**

- Hughes-Liu: type 1 (DEFAULT), recommended
  - 6 DOF per node: \((dx, dy, dz, rx, ry, rz)\)
  - One integration point along length
  - Integrated cross section (not "resultant" beam)
  - Transverse shear correction factor
  - Moveable mid-plane option
  - \(s, t\) directions defined by orientation node n3
*ELEMENT_SOLID

- Need: element ID, part ID, 8-noded for brick

*SECTION_SOLID

- Different formulation
- 8-noded reduce integration
- 8-noded fully integrated
- Ted, Wedge, linear and nonlinear elements
- other elements for coupled applications
*ELEMENT_SOLID

- **Constant Stress Solid: type 1 (DEFAULT)**
  - Single point integration with hourglass control
  - Requires hourglass control
  - Can sustain large nonlinear deformation

- **Fully Integrated S/R Solid: type 2**
  - 3 DOF per node: (dx, dy, dz)
  - 2x2x2 selective/reduced integration
  - No hourglass control needed
*ELEMENT_SHELL

- Need: element ID, part ID, 4 nodes for quads
- thickness can be defined in element card

*SECTION_SHELL

- Different Formulations
- Plane & axisymmetric element are defined as shells
- Linear and nonlinear shells
- Reduced and full integrated shells
- Other coupled and special elements
**ELEMENT_SHELL**

- **Belytschko-Tsay**: Type 2 (DEFAULT)
  - 6 DOF per node: (dx, dy, dz, rx, ry, rz)
  - Single point integration with hourglass control
  - Requires hourglass control (type 4 or 5)

- **Fast Shell**: type 16, recommended
  - 6 DOF per node: (dx, dy, dz, rx, ry, rz)
  - 2x2 integration with enhanced strain formulation
*ELEMENT_T SHELL

- Need: element ID, part ID, 8-noded

*SECTION_T SHELL

- one point integration and selective reduce integration
- Similar to solid element with enhancement based on shell formulations.
- To obtain shell like behavior it is necessary to have several integration point through the thickness while employing plan stress constitutive equations.
Notes