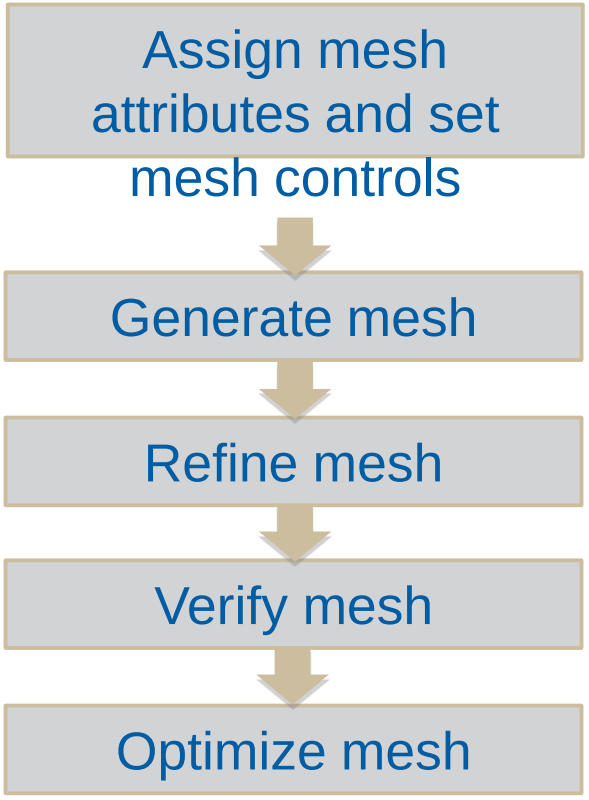
Meshing

ABAQUS Meshing

Meshing Workflow



OBJECTIVE—*balance results accuracy against rate of convergence*

CREATION—*seeding, element type, remeshing techniques*

VERIFICATION—*element quality, shape factor, aspect ratio, element degeneracy*

REMESHING/REFINEMENT—*based on results of analysis incl. large deformations or gradients*

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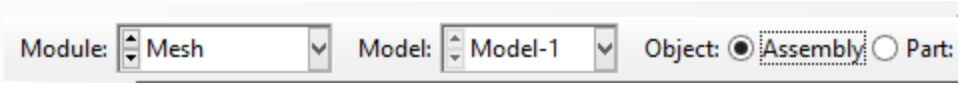
Dependent *v.* Independent

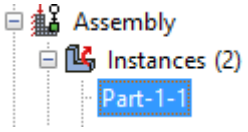
- **Dependent**
  Instance is a pointer to the meshed original part
- **Independent**
  An independent part instance is a copy of the geometry of the original part

No customization allowed: cannot modify geometry, partition, virtual topology



How to Switch:

1. In the context bar, change the Object
2. In the model tree, right click the instance name



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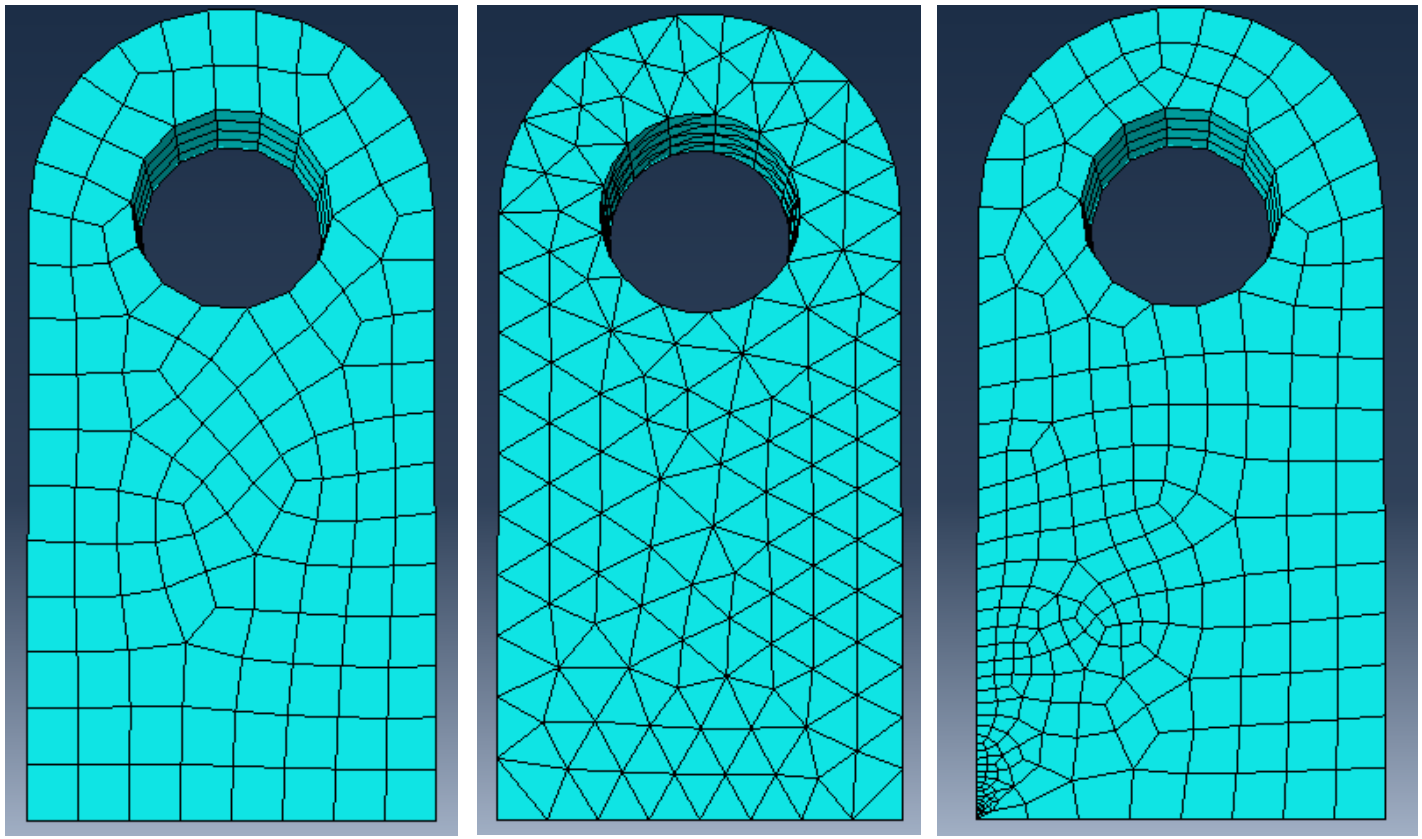
Mesh Attributes

- Element shape control
- Seed assignment and bias



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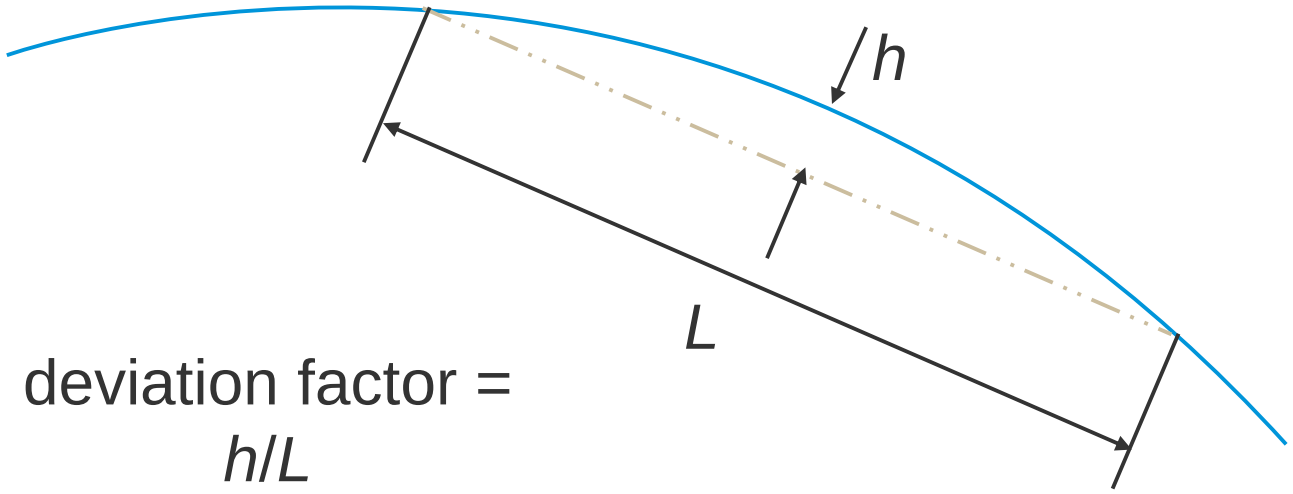
Mesh Attributes: Curvature Control

- Seed distribution based on edge curvature and target element size
- Accounts for deviation factor and minimum size factor



deviation factor = h/L

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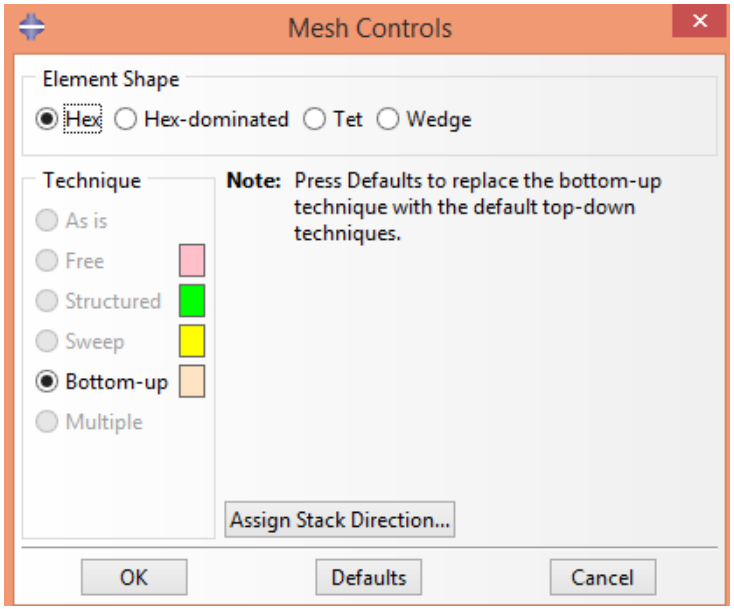
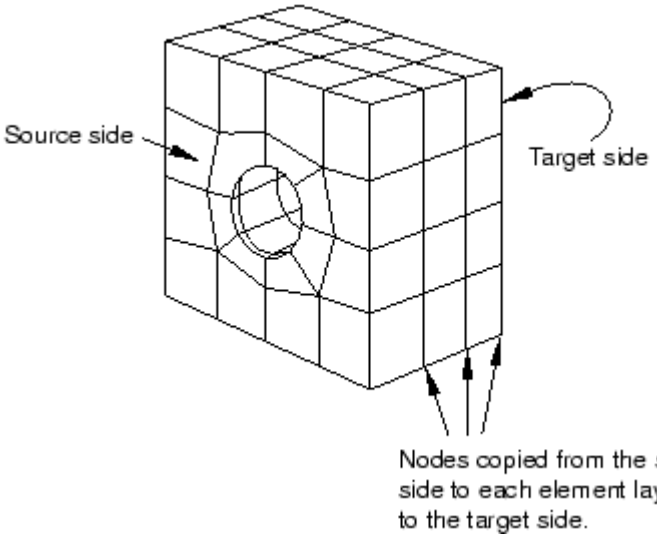
Meshing techniques

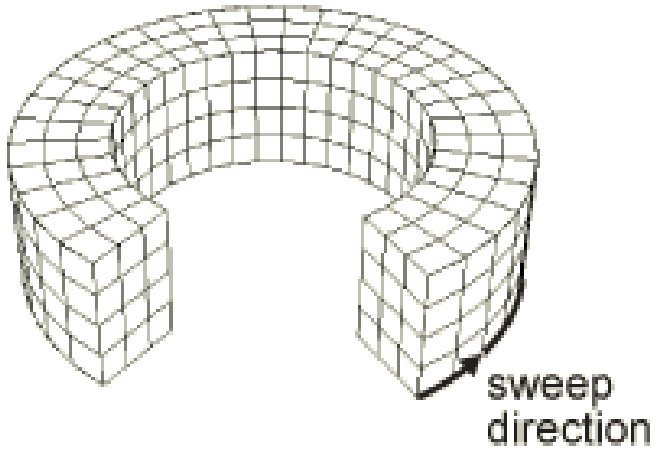
- **Top-down** meshing
  - **Structured** meshing
  - **Swept** meshing (source-target along path)
  - **Free** meshing
- **Unmeshable** part
  - **Bottom-up** meshing



ABAQUS Meshing

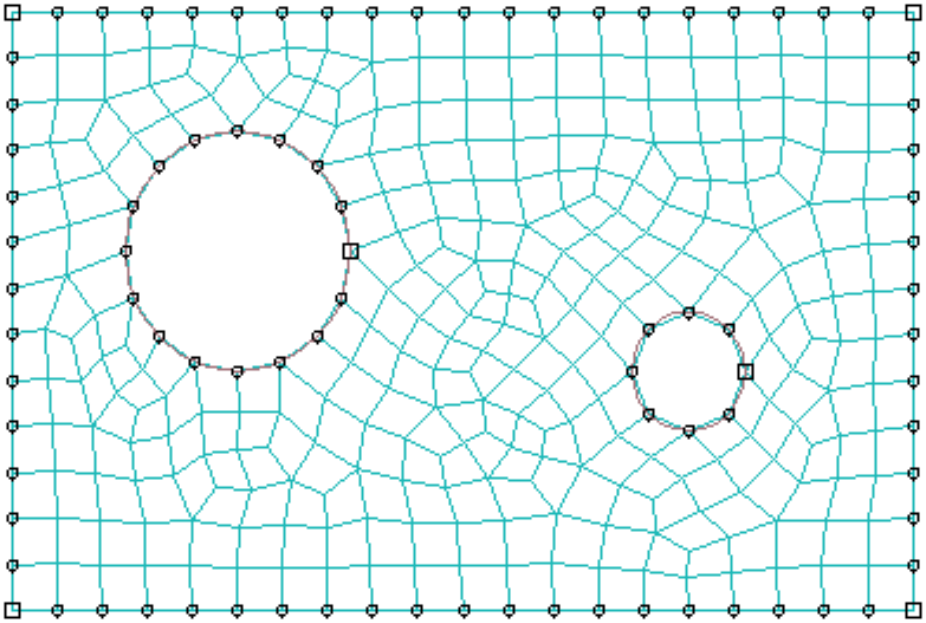
Swept Mesh





ABAQUS Meshing

Free Meshing



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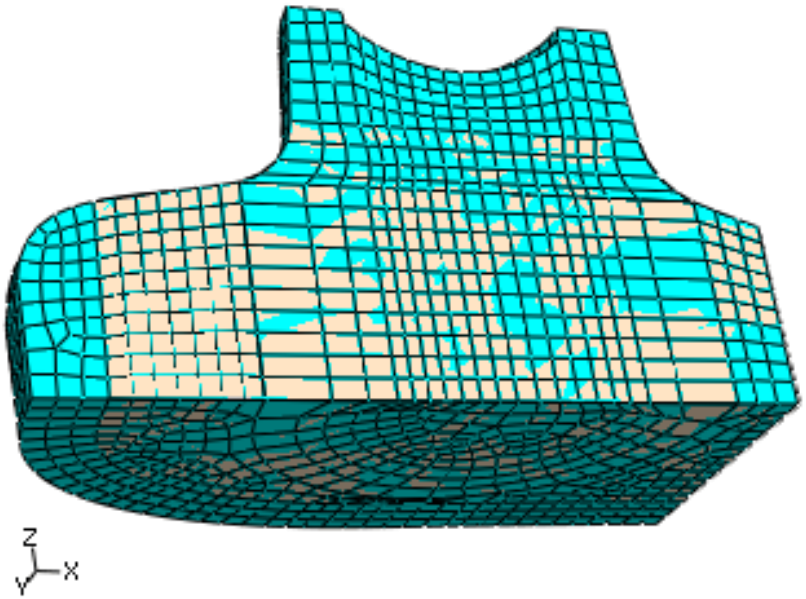
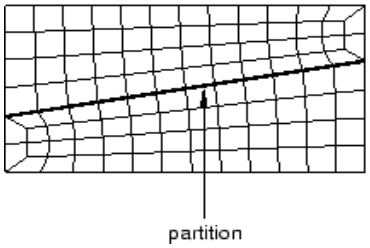
Bottom-Up Meshing

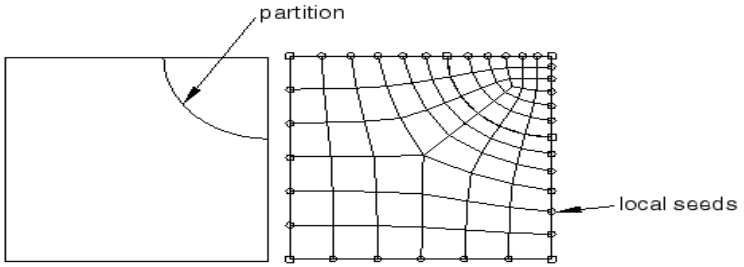


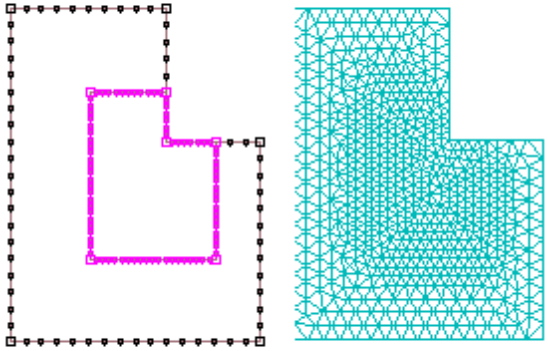
Example 17.11.10

ABAQUS Meshing

Refinement by Partitioning (structured)

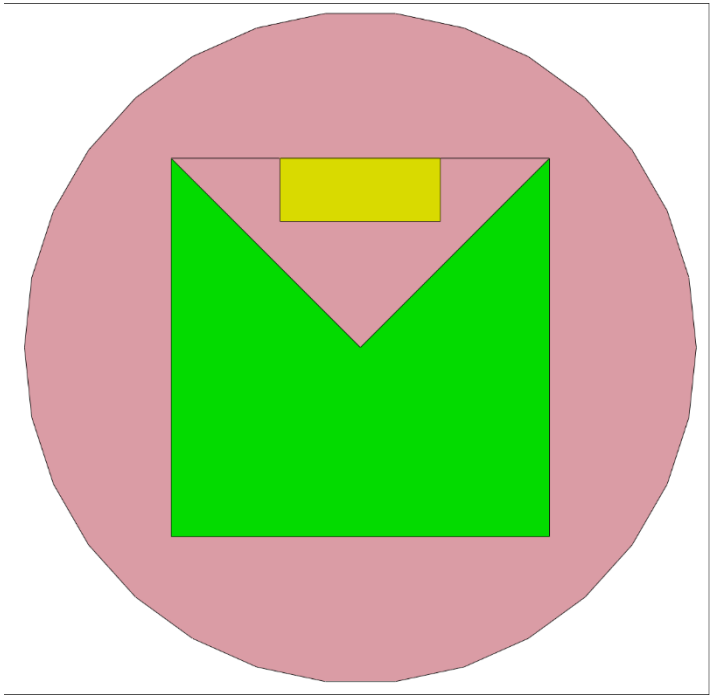


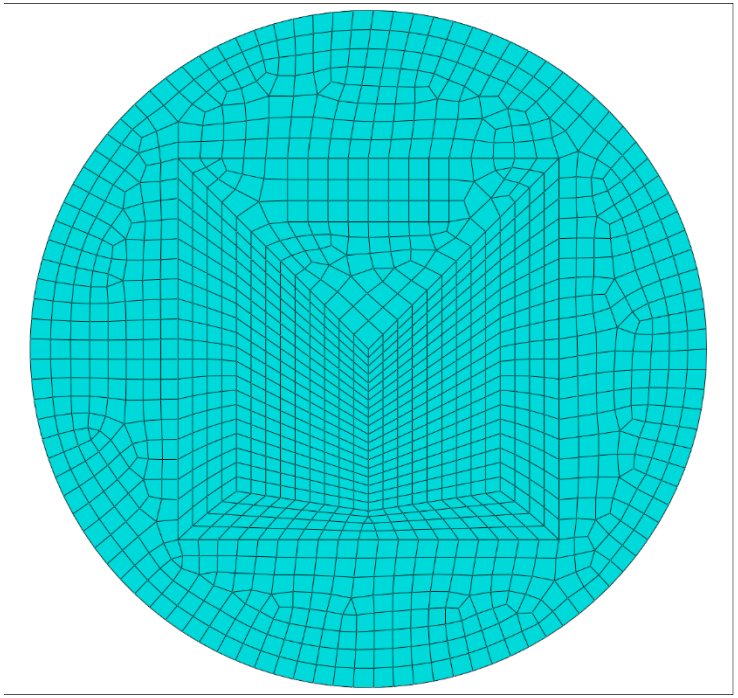




ABAQUS Meshing

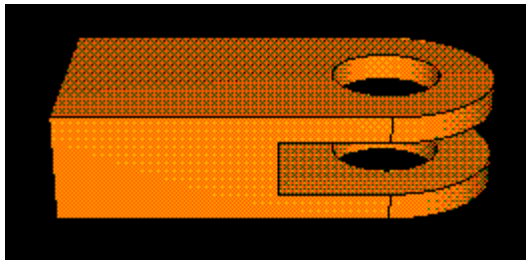
Refinement by Partitioning

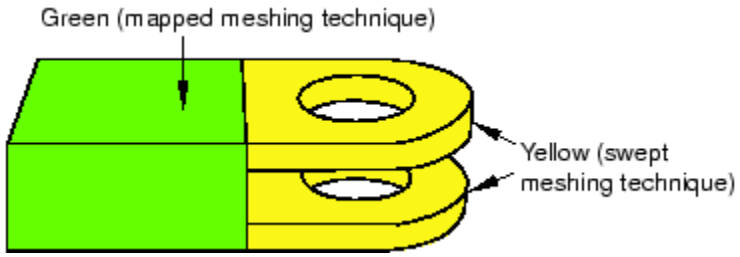


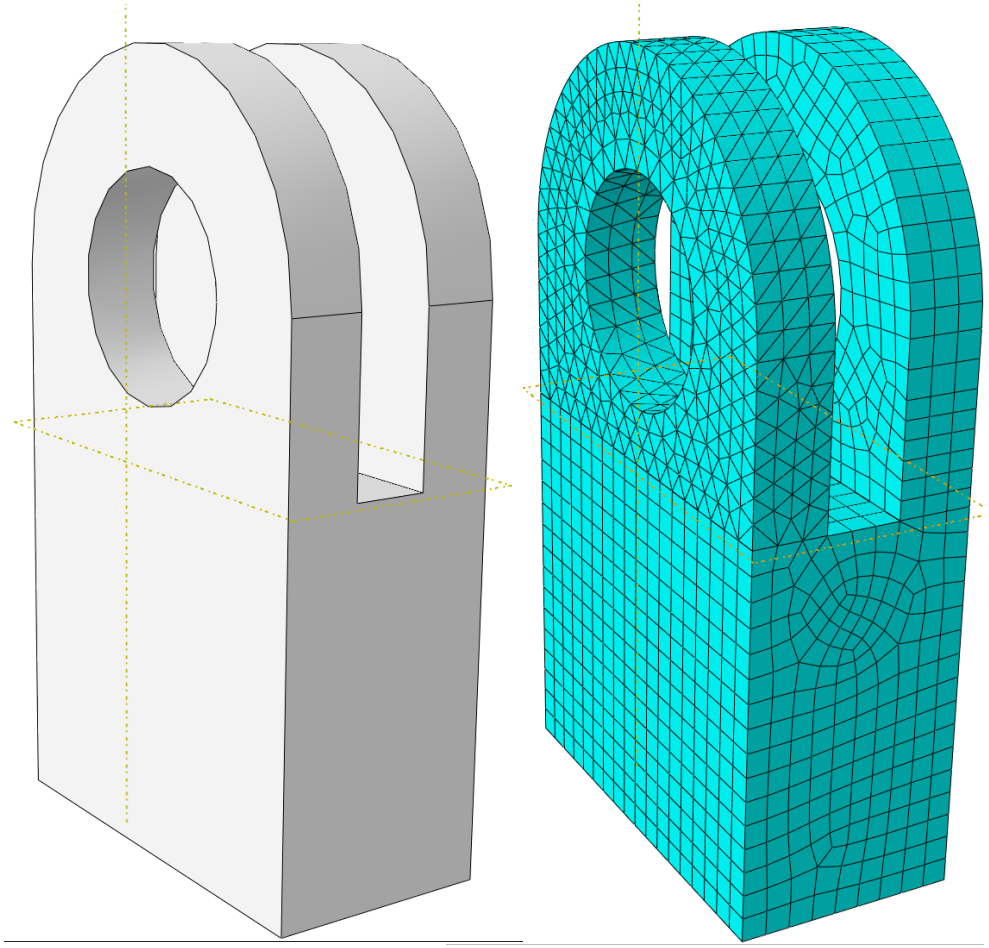


ABAQUS meshing

Refinement by Partition

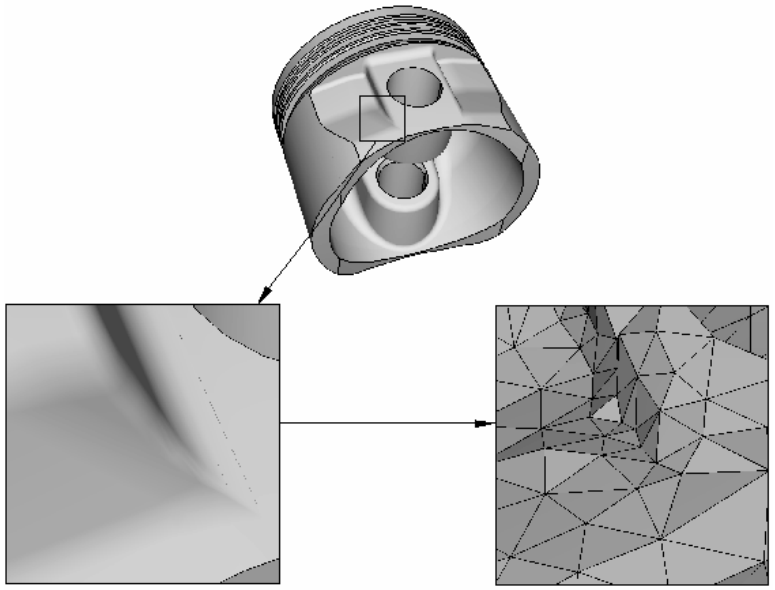


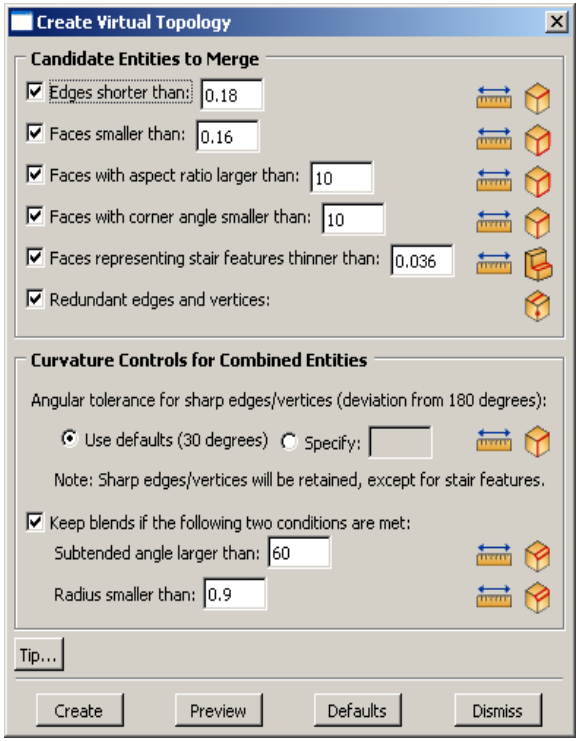




ABAQUS meshing

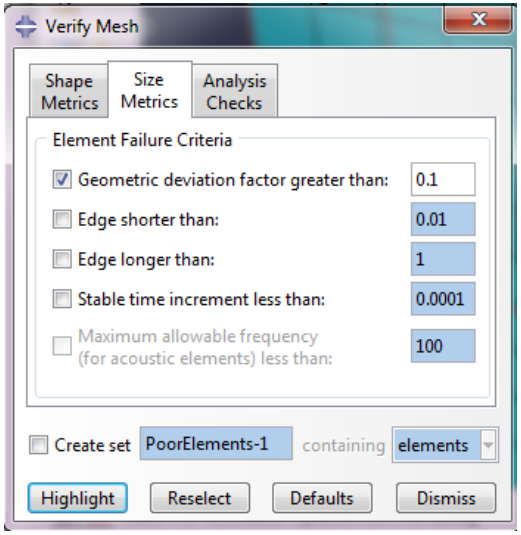
Refinement by virtual topology





ABAQUS meshing

Mesh Verification



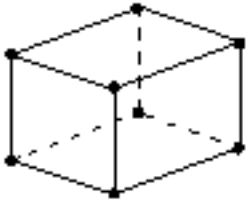
Aspect Ratio:
Ratio between longest and shortest edge of a element.

Shape Factor:
triangular and tetrahedral elements

Selection criterion	Quadrilateral	Triangle	Hexahedra	Tetrahedra	Wedge
Shape factor	N/A	0.01	N/A	0.0001	N/A
Smaller face corner angle	10	5	10	5	10
Larger face corner angle	160	170	160	170	160
Aspect ratio	10	10	10	10	10

ABAQUS Elements

Element Library



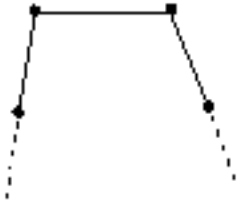
Continuum
(solid) elements

Shell
elements

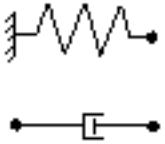
Beam
elements

Rigid
elements

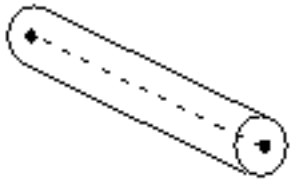
Membrane
elements



Infinite
elements



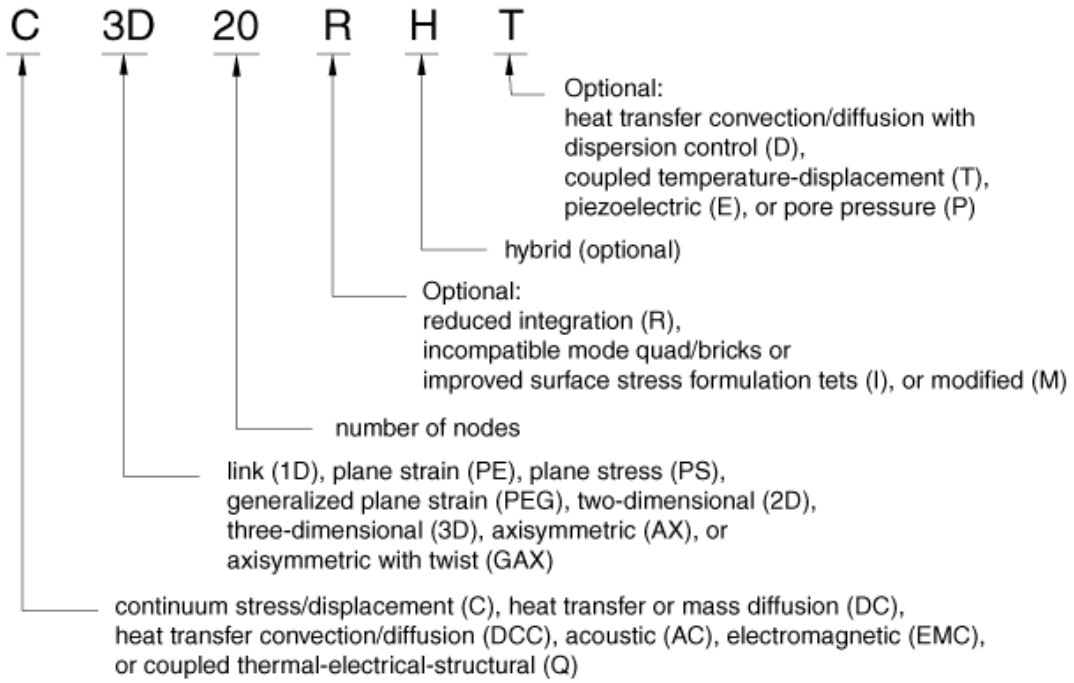
Springs and dashpots



Truss
elements

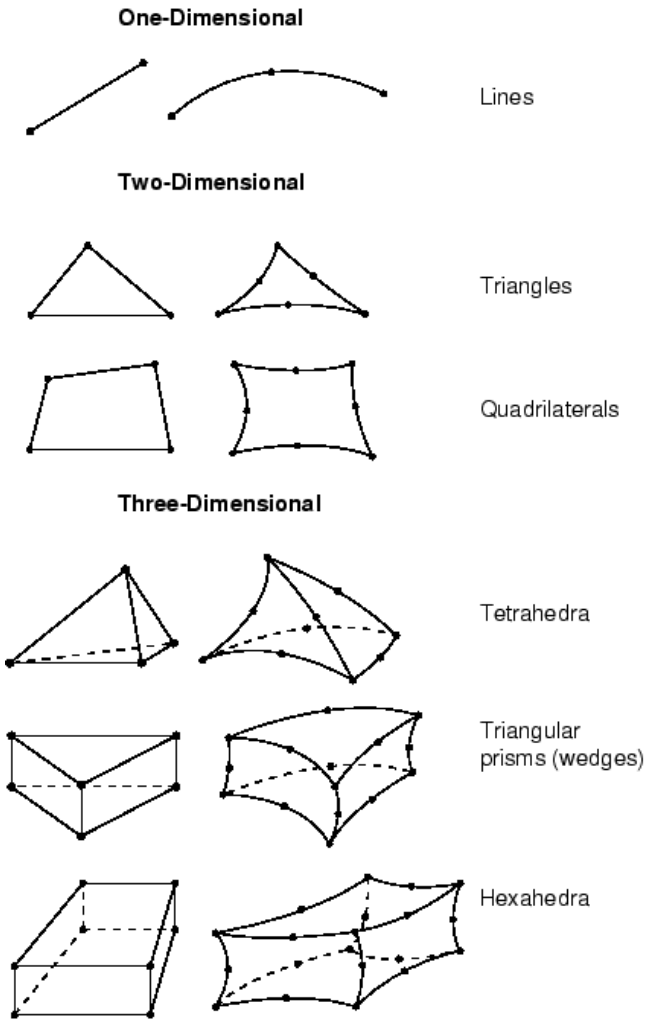
ABAQUS Elements

Element Naming Convention



ABAQUS Elements

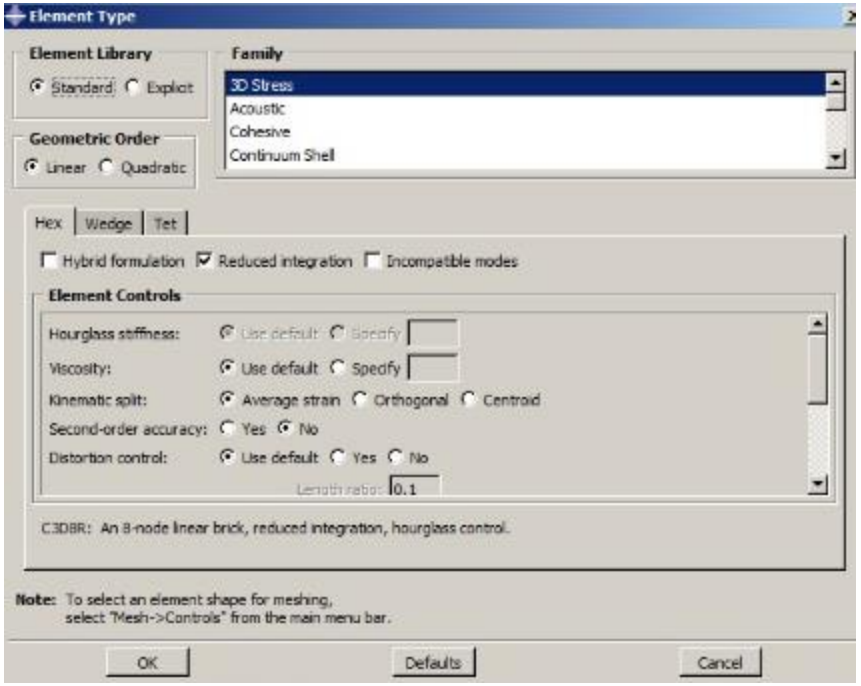
Element Selection & Properties



Topologically,

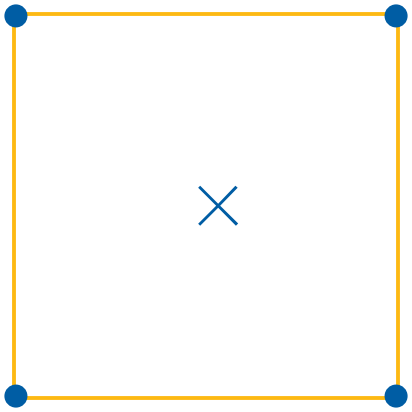
CPE4 = CAX4R = S4R = DC2D4 = AC2D4

No checking of DOFs in CAE

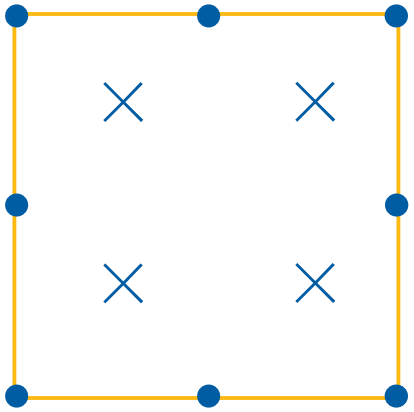


ABAQUS Elements

Reduced Integration



linear
(CPS4R
etc.)

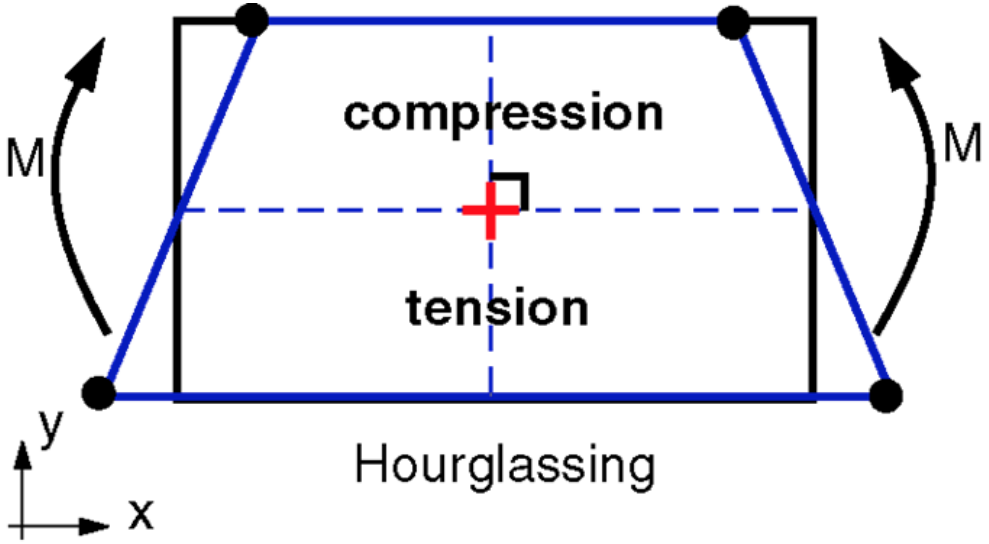


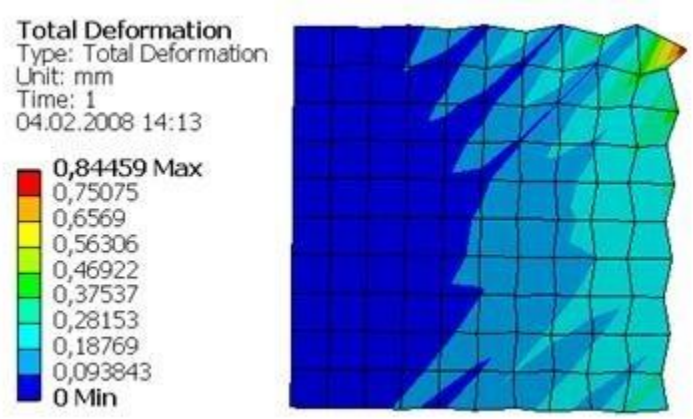
quadratic
(CPS8R
etc.)

C3D20R -> 27 ->8

ABAQUS Elements

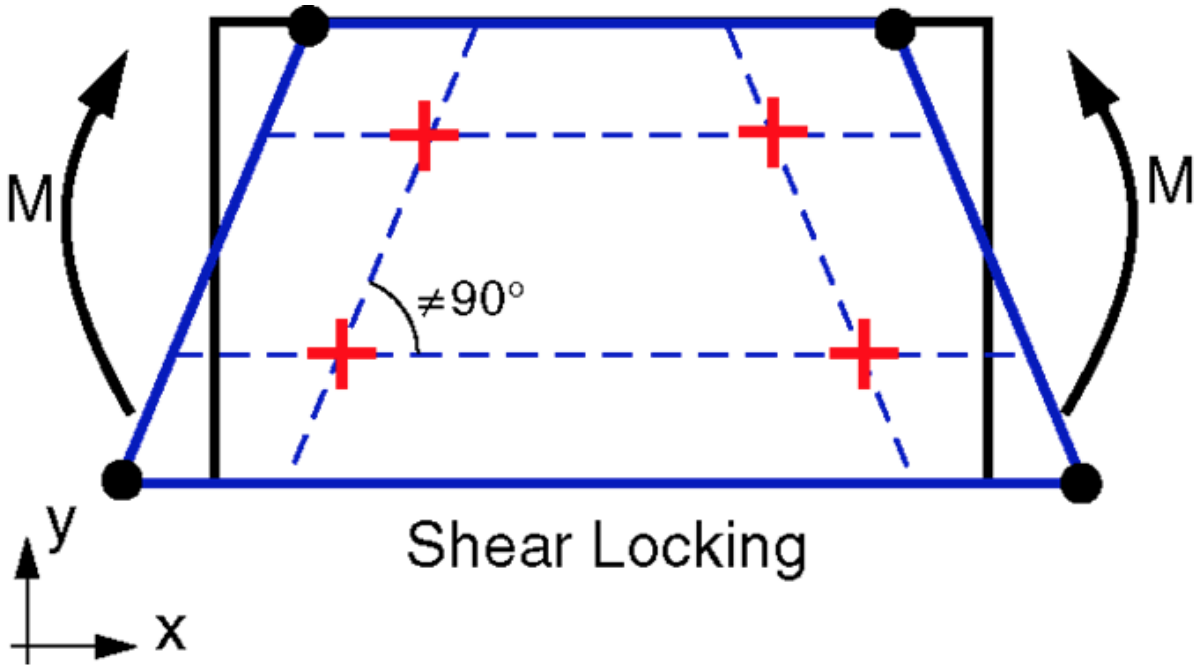
Hourglassing





ABAQUS Elements

Shear Locking



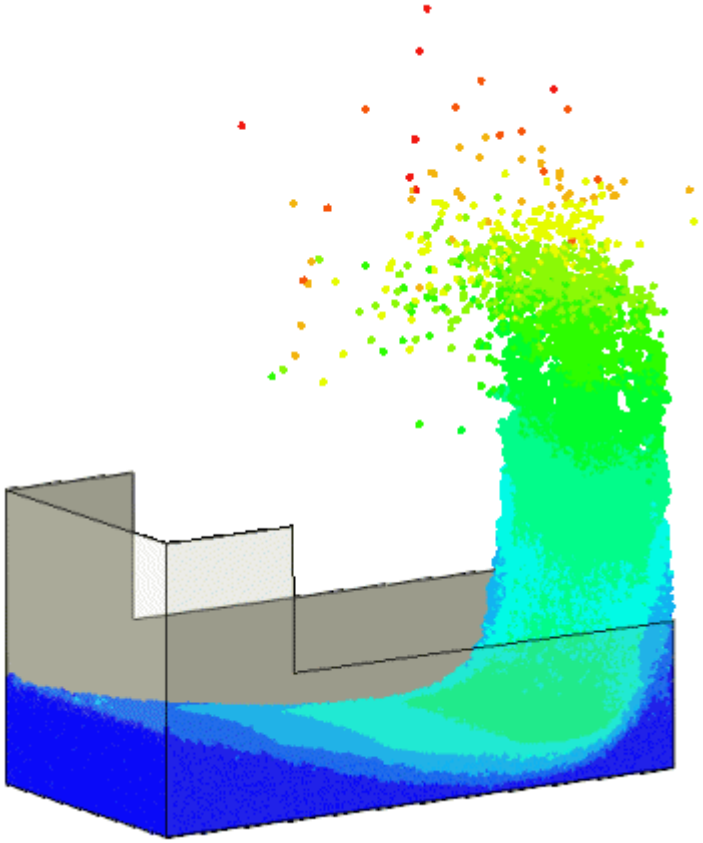
ABAQUS Elements

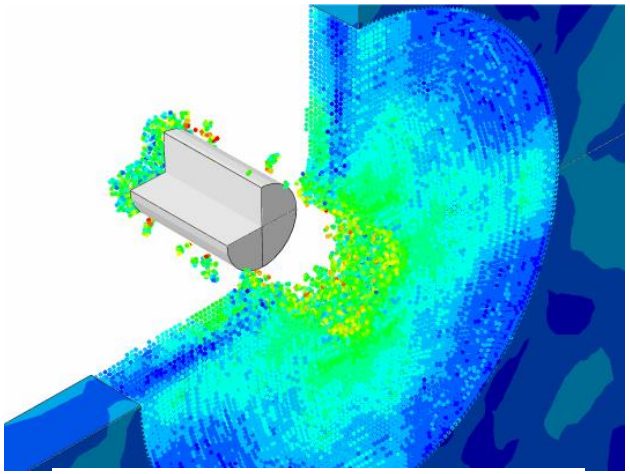
Formulation methods

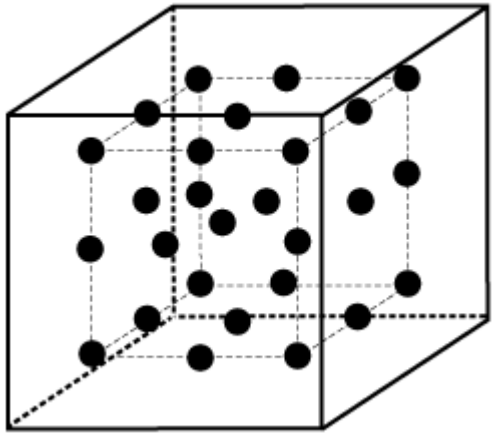
- Lagrangian - Mesh moves with material
- Eulerian – Mesh stays stationary
- ALE - Mesh moves independent of material

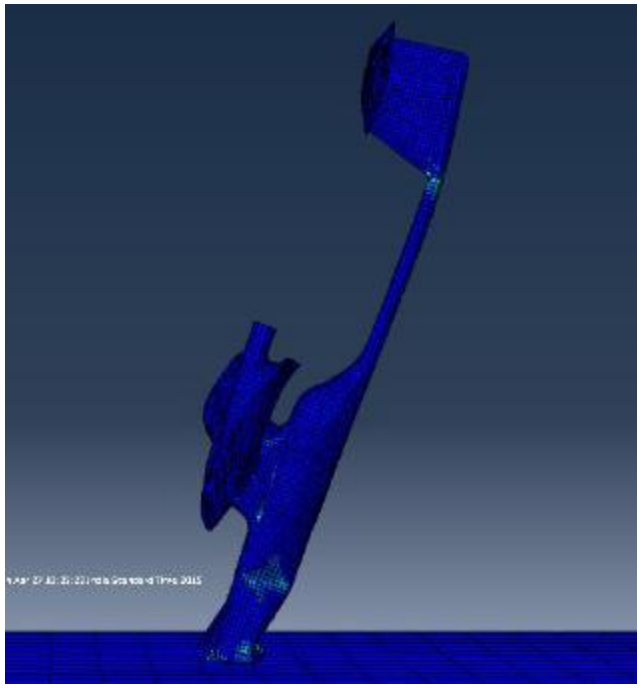
ABAQUS Elements

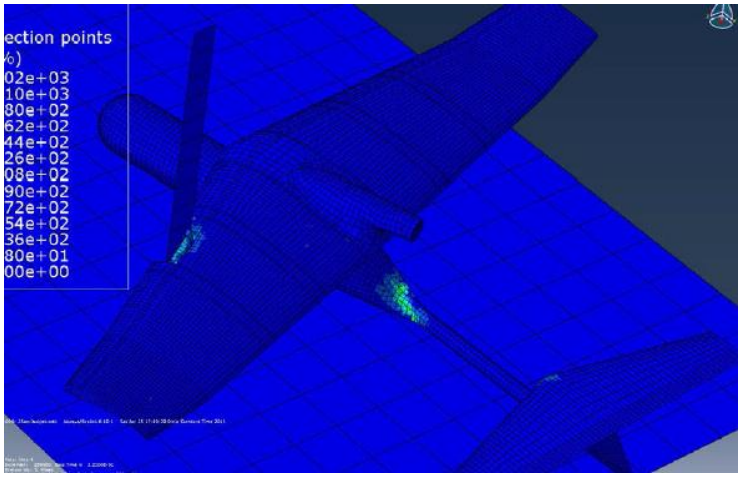
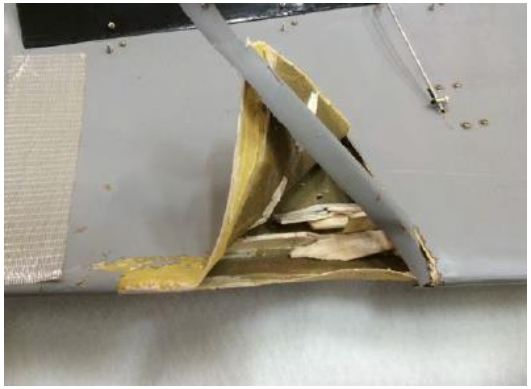
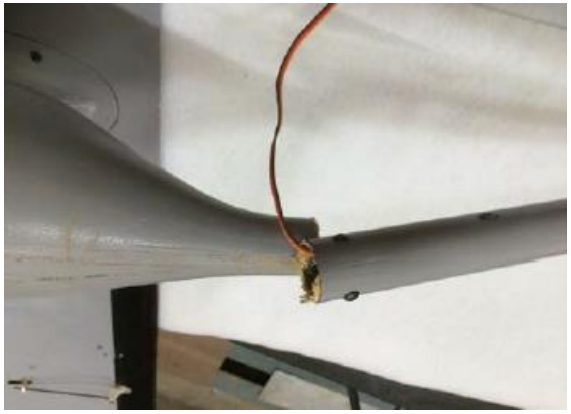
SPH/CEL (Smoothed Particle Hydrodynamics/Coupled Lagrangian Eulerian)
Mesh free methods







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%)
02e+03
10e+03
80e+02
62e+02
44e+02
26e+02
08e+02
90e+02
72e+02
54e+02
36e+02
80e+01
00e+00