اللهم عجل لولیک الفرج

Online Course

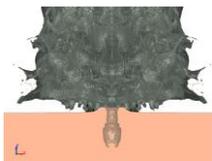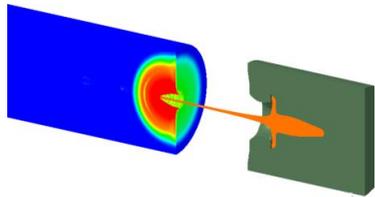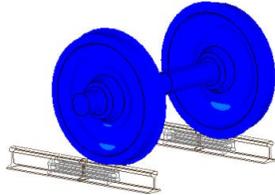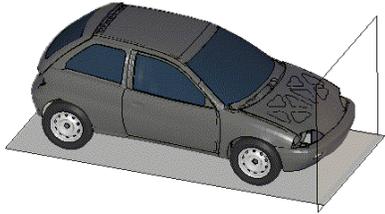# *Simulation and Numerical Modeling of Engineering Problems using*

LS-DYNA

Course instructor

Ahmad Rahmati-Alaei

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National University of Skills (NUS), Tehran, Iran
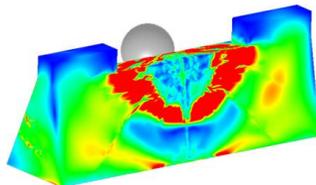
Part 3

1 **LS-DYNA Run Window (Details and sense switch command)**

2 **Element Types (Family, Shape, Degree, Formulation)**

3 **Bullet Penetration Simulation**

LS-DYNA Run Window (Details and time step calculation)


```
initialization completed
        1 t 0.0000E+00 dt 2.55E-06 flush i/o buffers            10/19/22 13:54:37
        1 t 0.0000E+00 dt 2.55E-06 write d3plot file            10/19/22 13:54:37
cpu time per zone cycle.............        0 nanoseconds
average cpu time per zone cycle....        0 nanoseconds
average clock time per zo                      onds

estimated total cpu time          =        0 sec (      0 hrs  0 mins)
estimated cpu time to complete    =        0 sec (      0 hrs  0 mins)
estimated total clock time        =      641 sec (      0 hrs 10 mins)
estimated clock time to complete  =      641 sec (      0 hrs 10 mins)
termination time                  = 2.000E+00
     3921 t 9.9983E-03 dt 2.55E-06 write d3plot file            10/19/22 13:54:38
     5000 t 1.2749E-02 dt 2.55E-06 flush i/o buffers            10/19/22 13:54:39
     7845 t 1.9998E-02 dt 2.55E-06 write d3plot file            10/19/22 13:54:40
    10000 t 2.5484E-02 dt 2.54E-06 flush i/o buffers            10/19/22 13:54:41
    11775 t 2.9999E-02 dt 2.54E-06 write d3plot file            10/19/22 13:54:41
    15000 t 3.8195E-02 dt 2.54E-06 flush i/o buffers            10/19/22 13:54:43
    15711 t 4.0000E-02 dt 2.54E-06 write d3plot file            10/19/22 13:54:43
    19653 t 4.9998E-02 dt 2.53E-06 write d3plot file            10/19/22 13:54:44
    20000 t 5.0877E-02 dt 2.53E-06 flush i/o buffers            10/19/22 13:54:44
    23604 t 5.9999E-02 dt 2.53E-06 write d3plot file            10/19/22 13:54:46
    25000 t 6.3528E-02 dt 2.53E-06 flush i/o buffers            10/19/22 13:54:46
    27563 t 6.9999E-02 dt 2.52E-06 write d3plot file            10/19/22 13:54:47
    30000 t 7.6143E-02 dt 2.52E-06 flush i/o buffers            10/19/22 13:54:48
    31531 t 7.9998E-02 dt 2.52E-06 write d3plot file            10/19/22 13:54:48
    35000 t 8.8719E-02 dt 2.51E-06 flush i/o buffers            10/19/22 13:54:50
    35510 t 9.0000E-02 dt 2.51E-06 write d3plot file            10/19/22 13:54:50
```
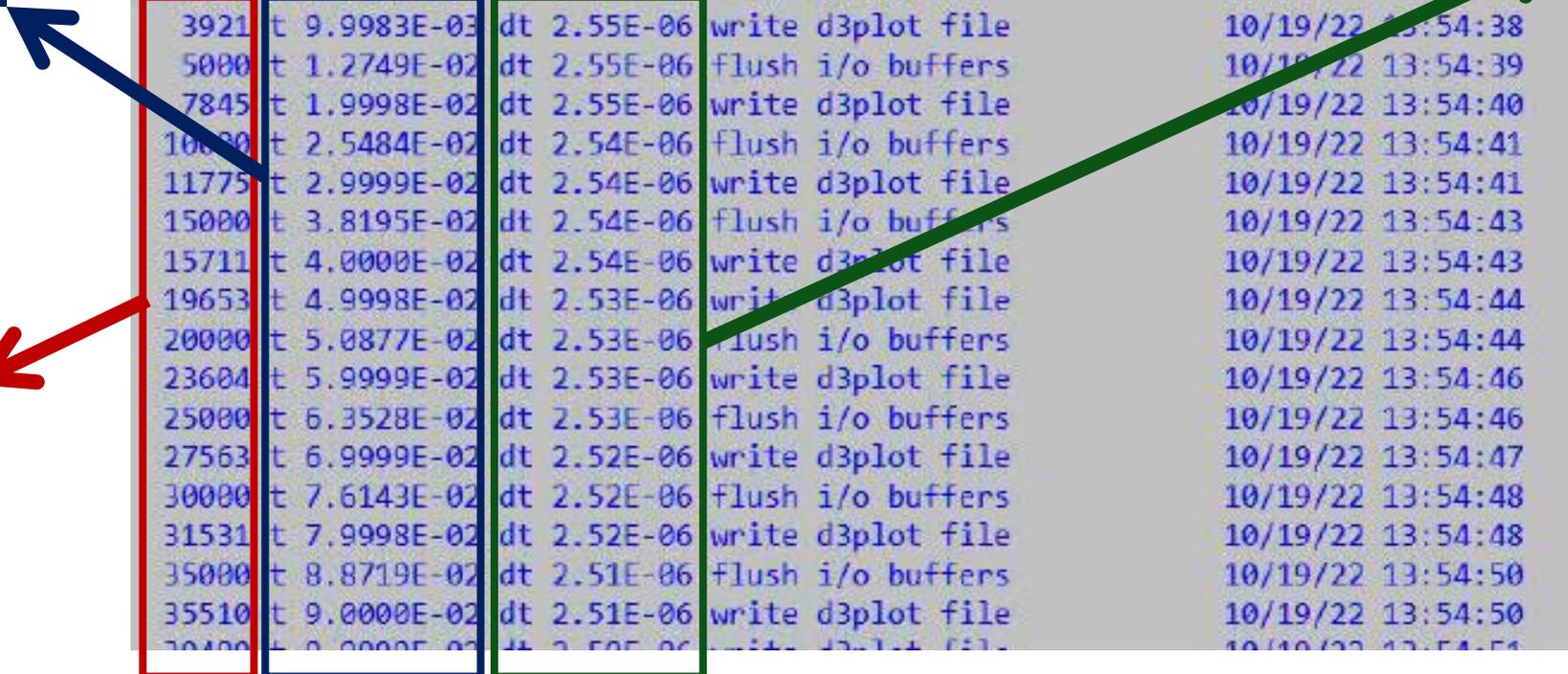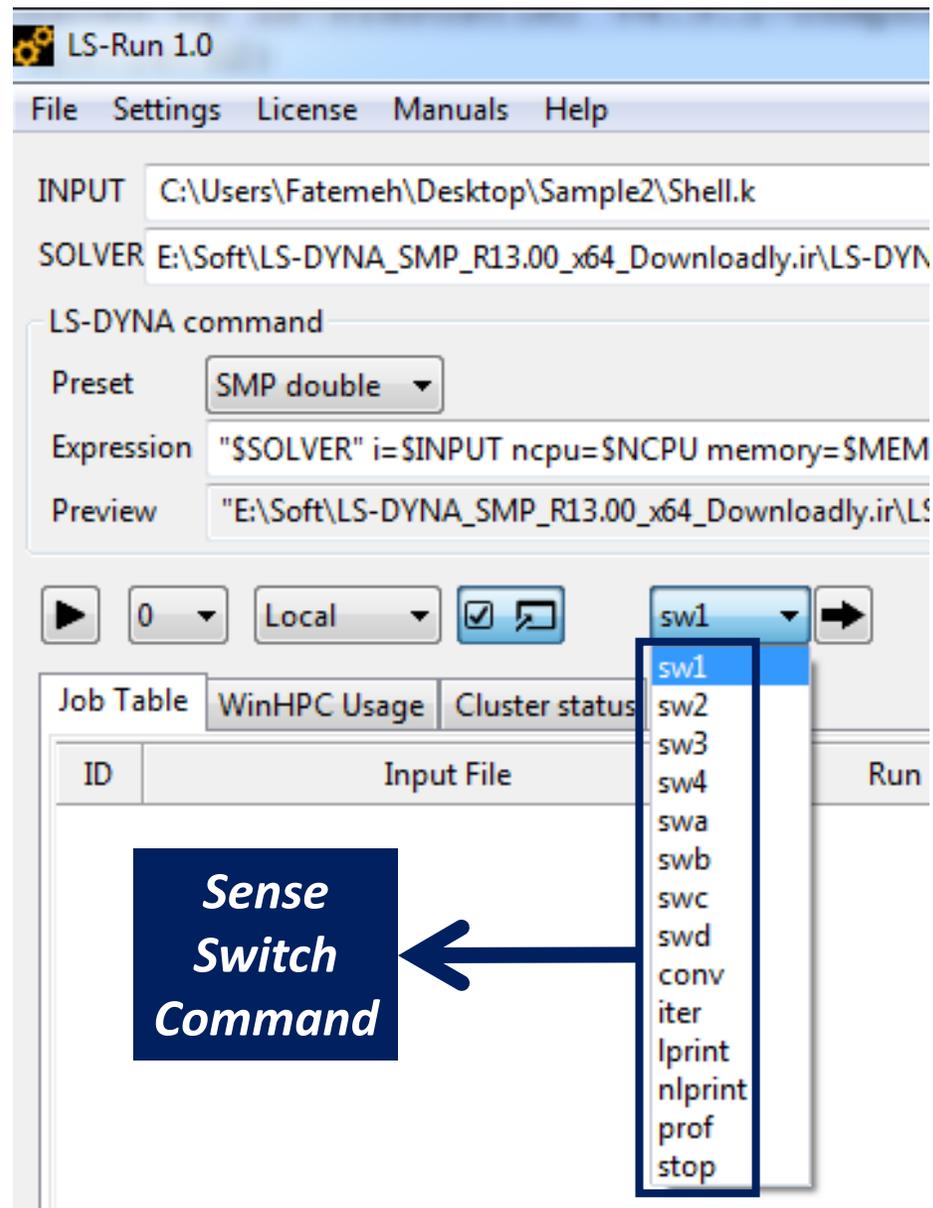
Estimation of run time

Time step of writing d3plot (Accoring to DT)

Time step of calculation (According to explicit method)

Cycle number of solution

LS-DYNA Run Window (Details and sense switch command)

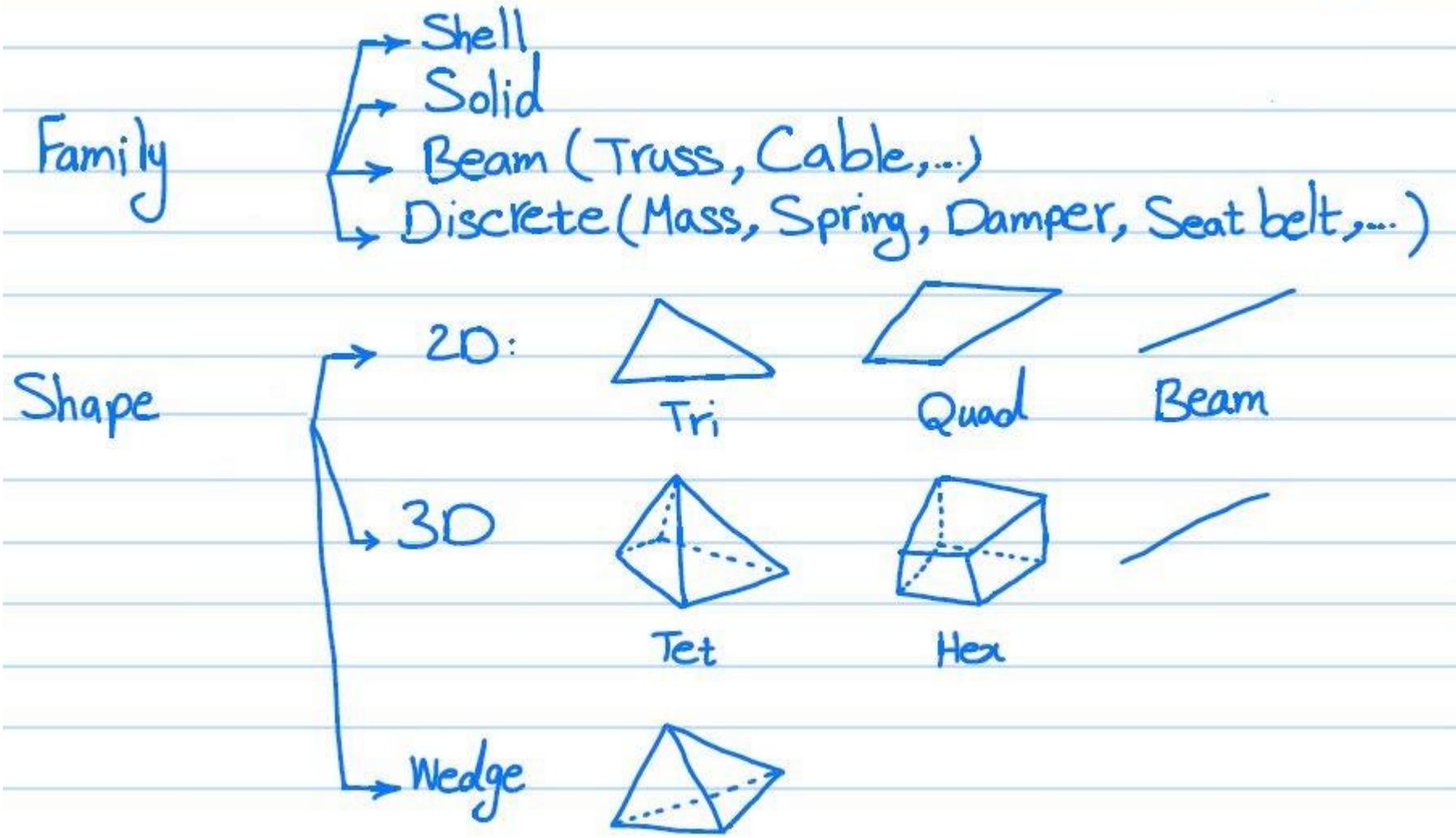sw1 - A restart (dump) file is written and LS-DYNA terminates.
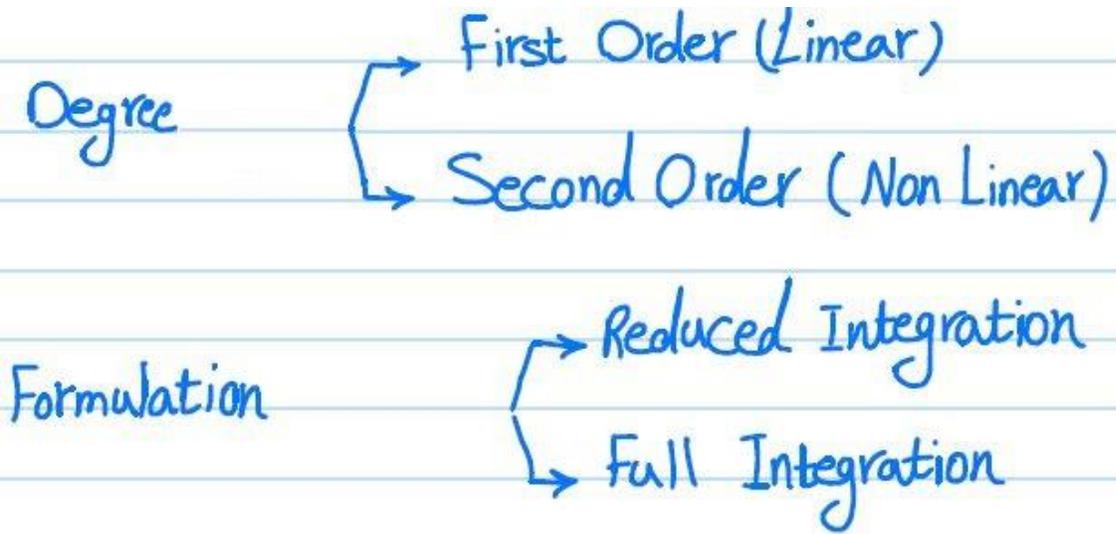
sw2 - LS-DYNA responds with time and cycle numbers.

sw3 - A restart file is written and LS-DYNA continues.

Element Types (Family, Shape, Degree, Formulation)

Family
- Shell
- Solid
- Beam (Truss, Cable, ...)
- Discrete (Mass, Spring, Damper, Seat belt, ...)

Shape

2D:

Tri   Quad   Beam

3D

Tet   Hex

Wedge

Element Types (Family, Shape, Degree, Formulation)

Degree
- First Order (Linear)
- Second Order (Non Linear)

Formulation
- Reduced Integration
- Full Integration

	Full Integration	Reduced Integration
First Order Linear	1 —— 2 × × × × 4 —— 3	1 —— 2 × 4 —— 3
Second Order Non Linear	1 —— 5 —— 2 × × × 8 × × × 6 × × × 4 —— 7 —— 3	1 —— 5 —— 2 × × 8 6 × × 4 —— 7 —— 3

Bullet Penetration Simulation
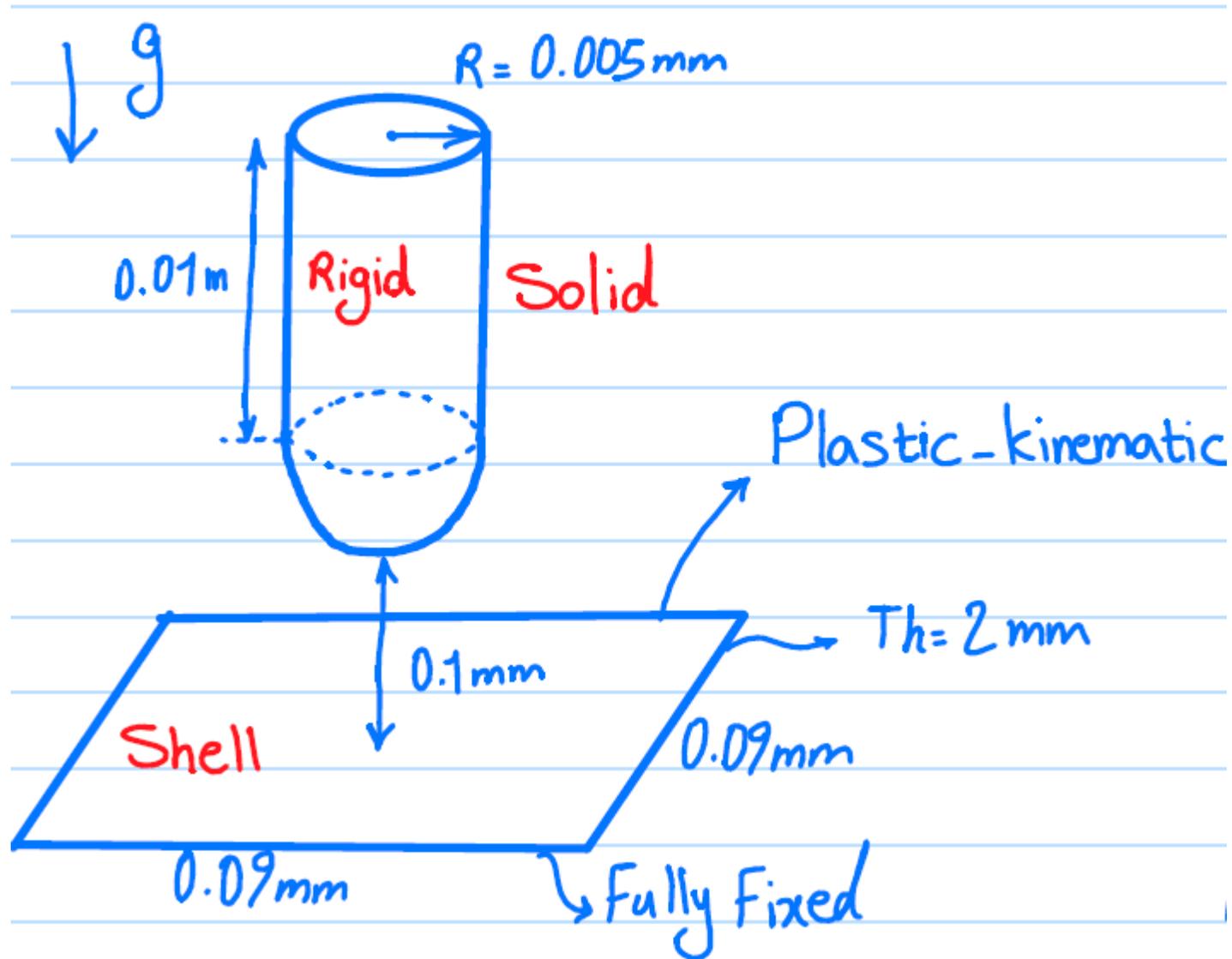
Geometry	• *No need in this simulation (New and practical without any geometry creation)*
Mesh	• **Shape Mesher / Element Editing / Element Generation**
Boundary Condition	• **Boundary -> SPC SET**
Material	• **MAT -> Plastic Kinematic (MAT 003)** • **MAT -> Rigid (MAT 020)**
Section	• **Section -> Shell** • **Section -> Solid**
Velocity	• **Initial -> Velocity Generation**
Termination	• **Control -> Termination**
Time Step	• **Database -> Binary D3plot**
Contact	• **Definition of interaction of two Lagrangian parts** • **Contact -> Automatic Surface to Surface**
Gravity	• **Define -> Curve** • **Load -> Body**

Course instructor

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