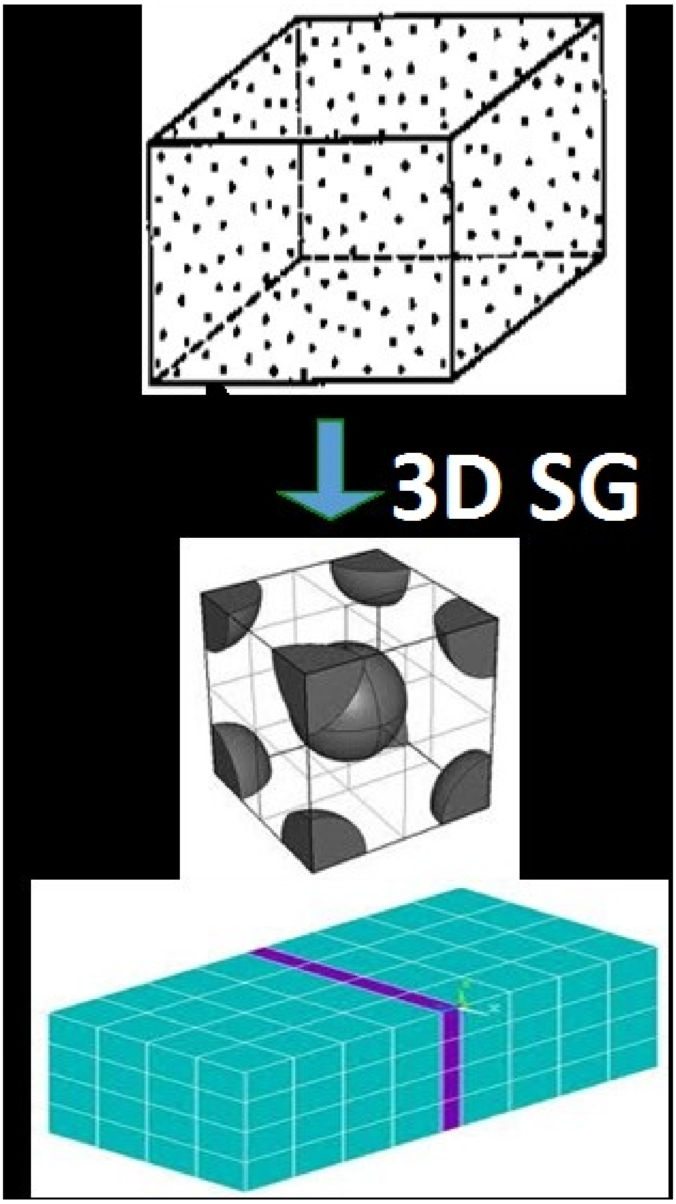
Predictions of 3D effective properties of particle reinforced composites



Let the material properties of the particle and matrix be: Particle-E-glass: E_{11} =80 GPa, v_{12}=0.2000 and

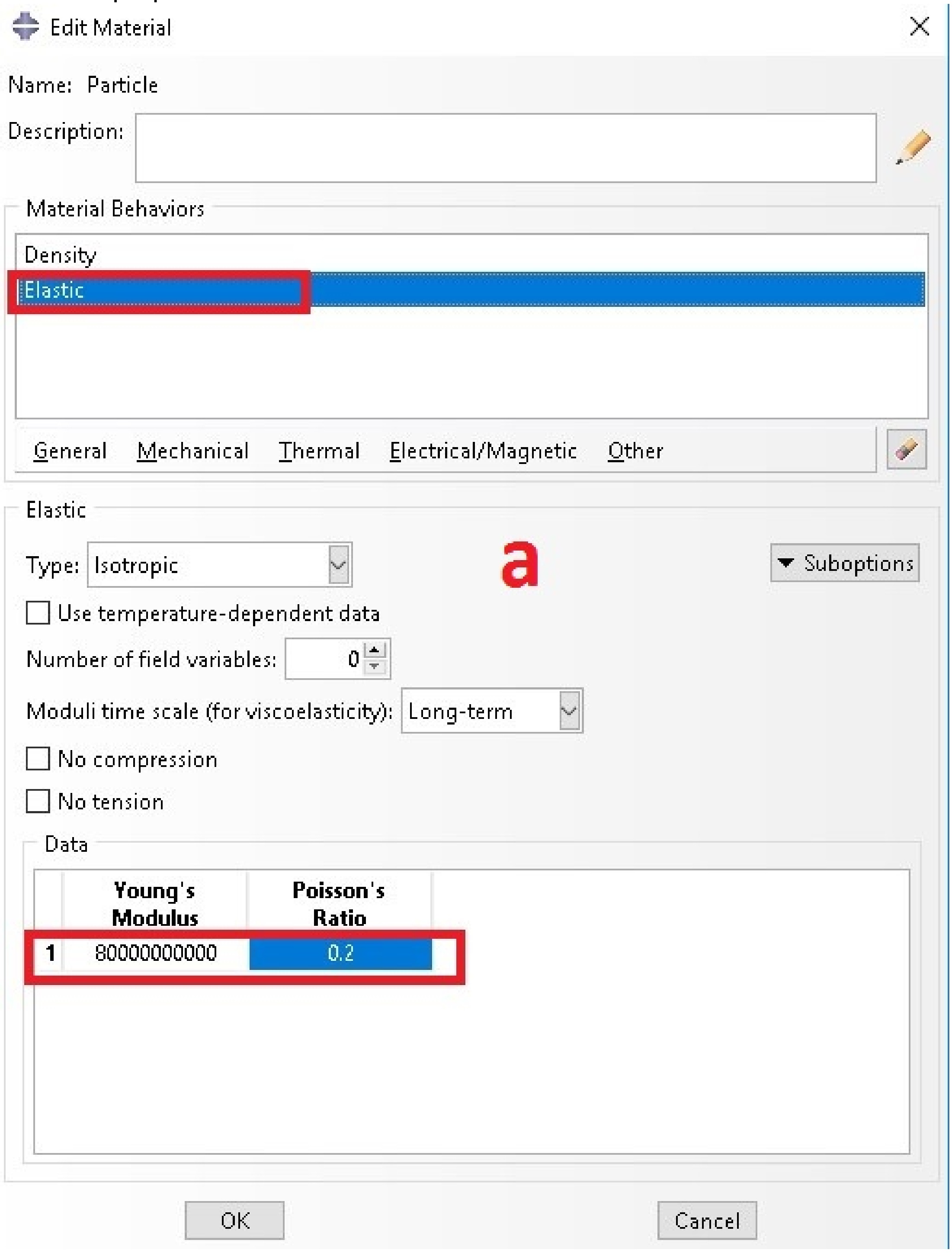
Matrix: E =3.35GP, ?=0.35

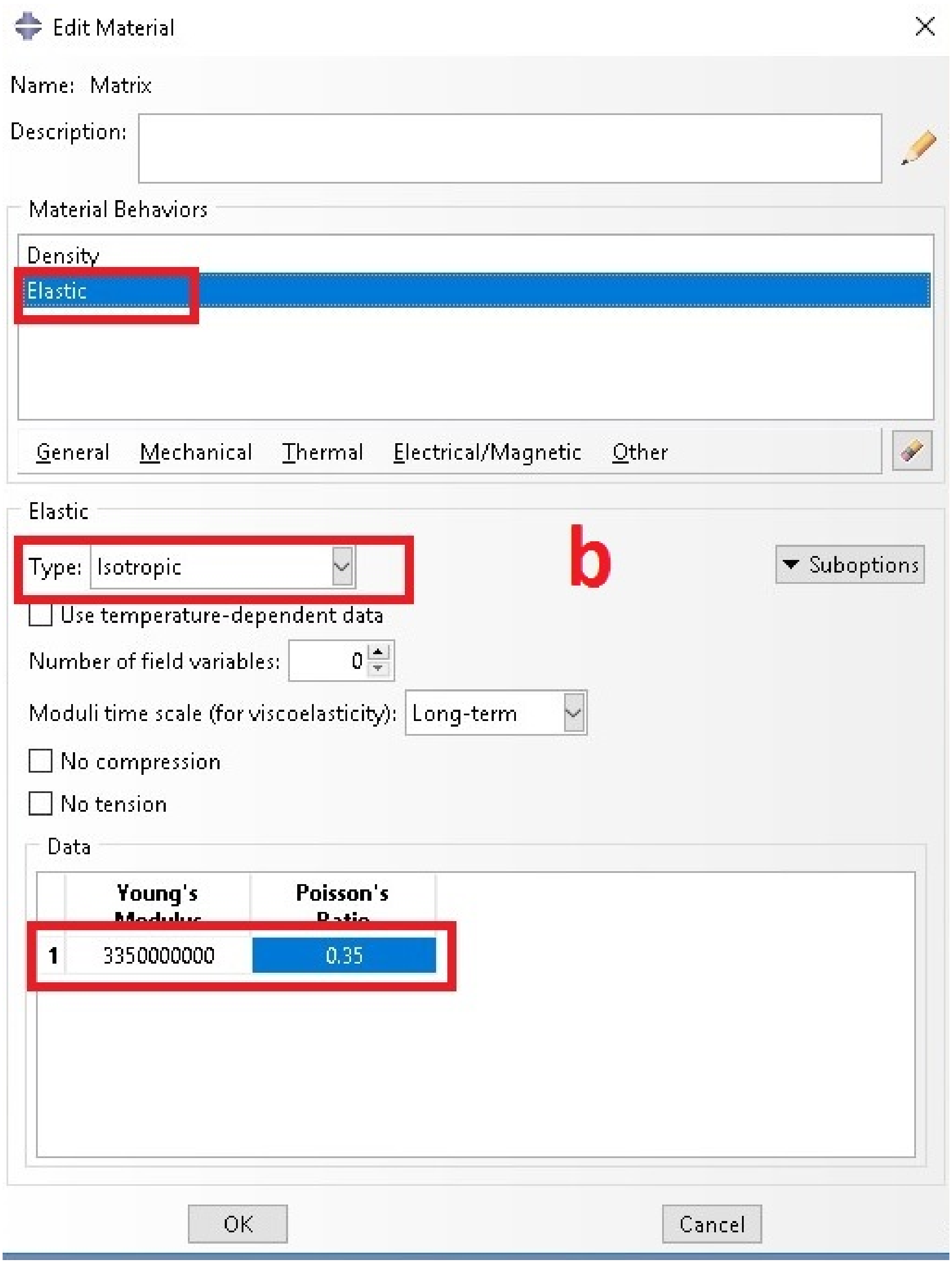
Particle volume of fraction is assumed to be 50%

The material properties are obtained from: “Soden, P. D., Hinton M. J. and Kaddour, A. S., Lamina properties, lay-up configurations and loading conditions for a range of fibre reinforced composite laminates. Compos. Sci. Technol., 1998, 58(7), 1011”
youtube link:
https://youtu.be/XdmrqaI3wtw

Step 1: Input material properties

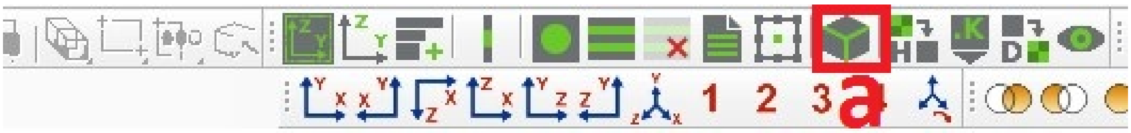
There are two materials namely particle/inclusion and matrix
a. Inclusion properties
b. Matrix properties



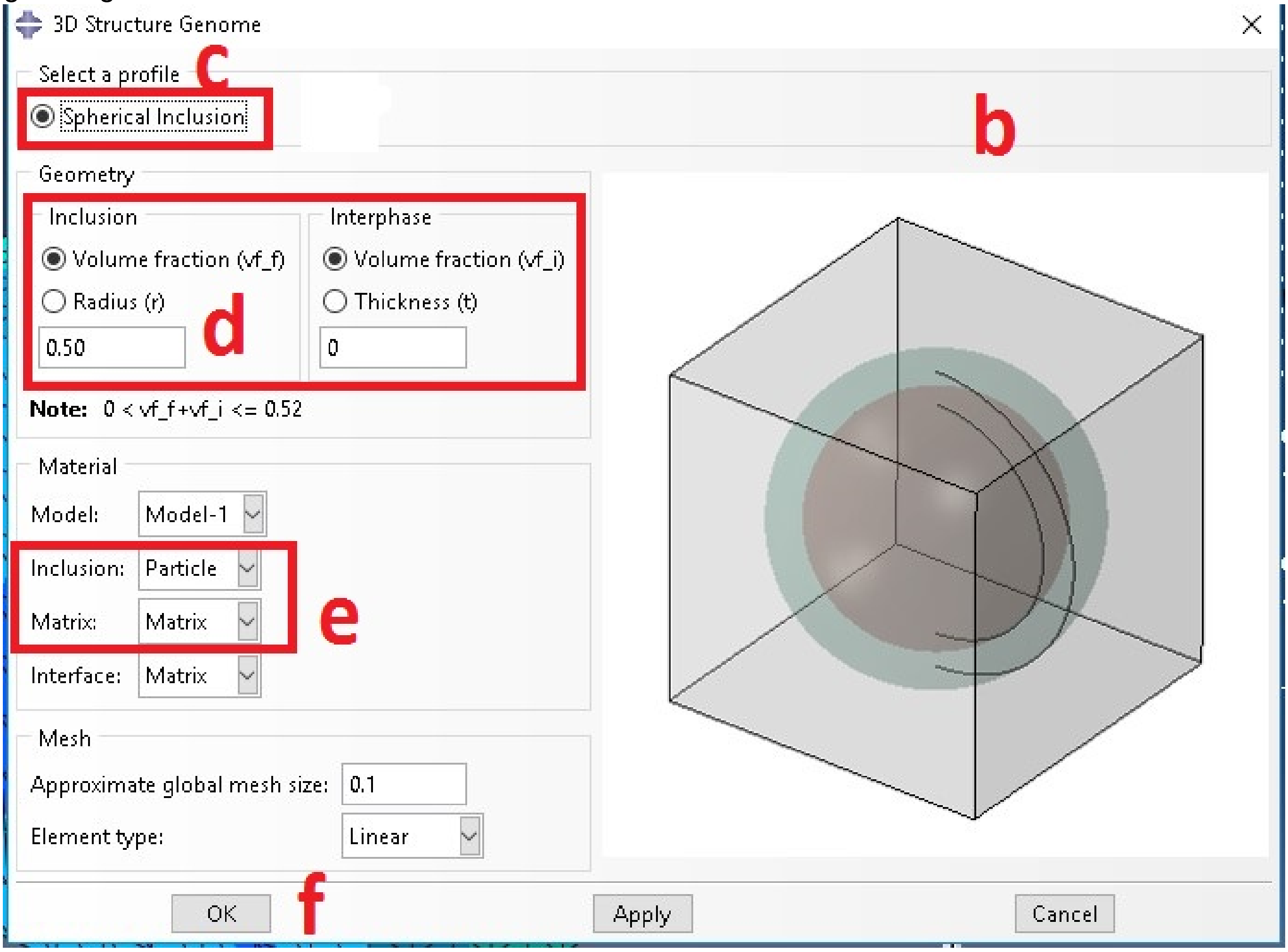


Step 2: Select appropriate SG

a. Select 3D SG that represent the current example

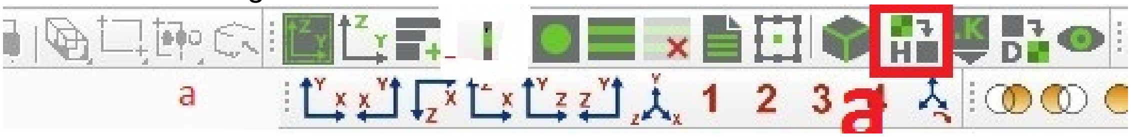


b. 3D SG wizard shows up
c. Select spherical inclusion as microstructure
d. Add inclusion volume fraction
e. Select material properties for inclusion and matrix
f. Click on OK to generate the SG
g. See generated 2D SG



Step 3- Homogenization- 3D effective properties

a. Click on Homogenization



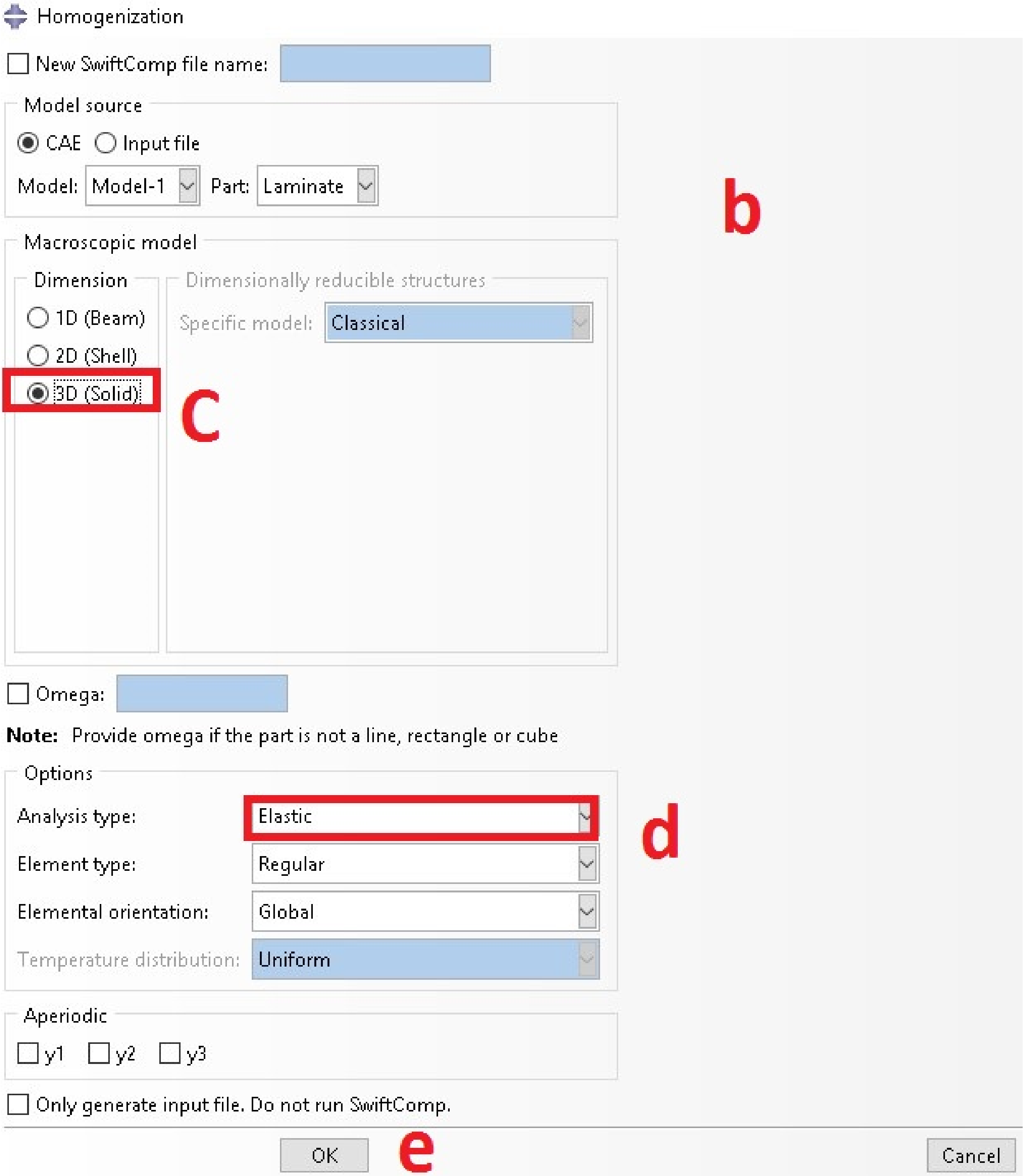
b. Homogenization wizard shows up (see below)

c. Select 3D (solid) Model

d. Select analysis type, elastic

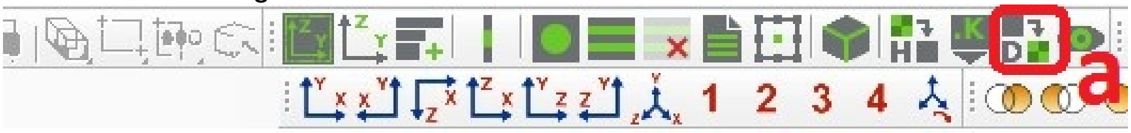
e. Click on OK to start homogenization

f. See the predicted 3D effective properties


Homogenization
New SwiftComp file name:
Model source
CAE
Input file
Model:
Model-1
Part:
Laminate
b
Macroscopic model
Dimension
1D (Beam)
2D (Shell)
3D (Solid)
Dimensionally reducible structures
Specific model:
Classical
c
Omega:
Note: Provide omega if the part is not a line, rectangle or cube
Options
Analysis type:
Elastic
d
Element type:
Regular
Elemental orientation:
Global
Temperature distribution:
Uniform
Aperiodic
y1
y2
y3
Only generate input file. Do not run SwiftComp.
OK
e
Cancel

Step 4: Perform dehomogenization

a. Select dehomogenzation

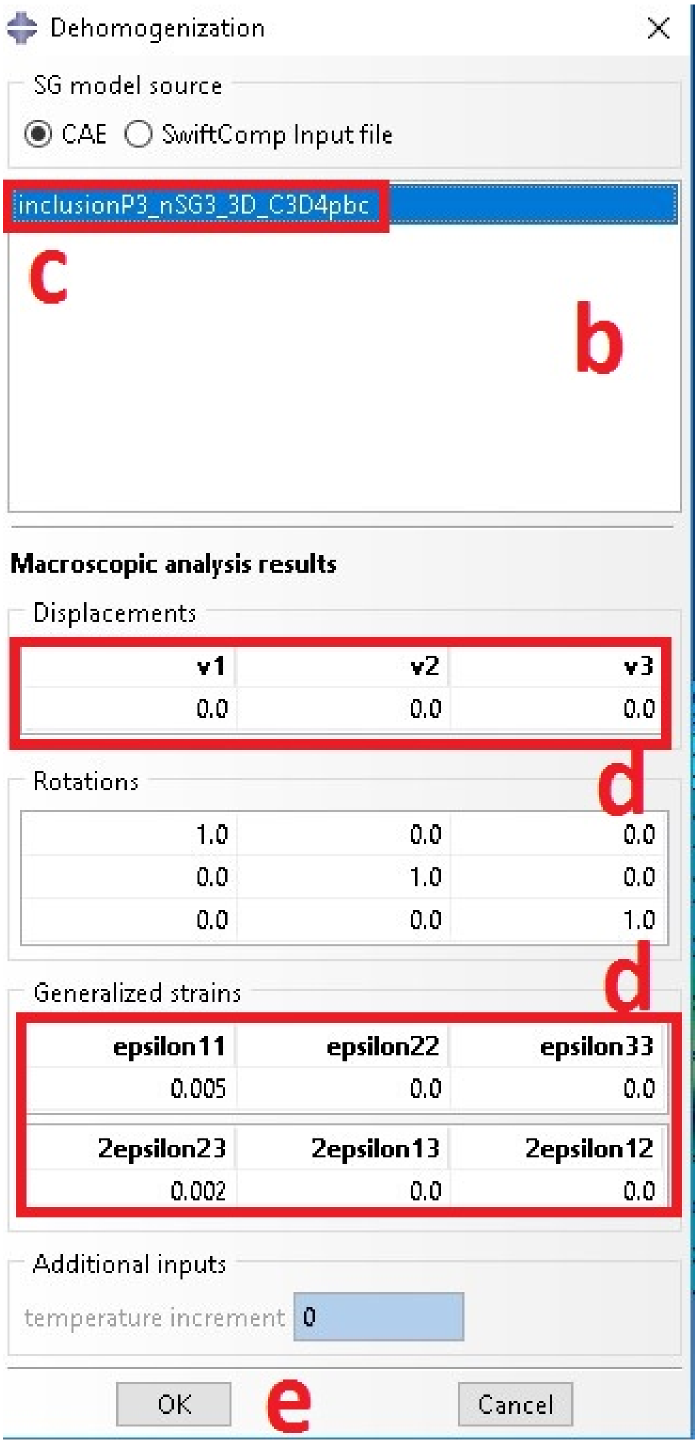


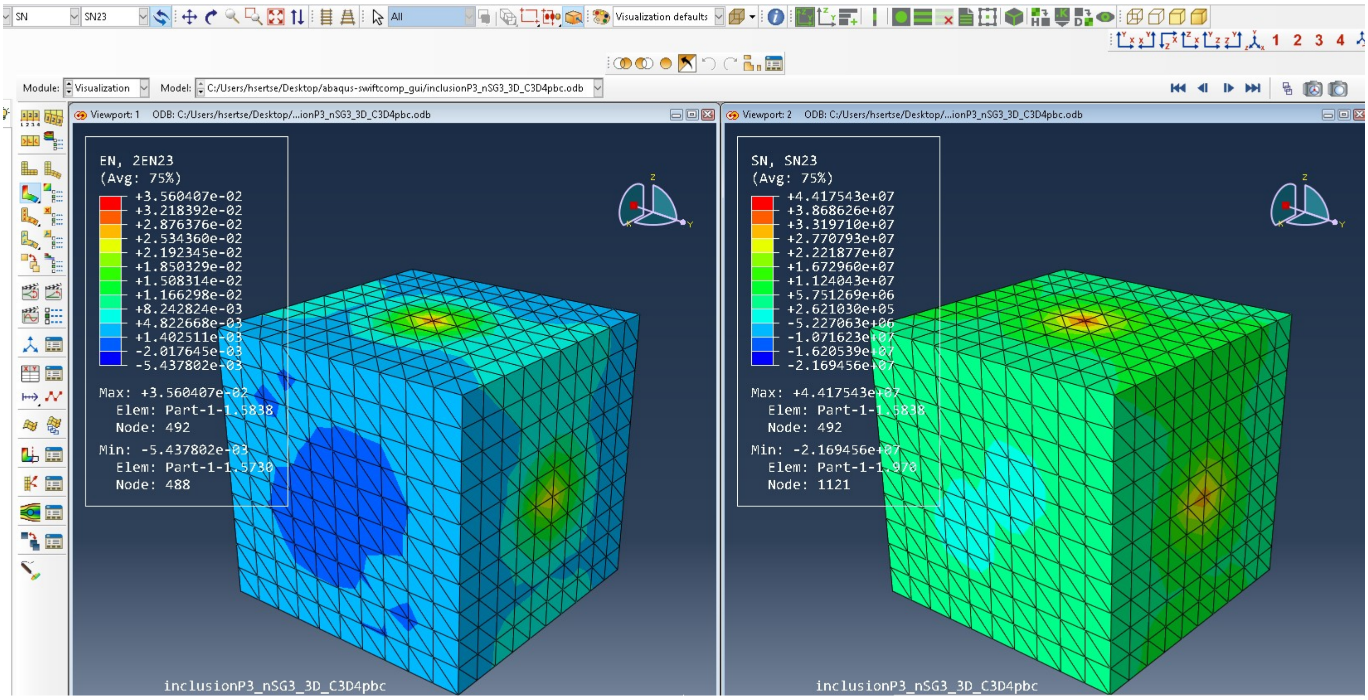
b. Dehomogenization wizard shows up

c. Select opt file

d. Add displacement to recovery displacement or strain loading to recover both local strain and stress, for current example problem let e_{11} be 0.005 and $2e_{23}$ be 0.002 e. Click on OK to start dehomogenization

f. See, dehomogenization


Dehomogenization
SG model source
CAE
SwiftComp Input file
inclusionP3_nSG3_3D_C3D4pbc
c
b
Macroscopic analysis results
Displacements
v1
v2
v3
0.0
0.0
0.0
d
Rotations
1.0 0.0 0.0
0.0 1.0 0.0
0.0 0.0 1.0
d
Generalized strains
epsilon11
epsilon22
epsilon33
0.005
0.0
0.0
2epsilon23
2epsilon13
2epsilon12
0.002
0.0
0.0
Additional inputs
temperature increment
0
OK
e
Cancel



youtube link:
https://youtu.be/XdmrqaI3wtw