

Use of Z-mat with Abaqus

Z-set group

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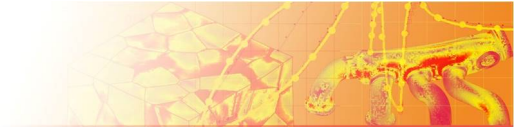


Plan



- 1 Use of Z-mat with Abaqus
- 2 Post-treatment of Abaqus results files with Zmaster/Z-post
- 3 Links with Zsopt for calibration

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Modifications to the Abaqus input file

Z-mat material file: **fz**

Abaqus input file:
cyclic_abaqus.inp

```
*NODE ...
*SOLID SECTION,ELSET=EALL,MATERIAL=fz
*MATERIAL,NAME=fz
*DEPVAR
  19
*USER MATERIAL,CONSTANTS=1
0.0
*STEP ..
```

```
***material
*integration theta_method_a 1. 1.e-10 50
***behavior gen_evп
**elasticity
  young 200000.
  poisson 0.300000
**potential gen_evп ep
*critерion mises
*flow plasticity
*isotropic nonlinear
  R0 300.000
  Q 100.000
  b 10.0000
*kinematic nonlinear
  C 25000.0
  D 50.0000
***return
```

Command: \$ Zmat cyclic_abaqus

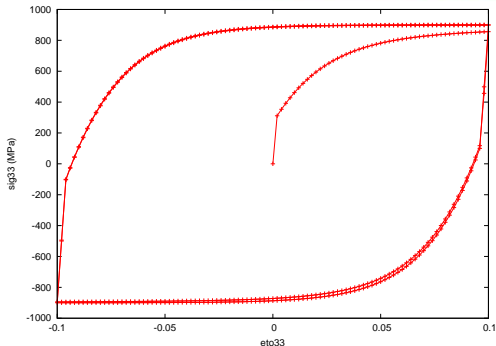
Zpreload utility

- Checks the behavior definition
- Printouts the names and number of SDVs needed by the Z-mat model
- Command: `$ Zpreload zf`
- 3D default output, for 2D use `Zpreload -d 2 ...`

```
Reading behavior in file: zf
=====
..
var_int Name:
  eel11(sdv1) eel22(sdv2) eel33(sdv3) eel12(sdv4) eel23(sdv5)
  eel31(sdv6)
  epcum(sdv7)
  al111(sdv8) al122(sdv9) al133(sdv10) al112(sdv11) al123(sdv12)
  al131(sdv13)

var_aux Name:
  epi11(sdv14) epi22(sdv15) epi33(sdv16) epi12(sdv17) epi23(sdv18)
  epi31(sdv19)
=====
done with material file reading...
```

Example: strain-controlled symmetric cyclic test



- FE mesh with a single element (c3d8)
- 2 cycles applied in 8 Abaqus steps

▶ Zmat -fg cyclic_abaqus

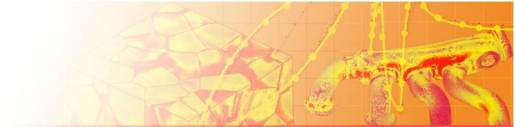
▶ Edit .inp

▶ Edit .sta

▶ Viewer

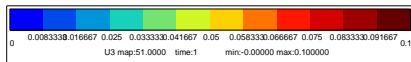
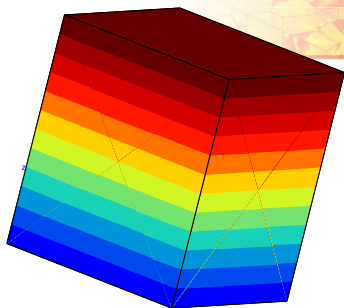
▶ Open terminal

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Reading odb files with the Zmaster GUI



- Alternative to abaqus viewer
- Basic graphical post-treatment operations
- Preserve Z-mat's SDV names
- Iso-contours at integration points



Zodb -G cyclic_abaqus.odb

Running Z-post on odb files

- General batch post-processing
- Damage post-processing
- Reading/Writing of odb files

```
****post_processing
***data_source odb
**open cyclic_abaqus.odb
***data_output odb
**problem_name zpost_for_abaqus
***local_post_processing
...
**process range
*var sig
****return
```

► [Zodb -pp zpost_for_abaqus](#)

► [Viewer](#)

► [Open terminal](#)

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Single element Abaqus vs Z-sim



- Common material file for model calibration and FE analysis
- Definition of the cyclic test using Z-sim
- Driving of Abaqus in SimOpt using external simulations
- Advantages of Z-sim for calibration:
 - easy definition (no mesh, boundary conditions, steps etc..)
 - very fast (mandatory for automatic optimization)

▶ [Zsopt cyclic](#)

▶ [Open terminal](#)