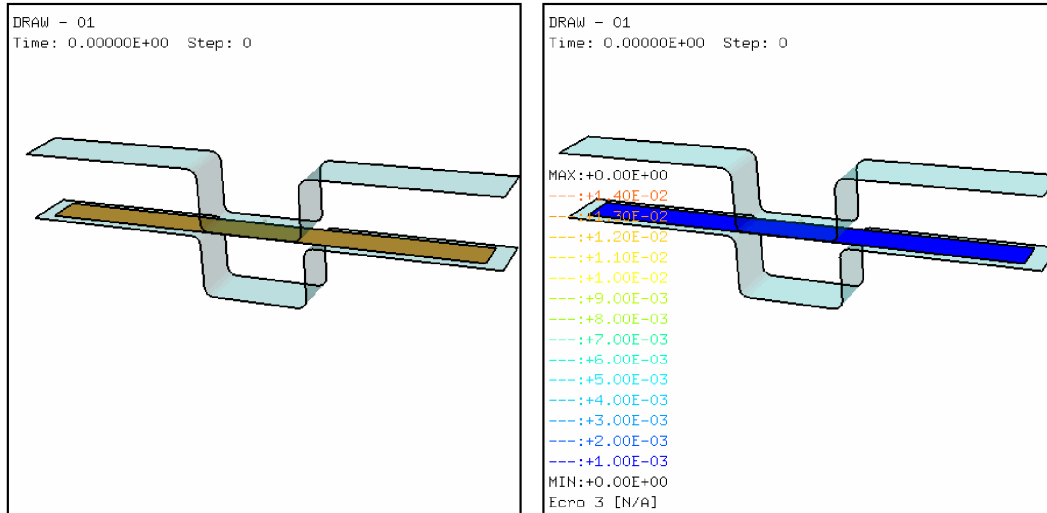


## Example 6a – Deep drawing A



*Deformation*

*Plastic strain*

30

### Problem description:

This example is the deep drawing of a thin elasto-plastic metal strip which is pressed between a punch and a die.

The simulation assumes a rigid, fixed die and a rigid punch which is moving at constant velocity.

The model assumes perfect sliding between the contacting parts (no friction).

### Numerical Solutions

#### **DRAW01**

This model uses 3904 elements of the Q4GS type to represent the piece, the punch and the die. Contact is prescribed by the GLIS directive between the piece and the punch and between the piece and the die.

The input file is:

```
DRAW - 01
*
ECHO
/CONV WIN
*-----Type of problem
TRID NONL
AMOR
*-----Sizing
DIME
PT3L 2 PT6L 4297
ZONE 2
PMAT 2
Q4GS 3904
ECRO 858884
BLOQ 25782
GLIS 2 5000
DOLI 5109 PCOE 5109
DEPL 5109
TABL 2 12 FNOM 2 PTAB 12
MTPO 1 MTEL 1

TERM
*-----Geometry (Mesh)
GEOM '(3E22.15)' '(7I110)' POIN 4299
PMAT 2
Q4GS 3904
TERM
*-----Nodal Coordinates
-1.000000000000000E-01 0.000000000000000E+00 5.000000000000000E-03
... (omissis)
3514 3515 4297 3512 3513 3514
*-----Additional geometrical data
COMP
GROU 8 'masses' LECT 1 2 TERM
'die' LECT 3 PAS 1 1562 TERM
'punch' LECT 1563 PAS 1 3122 TERM
'piece' LECT 3123 PAS 1 3906 TERM
'cmait' LECT 3123 PAS 1 3906 TERM
'cesc1' LECT 1563 PAS 1 3122 TERM
'cesc2' LECT 3 PAS 1 1562 TERM
'e_alit' LECT 1 TERM
```

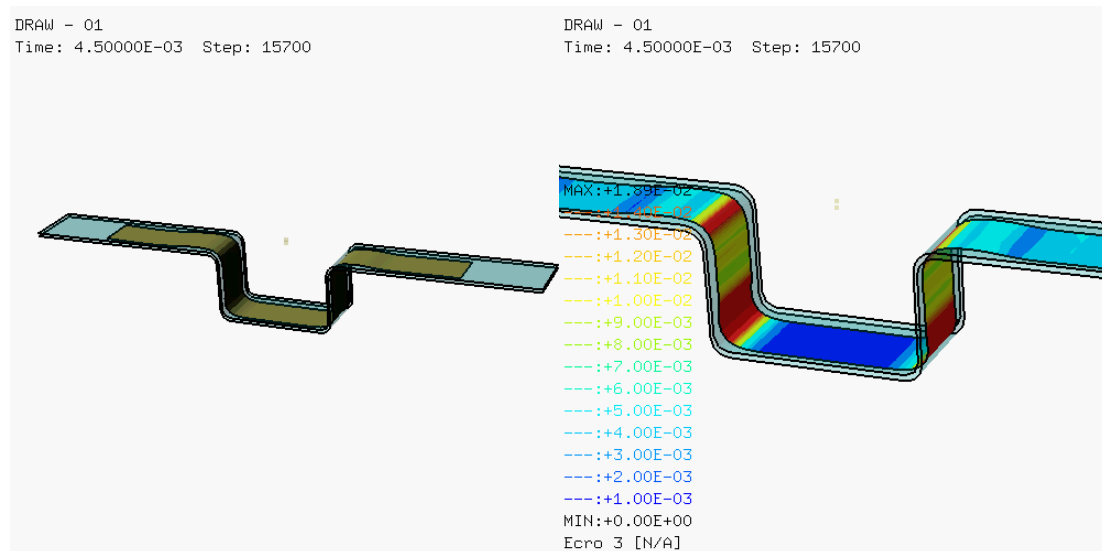
```

COUL jaun LECT masses TERM
turg LECT punch die TERM
roug LECT piece TERM
NGRO 7 'n_masses' LECT masses TERM
      'n_die' LECT die TERM
      'n_punch' LECT punch TERM
      'n_piece' LECT piece TERM
      'n_ext1' LECT 4298 TERM
      'n_ext2' LECT 4299 TERM
      'n_alit' LECT 1825 TERM
EPAI 1.E-03 LECT punch die TERM
EPAI 5.E-04 LECT piece TERM
*-----Materials
MATE
LINE RO 7.8E+03 YOUN 3.E+11
NU 3.E-01
LECT punch die TERM
VMIS ISOT RO 2.767E+03 YOUN 7.E+10
NU 3.E-01 ELAS 2.93E+08
TRAC 12 2.93000E+08 4.18571E-03
      3.09400E+08 6.10600E-03
      3.16350E+08 7.12129E-03
      3.24380E+08 8.46700E-03
      3.33800E+08 1.02786E-02
      3.45120E+08 1.29853E-02
      3.59060E+08 1.70604E-02
      3.76870E+08 2.38049E-02
      4.00710E+08 3.62904E-02
      4.34740E+08 6.35266E-02
      4.87940E+08 1.40321E-01
      1.09500E+09 1.00016E+02
LECT piece TERM
MASS 0.1E-02 LECT masses TERM
*-----Couplings
LIAIS
BLOQ 123456 LECT die TERM
      12456 LECT punch TERM
      246 LECT piece TERM
DEPL 3 0.1E+01 FONC 1 LECT punch TERM
GLIS 2

CMAI LECT cma1 TERM EXTE LECT n_ext1 TERM
CESC LECT cesc1 TERM
CMAI LECT cma1 TERM EXTE LECT n_ext2 TERM
CESC LECT cesc2 TERM
FONC 1 TABL 2
      0.0E+00 0.0E+00
      0.501E-02 -0.405E-01
*-----Initial conditions
INIT VITE 3 -8.08383 LECT punch TERM
*-----Storage
ECRI
DEPL VITE TFRE 4.5E-4 POIN LECT n_alit TERM
FICH ALIC TFRE 4.5E-05
FICH ALIC TEMP TFRE 4.5E-06
      POIN LECT n_alit TERM
      ELEM LECT e_alit TERM
*-----Options
OPTI LOG 1
*-----Time Steps
CALC TINI 0.E+00 TFIN 4.5E-03
*-----
SUIT
Post-treatment (time curves from alice temps file)
ECHO
*
RESU ALIC TEMP GARD PSCR
*
SORT GRAP
*
AXTE 1000.0 'Time [ms]'
*
COUR 1 'dz' DEPL COMP 3 NOEU LECT n_alit TERM
COUR 2 'vz' VITE COMP 3 NOEU LECT n_alit TERM
*
trac 1 axes 1.0 'DISPL. [M]'
trac 2 axes 1.0 'VELOC. [M/S]'
*
QUAL DEPL COMP 3 LECT n_alit TERM REPE -3.63772E-2 TOLE 5.E-3
*-----
FIN

```

The final deformed mesh and plastic strains are:



The final velocities and forces on the die:

