

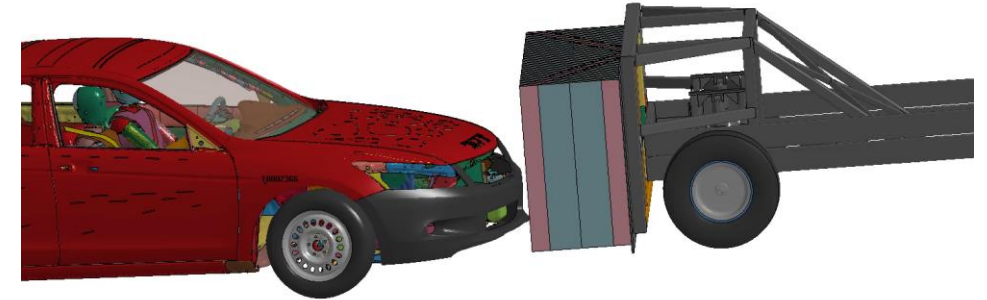
First ,go to‘ contact definition in LS-DYNA

Jimmy Forsberg, DYNAmore Nordic - an Ansys Company

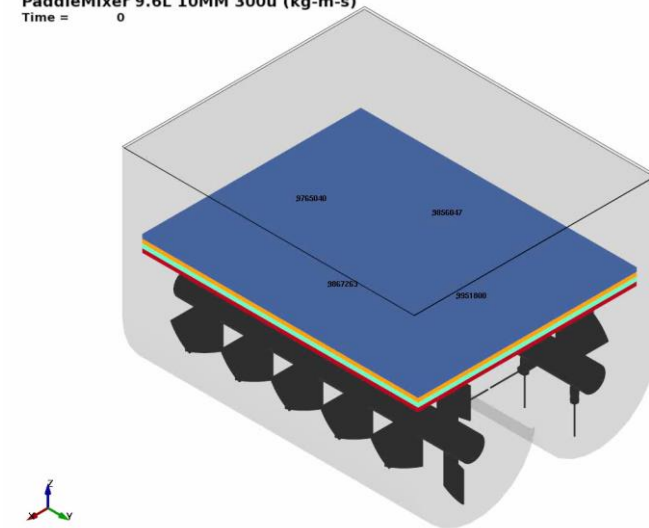
Which contact to use in LS-DYNA?

Overview of selection process – ordinary contact

- What kind of problem?
- Firstly – use MPP version of LS-DYNA
- Crash/drop test problem using the explicit solver
 - No solid element erosion
 - *CONTACT_AUTOMATIC_SINGLE_SURFACE
 - SOFT=1
 - SOFT=2
 - Solid element erosion – YES
 - *CONTACT_ERODING_SINGLE_SURFACE
 - SOFT=2
 - *CONTACT_AUTOMATIC_GENERAL (when SOFT=1 or 2)
 - Treatment of beam elements
 - Separate contact for edge treatment
- Implicit problem(/accuracy needs)
 - *CONTACT_AUTOMATIC_SINGLE_SURFACE_MORTAR
- Which elements are to be treated with the contact?
 - Non-traditional lagrangean elements/particles → special contact!



PaddleMixer 9.6L 10MM 300u (kg-m-s)
Time = 0



LS-DYNA Contact for explicit – SOFT=2



*CONTACT_ERODING_SINGLE_SURFACE

- Example of typical starting point for contact definition in explicit analysis using LS-DYNA

```
*CONTACT_ERODING_SINGLE_SURFACE
Global Contact definition
$#   surfA      surfB  surfATYP  surfBTYP  SAbboxID  SBboxID  SAPr  SBPr
      100         0         2         0         0         0         0         0
$#   fs         fd      dc        vc        vcd      Penchk      bt      dt
      0.3        0.3        0         0         20         0         0         0
$#   sfSA      sfSB      SAst      SBst      sfSAt      sfSBt      fsf      vsf
      0         0         0         0         0         0         0         0
$#   isym      erosop      iadj
      0         0         0
$#   soft      softscl  lcidab      maxpar      sbopt      depth      bsort      frcfrq
      2         0         0         0         3        5/35         0         0
$#   penmax      thkopt      shlthk      snlog      isym      i2d3d      sldthk      sldstf
      0         0         0         0         0         0         0         0
$#   igap      ignore      dprfac      dtstif      edgek      flangl      cid_rcf
      0         2         0  init.tss         0         0         0
$#   q2tri      dtpchk      sfnbr      fnscl      dnscl      tcso      tiedid      shldedg
      0         0        -0.5         0         0         0         0         1
$#   sharec      cparm8      ipback      srnde      fricsf      icor      ftorg      region
      0         0         0         0         0         0         0         0
$#   pstiff      ignroff      fstol      2Dbinr      ssftyp      swtpr      tetfac
      1         0         0         0         0         0         0         3
```

LS-DYNA Contact for explicit – SOFT=2



*CONTACT_ERODING_SINGLE_SURFACE

- Example of typical starting point for contact definition in explicit analysis using LS-DYNA

```
*CONTACT_ERODING_SINGLE_SURFACE
Global Contact definition
$# surfA surfB surfATYP surfBTYP SAboxID SBboxID SAPr SBPr
    100      0      2      0      0      0      0      0
$# fs fd dc vc vcd Penchk bt dt
    0.3 0.3 0 0 20 0 0 0
$# sfSA sfSB SAst SBst sfSAt sfSBt fsf vsf
    0 0 0 0 0 0 0 0
$# isym erosop iadj
    0 0 0
$# soft softscl lcidab maxpar sbopt depth bsort frcfrq
    2 0 0 0 3 5/35 0 0
$# penmax thkopt shlthk snlog isym i2d3d sldthk sldstf
    0 0 0 0 0 0 0 0
$# igap ignore dprfac dtstif edgek flangl cid_rcf
    0 2 0 init.tss 0 0 0
$# q2tri dtpchk sfnbr fnscl dnscl tcso tiedid shldedg
    0 0 -0.5 0 0 0 0 1
$# sharec cparm8 ipback srnde fricsf icor ftorg region
    0 0 0 0 0 0 0 0
$# pstiff ignroff fstol 2Dbinr ssftyp swtpr tetfac
    1 0 0 0 0 0 0 3
```



Define which part will be treated for contact (including selfcontact) – one *SET_PART

LS-DYNA Contact for explicit – SOFT=2



*CONTACT_ERODING_SINGLE_SURFACE

- Example of typical starting point for contact definition in explicit analysis using LS-DYNA

```
*CONTACT_ERODING_SINGLE_SURFACE
Global Contact definition
$#   surfA      surfB  surfATYP  surfBTYP  SAbboxID  SBboxID  SAPr  SBPr
    100         0        2        0         0        0        0        0
$#   fs         fd      dc        vc      vcd      Penchk      bt      dt
    0.3         0.3      0        0      20        0        0        0
$#   sfSA      sfSB      SAst      SBst      sfSAst      sfSBt      fsf      vsf
    0.0         0.0        0        0        0        0        0        0
$#   isym      erosop      iadj
    0          0          0
$#   soft      softscl      lcidab      maxpar      sbopt      depth      bsort      frcfrq
    2          0          0        0        3      5/35        0        0
$#   penmax      thkopt      shlthk      snlog      isym      i2d3d      sldthk      sldstf
    0          0          0        0        0        0        0        0
$#   igap      ignore      dprfac      dtstif      edgek      flangl      cid_rcf
    0          2          0      init.tss      0        0        0
$#   q2tri      dtpchk      sfnbr      fnscl      dnscl      tcso      tiedid      shldedg
    0          0      -0.5        0        0        0        0        1
$#   sharec      cparm8      ipback      srnde      fricsf      icor      ftorg      region
    0          0          0        0        0        0        0        0
$#   pstiff      ignroff      fstol      2Dbinnr      ssftyp      swtpr      tetfac
    1          0        0        0        0        0        0        3
```

← Friction definition and contact damping – recommended to have some energy dissipation in the contact.

See also:
DEFINE_FRICTION_TABLE

LS-DYNA Contact for explicit – SOFT=2



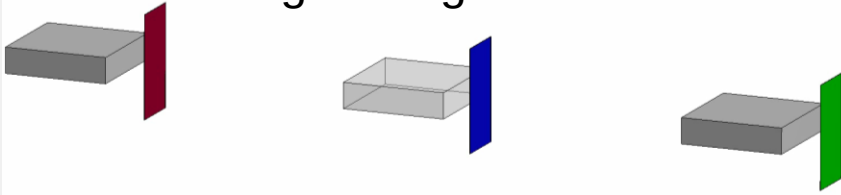
*CONTACT_ERODING_SINGLE_SURFACE

- Example of typical starting point for contact definition in explicit analysis using LS-DYNA

```
*CONTACT_ERODING_SINGLE_SURFACE
Global Contact definition
$#   surfA      surfB  surfATYP  surfBTYP  SAbboxID  SBboxID  SAPr      SBPr
      100         0        2        0         0         0         0         0
$#   fs         fd      dc        vc        vcd      Penchk    bt        dt
      0.3        0.3      0        0        20       0         0         0
$#   sfSA      sfSB      SAst      SBst      sfSAAt    sfSBt     fsf      vsf
      0         0        0        0         0         0         0         0
$#   isym      erosop    iadj
      0         0        0
$#   soft      softscl  lcidab    maxpar    sbopt     depth     bsort     frcfrq
      2         0        0        0         3         5/35      0         0
$#   penmax    thkopt    shlthk    snlog     isym      i2d3d     sldthk     sldstf
      0         0        0        0         0         0         0         0
$#   igap      ignore    dprfac    dtstif     edgek     flangl    cid_rcf
      0         2        0      init.tss    0         0         0
$#   q2tri     dtpchk     sfnbr     fnscl     dnscl     tcso      tiedid     shledg
      0         0        -0.5      0         0         0         0         1
$#   sharec    cparm8     ipback    srnde     fricsf     icor      ftorg      region
      0         0        0        0         0         0         0         0
$#   pstiff    ignroff    fstol     2Dbincr   ssftype    swtpr     tetfac
      1         0        0         0         0         0         0         3
```

SOFT=2 contact with contact search settings. Start with Depth= 5 or 35. 45 for more accuracy – costly.

Shell edges treated flat Neighbouring shell contact



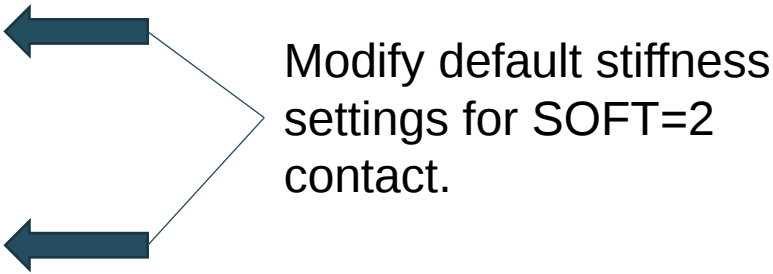
LS-DYNA Contact for explicit – SOFT=2



*CONTACT_ERODING_SINGLE_SURFACE

- Example of typical starting point for contact definition in explicit analysis using LS-DYNA

```
*CONTACT_ERODING_SINGLE_SURFACE
Global Contact definition
$#   surfA      surfB  surfATYP  surfBTYP  SAbboxID  SBboxID  SAPr      SBPr
      100         0         2         0         0         0         0         0
$#   fs         fd      dc        vc        vcd      Penchk    bt        dt
      0.3        0.3      0         0         20        0         0         0
$#   sfSA      sfSB      SAst      SBst      sfSAt      sfSBt      fsf      vsf
      0         0         0         0         0         0         0         0
$#   isym      erosop    iadj
      0         0         0
$#   soft      softscl  lcidab    maxpar    sbopt     depth     bsort     frcfrq
      2         0         0         0         3         5/35      0         0
$#   penmax    thkopt    shlthk    snlog     isym      i2d3d     sldthk     sldstf
      0         0         0         0         0         0         0         0
$#   igap      ignore    dprfac    dtstif    edgek     flangl     cid_rcf
      0         2         0         init.tss  0         0         0
$#   q2tri     dtpchk     sfnbr     fnscl     dnscl     tcso      tiedid     shldedg
      0         0         -0.5      0         0         0         0         1
$#   sharec    cparm8     ipback    srnde     fricsf     icor      ftorg      region
      0         0         0         0         0         0         0         0
$#   pstiff    ignroff    fstol     2Dbinr    ssftyp     swtpr     tetfac
      1         0         0         0         0         0         3
```



LS-DYNA Contact for explicit – SOFT=2



*CONTACT_ERODING_SINGLE_SURFACE

- Example of typical starting point for contact definition in explicit analysis using LS-DYNA

```
*CONTACT_ERODING_SINGLE_SURFACE
Global Contact definition
$#   surfA      surfB  surfATYP  surfBTYP  SAbboxID  SBboxID  SAPr  SBPr
      100         0         2         0         0         0         0         0
$#   fs         fd      dc        vc        vcd      Penchk      bt      dt
      0.3        0.3        0         0         20         0         0         0
$#   sfSA      sfSB      SAst      SBst      sfSAt      sfSBt      fsf      vsf
      0         0         0         0         0         0         0         0
$#   isym      erosop      iadj
      0         0         0
$#   soft      softscl  lcidab      maxpar      sbopt      depth      bsort      frcfrq
      2         0         0         0         3      5/35         0         0
$#   penmax      thkopt      shlthk      snlog      isym      i2d3d      sldthk      sldstf
      0         0         0         0         0         0         0         0
$#   igap      ignore      dprfac      dtstif      edgek      flangl      cid_rcf
      0      2         0      init.tss         0         0         0
$#   q2tri      dtpchk      sfnbr      fnscl      dnscl      tcso      tiedid      shldedg
      0         0      -0.5         0         0         0         0         0
$#   sharec      cparm8      ipback      srnde      fricsf      icor      ftorg      region
      0         0         0         0         0         0         0         0
$#   pstiff      ignroff      fstol      2Dbinr      ssftyp      swtpr      tetfac
      1         0         0         0         0         0         0         3
```

← Set treatment of initial penetrations

LS-DYNA Contact for explicit – SOFT=2



*CONTACT_AUTOMATIC_SINGLE_SURFACE

- Example of typical starting point for contact definition in explicit analysis using LS-DYNA

```
*CONTACT_AUTOMATIC_SINGLE_SURFACE
Global Contact definition
$# surfA      surfB      surfATYP  surfBTYP  SAboxID  SBboxID  SAPr      SBPr
    100        0         2          0         0         0         0         0
$#  fs        fd         dc         vc        vcd      Penchk    bt        dt
    0.3      0.3         0          0        20        0         0         0
$#  sfSA      sfSB      SAst      SBst      sfSAat   sfSBt     fsf       vsf
    0          0         0          0         0         0         0         0
$#  soft      softscl   lcidab   maxpar   sbopt    depth     bsort     frcfrq
    2          0         0          0         3        5/35      0         0
$#  penmax    thkopt    shlthk   snlog    isym     i2d3d     sldthk    sldstf
    0          0         0          0         0         0         0         0
$#  igap      ignore    dprfac   dtstif   edgek     flangl    cid_rcf
    0          2         0      init.tss  0         0         0         0
$#  q2tri     dtpchk    sfnbr    fnscl    dnscl     tcso      tiedid    shldedg
    0          0       -0.5         0         0         0         0         1
$#  sharec    cparm8    ipback   srnde    fricsf    icor      ftorq     region
    0          0         0          0         0         0         0         0
$#  pstiff    ignroff   fstol    2Dbinr   ssftyp    swtpr     tetfac
    1          0         0          0         0         0         3
```

In models where the contact do not need to account for solid element failure.

Only difference is that the fourth line is removed.

LS-DYNA Contact for explicit – SOFT=2



Honorable mention

- SA(SB)boxID: boxdefinitions to limit contact work to entities within boxes
- SA(SB)Pr: if output wanted to some of the output files
- Vc: set limit value for frictional shear stress
- sfSA(SB): scaling factor for penalty stiffness
- bsort: set to a low value in very high speed simulations (explosion)
- dprfac: if large sliding occurs (rarely needed)
- edgek: if too large edge2edge penetrations occur you can increase penalty stiffness here
- dtpchk: output of penetration check data for SOFT=2 contact

*CONTACT_ERODING_SINGLE_SURFACE

Global Contact definition

\$#	surfA	surfB	surfATYP	surfBTYP	SAboxID	SBboxID	SAPr	SBPr
	100	0	2	0	0	0	0	0
\$#	fs	fd	dc	vc	vcd	Penchk	bt	dt
	0.3	0.3	0	0	20	0	0	0
\$#	sfSA	sfSB	SAst	SBst	sfSAst	sfSBst	fsf	vsf
	0	0	0	0	0	0	0	0
\$#	isym	erosop	iadj					
	0	0	0					
\$#	soft	softscl	lcidab	maxpar	sbopt	depth	bsort	frcfrq
	2	0	0	0	3	5/35	0	0
\$#	penmax	thkopt	shlthk	snlog	isym	i2d3d	sldthk	sldstf
	0	0	0	0	0	0	0	0
\$#	igap	ignore	dprfac	dtstif	edgek		flangl	cid_rcf
	0	2	0	init.tss	0		0	0
\$#	q2tri	dtpchk	sfnbr	fnscl	dnscl	tcs0	tiedid	shldedg
	0	0	0	0	0	0	0	1
\$#	sharec	cparm8	ipback	srnde	fricsf	icor	ftorq	region
	0	0	0	0	0	0	0	0
\$#	pstiff	ignroff		fstol	2Dbinr	ssftyp	swtpr	tetfac
	1	0		0	0	0	0	3

Related cards



*CONTROL_SOLID

- Using an 'ERODING' contact definition will turn on general check for solid element quality – like Jacobian (any solid element in the model).
- PSFAIL: Define a *SET_PART and include all parts that should be valid for this criterion and restrict the evaluation of the criterion to these parts

```
*CONTROL_SOLID
$#  esort      fmatrx      niptets      swlocl      psfail      t10jtol      icoh      tet13k
      1          0          0          0          0          0          0          0
$#   pm1       pm2       pm3       pm4       pm5       pm6       pm7       pm8       pm9       pm10
$#  tet13v      rinrt
      1          0
```

Related cards

*CONTROL_TIMESTEP

- When using 'ERODING' contact be aware of parameter erode on *CONTROL_TIMESTEP

```
*CONTROL_TIMESTEP
$#  dtinit      tssfac      isdo      tslimt      dt2ms      lctm      erode      ms1st
      0          0          0          0          0          0          0          0
$#  dt2msf      dt2mslc      imsc1      rmscl      emsc1      ihdo
      0          0          0          0          0          0
$#          igado      dtusr
          0          0
```

- erode: Automatically set to 1 when using ERODING contact.
- $tsmin = dtstart * dtmin$

Related cards

*CONTROL_CONTACT

- Avoid setting general parameters on *CONTROL_CONTACT
 - Use setting on *CONTACT_xxx if possible

*CONTROL_CONTACT								
\$#	slsfac	rwpnal	islchk	shlthk	penopt	thkchg	orien	enmass
	0	0	0	0	0	1	0	0
\$#	usrstr	usrfrc	nsbcs	interm	xpene	ssthk	ecdt	tiedprj
	0	0	0	0	0	1	0	0
\$#	sfrc	dfrc	edc	vfc	th	th_sf	pen_sf	ptscl
	0	0	0	0	0	0	0	0
\$#	ignore	frceng	skiprwg	outseg	spotstp	spotdel	spothin	
	0	0	0	0	0	0	0	
\$#	isym	nserod	rwgaps	rwgdth	rwksf	icov	swradf	ithoff
	0	0	0	0	0	0	0	0
\$#	shledg	pstiff	ithcnt	tdcnof	ftall		shltrw	igactc
	0	0	0	0	1		0	0

LS-DYNA Contact for explicit



*CONTACT_ERODING_SINGLE_SURFACE – SOFT=1

- Example of typical starting point for contact definition in explicit analysis using LS-DYNA

```
*CONTACT_ERODING_SINGLE_SURFACE
TOP PLATE (NCC)
$# surfA surfB surfATYP surfBTYP SAboxID SBboxID SAPr SBPr
    100      0      2          0          0          0          0
$# fs fd dc vc vcd Penchk bt dt
   0.3 0.3  0  0  20      0      0      0
$# sfSA sfSB SAst SBst sfSAt sfSBt fsf vsf
    0      0      0      0      0      0      0      0
$# isym erosop iadj
    0      0      0
$# soft softscl lcidab maxpar sbopt depth bsort frcfrq
    1      0      0      0      0      0      0      0
$# penmax thkopt shlthk snlog isym i2d3d sldthk sldstf
    0      0      0      0      0      0      0      0
$# igap ignore dprfac dtstif edgek flangl cid_rcf
    0      2      0  init.tss      0      0      0
$# q2tri dtpchk sfnbr fnscl dnscl tcso tiedid shldedg
    0      0      0      0      0      0      0      0
$# sharec cparm8 ipback srnde fricsf icor ftorg region
    0      0      0      0      0      0      0      0
$# pstiff ignroff fstol 2Dbinr ssftyp swtpr tetfac
    0      0      0      0      0      0      0      0
```

Default on most parameters

Which contact to use in LS-DYNA?

*CONTACT_AUTOMATIC/ERODING_SINGLE_SURFACE

- Contact definition that treats shells and solids elements
 - Observe what kind of elements that are in that part set!
 - SOFT=2 do not treat particles, beams, etc..

- Do not treat beam/discrete elements!
 - *CONTACT_AUTOMATIC_GENERAL added for interaction with beams
 - Most often as beam2beam interactions (added nullbeams in crucial areas of model)

LS-DYNA Contact for explicit - Mortar

*CONTACT_AUTOMATIC_SINGLE_SURFACE_MORTAR

- Some situation demands a more accurate contact

*CONTACT_AUTOMATIC_SINGLE_SURFACE_MORTAR

Global Contact definition

\$#	surfA	surfB	surfATYP	surfBTYP	SAboxID	SBboxID	SAPr	SBPr
	100	0	2	0	0	0	0	0
\$#	fs	fd	dc	vc	vcd	Penchk	bt	dt
	0.3	0.3	0	0	20	0	0	0
\$#	sfSA	sfSB	SAst	SBst	sfSAst	sfSBst	fsf	vsf
	0	0	0	0	0	0	0	0
\$#	soft	softscl	lcidab	maxpar	sbopt	depth	bsort	frcfrq
	0	0	0	0	0	0	0	0
\$#	penmax	thkopt	shlthk	snlog	isym	i2d3d	sldthk	sldstf
	0	0	0	0	0	0	0	0
\$#	igap	ignore	mpar1	mpar2	edgek		flangl	cid_rcf
	0	2	0	0	0		0	0
\$#	q2tri	dtpchk	sfnbr	fnscl	dnscl	tcs0	tiedid	shldedg
	0	0	0	0	0	0	0	0
\$#	sharec	cparm8	ipback	srnde	fricsf	icor	ftorq	region
	0	0	0	0	0	0	0	0
\$#	pstiff	ignroff		fstol	2Dbnr	ssftyp	swtpr	tetfac
	0	0		0	0	0	0	0

- Eroded solid elements handled with automatically
- Treats beam elements

LS-DYNA Contact for explicit - Mortar



Honorable mention

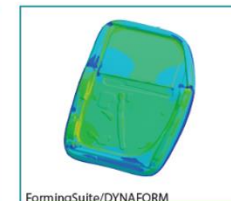
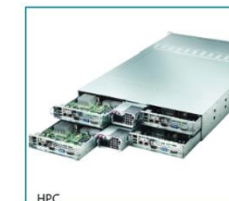
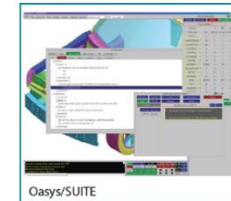
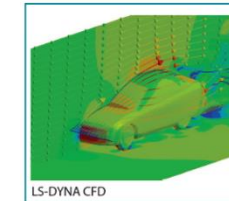
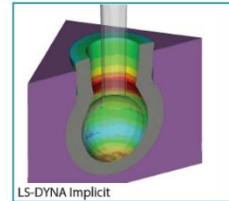
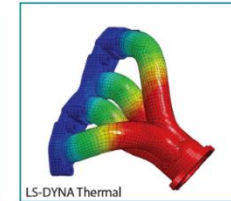
- sfSA: if too large penetrations found in analysis scale heavily here
- IGAP: increase stiffness at larger penetrations
- PENMAX: change release depth
- IGNORE: extra functionality – turn off self contact – ignore=-1/-2

*CONTACT_AUTOMATIC_SINGLE_SURFACE_MORTAR								
Global Contact definition								
\$#	surfA	surfB	surfATYP	surfBTYP	SAboxID	SBboxID	SAPr	SBPr
	100	0	2	0	0	0	0	0
\$#	fs	fd	dc	vc	vcd	Penchk	bt	dt
	0.3	0.3	0	0	20	0	0	0
\$#	sfSA	sfSB	SAst	SBst	sfSAst	sfSBt	fsf	vsf
	0	0	0	0	0	0	0	0
\$#	soft	softscl	lcidab	maxpar	sbopt	depth	bsort	frcfrq
	0	0	0	0	0	0	0	0
\$#	penmax	thkopt	shlthk	snlog	isym	i2d3d	sldthk	sldstf
	0	0	0	0	0	0	0	0
\$#	igap	ignore	mpar1	mpar2	edgk		flangl	cid_rcf
	0	2	0	0	0		0	0
\$#	q2tri	dtpchk	sfnbr	fnscl	dnscl	tcs0	tiedid	shldedg
	0	0	0	0	0	0	0	0
\$#	sharec	cparm8	ipback	srnde	fricsf	icor	ftorq	region
	0	0	0	0	0	0	0	0
\$#	pstiff	ignroff		fstol	2Dbinr	ssftyp	swtpr	tetfac
	0	0		0	0	0	0	0

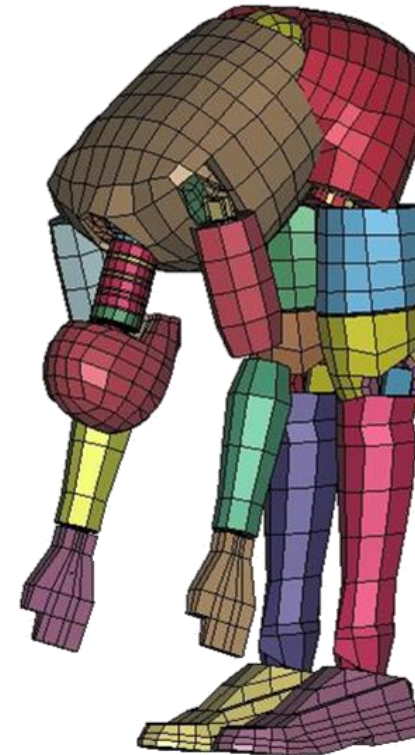
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Thank You



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