*CONTACT_AUTO_MOVE

Purpose: This feature allows for automatic move of a master surface in a contact definition to close an unspecified gap between a slave and the master surface. The gap may be caused as a result of an initial gravity loading on the slave part. The gap will be closed on a specified time to save CPU time. The master surface in metal forming application will typically be the upper cavity and the slave part will be the blank. This feature is applicable only in re-positioning of a tool in relationship to the blank after gravity loading in sheet metal forming application.

Cards 1	1	2	3	4	5	6	7	8
Variable	ID	CONTID	VID	LCID	ATIME	OFFSET		
Type	I	I	I	I	F	F		
Default	none	none	none	0	0.0	0.0		

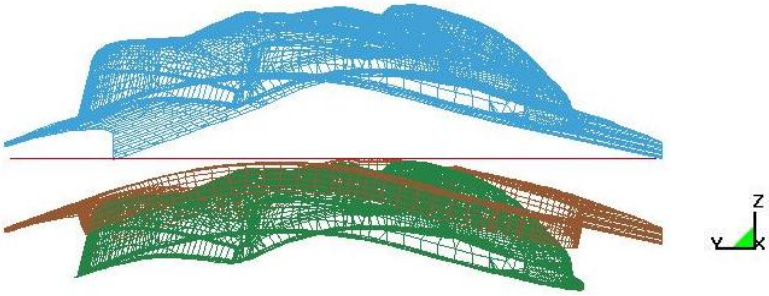
VARIABLE	DESCRIPTION
ID	Move ID for this automatic move input. GT.0: velocity controlled tool kinematics (the variable VAD=0 in *BOUNDARY_PRESCRIBED_MOTION_RIGID) LT.0: displacement controlled tool kinematics (VAD=2)
CONTID	Contact ID, as in *CONTACT_FORMING_...._ID, which defines the slave and master part set IDs.
VID	Vector ID of a vector oriented in the direction of movement of the master surface, as in *DEFINE_VECTOR. The origin of the vector is unimportant since the direction cosines of the vector are computed and used.
LCID	Load curve defining tooling kinematics, either by velocity versus time or by displacement versus time. This load curve will be adjusted automatically during a simulation to close the empty tool travel.
ATIME	Activation time defining the moment the master surface (tool) to be moved.
OFFSET	Time at which a master surface will move to close a gap distance, which may happen following the move of another mater surface. This is useful in sequential multiple flanging or press hemming simulation. Simulation time (CPU) is much faster based on the shortened tool travel (no change

VARIABLE	DESCRIPTION
	to the termination time).

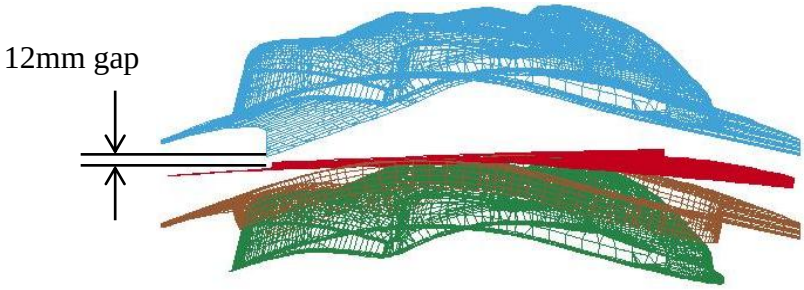
Remarks:

1. In an example shown below, referring to the partial input deck and figures attached, a combined simulation of gravity loading and binder closing of a fender outer is demonstrated. The geometry of the fender was taken from NUMISHEET 2002 benchmark. In this multi-step implicit static set up, the blank is allowed 0.3 "time" unit (3 implicit steps since DT0=0.1) to be loaded with gravity. At the end of gravity loading, a gap of 12mm was created between the upper die and the blank. The upper die is set to be moved at 0.3 "time" unit, closing the gap. It is noted that the upper die is controlled with displacement (VAD=2) in a shape of a right triangular in the displacement versus "time" space as defined by load curve #201, and the ID in *CONTACT_AUTO_MOVE is set to "-1".

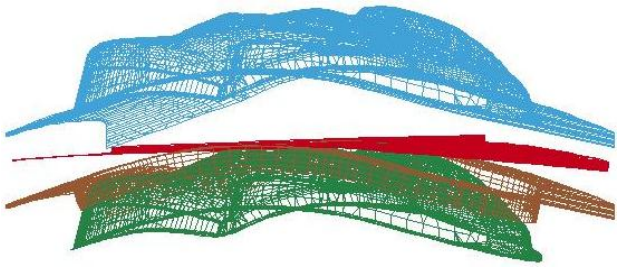
```
*PARAMETER
R grvtime       0.3
R endtime       1.0
R diemv      145.45
*CONTROL_TERMINATION
&endtime
*CONTROL_IMPLICIT_FORMING
2,2,100
*CONTROL_IMPLICIT_GENERAL
$   IMFLAG       DT0
         1      0.10
*CONTROL_ACCURACY
         1         2
*CONTACT_FORMING_ONE_WAY_SURFACE_TO_SURFACE_ID
11
....
....
....
$---+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
*BOUNDARY_PRESCRIBED_MOTION_RIGID
$#     pid       dof       vad      lcid        sf       vid     death     birth
         2         3         2       201 -1.000000         0       0.0     0.000
*CONTACT_AUTO_MOVE
$       ID    ContID       VID      LCID     ATIME
        -1        11        89       201  &grvtime
*DEFINE_VECTOR
89,0.0,0.0,0.0,0.0,0.0,-10.0
*DEFINE_CURVE
201
0.0,0.0
&grvtime,0.0
1.0,&diemv
```



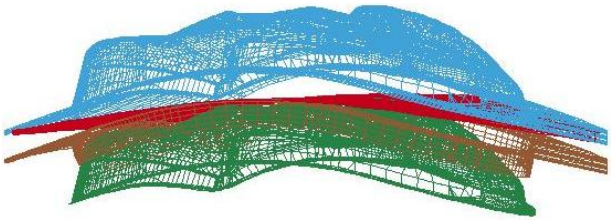
Initial position at t=0.0



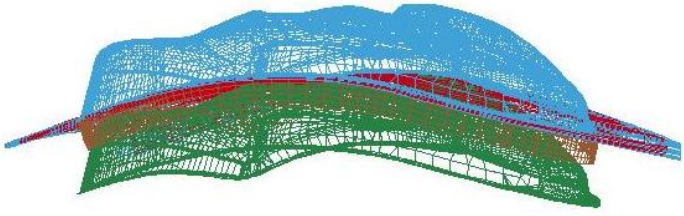
Gravity loaded shape at t=0.2



Upper die cavity moved at t=0.30,
closing the gap



Continue closing at t=0.743



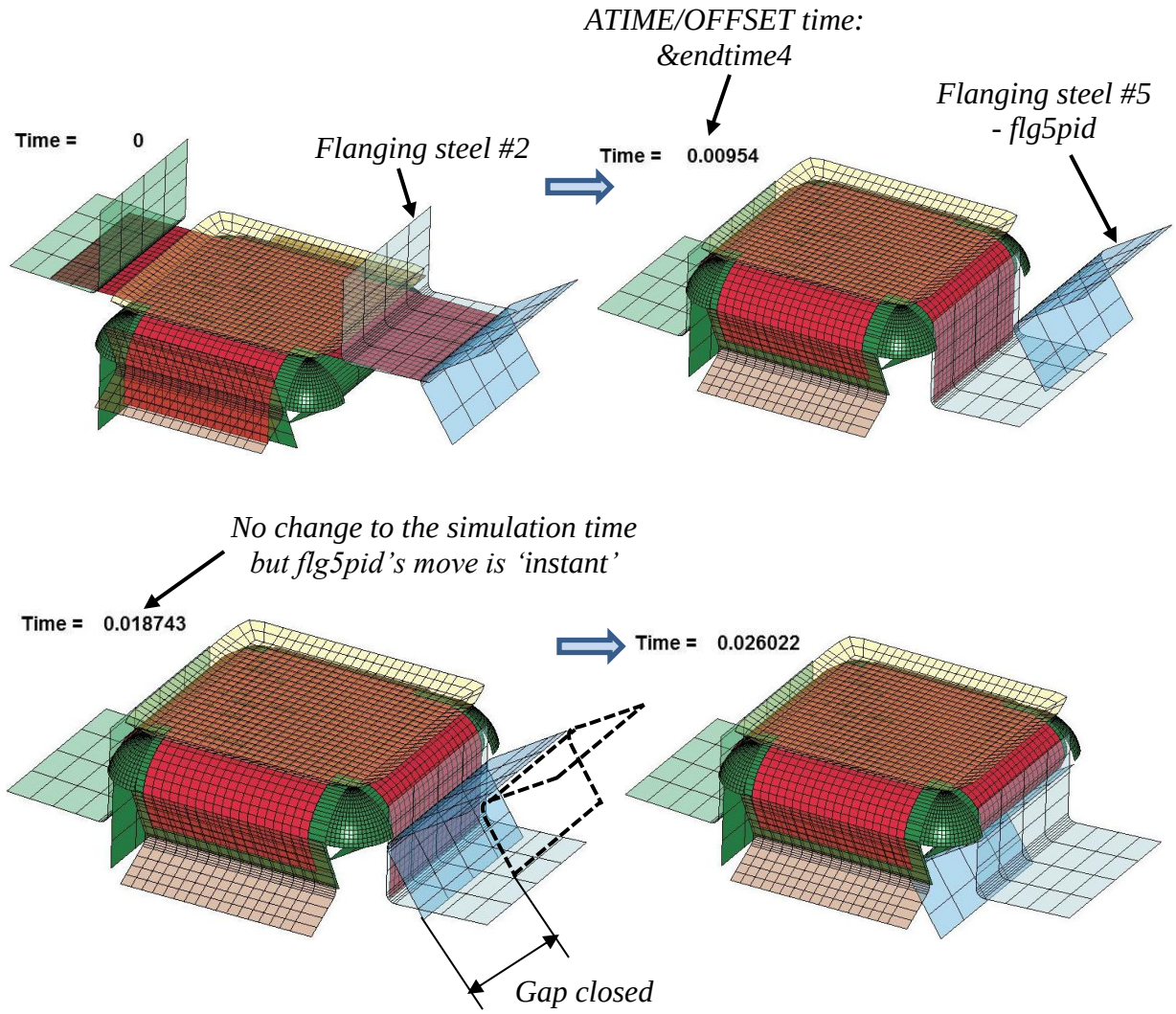
Final closing at t=1.0

Automatic closure of gap in implicit static binder closing

2. Similarly, for "velocity" controlled tool kinematics, an example is attached below. In this example, the "velocity" profile is ramped up initially and then kept constant. It is noted that the variable VAD in *BOUNDARY is "0", and ID in *CONTACT_AUTO_MOVE is set to positive "1" indicating it is a velocity boundary condition.

```
*PARAMETER
R grvtime       0.3
R tramp        0.001
R diemv       145.45
R clsv        1000.0
*PARAMETER_EXPRESSION
R tramp1  tramp+gravtime
R endtime tramp1+(abs(diemv)-0.5*clsv*tramp)/clsv
*CONTACT_FORMING_ONE_WAY_SURFACE_TO_SURFACE_ID
11
....
....
$---+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
*BOUNDARY_PRESCRIBED_MOTION_RIGID
$#     pid       dof       vad      lcid        sf       vid     death     birth
         2         3         0       201 -1.000000         0       0.0     0.000
*CONTACT_AUTO_MOVE
$       ID    ContID       VID      LCID     ATIME
         1        11        89       201  &grvtime
*DEFINE_VECTOR
89,0.0,0.0,0.0,0.0,0.0,-10.0
*DEFINE_CURVE
201
0.0,0.0
0.2,0.0
&tramp1,&clsv
&endtime,&clsv
```

3. The following example demonstrates the use of the variable OFFSET. As shown in the figure and refer to the partial input deck below, a total of 5 flange steels are being moved to complete a flanging process. Most parts of the input deck is from the 'flanging simulation' in eZ-Setup of LS-PrePost 4.0, with two additional keywords *CONTACT_AUTO_MOVE and *DEFINE_VECTOR added. Flanging steel #5 is to move in a cam angle defined by vector #7 following the completion of the flanging (straight down) process of flanging steel #2. The variables ATIME and OFFSET in *CONTACT_AUTO_MOVE are both defined as &endtime4, which is calculated based on the automatic positioning of tools/blank using *CONTROL_FORMING_AUTOPOSITION. At defined time, flanging steel #5 'jumps' into position so it just comes into contact with the partially formed down-standing flange, saving some CPU times. Flanging steel #5 continues to move to its home position completing the simulation. The CPU time savings is 27% in this case.



Closing a gap distance in a sequential flanging process

```
*KEYWORD
*PARAMETER
...
*PART

  &flg5pid  &flg5sec  &flg5mid
...
$---+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
$ Local coordinate system for flanging steel #5 move direction
*DEFINE_COORDINATE_SYSTEM
$#     cid         xo         yo         zo         xl         yl         zl
  &flg5cid  -5.09548   27.6584  -8.98238  -5.43587   26.8608  -9.48034
$#      xp         yp         zp
  -5.82509   27.5484  -8.30742
$---+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
$ Auto positioning
*CONTROL_FORMING_AUTOPOSITION_PARAMETER_SET
$      SID       CID       DIR      MPID  POSITION   PREMOVE     THICK  PARORDER
```

```
...
  &flg5sid  &flg5cid         3  &blk1sid        -1             &bthick    flg5mv
*PART_MOVE
$    PID            XMOV            YMOV            ZMOV     CID   IFSET
&flg5sid             0.0             0.0         &flg5mv&flg5cid       1
...
*MAT_RIGID
$      MID        RO         E         PR          N    COUPLE          M     ALIAS
  &flg5mid 7.830E-09 2.070E+05      0.28
$      CMO      CON1      CON2
         -1  &flg5cid    110111
$LCO or A1        A2        A3        V1        V2        V3
  &flg5cid
$---+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
*CONTACT_AUTO_MOVE
$       ID    CONTID       VID      LCID     ATIME    OFFSET
         1         7         7        10  &endtim4  &endtim4
*DEFINE_VECTOR
$      VID        XT        YT        ZT        XH        YH        ZH
         7       0.0       0.0       0.0-0.5931240 0.5930674-0.5444952
*CONTACT_FORMING_ONE_WAY_SURFACE_TO_SURFACE_ID
$      CID
         7
$     SSID      MSID     SSTYP     MSTYP    SBOXID    MBOXID       SPR       MPR
  &blk1sid  &flg5sid         2         2                              1         1
$       FS        FD        DC        VC       VDC    PENCHK        BT        DT
...
$---+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
$                   Tool kinematics
$  -------------------------closing
*BOUNDARY_PRESCRIBED_MOTION_RIGID_local
...
  &flg5pid         3         0         4       1.0         0  &endtim4
$  -------------------------flanging
*BOUNDARY_PRESCRIBED_MOTION_RIGID_local
...
  &flg5pid         3         0        10       1.0         0            &endtim4
$---+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
*END
```

4. This feature is implemented in LS-DYNA R5 Revision 64066 and later releases. The variable OFFSET is in R7 Revision 77137 and later releases.