**RADIOSS, MotionSolve, and OptiStruct**

# CONTACT

### Bulk Data Entry

**CONTACT** – Contact Interface Definition

### Description

Defines a contact interface.

### Format

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|
| CONTACT | CTID | PID/TYPE | SSID | MSID | MORIENT | SRCHDIS | | | |

### Example

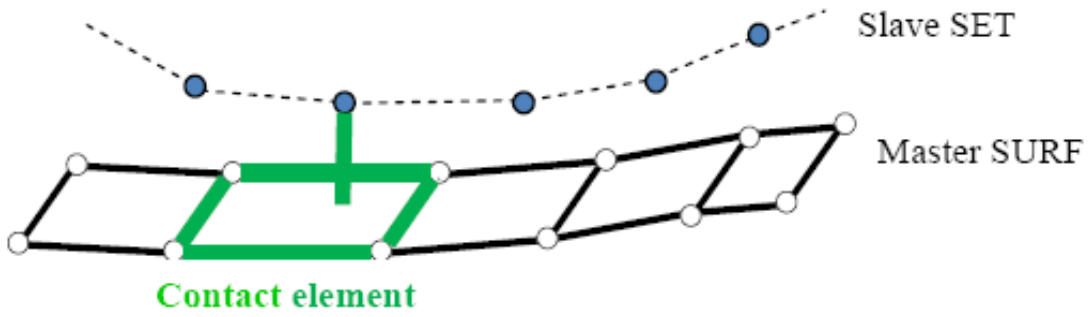
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|
| CONTACT | 5 | SLIDE | 7 | 8 | | | | | |

| Field | Contents |
|---|---|
| CTID | Contact interface identification number.<br>(Integer > 0) |
| PID | Property identification number of a PCONT, PCONTX entry.<br>(Integer > 0) |
| TYPE | Choose type of contact without pointing to contact property – respective default property settings will be used. Default settings can be changed using CONTPRM.<br>SLIDE – Sliding contact.<br>STICK – Contact with stick condition (stick applies to closed contacts only).<br>FREEZE – Enforced zero relative displacements on the contact interface (applies to both closed and open contacts). See comments 5 and 14.<br>Default = SLIDE (SLIDE, STICK, FREEZE) |
| SSID | Identification number of slave entity. See comments 2 and 12.<br>(Integer > 0) |
| MSID | Identification number of master entity. See comments 3 and 13.<br>(Integer > 0) |
| MORIENT | Orientation of contact “pushout” force from master surface. This only applies to masters that consist of shell elements or patches of grids. Masters defined on solid elements always push outwards irrespective of this flag.<br>OPENGAP – The contact interface is assumed open.<br>OVERLAP – Slave and master bodies overlap. |

| | |
|---|---|
| | NORM – Contact force is oriented along the vector normal to the master surface.<br>REVNORM – Contact force is oriented opposite to the default vector normal to the master surface.<br>Default = OPENGAP (OPENGAP, OVERLAP, NORM or REVNORM). See comments 6, 7, and 15. |
| SRCHDIS | Search distance criterion for creating contact condition. When specified, only slave nodes that are within SRCHDIS distance from master surface will have contact condition checked.<br>Default = twice the average edge length on the master surface (Real > 0 or blank) |

**Comments for nonlinear quasi-static analysis**

1. The CONTACT interface is constructed by searching, for each slave node, for a respective facet of the master surface, which contains the normal projection of the slave and is within SRCHDIS distance from the slave node. If no master segment with normal projection is found, then the nearest segment is picked if the direction from slave to master is within a certain angle (30 degrees) relative to the normal to the master segment. Having found a feasible master segment for the slave node, a contact element is created of a similar structure as the CGAPG element.




2. The slave entity (SSID) always consists of grid nodes. It may be specified as:
   - a set of grid nodes, defined using SET(GRID,..) command.
   - a surface, defined using SURF command (the slave nodes are picked from the respective nodes of the SURF faces).
   - a set of elements (shells or solids), defined using SET(ELEM,..) command. Slave nodes are picked from the respective nodes of the elements in the set. For 3-D solids, only nodes on the surface of the solid body are selected; internal nodes are not considered.
3. The master entity (MSID) may be defined as:
   - a surface, defined using SURF command.
   - a set of elements (shells or solids), defined using SET(ELEM,..) command. For sets of 3-D solids, element faces on the surface are automatically found and selected as master surface.
4. Prescribing TYPE=STICK is interpreted in OptiStruct as an enforced stick condition - such contact interfaces will not enter the sliding phase. Of course, the enforced stick only applies to contacts that are closed. Note that, in order to effectively enforce the stick condition, frictional offset may need to be turned off (See comment 8 on PCONT).
5. Prescribing TYPE=FREEZE enforces zero relative motion on the contact surface – the contact gap opening remains fixed at the original value and the sliding distance is forced to be zero. Also, rotations at the slave node are matched to the rotations of the master patch. The FREEZE condition applies to all respective contact elements, no matter whether open or closed.
6. MORIENT defines the master pushout direction, which is the direction of contact force that master surface exerts on slave nodes.

   It is important to note that, in most practical applications, leaving this field blank will provide correct resolution of contact, irrespective of the orientation of surface normals. Only in cases of master surfaces defined as shells or patches of grids, and combined with initial pre-penetration, is MORIENT needed.

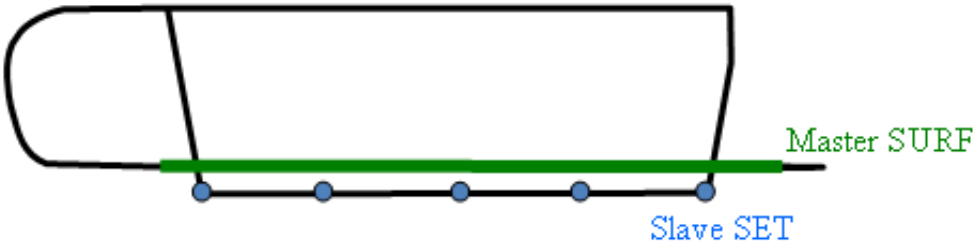
By default, MORIENT is ignored for solid elements – it applies only to master surfaces that consist of shell elements or patches of grids. (Master surfaces defined as faces of solid elements always push outwards, irrespective of the surface normals, or whether the contact gap is initially open or closed. See comment 7 for additional options).

a) In default behavior (OPENGAP), the pushout direction is defined using the assumption that the gap between slave and master is initially open, and the contact condition should prevent their contact (gap "padding" GPAD from the PCONT card is ignored in defining the pushout direction – this direction is based strictly on the positions of master and slave nodes).

The following example shows a typical use of OPENGAP:


b) OVERLAP assumes the reverse, namely that the slave and master bodies are already overlapping and the contact condition should push them apart (this is useful in case of pre-penetrating models when the entire slave set is pre-penetrating into the master object).

The following example shows a typical use of OVERLAP:




c) With the NORM option, the pushout force is oriented along the normal vector to the master surface. (Note that the surface normal may be reversed relative to the default normal to a shell element if a FLIP flag is present on the master SURF definition. This behavior corresponds to that of the ***reverse normals*** checkbox on the ***contactsurfs*** panel in HyperMesh). In cases when the slave node does not have a direct normal projection onto the master surface, and the "shortest distance" projection is used (GAPGPRJ set to SHORT on the GAPPRM card), the pushout force is oriented along the shortest distance line, yet with the orientation aligned with the normal vector.

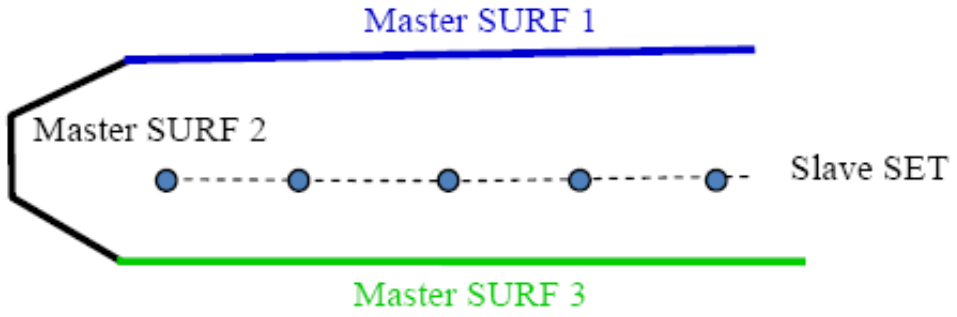
The following example shows a typical use of NORM:


d) REVNORM creates pushout force reversed relative to the NORM option.

7. By default, MORIENT does not apply to masters that are defined on solid elements – such masters always push outwards. This can be changed by choosing CONTPRM,CORIENT,ONALL which extends the meaning of MORIENT to all contact surfaces. In which case, it should be noted that the default normal is pointing inwards unless a FLIP flag appears on the master SURF definition for surfaces on solid elements, making the surface normal point outwards. (When creating contact surfaces in HyperMesh, this behavior corresponds to that of the ***reverse normals*** checkbox on the ***contactsurfs*** panel).

8. Presently one CONTACT element is created for each slave node. This assures reasonably efficient numerical computations without creating an excessive number of contact elements. However, this may require special handling in some cases, such as when a master surface wraps around the slave set. In such cases, switching the role of slave and master may be recommended. Alternatively, multiple CONTACT interfaces

can be created in order to cover all possible directions of relative motion (a simplified illustration is shown in the figure below). Additionally, individual GAP(G) elements can be used to handle such special situations.




9. This card is represented as a group in HyperMesh.

**Comments for geometric nonlinear analysis (ANALYSIS = NLGEOM subcases)**

10. CONTACT models an interface between a master surface and a set of slave grid points. A grid point can be at the same time as a slave and a master node. Each slave grid point can impact each master segment; except if it is connected to the impacted master segment. A grid point can impact on more than one segment. A grid point can impact on the two sides, on the edges, and on the corners of each segment. The contact uses a fast search algorithm without limitations.

    The main limitations of this interface follow: a) the time step in an explicit analysis is reduced in case of high impact speed or contacts with small gap, b) the contact may not work properly if used with a rigid body at high impact speed or rigid body with small gap, c) the contact does not solve edge to edge contact.

11. Additional control can be applied to the CONTACT definition in geometric nonlinear subcases through CONTPRM and PCONTX. These definitions are ignored in all other subcases. A geometric nonlinear subcase is one that has an ANALYSIS = NLGEOM entry in the subcase definition.

12. The slave entity (SSID) always consists of grid nodes. It may be specified as:

    - a set of grid nodes, defined using SET(GRID,..) command.
    - a surface, defined using SURF command (the slave nodes are picked from the respective nodes of the SURF faces).
    - a set of elements (shells or solids), defined using SET(ELEM,..) command. Slave nodes are picked from the respective nodes of the elements in the set. For 3-D solids, only nodes on the surface of the solid body are selected; internal nodes are not considered.

13. The master entity (MSID) may be defined as:

    - a surface, defined using SURF command.
    - a set of elements (shells or solids), defined using SET(ELEM,..) command.

14. TYPE = FREEZE is implemented as a TIE kinematic condition for large deformation subcases.

15. For implicit analysis, modified settings that improve the contact convergence are recommended. See CONTPRM, PCONTX.

16. This card is represented as a group in HyperMesh..

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Bulk Data Section

Guidelines for Bulk Data Entries

Bulk Data Entries by Function

The Input File