Data structures sd_contact

Summarized:

This document describes the contents of the object of the sd_contact type produces DEFI_CONTACT by the command.

Contents

1 General information

information describing the options of contact are stored in the data structure (SD) sd_contact (operator DEFI_CONTACT).

This SD stores two types of information:

- The total options of the contact, which do not depend on the zones;
- The local options of the contact, definite zones by zone.

Certain options are common to all the methods, others are specific to each formulation.
The access to the SD is made *via* specific routines which encapsulate the definition of the JEVEUX objects . It is advisable to use them exclusively.

A contact zone/friction comprises two surfaces which one seeks to prevent the interpenetration. There exist three formulations for the contact/friction (keyword FORMULATION):

The discrete formulation (DISCRETE)
the formulation continues (CONTINUE)
the formulation continues applied to XFEM (XFEM)

One gathers the formulation DISCRETE and the formulation CONTINUE in what one will call the formulations **with a grid**. Method XFEM is thus not a formulation with a grid.

There exists in addition a specific formulation (LIAISON_UNIL), dedicated to the simple unilateral conditions (without pairing). This formulation, derived from the discrete methods, makes it possible to impose a unilateral condition on a degree of freedom. For example: $DX < 4$ or $PRES < 3$. One makes use of it particularly in THM, to impose the conditions known as of seepage.

In the case of the formulations with a grid with NODAL pairing or MAIT_ESCL, there are two surfaces whose composition is given under key words GROUP_MA_MAIT/MAILLE_MAIT and GROUP_MA_ESCL/MAILLE_ESCL. In the case of formulation LIAISON_UNIL, there is only one surface whose composition is given under key words GROUP_MA/MAILLE/GROUP_NO/NOEUD. In the case of formulation XFEM, there is no mesh and one gives the cracks XFEM to which will apply the conditions of contact/friction (*via* keywords FISS_MAIT).

2 Structure of definition of the contact

```
sd_contact (K8)       :: = /FORMULATION

record = all
   (O) ".CHME.MODEL.NOMO": V K8 length  = 1    (O       ) ".CONTACT.PARACI
      ": V I long   = ZPARI          (  O) ".CONTACT.PARACR
      ": V R long   = ZPARR          (  O) ".TYPE":
   V   K8 length             = 1    /FORMULATION       =

"LIAISON_UNIL" (O) ".CONTACT.NDIMCU
      ": V I long   = 2    (O       ) ".  CONTACT.CMPGCU
      ": V K8 length   = NCMPG          (O) ".CONTACT.COED
   "  : V K8 length     = NNOCU          (O) ".CONTACT.COEG
   "  : V K8 length     = NCMPG          (O) ".CONTACT.LISNOE
      ": V I long   = NNOCU          (  O) ".CONTACT.POINOE
      ": V I long   = NNOCU          +1  /FORMULATION =

unilateral contact ("DISCRETE" or "CONTINUE" or "XFEM") (O) ".CONTACT.NDIMCO
      ": V I long   = ZDIME          /FORMULATION  =

with a grid ("DISCRETE" or "CONTINUE") (O) ".CONTACT.METHCO
      ": V I long   = ZMETH          *NZOCO  (O) ".CONTACT.DIRAPP
      ": V K8 length   = 3    *NZOCO       (O) ".CONTACT.DIRNOR
      ": V K8 length   = ZDIRN          *NZOCO (O) ".CONTACT.JFO
   1CO": V K8 length   = NZOCO          (O) ".CONTACT.JFO
   2CO": V K8 length   = NZOCO          (O) ".CONTACT.TOLECO
      ": V R long   = ZTOLE          *NZOCO  (O) ".CONTACT.JEUCOQ

      ": V R long   = NMACO          (  O) ".CONTACT.JEUPOU
      ": V R long   = NMACO           (O) ".CONTACT.PZONECO

      ": V I long  = NZOCO          +1  (O) ".CONTACT.PSUMACO
      ": V I long  = NSUCO          +1  (O) ".CONTACT.PSUNOCO
      ": V I long  = NSUCO          +1  (O) ".CONTACT.MAILCO
      ": V I long   = NMACO          (  O) ".CONTACT.NOEUCO
      ": V I long   = NNOCO           (O) ".CONTACT.MANOCO
      ": V I long   = NMANO          (  O) ".CONTACT.PMANOCO
      ": V I long  = 1    +NNOCO        (O) ".CONTACT.NOMACO
      ": V I long   = (          O  ) ".CONTACT.PNOMACO NAMED
      ": V I long  = 1    +NMACO        (F) ".CONTACT.PSSNOCO

      ": V I long  = 1    +NZOCO        (F) ".CONTACT.SSNOCO
      ": V I long   = STOCNO           (O) ".CONTACT.TYPENO

      ": V I long   = ZTYPN          *NNOCO  (O) ".CONTACT.TYPEMA
      ": V I long   = ZTYPM          *NMACO  (O) ".CONTACT.MAESCL
      ": V I long   = ZMAES          *NTMAE  /FORMULATION =

"DISCRETE" (O) ".CONTACT.CARADF
      ": V R long   = ZCMDF          *NZOCO  (F) ".CHME":
   V   sd_char_             meca    /FORMULATION       =

"CONTINUE" (O) ".CONTACT.CARACF
      ": V R long   = ZCMCF          *NZOCO  (F) ".CONTACT.PSANOFR
      ": V I long  = 1    +NZOCO        (F) ".CONTACT.SANOFR
      ": V I long   = STOCNO           (F) ".CONTACT.EXCLFR
      ": V R long   = ZEXCL          *NZOCO  (O) ".CHME.LIGRE
```

```
   ”   : V sd_ligrel       /FORMULATION          =

“XFEM” (O) “.CONTACT.CARAXF
       ”: V R long    = ZCMXF          *NZOCO  (O) “.CONTACT.MODELX
       ”: V K8 length   = 1          the length of
```

the SD for the contact is stored in routine FORTRAN CFMMVD. The call is simple: ZDIME = CFMMVD
(“ZDIME”) For example,

ZDIME gives the length of object DEFICO (1:16)/ “.NDIMCO”. When the SD is multi-zones, value ZLONG turned over by CFMMVD is a multiplier (the overall length of the object is worth then NZOCO*ZLONG with NZOCO the number of zones in contact). Any change length of the SD of contact must pass by this utility. One will take care to reflect the change in sd_contact.py simultaneously. Common objects for

3 all the formulations (O) ".CHME.MODEL.NOMO": V K8

length = 1 (O) ".CONTACT.PARACI " : V I long
= ZPARI (O) ".CONTACT . PARACR ": V R long
= ZPARR (O) ".TYPE" : V K8 length = 1 Here
the description of the single

objects (i.e. not depending on the contact zone) for all the methods. There are three objects: ".CHME.MODELE.NOMO" – gives the name of MODELE
".CONTACT. PARACI" – various parameters
of the whole type - single routine of access CFDISI ".CONTACT.PARACR" – various parameters of
the real type - single routine of access CFDISR ".TYPE" – standard of the load ("MECA_RE") For
each element of the objects containing the parameters

, one gives in the table below: The index; A description; (S) the keyword (S)
1.concerned (S
2.) in DEFI_CONTACT
3.; Question to pose in CFDISI or CFDISR; If
4.information is relevant (O) or not (N) for
5.each FORMULATION (D: DISCRETE, C: CONTINUE, X: XFEM , L: LIAISON_UNIL)
Parameters of the whole **type** PARACI (O) ".CONTACT.

3.1 PARACI": V I long = ZPARI Object

created in: caracp.f , caliun .f Objet filled
in: caraun.f, cazofm .f , cazocp.f ,
caralv .f, mmprel.f Object read in : cfdisi.f , cfdisl.f Index Description DEFI_CONTACT
Question CFDISI D C X U 1 Type

of geometrical		reactualization	0 – SANS -1	–	AUTOMATIQUE		
1	X – CONTROLE with x= NB_ITER_GEOM REAC_GEOM NB_ITER_GEOM NB_ITER_GEOM O O O N2 Stop on singular	contact matrix	0 - YES	1 –		N O N	S T O P _ S I N G U L I E R

2	STOP_SINGULIER O N N O 3 Many second simultaneous	members	during the construction				of
3	of Schur NB_RESOL NB_RESOL O N N O 4 Type of formulation 1 – DISCRETE	2 - CONTINUE	3	–	XFEM		4
4	LIAISON_UNIL FORMULATION FORMULATION O O O O 5 multiplying Number of iterations	of	contact X -		ITER_CONT_TYPE		
5	= ' MULT' with x= ITER_CONT_MULT -1 – ITER_CONT_TYPE = ' MAXI' ITER_CONT_TYPE ITER_CONT_MULT ITER_CONT_MULT O O O N 6 Number	maximum of geometrical iterations	ITER_GEOM_MAXI				ITER_GEOM_MAXI
6	O O O N 7 maximum Number of iterations	of friction	ITER_FROT_MAXI			ITER_FROT_MAXI	

7	N O O N 8 Zones all in mode without	computation 0 -	NON 1 - YES		RESOLUTION		
8	ALL_VERIF O O N N 9 Type of algorithm for the geometry	0 -	POINT_FIXE		1 -		NEWTON
9	ALGO_RESO_GEOM ALGO_RESO_GEOM O O O N 10 Number maximum of iterations	of contact	X - ITER_CONT_TYPE				=
10	" with x= ITER_CONT_MAXI -1 – ITER_CONT_TYPE = ' MULT' ITER_CONT_TYPE ITER_CONT_MAXI ITER_CONT_MAXI N O O N11 Zones	all in initial contact ("INTERPENETRATES	")	0 -		NON	1
11	YES CONTACT_INIT ALL_INTERPENETRE N O N N 12 Nombre of iterations	of GCP ITER_GCP_MAXI	ITER_GCP_MAXI		O	N	N
12	13 Type of preconditioner	of the GCP 0 -	SANS 1 - DIRICHLET				PRE_COND
13	PRE_COND O N N N 14 Nombre of iterations of the preconditioner		of GCP ITER_PRE_MAXI				
14	O N N N 15 Type of linear Search	for GCP	0 - ADMISSIBLE		1	-	
15	RECH_LINEAIRE RECH_LINEAIRE O N N N 16 YES Models	axisymmetric 0 - NON 1	- In AXISYMMETRIC				
16	N O N N 17 Method for contact	- DISCRETE	1 - STRESS		2	-	GCP
4	– PENALIZATION 5 – LAGRANGIAN ALGORITHME _CONT ALGO_CONT O N N N Method for the contact - CONTINUE	6 -	YES nothing ALGORITHME		CONT		N

	O N N Method for the contact - XFEM 7 -	*YES*	nothing ALGO_	CONT	N	N	O
	N 18 Method for friction - DISCRETE		0 - not	of	friction		
	1 – PENALIZATION 2 – LAGRANGIAN FROTTEMENT *ALGO_FROT ALGO_FROT* O N N N Method for friction	- CONTINUE 6 -	YES FROTTEMENT				ALGORITHME
	_FROT N O N N Method for friction -	XFEM 7 -	YES FROTTEMENT			ALGORITHME	_FROT
	N N O N 19 Lissage of norms 0 - NON	1 - YES	LISSAGE LISSAGE			O	O
19	N 20 Unutilised 21 an At least zone into	cohesive	0 -	NON	1	-	YES
20	*ALGORITHME_CONT*						
21	_XFM_CZM N N O N22 At least a zone in penalization	0	- NON 1 -	YES		ALGORITHME	_CONT

22	ALGO_FROT EXIS_PENA N O O N 23 an At least zone in	mode without computation 0	- NON 1	-	YES		RESOLUTION
23	EXIS_VERIF O O N N 24 All zones in nodal	integration	0 - NON	1 -		YES	INTEGRATION
24	ALL_INTEG_NOEUD N O N N 25 Stop if interpenetration	in mode	without computation 0	-	NON		1 -
25	YES STOP_INTERP STOP_INTERP O O N N At least 26 a zone in bilateral	contact	0 - NON 1	-	YES		SLIDE
26	EXIS_GLISSIERE O O O N 27 Type of algorithm for	the contact	0 - POINT_FIXE	1	-	NEWTON	
27	ALGORITHME_RESO_CONT ALGO_RESO_CONT N O N N 28 Type of algorithm for	friction	0 - POINT_FIXE		1	-	NEWTON
28	ALGO_RESO_FROT ALGO_RESO_FROT N O N N Parameters of the whole type	PARACR (O)	".CONTACT.PARACR	"	:	V	R

3.2 long = ZPARR Object created in :

caracp.f , caliun .f Objet filled in: cazocp.f
Object read in: cfdisr.f Index Description
DEFI_CONTACT Question CFDISR
D C X U 1 Threshold for

the geometrical		reactualization	X – RESI_GEOM	RESI_GEOM			
1	O O O N2 Threshold for the reactualization of friction	X -	RESI_FROT		RESI_FROT		
2	RESI_FROT N O O N 3 Tolerance interpenetration in mode without	computation	X - TOLE	_INTERP		TOLE	
3	TOLE_INTERP O O N N4 Residue of the GCP X - RESI_ABSO RESI_ABSO	RESI_ABSO	O N N	N	5	Residue	
4	of preconditioner GCP X -	COEF_RESI	COEF_RESI	COEF_RESI			
5	N N N common Object for the unilateral contact	Object NDIMCO	This object	is		common	

4 to all the formulations of the contact unilateral

4.1 , it

thus does not exist not in the case of formulation LIAISON_UNIL. (O) ".CONTACT.NDIMCO": V I long = ZDIME Object created in : caracp.f Object

filled in: dimeco.f , limacx.f , xmacon.f Object
read in: cfdisi.f , cfdisl.f
Index Description Question CFDISI 1 Dimension of
space NDIM 2 Many contact zones

NZOCO	3 Many	contact surfaces
1	NSUCO 4 Number of meshes	
2	contact NMACO 5 Many	nodes
3	contact NNOCO 6 Not used	7 Not
4	used 8 Nombre total nodes	
5	NTNOE 9 Nombre total	meshes
6	*slaves NTMAE*	
7	*10 Nombre total*	
8	main nodes NTNOM 11 Many	
9	meshes main NTMAM 12 Many	
10	nodes slaves indeed	in
11	NTNOEC 13 Nombre total of meshes	
12	indeed in contact NTMAEC 14 Nombre total of	main
13	indeed in contact NTNOMC 15 Nombre total of	meshes
14	indeed in contact NTMAMC 16 Nombre total of	points
15	17 Nombre total of points indeed in contact NTPC	18 Dimension
16	of the table of connectivity	
17	mailles→nœuds NTMANO Note: The number	of points
18	CONTINUE has meaning only in the formulation (it	depends

then on the diagram
•of integration). For the discrete methods, it is equal to the number of nodes slaves; The term "indeed in contact" corresponds if the quantities are related to
•a resolution of computation (RESOLUTION='OUI' in DEFI_CONTACT). For example, for the nodes slaves: NTNOE: nombre total of nodes slaves ; NTNOEC: many nodes slaves on which

- •one will calculate; NTNOEV=NTNOE-NTNOEC
- •: many nodes slaves on which one will make only pairing
- •; Objects common to all the formulations with a grid Here the description of the objects depending

5 on the contact zone dedicated to the formulations with a grid

(continuous method and DISCRETE). Options of pairing per zone These objects correspond to the variable options of pairing

5.1 from one contact zone to another

. For each element of the objects containing the parameters one gives in the tables below: The index; A description; (S) the keyword (S) concerned (S) in DEFI_CONTACT; Question
1.to pose in
2.MMINF*; Object
3.METHCO (O) ".CONTACT.METHCO": V I long = ZMETH
4.*NZOCO Object created in: caracm.f Object

5.1.1 filled in

: cazocm.f, dimecz.f Object read in: mminfr.f, mminfi.f
, mminfl.f Object indexed by
the number of the contact zone . Index on
the zone Description DEFI_CONTACT Question MMINF
* 1 Type of pairing 0 – NODAL 1 – MAIT_ESCL

APPARIEMENT MMINFI	APPARIEMENT	2 Presence	of keywords	
1	_POUTRE DIST_POUTRE MMINFL DIST _POUTRE 3 Presence	of keyword	DIST	_COQUE DIST
2	COQUE MMINFL DIST_COQUE 4 Type of	norm 0	- MAIT	1 - MAIT_ESCL
3	2 – NORMAL ESCL MMINFI NORMAL	MMINFL	MAIT	ESCL MAIT_ESCL
4	5 Type of the vector carried by master mesh 0 - AUTO	1 -	FIXES 2	- VECT_Y
			VECT	_MAIT MAIT_ FIXED MAIT_
5	MMINFI VECT_MAIT MMINFR VECT_MAIT_DIRX 1Accès object ".CONTACT .DIRNOR"	VECT_MAIT_DIRY VECT_MAIT _DIRZ 6 Type	of the vector	carried
			by	the mesh slave [1] VECT_ESCL ESCL_FIXE ESCL
6	_Y MMINFI VECT_ESCL MMINFR VECT _ESCL_DIRX 2Accès object ".CONTACT .DIRNOR"	VECT_ESCL_DIRY VECT_ESCL _DIRZ 7 Type	of search	for
			pairing	0 - AUTO [2] DIRE_APPA MMINFI TYPE_APPA MMINFR
		_APPA_DIRY	MMINFL	TYPE

1 0 – AUTO 1 - FIXES 2 - VECT_Y
2 – FIXES Number of slave nodes TYPE _APPA

7	_APPA _DIRX 3Accès object “ .CONTACT .DIRAPP” TYPE	TYPE_APPA _DIRZ	_APPA_ FIXE 8	Number of meshes [3] NBMAE 9 on
			zone	MMINFI NBNOE
8	Number of meshes main on zone		MMINFI	NBMAM
9	11 Number of master nodes on zone		MMINFI	NBNOM
10	12 Number of meshes slaves in effective		contac t	on
11	zone MMINFI NBMAEC 13 Number of slave nodes			in
12	contact on zone MMINFI Main NBNOEC 14		Number of meshes	in
13	contact on zone MMINFI NBMAMC 15 Number of master nodes			in
14	contact on zone MMINFI NBNOMC 16 Shift in		the vector s	for
15	meshes slaves MMINFI JDECME 17 Shift in		the vector s	for
16	meshes main MMINFI JDECMM 18 Shift in		the vector s	for
17	the nodes slaves MMINFI JDECNE 19 Shift in		the vector s	for
18	nodes MMINFI JDECNM 20 Number of points MMINFI		NTPT	21 points
19	Number indeed in contact MMINFI NTPC 22 Zone		in mode	without
20	0 – NON (RESOLUTION			= ' NON
21	1 – YES (RESOLUTION=' OUI') RESOLUTION		MMINFL	VERIF
22	CALCUL Object DIRAPP (O) “ .CONTACT.DIRAPP”: V K8 length = 3*NZOCO Object created in	: caracm.f	Object filled	in : cazocm.f

5.1.2 Object read

in : mminfr.f Object indexed by the number of
the contact zone. Index on
the zone Description DEFI_CONTACT
Question MMINF * 1 Direction
of search for pairing following X DIRE_APPA

MMINFR DIRE_APPA_	DIRX 2 Direction	of search	for pairing	
1	following Y DIRE_APPA MMINFR DIRE_APPA_DIRY 3	Direction	of search	for pairing

3 slaves on zone MMINFI

2	following Z DIRE_APPA MMINFR DIRE_APPA_DIRZ Object	DIRNOR	(O) ".CONTACT	.DIRNOR"
3	V K8 length = ZDIRN*NZOCO Object created in:	caracm .f	Objet filled	in: cazocm.f

5.1.3 Object read in

: mminfr.f Object indexed by the number of the contact zone
. Index on the zone
Description DEFI_ CONTACT
Question MMINF* 1 Norm main
following X MAIT_FIXE MAIT_VECT_Y MMINFR VECT

_MAIT_DIRX 2 Norm	main following	Y FIXED	MAIT_ MAIT_VECT_	
1	MMINFR VECT_MAIT _DIRY 3	Norm main following	Z MAIT	_FIXE MAIT_VECT
2	MMINFR VECT_MAIT _DIRZ 4	Normal slave following	X FIXED	ESCL_ ESCL_VECT_
3	MMINFR VECT_ESCL _DIRX 5	Normal slave following	Y FIXED	ESCL_ ESCL_VECT_
4	MMINFR VECT_ESCL _DIRY 6	Normal slave following	Z ESCL	_FIXE ESCL_VECT
5	MMINFR VECT_ESCL _DIRZ Objects	JFO1 CO and JFOCO2	(O) ".CONTACT	.JFO1CO":
6	V K8 length = NZOCO (O) ".CONTACT	.JFO2CO ": V K8 length	= NZOCO	Object created

5.1.4 in: caracm .f Objet

filled in: cazocm.f Object read in: mminfl.f
Object indexed by the number of the contact zone
. Index on the zone Description
DEFI_CONTACT Question
MMINF* 1 additional Clearance
on master mesh Name of function DIST_MAIT

MMINFL DIST_MAIT	Index on	the zone additional	Description	
1	DEFI_CONTACT Question MMINF* 1 Clearance *on mesh slave*	Name of	function	DIST_ESCL

MMINFL DIST_ESCL	Object TOLECO	(O) ".CONTACT	.TOLECO": V	
1	long = ZTOLE*NZOCO Object created in	in:	cazocm.f	read in

	: caracm.f Object filled		Object	

5.1.5 : mminfr.f Object

indexed by the number of the contact zone.
Index on the zone Description
DEFI_CONTACT Question MMINF*
1 Parameter projection out
- mesh TOLE_PROJ_EXT MMINFR TOLE_PROJ_EXT 2 Parameter

tolerance outdistances	pairing	TOLE_	APPA MMINFR TOLE	
1	_APPA 3 Parameter tolerance interpenetration		in mode	without computation TOLE
2	_INTERP MMINFR TOLE_INTERP Options of pairing	per mesh	(slave	) Objects
3	JEUPOU/JEUCOQ (O) ".CONTACT.JEUPOU": V R long = NMACO	(O) ".CONTACT	.JEUCOQ	": V R

5.2 long = NMACO These objects contain additional
5.2.1 clearance by mesh

slave when one uses beams
(keyword DIST_POUTRE) or shells (keyword

DIST_COQUE). Information (thickness of the shell or radius of the beam is read directly in the SD cara_elem given in DEFI_CONTACT). Object created in: capoco.f, cacoco.f Object filled in: capoco.f, cacoco.f Object read in: cfdism.f, cfdist.f Object indexed by **the number of the mesh**

slave in MAILCO (POSMAE). Index
on the slave mesh Description DEFI_CONTACT
1 additional Clearance on mesh
slave of beam DIST_ POUTRE CARA_ELEM Index on the slave mesh

additional Description	DEFI_CONTACT 1 Clearance	on
1	slave of shell DIST_ COQUE CARA_ELEM Description	of the contact zones

the system of contact	is composed	of several zones
1	, themselves divided into two surfaces made up	of meshes , containing

5.3 nodes. Contact surfaces

are located by their absolute number in the list of all contact surfaces, all confused zones. Only tables MAILCO, NOEUCO and SANSNO and the index the nodes meshes i by their absolute number in the mesh; all the other tables use
the index in MAILCO and NOEUCO to indicate a mesh or a node. This index often is called position and noted POSMA/POSNO in the routines (whereas the absolute number of the mesh or of the node are rather indicated by NUMMA/NUMNO). Object PZONECO (O) ".CONTACT.PZONECO ": V I long = Pointer NZOCO+1 of access towards surfaces for each contact zone. Created in poinco.f , filled in

5.3.1 nbzoco.f. Number

ISURF1 of the first surface (Master) for

zone IZONE: ISURF1 = ZI (JZONE+IZONE-1) +1 Number ISURF2 of the second surface (slave) for zone IZONE

: ISURF 2 = ZI (JZONE+IZONE) Routine of direct access (to be privileged
): SUBROUTINE CFZONE (DEFICO

, IZONE, TYPSUR , ISURF) IN DEFICO: SD OF DEFINITION OF THE CONTACT IN IZONE
: NUMERO OF CONTACT ZONE

IN TYPSUR: TYPE OF SURFACE "MAIT"
"ESCL" OUT ISURF: NUMERO IN the SURFACE FOR
access PSUNOCO/PSUMACO Objects PSUMACO/PSUNOCO
(O) " .CONTACT.PSUMACO": V I long
= NSUCO+1 (O) ".CONTACT.PSUNOCO
":
V I
long = NSUCO +1 Pointer of access towards meshes/nodes of each

5.3.2 contact surface .

One points towards objects MAILCO and NOEUCO.
Created in poinco.f, filled in nbsuco.f. Shift

JDECMA in MAILCO for the first mesh of surface ISURF: JDECMA = ZI (JSUMA+ISURF-1) Shift JDECNO in NOEUCO for the first node of surface

ISURF: JDECNO = ZI (JSUNO +ISURF - 1) Number NBMA of meshes for surface
ISURF: NBMA = ZI (JSUMA+ISURF

) – ZI (JSUMA+ ISURF- 1) Number NBNO of nodes for surface ISURF :
NBNO = ZI (JSUNO+ISURF) –

ZI (JSUNO +ISURF - 1) to reach a node or
a mesh, one uses the shifts given

in PSUMACO /PSUNOCO to traverse MAILCO and
NOEUCO. Integers (often noted POSMA in

the code) contents in PSUMACO vary between 1 and NMACO. Integers (often noted POSNO in the code) contents in PSUNOCO vary between 1 and NNOCO. Routine of direct access (to be privileged) : SUBROUTINE CFNBSF (DEFICO , ISURF, TYPENT, NBENT, JDEC) IN DEFICO: SD OF DEFINITION OF THE CONTACT IN TYPENT: TYPE OF ENTITE "

NOEU" ACCESS WITH THE NODES FASTENERS WITH THE SURFACE "

```
MAIL" ACCESS WITH MESHES THE ATTACHEES WITH SURFACE IN  ISURF
     : NUMERO OF SURFACE OUT NBENT: ENTITY
     MANY OUT JDEC:
               DECALAGE  IN the VECTORS FOR LE FIRST Of
               the SURFACE  Objects MAILCO/NOEUCO (O) ".CONTACT.MAILCO
   "  : V  I long = NMACO (O) ".CONTACT
   .NOEUCO  ": V I long
   = NNOCO Gives   the absolute number of meshes/nodes of contact. One
points
```

5.3.3 towards the objects of

```
   the SD mesh. One   reaches           these objects
thanks to  pointers   PSUMACO          /  PSUNOCO. Created
```

and filled in liexco.f. Absolute number NUMMA of I - ème mesh of the surface of number ISURF : NUMMA = ZI (JMACO+JDECMA-1+ISURF) absolute Number NUMNO of I - ème node of the surface of number

ISURF: NUMNO = ZI (JNOCO +JDECNO - 1+ISURF) integers (often noted NUMMA in the code) contents in MAILCO

vary between 1 and the nombre total of meshes in the mesh . Integers (often noted NUMNO in

the code) contents in NOEUCO vary between 1 and the nombre total of nodes in the mesh . Routines of direct access (to be privileged): SUBROUTINE CFNUMM (DEFICO , NMA , POSNMA, NUMNMA) IN DEFICO : SD OF CONTACT (DEFINITION) IN NMA: NUMBER OF MESHES IN POSNMA

: INDICES IN MAILCO OF MESHES OUT THE NUMNMA

```
: ABSOLUTE NUMBERS OF MESHES   IN THE MESH
   SUBROUTINE  CFNUMN (DEFICO, NO, POSNNO, NUMNNO
     ) IN    DEFICO: SD OF CONTACT
     (DEFINITION) IN NO: NUMBER OF NODES
   IN POSNNO: INDICES IN NOEUCO OF NODES OUT NUMNNO:

ABSOLUTE NUMBERS OF THE NODES IN   THE MESH SUBROUTINE
     CFPOSN (DEFICO, POSMAI, POSNNO, NAMED
   )  IN    DEFICO: SD OF CONTACT
   (  DEFINITION) IN POSMAI: INDEX OF THE MESH
   (IN SD CONTACT) OUT POSNNO: INDICES IN NOEUCO OF

THE NODES OUT NAMED: NUMBER OF NODES OF THE MESH
     (IN THE SD OF CONTACT) SUBROUTINE
   CFNOMM  (NAMED, DEFICO, TYPENT, POSE, NAME) IN NAMED
   : NOM OF MAILLAGE IN THE DEFICO: SD OF DEFINITION
   OF THE CONTACT IN POSE: POSITION OF THE ENTITE IN SD CONTACT

IN TYPENT: TYPE  OF ENTITE <MAIL> NETS <NOEU
   >  NOEUD   OUT NAME: NOM Of
     the ENTITE Objects MANOCO/PMANOCO (O) ".CONTACT
     .PMANOCO": V I long = NNOCO+1 (O) ".CONTACT.MANOCO
     ": V I long = NMANO
                 One reaches
                 opposite
```

connectivity via objects MANOCO

5.3.4 /PMANOCO . Opposite

connectivity turns over for a given node
meshes which is attached there . Object

PMANOCO is indexed by the number of *the node* of contact in NOEUCO (number given by PSUNOCO and often noted POSNO in the code). The values contained in
PMANOCO point towards MANOCO, they vary between 1 and NMANO. Integers (often noted POSMA in the code) contents in MANOCO vary between 1 and NMACO (they point towards MAILCO). Created and filled in tablco.f. Shift JDEC in MANOCO of the first mesh attached to the node of number POSNO in CONTNO: JDEC = ZI (JPOMA+POSNO-1) Number NBMANO
of meshes attached to the node of

number POSNO in CONTNO : NBMANO = ZI (JPOMA+POSNO) – ZI (JPOMA+POSNO-1) Number POSMA in MAILCO
of I-ème nets attached

to the node of number POSNO in CONTNO: POSMA = ZI (JMANO +JDEC - 1+I)
Routines of direct access (to be privileged):

SUBROUTINE CFNBEN (DEFICO , POSE , TYPENT , NBENT, JDECEN) IN DEFICO : SD OF DEFINITION OF THE CONTACT IN POSE
: POSITION OF THE ENTITE

IN SD CONTACT IN TYPENT: TYPE OF ENTITE

```
"CONINV" POSE IS ONE NOEUD - > ONE REACHES THE ATTACHEES
   MESHES  A THIS NOEUD (CONNECTIVITY INVERSE
     ) "CONNEX" POSE IS A MESH - > ONE A REACHES
     THE NODES FASTENERS THIS MESH
                 (DIRECT CONNECTIVITY) OUT
                 NBENT: ENTITY MANY FASTENERS OUT JDECEN
                 : DECALAGE FOR TABLEAU
                 SUBROUTINE CFINVM (DEFICO, JDECIV
                 , IMA, POSMA) IN DEFICO: SD OF CONTACT (DEFINITION
                 ) IN IMA: SEQUENCE NUMBER
     OF THE MESH IN SD IDIOT. INVERSE
   . IN JDECIV: DECALAGE FOR READING

IN SD IDIOT. INVERSE. OUT POSMA   : POSITION
     Of the mesh Objects NOMACO/PNOMACO
   (O  ) ".CONTACT    .PNOMACO": V I long = NMACO+1 (O) ".CONTACT
   .NOMACO  ": V I long = One NAMED reaches the connectivity
   of meshes  via a dedicated object
```

5.3.5 and not via the usual

objects of the sd_maillage (like CONNEX).
There is indeed a difference because of

QUAD8 from which one excludes the nodes mediums of the contact (the mesh of contact QUAD8 thus contains only 4 nodes). Moreover connectivity was reduced to meshes of contact, which allows a faster access. Object PNOMACO is indexed by the number of the mesh contact in MAILCO (number given by PSUMACO and often noted POSMA in the code). The values contained in
PNOMACO point towards NOMACO, they vary between 1 and NAMED. Integers (often noted POSNO in the code) contents in NOMACO vary between 1 and NNOCO (they point towards

NOEUCO). Created and filled in tablco.f. Shift JDEC in NOMACO of the first node of the mesh of number POSMA in MAILCO : JDEC = ZI (JPONO +POSMA - 1) Number NBNOMA of nodes for the mesh of number POSMA in

MAILCO: NBNOMA = ZI (JPONO+POSMA) - ZI (JPONO+POSMA-1) Number POSNO in NOEUCO of I ème
node of the mesh of

number POSMA in MAILCO: POSNO = ZI (JNOMA+JDEC- 1+I) Routines of direct access (to be privileged): SUBROUTINE CFNBEN

(DEFICO , POSE , TYPENT , NBENT , JDECEN) IN DEFICO: SD OF DEFINITION OF THE CONTACT IN POSE
: POSITION OF THE ENTITE IN

SD CONTACT IN TYPENT: TYPE OF ENTITE “

```
CONINV” POSE IS ONE NOEUD - > ONE REACHES THE ATTACHEES
   MESHES  A THIS NOEUD (CONNECTIVITY INVERSE
   )  “CONNEX” POSE IS A MESH - > ONE A REACHES
     THE NODES FASTENERS THIS MESH
                (DIRECT CONNECTIVITY) OUT
                NBENT: ENTITY MANY FASTENERS OUT JDECEN
                : DECALAGE FOR TABLEAU
                SUBROUTINE CFCONN (DEFICO, JDECNO
                , INO, POSNO) IN DEFICO: SD OF CONTACT (DEFINITION
                ) IN INO: SEQUENCE NUMBER
   OF NOEUD  IN SD IDIOT. IN JDECNO
   : DECALAGE FOR READING IN SD IDIOT

. OUT POSNO: POSITION OF NOEUD the Exclusion   of
   the nodes  /mailles Objects PSSNOCO/SSNOCO
     (F) “.    CONTACT.PSSNOCO”: V I long = NZOCO
   +1 (  F) “.CONTACT.SSNOCO”: V I long = STOCNO Objects
   used  to exclude from
```

5.4 the nodes given by SANS_GROUP

5.4.1 _NO/SANS _NO or SANS _GROUP

```
_MA/SANS_MAILLE   and valid           for  formulations
   DISCRETE and CONTINUE      .       PSSNOCO  is a pointer
```

of indirection towards SSNOCO. Created and filled in sansco.f/sansno.f. Shift JDEC in SSNOCO of the first node excluded for zone IZONE: JDEC = ZI (JPSANS +IZONE - 1) Number NBEXNO of nodes excluded for
zone IZONE: NBEXNO = ZI (JPSANS+IZONE) – ZI

(JPSANS+IZONE – 1) the absolute number of the node in the mesh is stored in SSNOCO with the index

given by PSSNOCO . The routine cfmmex.f makes it possible to say
if a node is part of this group (cf §7.2)

. Information on meshes and the nodes Object TYPENO (O) “ .CONTACT .TYPENO”: V I long = ZTYPN*NNOCO object “.CONTACT .TYPENO” is indexed by the number of the node of in *NOEUCO* 7.2(number

5.5 given by PSUNOCO and often noted

5.5.1 POSNO in

the code). It turns over the type of the node is outside the field of definition with a right profile of the EXCLU type node: -1 if it is

slave, +1 if he is Master , as well as the contact zone to which he belongs . Created and filled in typeco.f. Routines of direct access (to be privileged): SUBROUTINE CFZONN (DEFICO, POSNO, IZONE) IN DEFICO: SD OF CONTACT (DEFINITION) IN POSNO: INDEX IN NOEUCO OF NOEUD OUT THE IZONE : NUMERO OF

ZONE SUBROUTINE CFTYPN (DEFICO, POSNO, TYPNO

```
) IN DEFICO: SD OF CONTACT (DEFINITION
    )  IN POSNO: INDEX IN NOEUCO OF NOEUD
      OUT THE TYPNO  : TYPE OF NOEUD "the MAIT" OR
   "ESCL" Object  TYPEMA (O) ".CONTACT

.TYPEMA": V I long = ZTYPM*NMACO
     object ".CONTACT.TYPEMA" is indexed by
     the number  of the mesh contact in
   MAILCO (number  given by PSUMACO and often
```

5.5.2 noted POSMA

in the code). It turns over the type of the mesh

: -1 if it is slave, +1 if he is Master. He is also used as pointer of access to object MAESCL by providing index INDMAE of a mesh slave in all meshes the gathered slaves. Created and filled in typeco.f. Routine D" direct access (to be privileged): SUBROUTINE CFTYPM (DEFICO, POSMA, TYPMA) IN DEFICO: SD OF CONTACT (DEFINITION) IN POSMA: INDEX IN MAILCO OF THE MESH
OUT TYPMA : TYPE Of the mesh

"MAIT" OR "ESCL" Object MAESCL (O) ".

```
CONTACT.MAESCL": V I long = ZMAES*NTMAE
     Object created in: typeco .f Objet
   filled  in  : typeco .f Objet read in:
   mminfm .f Objet  reached thanks to pointer TYPEMA
```

5.5.3 . Created and

filled in typeco.f. The table is built by gathering

all meshes the slaves
of all the zones . MAESCL
(1) with MAESCL (NBMAE (1)
), one has all meshes the slaves of the first
contact zone , then of

MAESCL (NBMAE (1) +1) with MAESCL (NBMAE (2)), there are all meshes the slaves of the second contact zone , etc object TYPEMA provides such an index and is thus used as pointer of access to MAESCL. This table turns over various information on meshes the slaves (primarily in

formulation CONTINUE). Index on the slave mesh Description Question MMINFM 1 Value of the index of the mesh
in MAILCO No accesses 2 Number of the zone to which belongs mesh IZONE 3 Number of points

of integration NPTM 4 Element	from which	nodes
1	by specific SANS_*_FR NDEXFR Objects	for formulation
2	DISCRETE One gives in this section the description	
3	the objects depending on the contact zone	
4	and dedicated to formulation DISCRETE. Object CARADF	(O) ".

6 CONTACT.CARADF": V R long = ZCMDF*NZOCO Object

created in: caracd .f Objet filled in: cazocd.f Object read in: mminfr.f, mminfi.f, mminfl.f Object indexed by the number of

6.1 the contact zone

. Index on the zone Description DEFI_CONTACT
Question MMINF* 1 Contribution stamps
friction COEF _MATR_
FROT MMINFR COEF _MATR_FROT 2 Coefficient of penalization
for contact E_N MMINFR E_N 3 Coefficient

of penalization	for	friction E_T	MMINFR E_T	
1	Coefficient of kinetic friction of Coulomb	COULOMB MMINFR	COEF	_COULOMB 5 Parameter
2	of alarm in mode bilateral contact (slide		) ALARME	_JEU
3	MMINFR ALARME_JEU 6 bilateral Contact on	the zone	0 - NON	1
4	YES SLIDE MMINFL SLIDE _ZONE	SD tank	_meca	(F) ".CHME":
5	V sd_char_meca This SD is a sd_char_meca (cf [D4.06.04	]) used	to impose	linear
6	relations with the nodes mediums in the presence of elements		QUAD8. Specific	objects

6.2 for the formulation

CONTINUE Object CARACF

(O) ".CONTACT.CARACF ": V R *long* = ZCMCF*NZOCO Object created in: caracc.f Object filled in: cazocc.f Object read in: mminfr.f, mminfi.f, mminfl.f

7 Object indexed by the number of the contact zone

7.1 . Index on

the zone Description DEFI _ CONTACT Question MMINF*

1 Type of integration 1 - "AUTO
" X2 – "GAUSS" X3 - "SIMPSON
" X4 – "NCOTES " X - ORDRE _INT INTEGRATION ORDRE
_INT MMINFI INTEGRATION 2 Value of the coefficient of

increase in contact	COEF_ CONT	COEF_ PENA	_CONT MMINFR COEF	
1	_AUGM _CONT 3 Type of algorithm in contact (increased or penalized) 1 - STANDARD 3 - PENALIZATION	ALGORITHME _CONT MMINFI	ALGORITHME	_CONT 4
2	of the coefficient of increase in friction	COEF_ FROT COEF_ PENA_FROT	MMINFR	COEF_ AUGM_ FROT
3	Type of algorithm in friction (increased or penalized) 1 - STANDARD 3 - PENALIZATION	ALGO_FROT	MMINFI	ALGO_FROT
4	6 Coefficient of kinetic friction of Coulomb COULOMB MMINFR	COEF_ COULOMB 7 initial	Value	of the threshold of Tresca
5	SEUIL_INIT MMINFR SEUIL_INIT 8 Surfaces initially in contact 0 - NON 1 - YES 2	- INTERPENETRATES	CONTACT	_INIT
6	CONTACT_INIT 9 bilateral Contact	on	zone 0	- NON 1 -
7	SLIDE MMINFL GLISSIERE_ZONE	10 Elimination		of nodes of the contact
8	0 – NON 1 – YES SANS _*_NO MMINFL SANS_GROUP_NO 11 Elimination	of nodes	of friction	0
9	NON 1 – YES SANS_*_FR MMINFL SANS_ GROUP_NO_FR	12 Many	excluded	directions of
10	friction 0 – no direction CONTINUE excludes 1 -	only one excluded	direction	2 - all
11	excluded directions SANS_*_FR DIRE_EXCL_FROT MMINFI EXCL_DIR	Objects	PSANOFR	/SANOFR In

12	only, one draft the keywords SANS_GROUP_NO_FR/SANS_NOEUD_FR which make it possible to locate nodes or the meshes particular ones	on contact surfaces	:	(F)" .CONTACT

7.2 .PSANOFR ": V I

long = 1+NZOCO (F)" .CONTACT .SANOFR': V I long = STOCNO the storage of this information is virtually identical to the storage of the nodes excluded of the contact (cf §5.4). A utility routine

makes it possible to say if a node is part of the groups previously described : SUBROUTINE

CFMMEX (DEFICO, TYPEXC, IZONE, NUMNOE, SUPPOK) IN DEFICO: SD FOR THE DEFINITION OF CONTACT IN TYPEXC: *TYPE* OF5.4

"FROT" GIVES SANS_*_FR "CONT PAR" GIVES SANS_* IN IZONE PAR: NUMERO OF CONTACT ZONE IN

NUMNOE: NUMERO ABSOLU OF NOEUD A SEEKING SUPPOK OUT
: 1 SO LE NOEUD BEEN part OF the EXCLUDED NODES
Object EXCLFR (F) IS WORTH ".CONTACT
.EXCLFR": V R long
= ZEXCL*NZOCO This object
is used to specify the vectors of exclusion
of direction of friction in the case of option
SANS_*_FR. Object created in: caracc.f Object filled in

7.3 : cazocc.f Object

read in: mminfr.f Object indexed by the number

of the contact zone. Index on the zone Description DEFI_CONTACT Question MMINF* 1 Direction of exclusion following
X DIRE_EXCL_FROT MMINFR EXCL
_FROT_DIRX 2 Direction of exclusion
following Y TO SAY _EXCL_FROT
MMINFR EXCL_FROT_DIRY 3 Direction of exclusion

following Z DIRE_EXCL_	FROT MMINFR	EXCL_FROT_DIRZ	SD ligrel (	
1	".CHME.LIGRE": V sd _ligrel This	SD of the type	sd_ligrel	(cf [D4.06.02
2	contains the definition of Lagrange	late added		to the model on
3	the nodes slaves by the formulation	continues. Specific	objects	for

7.4 formulation

XFEM Object MODELX (O) ".CONTACT

.MODELX": V K8 `length = 1` *This* object contains the name of model XFEM. It is used for the checking when LIAISON_XFEM=OUI. Object CARAXF (O) ".CONTACT.CARAXF"

8 : V R long = ZCMXF*NZOCO Object created in

8.1 : caracx.f Object

filled in: cazocx.f Object read in

: mminfr.f, mminfi.f, mminfl.f Object indexed by the number of the contact zone. Index on the zone Description

8.2 DEFI

_CONTACT Question MMINF * 1 Type of integration INTEGRATION MMINFI INTEGRATION
2 Value of parameter COEF_REGU
_CONT COEF_REGU _CONT MMINFR COEF_AUGM _CONT COEF
_REGU_CONT 3 Value of parameter COEF_REGU_FROT

COEF_REGU _FROT MMINFR	COEF_AUGM	_FROT COEF_REGU	_FROT 4 Coefficient of kinetic friction	
1	of	Coulomb COULOMB	MMINFR	COEF_COULOMB
2	5 Friction in the zone 0 - NON	3 - YES FROTTEMENT		MMINFI FROTTEMENT _ZONE MMINFL
3	FROTTEMENT_ZONE 6 initial Value	of the threshold of Tresca	SEUIL	_INIT MMINFR SEUIL_INIT
4	Surfaces initially in contact 0 –	NON 1 -	YES CONTACT	_INIT MMINFI
5	CONTACT_INIT 8 Not used 9 Algorithm	of suppression	LBB	0 - NON 1 -
			VERSION	1 2 - VERSION2
6	_LAGR MMINFI ALGO_LAGR 10 bilateral	Contact	on	the zone 0 -
7	NON 1 – YES SLIDE MMINFL SLIDE _ZONE 11 Value	of parameter	COEF	_STAB_CONT
8	*_STAB_CONT*			
9	COEF_STAB_CONT 12 Value of parameter COEF_PENA_CONT COEF_PENA_CONT	MMINFR	COEF_PENA	_CONT 13
10	of parameter COEF_STAB_FROT COEF_STAB _FROT MMINFR	COEF_STAB	_FROT	14 Value of parameter
11	COEF_PENA_FROT COEF_PENA_FROT	MMINFR COEF_PENA	_FROT	15 Parameter projection
12	out-mesh TOLE _PROJ_EXT MMINFR	TOLE_PROJ_	EXT. 16	Type of relation
13	CZM 0 – NOT OF CZM 1 - CZM_EXP_REG	2 - CZM_LIN_REG		RELATION MMINFR

14	RELATION MMINFL CONT _XFEM_CZM 17	Algorithm for	contact	1 - STANDARD
15	2 – ADVANCE 3 – PENALIZATION	4 - CZM	ALGORITHME_ CONT	MMINFR CZM_
16	MMINFL ALGO_CONT_PENA 18 Algorithm for friction 1 - STANDARD 2	- ADVANCE	3 -	Specific
			PENALIZATIO N	ALGORITHME _FROT
17	ALGORITHME _FROT_PENA Objects for formulation LIAISON_UNIL Object NDIMCU (O) ".CONTACT	.NDIMCU	": V	I long = 2 Object
			created	in: caliun.f
18	Object filled in: creaun.f Object read in: cudisi.f Index Description Question	CUDISI 1	Nombre total	of unilateral

9 connections NNOCU 2 Nombre total of ddls implied

9.1 in unilateral

connections NCMPG Object COEFD
(O) ".CONTACT.COEFD": V K8 length
= NNOCU This object stores
the name of the functions giving

the coefficient	of the unilateral	conditions
1	to the member of right. Object LISNOE	(O) ".
2	.LISNOE": V I long = NNOCU This object stores the number	of the nodes

9.2 implied

under the unilateral conditions . Object

POINOE (O) ".CONTACT.POINOE": V I long = NNOCU+1 This object is used as pointer of access to objects CMPGCU

9.3 and COEFG . Shift

JDECMP for the first component

of unilateral condition INO: JDECMP = ZI (JPOIN+INO-1) Number NCMP of components

9.4 for implied

under unilateral condition INO: NCMP

= ZI (JPOIN+INO) – ZI (JPOIN+INO-1) Objects CMPGCU and COEFG (

O) ".CONTACT .CMPGCU ": V K8 length = NCMPG (O) ".CONTACT.COEFG": V K8 length = NCMPG
These objects make it possible

to store the degrees of freedom to which apply the unilateral conditions
as well as the name of the functions which

9.5 are the coefficients of

these conditions (with the member of left thus).
ICMP-eme component of INO-ème unilateral

condition: CMP = ZK8 (JCMPG+JDECMP-1+ICMP) Coefficient component function of the ICMP-eme of INO-ème unilateral condition: COEFG = ZK8 (JCOEFG+JDECMP-1+ICMP)