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ASTROS eBASE Schemata Description

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FOREWORD

All intermodular communication in ASTROS is done through data stored on the eBase database. As a result, there are many relations, matrices, and unstructured entities that are defined to store the data requisite to the analyses.This manual provides a description of each of the database entities that are used in the ASTROS system.These data are useful both to the ASTROS programmer, who needs to know the description of each of the entities to interpret and modify the ASTROS source code, and to the general user in that these data are available on the database for other uses such as eShell and UAI/DataMaster. For supplementary post-processing, the matrix entities may be combined using the MAPOL language to generate data not otherwise computed. At a more sophisticated level, a user-written Fortran module may take existing data from the entities to perform more advanced operations that are beyond the capabilities of the ASTROS executive system.

The entities are documented in alphabetical order and every entity which is used in intermodule communication is included.Those entities which are used for scratch storage within a module are documented in-line rather than in the Programmer's Manual. The entities presented here fall into three categories: system level, hidden entities, and MAPOL entities. The first include those entities that communicate system information between modules.The hidden and MAPOL entities are those which are declared in the MAPOL sequence itself. The hidden entities do not subsequently appear in the MAPOL sequence; their declaration is included as a convenience to the ASTROS executive system.The most common example of a hidden entity is any relation associated with a Bulk Data entry.These relations are used internally by numerous modules but they do not appear in the MAPOL calling sequences because their inclusion would result in an impractically large number of arguments. MAPOL entities are the most relevant and include most matrix entities and a large number of relational entities that are used to pass data between engineering modules.

The entity documentation format is slightly different for each of the entity classes. The core information, however, is the same for each class and includes the entity name, a description of its contents, the

modules that create or add data to the entity, and any additional notes required to define special data handling functions. Each entity class then has an additional set of information.

Matrix entities have a section labeled *Matrix Form* which gives the row and column dimensions of the matrix and indicates the numeric precision and the form of the entity. Relational entities have a section called *Relation Attributes* which lists the schema of the relation and defines the meaning of each of the attributes. Finally, unstructured entities have have a section labeled *Entity Structure* which lists and defines the number and contents of the records of the entity.

LIST OF ENTITIES

Entity: AA

Entity Type: Matrix

Description: Acceleration in the a-set merged from the AL and AR matrices (see AG).

Entity: AAICMAT

Entity Type: Subscripted Matrix

Description: Aerodynamic influence coefficient matrix for an antisymmetric boundary condition and a given Mach number.The Mach number associated with a given subscript is given in the TRIM relation.

Matrix Form: Square, real and asymmetric.The dimension of the matrix is equal to the number of panels in the steady aerodynamics USSAERO model.

Created By: Module STEADY

Notes:

1. STEADY creates as many matrices as there are distinct antisymmetric Mach numbers in the user's input packet.If a combination of symmetric and antisymmetric Mach numbers are used, the MINDEX changes for each distinct Mach number.An AAICMAT entity is created for a given MINDEX only if the corresponding Mach number requires the antisymmetric boundary conditions.It is possible, therefore, that, in the range from 1 to MINDEX, some subscript values will not have a corresponding AAICMAT.

Entity: ACPT

Entity Type: Unstructured

Description: Contains one record for each independent group of aerodynamic elements with data needed to generate the aerodynamic matrices.

Entity Structure:

WORD	TYPE	ITEM
1	I	Key word, 1 for doublet lattice
2	I	Number of panels, NP
3	I	Number of strips, NSTRIP
4	I	Number of boxes, NTP
5	R	F, fraction of box chord from center of pressure to downwash center
NP Words	I	NCARAY, boxes per chord
NP Words	I	NBARAY, last box on panel
NSTRIP Words	R	YS aero coordinates of strip
NSTRIP Words	R	ZS center
NSTRIP Words	R	EE strip half width
NSTRIP Words	R	SG sine of dihedral angle
NSTRIP Words	R	CG cosine of dihedral angle
NTP Words	R	XIC coordinate of center of pressure
NTP Words	R	DELX box chord
NTP Words	R	XLAM tangent of sweepback angle
NTP Words	R	TR box taper ratios
1	I	Key word, 2 for Doublet Lattice with Bodies
2	I	NJ, Number of J points
3	I	NK, Number of K points
4	I	NP, Number of Panels
5	I	NB, Number of Bodies
6	I	NTP, Number of Boxes
7	I	NBZ, Number of Z Bodies
8	I	NBY, Number of Y Bodies
9	I	NTZ, Number of Z Interference Body Elements
10	I	NTY, Number of Y Interference Body Elements
11	I	NTO, Sum of NTP + NTZ + NTY
12	I	NTZS, Number of Z Slender Body Elements
13	I	NTYS, Number of Y Slender Body Elements
14	I	NSTRIP, Number of strips on panels
NP Words	I	NCARAY, Boxes per chord
NP Words	I	NBARAY, Last box on panel
NP Words	I	NAS, Associated bodies per panel
NB Words	I	*NBEA1, Number of interference elements
NB Words	I	*NBEA2, Z-Y flag
NB Words	I	*NSBEA, Number of slender elements
NB Words	R	ZB, Z Body center
NB Words	R	YB, Y Body center
NB Words	R	AVR, Half-width of body
NB Words	R	ARB, Cross-section aspect ratio
NB Words	I	NFL, θ=distribution per body
NB Words	R	XLE, X-leading edge

WORD	TYPE	ITEM
NB Words	R	XTE, X-trailing edge
NB Words	I	NT121, number θ1's for bodies
NB Words	I	NT122, number θ2's for bodies
NB+STRIP	R	ZS, Z - of strip center
NB+STRIP	R	YS, Y - of strip center
NSTRIP Words	R	EE, strip half-width
NSTRIP Words	R	SG, sine of dihedral angle
NSTRIP Words	R	CG, cosine of dihedral angle
NTP+ ΣNBEA1	R	X, 3/4 chord
NTP+ ΣNBEA1	R	DELX, box chord
NTP Words	R	XIC, coordinates of center of pressure
NTP Words	R	XLAM, tangent of sweepback angle
ΣNSBEA Words	R	AO, half-widths for bodies
ΣNSBEA Words	R	XIS1, X - of slender leading edge
ΣNSBEA Words	R	XIS2, X - of slender trailing edge
ΣNSBEA Words	R	AOP, X-derivatives of body half-width
ΣNBEA1 Words	R	RIA, Radius of interference elements
ΣNAS Words	I	NASB, associated bodies
ΣNFL Words	I	IFLA1, body with θ1 distribution
ΣNFL Words	I	IFLA2, Body with θ2 distribution
ΣNT121 WordS	R	TN1A, θ1's for bodies
ΣNT122 Words	R	TN2A, θ2's for bodies

Entity: AECOMPS

Entity Type: Relation

Description: Contains data on the aerodynamic components in the planar and nonplanar steady aerodynamics model.

Relation Attributes:

NAME	TYPE	DESCRIPTION	
MODEL	I	Planar or nonplanar steady aerodynamics model identifier	
		1	For planar model
		-1	For nonplanar model
ACID	I	Component identification number	
MACROTYPE	C(8)	Type of macroelement (CAERO6 or PAERO6)	
GROUP	I	Group identification number	
ACMPNT	C(8)	Component type , selected from: WING, FIN, CANARD, POD, or FUSEL	
TYPE	I>0	Type of degree of freedom.For STEADY aero models all DOF's are TYPE=1.Refer to AECOMPU for other types.	
FIINTID	I	First internal degree of freedom on the macroelement	
NCBOX	I	Number of chordwise boxes for lifting surfaces or number of circumferential boxes for bodies	
NSBOX	I	Number of spanwise boxes for lifting surfaces or number of axial boxes for bodies	
BNDRY	R(12)	Coordinates of the component corners in basic coordinates	

Created By: Module STEADY

Notes:

1. The boundary coordinates are the x, y, z coordinates for each of the corners of lifting elements.Body elements do not use BNDRY.

   The data are in the following order:
   (1-3) Leading Edge Root
   (4-6) Trailing Edge Root
   (7-9) Trailing Edge Tip
   (10-12) Leading Edge Tip

Entity: AECOMPU

Entity Type: Relation

Description: Contains data on the aerodynamic components in the unsteady aerodynamics model.

Relation Attributes:

NAME	TYPE	DESCRIPTION
ACID	I	Component identification number
MACROTYPE	C(8)	Type of macroelement, CAERO1 or CAERO2
GROUP	I	Group identification number
ACMPNT	C(8)	Component type, select from WING or BODY
TYPE	I>0	Degree of freedom type
		2 for WING and Z body elements
		3 for Y body elements
		4 for ZY body elements
FIINTID	I	First internal degree of freedom on the macroelement
NCBOX	I	Number of chordwise boxes for lifting surfaces or number of circumferential boxes for bodies
NSBOX	I	Number of spanwise boxes for lifting surfaces or number of axial boxes for bodies
BNDRY	R(12)	Coordinates of the component corners in basic coordinates

Created By: Module UNSTEADY

Notes:

1. The boundary coordinates are the x, y, z coordinates for each of the corners of lifting elements.Body elements do not use BNDRY.

   The data are in the following order:
   1. Leading Edge Root
   2. Trailing Edge Root
   3. Trailing Edge Tip
   4. Leading Edge Tip

Entity: AEFACT

Entity Type: Relation

Description: Contains aerodynamic input data as defined on the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
VALUE	R	Data value

Created By: Module IFP

Note:

1. This relation contains one tuple for each value in each set defined on the AEFACT card entry.

Entity: AERO

Entity Type: Relation

Description: Contains basic aerodynamic data for use in unsteady aerodynamics as input from the bulk data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
ACSID	I≥0	Coordinate system identification number for the aerodynamic coordinate system
REFC	R>0.0	Reference length for reduced frequency
RHOREF	R>0.0	Reference density

Created By: Module IFP

Entity: AEROGEOM

Entity Type: Relation

Description: Contains the aerodynamic planform geometric grid points for the planar and nonplanar steady aerodynamics model.These grid points are not used for data recovery, but can be used in combination with the "elements" in CAROGEOM to create an ASTROS FE model using RODs and QUADs that represents the paneling of the aero model.

Relation Attributes:

NAME	TYPE	DESCRIPTION	
MODEL	I	Model code:	
		1	for the planar model
		-1	for the nonplanar model
GRIDID	I	Aerodynamic grid identification number	
X	R	Basic coordinates of the geometric point	
Y	R		
Z	R		

Created By: STEADY and / or STEADYNP modules

Notes:

1. These grid points represent the airfoil and panel geometry of the aerodynamic model identified by the MODEL attribute.The connectivity of these grid points is given in the CAROGEOM entity.

Entity: AEROS

Entity Type: Relation

Description: Contains the basic parameters for static aeroelasticity as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
ACSID	I>0	Aerodynamic coordinate system identification
RCSID	I>0	Reference coordinate system for rigid body motions
REFC	R>0.0	Reference chord length
REFB	R>0.0	Reference span
REFS	R>0.0	Reference wing area
GREF	I>0	Reference grid point
REFD	R>0.0	Body component reference diameter
REFL	R>0.0	Body component reference length

Created by: Module IFP

Entity: AERUGEOM

Entity Type: Relation

Description: Contains the aerodynamic planform geometric grid points for the flutter analysis model.These grid points are not used for data recovery, but can be used in combination with the "elements" in CAROUGEO to create an ASTROS FE model using ROD's and QUAD's that represents the paneling of the aero model.

Relation Attributes:

NAME	TYPE	DESCRIPTION
GRIDID	I	Aerodynamic grid identification number
X	R	Basic coordinates of the geometric point
Y	R	
Z	R	

Created By: UNSTEADY module

Notes:

1. The connectivity of these grid points is given in the CAROUGEO entity.

Entity: AESURF

Entity Type: Relation

Description: Contains the specification of an aerodynamic control surface as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
LABEL	C(8)	Alphanumeric data identifying the control surface
TYPE	C(8)	Surface type
ACID	I > 0	Aerodynamic component identification number for control surface definition
CID	I > 0	Coordinate system defining the surface hinge line
FBOX	I > 0	First aerodynamic box on the control surface
LBOX	I > 0	Last aerodynamic box on the control surface

Created By: Module IFP

Entity: AF

Entity Type: Matrix

Description: Merged from the AA matrix (see AG).

Entity: AG

Entity Type: Subscripted Matrix

Description: Contains the accelerations of the structural degrees of freedom.

Matrix Form: A variable sized matrix having one row for each structural degree of freedom and one column for each load condition in the current boundary condition.

Created By: MAPOL

Notes:

1. The dimension of this subscripted matrix must be large enough for all optimization and analysis boundary conditions.
2. This entity is only filled for analysis of unrestrained structures.
3. The MAPOL sequence recovers this matrix in the following order (see the Theoretical Manual for the explicity form of this recovery):

$$\begin{bmatrix} AL \\ AR \end{bmatrix} \rightarrow AA$$

$$\begin{bmatrix} \varphi \\ AA \end{bmatrix} \rightarrow AF$$

$$\begin{bmatrix} \varphi \\ AF \end{bmatrix} \rightarrow AN$$

$$\begin{bmatrix} UM* \\ AN \end{bmatrix} \rightarrow AG$$

*UM contains accelerations in the M-set.The entity name is reused in the MAPOL sequence.

Entity: AGA

Entity Type: Matrix

Description: Contains the active acceleration vectors for the current boundary condition.

Matrix Form: A matrix having one column for each active acceleration vector and one row for each degree of freedom in the structural model.

Created By: MAPOL

Notes:

1. This entity is only generated during sensitivity evaluation of unrestrained boundary conditions.

Entity: AICMAT

Entity Type: Subscripted Matrix

Description: Aerodynamic influence coefficient matrix for a symmetric boundary condition and a given Mach number.The Mach number associated with a given subscript is given in the TRIM relation.

Matrix Form: Square, real and asymmetric.The dimension of the matrix is equal to the number of panels in the steady aerodynamics USSAERO model.

Created By: Module STEADY

Notes:

1. STEADY creates as many matrices as there are distinct symmetric Mach numbers in the user's input packet.If a combination of symmetric and antisymmetric Mach numbers are used, the MINDEX changes for each distinct Mach number.An AICMAT entity is created for a given MINDEX only if the corresponding Mach number requires the symmetric boundary conditions.It is possible, therefore, that, in the range from 1 to MINDEX, some subscript values will not have a corresponding AICMAT.

Entity: AICS

Entity Type: Matrix

Description: Steady aerodynamic influence coefficient matrix for a given boundary condition in the structural coordinates.

Matrix Form: Square, real and asymmetric.The dimension of the matrix is equal to the number of degrees of freedom in the f-set.

Created By: MAPOL

Notes:

1. This matrix is derived from splining the AICMAT or AAICMAT matrix to the structural degrees of freedom.

Entity: AIRFOIL

Entity Type: Relation

Description: Contains the airfoil properties to be used in the aerodynamic analyses as defined on the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
ACID	I>0	Aircraft component identification number
ACMPNT	C(8)	Component type (i.e.WING)
CP	I>0	Coordinate system identification number
CHORD	I>0	AEFACT setid for the chordwise division points
UST	I>0	AEFACT setid for the upper surface half thicknesses
LST	I ≥ 0	AEFACT setid for the lower surface half thicknesses
CAMBER	I ≥ 0	AEFACT setid for the camber ordinants
RADIUS	R > 0	Airfoil leading edge radius
X1, Y1, Z1	R	Location of point 1 in coordinate system CP
X12	R>0.0	Edge chord length in coordinate system CP
IPANEL	I≥0	AEFACT setid containing chordwise cuts for wing paneling

Created By: IFP Module

Entity: AIRFRC

Entity Type: Subscripted Matrix

Description: Rigid body aerodynamic load vectors for a given Mach number. There is one vector for each configuration parameter associated with the Mach index.There are six symmetric parameters: NX, NZ, QACCEL, THKCAM, ALPHA and QRATE and 6 antisymmetric parameters: NY, PACCEL, RACCEL, BETA, PRATE, RRATE.In addition, each symmetric and antisymmetric control surface AESURF will generate a column.For a given subscript, the AIRFRC matrix contains the six columns for the symmetric parameters plus one column for each symmetric AESURF if the SYMMETRIC forces are needed for the associated Mach number.It contains six columns for the antisymmetric parameters and one column for each antisymmetric AESURF if the ANTISYMMETRIC forces are needed for the associated Mach number.If both are needed, all 12 parameters and all AESURF entries in the model have columns.The ordering of the columns corresponds to the order of entries in the STABCF entity.

Matrix Form: Rectangular and real.The number of rows is equal to the number of panels in the steady aerodynamics model while the number of columns is equal to the number of entries in the STABCF relation that have the same MACHINDX value as the subscript value.The columns of AIRFRC are stored in the same order as the entries in STABCF.Refer to the STABCF entity for more details.

Created By: STEADY Module

Notes:

1. STEADY creates as many matrices as there are distinct Mach numbers in the bulk data packet.

Entity: AJJTL

Entity Type: Matrix

Description: List of unsteady aerodynamic matrices to compute panel pressures due to slopes at the control point.

Matrix Form: Square, complex matrix with the number of rows and colums equal to the number of aerodynamic panels.

Created By: AMP

Notes:

1. AJJTL is a matrix list with the number of matrices equal to the number of M-k pairs in the input stream.

Entity: AL

Entity Type: Matrix

Description: Acceleration in the l-set obtained from D and AR (see AG).

Entity: AMAT

Entity Type: Matrix

Description: Matrix containing the sensitivity of the constraints to changes in the design variables.

Matrix Form: The number of columns is equal to the number of active constraints.The number of rows is equal to the number of design variables.

Created By: Modules ACTCON, AEROEFFS, AEROSENS, FREQSENS, FLUTSENS, MAKDFV, MKAMAT, and LAMINSNS

Notes:

1. The columns are written in the order they appear on the CONST relation except that, for a given boundary condition, all the constraints for a given

subcase are grouped together.On the CONST relation, these constraints are grouped by type.

2. See CONST.

3. CONST and AMAT are brought into alignment in DESIGN where the CONST tuples are ordered to have all subcases grouped together.

Entity: AR

Entity Type: Matrix

Description: Contains the accelerations for the support degrees of freedom (see AG).

Matrix Form: A variable sized matrix having one row for each support degree of freedom and one column for each load condition in the current boundary condition.

Created By: Module INERTIA

Notes:

1. This matrix is only formed for the analysis of unrestrained structures.

Entity: ASET

Entity Type: Relation

Description: Contains the external grid identification numbers and components associated with the analysis set as defined on the ASET entries of the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	ASET identification number
GRID1	I>0	Grid or scalar point identification number
COMPNTS	I≥0	Component number; Zero for scalar points, 1-6 for grid points

Created By: Module IFP

Notes:

1. Used by the MKUSET module to build the USET relation.

Entity: ASET1

Entity Type: Relation

Description: Contains the external grid identification numbers and components associated with the analysis set as defined on the ASET1 entries of the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	ASET identification number
COMPNTS	I≥0	Component number; Zero for scalar points, 1-6 for grid points
GRID1	I>0	Grid or scalar point identification number

Created By: Module IFP

Notes:

1. Used by the MKUSET module to build the USET relation.

Entity: ATTACH

Entity Type: Relation

Description: Contains the definitions of aerodynamic boxes whose forces are to be attached to a referenced grid as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
MACROID	I>0	Element identification number of an aerodynamic macroelement
ID1	I>0	External box identification number of the first aero box on the macroelement
ID2	I>0	External box identification number of the last aero box on the macroelement
REFGRD	I>0	The external identification number of the referenced grid point

Created By: Module IFP

Entity: AXSTA

Entity Type: Relation

Description: Contains the body axial station parameters for the aerodynamic model as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
BCID	I>0	Body component identification number
XSTA	R	X ordinate of body station
CBOD	R	Z ordinate of body station
ABOD	R>0.0	Body cross-sectional area at XBOD
YRAD	I≥0	AEFACT setid containing the y-ordinates of the body section
ZRAD	I≥0	AEFACT setid containing the Z-ordinates of the body section

Created By: Module IFP

Entity: BDD

Entity Type: Matrix

Description: Damping matrix in the direct dynamic set.

Matrix Form: Square matrix with the number of rows and columns equal to the number of degrees of freedom in the d-set.

Created By: DMA

Entity: BEAMEST

Entity Type: Relation

Description: Contains the element summary data for the BAR element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
PID	I>0	Element property identification number
PTYPE	C(8)	Element property type
SIL1	I>0	Internal grid point id for end A
SIL2	I>0	Internal grid point id for end B
ORIENTX	R	Orientation vector for element
ORIENTY	R	
ORIENTZ	R	
ICSSV	I≥0	The external coordinate system in which the orientation vector is defined.
PINA, PINB	I≥0	The offset pinned degrees of freedom for ends A and B
OFFSETAX	R	The offset vectors for ends A and B
OFFSETAY	R	
OFFSETAZ	R	
OFFSETBX	R	
OFFSETBY	R	
OFFSETBZ	R	
MID1	I>0	The material id for the element
AREA	R > 0	The beam cross-sectional area
I1	R ≥ 0	The area moment of inertia (Plane 1)
I2	R ≥ 0	The area moment of inertia (Plane 2)
TORSION	R ≥ 0	The beam torsional constant
NSM	R ≥ 0	The beam non structural mass
C1, C2, D1, D2	R	Element stress recovery coefficients
E1, E2, F1, F2	R	
KFACT1	R	Shear area factor (plane 1)
KFACT2	R	Shear area factor (plane 2)
I12	R	Beam product of inertia
R1SQR	R	Inertia term; Definition for design
R2SQR	R	
ALPHA	R	
COORD1	I≥0	External coordinate system of end A
X1, Y1, Z1	R	Basic coordinates of end A
COORD2	I≥0	External coordinate system of end B
X2, Y2, Z2	R	Basic coordinates of end B
SCON	I	Stress constraint flag
DESIGN	I	Design flag
STHRM	R	Thermal stress term
STHRMA	R	Thermal strain term
TREFPT	I	Pointer to TREF entity for thermal stress/load evaluation
NLFLAG	I≥0	Design variable nonlinear flag = 0 Design variable is linear = 1 Designed element using PBAR1 property, design variable is nonlinear
SHAPE	C(8)	Cross section shape
NDSEC	I≥0	Number of dimensions
DSEC1	R≥ 0.0	Cross section dimension 1

NAME	TYPE	DESCRIPTION
D1DES1	I≥0	Design flag for dimension 1 = 1 Designed dimension = 0 Non-designed demension
DSEC2	R ≥ 0.0	Cross section dimension 2
D2DES	I≥0	Design flag for dimension 2 = 1 Designed dimension = 0 Non-designed demension
DSEC3	R ≥ 0.0	Cross section dimension 3
D3DES	I≥0	Design flag for dimension 3 = 1 Designed dimension = 0 Non-designed demension
DSEC4	R≥ 0.0	Cross section dimension 4
D4DES	I≥0	Design flag for dimension 4 = 1 Designed dimension = 0 Non-designed demension
DSEC5	R≥ 0.0	Cross section dimension 5
D5DES	I≥0	Design flag for dimension 5 = 1 Designed dimension = 0 Non-designed demension
DSEC6	R ≥ 0.0	Cross section dimension 6
D6DES	I≥0	Design flag for dimension 6 = 1 Designed dimension = 0 Non-designed demension
DSEC7	R ≥ 0.0	Cross section dimension 7
D7DES	I≥0	Design flag for dimension 7 = 1 Designed dimension = 0 Non-designed dimension
DSEC8	R≥ 0.0	Cross section dimension 8
D8DES	I≥0	Design flag for dimension 8 = 1 Designed dimension = 0 Non-designed demension
DSEC9	R ≥ 0.0	Cross section dimension 9
D9DES	I≥0	Design flag for dimension 9 = 1 Designed dimension = 0 Non-designed demension
DSEC10	R ≥ 0.0	Cross section dimension 10
D10DES	I≥0	Design flag for dimension 10 = 1 Designed dimension = 0 Non-designed demension
ELRSPREQ	I	User function element response flag

Created by: Module MAKEST

Notes:

1. This relation contains one tuple for each beam element in the problem.It is built from the CBAR, PBAR and associated material and design relations.

Entity: BFRC

Entity Type: Matrix

Description: Matrix of rigid body load vectors for unit values of angle of attack, pitch rate and trim surface deflection.

Matrix Form: Rectangular real matrix with three columns and rows equal to the number of panels in the unsteady aerodynamics model.

Created By: Module BLASTFIT

Entity: BGPDT

Entity Type: Relation

Description: Contains the coordinates of the grid points in the basic coordinate system.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EXTID	I>0	The grid or scalar point external identification number
INTID	I>0	Equivalent internal identification number
FLAG	I>0	Flag indicating the point is a grid point or a scalar point
CD	I	The displacement coordinate system for the grid point
X, Y, Z	R	Spatial coordinates of the point in the basic coordinate system

Created by: Module BCBGPDT

Notes:

1. This relation contains one tuple for each grid or scalar point in the problem.
2. This relation is built from the GRID, SPOINT, EPOINT, CSTM and SEQGP relations.
3. The FLAG equals 6 if the point is a grid point and equals 1 if a scalar point and 0 if not in the g-set.
4. The internal identification number is determined by assigning INTID in increasing order of EXTID's.
5. Scalar points are also denoted by CD=-1; X=Y=Z=0.0.

Entity: BHH

Entity Type: Matrix

Description: Damping matrix in the modal dynamic set.

Matrix Form: Square matrix with the number of rows and columns equal to the number of degrees of freedom in the h-set.

Created By: DMA

Notes:

1. Info (11) for the entity contains a coupled flag
   = 0 Uncoupled
   = 1 Coupled

2. Info (12) contains damping data
   = 0 Modal damping only
   = 1 Viscous damping only
   = 2 Both modal and viscous damping

Entity: BODY

Entity Type: Relation

Description: Contains the body configuration parameters for the aerodynamic model as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
BCID	KI>0	Body component id
ACMPNT	C(8)	Component type (i.e., POD)
CP	I≥0	Coordinate system id for geometry input
NRAD	I≥0	Number of equal body cuts used to define the body panels
X, Y, Z	R	Ordinates of the body in coordinate system CP

Created By: Module IFP

Entity: CAERO1

Entity Type: Relation

Description: Contains an aerodynamic macroelement (panel) in terms of two leading-edge locations and side chords.This is used for unsteady aerodynamics.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
PID	I>0	Identification number of property card.Used to specify associated bodies
CP	I>0	Coordinate system for locating points 1 and 4
NSPAN	I≥0	Number of spanwise boxes; if a positive value is given NSPAN, equal divisions are assumed; if zero or blank, a list of division points is given at LSPAN
NCHORD	I≥0	Number of chordwise boxes; if a positive value is given NCHORD, equal divisions are assumed; if zero or blank, a list of division points is given at LCHORD
LSPAN	I≥0	ID of an AEFACT data card containing a list of division points for spanwise boxes.Used only if NSPAN is zero or blank
LCHORD	I≥0	ID of an AEFACT data card containing a list of division points for chordwise boxes.Used only if NCORD is zero or blank
IGID	I>0	Interference group identification (aerodynamic elements with different IGID's are uncoupled)
X1, Y1, Z1	R	Location of point 1 in coordinate system CP
X12	R ≥ 0	Edge chord length (in aerodynamic coordinate system) (Cannot be zero if X43 is zero)
X4, Y4, Z4	R	Location of point 4 in coordinate system CP
X43	R ≥ 0	Edge chord length (in aerodynamic coordinate system)(Cannot be zero if X12 is zero)

Created By: Module IFP

Entity: CAERO2

Entity Type: Relation

Description: Contains the definition of an aerodynamic body for unsteady aerodynamics as input from the bulk data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
PID	I>0	Property identification number
CP	I≥0	Coordinate system for locating point 1
NSB	I≥0	Number of slender body elements
NINT	I≥0	Number of interference elements
LSB	I≥0	AEFACT identification number defining slender body division points
LINT	I≥0	AEFACT identification number defining interference element division points
IGID	I>0	Interference group identification
X1, Y1, Z1	R	Location of point 1 in coordinate system CP
X12	R>0.0	Length of the body in the x-axis of the aerodynamic coordinate system

Created By: Module IFP

Entity: CAERO6

Entity Type: Relation

Description: Contains the definition of an aerodynamic macroelement used in aerodynamic analyses as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
ACID	I>0	Aircraft component identification number
ACMPNT	C(8)	Component type (i.e., WING)
CP	I≥0	Coordinate system identification number for geometry input
GROUP	I>0	Group identification number
SPAN	I≥0	AEFACT setid for the division points of spanwise boxes
CHORD	I≥0	AEFACT setid for the chordwise division points

Created By: Module IFP

Entity: CAROGEOM

Entity Type: Relation

Description: Contains the connectivity data for the aerodynamic planform of the planar and nonplanar steady aerodynamics model.These elements are not used for data recovery, but can be used in combination with the "grids" in AEROGEOM to create an ASTROS FE model using RODs and QUADs that represents the paneling of the aero model.

Relation Attributes:

NAME	TYPE	DESCRIPTION
MODEL	I	= 1 for the planar model = –1 for the nonplanar model
EID	I>0	External aerodynamic box identification number
INTEID	I>0	Internal aerodynamic box identification number (aerodynamic degree of freedom number) see Remark 2
MACROID	I>0	Macroelement identification number on which the box lies
MACROTYP	C(8)	Macroelement type (e.g.PAERO6, CAERO6)
CMPNT	C(8)	Component type (FIN, CANARD, WING, FUSEL, of POD)
NGRID	I>0	Number of grids connected to the box = 4 or 3 for panels = 2 for airfoil line segments
GRID1	I>0	Identification number of an AEROGEOM grid for inboard or upstream location
GRID2	I>0	Identification number of an AEROGEOM grid for inboard or downstream location
GRID3	I>0	Identification number of AEROGEOM grid for outboard or downstream location
GRID4	I≥0	Identification number of AEROGEOM grid for outboard or upstream location

Created By: STEADY and / or STEADYNP modules

Notes:

1. The grid points referred to by this relation are stored in the AEROGEOM entity.
2. Airfoil geometry is also defined by this relation but the "elements" are line segments not related to the control points of the panel model.For these elements, the internal identification number is set to – 1 rather than the degree of freedom identifier in solution matrices.
3. Airfoil geometry is defined by any and all elements with NGRID=2.

Entity: CAROUGEO

Entity Type: Relation

Description: Contains the connectivity data for the aerodynamic planform of the flutter analysis model.These elements are not used for data recovery, but can be used in combination with the "grids" in AERUGEOM to create an ASTROS FE model using ROD's and QUAD's that represents the paneling of the aero model.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EXTID	I>0	External aerodynamic box identification number
INTEID	I>0	Internal aerodynamic box identification number (aerodynamic degree of freedom number) see Remark 2
MACROID	I>0	Macroelement identification number on which the box lies
NGRID	I>0	Number of grids connected to the box 4 or 3 for panels 2 for airfoil line segments
MACROTYP	C(8)	Macroelement type (e.g.PAERO6, CAERO6)
IGID	I>0	Interference group identification
GRID1	I>0	Identification number of an AEROGEOM grid for inboard or upstream location
GRID2	I>0	Identification number of an AEROGEOM grid for inboard or downstream location
GRID3	I>0	Identification number of AEROGEOM grid for outboard or downstream location
GRID4	I≥0	Identification number of AEROGEOM grid for outboard or upstream location

Created By: UNSTEADY module

Notes:

1. The grid points referred to by this relation are stored in the AERUGEOM entity.

2. Airfoil geometry is also defined by this relation but the "elements" are line segments not related to the control points of the panel model.For these elements, the internal identification number is set to – 1 rather than the degree of freedom identifier in solution matrices.

3. Airfoil geometry is defined by any and all elements with NGRID=2.

Entity: CASE

Entity Type: Relation

Description: Contains the case parameters for each analysis within each boundary condition as input in the solution control packet.

Relation Attributes:

NAME	TYPE	DESCRIPTION
OAFLAG	I>0	Optimize/analyze flag 1 Optimize 2 Analyze
BCID	I>0	Boundary condition identification number
CASEID	KI>0	Subcase identification number
SUBCASE	I>0	Subcase identification number if (DISC = 1, 3, 5, 8) or Mode Number if (DISC = 2, 7)
MPCSETID	I	Multipoint constraint set identification number
SPCSETID	I	Single point constraint set identification number
AUTOSPC	I	AUTOSPC request flag
ASPCPRNT	I	AUTOSPC print flag
ASPCPUNC	I	AUTOSPC punch flag
ASPCEPS	R	AUTOSPC threshhold
REDSETID	I	Guyan reduction constraint set identification number
SUPSETID	I	Support set identification number
METHOD	I	Real eigenvalue extraction method set identification number
CMETHOD	I	Complex eigenvalue extraction method set identification number
DYNRED	I	Dynamic reduction set identification number
INERTIA	I	Inertia relief mode shapes set identification number
TFSETID	I	Transfer function set identification number
K2PP	C(8)	K2PP name
M2PP	C(8)	M2PP name
B2PP	C(8)	B2PP name
K2GG	C(8)	K2GG name
M2GG	C(8)	M2GG name

NAME	TYPE	DESCRIPTION
DISFLAG	I	Discipline flag 1 Statics 2 Modes 3 Saero 4 Flutter 5 Transient 6 Frequency 7 Buckling 8 Blast 9 Nonplanar Saero
MECHLOAD	I	Mechanical load set identification number
THRMLOAD	I	Thermal load set identification number
GRAVLOAD	I	Gravity load set identification number
TRIMID	I	Trim set identification number
TRIMSYM	I	Trim symmetry flag –1 Antisymmetric 0 Asymmetric 1 Symmetric
DCONST	I	Design constraint set identification number
DCSTRESS	I	Stress constraint set identification number
DCSTRAIN	I	Strain constraint set identification number
DCONFID	I	DCONF identifiction number
DLOADID	I	Dynamic load set identification number
DRMETH	I	Dynamic response method 1 Direct 2 Modal
TIMESTEP	I	Time step set identification number
FREQSTEP	I	Frequency step set identification number
FFTID	I	Fast Fourier transform set identification number
GUSTID	I	Gust set identification number
INITCON	I	Initial condition set identification number
RANDOMID	I	Random set identification number
BLASTID	I	Blast set identification number
BUCKLEID	I	Buckling eigenvalue extraction set identification number
FLUTID	I	Flutter set identification number
CONTROL	C(8)	Name of aerodynamic extra point splining matrix
DAMPID	I	Damping set identification number
ESET	I	Extra point set identification number

NAME	TYPE	DESCRIPTION
ACCEPRNT	I(20)	Acceleration print selection (1) Print set identification number > 0 or 0 NONE –1 ALL –2 LAST (2) Punch set identification number (3) Print form 0 Rectangular 1 Polar (4) Punch form (5) Print frequency set identification number (6) Punch frequency set identification number (7) Print iteration set identification number (8) Punch iteration set identification number (9) Print mode set identification number (10) Punch maode set identification number (11) Print time set identification number (12) Punch time set identification number
AIRDPRNT	I(20)	Aerodynamic displacement print selection
BUCKPRNT		Buckling print selection
DISPPRNT	I(20)	Displacement print selection (1) Print set identification number (2) Punch set identification number (3) Print form 0 Rectangular 1 Polar (4) Punch form
ENERPRNT	I(20)	Strain energy print selection
FORCPRNT	I(20)	Element force print selection
GPFOPRNT	I(20)	Grid point force print selection
GPWGPRNT	I(20)	Grid point weight generation print selection
LOADPRNT	I(20)	Load print selection
MASSPRNT	I(20)	Mass matrix print selection
MPCFPRNT	I(20)	Multi-point constraint force print selection
QHHPRNT	I(20)	QHH matrix print selection
QHJPRNT	I(20)	QHJ matrix print selection
ROOTPRNT	I(20)	Flutter and normal modes eigenvalue print selection
SPCFPRNT	I(20)	Single point constraint force print selection
STIFPRNT	I(20)	Stiffness matrix print selection
STRAPRNT	I(20)	Strain print selection (13) Print layer/laminate option (14) Punch layer/laminate option 0 Layer strain 1 Laminate strain 2 Both layer and laminate strain

NAME	TYPE	DESCRIPTION
STREPRNT	I(20)	Stress print selection (13) Print layer/laminate option (14) Punch layer/laminate option 0 Layer stress 1 Laminate stress 2 Both layer and laminate stress
TPREPRNT	I(20)	Trim pressure coefficient print selection
VELOPRNT	I(20)	Velocity print selection
TRIMPRNT	I	Steady aeroelastic trim print toggle
TITLE	C(72)	User label TITLE
SUBTITLE	C(72)	User label SUBTITLE
LABEL	C(72)	User label LABEL

Created By: Module SOLUTION

Notes:

1. The format of the ACCEPRNT vector is typical of the format of all the print selection vectors.Additionally, the format for the print set Identification number in the ACCEPRNT vector is typical of that of the other set Identification numbers in the vector.

2. The CASE, JOB and OPTIMIZE relation entities together contain the solution control requests as input in the solution control packet.CASE contains the case-dependent parameters, JOB contains the case-independent requests and OPTIMIZE contains the optimization-dependent requests.

Entity: CASELIST

Entity Type: Relation

Description: Contains the list of subcase identification numbers as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I	Set identification number
CASEID	I	Subcase identification number

Created By: Module IFP.

Entity: CBAR

Entity Type: Relation

Description: Contains the element connectivity data for the BAR element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
PID1	I>0	Property identification number of a PBAR tuple
GRID1	I>0	Grid point identification for end A
GRID2	I>0	Grid point identification for end B
GRID3	I≥0	Grid point identification for orientation vector definition
ORIENTX	R	Orientation vector
ORIENTY	R	
ORIENTZ	R	
TMAX	R	Maximum area for design
PINA	I≥0	Components pinned at end A
PINB	I≥0	Components pinned at end B
OFFSETAX	R	Offsets from GRID1 and GRID2 to the ends of the beam element
OFFSETAY	R	
OFFSETAZ	R	
OFFSETBX	R	
OFFSETBY	R	
OFFSETBZ	R	

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the BEAMEST relation.

Entity: CELAS1

Entity Type: Relation

Description: Contains the element connectivity data for the scalar spring element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
PID1	I>0	Identification number of a PELAS property entry
GRID1	I≥0	Grid or scalar point identification number
COMPNTS1	6≥I≥0	Component number
GRID2	I≥0	Grid or scalar point identification number
COMPNTS2	6≥I≥0	Component number
TMAX	R	Maximum spring constant value for design

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the ELASEST relation.

Entity: CELAS2

Entity Type: Relation

Description: Contains the element connectivity and property data for the scalar spring element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
K	R	The value of the scalar spring constant
GRID1	I≥0	Grid or scalar point identification number
COMPNTS1	6≥I≥0	Component number
GRID2	I≥0	Grid or scalar point identification number
COMPNTS2	6≥I≥0	Component number
DAMPCOEF	R	Damping coefficient
STRSCOEF	R	Stress coefficient
TMIN	R	Minimum spring constant value for design
TMAX	R	Maximum spring constant value for design

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the ELASEST relation.

Entity: CENTRESP

Entity Type: Relation

Description: Contains the user function requested element centroidal coordinate values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module PFBULK

Entity: CIHEX1

Entity Type: Relation

Description: Contains the element connectivity data for the linear isoparametric hexahedron element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
PID	I>0	Identification number of property card
GRIDi i=1,...,8	I>0	Grid point identification numbers defining the element geometry

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the IHEX1EST relation.

Entity: CIHEX2

Entity Type: Relation

Description: Contains the element connectivity data for the quadratic isoparametric hexahedron element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
PID	I>0	Identification number of property entry
GRIDi i=1,...,20	I>0	Grid point identification numbers defining the element geometry

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the IHEX2EST relation.

Entity: CIHEX3

Entity Type: Relation

Description: Contains the element connectivity data for the cubic isoparametric hexahedron element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
PID	I>0	Identification number of property card
GRIDi i=1,...,32	I>0	Grid point identification numbers defining the element geometry

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the IHEX3EST relation.

Entity: CLAMBDA

Entity Type: Relation

Description: Contains results of a flutter analysis for a series of boundary conditions, Mach numbers and atmospheric densities.

Relation Attributes:

NAME	TYPE	DESCRIPTION
NITER	I	Iteration number
BCID	I	The boundary condition number
MACH	R	Mach number of the flutter analysis
RHOREF	R	Reference atmospheric density
RHO	R	Atmospheric density of the flutter analysis
VELOCITY	R	True velocity of the flutter analysis
FSID	I	Flutter set identification
SCNUM	I	Flutter subcase identification number
MODENO	I	Mode number associated with the flutter
RLAMB	R	Real part of the flutter eigenvalue
ILAMB	R	Imaginary part of the flutter eigenvalue
DAMPVAL	R	Damping ratio
OMEGA	R	Frequency in radians per second of the flutter eigenvalue = 2 * VELOCITY * ILAMB / REFB
PNUM	I	Pointer to CONST tuple for the associated constraint

Created By: Module FLUTTRAN

Notes:

1. The reference semichord for the unsteady area model is stored as the eleventh word of the INFO array.

Entity: CMASS1

Entity Type: Relation

Description: Contains the element connectivity data for the scalar mass element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
PID1	I>0	Property identification number of a PMASS tuple
GRID1	I>0	Grid or scalar point identification number
COMPNTS1	I≥0	Component of GRID1 to which the element is connected
GRID2	I≥0	Grid or scalar point identification number
COMPNTS2	I≥0	Component of GRID2 to which the element is connected
TMAX	R	Maximum mass for design

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the MASSEST relation.

Entity: CMASS2

Entity Type: Relation

Description: Contains the element connectivity data for the scalar mass element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
MASS	R	The value of the scalar mass
GRID1	I>0	Grid or scalar point identification number
COMPNTS1	I≥0	Component of GRID1 to which the element is connected
GRID2	I≥0	Grid or scalar point identification number
COMPNTS2	I≥0	Component of GRID2 to which the element is connected
TMIN	R	Minimum mass for design
TMAX	R	Maximum mass for design

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the MASSEST relation.

Entity: CONEFFF

Entity Type: Relation

Description: Contains the definition of adjustment factors for control surface effectiveness values for use in flutter analysis.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Effectiveness identification number
EFFVAL	R	Effectiveness value
MODE	I>0	Structural mode to which the effectiveness is to be applied
MACROID	I	aerodynamic component (macroelement) on which the control surface lies
BOX1, BOX2	I>0	First and last box whose effectiveness is to be altered

Created By: Module IFP

Entity: CONEFFS

Entity Type: Relation

Description: Contains the definition of adjustment factors for control surface effectiveness values for use in static aeroelastic analysis and nonplanar aerodynamic analysis.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Effectiveness identification number
LABELI	C(8)	Control surface label
EFFI	R	Effectiveness value for the associated surface

Created By: Module IFP

Entity: CONLINK

Entity Type: Relation

Description: Contains the control surfaces and participation factors specified on the CONLINK Bulk Data entry.

Relation Attributes:

NAME	TYPE	DESCRIPTION
LABEL	C(8)	Label of the control surface that is made up of a combination of other conatro surfaces
LABELI	C(8)	Label of control surface defined by AESURF
VALUEI	R	Participation factor

Created By: Module IFP

Entity: CONM1

Entity Type: Relation

Description: Contains the element data for a 6 x 6 symmetric mass matrix at a grid point as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
GRID1	I>0	Grid point identification number
CID1	I≥0	Coordinate system identification number for matrix coordinate system
M11, M21, M22	R	Elements of the 6x6 symmetric mass matrix
M31, M32, M33	R	
M41, M42, M43	R	
M44	R	
M51, M52, M53	R	
M54, M55	R	
M61, M62, M63	R	
M64, M65, M66	R	

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the CONM1EST relation.

Entity: CONM1EST

Entity Type: Relation

Description: Contains the element summary data for a concentrated mass defined in the CONM1 relation.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
SIL1	I>0	Internal grid point identification number
CIDMASS	I≥0	Coordinate system identification number for matrix coordinate system
M11, M21, M22	R	Elements of the 6x6 symmetric mass matrix
M31, M32, M33	R	
M41, M42, M43	R	
M44	R	
M51, M52, M53	R	
M54, M55	R	
M61, M62, M63	R	
M64, M65, M66	R	
CORD1	I≥0	Coordinate system of SIL1
X, Y, Z	R	Basic coordinates of SIL1

Created By: Module MAKEST

Notes:

1. This relation is built from the CONM1 and grid relations.It contains one tuple for each concentrated mass element defined in the CONM1 relation.

Entity: CONM2

Entity Type: Relation

Description: Contains the element data for a concentrated mass at a structural grid point as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
GRID1	I>0	Grid point identification number
CID1	I	Coordinate system identification number
MASS	R	Value of the concentrated mass
X1, X2, X3	R	Components of offset from GRID1 to the mass
I11, I21, I22	R	Mass moments of inertia
I31, I32, I33	R	
TMIN	R	Minimum mass for design
TMAX	R	Maximum mass for design

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the CONM2EST relation.

Entity: CONM2EST

Entity Type: Relation

Description: Contains the element summary data for a concentrated mass element defined in the CONM2 relation.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
SIL1	I>0	Internal grid point identification number
CIDMASS	I≥0	Coordinate system identification number
MASS	R	Mass value
OFFSETX	R	Offsets from SIL1 to mass (see note 1)
OFFSETY	R	
OFFSETZ	R	
I11, I21,I22	R	Mass moments of inertia (see Note 1)
I31, I32, I33	R	
COORD1	I≥0	Displacement coordinate system for SIL1
X, Y, Z	R	Basic coordinates of SIL1
DESIGN	I	Design flag
NLFLAG	I≥0	Design variable nonlinear flag 0 Linear 1 $I_{ij} \neq 0$

Created By: Module MAKEST

Notes:

1. Refer to the CONM2 Bulk Data Entry for further details on the definition of the OFFSET and Iij terms.

2. This relation is built from the CONM2 grid relations. It contains one tuple for each concentrated mass element defined in the CONM2 relation.

Entity: CONROD

Entity Type: Relation

Description: Contains the connectivity and property data for a ROD element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
GRID1	I>0	Grid point identification number for end A
GRID2	I>0	Grid point identification number for end B
MID1	I>0	Material property identification number
AREA	R≥0	Element cross-sectional area
TORSION	R≥0	Element torsional constant
STRSCOEF	R	Stress recovery factor
NSM	R≥0	Element nonstructural mass
TMIN	R≥0	Minimum cross-sectional area in design
TMAX	R≥0	Maximum cross-sectional area in design

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the RODEST relation.

Entity: CONST

Entity Type: Relation

Description: Contains the constraint values and constraint sensitivity processing data.

Relation Attributes:

NAME	TYPE	DESCRIPTION
NITER	I>0	Iteration number
CVAL	R	Constraint value
CTYPE	I>0	Constraint type (see Note 2 below)
BCID	I>0 or NULL	Boundary condition identification number for constraint value if boundary condition dependent Non-boundary dependent constraints are: minimum thickness (CTYPE=1) maximum thickness (CTYPE=2) laminate composition (CTYPE=13) laminate min.gauge (CTYPE=14) ply min.gauge (CTYPE=15) BAR dimension relation (CTYPE=18)
CASEID	I	Case identification number
DISFLAG	I>0 or NULL	Discipline type flag from CASE relation (where appropriate) Non-discipline dependent constraints are: minimum thickness (CTYPE=1) maximum thickness (CTYPE=2) laminate composition (CTYPE=13) laminate min.gauge (CTYPE=14) ply min.gauge (CTYPE=15) BAR dimension relation (CTYPE=18)
ACTVFLAG	I>0 or NULL	Flag denoting status of the constraint as active (=1) or inactive (=0) ACTVFLAG will have NULL value prior to constraint screening in ACTCON The entry with CLASS as OBJECTIVE has its ACTVFLAG set to be active
SCNUM	I>0 or NULL	See Remark 11
PNUM	I>0 or NULL	See Remark 12
SUBSCRPT	I>0 or NULL	Subscript number for SAERO discipline constraints of types 3, 4, 5, 6, 9, 10, 11, and 12
DISPCOL	I>0 or NULL	Column number in the matrix of pseudodisplacements/accelerations for static aeroelastic constraints ot types 9, 10, and 12
ETYPE	C(8) or NULL	Element type used for stress/strain and thickness constraints
EID	I or NULL	Element identification number
LAYERNUM	I or NULL	Element layer information (See Remark 14)
DVSYMBL	C(8)	Designed dimension symbol selected fro D1 through D10 for BAR element cross section dimension; A for element area, T for element thickness.
SCON	I>0 or NULL	See Remark 13
VSCON	R(6)	Allowables for stress/strain constraints
SENSPRM1	R	General values useful for sensitivity calculations (see Remark 10)
SENSPRM2	R	
SENSPRM3	R	
SENSPRM4	C(8)	
SENSPRM5	R(10)	
SENSPRM6	C(8)	
PRINTKEY	I	Pointer to the GRADIENT entity containing the gradient of the constraint with respect to the global variables, 0 if no gradient was stored (see Remark 15)
BENDPOST	I	Bending position flag for nonlinear sensitivity
INSTANCE	I	User function instance number
CLASS	C(16)	User function class (OBJECTIVE/CONSTRAINTS)
UFNAME	C(8)	User function name

Created By: See Note below.

Notes:

1. NULL values imply the value is supplied with the database default null value.These are typically bit patterns which represent illegal values of their respective data types.See RENULi utility documentation.For this relation, zero is sometimes used in place of the database NULL value.

2. The constraint types are:

TYPE	CONSTRAINT
0	Objective function
1	Minimum thickness constraint
2	Maximum thickness constraint
3	Displacement constraint
4	Stress constraint
5	Strain constraint on Ex principal strain
6	Strain constraint on Ey principal strain

7	Frequency constraint
8	Flutter constraint
9	Lift Effectiveness Constraint
10	Aileron Effectiveness Constraint
11	Trim Parameter Limit Value Constraint (DCONTRM)
12	Stability Derivative Constraint (DCONSCF)
13	Laminate Composition Constraint (DCONLAM)
14	Laminate Minimum Gauge Constraint (DCONLMN)
15	Ply Minimum Gauge Constraint (DCONPMN)
16	Panel Buckling Constraint (DCONBK)
17	Euler Buckling Constraint (DCONBKE)
18	BAR Element Dimemsion Relation Constraint(DCONSDE)
19	User Function Constraint (DCONF)

3. Constraints of Types 1 and 2 are evaluated in the TCEVAL module.The sensitivities are evaluated in the MAKDFV module.

4. Constraints of Type 3 are evaluated in the DCEVAL module. The sensitivities are evaluated in the MAKDFU module.

5. Constraints of Type 4, 5 and 6 are evaluated in the SCEVAL module.The sensitivities are evaluated in the MAKDFU module.

6. Constraints of Type 7 are evaluated in the FCEVAL module. The sensitivities are evaluated in the FREQSENS module.

7. Constraints of Type 8 are evaluated in the FLUTTRAN module. The sensitivities are evaluated in the FLUTSENS module.

8. Constraints of Types 9, 10, 11, and 12 are evaluated in the SAERO module.The sensitivities of 9, 10, and 12 are evaluated in the AEROEFFS and those of 11 in the AEROSENS module.

9. Constraints of Types 13, 14, and 15 are evaluated in the LAMINCON module.The sensitivities are evaluated in the LAMINSNS module.

   Constraints of Types 16 and 17 are evaluated in the modules PBKLEVAL and EBKLEVAL, respectively.The sensitivities are evaluated in the modules PBKLSENS and EBKLSENS, respectively.

   Constraints of Types 18 are evaluated in the BCEVAL module. The sensitivities are evaluated in the MKDFDV module.

   User function constraints (Types 18) are evaluated in the FNEVAL module.The sensitivities are evaluated in the DESIGN module.

10. The SENSPRM1, 2, 3, 4, 5 and6 attributes contain values useful in sensitivity analysis for certain constraint types.

TYPE	CONTENTS
1	SENSPRM1 contains the minimum gauge used to normalize the constraint.
2	SENSPRM2 contains the maximum gauge used to normalize the constraint.
7	SENSPRM1 contains the current value of the associated eigenvalue.
9	SENSPRM1 contains the current value of the associated rigid lift curve slope.SENSPRM2 contains the value of the associated required ratio.
10	SENSPRM1 contains the current value of the associated dimensional flexible rolling moment slope due to aileron deflection.
	SENSPRM2 contains the current value of the associated flexible rolling moment slope due to roll rate.
	SENSPRM3 contains the required roll effectiveness and other constants: **SENSPRM3** $= \frac{b * 180}{2\varepsilon_{RQ}}$ where b = reference span $2\varepsilon_{RQ}$ = required aileron effectiveness
	SENSPRM4 contains the name of the rolling control surface whose effectiveness is constrained.
11	SENSPRM1 contains the required value of the trim parameter.
	SENSPRM4 contains the name of the trim parameter whose derivative is constrained.
12	SENSPRM1 contains the required dimensional value of the stability derivative.
	SENSPRM2 contains the real equivalent of the degree of freedom number (1, 2, ...or 6) representing the DOF associated with the derivative.
	SENSPRM4 contains the name of the trim parameter or acceleration whose derivative is constrained.
13	SENSPRM1 contains the required upper or lower bound percentage of ply to laminate thickness.
	SENSPRM2 contains the current ply thickness
	SENSPRM3 contains the current laminate thickness
14	SENSPRM1 contains the minimum thickness value.
	SENSPRM3 contains the current laminate thickness
15	SENSPRM1 contains the minimum thickness value.
	SENSPRM2 contains the current ply thickness
17	SENSPRM6 contains the PBAR1 indicator.
	SENSPRM5 contains the buckling sensitivity information related with each BAR element cross section dimension.

18	SENSPRM5 contains the required cross section dimension factors.

11. The SCNUM attribute contains general information to allow computation of the sensitivities.These data are the following:

VALUE	CONTENTS
1	= 0 if constraint does not appear on a DCONTHK/2 entry = 1 if it does appear on DCONTHK/2
2	NULL
3	Subcase number of discipline generating the constraint
4	Subcase number of discipline generating the constraint
5	Subcase number of discipline generating the constraint
6	Subcase number of discipline generating the constraint
7	Mode number associated with the constraint
8	Subcase number generating the constraint
9	Subcase number generating the constraint
10	Subcase number generating the constraint
11	Subcase number generating the constraint
12	Subcase number generating the constraint
13	NULL
14	NULL
15	NULL
16	Subcase number generating the constraint
17	Subcase number generating the constraint
18	NULL
19	NULL

12. The PNUM attribute contains general pointer information to allow computation of the sensitivities.The pointer data are the following:

TYPE	CONTENTS
1	PMINT matrix column number associated with the constraint
2	PMAXT matrix column number associated with the constraint
3	Displacement constraint number which points into the DCENT entity
4	Row in GLBSIG where first stress component for the element is stored
5	Row in GLBSIG where first stress component for the element is stored
6	Row in GLBSIG where first stress component for the element is stored
7	NULL
8	Count number in a running count of flutter roots.Matches the PNUM attribute in CLAMBDA
9	NULL
10	NULL
11	NULL
12	NULL
13	Defines the *laminate* = 0 if the lamanate thickness comprises all layers = LAMSET id of PLYLIST data if the lamanate thickness comprises a subset of layers
14	0
15	0
16 17	Count number matches the PNUM attribute in PDLIST
18	0
19	0

13. The SCON attribute contains general information to allow computation of the sensitivities.These data are the following:

TYPE		CONTENTS
1	NULL	
2	NULL	
3	DCONDSP/DCID value	
4	1	for Von Mises Stress
	2	for Tsai Wu Stress
5-6	+3	Principal strain constraint using tension allowable
	-3	Principal strain constraint using compression allowable
	+4	Fiber/transverse strain constraint using tension allowable
	-4	Fiber/transverse strain constraint using compression allowable
7	1	UPPER bound flag
	-1	LOWER bound flag
8	A combined number noting the velocity, mode and subcase number generating the constraint of the form: xxxyyyzzz where xxx = subcase number yyy = mode number zzz = velocity number each are limited to 999.This value is only useful in that sorting by SCON sorts the constraints by velocity within each mode within each subcase.	
9-13	+1	UPPER bound flag
	-1	LOWER bound flag
14-19		0

14. The LAYERNUM is NULL except for: Types 1, 4, 5, and 6, which contain the layer number (if applicable) or 0; and Types 13, and 15 which, contain the layer number of the *ply* if greater than 0, or the PLYLIST id of the set of layers in the *ply* if less than 0.

15. The PRINTKEY is only set if the gradient is stored.This is done only when the requested objective and / or constraint fradient is selected in a print of punch request.

Entity: CONSTORD

Entity Type: Relation

Description: Contains the reorded constraint values and constraint sensitivity processing data for the current design iteration.

Relation Attributes:

NAME	TYPE	DESCRIPTION
NITER	I>0	Iteration number
CVAL	R	Constraint value
CTYPE	I>0	Constraint type (see Note 2 for CONST)
BCID	I>0 or NULL	Boundary condition identification number for constraint value if boundary condition dependent Non-boundary dependent constraints are: minimum thickness (CTYPE=1) maximum thickness (CTYPE=2)
DISFLAG	I>0 or NULL	Discipline type flag from CASE relation (where appropriate) Non-discipline dependent constraints are: minimum thickness (CTYPE=1) maximum thickness (CTYPE=2) laminate composition (CTYPE=13) laminate min.gauge (CTYPE=14) ply min.gauge (CTYPE=15)
SCNUM	I>0 or NULL	See Remark 11 for CONST
PNUM	I>0 or NULL	See Remark 12 for CONST
SUBSCRPT	I>0 or NULL	Subscript number for SAERO discipline constraints of types 3, 4, 5, 6, 9, 10, 11, and 12
SCON	I>0 or NULL	See Remark 13 for CONST
SENSPRM4	C(8)	String for sensitivity
PRINTKEY	I	Pointer to the GRADIENT entity containing the gradient of the constraint with respect to the global variables = 0 if no gradient was stored (see Remark 15 for CONST)

Created By: See Note in preceding CONST description.

Entity: CONVERT

Entity Type: Relation

Description: Contains the conversion factors for various physical quantities as input from the Bulk Data file.

Relation Attributes:

NAME	Type	DESCRIPTION
QUANTITY	C(8)	Character string identifying the physical quantity whose units are to be converted
FACTOR	R	Conversion factor to be applied

Created By: Module IFP

Notes:

1. Refer to CONVERT Bulk Data entry for the valid QUANTITY values.

Entity: CORDRESP

Entity Type: Relation

Description: Contains the user function requested grid point coordinate values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module PFBULK

Entity: CORD1C

Entity Type: Relation

Description: Contains the coordinate system definition for a cylindrical coordinate system as input from the Bulk Data file.

Relation Attributes:

NAME	Type	DESCRIPTION
CID1	I>0	Coordinate system identification number
GRID1	I>0	The grid point identification number which locates the system origin
GRID2	I>0	The grid point identification number which defines the system z-axis
GRID3	I>0	The grid point identification number which defines a point lying in the system xz-plane

Created By: Module IFP

Notes:

1. This relation is used by the MKTMAT module to build the CSTM relation.

Entity: CORD2C

Entity Type: Relation

Description: Contains the coordinate system definition for a cylindrical coordinate system as input from the Bulk Data file.

Relation Attributes:

NAME	Type	DESCRIPTION
CID1	I>0	Coordinate system identification number
RID	I≥=0	Coordinate system identification number of system in which the coordinates of the defining locations are given
A1, A2, A3	R	Coordinates of system origin
B1, B2, B3	R	Coordinates defining z-axis
C1, C2, C3	R	Coordinates defining xz plane

Created By: Module IFP

Notes:

1. This relation is used by the MKTMAT module to build the CSTM relation.

Entity: CORD1R

Entity Type: Relation

Description: Contains the coordinate system definition for a rectangular coordinate system as input from the Bulk Data file.

Relation Attributes:

NAME	Type	DESCRIPTION
CID1	I>0	Coordinate system identification number
GRID1	I>0	The grid point identification number which locates the system origin
GRID2	I>0	The grid point identification number which defines the system z-axis
GRID3	I>0	The grid point identification number which defines a point lying in the system xz-plane

Created By: Module IFP

Notes:

1. This relation is used by the MKTMAT module to build the CSTM relation.

Entity: CORD2R

Entity Type: Relation

Description: Contains the coordinate system definition for a rectangular coordinate system as input from the Bulk Data file.

Relation Attributes:

NAME	Type	DESCRIPTION
CID1	I>0	Coordinate system identification number
RID	I≥0	Coordinate system identification number of system in which the coordinates of the defining locations are given
A1, A2, A3	R	Coordinates of system origin
B1, B2, B3	R	Coordinates defining z-axis
C1, C2, C3	R	Coordinates defining xz-plane

Created By: Module IFP

Notes:

1. This relation is used by the MKTMAT module to build the CSTM relation.

Entity: CORD1S

Entity Type: Relation

Description: Contains the coordinate system definition for a spherical coordinate system as input from the Bulk Data file.

Relation Attributes:

NAME	Type	DESCRIPTION
CID1	I>0	Coordinate system identification number
GRID1	I>0	The grid point identification number which locates the system origin
GRID2	I>0	The grid point identification number which defines the system z-axis
GRID3	I>0	The grid point identification number which defines a point lying in the system xz-plane

Created By: Module IFP

Notes:

1. This relation is used by the MKTMAT module to build the CSTM relation.

Entity: CORD2S

Entity Type: Relation

Description: Contains the coordinate system definition for a spherical coordinate system as input from the Bulk Data file.

Relation Attributes:

NAME	Type	DESCRIPTION
CID1	I>0	Coordinate system identification number
RID	I≥0	Coordinate system identification number of system in which the coordinates of the defining locations are given
A1, A2, A3	R	Coordinates of system origin
B1, B2, B3	R	Coordinates defining z-axis
C1, C2, C3	R	Coordinates defining xz-plane

Created By: Module IFP

Notes:

1. This relation is used by the MKTMAT module to build the CSTM relation.

Entity: CQDMEM1

Entity Type: Relation

Description: Contains the element connectivity data for the linear isoparametric quadrilateral membrane element as input from the Bulk Data file.

Relation Attributes:

NAME	Type	DESCRIPTION
EID	KI>0	Element identification number
PID1	I>0	Property identification number of P-Type tuple
GRIDi i=1,...,4	I>0	Grid point identification number
CID	I≥0	Coordinate system used to define material axis
THETA	R	Material orientation angle for anisotropic materials
TMAX	R≥0	Maximun element thickness in design

Created By: Module IFP

Notes:

1. The PID refers to a PQDMEM1 tuple.
2. This relation is used by the MAKEST module to build the QDMM1EST relation.
3. Note that the relation contains two attributes CID and THETA to account for the dual definition of the THETA field on the CQDMEM1 bulk data entry.

Entity: CQUAD4

Entity Type: Relation

Description: Contains the element connectivity data for the quadrilateral bending element as input from the Bulk Data file.

Relation Attributes:

NAME	Type	DESCRIPTION
EID	KI>0	Element identification number
PID1	I>0	Property identification number of P-Type tuple
GRIDi i=1,...,4	I>0	Grid point identification number
CID1	I≥0	Coordinate system used to define material orientation
THETA	R	Material orientation angle for anisotropic materials

NAME	Type	DESCRIPTION
OFFSETO	R	Offset of element reference plane from plane of the grid point
TMAX	R≥0	Maximun laminate thickness in design
THICKi i=1,...,4	R≥0	Element thickness at grid point GRIDi

Created By: Module IFP

Notes:

1. The PID may refer to a PCOMPi or PSHELL tuple.
2. This relation is used by the MAKEST module to build the QUAD4EST relation.
3. Note that the relation contains two attributes CID and THETA to account for the dual definition of the THETA field on the CQUAD4 bulk data entry.

Entity: CROD

Entity Type: Relation

Description: Contains the element connectivity data for the ROD element as input from the Bulk Data file.

Relation Attributes:

NAME	Type	DESCRIPTION
EID	KI>0	Element identification number
PID1	I>0	Property identification number of a PROD tuple
GRID1	I>0	Grid point identification number defining end A
GRID2	I>0	Grid point identification number defining end B
TMAX	R≥0	Maximum cross-sectional area in design

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the RODEST relation.

Entity: CSHEAR

Entity Type: Relation

Description: Contains the connectivity data for the shear panel as input from the Bulk Data file.

Relation Attributes:

NAME	Type	DESCRIPTION
EID	KI>0	Element identification number
PID1	I>0	Property identification number of a PSHEAR tuple
GRIDi i=1,...,4	I>0	Grid point identification numbers defining the element geometry
TMAX	R≥0	Maximum thickness in design

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the SHEAREST relation.

Entity: CSTM

Entity Type: Relation

Description: Contains the coordinate transformation matrices for all external coordinate systems.

Relation Attributes:

NAME	Type	DESCRIPTION
CID	KI>0	Unique coordinate system identification number
CORDTYPE	I>0	The type of coordinate system
X0, Y0 ,Z0	R	Basic coordinates of the system origin
T11, T21, T31	R	Elements of the 3 x 3 orthogonal transformation matrix in column order
T12, T22, T32	R	
T13, T23, T33	R	

Created By: Module MKTMAT

Notes:

1. This relation contains one tuple for each external coordinate system in the problem.
2. The CORDTYPE attribute contains a value of:
   - 1 if the system is rectangular
   - 2 if the system is cylindrical
   - 3 if the system is spherical

Entity: CTRIA3

Entity Type: Relation

Description: Contains the connectivity data for the triangular shell element as input from the Bulk Data file.

Relation Attributes:

NAME	Type	DESCRIPTION
EID	KI>0	Element identification number
PID1	I>0	Property tuple identification number
GRIDi i=1,...,3	I>0	Grid point identification numbers defining the element geometry
CID1	I	Coordinate system used to define the material orientation
THETA	R	Material orientation angle for anisotropic materials
OFFSET0	R	Offset of element reference plane from plane of the grid point
TMAX	R≥0	Maximum laminate thicknesses at each grid point
THICKi i=1,...,3	R≥0	Element thicknesses at Gridi

Created By: Module IFP

Notes:

1. The PID may refer to a PCOMPi or PSHELL tuple.
2. This relation is used by the MAKEST module to build the TRIA3EST relation.
3. Note that the relation contains two attributes CID and THETA in order to account for the dual definition of the THETA field on the CTRIA3 Bulk Data entry.

Entity: CTRMEM

Entity Type: Relation

Description: Contains the connectivity data for the constant strain triangular membrane element as input from the Bulk Data file.

Relation Attributes:

NAME	Type	DESCRIPTION
EID	KI>0	Element identification number
PID1	I>0	Property identification number of a PTRMEM tuple
GRIDi i=1,...,3	I>0	Grid identification numbers defining the geometry
CID	I≥0	Coordinate system used to define the material axis
THETA	R	Material orientation angle for anisotropic materials
TMAX	R≥0	Maximum thickness in design

Created By: Module IFP

Notes:

1. This relation is used by the MAKEST module to build the TRMEMEST relation.
2. Note that the relation has two attributes CID and THETA to account for the dual definition of the THETA field on the CTRMEM bulk data entry.

Entity: D

Entity Type: Subscripted Matrix

Description: Contains the rigid body transformation matrix relating the displacements of the solution set to those of the support set.

Matrix Form: A variable sized design invariant matrix having one column for each degree of freedom in the support set and one row for each degree of freedom in the solution set for the current boundary condition.

Created By: MAPOL

Notes:

1. This matrix is design invariant and is, therefore, computed only once for each unrestrained boundary condition.

Entity: DCENT

Entity Type: Unstructured

Description: Contains collected displacement constraint information.

Record:

1. ID's of the NDSET displacement constraint sets.

i. Contains data for the (i-1)th constraint set.The information on each of these record is:

WORD	VARIABLE	DESCRIPTION
1	SETID	From DCONDSP
2	NDCID	Number of constraints in this set
j	DCID	Displacement constraint ID
j+1	CTYPE	Constraint type (see Remark 4)
j+2	ALLOWD	Allowable
j+3	NTERMS	Number of terms in the constraint
k	INTID	Internal ID of constraint component
k+1	AJ	Factor on component

Notes:

1. There are NTERMS nested blocks of k data for each block of j data.
2. There are NDCID nested blocks of j data for each record.
3. There are NSET+1 records in the entity.
4. The constraint type is either UPPER bound (CTYPE=1) or LOWER bound (CTYPE=-1).

Entity: DCONALE

Entity Type: Relation

Description: Contains the roll effectiveness constraint definition as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Aerodynamic set identification of the imposed constraint
LABEL	C(8)	Control surface label
CTYPE	C(8)	Constraint type, either UPPER or LOWER
AEREQ	R	The required roll effectiveness

Created By: Module IFP

Entity: DCONBK

Entity Type: Relation

Description: Contains the local panel buckling constraint definition as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I	Plate panel buckling constraint set identification
ETYPE	C(8)	Element type (QUAD4, TRIA3)
EID	I>0	Element identification number
LENGTH	R>0.0	Plate buckling panel length
WIDTH	R>0.0	Plate buckling panel width
BC	C(8)	Boundary conditions for control element
CTYPE	C(8)	Constraint type, either UPPER or LOWER
LAMREQ	R	Buckling eigenvalue limit

Created By: Module IFP

Entity: DCONBKE

Entity Type: Relation

Description: Contains the Euler buckling constraint definition as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I	Plate panel buckling constraint set identification
ETYPE	C(8)	Element type (BAR, ROD)
EID	I>0	Element identification number
LENGTH	R>0.0	Rod buckling length
BC	C(8)	Boundary conditions for control element
CTYPE	C(8)	Constraint type, either UPPER or LOWER
LAMREQ	R	Buckling eigenvalue limit
RSQR	R	Inertia linking parameters for ROD
ALPHA		

Created By: Module IFP

Entity: DCONCLA

Entity Type: Relation

Description: Contains the flexible lift curve slope constraint definition as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I	Aerodynamic set identification of the imposed constraint
CTYPE	C(8)	Constraint type, either UPPER or LOWER
CLAREQ	R	The required flexible lift curve slope ratio

Created By: Module IFP

Entity: DCONDSP

Entity Type: Relation

Description: Contains the design displacement constraint as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Constraint set identification number
DCID	I>0	Constraint identification number
CTYPE	C(8)	Constraint type, either UPPER or LOWER
ALLOWD	R	Allowable displacement
LABEL	C(8)	User defined label
GRIDI	I>0	Grid point id to which constraint is applied
COMPNTI	6≥I≥1	Component of GRIDI
AJ	R	Constraint coefficient

Created By: Module IFP

Entity: DCONEP

Entity Type: Relation

Description: Contains the principle strain constraint definition by specifying the identification numbers of constrained elements.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Strain constraint set identification number
ST	R	Principle strain limit in tension
SC	R	Principle strain limit in compression
SS	R	Principle strain limit in shear
ETYPE	C(8)	Element type
LAYRNUM	I	Layer number of a composite element
EID	I>0	Element identification number

Created By: Module IFP

Entity: DCONEPM

Entity Type: Relation

Description: Contains the principle strain constraint definition by specifying the material identification numbers.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Strain constraint set identification number
ST	R	Principle strain limit in tension
SC	R	Principle strain limit in compression
SS	R	Principle strain limit in shear
MID	I>0	Material identification number

Created By: Module IFP

Entity: DCONEPP

Entity Type: Relation

Description: Contains the principle strain constraint definition by specifying the element property identification numbers

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Strain constraint set identification number
ST	R	Principle strain limit in tension
SC	R	Principle strain limit in compression
SS	R	Principle strain limit in shear
PTYPE	C(8)	Property type
LAYRNUM	I	Layer number of a composite element
PID	I>0	Property identification number

Created By: Module IFP

Entity: DCONF

Entity Type: Relation

Description: Contains the definition of the synthetic response constraints or a synthetic objective function as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
LABEL	C(8)	User defined label for the design function
FNAME	C(8)	Name of the function defined in Functions packet
ARGLABEL	C(8)	Name of the argument defined in functions packet
INTARG	I>0	Integer value of the argument
RELARG	R>0.0	Real value of the argument

Created By: Module IFP

Entity: DCONFLT

Entity Type: Relation

Description: Contains the definition of the flutter constraint as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION	
SETID	I>0	Set identification number	
GFACT	R>0.0	Constraint definition scaling factor	
VTYPE	C(8)	Text string identifying the velocity type for the table	
		TRUE	for true velocities
		EQUIV	for equivalent velocities
VI	R>0.0	Velocity value	
GAMAI	R	Damping value	

Created By: Module IFP

Notes:

1. The relation contains one tuple for each velocity, damping pair given in the Bulk Data.

Entity: DCONFRQ

Entity Type: Relation

Description: Contains the frequency constraint definition as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Aerodynamic set identification of the imposed constraint
MODE	I>0	Mode number of the frequency to be constrained
CTYPE	C(8)	Constraint type either UPPER or LOWER
FRQALL	R>0.0	The frequency constraint value

Created By: Module IFP

Entity: DCONFT

Entity Type: Relation

Description: Contains the fiber / transverse strain constraint definition by specifying the identification numbers of constrained elements.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Strain constraint set identification number
EFT	R>0.0	Tensile strain limit in the fiber direction
EFC	R	Compressive strain limit in the fiber direction
ETT	R>0.0	Tensile strain limit in the transverse direction
ETC	R	Compressive strain limit in the transverse direction
ETYPE	C(8)	Element type
LAYRNUM	I	Layer number of a composite element
EID	I>0	Element identification number

Created By: Module IFP

Entity: DCONFTM

Entity Type: Relation

Description: Contains the fiber / transverse strain constraint definition by specifying the material identification numbers.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Strain constraint set identification number
EFT	R>0.0	Tensile strain limit in the fiber direction
EFC	R	Compressive strain limit in the fiber direction
ETT	R>0.0	Tensile strain limit in the transverse direction
ETC	R	Compressive strain limit in in the transverse direction
MID	I>0	Material identification number

Created By: Module IFP

Entity: DCONFTP

Entity Type: Relation

Description: Contains the fiber / transverse strain constraint definition by specifying the element property identification numbers.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Strain constraint set identification number
EFT	R>0.0	Tensile strain limit in the fiber direction
EFC	R	Compressive strain limit in the fiber direction
ETT	R>0.0	Tensile strain limit in the transverse direction
ETC	R	Compressive strain limit in in the transverse direction
PTYPE	C(8)	Property type
LAYRNUM	I	Layer number of a composite element
PID	I>0	Property identification number

Created By: Module IFP

Entity: DCONLAM

Entity Type: Relation

Description: Contains the laminate composition constraints as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
CTYPE	C(8)	Constraint type, either UPPER or LOWER
PERCENT	R	Percent allowable ply thickness
PLYNUM	I>0	Ply number
	=-1	If PLYSET is used
PLYSET	I>0	PLYLIST identification number
	=-1	If PLYNUM is used
LAMCHAR	C(8)	The string ALL or blank if LAMSET is used
LAMSET	I	PLYLIST identification number
	=0	If LAMCHAR=ALL
SID	I>0	ELEMLIST set identification number

Created By: Module IFP

Entity: DCONLIST

Entity Type: Relation

Description: Contains the definition of the constraint lists as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
CTYPE	C(8)	Constraint type identifier
NRFAC	R	Retention factor for minimum number of constraints
EPS	R	Lower bound value for constraint selection by value

Created By: Module IFP

Entity: DCONLMN

Entity Type: Relation

Description: Contains the laminate minimum gauge constraints as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
MINTHK	R>0.0	Allowable minimum gauge
LAMCHAR	C(8)	The string ALL or blank if LAMSET is used
LAMSET	I=0	PLYLIST identification number or 0 if LAMCHAR=ALL
SID	I>0	ELEMLIST set identification number
SIDEONLY	I=1 or NULL	If 1, SIDEONLY indicates that this constraint is redundant with a side constraint.

Created By: Module IFP

Entity: DCONPMN

Entity Type: Relation

Description: Contains the ply minimum gauge constraints as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
MINTHK	R>0.0	Allowable minimum gauge
PLYNUM	I>0	Ply number
	=-1	I PLYSET is used
PLYSET	I>0	PLYLIST identification number
	=-1	I PLYNUM is used
SID	I>0	ELEMLIST set identification number
SIDEONLY	=1	If this constraint is redundant with a side constraint
	NULL	If constraint is not redundant

Created By: Module IFP

Entity: DCONSCF

Entity Type: Relation

Description: Contains the definition of a constraint on the flexible stability derivative at the reference grid point associated with the force or moment due to a trim parameter or control surface deflection of the form.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Constraint set identification
ACCLAB	C(8)	Structural acceleration label
PRMLAB	C(8)	Constrained control surface label or aeroelastic trim parameter
CTYPE	C(8)	Constraint type
PRMREQ	R	Stability coefficient bounds
UNITS	C(8)	Stability coefficient units

Created By: Module IFP

Entity: DCONSDE

Entity Type: Relation

Description: Contains the definition of BAR element cross-sectional dimension side constraints.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVSYMBL	C(8)	Designed dimension symbol selected from D1 through D10
TMIN	R≥0.0	Minimum cross-sectional dimension in design
TMAX	R≥0.0	Maximum cross-sectional dimension in design
ETYPE	C(8)	Element type.BAR
EID	I>0	Element identification number

Created By: Module IFP

Entity: DCONSDL

Entity Type: Relation

Description: Contains the definition of BAR element cross-sectional dimension side constraints.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVSYMBL	C(8)	Cross-section dimension symbol selected from D1 through D10
TMIN	R≥0.0	Minimum cross-sectional dimension in design
TMAX	R≥0.0	Maximum cross-sectional dimension in design
ELID	I>0	Element identification number

Created By: Module IFP

Entity: DCONTH2

Entity Type: Relation

Description: Contains the list of layers of composite elements for which thickness constraints are always to be retained in optimization with shape function design variable linking as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION	
ETYPE	C(8)	Element type selected from:	
		QUAD4	QDMEM1
		TRIA3	TRMEM
PLYNUM	I>0 or -1	Ply number or -1 indicating PLYSET is used	
PLYSET	I>0 or -1	PLYLIST set identification or -1 indicating PLYNUM is used	
EID	I>0	Element identification number	

Created By: Module IFP

Entity: DCONTH3

Entity Type: Relation

Description: Contains the list of BAR element cross-sectional dimensions for which side constraints are always to be retained in optimization with shape function design variable linking as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
ETYPE	C(8)	Element type.BAR
DVSYMBL	C(8)	Cross-section dimension symbol selected from D1 through D10
EID	I>0	Element identification number

Created By: Module IFP

Entity: DCONTHK

Entity Type: Relation

Description: Contains the list of elements for which thickness constraints are always to be retained in optimization with shape function design variable linking as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION	
ETYPE	C(8)	Element type selected from:	
		BAR	QUAD4
		ELAS	ROD
		MASS	SHEAR
		QDMEM1	TRIA3
		TRMEM	
EID	I>0	Element identification number	

Created By: Module IFP

Entity: DCONTRM

Entity Type: Relation

Description: Contains the definitions of a trim parameter constraint.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Constraint set identification
PRMLAB	C(8)	Constrained control surface label or aeroelastic trim parameter
CTYPE	C(8)	Constraint type
PRMREQ	R	Trim parameter bound

Created By: Module IFP

Entity: DCONTW

Entity Type: Relation

Description: Contains the Tsai-Wu stress constraint definition by specifying the identification numbers of constrained elements.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Stress constraint set identification
XT	R>0.0	Tensile stress limit in the longitudinal direction
XC	R	Compressive stress limit in the longitudinal direction
YT	R>0.0	Tensile stress limit in the transverse direction
YC	R	Compressive stress limit in the transverse direction
SS	R>0.0	Shear stress limit for in-plane stress
F12	R	Tsai-Wu interaction term
ETYPE	C(8)	Element type
LAYRNUM	I	Layer number of a composite element
EID	I>0	Element identification number

Created By: Module IFP

Entity: DCONTWM

Entity Type: Relation

Description: Contains the Tsai-Wu stress constraint definition by specifying the material identification numbers.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Stress constraint set identification
XT	R>0.0	Tensile stress limit in the longitudinal direction
XC	R	Compressive stress limit in the longitudinal direction
YT	R>0.0	Tensile stress limit in the transverse direction
YC	R	Compressive stress limit in the transverse direction
SS	R>0.0	Shear stress limit for in-plane stress
F12	R	Tsai-Wu interaction term
MID	I>0	Material identification number

Created By: Module IFP

Entity: DCONTWP

Entity Type: Relation

Description: Contains the Tsai-Wu stress constraint definition by specifying the element property identification numbers.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Stress constraint set identification
XT	R>0.0	Tensile stress limit in the longitudinal direction
XC	R	Compressive stress limit in the longitudinal direction
YT	R>0.0	Tensile stress limit in the transverse direction
YC	R	Compressive stress limit in the transverse direction
SS	R>0.0	Shear stress limit for in-plane stress
F12	R	Tsai-Wu interaction term
PTYPE	C(8)	Property type
LAYRNUM	I	Layer number of a composite element
PID	I>0	Property identification number

Created By: Module IFP

Entity: DCONVM

Entity Type: Relation

Description: Contains the Von-Mises stress constraint definition by specifying the identification numbers of constrained elements.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Stress constraint set identification number
ST	R	Stress limit in tension
SC	R	Stress limit in compression
SS	R	Stress limit in shear
ETYPE	C(8)	Element type
LAYRNUM	Integer	Layer number of a composite element
EID	I>0	Element identification number

Created By: Module IFP

Entity: DCONVMM

Entity Type: Relation

Description: Contains the Von-Mises stress constraint definition by specifying the material identification numbers.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Stress constraint set identification number
ST	R	Stress limit in tension
SC	R	Stress limit in compression
SS	R	Stress limit in shear
MID	I>0	Material identification number

Created By: Module IFP

Entity: DCONVMP

Entity Type: Relation

Description: Contains the Von-Mises stress constraint definition by specifying the element property identification numbers.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Stress constraint set identification number
ST	R	Stress limit in tension
SC	R	Stress limit in compression
SS	R	Stress limit in shear
PTYPE	C(8)	Property type
LAYRNUM	Integer	Layer number of a composite element
PID	I>0	Property identification number

Created By: Module IFP

Entity: DDELDV

Entity Type: Matrix

Description: Matrix of sensitivities of the trim angles to changes in the design variables.

Matrix Form: The number of rows is equal to the number of trim parameters while the number of columns is equal to the number of active flight conditions times the number of design variables.

Created By: Module AEROSENS

Notes:

1. DDELDV is needed only when the design task includes aero elastic trim and the flight conditions have been determined to be active by module ABOUND.
2. DDELDV is determined through the solution of the equation:

   [***RHS***] [***DDELDV***] = [***DRHS***]

Entity: DDMVI

Entity Type: Unstructured

Description: Contains the nonlinear finite difference mass design sensitivity matrices.

Entity Structure:

Record:

i. Contains all or a portion of the nonlinear mass design sensitivity matrix for a given design variable.

Created By: Module NLEMA1

Notes:

1. Relation DGMMCT contains connectivity and MCODE information which defines how the matrices are stored.
2. The sensitivity matrices are stored in the same precision as the MGG matrix.

Entity: DDPGRV

Entity Type: Matrix

Description: Contains the nonlinear gravity load finite difference sensitivities for each gravity load set referenced in solution control.

Matrix Form: A variable-sized matrix having one row for each structural degree of freedom and one column for each gravity load condition for each design variable (including the zeroth design variable).The order of the matrix columns is:

a. The NGRAV columns for each gravity load set for the zeroth design variable in load set id order.

b. The NGRAV columns for each gravity load set for the first design variable in load set id order, etc.

Created By: NLLODGEN

Notes:

1. This matrix is empty if no gravity loads are referenced in solution control or in a LOAD Bulk Data entry, or if there are no nonlinear design variables.
2. This matrix and matrix [DPGRVI] constitute the total gravity load sensitivities.

Entity: DDPTHV

Entity Type: Matrix

Description: Contains the nonlinear thermal load finite difference sensitivities for each thermal load set referenced in the solution control.

Matrix Form: A variable-sized matrix having one row for each structural degree of freedom and one column for each thermal load condition for each design variable (including the zeroth design variable).The order of the matrix columns is:

a. The NTHERM columns for each thermal load set for the zeroth design variable in load set id order.

b. The NTHERM columns for each thermal load set for the first design variable in load set id order, etc.

Created By: Module NLLODGEN

Notes:

1. This matrix is empty if no thermal loads are referenced in solution control, or if there are no nonlinear design variables.
2. This matrix and matrix [DPTHVI] constitute the total thermal load sensitivities.

Entity: DDVCT

Entity Type: Relation

Description: Contains the data required for the assembly of the nonlinear portion (in finite difference form) of design sensitivity matrices.This relation is sorted first by DVID and then by KSIL.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I>0	Design variable identification number
PREF	R	Design variable linking factor
ALPHA	R	Exponential power associated with the design variable
KSIL	I>0	Internal identification for a grid connected to the element
KCODE	I>0	A code word denoting the form in which the element stiffness matrix is stored
MCODE	I>0	A code word denoting the form in which the element mass matrix is stored
TCODE	I≥0	A code word denoting the form in which the element thermal loads sensitivities are stored
TREFPT	I	The position in TREF for the associated reference temperature
NODES	I>0	The number of nodes connected to the element
IREC	I>0	The record number of the unstructured entity KELM, MELM, or TELM that contains the partition of the element matrix
ASILS	I(4)	List of associated sils of the element in sorted order

Created By: Module NLEMG

Notes:

1. This relation contains one tuple for each nonlinear design variable for each node of each structural element.
2. The code words KCODE, MCODE and TCODE have the following definition:

KCODE MCODE TCODE	MEANING
7	Element has extensional DOF's only
8	Element has rotational DOF's only
9	Element has both extension and rotation
10	Element matrix has only diagonal extensional entries
11	Element matrix has only diagonal rotational entries
12	Element matrix has diagonal entries for all grid point DOF's

3. A KCODE, MCODE or TCODE of zero implies that the element has no associated stiffness, mass or thermal load.
4. Design variable offset value is stored in INFO(11) from NLEMG.It is used for the pseudo design variable spawned to handle the non-linear portion of the BAR element stiffness.
5. 7, 8, and 9 are the only values supported for TCODE.
6. This relation contains no tuples for linear design variables.

Entity: DDVSIZE

Entity Type: Unstructured

Description: Contains memory allocation information on the DDVCT relation.

Entity Structure:

Record 1.

WORD 1	Maximum number of DDVCT tuples associated with any one design variable other than zero
WORD 2	Number of tuples connected to "design variable" zero
WORD 3 through NDV+2	Number of tuples connected to each design variable

Created By: Module NLEMG

Notes:

1. Entity contains one record with NDV +2 words.

Entity: DELTA

Entity Type: Subscripted Matrix

Description: A vector of trim parameters for each flight condition.

Matrix Form: The number of rows is dependent on the type of trim analysis being performed.The number of columns is equal to the number of load conditions being applied for the current Mach number and boundary condition.

Created By: Module SAERO

Notes:

1. For symmetric analyses, there are two to four rows in DELTA, depending on the value of TRMTYP on the TRIM Bulk Data entry.

Entity: DENSLIST

Entity Type: Relation

Description: Contains the list of density values as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I	Set identification number
DENSITY	R>0.0	Density value

Created By: Module IFP.

Entity: DESELM

Entity Type: Relation

Description: Contains design variable connection information uniquely associating one design variable to one element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I>0	Design variable id
EID1	I>0	Element identification
ETYPE1	C(8)	Element type
VMIN	R	Minimum value of design variable
VMAX	R	Maximum value of design variable
VALUE	R	Initial value of design variable
LAYERNUM	I	Layer of a composite material
LABEL	C(8)	User label
DVSYMBL	C(8)	Designed dimension symbol selected fro D1 through D10 for BAR element cross section dimension; A for element area, T for element thickness; M for element mass; and K for element stiffness.)

Created By: Module IFP

Notes:

1. The LAYERNUM entry identifies the layer on the PCOMP entry for the element defined by EID1 and ETYPE1.

Entity: DESHIST

Entity Type: Relation

Description: Contains information on the results of major iterations in the design task.

Relation Attributes:

NAME	TYPE	DESCRIPTION
NITER	I>0	Iteration number for optimization
OBJEXACT	R	Exact objective function value
OBJAPROX	R	Approximate objective function value after the **NITER**th approximate problem has been solved.
NFUNC	I≥0	Number of function evaluations in the current iteration
NGRAD	I≥0	Number of gradient evaluations in the current iterations
NCON	I≥0	Number of constraints
NAC	I≥0	Number of active constraints
NVC	I≥0	Number of violated constraints
NLBS	I≥0	Number of active lower bound side constraints
NUBS	I≥0	Number of active upper bound side constraints
CONVRGD	I≥0	Convergence flag

Created By: Module DESIGN

Notes:

1. If CONVRGD is o, then the design has not converged, if it is 1, then the design has converged.

Entity: DESLINK

Entity Type: Relation

Description: Contains design variable linking information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
ETYPE	C(8)	Element type selected from: BAR, ELAS, QDMEM1, QUAD4, ROD, SHEAR, TRIA3, TRMEM
LAYRNUM	I	Layer number
	0	If noncomposite element
DVSYMBL	C(8)	Designed dimension symbol selected fro D1 through D10 for BAR element cross section dimension; A for element area, T for element thickness; M for element mass; and K for element stiffness.)
DVID	I>0	Global design variable connected to this EID/LAYER
PREF	R	Design Variable Linking Factor ([PTRANS] matrix term)

Created By: MAKEST

Notes:

1. There is one entry for each local design variable for each global design variable linked to it.Basically, this is a relational form of the [PTRANS] matrix.

Entity: DESVARP

Entity Type: Relation

Description: Contains the properties of each physically linked design variable.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I>0	Design variable id
LINKID	I>0	ELIST or PLIST identification number
VMIN	R	Minimum value of the design variable
VMAX	R	Maximum value of the design variable
VALUE	R	Initial value of the design variable
LAYERNUM	I	Layer number for a composite element
LAYRLST	I	PLYLIST identification number for layer list
LABEL	C(8)	User label to describe the design

Created By: Module IFP

Notes:

1. The LAYERNUM entry identifies the single ply of a composite element.LAYERNUM = -1 if LAYRLST is used.

2. The LAYRLST entry identifies the list of plies linked to the design variable.LAYRLST = -1 if LAYRNUM is used.

Entity: DESVARS

Entity Type: Relation

Description: Contains the properties of shape function linked design variable.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I>0	Design variable id
SHAPEID	I>0	SHAPE set identification number
VMIN	R	Minimum value of the design variable
VMAX	R	Maximum value of the design variable
VALUE	R	Initial value of the design variable
LAYERNUM	I	Layer number for a composite element
LAYRLST	I	PLYLIST identification number for layer list
LABEL	C(8)	User label

Created By: Module IFP

Notes:

1. The LAYERNUM entry identifies the single ply of a composite element.LAYERNUM = -1 if LAYRLST is used.

2. The LAYRLST entry identifies the list of plies linked to the design variable.LAYRLST = -1 if LAYRNUM is used.

Entity: DFDU

Entity Type: Matrix

Description: See Notes.

Matrix Form: A variable sized matrix having one row for each structural degree of freedom and one column for each currently active constraint.
The order of the DFDU columns is as follows for each active boundary condition:

a. The sensitivities of active displacement constraints for each active load condition.

b. The sensitivities of each active stress or strain constraint in each active load condition.

Created By: Module MAKDFU or MAPOL

Notes:

1. For the Gradient Method, contains the sensitivities of the currently active constraints to the global displacements for those constraints that are functions of the displacements.

2. For the Virtual Load Method, contains the sum of the sensitivity of the design dependent loads and the product of the design sensitivity stiffness matrix and the active displacement vectors.

3. The MAPOL sequence supports the following partitions of the DFPU matrix (see Theoretical Manual for the explicity formation of these submatrices):

$$DFDU \rightarrow \begin{bmatrix} \varphi \\ DFDUN \end{bmatrix}$$

$$DFDUN \rightarrow \begin{bmatrix} \varphi \\ DFDUF \end{bmatrix}$$

Entity: DFDUF

Entity Type: Matrix

Description: A partition of matrix DFDUN (see DFDU).

Entity: DFDU

Entity Type: Matrix

Description: A partition of matrix DFDUN (see DFDU).

Entity: DFSV

Entity Type: Matrix

Description: Contains design variable nonlinear S-matrix derivatives related active stress/strain constraint sensitivity terms.

Matrix Form: A variable sized matrix having one row for each active subcase for each design variable and one column for each currently active constraint.
The order of the DFSV columns is as follows for each active boundary condition:

a. Null columns corresponding to the sensitivities of active displacement constraints for each active load condition.

b. The sensitivities of each active stress and/or strain constraint in each active load condition.

Created By: Module MKDFSV

Entity: DGMMCT

Entity Type: Relation

Description: Contains data required to interpret the DDMVI unstructured entity for the purpose of generating all of the mass stiffness matrix partitions.The relation is sorted by DVID and KSIL.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I>0	Design variable identification
KSIL	I>0	Internal id of grid or scalar point connected to the design variable
MCODE	I>0	Codeword denoting the form in which the DDMVI data are stored
NODES	0 < I ≤ 20	Number of nodes being processed with this KSIL
IREC	I>0	Record number of DDMVI entity where data are stored
ASIL	I(20)	List of associated SILS
ALPHA	R	Exponential power associated with BAR element design variable

Created By: Module NLEMA1

Notes:

1. MCODE is defined by:

MCODE	MEANING
1	Multiple associated grids with both extensional and rotational degrees of freedom.
2	Column being assembled is a scalar point.Associated SILS may or may not be scalar points.
3	Column being assembled is a grid point.At least one row is a scalar point.
4	Only extensional degrees of freedom are included in the assembly process.

2. The INFO array for this entity contains additional memory management allocation data:

INFO(11)	The number of tuples connected to the zeroth design variable.
INFO(12)	The maximum number of tuples connected to any one of the remaining design variables.

Entity: DISPDRVA

Entity Type: Relation

Description: Contains the user function requested displacement response sensitivity information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
MXCOL	I>0	Matrix column number in [MXDSPDVA] for the sensitivity values

Created By: Module MKAMAT

Entity: DISPRESP

Entity Type: Relation

Description: Contains the user function requested displacement response values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module DCEVAL

Entity: DKUG

Entity Type: Matrix

Description: The product of the design sensitivity matrices and the active displacement vectors.

Matrix Form: The number of columns is equal to NAC, the number of active subcases times NDV, the number of design variables.The number of rows is equal to the number of terms in the g-set.

Created By: MAKDVU

Notes:

1. The sensitivity to the first design variable for all the active subcases occupies the first NAC columns.This is followed by columns for each of the remaining design variables turn.

2. The negative of the product is created in order to simplify later matrix operations.

Entity: DKELM

Entity Type: Unstructured

Description: Contains the element nonlinear finite difference stiffness sensitivity matrix partitions.

Entity Structure:

Record:

i the record contains a partition of the stiffness matrix with either 1, 3, or 6 entries for each node

KCODE	FORMAT OF RECORD
7	3 columns of 3 entries/node
8	3 columns of 3 entries/node
9	6 columns of 6 entries/node

Created By: Module NLEMG

Notes:

1. This entity contains one record for each *strip* of each element nonlinear design stiffness derivative matrix.A strip or partition is defined as all those columns of the element matrix associated with a pivot sil (the ID of the first DOF of a grid point or the id of a scalar point).

2. Refer to the DDVCT relation for further details, as these two database entities are closely linked.

3. The matrix partitions are stored in the same precision as the KGG matrix.

4. DKELM and KELM are used to generate all of the element stiffness sensitivity matrix partitions.

Entity: DKVI

Entity Type: Unstructured

Description: Contains the stiffness design sensitivity matrices.

Entity Structure:

Record:

1. Contains all of a portion of the stiffness design sensitivity matrix for a given design variable.

Created By: Module NLEMA1

Notes:

1. Relation GMKCT contains connectivity and KCODE information which defines how the matrices are stored.
2. The sensitivity matrices are stored in the same precision as the KGG matrix.
3. DKVI is built from DKVI0 (which contains the linear stiffness design sensitivity matrix) and from the finite difference nonlinear stiffness design sensitivity.

Entity: DKVI0

Entity Type: Unstructured

Description: Contains the linear stiffness design sensitivity matrices.

Entity Structure:

Record:

1. Contains all of a portion of the linear stiffness design sensitivity matrix for a given design variable.

Created By: Module NLEMA1

Notes:

1. Relation GMKCT0 contains connectivity and KCODE information which defines how the matrices are stored.
2. The sensitivity matrices are stored in the same precision as the KGG matrix.
3. The INFO array contains information on the generation of the mass matrix.

INFO(11)	0 1	Don't generate the global mass matrix Generate the global mass matrix in the final analysis
INFO(12)	1	Generate the global mass matrix for the optimization

Entity: DKVIG

Entity Type: Unstructured

Description: Contains the stiffness matrix partitions.

Entity Structure:

Record:

1. Contains all of a portion of the stiffness matrix for a given design variable.

Created By: Module NLEMA1

Notes:

1. Relation GMKCTG contains connectivity and KCODE information which defines how the matrices are stored.
2. The matrices are stored in the same precision as the KGG matrix.
3. The INFO array contains information on the generation of the mass matrix.

INFO(11)	0 1	Don't generate the global mass matrix Generate the global mass matrix in the final analysis
INFO(12)	1	Generate the global mass matrix for the optimization

Entity: DK1V

Entity Type: Matrix

Description: An intermediate matrix in the calculation of the sensitivities of static aeroelastic displacements.

Matrix Form: Rectangular real matrix with the number of rows equal to the number of a-set degrees and the number of columns equal to the number of active displacement vectors times the number of design variables.

Created By: MAPOL

Notes:

1. This matrix is the solution to:
   [K11][DK1V] = [DP1]

Entity: DLAGS

Entity Type: Relation

Description: Contains loading information for a dynamics load set as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DSID	I>0	DLAGS set identification number
LSID	I>0	Static load set id
TAU	R	Time delay value
PHASE	R	Phase lag value

Created By: Module IFP

Entity: DLOAD

Entity Type: Relation

Description: Contains dynamic loads information as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I>0	Load set identification number
SCAL	R	Overall scale factor
SCALI	R	Scale factor for this tuple
LOADI	I>0	ID of the associated TLOADi or RLOADi set for this tuple

Created By: Module IFP

Notes:

1. The relation is used in the transient response and / or the frequency response module.

Entity: DLONLY

Entity Type: Relation

Description: Contains loads information for dynamic response as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DSID	I>0	DLONLY set identification number
POINT	I>0	Grid, scalar or extra point ID
COMP	I≥0	Component number
AVAL	R	Load value

Created By: Module IFP

Notes:

1. Subroutine PREDOL processes DLONLY data and write them to the UDLOLY entity.

2. COMP is 1-6 for grid points and zero for extra or scalar points.

Entity: DMAG

Entity Type: Matrix

Description: Matrix product of mass design sensitivity matrices and active acceleration vectors.

Matrix Form: The number of columns is equal to NAC, the number of active subcases, times NDV, the number of design variables.The number of rows is equal to the number g-set degrees of freedom.

Created By: MAKDVU

Entity: DMELM

Entity Type: Unstructured

Description: An unstructured database entity that contains the element nonlinear finite difference mass sensitivity matrix partitions.

Entity Structure:

Record:

1. The record contains a partition of the stiffness matrix with either one, three, or six entries for each node

KCODE	FORMAT OF RECORD
7	3 columns of 3 entries/node
10	3 columns of 1 entry/node (diagonal)

Created By: Module NLEMG

Notes:

1. This entity contains one record for each *strip* of each element nonlinear design mass sensitivity matrix.A strip or partition is defined as all those columns of the element matrix associated with a pivot sil (the id of the first dof of a grid point or the id of a scalar point).

2. Refer to the DDVCT relation for further details, as these two database entities are closely linked.

3. The matrix partitions are stored in the same precision as the MGG matrix.

4. DMELM and MELM are used to generate all of the element mass sensitivity matrix partitions.

Entity: DMIG

Entity Type: Relation

Description: Contains the direct matrix input data for structural matrices as defined in the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
NAME	C(8)	Matrix entity name
PREC	C(4)	Matrix precision
FORM	C(8)	Matrix form
GCOL	I	External point identification of column index
CCOL	I	Grid component number of column index
GROW	I	External point id of row index
CROW	I	Grid point component of row index
XIJ	R	Real part of matrix term
YIJ	R	Imaginary part of matrix term

Created By: Module IFP

Entity: DMU

Entity Type: Matrix

Description: The reduced mass sensitivity matrix used in the calculation of sensitivities of displacements when there are unrestrained degrees of freedom.

Matrix Form: The number of rows is equal to the number of SUPPORT degrees of freedom and the number of columns is equal to the number of columns in DMUG.

Created By: MAPOL

Notes:

1. This matrix is computed from:

$$[\ \boldsymbol{DMU}\ ] = [\ \boldsymbol{D}\ ]^{\boldsymbol{T}} * [\ \boldsymbol{DMUL}\ ] + [\ \boldsymbol{DMUR}\ ]$$

Entity: DMUA

Entity Type: Matrix

Description: A partition of the DMUF matrix (see DMUG).

Entity: DMUF

Entity Type: Matrix

Description: A partition of the DMU matrix (see DMUG).

Entity: DMUG

Entity Type: Matrix

Description: Contains the product of the mass design sensitivity matrices and the active acceleration vectors.

Matrix Form: The number of columns is equal to NAC, the number of active subcases times NDV, the number of design variables.The number of rows is equal to the number of degrees of freedom in the g-set.

Created By: Module MAKDVU

Notes:

1. This matrix is created only when there are unrestrained degrees of freedom.
2. The sensitivity to the first design variable for all the active subcases occupies the first NAC columns.This is followed by columns for each of the remaining design variables in turn.
3. The negative of the product is created in order to simplify the later matrix operations.
4. The MAPOL sequence supports the partitions of the DMUG matrix (see the Theoretical Manual for the explicity formation of these submatrices:)

$$\boldsymbol{DMUG} \rightarrow \begin{bmatrix} \varphi \\ \boldsymbol{DMUN} \end{bmatrix}$$

$$\boldsymbol{DMUN} \rightarrow \begin{bmatrix} \varphi \\ \boldsymbol{DMUF} \end{bmatrix}$$

$$\boldsymbol{DMUF} \rightarrow \begin{bmatrix} \boldsymbol{DMUO*} \\ \boldsymbol{DMUA} \end{bmatrix}$$

$$\boldsymbol{DMUA} \rightarrow \begin{bmatrix} \boldsymbol{DMUR} \\ \boldsymbol{DMUL} \end{bmatrix}$$

* Generated for Guyan reduction only.

Entity: DMUL

Entity Type: Matrix

Description: A partition of the DMUA matrix (see DMUG).

Entity: DMUN

Entity Type: Matrix

Description: A partition of the DMUG matrix (see DMUG).

Entity: DMUO

Entity Type: Matrix

Description: A partition of the DMUF matrix (see DMUG).

Entity: DMUR

Entity Type: Matrix

Description: A partition of the DMUA matrix (see DMUG).

Entity: DMVI

Entity Type: Unstructured

Description: Contains the mass design sensitivity matrices.

Entity Structure:

Record:

i. Contains all or a portion of the mass design sensitivity matrix for a given design variable.

Created By: Module NLEMA1

Notes:

1. Relation GMMCT contains connectivity and MCODE information which defines how the matrices are stored.
2. The sensitivity matrices are stored in the same precision as the MGG matrix.
3. DMVI is built from DMVI0 (which contains the linear mass design sensitivity matrix) and from the finite difference nonlinear mass design sensitivity.

Entity: DMVI0

Entity Type: Unstructured

Description: Contains the linear mass design sensitivity matrices.

Entity Structure:

Record:

i. Contains all or a portion of the linear mass design sensitivity matrix for a given design variable.

Created By: Module NLEMA1

Notes:

1. Relation GMMCT0 contains connectivity and MCODE information which defines how the matrices are stored.
2. The sensitivity matrices are stored in the same precision as the MGG matrix.

Entity: DMVID

Entity Type: Unstructured

Description: Contains the nonlinear design mass matrix partitions.

Entity Structure:

Record:

i. Contains all or a portion of the nonlinear design mass matrix for the zeroth design variable.

Created By: Module NLEMA1

Notes:

1. Relation GMMCTD contains connectivity and MCODE information which defines how the matrices are stored.
2. The matrices are stored in the same precision as the MGG matrix.

Entity: DMVIG

Entity Type: Unstructured

Description: Contains the mass matrix partitions.

Entity Structure:

Record:

i. Contains all or a portion of the mass matrix for a given design variable.

Created By: Module NLEMA1

Notes:

1. Relation GMMCTG contains connectivity and MCODE information which defines how the matrices are stored.
2. The matrices are stored in the same precision as the MGG matrix.

Entity: DPAV

Entity Type: Matrix

Description: Partition of the DPFV matrix (see DPGV).

Entity: DPFV

Entity Type: Matrix

Description: Partition of the DPNV matrix (see DPGV).

Entity: DPGRVD

Entity Type: Matrix

Description: Contains the gravity loads related to nonlinear design elements for each gravity load set referenced in solution control.

Matrix Form: A variable-sized matrix having one row for each structural degree of freedom and one column for each gravity load condition for each design variable (including the zeroth design variable).The order of the matrix columns is:

a. The NGRAV columns for each gravity load set for the zeroth design variable in load set id order.

b. The NGRAV columns for each gravity load set for the first design variable in load set id order, etc.

Created By: NLLODGEN

Notes:

1. This matrix is empty if no gravity loads are referenced in solution control or in a LOAD Bulk Data entry, or if there are no nonlinear design variables.

2. [DPGRVD] and [DDPGRI] are used to generate the total gravity loads.

Entity: DPGRVI

Entity Type: Matrix

Description: Contains the linear gravity load sensitivities for each gravity load set referenced in solution control.

Matrix Form: A variable-sized matrix having one row for each structural degree of freedom and one column for each gravity load condition for each design variable (including the zeroth design variable).The order of the matrix columns is:

a. The NGRAV columns for each gravity load set for the zeroth design variable in load set id order.

b. The NGRAV columns for each gravity load set for the first design variable in load set id order, etc.

Created By: LODGEN

Notes:

1. This matrix is empty if no gravity loads are referenced in solution control or in a LOAD Bulk Data entry, or if there are neither linear design variables nor nondesigned elements.

2. [DPGRVI] and [DDPGRV] constitute the total gravity load sensitivities.

3. [DPGRVI] and [DPGRVD] are used to generate the total gravity load at the current design point.

Entity: DPGV

Entity Type: Matrix

Description: See Notes.

Matrix Form: Real rectangular matrix with one row for each g-set degree of freedom.The number of columns is equal to the number of active subcases times the number of design variables.

Created By: MAPOL or MAKDFU

Notes:

1. For the Gradient Method, contains the right-hand sides for the sensitivity calculations.If there are design dependent loads, DPGV is the sum of DPVJ and DKUG.If there are no design dependent loads, DPGV is equivalent to DKUG.

2. For the Virtual Load Method, contains the sensitivities of the currently active constraints to the global displacements.

3. The MAPOL sequence supports the following partitions of the DPVG matrix (see the Theoretical Manual for the explicit formation of these matrices):

$$DPGV \rightarrow \begin{bmatrix} \varphi \\ DPNV \end{bmatrix}$$

$$DPNV \rightarrow \begin{bmatrix} \varphi \\ DPFV \end{bmatrix}$$

$$DPFV \rightarrow \begin{bmatrix} DPOV* \\ DPAV \end{bmatrix}$$

$$DPAV \rightarrow \begin{bmatrix} DPRV \\ DPLV \end{bmatrix}$$

* Generated for the Guyan reduction only.

Entity: DPLV3

Entity Type: Matrix

Description: Partition of the DPAV matrix (see DPGV).

Entity: DPNV

Entity Type: Matrix

Description: Partition of the DPGV matrix (see DPGV).

Entity: DPOV

Entity Type: Matrix

Description: Partition of the DPFV matrix (see DPGV).

Entity: DPRV

Entity Type: Matrix

Description: Partition of the DPFV matrix (see DPGV).

Entity: DPTHVD

Entity Type: Matrix

Description: Contains the thermal loads related to nonlinear design elements for each thermal load set referenced in the solution control.

Matrix Form: A variable-sized matrix having one row for each structural degree of freedom and one column for each thermal load condition for each design variable (including the zeroth design variable).The order of the matrix columns is:

a. The NTHERM columns for each thermal load set for the zeroth design variable in load set id order.

b. The NTHERM columns for each thermal load set for the first design variable in load set id order, etc.

Created By: Module NLODGEN

Notes:

1. This matrix is empty if no thermal loads are referenced in solution control, or if there are no nonlinear design variables.

2. [DPTHVD] and [DPTHVI] are used to generate the total thermal loads.

Entity: DPTHVI

Entity Type: Matrix

Description: Contains the linear thermal loads sensitivities for each thermal load set referenced in the solution control.

Matrix Form: A variable-sized matrix having one row for each structural degree of freedom and one column for each thermal load condition for each design variable (including the zeroth design variable).The order of the matrix columns is:

a. The NTHERM columns for each thermal load set for the zeroth design variable in load set id order.

b. The NTHERM columns for each thermal load set for the first design variable in load set id order, etc.

Created By: Module LODGEN

Notes:

1. This matrix is empty if no thermal loads are referenced in solution control, or if there are neither linear design variables and nor nondesigned element.

2. [DPTHVI] and [DDPTHV] constitute the total thermal loads sensitivities.

3. [DPTHVI] and [DPTHVD] are used to generate the total thermal load.

Entity: DPVJ

Entity Type: Matrix

Description: Contains the sensitivities of the active loads to the design variables.

Matrix Form: A variable-size matrix having one row for each structural degree of freedom and one column for each active load in the current active boundary condition.The order of the columns is as follows:

a. The sensitivities of each active load condition in load condition order for the first design variable.

b. The sensitivities of each active load condition in load condition order to the second design variable etc

Created By: Module DDLOAD

Notes:

1. If any <u>one</u> load condition in the current active boundary condition is design dependent, the full DPVJ matrix must be created so that the DPVJ and the DKUG matrices are conformable.

2. If no design depend loads exist in the current active boundary condition, the matrix is empty.

3. The DPVJ is currently built from the appropriate linear combinations of DPTHVI and DPGRVI columns.

Entity: DP1

Entity Type: Matrix

Description: A load sensitivity matrix used in the calculation of displacement sensitivities when there are unrestrained degrees of freedom.

Matrix Form: A rectangular matrix with the number of rows equal to the number of degrees of freedom in the a-set and the number of columns is equal to the product of the number of columns equal the number of columns in DPGV.

Created By: MAPOL

Notes:

1. DP1 is computed by performing a ROWMERGE on matrix entities DMU and DPGL.

Entity: DRHS

Entity Type: Matrix

Description: Sensitivity of the applied loads to the changes in the design variables after they have been reduced to the support set.

Matrix Form: The number of rows is equal to the number of degrees of freedom in the r-set while the number of design variables times the number of active load cases as determined by the ABOUND module.

Created By: MAPOL

Notes:

1. If an inertia relief sensitivity analysis is being per formed, DRHS is DPRV plus the transpose of D times DPLV.

2. If a static aeroelastic sensitivity analysis is being performed, K21 times DKLV is subtracted from the DRHS defined above.

Entity: DTELM

Entity Type: Unstructured

Description: Contains the element design nonlinear thermal load sensitivity partitions for nonlinear designed elements if any thermal loads have been defined in the model.

Entity Structure:

Record:

i. Each record contains the geometric and material thermal load sensitivity partitions for each nonlinear design element in the model if any thermal loads have been defined in the model.

Created By: Module NLEMG

Notes:

1. This entity contains one record for each partition of each nonlinear element thermal load sensitivity matrix.A partition is that portion of the matrix connected to one pivot sil.

2. Refer to the DDVCT relation documentation for further details.

3. The DTELM terms are stored in the same precision as the PG matrix.

4. DTELM and TELM are used to generate all of the element thermal load sensitivity matrix partitions.

Entity: DUAD

Entity Type: Matrix

Description: Matrix of sensitivities of the a-set accelerations to changes in the design variables.

Matrix Form: The number of rows is equal to the number of degrees of freedom in the a-set while the number of columns is equal to the number of active load cases times the number of design variables.

Created By: MAPOL

Notes:

1. This matrix is formed by merging DURD and DULD.

2. This matrix is constructed only when there is inertia relief and when the load vectors have been determined to be active by module ABOUND.

Entity: DUAV

Entity Type: Matrix

Description: Sensitivity of displacements in the a-set.

Matrix Form: The number of columns is equal to the number of active subcases times the number of design variables.The number of rows is equal to the number of terms in the a-set.

Created By: MAPOL, Module AEROSENS or Module FBS

Notes:

1. For static analysis without inertia relief DUAV is determined by FBS; for inertia relief, DUAV is merged from DURV and DULV.For static aeroelasticity, DUAV is calculated in AEROSENS.

Entity: DUFV

Entity Type: Matrix

Description: Sensitivity of displacements in the f-set.

Matrix Form: The number of columns is equal to the number of active subcases times the number of design variables.The number of rows is equal to the number of terms in the f-set.

Created By: MAPOL

Notes:

1. For generalized dynamic reduction, DUFV is obtained from DUAV and GSUBO.For Guyan Reduction, DUFV is obtained from merging DUAV and temporary matrix UO which represents the sensitivity of the displacements in the o-set.

Entity: DUG

Entity Type: Matrix

Description: Summation of the DKUG and DMUG matrices.

Matrix Form: The number of columns is equal to NAC, the number of active subcases, times NDV, the number of design variables.The number of columns is equal to the number of degrees of freedom in the g-set.

Created By: MAPOL

Notes:

1. If there are no SUPPORT degrees of freedom, DUG is equivalenced into DKUG.

Entity: DULD

Entity Type: Matrix

Description: Matrix of sensitivities of the l-set accelerations to changes in the design variables.

Matrix Form: The number of rows is equal to the number of degrees of freedom in the l-set while the number of columns is equal to the number of active load cases times the number of design variables.

Created By: MAPOL

Notes:

1. This matrix is formed by multiplying D by DURD.
2. This matrix is constructed only when there is inertia relief and when the load vectors have been determined to be active by module ABOUND.

Entity: DULV

Entity Type: Matrix

Description: Sensitivity of displacements in the l-set.The computed sensitivity of the active subcases to changes in the design variable.

Matrix Form: The number of columns is equal to the number of active subcases times the number of design variables.The number of rows is equal to the number of terms in the l-set.

Created By: Module FBS

Notes:

1. This matrix is created only when there is statics with inertia relief and when the load vectors have been determined to be active by module ABOUND.

Entity: DURD

Entity Type: Matrix

Description: The sensitivity of the rigid body acceleration matrix to changes in the design variables.

Matrix Form: Real and rectangular.The number of rows is equal to the number of degrees of freedom in the r-set while the number of columns is equal to the number of active subcases times the number of design variables.

Created By: Module INERTIA

Notes:

1. This matrix is formed only when there is inertia relief and the applied load has been determined to be active by module ABOUND.
2. The matrix is formed by solving

   $[\boldsymbol{MRR}]\ [\boldsymbol{DURD}] = [\boldsymbol{DRHS}]$

Entity: DVCT

Entity Type: Relation

Description: Contains the data required for the assembly of the linear portion (in analytical form) of design sensitivity matrices.Relation is sorted first by DVID and then by KSIL.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I>0	Design variable identification number
PREF	R	Design variable linking factor
ALPHA	R	Exponential power associated with the design variable
KSIL	I>0	Internal identification for a grid connected to the element
KCODE	I>0	A code word denoting the form in which the element stiffness matrix is stored
MCODE	I>0	A code word denoting the form in which the element mass matrix is stored
TCODE	I≥0	A code word denoting the form in which the element thermal loads sensitivities are stored
TREFPT	I	The position in TREF for the associated reference temperature
NODES	I>0	The number of nodes connected to the element
IREC	I>0	The record number of the unstructured entity KELM, MELM, or TELM that contains the partition of the element matrix
ASILS	I(32)	List of associated sils of the element in sorted order

Created By: Module EMG

Notes:

1. This relation contains one tuple for each design variable for each node of each structural element.

2. The words KCODE, MCODE and TCODE have the following definition:
   a. For scalar elements (No meaning for TCODE)

KCODE MCODE TCODE	MEANING
1	Scalar point connected to ground
2	Grid point component connected to a scalar point
3	Scalar point connected to grid component
4	Scalar point connected to a scalar point
5	Grid point component connected to ground
6	Grid point component connected to a second grid point component

   b. For other elements (connected to Grid points)

KCODE MCODE TCODE	MEANING
7	Element has extensional DOF's only
8	Element has rotational DOF's only
9	Element has both extension and rotation
10	Element matrix has only diagonal extensional entries
11	Element matrix has only diagonal rotational entries
12	Element matrix has diagonal entries for all grid point DOF's

3. A KCODE, MCODE or TCODE of zero implies that the element has no associated stiffness, mass or thermal load.

4. Design variable offset value is stored in INFO(11) from EMG.It is used for the pseudo design variable spawned to handle the nonlinear portion of the BAR element stiffness.

5. 7, 8, and 9 are the only values supported for TCODE.

6. This relation contains tuples for nonlinear design variables for which related records of unstructured entities KECM, MECM or TECM are empty.

Entity: DVCTD

Entity Type: Relation

Description: Contains the data required for the assembly of the nonlinear design element sensitivity matrices.Relation is sorted by KSIL.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I>0	Design variable identification number
PREF	R	Design variable linking factor
ALPHA	R	Exponential power associated with the design variable
KSIL	I>0	Internal identification for a grid connected to the element
KCODE	I>0	A code word denoting the form in which the element stiffness matrix is stored
MCODE	I>0	A code word denoting the form in which the element mass matrix is stored

NAME	TYPE	DESCRIPTION
TCODE	I≥0	A code word denoting the form in which the element thermal loads sensitivities are stored
TREFPT	I	The position in TREF for the associated reference temperature
NODES	I>0	The number of nodes connected to the element
IREC	I>0	The record number of the unstructured entity KELM, MELM, or TELM that contains the partition of the element matrix
ASILS	I(4)	List of associated sils of the element in sorted order

Created By: Module NLEMG

Notes:

1. This relation contains one tuple for the zeroth design variable for each node of each nonlinear design structural element.

2. The words KCODE, MCODE and TCODE have the following definition:

KCODE MCODE TCODE	MEANING
7	Element has extensional DOF's only
8	Element has rotational DOF's only
9	Element has both extension and rotation
10	Element matrix has only diagonal extensional entries
11	Element matrix has only diagonal rotational entries
12	Element matrix has diagonal entries for all grid point DOF's

3. A KCODE, MCODE or TCODE of zero implies that the element has no associated stiffness, mass or thermal load.

4. Design variable offset value is stored in INFO(11) from NLEMG.It is used for the pseudo design variable spawned to handle the non-linear portion of the BAR element stiffness.

5. 7, 8, and 9 are the only values supported for TCODE.

6. This relation contains no tuple for linear design variables.

Entity: DVSIZE

Entity Type: Unstructured

Description: Contains memory allocation information on the DVCT relation.

Entity Structure:

Record 1.

WORD	CONTENTS
1	Maximum number of DVCT tuples associated with any one design variable other than zero
2	Number of tuples connected to "design variable" zero
3 through NDV+2	Number of tuples connected to each design variable

Created By: Module EMG

Notes:

1. Entity contains one record with NDV +2 words.

Entity: DVSIZED

Entity Type: Unstructured

Description: Contains memory allocation information on the DVCTD relation.

Entity Structure:

Record 1.

WORD	CONTENTS
1	0
2	Number of tuples connected to "design variable" zero
3 through NDV+2	0

Created By: Module NLEMG

Notes:

1. Entity contains one record with NDV +2 words.

Entity: DVTOPTE

Entity Type: Relation

Description: Contains the designed element thickness variation type definition by specifying the element identification numbers.

Relation Attributes:

NAME	TYPE	DESCRIPTION
TYPE	C(8)	Designed element thickness variation
ETYPE	C(8)	Element type
EID	I>0	Element identification number

Created By: Module IFP

Entity: DVTOPTL

Entity Type: Relation

Description: Contains the designed element thickness variation type definition by specifying the element list set ID numbers.

Relation Attributes:

NAME	TYPE	DESCRIPTION
TYPE	C(8)	Designed element thickness variation
ELID	I>0	Element list set ID number

Created By: Module IFP

Entity: DVTOPTP

Entity Type: Relation

Description: Contains the designed element thickness variation type definition by specifying the element property identification numbers.

Relation Attributes:

NAME	TYPE	DESCRIPTION
TYPE	C(8)	Designed element thickness variation
PTYPE	C(8)	Element property type
PID	I>0	Element property identification number

Created By: Module IFP

Entity: DDWGH2

Entity Type: Unstructured

Description: Contains the nonlinear portion of DWGH, the sensitivities of the weight to the design variables.

Entity Structure:

Record:

1. Design variable identification numbers including zeroth design variable.
2. The nonlinear portion of DWGH corresponding to each design variable ID at the 1st record.

Created By: Module NLEMA1

Notes:

1. The length of each record is NDV+1.

Entity: DWGH1

Entity Type: Unstructured

Description: Contains the linear design invariant portion of DWGH, the sensitivities of the weight to the design variables.

Entity Structure:

Record:

1. Design variable identification numbers including zeroth design variable.
2. The invariant portion of DWGH corresponding to each design variable ID at the 1st record.

Created By: Module EMA1

Notes:

1. The length of each record is NDV+1.

Entity: DWNWSH

Entity Type: Matrix

Description: Matrix containing downwash vectors that are computed for unit values of angle of attack, pitch rate and trim surface deflection.

Matrix Form: Rectangular real matrix with three columns and rows equal to the number of panels in the unsteady aerodynamics model.

Created By: Module BLASTFIT

Entity: DYNRED

Entity Type: Relation

Description: Contains the necessary information to perform general dynamic reduction as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
FMAX	R > 0	Highest frequency of interest
NVEC	I>0	Number of generalized coordinates desired
NIT	I>0	Not Used
ISEED	I>0	
NQDES	I>0	
EPZ	R	
FACTOR	R	

Created By: Module IFP

Entity: D1JK

Entity Type: Matrix

Description: The real part of the substantial derivative matrix.

Matrix Form: A rectangular complex matrix with the number of rows equal to the number of aerodynamic panels and the number of columns equal to the number of aerodynamic degrees of freedom .

Created By: Module UNSTEADY

Notes:

1. The complete substantial derivative matrix is equal to:
   [D1JK] + (ik)**[D2JK]**
   where k is the reduced frequency.
2. The number of J degrees of freedom is in INFO(11) and the number of K degrees of freedom is in INFO(12).

Entity: D2JK

Entity Type: Matrix

Description: The imaginary part of the substantial derivative matrix.

Matrix Form: A complex matrix with the number of rows equal to the number of aerodynamic panels and the number of columns equal to the number of aerodynamic degrees of freedom.

Created By: Module UNSTEADY

Notes:

1. The complete substantial derivative matrix is equal to:
   [D1JK] + (iK)**[D2JK]**
   where k is the reduced frequency.

Entity: EIDTYPE

Entity Type: Relation

Description: Contains the list of element identification numbers and corresponding element types.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
ETYPE	C(8)	Element type

Created By: Module IFP

Entity: EIGC

Entity Type: Relation

Description: Contains the necessary information to perform complex eigenvalue analysis as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	KI>0	Set identification number
METHOD	C(8)	Method of complex eigenvalue extraction
NORM	C(8)	Eigenvector normalization technique
GRID1	I≥0	Grid or scalar point identification number
COMPNTS1	I≥0	Component of GRID1
ORTHPARM	R>0.0	Mass orthogonality test parameter
PA	R	The real part of complex point A
QA	R	The imaginary part of complex point B
PB	R	The real part of complex point A
QB	R	The imaginary part of complex point B
WIDTH	R>0.0	Width of region in complex plane
ROOTEST	I>0	Estimated number of roots in the range
ROOTDES	I≥0	Desired number of roots

Created By: Module IFP

Entity: EIGR

Entity Type: Relation

Description: Contains the necessary information to perform real eigenvalue analysis as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	KI>0	Set identification number
METHOD	C(8)	Method of eigenvalue extraction
MINFREQ	R≥0.0	Lower bound for frequency
MAXFREQ	R≥0.0	Upper bound for frequency
ROOTEST1	I>0	Estimated number of roots in the range
ROOTDES1	I≥0	Desired number of roots
RGDMAG	R	Rigid body mode test parameter
ORTHPARM	R>0.0	Mass orthogonality test parameter
NORM	C(8)	Eigenvector normalization technique
GRID1	I≥0	Grid or scalar point identification number
COMPNTS1	I≥0	Component of GRID1

Created By: Module IFP

Entity: ELASEST

Entity Type: Relation

Description: Contains the element summary data for the ELAS1 and ELAS2 elements.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
SIL1, SIL2	I≥0	Internal grid or scalar point identification number
COMPNT1	I≥0	Component of SIL1 to which the element is attached
COMPNT2	I≥0	Component of SIL2 to which the element is attached
K	R	Stiffness value
GE	R	Damping coefficient
STRSCOEF	R	Stress coefficient
DESIGN	I≥0	Design flag, nonzero if element is designed

Created By: Module MAKEST

Notes:

1. This relation is built from the CELAS1 and CELAS2 relations along with associated property and grid relations.It contains one tuple for each scalar spring element in the problem.

Entity: ELEMDRVA

Entity Type: Relation

Description: Contains the user function requested element stress and strain response sensitivity information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
MXCOL	I>0	Matrix column number in [MXELMDVA] for the sensitivity values

Created By: Module MKAMAT

Entity: ELEMLIST

Entity Type: Relation

Description: Contains the list of elements for which element dependent outputs are requested as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION	
SID	I>0	Design variable identification number	
ETYPE	C(8)	Element type selected from:	
		BAR	ELAS
		IHEX1	IHEX2
		IHEX3	QDMEM1
		QUAD4	ROD
		SHEAR	TRIA3
		TRMEM	
EID	I>0	Element identification number	

Created By: Module IFP

Entity: ELEMRESP

Entity Type: Relation

Description: Contains the user function requested element stress and strain response values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module SCEVAL

Entity: ELIST

Entity Type: Relation

Description: Contains the element identification numbers of elements specified on the ELIST Bulk Data entry.

Relation Attributes:

NAME	TYPE	DESCRIPTION	
LINKID	I>0	ELIST set identification number	
ETYPE1	C(8)	Element type selected from:	
		BAR	CONROD
		CONM2	ELASi
		MASSi	QDMEM1
		QUAD4	ROD
		SHEAR	TRIA3
		TRMEM	
EID1	I>0	Element identification number	

Created By: Module IFP

Entity: ELISTM

Entity Type: Relation

Description: Contains the element identification numbers of elements specified on the ELISTM Bulk Data entry.

Relation Attributes:

NAME	TYPE	DESCRIPTION	
LINKID	I>0	ELIST set identification number	
ETYPE1	C(8)	Element type selected from:	
		BAR	CONROD
		CONM2	ELASi
		MASSi	QDMEM1
		QUAD4	ROD
		SHEAR	TRIA3
		TRMEM	
EID1	I>0	Element identification number	
DVSYMBL	C(8)	Designed dimension symbol selected fro D1 through D10 for BAR element cross section dimension; A for element area, T for element thickness; M for element mass; and K for element stiffness.)	

Created By: Module IFP

Entity: EOBAR

Entity Type: Relation

Description: Contains the element response quantities for the BAR element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
OAFLAG	I>0	Optimize/analyze flag 1 Optimization 2 Analysis
NITER	I>0	Iteration number for optimization
BCID	I>0	Boundary condition identification number
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 5 Transient 7 Buckling
SUBCASE	I>0	Subcase identification number if (DISC = 1, 3, 5, 8) or Mode Number if (DISC = 2, 7)
CASEID	I	Case index number
EID	I>0	Element identification number
ETYPE	C(8)	Element type (“BAR”)
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
ESER	R	Real part of element strain energy
ESEI	R	Imaginary part of element strain energy
RSA1	R	Real part of first bending stress at end A
ISA1	R	Imaginary part of first bending stress at end A
RSA2	R	Real part of second bending stress at end A
ISA2	R	Imaginary part of second bending stress at end A
RSA3	R	Real part of third bending stress at end A
ISA3	R	Imaginary part of third bending stress at end A
RSA4	R	Real part of fourth bending stress at end A
ISA4	R	Imaginary part of fourth bending stress at end A
RAAX	R	Real part of axial stress at end A
IAAX	R	Imaginary part of axial stress at end A
MAXA	R	Maximum stress at end A
MINA	R	Minimum stress at end A
TSAFE	R	Safety margin in tension
RSB1	R	Real part of first bending stress at end B
ISB1	R	Imaginary part of first bending stress at end B
RSB2	R	Real part of second bending stress at end B
ISB2	R	Imaginary part of second bending stress at end B
RSB3	R	Real part of third bending stress at end B
ISB3	R	Imaginary part of third bending stress at end B
RSB4	R	Real part of fourth bending stress at end B
ISB4	R	Imaginary part of fourth bending stress at end B
RBAX	R	Real part of axial stress at end B
IBAX	R	Imaginary part of axial stress at end B
MAXB	R	Maximum stress at end B
MINB	R	Minimum stress at end B
CSAFE	R	Safety margin in compression
RSNA1	R	Real part of first bending strain at end A
ISNA1	R	Imaginary part of first bending strain at end A
RSNA2	R	Real part of second bending strain at end A
ISNA2	R	Imaginary part of second bending strain at end A
RSNA3	R	Real part of third bending strain at end A
ISNA3	R	Imaginary part of third bending strain at end A
RSNA4	R	Real part of fourth bending strain at end A
ISNA4	R	Imaginary part of fourth bending strain at end A
RAAXN	R	Real part of axial strain at end A
IAAXN	R	Imaginary part of axial strain at end A
MAXAN	R	Maximum strain at end A
MINAN	R	Minimum strain at end A
RSNB1	R	Real part of first bending strain at end B
ISNB1	R	Imaginary part of first bending strain at end B
RSNB2	R	Real part of second bending strain at end B
ISNB2	R	Imaginary part of second bending strain at end B
RSNB3	R	Real part of third bending strain at end B
ISNB3	R	Imaginary part of third bending strain at end B

NAME	TYPE	DESCRIPTION
RSNB4	R	Real part of fourth bending strain at end B
ISNB4	R	Imaginary part of fourth bending strain at end B
RBAXN	R	Real part of axial strain at end B
IBAXN	R	Imaginary part of axial strain at end B
MAXBN	R	Maximum strain at end B
MINBN	R	Minumum strain at end B
RBMA1	R	Real part of bending moment A1
IBMA1	R	Imaginary part of bending moment A1
RBMA2	R	Real part of bending moment A2
IBMA2	R	Imaginary part of bending moment A2
RBMB1	R	Real part of bending moment B1
IBMB1	R	Imaginary part of bending moment B1
RBMB2	R	Real part of bending moment B2
IBMB2	R	Imaginary part of bending moment B2
RSHEAR1	R	Real part of shear 1
ISHEAR1	R	Imaginary part of shear 1
RSHEAR2	R	Real part of shear 2
ISHEAR2	R	Imaginary part of shear 2
RFORAX	R	Real part of axial force
IFORAX	R	Imaginary part of axial force
RTORQUE	R	Real part of torque
ITORQUE	R	Imaginary part of torque

Created By: Module EDR

Notes:

1. This relation is used by module OFPEDR for output printing and punching.

Entity: EODISC

Entity Type: Unstructured

Description: Contains the element discipline types and their subcases for which element response quantities are to be computed for each element in the structural model for each boundary condition.

Record:

i. Record i contains the following for each EID / BCID combination to the EOSUMMARY relation.

WORD	CONTENTS
1	NDISC, the number of disciplines in the EODISC record
2	DISC, discipline ID for the current discipline
3	NSUB, the number of subcases for which output is desired from discipline DISC
4 to 3+NSUB	SUB_i, the subcase numbers in sorted order

Created By: Module PFBULK

Notes:

1. Words 2 through 4+NSUB are repeated for each of the NDISC disciplines to generate a record in the form.

   NDISC(DISC$_i$,NSUB$_i$,(SUB$_j$),$_j$= 1,NSUB), $_i$= 1, NDISC)

2. Each record of EODISC is referenced by the RECORD attribute of the EOSUMMARY relation.

3. The EOSUMMARY / EODISC combination is used by EDR and OFPEDR to control element response quantity computations.

4. Each record is ordered in discipline, in subcase order.

5. The records are ordered by boundary condition ID, element type (alphabetical) and element ID.

Entity: EOELAS

Entity Type: Relation

Description: Contains the element response quantities for the ELAS element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
OAFLAG	I>0	Optimize/analyze flag 1 Optimization 2 nalysis
NITER	I>0	Iteration number for optimization
BCID	I>0	Boundary condition identification number
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 5 Transient 7 Bucklingransient
SUBCASE	I>0	Subcase identification number if (DISC = 1, 3, 5, 8) or Mode Number if (DISC = 2, 7)
CASEID	I	Case index number
EID	I>0	Element identification number
ETYPE	C	Element type (“ELAS”)

NAME	TYPE	DESCRIPTION
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
ESER	R	Real part of element strain energy
ESEI	R	Imaginary part of element strain energy
STRSR	R	Real part of stress
STRSI	R	Imaginary part of stress
FORR	R	Real part of force
FORI	R	Imaginary part of force

Created By: Module EDR

Notes:

1. This relation is used by module OFPEDR for output printing and punching.

Entity: EOHEX1

Entity Type: Relation

Description: Contains the element response quantities for the IHEX1 element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
OAFLAG	I>0	Optimize/analyze flag 1 Optimization 2 Analysis
NITER	I>0	Iteration number for optimization
BCID	I>0	Boundary condition identification number
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 5 Transient 7 Buckling
SUBCASE	I>0	Subcase identification number if (DISC = 1, 3, 5, 8) or Mode Number if (DISC = 2, 7)
CASEID	I	Case index number
EID	I>0	Element identification number
ETYPE	C(8)	Element type (“IHEX1”)
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
GID	I>0	Stress point identification number
ESER	R	Real part of element strain energy
ESEI	R	Imaginary part of element strain energy
RSTRSX	R	Real part of normal stress in x-direction
ISTRSX	R	Imaginary part of normal stress in x-direction
RSSXY	R	Real part of shear stress in xy-plane
ISSXY	R	Imaginary part of shear stress in xy-plane
PSTRESS1	R	First principal stress
XCOS1	R	First principal x cosine
XCOS2	R	Second principal x cosine
XCOS3	R	Third principal x cosine
MEANSTRS	R	Mean stress
OCTSTRS	R	Octahedral shear stress
RSTRSY	R	Real part of normal stress in y-direction
ISTRSY	R	Imaginary part of normal stress in y-direction
RSSYZ	R	Real part of normal stress in yz-direction
ISSYZ	R	Imaginary part of normal stress in yz-direction
PSTRESS2	R	Second principal stress
YCOS1	R	First principal y cosine
YCOS2	R	Second principal y cosine
YCOS3	R	Third principal y cosine
RSTRSZ	R	Real part of normal stress in z-direction
ISTRSZ	R	Imaginary part of normal stress in z-direction
RSSZX	R	Real part of shear stress in zx-plane
ISSZX	R	Imaginary part of shear stress in zx-plane
PSTRESS3	R	Third principal stress
ZCOS1	R	First principal z cosine
ZCOS2	R	Second principal z cosine
ZCOS3	R	Third principal z cosine
RSTRNX	R	Real part of normal strain in x-direction
ISTRNX	R	Imaginary part of normal strain in x-direction
RSNXY	R	Real part of shear strain in xy-plane
ISNXY	R	Imaginary part of shear strain in xy-plane
PSTRAIN1	R	First principal strain
XCOS1N	R	First principal x cosine
XCOS2N	R	Second principal x cosine
XCOS3N	R	Third principal x cosine
MEANSTRN	R	Mean strain
OCTSTRN	R	Octahedral shear strain
RSTRNY	R	Real part of normal strain in y-direction

NAME	TYPE	DESCRIPTION
ISTRNY	R	Imaginary part of normal strain in y-direction
RSNYZ	R	Real part of shear strain in yz-plane
ISNYZ	R	Imaginary part of shear strain in yz-plane
PSTRAIN2	R	Second principal strain
YCOS1N	R	First principal y cosine
YCOS2N	R	Second principal y cosine
YCOS3N	R	Third principal y cosine
RSTRNZ	R	Real part of normal strain in z-direction
ISTRNZ	R	Imaginary part of normal strain in z-direction
RSNZX	R	Real part of shear strain in zx-plane
ISNZX	R	Imaginary part of shear strain in zx-plane
PSTRAIN3	R	Third principal strain
ZCOS1N	R	First principal z cosine
ZCOS2N	R	Second principal z cosine
ZCOS3N	R	Third principal z cosine

Created By: Module EDR

Notes:

1. This relation is used by module OFPEDR for output printing and punching.
2. One tuple exists for each of the nine stress points in the element.
3. The first eight stress points (attribute GID) are coincident with the element grid points and are numbered 1 through 8 in the order that the grid points are specified on the CIHEX1 entity.The ninth stress point (GID=9) is located at the center of the element.

Entity: EOHEX2

Entity Type: Relation

Description: Contains the element response quantities for the IHEX2 element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
OAFLAG	I>0	Optimize/analyze flag 1 Optimization 2 Analysis
NITER	I>0	Iteration number for optimization
BCID	I>0	Boundary condition identification number
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 5 Transient 7 Buckling
SUBCASE	I>0	Subcase identification number if (DISC = 1, 3, 5, 8) or Mode Number if (DISC = 2, 7)
CASEID	I	Case index number
EID	I>0	Element identification number
ETYPE	C(8)	Element type (“IHEX2”)
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
GID	I>0	Stress point identification number
ESER	R	Real part of element strain energy
ESEI	R	Imaginary part of element strain energy
RSTRSX	R	Real part of normal stress in x-direction
ISTRSX	R	Imaginary part of normal stress in x-direction
RSSXY	R	Real part of shear stress in xy-plane
ISSXY	R	Imaginary part of shear stress in xy-plane
PSTRESS1	R	First principal stress
XCOS1	R	First principal x cosine
XCOS2	R	Second principal x cosine
XCOS3	R	Third principal x cosine
MEANSTRS	R	Mean stress
OCTSTRS	R	Octahedral shear stress
RSTRSY	R	Real part of normal stress in y-direction
ISTRSY	R	Imaginary part of normal stress in y-direction
RSSYZ	R	Real part of normal stress in yz-plane
ISSYZ	R	Imaginary part of normal stress in yz-plane
PSTRESS2	R	Second principal stress
YCOS1	R	First principal y cosine
YCOS2	R	Second principal y cosine
YCOS3	R	Third principal y cosine
RSTRSZ	R	Real part of normal stress in z-direction
ISTRSZ	R	Imaginary part of normal stress in z-direction
RSSZX	R	Real part of shear stress in xy-plane
ISSZX	R	Imaginary part of shear stress in xy-plane

NAME	TYPE	DESCRIPTION
PSTRESS3	R	Third principal stress
ZCOS1	R	First principal z cosine
ZCOS2	R	Second principal z cosine
ZCOS3	R	Third principal z cosine
RSTRNX	R	Real part of normal strain in x-direction
ISTRNX	R	Imaginary part of normal strain in x-direction
RSNXY	R	Real part of shear strain in xy-plane
ISNXY	R	Imaginary part of shear strain in xy-plane
PSTRAIN1	R	First principal strain
XCOS1N	R	First principal x cosine
XCOS2N	R	Second principal x cosine
XCOS3N	R	Third principal x cosine
MEANSTRN	R	Mean strain
OCTSTRN	R	Octahedral shear strain
RSTRNY	R	Real part of normal strain in y-direction
ISTRNY	R	Imaginary part of normal strain in y-direction
RSNYZ	R	Real part of shear strain in yz-plane
ISNYZ	R	Imaginary part of shear strain in yz-plane
PSTRAIN2	R	Second principal strain
YCOS1N	R	First principal y cosine
YCOS2N	R	Second principal y cosine
YCOS3N	R	Third principal y cosine
RSTRNZ	R	Real part of normal strain in z-direction
ISTRNZ	R	Imaginary part of normal strain in z-direction
RSTZX	R	Real part of shear strain in z-direction
ISNZX	R	Imaginary part of shear strain in z-direction
PSTRAIN3	R	Third principal strain
ZCOS1N	R	First principal z cosine
ZCOS2N	R	Second principal z cosine
ZCOS3N	R	Third principal z cosine

Created By: Module EDR

Notes:

1. This relation is used by module OFPEDR for output printing and punching.
2. One tuple exists for each of the nine stress points in the element.
3. The first 20 stress points are in the same order as the grid points are specified on the CIHEX2 entity and are numbered 1 through 20.The corner stress points coincident with the corner grid points while the mid-edge stress points are exactly at the mid-edge point.The 21st stress point is located at the element center.

Entity: EOHEX3

Entity Type: Relation

Description: Contains the element response quantities for the IHEX3 element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
OAFLAG	I>0	Optimize/analyze flag 1 Optimization 2 Analysis
NITER	I>0	Iteration number for optimization
BCID	I>0	Boundary condition identification number
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 5 Transient 7 Buckling
SUBCASE	I>0	Subcase identification number if (DISC = 1, 3, 5, 8) or Mode Number if (DISC = 2, 7)
CASEID	I	Case index number
EID	I>0	Element identification number
ETYPE	C(8)	Element type (“IHEX3”)
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
GID	I>0	Stress point identification number
ESER	R	Real part of element strain energy
ESEI	R	Imaginary part of element strain energy
RSTRSX	R	Real part of normal stress in x-direction
ISTRSX	R	Imaginary part of normal stress in x-direction
RSSXY	R	Real part of shear stress in xy-plane
ISSXY	R	Imaginary part of shear stress in xy-plane
PSTRESS1	R	First principal stress
XCOS1	R	First principal x cosine
XCOS2	R	Second principal x cosine
XCOS3	R	Third principal x cosine
MEANSTRS	R	Mean stress

NAME	TYPE	DESCRIPTION
OCTSTRS	R	Octahedral shear stress
RSTRSY	R	Real part of normal stress in y-direction
ISTRSY	R	Imaginary part of normal stress in y-direction
RSSYZ	R	Real part of normal stress in yz-plane
ISSYZ	R	Imaginary part of normal stress in yz-plane
PSTRESS2	R	Second principal stress
YCOS1	R	First principal y cosine
YCOS2	R	Second principal y cosine
YCOS3	R	Third principal y cosine
RSTRSZ	R	Real part of normal stress in z-direction
ISTRSZ	R	Imaginary part of normal stress in z-direction
RSSZX	R	Real part of shear stress in xy-plane
ISSZX	R	Imaginary part of shear stress in xy-plane
PSTRESS3	R	Third principal stress
ZCOS1	R	First principal z cosine
ZCOS2	R	Second principal z cosine
ZCOS3	R	Third principal z cosine
RSTRNX	R	Real part of normal strain in x-direction
ISTRNX	R	Imaginary part of normal strain in x-direction
RSNXY	R	Real part of shear strain in xy-plane
ISNXY	R	Imaginary part of shear strain in xy-plane
PSTRAIN1	R	First principal strain
XCOS1N	R	First principal x cosine
XCOS2N	R	Second principal x cosine
XCOS3N	R	Third principal x cosine
MEANSTRN	R	Mean strain
OCTSTRN	R	Octahedral shear strain
RSTRNY	R	Real part of normal strain in y-direction
ISTRNY	R	Imaginary part of normal strain in y-direction
RSNYZ	R	Real part of shear strain in yz-plane
ISNYZ	R	Imaginary part of shear strain in yz-plane
PSTRAIN2	R	Second principal strain
YCOS1N	R	First principal y cosine
YCOS2N	R	Second principal y cosine
YCOS3N	R	Third principal y cosine
RSTRNZ	R	Real part of normal strain in z-direction
ISTRNZ	R	Imaginary part of normal strain in z-direction
RSTZX	R	Real part of shear strain in z-direction
ISNZX	R	Imaginary part of shear strain in z-direction
PSTRAIN3	R	Third principal strain
ZCOS1N	R	First principal z cosine
ZCOS2N	R	Second principal z cosine
ZCOS3N	R	Third principal z cosine

Created By: Module EDR

Notes:

1. This relation is used by module OFPEDR for output printing and punching.
2. One tuple exists for each of the nine stress points in the element.
3. The first 20 stress points are in the same order as the grid points are specified on the CIHEX3 entity and are numbered 1 through 20.The corner stress points coincident with the corner grid points while the mid-edge stress points are exactly at the mid-edge point.The 21st stress point is located at the element center.

Entity: EOQDMM1

Entity Type: Relation

Description: Contains the element response quantities for the QDMEM1 element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
OAFLAG	I>0	Optimize/analyze flag 1 Optimization 2 Analysis
NITER	I>0	Iteration number for optimization
BCID	I>0	Boundary condition identification number
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 5 Transient 7 Buckling
SUBCASE	I>0	Subcase identification number if (DISC = 1, 3, 5, 8) or Mode Number if (DISC = 2, 7)
CASEID	I	Case index number
EID	I>0	Element identification number

NAME	TYPE	DESCRIPTION
ETYPE	C(8)	Element type (“QDMEM1”)
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
LAYRNUM	I>0	Layer number
ESER	R	Real part of element strain energy
ESEI	R	Imaginary part of element strain energy
RSTRSX	R	Real part of normal stress in x-direction
ISTRSX	R	Imaginary part of normal stress in x-direction
RSTRSY	R	Real part of normal stress in y-direction
ISTRSY	R	Imaginary part of normal stress in y-direction
RSTRSS	R	Real part of shear stress
ISTRSS	R	Imaginary part of shear stress
THSTRS	R	Principal angle for stress
STRS1	R	Major principal stress
STRS2	R	Minor principal stress
MSSTRS	R	Maximum shear stress
RSTRNX	R	Real part of normal strain in x-direction
ISTRNX	R	Imaginary part of normal strain in x-direction
RSTRNY	R	Real part of normal strain in y-direction
ISTRNY	R	Imaginary part of normal strain in y-direction
RSTRNS	R	Real part of shear strain
ISTRNS	R	Imaginary part of shear strain
THSTRN	R	Principal angle for strain
STRN1	R	Major principal strain
STRN2	R	Minor principal atrain
MSSTRN	R	Maximum shear strain
RFX	R	Real part of force in x-direction
IFX	R	Imaginary part of force in x-direction
RFY	R	Real part of force in y-direction
IFY	R	Imaginary part of force in y-direction
RFXY	R	Real part of shear force in xy-plane
IFXY	R	Imaginary part of shear force in xy-plane

Created By: Module EDR

Notes:

1. This relation is used by module OFPEDR for output printing and punching.

Entity: EOQUAD4

Entity Type: Relation

Description: Contains the element response quantities for the QUAD4 element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
OAFLAG	I>0	Optimize/analyze flag 1 Optimization 2 Analysis
NITER	I>0	Iteration number for optimization
BCID	I>0	Boundary condition identification number
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 5 Transient 7 Buckling
SUBCASE	I>0	Subcase identification number if (DISC = 1, 3, 5, 8) or Mode Number if (DISC = 2, 7)
CASEID	I	Case index number
EID	I>0	Element identification number
ETYPE	C(8)	Element type (“QUAD4”)
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
LAYRNUM	I>0	Layer number
CMPZIT	I≥0	Composite type flag 0 Noncomposite element 1 Nondesigned and nonconstrained composite element 2 Nondesigned and constrained composite element 3 Designed membrane composite element 4 Designed bending composite element
ESER	R	Real part of element strain energy
ESEI	R	Imaginary part of element strain energy
Z1	R	Fiber distance 1
RSTRSX1	R	Real part of normal stress in x-direction at Z1
ISTRSX1	R	Imaginary part of normal stress in x-direction at Z1
RSTRSY1	R	Real part of stress in y-direction at Z1
ISTRSY1	R	Imaginary part of stress in y-direction at Z1
RSSXY1	R	Real part of shear stress at Z1
ISSXY1	R	Imaginary part of shear stress at Z1

NAME	TYPE	DESCRIPTION
ANGLES1	R	Principal angle for stress at Z1
STRS11	R	Major principal stress at Z1
STRS12	R	Minor principal stress at Z1
MAXSS1	R	Maximum shear stress at Z1
Z2	R	Fiber distance 2
RSTRSX2	R	Real part of stress in x-direction at Z2
ISTRSX2	R	Imaginary part of stress in x-direction at Z2
RSTRSY2	R	Real part of stress in y-direction at Z2
ISTRSY2	R	Imaginary part of stress in y-direction at Z2
RSSXY2	R	Real part of shear stress at Z2
ISSXY2	R	Imaginary part of shear stress at Z2
ANGLES2	R	Principal angle for stress at Z2
STRS21	R	Major principal stress at Z2
STRS22	R	Minor principal stress at Z2
MAXSS2	R	Maximum shear stress at Z2
RSTRNX1	R	Real part of strain in x-direction at Z1
ISTRNX1	R	Imaginary part of strain in x-direction at Z1
RSTRNY1	R	Real part of strain in y-direction at Z1
ISTRNY1	R	Imaginary part of strain in y-direction at Z1
RSNXY1	R	Real part of shear strain at Z1
ISNXY1	R	Imaginary part of shear strain at Z1
ANGLEN1	R	Principal axis angle at Z1
STRN11	R	Major principal strain at Z1
STRN12	R	Minor principal strain at Z1
MAXSN1	R	Maximum shear strain at Z1
RSTRNX2	R	Real part of strain in x-direction at Z2
ISTRNX2	R	Imaginary part of strain in x-direction at Z2
RSTRNY2	R	Real part of strain in y-direction at Z2
ISTRNY2	R	Imaginary part of strain in y-direction at Z2
RSNXY2	R	Real part of shear strain at Z2
ISNXY2	R	Imaginary part of shear strain at Z2
ANGELN2	R	Principal axis angle at Z2
STRN21	R	Major principal strain at Z2
STRN22	R	Minor principal strain at Z2
MAXSN2	R	Maximum shear strain at Z2
RMEMX	R	Real part of membrane force in x-direction
IMEMX	R	Imaginary part of membrane force in x-direction
RMEMY	R	Real part of membrane force in y-direction
IMEMY	R	Imaginary part of membrane force in y-direction
RMEMXY	R	Real part of membrane force in xy-plane
IMEMXY	R	Imaginary part of membrane force in xy-plane
RBENDX	R	Real part of bending moment in x-direction
IBENDX	R	Imaginary part of bending moment in x-direction
RBENDY	R	Real part of bending moment in y-direction
IBENDY	R	Imaginary part of bending moment in y-direction
RBENDXY	R	Real part of bending moment in xy-plane
IBENDXY	R	Imaginary part of bending moment in xy-plane
RSHEARX	R	Real part of shear force in x-direction
ISHEARX	R	Imaginary part of shear force in x-direction
RSHEARY	R	Real part of shear force in y-direction
ISHEARY	R	Imaginary part of shear force in y-direction

Created By: Module EDR

Notes:

1. This relation is used by module OFPEDR for printing and punching.

Entity: EOROD

Entity Type: Relation

Description: Contains the element response quantities for the ROD element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
OAFLAG	I>0	Optimize/analyze flag 1 Optimization 2 Analysis
NITER	I>0	Iteration number for optimization
BCID	I>0	Boundary condition identification number
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 5 Transient 7 Buckling
SUBCASE	I>0	Subcase identification number if (DISC = 1, 3, 5, 8) or Mode Number if (DISC = 2, 7)
CASEID	I	Case index number
EID	I>0	Element identification number
ETYPE	C(8)	Element type (“ROD”)
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
ESER	R	Real part of element strain energy
ESEI	R	Imaginary part of element strain energy
RAXSTRS	R	Real part of axial stress
IAXSTRS	R	Imaginary part of axial stress
RTORSTRS	R	Real part of torsional stress
ITORSTRS	R	Imaginary part of torsional stress
AMARSTRS	R	Axial stress margin of safety
TMARSTRS	R	Torsional stress margin of safety
RAXSTRN	R	Real part of axial strain
IAXSTRN	R	Imaginary part of axial strain
RTORSTRN	R	Real part of torsional strain
ITORSTRN	R	Imaginary part of torsional strain
RAXFOR	R	Real part of axial force
IAXFOR	R	Imaginary part of axial force
RTORQUE	R	Real part of torsional force
ITORQUE	R	Imaginary part of torsional force

Created By: Module EDR

Notes:

1. This relation is used by module OFPEDR for printing and punching.

Entity: EOSHEAR

Entity Type: Relation

Description: Contains the element response quantities for the SHEAR element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
OAFLAG	I>0	Optimize/analyze flag 1 Optimization 2 Analysis
NITER	I>0	Iteration number for optimization
BCID	I>0	Boundary condition identification number
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 5 Transient 7 Buckling
SUBCASE	I>0	Subcase identification number if (DISC = 1, 3, 5, 8) or Mode Number if (DISC = 2, 7)
CASEID	I	Case index number
EID	I>0	Element identification number
ETYPE	C(8)	Element type (“SHEAR”)
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
ESER	R	Real part of element strain energy
ESEI	R	Imaginary part of element strain energy
RMAXSTRS	R	Real part of maximum shear stress
IMAXSTRS	R	Imaginary part of maximum shear stress
RAVESTRS	R	Real part of average shear stress
IAVESTRS	R	Imaginary part of average shear stress
SMARSTRS	R	Stress safety margin
RMAXSTRN	R	Real part of maximum shear strain
IMAXSTRN	R	Imaginary part of maximum shear strain
RAVESTRN	R	Real part of average shear strain
IAVESTRN	R	Imaginary part of average shear strain
RF14	R	Real part of normal force on 1 from 4
IF14	R	Imaginary part of normal force on 1 from 4
RF12	R	Real part of normal force on 1 from 2
IF12	R	Imaginary part of normal force on 1 from 2
RF21	R	Real part of normal force on 2 from 1

NAME	TYPE	DESCRIPTION
IF21	R	Imaginary part of normal force on 2 from 1
RF23	R	Real part of normal force on 2 from 3
IF23	R	Imaginary part of normal force on 2 from 3
RF32	R	Real part of normal force on 3 from 2
IF32	R	Imaginary part of normal force on 3 from 2
RF34	R	Real part of normal force on 3 from 4
IF34	R	Imaginary part of normal force on 3 from 4
RF43	R	Real part of normal force on 4 from 3
IF43	R	Imaginary part of normal force on 4 from 3
RF41	R	Real part of normal force on 4 from 1
IF41	R	Imaginary part of normal force on 4 from 1
RK1	R	Real part of shear panel kick force at 1
IK1	R	Imaginary part of shear panel kick force at 1
RS12	R	Real part of shear force 1-2
IS12	R	Imaginary part of shear force 1-2
RK2	R	Real part of shear panel kick force at 2
IK2	R	Imaginary part of shear panel kick force at 2
RS23	R	Real part of shear force 2-3
IS23	R	Imaginary part of shear force 2-3
RK3	R	Real part of shear panel kick force at 3
IK3	R	Imaginary part of shear panel kick force at 3
RS34	R	Real part of shear force 3-4
IS34	R	Imaginary part of shear force 3-4
RK4	R	Real part of shear panel kick force at 4
IK4	R	Imaginary part of shear panel kick force at 4
RS41	R	Real part of shear force 4-1
IS41	R	Imaginary part of shear force 4-1

Created By: Module EDR

Notes:

1. This relation is used by module OFPEDR for output printing and punching.

Entity: EOSUMMRY

Entity Type: Relation

Description: Contains a summary of the element output requests.

Relation Attributes:

NAME	TYPE	DESCRIPTION
BCID	I>0	Boundary condition identification number
NITER	I≥–1	Iteration step for output (–1 for all)
EID	I>0	Element identification number
ETYPE	C(8)	Element type (example: “ROD”)
RECORD	I>0	Record number in EODISC unstructured entity containing related data

Created By: Module PFBULK

Notes:

1. For each BCID, the tuples are sorted by ETYPE and then EID.

Entity: EOTRIA3

Entity Type: Relation

Description: Contains the element response quantities for the TRIA3 element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
OAFLAG	I>0	Optimize/analyze flag 1 Optimization 2 Analysis
NITER	I>0	Iteration number for optimization
BCID	I>0	Boundary condition identification number
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 5 Transient 7 Buckling
SUBCASE	I>0	Subcase identification number if (DISC = 1, 3, 5, 8) or Mode Number if (DISC = 2, 7)
CASEID	I	Case index number
EID	I>0	Element identification number
ETYPE	C(8)	Element type (“TRIA3”)

NAME	TYPE	DESCRIPTION
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
CMPZIT	I≥0	Composite type flag 0 Noncomposite element 1 Nondesigned and nonconstrained composite element 2 Nondesigned and constrained composite element 3 Designed membrane composite element 4 Designed bending composite element
LAYRNUM	I>0	Layer number
ESER	R	Real part of element strain energy
ESEI	R	Imaginary part of element strain energy
Z1	R	Fiber distance 1
RSTRSX1	R	Real part of normal stress in x-direction at Z1
ISTRSX1	R	Imaginary part of normal stress in x-direction at Z1
RSTRSY1	R	Real part of stress in y-direction at Z1
ISTRSY1	R	Imaginary part of stress in y-direction at Z1
RSSXY1	R	Real part of shear stress at Z1
ISSXY1	R	Imaginary part of shear stress at Z1
ANGLES1	R	Principal angle for stress at Z1
STRS11	R	Major principal stress at Z1
STRS12	R	Minor principal stress at Z1
MAXSS1	R	Maximum shear stress at Z1
Z2	R	Fiber distance 2
RSTRSX2	R	Real part of stress in x-direction at Z2
ISTRSX2	R	Imaginary part of stress in x-direction at Z2
RSTRSY2	R	Real part of stress in y-direction at Z2
ISTRSY2	R	Imaginary part of stress in y-direction at Z2
RSSXY2	R	Real part of shear stress at Z2
ISSXY2	R	Imaginary part of shear stress at Z2
ANGLES2	R	Principal angle for stress at Z2
STRS21	R	Major principal stress at Z2
STRS22	R	Minor principal stress at Z2
MAXSS2	R	Maximum shear stress at Z2
RSTRNX1	R	Real part of strain in x-direction at Z1
ISTRNX1	R	Imaginary part of strain in x-direction at Z1
RSTRNY1	R	Real part of strain in y-direction at Z1
ISTRNY1	R	Imaginary part of strain in y-direction at Z1

NAME	TYPE	DESCRIPTION
RSNXY1	R	Real part of shear strain at Z1
ISNXY1	R	Imaginaryl part of shear strain at Z1
ANGLEN1	R	Principal axis angle at Z1
STRN11	R	Major principal strain at Z1
STRN12	R	Minor principal strain at Z1
MAXNS1	R	Maximum shear strain at Z1
RSTRNX2	R	Real part of strain in x-direction at Z2
ISTRNX2	R	Imaginary part of strain in x-direction at Z2
RSTRNY2	R	Real part of strain in y-direction at Z2
ISTRNY2	R	Imaginary part of strain in y-direction at Z2
RSNXY2	R	Real part of shear strain at Z2
ISNXY2	R	Imaginary part of shear strain at Z2
ANGELN2	R	Principal axis angle at Z2
STRN21	R	Major principal strain at Z2
STRN22	R	Minor principal strain at Z2
MAXSN2	R	Maximum shear strain at Z2
RMEMX	R	Real part of membrane force in x-direction
IMEMX	R	Imaginary part of membrane force in x-direction
RMEMY	R	Real part of membrane force in y-direction
IMEMY	R	Imaginary part of membrane force in y-direction
RMEMXY	R	Real part of membrane force in xy-plane
IMEMXY	R	Imaginary part of membrane force in xy-plane
RBENDX	R	Real part of bending moment in x-direction
IBENDX	R	Imaginary part of bending moment in x-direction
RBENDY	R	Real part of bending moment in y-direction
IBENDY	R	Imaginary part of bending moment in y-direction
RBENDXY	R	Real part of bending moment in xy-plane
IBENDXY	R	Imaginary part of bending moment in xy-plane
RSHEARX	R	Real part of shear force in x-direction
ISHEARX	R	Imaginary part of shear force in x-direction
RSHEARY	R	Real part of shear force in y-direction

NAME	TYPE	DESCRIPTION
ISHEARY	R	Imaginary part of shear force in y-direction

Created By: Module EDR

Notes:

1. This relation is used by module OFPEDR for output printing and punching.

Entity: EOTRMEM

Entity Type: Relation

Description: Contains the element response quantities for the TRMEM element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
OAFLAG	I>0	Optimize/analyze flag 1 Optimization 2 Analysis
NITER	I>0	Iteration number for optimization
BCID	I>0	Boundary condition identification number
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 5 Transient 7 Buckling
SUBCASE	I>0	Subcase identification number if (DISC = 1, 3, 5, 8) or Mode Number if (DISC = 2, 7)
CASEID	I	Case index number
EID	I>0	Element identification number
ETYPE	String	Element type (“TRMEM”)
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
LAYRNUM	I>0	Layer number
ESER	R	Real part of element strain energy
ESEI	R	Imaginary part of element strain energy
RSTRSX	R	Real part of normal stress in x-direction
ISTRSX	R	Imaginary part of normal stress in x-direction
RSTRSY	R	Real part of normal stress in y-direction
ISTRSY	R	Imaginary part of normal stress in y-direction
RSTRSS	R	Real part of shear stress
ISTRSS	R	Imaginary part of shear stress
THSTRS	R	Principal angle for stress
STRS1	R	Major principal stress
STRS2	R	Minor principal stress
MSSTRS	R	Maximum shear stress
RSTRNX	R	Real part of normal strain in x-direction
ISTRNX	R	Imaginary part of normal strain in x-direction
RSTRNY	R	Real part of normal strain in y-direction
ISTRNY	R	Imaginary part of normal strain in y-direction
RSTRNS	R	Real part of shear strain
ISTRNS	R	Imaginary part of shear strain
THSTRN	R	Principal angle for strain
STRN1	R	Major principal strain
STRN2	R	Minor principal atrain
MSSTRN	R	Maximum shear strain
RFX	R	Real part of force in x-direction
IFX	R	Imaginary part of force in x-direction
RFY	R	Real part of force in y-direction
IFY	R	Imaginary part of force in y-direction
RFXY	R	Real part of shear force in xy-plane
IFXY	R	Imaginary part of shear force in xy-plane

Created By: Module EDR

Notes:

1. This relation is used by module OFPEDR for output printing and punching.

Entity: EPOINT

Entity Type: Relation

Description: Contains the identification numbers of those points to be used as extra points.Input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Extra point set identification number
EXTID	I>0	Extra point identification number

Created By: Module IFP

Entity: ESAVE

Entity Type: Relation

Description: Contains a list of database entities whose contents are to be saved rather then purged through the UTPURG utility.

Relation Attributes:

NAME	TYPE	DESCRIPTION
ENTNAM	C(8)	The name of a database entity.

Created By: Module IFP

Notes:

1. An entity named in this relation will not have its contents purged by the UTPURG utility.

Entity: FARGLIST

Entity Type: Relation

Description: Contains the user function argument list information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
FINDX	I>0	User function index number
ARGREF	I	Argument reference
IDENT	C(8)	Internal user function name

Created By: Module FPKEVL

Entity: FCHAIN

Entity Type: Relation

Description: Contains the user function chain evaluation data generated from a lexical prepass.

Relation Attributes:

NAME	TYPE	DESCRIPTION
FINDX	I>0	User function index number
IDENT	C(8)	Internal user function name
NUMTOK	I	Number of tokens
TOKREF	I	Token reference in FTOKLIST and FDERLIST
NUMARG	I	Number of arguments
ARGREF	I	Argument reference in FARGLIST

Created By: Module FPKEVL

Entity: FDERLIST

Entity Type: Relation

Description: Contains the user function packet token list for function gradient evaluation.

Relation Attributes:

NAME	TYPE	DESCRIPTION
FINDX	I>0	User function index number
TOKREF	I	Token reference
BAKREF	I	Back token reference
TOKEN	C(8)	Token
INSCOD	C(8)	Instruction code
OPCODE	I	Operator code
OPCOMP	I	Operator component
INTVAL	I	Integer value
RSPVAL	R	Real value

Created By: Module FPKEVL

Entity: FDAMPDVA

Entity Type: Relation

Description: Contains the user function requested flutter damping response sensitivity information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
MXCOL	I>0	Matrix column number in **[MXFDPDVA]** for the sensitivity values

Created By: Module FLUTSENS

Entity: FDAMPRSP

Entity Type: Relation

Description: Contains the user function requested flutter damping response values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module FLUTTRAN

Entity: FFREQDVA

Entity Type: Relation

Description: Contains the user function requested flutter frequency response sensitivity information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
MXCOL	I>0	Matrix column number in **[MXFFQDVA]** for the sensitivity values

Created By: Module FLUTSENS

Entity: FFREQRSP

Entity Type: Relation

Description: Contains the user function requested flutter frequency response values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module FLUTTRAN

Entity: FLCFDRVA

Entity Type: Relation

Description: Contains the user function requested steady aeroelastic flexible stability coefficient response sensitivity information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
MXCOL	I>0	Matrix column number in **[MXFCFDVA]** for the sensitivity values

Created By: Module AEROEEFS

Entity: FLCFRESP

Entity Type: Relation

Description: Contains the user function requested steady aeroelastic flexible stability coefficient response values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module SAERO

Entity: FFT

Entity Type: Relation

Description: Contains the parameters required for controlling the Fast Fourier Transformation as input from the Bulk Data file

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	KI>0	FFT set identification number
TIME	R>0	Length of time period
NT	I≥2	Number of time points
RDELTF	R	Ratio of frequency range increment to 1/TIME
RF	R	Ratio of frequency range to NT/2*TIME
FRIM	C(8)	Frequency interpolation method
OTYPE	C(8)	Types of response output
FLIM	C(8)	Frequency load interpolation method

Created By: Module IFP

Entity: FLFACT

Entity Type: Relation

Description: Contains flutter aerodynamic input data as defined on the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
VALUE	R	Data value

Created By: Module IFP

Notes:

1. This relation contains one tuple for each value in each set defined on the FLFACT entry.

Entity: FLUTMODE

Entity Type: Matrix

Description: A matrix used to store the complex modal participation factors for any flutter eigenvectors computed during flutter analyses in analysis boundary conditions.

Matrix Form: A complex rectangular matrix with one row for each normal mode (including those omitted from the flutter analysis) and one column for each flutter eigenvector found in the current boundary condition.

Created By: FLUTTRAN

Notes:

1. The FLUTREL entity contains additional data to identify the flutter condition for each mode.
2. This entity is flushed between each analysis boundary condition having flutter analyses.
3. This entity is not used in the optimization boundary conditions.

Entity: FLUTREL

Entity Type: Relation

Description: Contains the flutter results for each flutter eigenvector / eigenvalue found during flutter analyses.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SUBID	I>0	Flutter subcase identification number
COLUMN	I>0	Column number in FLUTMODE for corresponding participation factors
MACH	R	Flutter Mach number
RHORATIO	R>0	Flutter density ratio
RFRQ	R>0	Flutter reduced frequency
VEL	R	Flutter velocity
RHOREF	R>0	Reference density
REFCHORD	R>0	Reference chord length

Created By: Module FLUTTRAN

Notes:

1. This entity is used to print the flutter mode shapes in physical coordinates.

Entity: FLUTTER

Entity Type: Relation

Description: Contains the definition of data needed to perform flutter analyses as input from the bulk data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
METHOD	C(4)	Flutter analysis method = K, PK or KE
DENS	I>0	Identification of FLFACT tuples defining density ratios
MACHVAL	R>0.0	Mach number to be used in the Flutter analyses
VEL	I>0	Identification of FLFACT tuples specifying velocities
MLIST	I	Identification number of SET1 entries listing the normal modes to be omitted in the flutter analysis
KLIST	I	Identification of FLFACT tuples specifying a list of "hard point" reduced frequencies for the given Mach number for use in the Flutter analysis
EFFID	I	Identification of a CONEFFF set specifying control surface effectiveness values
SYMXZ	I	Symmetry flag for xz-plane
SYMXY	I	Symmetry flag for xy-plane
EPS	R	Convergence parameter for flutter eigenvalue
CURVFIT	C(8)	Type of curve fit to be used in the PK flutter analysis

Created By: Module IFP

Entity: FNARO

Entity Type: Relation

Description: Contains the user function instances requesting steady aeroelastic response information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DCREF	I>0	User function set identification number
INSTANCE	I>0	User function instance number
POSITION	I(2)	Response position index in the user function
CLASS	C(16)	User function class , either OBJECTIVE or CONSTRAINT)
BCND	I>0	Boundary condition identification number
CASEID	I>0	Subcase identification number
TYPE	C(8)	Response type selected from FLEXCF, RIGIDCF, or TRIM
AXIS	C(8)	Rigid body axis of coefficient
PARAM	C(8)	Trim parameter

Created By: Module FPKEVL

Notes:

1. The allowable values for AXIS are:
   DRAG, SIDE, LIFT, ROLL, PITCH, YAW.
2. The allowable values for PARAM are:
   ALPHA, BETA, PRATE, QRATE, RRATE, PACCEL, QACCEL, RACCEL,
   and user defined surfaces.

Entity: FNCEN

Entity Type: Relation

Description: Contains the user function instances requesting element centroidal coordinates information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DCREF	I>0	User function set identification number
INSTANCE	I>0	User function instance number
POSITION	I(2)	Response position index in the user function
CLASS	C(16)	User function class, either OBJECTIVE or CONSTRAINT)
EID	I>0	Element identification number
TYPE	C(8)	Element type
COMP	C(4)	Coordinate component selected from X1, X2, or X3
CID	I	Coordinate system identification number

Created By: Module FPKEVL

Entity: FNCOR

Entity Type: Relation

Description: Contains the user function instances requesting grid point coordinates information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DCREF	I>0	User function set identification number
INSTANCE	I>0	User function instance number
POSITION	I(2)	Response position index in the user function
CLASS	C(16)	User function class, either OBJECTIVE or CONSTRAINT
GID	I>0	Grid point identification number
CID	I	Coordinate system identification number
COMP	C(4)	Coordinate component selected from X1, X2, or X3)

Created By: Module FPKEVL

Entity: FNDNV

Entity Type: Relation

Description: Contains the user function instances requesting global design variable information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DCREF	I>0	User function set identification number
INSTANCE	I>0	User function instance number
POSITION	I(2)	Response position index in the user function
CLASS	C(16)	User function class, either OBJECTIVE or CONSTRAINT)
DV	I>0	Design variable identification number

Created By: Module FPKEVL

Entity: FNELM

Entity Type: Relation

Description: Contains the user function instances requesting element stress and strain response information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DCREF	I>0	User function set identification number
INSTANCE	I>0	User function instance number
POSITION	I(2)	Response position index in the user function
CLASS	C(16)	User function class either OBJECTIVE or CONSTRAINT)
BCND	I>0	Boundary condition identification number
DTYPE	C(8)	Discipline type, either STATICS or SAERO
CASEID	I>0	Subcase identification number
MODEID	I>0	Mode number
EID	I>0	Element identification number
TYPE	C(8)	Element type
PLYID	I≥0	Composite element layer number
QUANTY	C(8)	Response type, either STRESS or STRAIN
COMP	C(8)	Stress/strain component

Created By: Module FPKEVL

Notes:

1. The allowable stress components are:

ROD	SIGAXL, SIGTOR, SIG1, SIG2, MAXSHEAR
BAR	SIGAXL, SIGCA, SIGDA, SIGEA, SIGFA, SIGCB, SIGDB, SIGEB, SIGFB
SHEAR	MAXSHEAR
QDMEM1 TRMEM	SIGX, SIGY, TAUXY, SIG1, SIG2, MAXSHEAR, FIBER, TRANSV
QUAD4 TRIA3	SIGX, SIGY, TAUXY, SIG1, SIG2, MAXSHEAR, FIBER, TRANSV,TSIGX, TSIGY, TTAUXY, TSIG1, TSIG2, TMAXSHEAR, TFIBER, TTRANSV, BSIGX, BSIGY, BTAUXY, BSIG1, BSIG2, BMAXSHEAR, BFIBER, BTRANSV

2. The allowable strain components are:

ROD	EPSAXL, EPSTOR, EPS1, EPS2, MAXSHEAR
BAR	EPSAXL, EPSCA, EPSDA, EPSEA, EPSFA, EPSCB, EPSDB, EPSEB, EPSFB
SHEAR	MAXSHEAR
QDMEM1 TRMEM	EPSX, EPSY, TAUXY, EPS1, EPS2, MAXSHEAR, FIBER, TRANSV
QUAD4 TRIA3	EPSX, EPSY, TAUXY, EPS1, EPS2, MAXSHEAR, FIBER, TRANSV,TEPSX, TEPSY, TTAUXY, TEPS1, TEPS2, TMAXSHEAR, TFIBER, TTRANSV, BEPSX, BEPSY, BTAUXY, BEPS1, BEPS2, BMAXSHEAR, BFIBER, BTRANSV

Entity: FNFLT

Entity Type: Relation

Description: Contains the user function instances requesting flutter analysis response information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DCREF	I>0	User function set identification number
INSTANCE	I>0	User function instance number
POSITION	I(2)	Response position index in the user function
CLASS	C(16)	User function class, either OBJECTIVE or CONSTRAINT
BCND	I>0	Boundary condition identification number
CASEID	I>0	Subcase identification number
MODEID	I>0	Mode number
MACH	R>0.0	Mach value
DENSITY	R>0.0	Density value
VELOCITY	R>0.0	Velocity value
QUANTY	C(8)	Response type selected from FROOT, FDAMP, or FREQ
COMP	C(8)	Damping component

Created By: Module FPKEVL

Entity: FNFRQ

Entity Type: Relation

Description: Contains the user function instances requesting normal mode frequency response information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DCREF	I>0	User function set identification number
INSTANCE	I>0	User function instance number
POSITION	I(2)	Response position index in the user function
CLASS	C(16)	User function class, either OBJECTIVE or CONSTRAINT
BCND	I>0	Boundary condition identification number
CASEID	I>0	Subcase identification number
MODEID	I>0	Mode number

Created By: Module FPKEVL

Entity: FNGRD

Entity Type: Relation

Description: Contains the user function instances requesting grid point displacement response information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DCREF	I>0	User function set identification number
INSTANCE	I>0	User function instance number
POSITION	I(2)	Response position index in the user function
CLASS	C(16)	User function class, either OBJECTIVE or CONSTRAINT
BCND	I>0	Boundary condition identification number
DTYPE	C(8)	Discipline type, either STATICS or SAERO
CASEID	I>0	Subcase identification number
MODEID	I>0	Mode number
GID	I>0	Grid point identification number
CID	I	Coordinate system identification number
QUANTY	C(8)	Response type, DISP)
COMP	C(4)	Coordinate component selected from T1, T2, T3, R1, R2, or R3

Created By: Module FPKEVL

Entity: FNMAS

Entity Type: Relation

Description: Contains the user function instances requesting element mass information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DCREF	I>0	User function set identification number
INSTANCE	I>0	User function instance number
POSITION	I(2)	Response position index in the user function
CLASS	C(16)	User function class, either OBJECTIVE or CONSTRAINT
EID	I>0	Element identification number
TYPE	C(8)	Element type
PLYID	I≥0	Composite element layer number

Created By: Module FPKEVL

Entity: FNTHK

Entity Type: Relation

Description: Contains the user function instances requesting element thickness information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DCREF	I>0	User function set identification number
INSTANCE	I>0	User function instance number
POSITION	I(2)	Response position index in the user function
CLASS	C(16)	User function class, either OBJECTIVE or CONSTRAINT
EID	I>0	Element identification number
TYPE	C(8)	Element type
PLYID	I≥0	Composite element layer number

Created By: Module FPKEVL

Entity: FNWGH

Entity Type: Relation

Description: Contains the user function instances requesting element weight information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DCREF	I>0	User function set identification number
INSTANCE	I>0	User function instance number
POSITION	I(2)	Response position index in the user function
CLASS	C(16)	User function class, either OBJECTIVE or CONSTRAINT
EID	I>0	Element identification number
TYPE	C(8)	Element type
PLYID	I≥0	Composite element layer number

Created By: Module FPKEVL

Entity: FORCE

Entity Type: Relation

Description: Contains the definition of a static load at a grid point as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
GRID1	I>0	Grid point at which the load is applied
CID1	I≥0	Coordinate system identification
SCALE	R	Scale factor
N1, N2, N3	R	Components of the force vector

Created By: Module IFP

Entity: FORCE1

Entity Type: Relation

Description: Contains the definition of a load applied at a grid point with the direction determined by a line connecting two grid points.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
GRID1	I>0	Grid point id at which the force is applied
SCALE	R	Scale factor
GRID2, GRID3	I>0	Grid point identification numbers

Created By: Module IFP

Entity: FREQ

Entity Type: Relation

Description: Contains frequency values to be used for solution in frequency response.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I>0	Set identification number
FREQ	R	Frequency value

Created By: Module IFP

Notes:

1. The relation is used in subroutine PREFRQ in the generation of the FREQL entity.
2. The unit for FREQ is Hertz.
3. The set is selected in Solution Control.

Entity: FREQ1

Entity Type: Relation

Description: Contains information to specify frequencies used in frequency response solution as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I>0	Set identification number
F1	R≥0.0	First frequency in a set
DFRQ	R>0.0	Frequency increment
NDFR	I	Number of increments

Created By: Module IFP

Notes:

1. The relation is used in subroutine PREFRQ in the generation of the FREQL entity.
2. Units for F1 and DFREQ, when input, are Hertz.
3. The set is selected in Solution Control.

Entity: FREQ2

Entity Type: Relation

Description: Contains information to specify frequencies used in frequency response solution as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I>0	Set identification number
F1	R>0.0	First frequency value
F2	R>0.0 F2>F1	Last frequency value
NLOGI	I>0	Number of increments

Created By: Module IFP

Notes:

1. The relation is used in subroutine PREFRQ in the generation of the FREQL entity.
2. Units for F1 and F2, when input, are Hertz.
3. The set is selected in Solution Control.

Entity: FREQL

Entity Type: Unstructured

Description: Contains a list of frequencies for each frequency set.

Record:

1. Contains a list of the LIDs of the frequency sets in the Bulk Data file.

i. Contains the frequency list for the $(i-1)^{th}$ set ID.

Created By: Module PFBULK

Notes:

1. This entity is used in the generation of frequency dependent loads in the DMA module.

Entity: FREQLIST

Entity Type: Relation

Description: Contains the list of frequencies for which outputs are requested as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I	Set identification number
FREQ	R	Frequency value in Hertz.

Created By: Mobile IFP

Entity: FREQDRVA

Entity Type: Relation

Description: Contains the user function requested normal mode response sensitivity information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
MXCOL	I>0	Matrix column number in [MXFRQDVA] for the sensitivity values

Created By: Module FREQSENS

Entity: FREQRESP

Entity Type: Relation

Description: Contains the user function requested normal mode response values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module FCEVAL

Entity: FROOTDVA

Entity Type: Relation

Description: Contains the user function requested flutter root response sensitivity information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
MXCOL	I>0	Matrix column number in [MXFRTDVA] for the sensitivity values

Created By: Module FLUTSENS

Entity: FROOTRSP

Entity Type: Relation

Description: Contains the user function requested flutter root response values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
RVALUE	R	Real part of the response value
IVALUE	R	Imaginary part of the response value

Created By: Module FLUTTRAN

Entity: FTOKLIST

Entity Type: Relation

Description: Contains the user function packet token list for function evaluation.

Relation Attributes:

NAME	TYPE	DESCRIPTION
FINDX	I>0	User function index number
TOKREF	I	Token reference
TOKEN	C(8)	Token
INSCOD	C(8)	Instruction code
OPCODE	I	Operator code
OPCOMP	I	Operator component
INTVAL	I	Integer value
RSPVAL	R	Real value

Created By: Module FPKEVL

Entity: GASUBO

Entity Type: Subscripted Matrix

Description: Contains the matrix product:

$$-[KAOO]^{-1}[KAOA]$$

used in the static reduction of the free degrees of freedom.This matrix includes the aeroelastic terms.

Matrix Form: A variable-sized matrix having one row for each omitted degree of freedom and one column for each degree of freedom in the analysis set for the current boundary condition.

Created By: MAPOL

Notes:

1. The dimension of this subscripted matrix must be large enough for all optimization and analysis boundary conditions.

Entity: GDVLIST

Entity Type: Relation

Description: Contains the definition of the list of global design variables as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I	Set identification number
DVID	I	Global design variable identification

Created By: Module IFP

Entity: GDVDRVA

Entity Type: Relation

Description: Contains the user function requested global design variable sensitivity information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
MXCOL	I>0	Matrix column number in [MXGDVDVA] for the sensitivity values

Created By: Module GRVGRAD

Entity: GDVRESP

Entity Type: Relation

Description: Contains the user function requested global design variable values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module GDVRESP

Entity: GENEL

Entity Type: Unstructured

Description: Contains GENEL data as input from the Bulk Data file

Entity Structure: One record for each GENEL entry.Each record has the following structure:

WORD	NAME	DESCRIPTION
1	EID	Element identification number
2	NGI	Number of GIDI/COMPI pairs
3	NGD	Number of GIDD/COMPD pairs
4	NKZ	Number of NK or Z terms
5	C(1)	Matrix type, K or Z
6	NS	
7 to 6+2 NGI	GIDI COMPI	List of u_l grid/components.The NGI pairs are the GIDI/COMPI values (2 NGI words)
7+2 to 6+2 NGI +2 NGD	GIDD COMPD	List of u_d grid/components.The NGD pairs are the GIDD/COMPD values (2 NGD words)
7+2 NGI +2 NGD to 6+2 NGI +2 NGD + NKZ	C(1)	List of the NKZ terms of the "K" or "Z" matrix
7+2 NGI +2 NGD + NKZ to END	S	List of the NS terms of the S matrix

Any of NGI, NGD, NKZ or NS can be zero with the resultant list being absent from the record.The order of terms will be maintained as per the input entry.

Created By: Module IFP

Entity: GEOMSA

Entity Type: Relation

Description: Contains data on the geometric location of the aerodynamic degrees of freedom for the planar and nonplanar steady aerodynamics models.

Relation Attributes:

NAME	TYPE	DESCRIPTION
MODEL	I	Planar or nonplanar steady aerodynamics model identifier 1 for planar model –2 for nonplanar model
MACROID	I	Component identification number
ACMPNT	C(8)	Component type selected from WING, FIN, CANARD, POD, or FUSEL
NDOF	I	Number of degrees of freedom at the point. Value is 1 for all steady aerodynamic boxes, refer to GEOMUA for unsteady model options.
EXTID	I	External box identification number
INTID	I	Internal box identification number.This is the row and/or column number in the AICMAT
AREA	R	The area of the box.
X	R	The x location of the box centroid in basic coordinates.
Y	R	The y location of the box centroid in basic coordinates.
Z	R	The z location of the box centroid in basic coordinates.
N1	R	The x component of the box normal in basic coordinates.
N2	R	The y component of the box normal in basic coordinates.
N3	R	The z component of the box normal in basic coordinates.
R1	R	The x component of the box rotation axis in basic coordinates.
R2	R	The y component of the box rotation axis in basic coordinates.
R3	R	The z component of the box rotation axis in basic coordinates.

Created By: Module STEADY and STEADYNP

Notes:

1. These data are used in splining the aerodynamic forces to the structural model, in splining structural deflections to the aerodynamic model and in recovering trimmed pressures and displacements on the aerodynamic model.

Entity: GEOMUA

Entity Type: Relation

Description: Contains data on the geometric location of the aerodynamic degrees of freedom for the unsteady aerodynamics models.Two entries are loaded for ZY boxes to account for the two normals during splining.

Relation Attributes:

NAME	TYPE	DESCRIPTION
MACROID	I	Component identification number
ACMPNT	C(8)	Component type selected from WING, FIN, CANARD, POD, or FUSEL
NDOF	I	Number of degrees of freedom at the point. 1 for all lifting surface boxes CAERO1 2 for all body surface boxes CAERO2
EXTID	I	External box identification number
INTID	I	Internal box identification number.
AREA	R	The area of the box.
X	R	The x location of the box centroid in basic coordinates.
Y	R	The y location of the box centroid in basic coordinates.
Z	R	The z location of the box centroid in basic coordinates.
N1	R	The x component of the box normal in basic coordinates.
N2	R	The y component of the box normal in basic coordinates.
N3	R	The z component of the box normal in basic coordinates.
R1	R	The x component of the box rotation axis in basic coordinates.
R2	R	The y component of the box rotation axis in basic coordinates.
R3	R	The z component of the box rotation axis in basic coordinates.

Created By: Module UNSTEADY

Entity: GGO

Entity Type: Matrix

Description: Rigid body transformation matrix to transfer displacements at the origin of the basic coordinate system to g-set displacements.

Matrix Form: Real rectangular matrix with g-set rows and up to six columns.

Created By: Module GDR1

Entity: GLBDES

Entity Type: Relation

Description: Contains current design variable information for all design variables in the problem.

Relation Attributes:

NAME	TYPE	DESCRIPTION
NITER	I	Iteration number
DVID	KI>0	Design variable identification number
OPTION	I 1,2,3	Design variable linking option
LINKID	I	Link set identification
EID	I>0	Element id if design variable uniquely linked to one element
ETYPE	C(8)	Element type if unique linking
LAYRNUM	I	Layer number if unique or physical linking
LAYRLST	I	PLYLIST identifier if multiple plies are linked together
DVSYMBL	C(8)	Designed dimension symbol selected fro D1 through D10 for BAR element cross section dimension; A for element area; T for element thickness; M for element mass; K for element stiffness.
VMIN	R	Minimum value for design variable
VMAX	R	Maximum value for design variable
VMINCRNT	R	Current minimum value for design variable
VMAXCRNT	R	Current maximum value for design variable
VALUE	R	Current value of design variable
LABEL	C(8)	User identification label
ACTVFLAG	I	Active flag for design variable

Created By: Module MAKEST

Notes:

1. The linking options are:

OPTION	TYPE
1	DESELM linking
2	DESVARP linking
3	DESVARS linking

2. Design variable offset is stored in INFO(11) from MAKEST.The value is transferred to DVCT in the EMG module and DVCTD, DDVCT in the NLEMG module.The offset is used to generate pseudo design variables to control the bending behavior of designed CBAR elements.

Entity: GLBSIG

Entity Type: Matrix

Description: Contains the stress and strain components in the element coordinate system for linearly designed elements constrained through stress/strain constraint bulk data entries.

Matrix Form: A variable-size matrix having one row for each stress/strain component for each element subject to a linear strength constraint and one column for each load condition within each boundary condition.The order of the matrix rows is in element id order of linearly constrained elements within each element type.The element types are currently processed in the following order:

(1) BAR; σa1, σa2, σa3, σa4, σb1, σb2, σb3, σb4
(2) QDMEM1; σx, σy, τxy
(3) QUAD4; σx, σy, τxy
(4) ROD; σx, τxy
(5) SHEAR; τxy
(6) TRIA3; σx, σy, τxy
(7) TRMEM; σx, σy, τxy

The columns are processed in load condition order for each boundary condition.

Created By: Module SCEVAL

Notes:

1. If no linearly designed elements are constrained, this matrix will be empty.
2. Refer to the SMAT documentation for further details as GLBSIG is essentially:
   $[SMAT]^t [u_g]$
3. Each boundary condition's load conditions are appended onto the existing GLBSIG columns within the SCEVAL module.

Entity: GMKCT

Entity Type: Relation

Description: Contains data required to interpret the DKVI unstructured entity.The relation is sorted by DVID and KSIL.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I≥0	Design variable identification
KSIL	I>0	Internal id of grid or scalar point connected to the design variable
KCODE	I>0	Codeword denoting the form in which the DKVI data are stored
NODES	0<I≤ 20	Number of nodes being processed with this KSIL
IREC	I>0	Record number of DKVI entity where data are stored
ASIL	I(20)	List of associated SILS
ALPHA	R	Exponential power associated with BAR element design variable

Created By: Module NLEMA1

Notes:

1. The KCODE definitions are:

1	Multiple associated grids with both extensional and rotational degrees of freedom.
2	Column being assembled is a scalar point.Associated SILS may or may not be scalar points.
3	Column being assembled is a grid point.At least one row is a scalar point.
4	Only extensional degrees of freedom are included in the assembly process

2. The INFO array for this entity contains additional memory management allocation data:

INFO(11)	The number of tuples connected to the zeroth design variable.
INFO(12)	The maximum number of tuples connected to any one of the remaining design variables.

Entity: GMKCT0

Entity Type: Relation

Description: Contains data required to interpret the DKVI0 unstructured entity.The relation is sorted by DVID and KSIL.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I>0	Design variable identification
KSIL	I>0	Internal id of grid or scalar point connected to the design variable
KCODE	I>0	Codeword denoting the form in which the DKVI0 data are stored
NODES	0<I≤ 20	Number of nodes being processed with this KSIL
IREC	I>0	Record number of DKVI0 entity where data are stored
ASIL	I(20)	List of associated SILS
ALPHA	R	Exponential power associated with BAR element design variable

Created By: Module EMA1

Notes:

1. The KCODE definitions are:

1	Multiple associated grids with both extensional and rotational degrees of freedom.
2	Column being assembled is a scalar point.Associated SILS may or may not be scalar points.
3	Column being assembled is a grid point.At least one row is a scalar point.
4	Only extensional degrees of freedom are included in the assembly process

2. The INFO array for this entity contains additional memory management allocation data:

INFO(11)	The number of tuples connected to the zeroth design variable.
INFO(12)	The maximum number of tuples connected to any one of the remaining design variables.

Entity: GMKCTG

Entity Type: Relation

Description: Contains data required to interpret the DKVIG unstructured entity.The relation is sorted by DVID and KSIL.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I>0	Design variable identification
KSIL	I>0	Internal id of grid or scalar point connected to the design variable
KCODE	I>0	Codeword denoting the form in which the DKVIG data are stored
NODES	0<I≤ 20	Number of nodes being processed with this KSIL
IREC	I>0	Record number of DKVIG entity where data are stored
ASIL	I(20)	List of associated SILS
ALPHA	R	Exponential power associated with BAR element design variable

Created By: Module NLEMA1

Notes:

1. KCODE definitions:

1	Multiple associated grids with both extensional and rotational degrees of freedom.
2	Column being assembled is a scalar point.Associated SILS may or may not be scalar points.
3	Column being assembled is a grid point.At least one row is a scalar point.
4	Only extensional degrees of freedom are included in the assembly process

2. The INFO array for this entity contains additional memory management allocation data:

INFO(11)	The number of tuples connected to the zeroth design variable.
INFO(12)	The maximum number of tuples connected to any one of the remaining design variables.

Entity: GMMCT

Entity Type: Relation

Description: Contains data required to interpret the DMVI unstructured entity.The relation is sorted by DVID and KSIL.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I>0	Design variable identification
KSIL	I>0	Internal id of grid or scalar point connected to the design variable
MCODE	I>0	Codeword denoting the form in which the DMVI data are stored
NODES	0<I≤ 20	Number of nodes being processed with this KSIL
IREC	I>0	Record number of DMVI entity where data are stored
ASIL	I(20)	List of associated SILS
ALPHA	R	Exponential power associated with BAR element design variable

Created By: Module NLEMA1

Notes:

1. MCODE definitions:

1	Multiple associated grids with both extensional and rotational degrees of freedom.
2	Column being assembled is a scalar point.Associated SILS may or may not be scalar points.
3	Column being assembled is a grid point.At least one row is a scalar point.
4	Only extensional degrees of freedom are included in the assembly process

2. The INFO array for this entity contains additional memory management allocation data:

INFO(11)	The number of tuples connected to the zeroth design variable.
INFO(12)	The maximum number of tuples connected to any one of the remaining design variables.

Entity: GMMCT0

Entity Type: Relation

Description: Contains data required to interpret the DMVI0 unstructured entity.The relation is sorted by DVID and KSIL.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I>0	Design variable identification
KSIL	I>0	Internal id of grid or scalar point connected to the design variable
MCODE	I>0	Codeword denoting the form in which the DMVI0 data are stored
NODES	0<I≤ 20	Number of nodes being processed with this KSIL
IREC	I>0	Record number of DMVI0 entity where data are stored
ASIL	I(20)	List of associated SILS
ALPHA	R	Exponential power associated with BAR element design variable

Created By: Module EMA1

Notes:

1. MCODE definitions:

1	Multiple associated grids with both extensional and rotational degrees of freedom.
2	Column being assembled is a scalar point.Associated SILS may or may not be scalar points.
3	Column being assembled is a grid point.At least one row is a scalar point.
4	Only extensional degrees of freedom are included in the assembly process

2. The INFO array for this entity contains additional memory management allocation data:

INFO(11)	The number of tuples connected to the zeroth design variable.
INFO(12)	The maximum number of tuples connected to any one of the remaining design variables.

Entity: GMMCTD

Entity Type: Relation

Description: Contains data required to interpret the DMVID unstructured entity.The relation is sorted by DVID and KSIL.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I>0	Design variable identification
KSIL	I>0	Internal id of grid or scalar point connected to the design variable
MCODE	I>0	Codeword denoting the form in which the DMVID data are stored
NODES	0<I≤ 20	Number of nodes being processed with this KSIL
IREC	I>0	Record number of DMVID entity where data are stored
ASIL	I(20)	List of associated SILS
ALPHA	R	Exponential power associated with BAR element design variable

Created By: Module NLEMA1

Notes:

1. MCODE definitions:

1	Multiple associated grids with both extensional and rotational degrees of freedom.
2	Column being assembled is a scalar point.Associated SILS may or may not be scalar points.
3	Column being assembled is a grid point.At least one row is a scalar point.
4	Only extensional degrees of freedom are included in the assembly process

2. The INFO array for this entity contains additional memory management allocation data:

INFO(11)	The number of tuples connected to the zeroth design variable.
INFO(12)	The maximum number of tuples connected to any one of the remaining design variables.

Entity: GMMCTG

Entity Type: Relation

Description: Contains data required to interpret the DMVIG unstructured entity.The relation is sorted by DVID and KSIL.

Relation Attributes:

NAME	TYPE	DESCRIPTION
DVID	I>0	Design variable identification
KSIL	I>0	Internal id of grid or scalar point connected to the design variable
MCODE	I>0	Codeword denoting the form in which the DMVIG data are stored
NODES	0<I≤ 20	Number of nodes being processed with this KSIL
IREC	I>0	Record number of DMVIG entity where data are stored
ASIL	I(20)	List of associated SILS
ALPHA	R	Exponential power associated with BAR element design variable

Created By: Module NLEMA1

Notes:

1. MCODE definitions:

1	Multiple associated grids with both extensional and rotational degrees of freedom.
2	Column being assembled is a scalar point.Associated SILS may or may not be scalar points.
3	Column being assembled is a grid point.At least one row is a scalar point.
4	Only extensional degrees of freedom are included in the assembly process

2. The INFO array for this entity contains additional memory management allocation data:

INFO(11)	The number of tuples connected to the zeroth design variable.
INFO(12)	The maximum number of tuples connected to any one of the remaining design variables.

Entity: GPFDATA

Entity Type: Relation

Description: Contains the grid point forces.

Relation Attributes:

NAME	TYPE	DESCRIPTION
BC	I>0	Boundary condition identification number
NITER	I>0	Iteration number for optimization
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 5 Transient 7 Buckling
SUBCASE	I>0	Subcase identification number if (DISC = 1, 3, 5, 8) or Mode Number if (DISC = 2, 7)
EID	I>0	Element identification number
ETYPE	C(8)	Element type (example: “BAR”)
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
GRIDID	I>0	GRID point identification number
SIL	I>0	Internal grid point identification number
FLAG	I>0	Flag indicating the point is a grid point or a scalar point
RFORCE	R(6)	Real parts of force components
IFORCE	R(6)	Imaginary parts of force components

Created By: Module EDR

Notes:

1. This relation is used by module OFPEDR for output printing and punching.
2. The FLAG equals 6 if the point is a grid point and equals 1 if a scalar point and 0 if not in the g-set.

Entity: GPFELEM

Entity Type: Relation

Description: Contains the list of elements connected to structural nodes for which grid point forces have been requested.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I>0	Set identification number of GPFORCE print request
ETYPE	C(8)	Element type (example: “BAR”)
EID	I>0	Element identification number
NGRID	I>0	Number of grid points in the element for which grid point forces are needed
AGRID	I(32)	Array containing sorted list of GIDs

Created By: Module PFBULK

Notes:

1. SID refers to the GRIDLIST bulk data entry used in the GPFORCE Solution Control print request id in Solution Control.

Entity: GPST

Entity Type: Unstructured

Description: Contains the grid point singularity summary table.

Entity Structure:

Record:

1. There are ten words for each grid point component or each scalar point, and

   all of the summary table are in one record.

   Each ten words are as follows:

WORD	DESCRIPTION
1	External ID
2	Type (GRID, SCALAR) G or S in hollerith
3	Component if grid point
4,5,6	Singularity direction vector
7	Stiffness ratio
8	Old set label
9	New set label
10	Asterisk or blank (Asterisk means USET updated)

Created By: GPSP

Entity: GPWGGRID

Entity Type: Relation

Description: Contains the definition of a location for grid point weight generation as input by the GPWG data entry in the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
GRIDPNT	I	Grid point identification or NULL if explicit location is given
X0	R	x location of the point
Y0	R	y location of the point
Z0	R	z location of the point

Created By: Module IFP

Notes:

1. GRIDPNT and X0,Y0,Z0 are mutually exclusive mechanisms to enter a location
2. Only the first tuple of GPWGGRID will be used
3. If no tuples exist, the GPWG is performed at the origin of the basic coordinate system

Entity: GRADIENT

Entity Type: Relation

Description: Contains the gradients of objective and constraint gradients requested to be printed or punched.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PRINTKEY	I	Key value referred to by the CONST relation
DVID	I	Design variable identification number
GRADIENT	R	Gradient value for the constraint in CONST with the associated PRINTKEY

Created By: Module DESIGN

Notes:

1. This entity contains one tuple for every global design variable for each tuple of CONST with a nonzero PRINTKEY attribute. That attribute points to the associated tuples of this entity.

Entity: GRAV

Entity Type: Relation

Description: Contains the definition of the gravity vectors to be used in applying gravity loading to the model.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
CID1	I≥0	Coordinate system id
SCALE	R	Scale factor
N1, N2, N3	R	Components of the gravity vector

Created By: Module IFP

Entity: GRID

Entity Type: Relation

Description: Contains the geometric and permanent constraint data for a structural grid point as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
GRIDID	KI>0	The external grid point id
CP	I≥0	The coordinate system in which the location of the point is defined
X, Y, Z	R	The location of the grid point
CD	I≥0	The id of the coordinate system to be used to define displacements, constraints, degrees of freedom, and solution vectors
PERMSPC	I≥0	The permanent single point constraints associated with the grid point

Created By: Module IFP

Entity: GRIDLIST

Entity Type: Relation

Description: Contains the list of grid, scalar or extra points for which node dependent outputs are requested as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I	Set identification number
GID	I	External grid/scalar/extra point identification number

Created By: Module IFP

Entity: GRIDTEMP

Entity Type: Unstructured

Description: Contains temperature data for all grid and scalar points for all thermal load sets defined.

Record:

1. A list of all set identification numbers in sorted order.

i. Contains the grid and scalar point temperatures for the (i-1)th specified thermal load case.The storage order of temperature data within each record follows the ordering of KSIL values in the BGPDT table with extra points excluded.

Created By: PFBULK

Notes:

1. This entity is used in EMG to compute average element temperatures and is used in LODGEN to compute the global thermal load sensitivity vectors.

Entity: GSKF

Entity Type: Matrix

Description: The transpose of GSTKF (see GSTKG).

Entity: GSTKF

Entity Type: Matrix

Description: A partition of the GSTKN matrix (see GSTKG)

Entity: GSTKG

Entity Type: Matrix

Description: The interpolation matrix relating slopes in the streamwise direction at the aerodynamic degrees of freedom to the displacements at the global structural degrees of freedom.

Matrix Form: A variable-sized matrix having one column for each steady aerodynamic box and one row for each structural degree of freedom.

Created By: Module SPLINES

Notes:

1. The MAPOL sequence supports the following partitions of the GSTKG matrix (see the Theoretical Manual for the explicit formation of these submatrices):

$$\mathbf{GSTKG} \rightarrow \begin{bmatrix} \varphi \\ \mathbf{GSTKN} \end{bmatrix}$$

$$\mathbf{GSTKN} \rightarrow \begin{bmatrix} \varphi \\ \mathbf{GSTKF} \end{bmatrix}$$

$$\mathbf{GSKF} = [\mathbf{GSTKF}]^{\mathbf{T}}$$

Entity: GSTKN

Entity Type: Matrix

Description: A partition of the GSTKG matrix (see GSTKG).

Entity: GSUBO

Entity Type: Subscripted Matrix

Description: See Notes.

Matrix Form: A variable-sized matrix with one row for each omitted degree of freedom and one column for each degree of freedom retained for analysis.The precision of this matrix is the same as that of the KGG matrix.

Created By: MAPOL

Notes:

1. For Guyan reduction GSUBO contains the matrix product
   $\mathbf{- [KOO]^{-1} [KOA]}$

2. If no omitted degrees of freedom are defined for the model, GSUBO will be initialized.

3. For generalized dynamic reduction, GSUBO relates degrees of freedom in the f- to q- set (union of a-, k-, and j-sets) degrees of freedom.

Entity: GTKF

Entity Type: Matrix

Description: A partition of the GTKN matrix (see GTKN).

Entity: GTKG

Entity Type: Matrix

Description: The interpolation matrix relating the forces at the aerodynamic degrees of freedom to the forces at the global structural degrees of freedom.

Matrix Form: A variable-sized matrix having one column for each steady aerodynamic degree of freedom (box) and one row for each structural degree of freedom.

Created By: Module SPLINES

Notes:

1. The MAPOL sequence creates the following partitions of the GTKG matrix (see the Theoretical Manual for the explicit formation of these submatrices):

$$GTKG \rightarrow \begin{bmatrix} \varphi \\ GTKN \end{bmatrix}$$

$$GTKN \rightarrow \begin{bmatrix} \varphi \\ GTKF \end{bmatrix}$$

Entity: GTKN

Entity Type: Matrix

Description: A partition of the GTKG matrix (see GTKG).

Entity: GUST

Entity Type: Relation

Description: Contains vertical gust data for a gust analysis as input from the bulk data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I>0	Gust set ID
GLOAD	I>0	ID of an entry which defines time or frequency dependent loads.
WG	R>0.0	Scale factor for gust velocity
XO	R≥0.0	Location of reference plane in aerodynamic coordinates
V	R>0.0	Velocity of the vehicle
QDP	R>0.0	Dynamic pressure of the vehicle
MACH	R≥0.0	Mach number of the vehicle
SYMXZ	I	Symmetry flag for xz-plane
SYMXY	I	Symmetry flag for xy-lane

Created By: Module IFP

Entity: IARGLIST

Entity Type: Relation

Description: Contains the resolved user function argument list information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I>0	User function instance number
FINDX	I>0	User function index number
ARGREF	I	Argument reference
IDENT	C(8)	Internal function name
TYPE	I	Argument type
INTVAL	I	Integer value
RSPVAL	R	Real value

Created By: Module FPKEVL

Entity: IC

Entity Type: Relation

Description: Contains the values of initial displacements and velocities for use in direct transient response analysis as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I	Set identification number
GRID	I	Grid, scalar or extra point identification number
COMP	I	Grid point component number
U0	R	Initial displacement value
V0	R	Initial velocity value

Created By: Module IFP

Entity: ICDATA

Entity Type: Unstructured

Description: Contains the collection of initial condition data for all initial condition sets referenced in Solution Control.

Entity Structure:

Record:

1. A list of all set identification numbers in sorted order.

i. Contains the initial conditions for the $(i-1)^{th}$ initial condition set.Each record has the following form:

WORD	VARIABLE	DESCRIPTION
1	SID	Set identification
j	ROW	Internal number of the degree of freedom affected by the initial condition in increasing Row order
j+1 to j+2		For each degree of freedom two words are stored: initial displacement and initial velocity

Created By: PFBULK

Notes:

1. This entity is used in DMA to assemble the ICMATRIX entity for the boundary condition.

2. The j index runs from 2 to 3 * NROW by 3 for each degree of freedom in the model that has a nonzero initial condition.

Entity: ICMATRIX

Entity Type: Matrix

Description: Contains the matrix of transient response initial conditions in the d-set for the current boundary condition.

Matrix Form: A variable-sized rectangular matrix having one row for each degree of freedom in the d-set and two columns for each transient response subcase.The first column is the vector of initial displacement and the second is the vector of initial velocity.

Created By: DMA

Notes:

1. This entity will be flushed for each boundary condition having dynamic response disciplines.

Entity: IFM

Entity Type: Subscripted Matrix

Description: Intermediate matrix in the reduction of the mass matrix for unrestrained boundary conditions.

Matrix Form: The number of rows is equal to the number of degrees of freedom in the o-set while the number of columns is equal to the number of degrees of freedom in the a-set.

Created By: MAPOL

Notes:

1. If there are no aerodynamics, IFM is computed from MOO times GSUBO plus MOA.

2. If there are aerodynamics, IFM is computed from MOO times GASUBO plus MOA.

3. Since IFM is required in the sensitivity analysis, it is subscripted by boundary condition number.

Entity: IFR

Entity Type: Subscripted Matrix

Description: Intermediate matrix in the reduction of the mass matrix.

Matrix Form: The number of rows is equal to the number of degrees of freedom in the l-set while the number of columns is equal to the number of degrees of freedom in the r-set.

Created By: MAPOL

Notes:

1. IFR is computed as MLL times D plus MLR.

2. Since IFS is required in the sensitivity anaysis, it is subscripted by boundary condition number.

Entity: IHEX1EST

Entity Type: Relation

Description: Contains the element summary data for the linear isoparametric hexahedron element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
SIL_i i=1,...8	I>0	Internal grid points identification numbers
$COORD_i$ i=1,...8	I>0	External coordinate system identification number for displacements at SIL_i
X_i i=1,...8	R	Basic coordinates of SIL_i
Y_i i=1,...8	R	
Z_i i=1,...8	R	
MID	I>0	Material identification number
CID	I>0	Coordinate system identification number in which anisotropic material is defined.
NIP	I	Number of integration points in each coordinate direction
AR	R	Maximum aspect ratio of element
ALFA	R	Maximum angle (degrees) for face normals
BETA	R	Maximum angle (degrees) for mid-edge points

Created By: Module MAKEST

Notes:

1. This relation is built from the CIHEX, the PIHEX and the basic grid point relations.It contains one tuple for each linear isoparametric hexahedron element in the problem.

Entity: IHEX2EST

Entity Type: Relation

Description: Contains the element summary data for the quadratic isoparametric hexahedron element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
SILS	I(20)	Internal grid point identification numbers
$COORD_i$ i=1,...20	I≥0	External coordinate system identification number for displacements at SILSi
X_i i=1,...20	R(3)	Basic coordinates of $SILS_i$
MID	I>0	Material identification number
CID	I>0	Coordinate system identification number in which anisotropic material is defined
NIP	I = 2,3,4	Number of integration points in each coordinate direction
AR	R	Maximum aspect ratio of element
ALFA	R	Maximum angle (degrees) for face normals
BETA	R	Maximum angle (degrees) for mid-edge points

Created By: Module MAKEST

Notes:

1. This relation is built from the CIHEX, the PIHEX, and the basic grid point relations.It contains one tuple for each quadratic isoparametric hexahedron element in the problem.

Entity: IHEX3EST

Entity Type: Relation

Description: Contains the element summary data for the cubic isoparametric hexahedron element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
SILS	I(32)	Internal grid point identification numbers
$COORD_1$ i=1,...32	I≥0	External coordinate system identification number for displacements at SILSi
X_i i=1,...32	R(3)	Basic coordinates of $SILS_i$
MID	I>0	Material identification number
CID	I>0	Coordinate system identification number in which anisotropic material is defined
NIP	I	Number of integration points in each coordinate direction
AR	R	Maximum aspect ratio of element
ALFA	R	Maximum angle (degrees) for face normals
BETA	R	Maximum angle (degrees) for mid-edge points

Created By: Module MAKEST

Notes:

1. This relation is built from the CIHEX, the PIHEX, and the basic grid point relations.It contains one tuple for each quadratic isoparametric hexahedron element.

Entity: ITERLIST

Entity Type: Relation

Description: Contains the definition of the list of design iterations as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I	Set identification number
NITER	I	Design iteration number

Created By: Module IFP

Entity: JOB

Entity Type: Relation

Description: Contains the case-independent solution control parameters as input in the solution control packet.

Relation Attributes:

NAME	TYPE	DESCRIPTION	
AIRFPRNT	I(20)	1	Airfoil shape print selection > 0 Identification number 0 NONE –1 ALL –2 LAST
		2	Punch set identification number
		3	Print form 0 Rectangular 1 Polar
		4	Punch form
		5	Print frequency set identification number
		6	Punch frequency set identification number
		7	Print iteration set identification number
		8	Punch iteration set identification number
		9	Print mode set identification number
		10	Punch maode set identification number
		11	Print time set identification number
		12	Punch time set identification number
		13-20	Unused
PLANPRNT	I(20)	Planform print selection	
PRESPRNT	I(20)	Unit pressure coefficient print selection	
TITLE	C(72)	User label TITLE	
SUBTITLE	C(72)	User label SUBTITLE	
LABEL	C(72)	User label LABEL	

Created By: Module Solution

Notes:

1. The format of the AIRFPRNT vector is typical of the format of all the print selection vectors.Additionally, the format for the print set Identification number in the AIRFPRNT vector is typical of that of the other set Identification numbers in the vector.

2. The CASE, JOB and OPTIMIZE relation entities together contain the solution control requests as input in the solution control packet.CASE contains the case-dependent parameters, JOB contains the case-independent requests and OPTIMIZE contains the optimization-dependent requests.

Entity: JSET

Entity Type: Relation

Description: Contains the external grid identification numbers and components with the analysis set as defined on the JSET entries of the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	JSET identification number
GRID1	I>0	Grid or Scalar point id
COMPNTS	I>0	Component number: 0 for scalar points 1-6 for grid points

Created By: Module IFP

Notes:

1. Used by the MKUSET Module to build the USET relation.

Entity: JSET1

Entity: Relation

Description: Contains the external grid identification numbers and components associated with the analysis set as defined on the JSET1 entries of the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	JSET identification number
COMPNTS	I>0	Component number: 0 for scalar points 1-6 for grid points
GRID1	I>0	Grid or Scalar point id

Created By: Module IFP

Notes:

1. Used by the **MKUSET** Module to build the **USET** relation.

Entity: KAA

Entity Type: Matrix

Description: Partition of the KFF matrix (see KGG).

Entity: KAAA

Entity Type: Matrix

Description: Partition of the KAFF matrix (see KAFF).

Entity: KAFF

Entity Type: Matrix

Description: Contains the stiffness matrix for the free degrees of freedom in the current boundary condition including the aeroelastic terms.

Matrix Form: A variable-sized asymmetric matrix having one row and one column for each free degree of freedom in the current boundary condition.

Created By: MAPOL

Notes:

1. The matrix is formed using

   $$[\,\mathbf{KAFF}\,] = [\,\mathbf{KAFF}\,] - \bar{\mathbf{q}}\,[\,\mathbf{AICS}\,]$$

2. The MAPOL sequence supports the following partitions of the KAFF matrix (see the Theoretical Manual for the explicit formation of these submatrices):

   $$\mathbf{KAFF} \rightarrow \begin{bmatrix} \varphi & \varphi \\ \mathbf{KAO} & \mathbf{KAAA} \end{bmatrix}$$

   $$\mathbf{KAAA} \rightarrow \begin{bmatrix} \mathbf{KARR} & \mathbf{KARL} \\ \mathbf{KALR} & \mathbf{KALL} \end{bmatrix}$$

Entity: KALL

Entity Type: Matrix

Description: Partition of the KAAA matrix (see KAFF).

Entity: KALR

Entity Type: Matrix

Description: Partition of the KAAA matrix (see KAFF).

Entity: KAO

Entity Type: Matrix

Description: Partition of the KAFF matrix (see KAFF).

Entity: KARL

Entity Type: Matrix

Description: Partition of the KAAA matrix (see KAFF).

Entity: KARR

Entity Type: Matrix

Description: Partition of the KAAA matrix (see KAFF).

Entity: KDDF

Entity Type: Matrix

Description: Stiffness matrix in the direct set used in frequency response analysis.

Matrix Form: Complex square matrix with the number of rows and columns equal to the number of degrees of freedom in the d-set.

Created By: DMA

Entity: KDDT

Entity Type: Matrix

Description: Stiffness matrix in the direct set used in frequency response analysis.

Matrix Form: Complex square matrix with the number of rows and columns equal to the number of degrees of freedom in the d-set.

Created By: DMA

Entity: KELM

Entity Type: Unstructured

Description: Contains the matrix partitions of the element nondesign stiffness and linear design stiffness.

Entity Structure:

If the element is a scalar element, then the record contains the components of the connected grid point(s) (if any) and the value K.

KCODE	FORMAT OF RECORD
1	K
2	COMP1, 0, +–K, –+K
3	0, COMP1, +–K, –+K
4	+–K, –+K
5	COMP1, 0, K
6	COMP1, COMP2, +–K, –+K

Otherwise, the record contains a partition of the stiffness matrix with either 1, 3, or 6 entries for each node

KCODE	FORMAT OF RECORD
7	3 columns of 3 entries/node
8	3 columns of 3 entries/node
9	6 columns of 6 entries/node

Created By: Module EMG

Notes:

1. This entity contains one record for each *strip* of each element stiffness matrix.A strip or partition is defined as all those columns of the element matrix associated with a pivot sil (the id of the first DOF of a grid point or the id of a scalar point).
2. Refer to the DVCT relation for further details, as these two database entities are closely linked.
3. The matrix partitions are stored in the same precision as the KGG matrix.
4. The records related to nonlinear design stiffness are empty.
5. KELM and DKELM are used to generate all of the element stiffness sensitivity matrix partitions.
6. KELM and KELMD are used to generate all of the element stiffness sensitivity matrix partitions.

Entity: KELMD

Entity Type: Unstructured

Description: Contains the element nonlinear design stiffness matrix partitions.

Entity Structure: The record contains a partition of the stiffness matrix with either 1, 3, or 6 entries for each node

KCODE	FORMAT OF RECORD
7	3 columns of 3 entries/node
8	3 columns of 3 entries/node
9	6 columns of 6 entries/node

Created By: Module EMG

Notes:

1. This entity contains one record for each *strip* of each element nonlinear design stiffness matrix.A strip or partition is defined as all those columns of the element matrix associated with a pivot sil (the id of the first DOF of a grid point or the id of a scalar point).
2. Refer to the DVCTD relation for further details, as these two database entities are closely linked.
3. The matrix partitions are stored in the same precision as the KGG matrix.
4. KELMD and KELM are used to generate all of the element stiffness sensitivity matrix partitions.

Entity: KFF

Entity Type: Matrix

Description: Partition of the KNN matrix (see KGG).

Entity: KFS

Entity Type: Matrix

Description: Partition of the KNN matrix (see KGG).

Entity: KGG

Entity Type: Matrix

Description: Contains the current global stiffness matrix for the design problem.

Matrix Form: A variable-size symmetric matrix having one row and one column for each structural degree of freedom in the problem.

Created By: Module MAPOL

Notes:

1. The KGG matrix is formed in the second phase stiffness matrix assembly.
2. The MAPOL sequence supports the following partitions of the KGG matrix (see the Theoretical Manual for the explicit formation of these submatrices):

$$\mathbf{KGG} \rightarrow \begin{bmatrix} \varphi & \varphi \\ \varphi & \mathbf{KNN} \end{bmatrix}$$

$$\mathbf{KNN} \rightarrow \begin{bmatrix} \mathbf{KSS} & \varphi \\ \mathbf{KFS} & \mathbf{KNN} \end{bmatrix}$$

$$\mathbf{KFF} \rightarrow \begin{bmatrix} \mathbf{KOO}* & \mathbf{KOA}* \\ \varphi & \mathbf{KAA} \end{bmatrix}$$

$$\mathbf{KAA} \rightarrow \begin{bmatrix} \varphi & \varphi \\ \mathbf{KLR} & \mathbf{KLL} \end{bmatrix}$$

* Generalized dynamic reduction only

Entity: KHHF

Entity Type: Subscripted Matrix

Description: Stiffness matrix in the modal set used in frequency response and flutter analyses.

Matrix Form: Complex square matrix with the number of rows and columns equal to the number of degrees of freedom in the h-set.

Created By: DMA

Notes:

1. The matrix may be required in the flutter sensitivity analysis and is therefore subscripted by boundary condition.

Entity: KHHT

Entity Type: Subscripted Matrix

Description: Stiffness matrix in the modal set used in transient response analysis.

Matrix Form: Complex square matrix with the number of rows and columns equal to the number of degrees of freedom in the h-set.

Created By: DMA

Entity: KLL

Entity Type: Matrix

Description: Partition of the KAA matrix (see KGG).

Entity: KLLINV

Entity Type: Subscripted Matrix

Description: Contains the upper and lower triangular sections of the [KLL] symmetric stiffness matrix.

Matrix Form: A variable-sized matrix having one row and one column for each degree of freedom left over for analysis after partition / reduction.The precision of this matrix is the same as the KGG matrix.

Created By: SDCOMP

Notes:

1. This matrix is formed for use by the FBS utility.

Entity: KLLL

Entity Type: Matrix

Description: Contains the lower triangular portion of the decomposed KAAA matrix.Note that KAAA is asymmetric requiring use of the general decomposition routine.

Matrix Form: Refer to the DECOMP utility documentation.

Created By: DECOMP

Notes:

1. This matrix is formed to be used in the general forward backward substitution module GFBS.

Entity: KLLU

Entity Type: Matrix

Description: Contains the upper triangular portion of the decomposed partition of the KAAA matrix.Note that KAAA is asymmetric requiring use of the general decomposition routine.

Matrix Form: Refer to the DECOMP utility documentation.

Created By: DECOMP

Notes:

1. This matrix is formed to be used in the general forward backward substitution module GFBS.

Entity: KLR

Entity Type: Matrix

Description: A partition of the KAA matrix (see KGG).

Entity: KL11

Entity Type: Subscripted Matrix

Description: Lower triangular portion of the decomposed K11 matrix.

Matrix Form: Square real matrix having one row and one column for each a-set degree of freedom.

Created By: DECOMP

Notes:

1. K11 is not symmetric.
2. This matrix is formed for use by the GFBS utility.
3. The matrix may be required in the sensitivity analysis and is therefore subscripted by boundary condition.

Entity: KNN

Entity Type: Matrix

Description: A partition of the KGG matrix (see KGG).

Entity: KOA

Entity Type: Matrix

Description: A partition of the KFF matrix used in Generalized Dynamic reduction.

Matrix Form: Real rectangular matrix with one row for each o-set degree of freedom and one column for each a-set degree of freedom.

Created By: PARTN

Notes:

1. This matrix is required only for generalized dynamic reduction and only when the user has specified a-set degrees of freedom.

Entity: KOO

Entity Type: Matrix

Description: A partition of the KFF matrix used in Generalized Dynamic reduction.

Matrix Form: Real squar matrix with one row for each o-set degree of freedom.

Created By: PARTN

Notes:

1. This matrix is required only for generalized dynamic reduction.
2. If the user has not specified a-set degrees of freedom, KOO is equivalented to KFF.

Entity: KOOINV

Entity Type: Subscripted Matrix

Description: Contains the upper and lower triangular matrices resulting from the symmetric decomposition of the KOO matrix for the current boundary condition.

Matrix Form: A variable-sized matrix having one row and one column for each omitted degree of freedom in the boundary condition.

Created By: FREDUCE

Notes:

1. This matrix has the same precision as the global stiffness matrix.
2. If no degrees of freedom have been omitted in the current boundary condition, this matrix will have no rows or columns.
3. This matrix is formed for use by the Forward Backward Substitution Utility.
4. Note that KOOINV plays the same role as KOOL/KOOU for symmetric analyses.

Entity: KOOL

Entity Type: Subscripted Matrix

Description: Contains the lower triangular portion of the decomposed partition of the KAAA matrix.Note that KAAA is asymmetric requiring use of the general decomposition routine.

Matrix Form: Refer to the DECOMP utility documentation.

Created By: FREDUCE

Notes:

1. This matrix is formed to be used in the general forward backward substitution module GFBS.
2. Note that KOOL/KOOU play the same role as KOOINV for asymmetric analyses.

Entity: KOOU

Entity Type: Subscripted Matrix

Description: Contains the upper triangular portion of the decomposed partition of the KAAA matrix.Note that KAAA is asymmetric requiring use of the general decomposition routine.

Matrix Form: Refer to the DECOMP utility documentation.

Created By: Module DECOMP

Notes:

1. This matrix is formed to be used in the general forward backward substitution module GFBS.
2. Note that KOOL/KOOU play the same role as KOOINV for asymmetric analyses.

Entity: KSOO

Entity Type: Matrix

Description: Shifted stiffness matrix used in Generalized Dynamic reduction.

Matrix Form: Real square symmetric matrix with one row and one column for each o-set of degree of freedom.

Created By: Module GDR1

Notes:

1. This matrix is computed from:
   [KSOO] = [KOO] -s[MOO];
   with the shift parameter, s, computed in GDR1.

Entity: KSS

Entity Type: Matrix

Description: Partition of the KNN matrix (see KGG).

Entity: KU11

Entity Type: Subscripted Matrix

Description: Upper triangular portion of the decomposed K11 matrix.

Matrix Form: Square real matrix having one row and one column for each a-set degree of freedom.

Created By: DECOMP

Notes:

1. K11 is not symmetric.
2. This matrix is formed for use by the GFBS utility.
3. The matrix may be required in the sensitivity analysis and is therefore subscripted by boundary condition.

Entity: K11

Entity Type: Matrix

Description: An intermediate matrix that is constructed as part of the solution of unrestrained structures.

Matrix Form: A R, square matrix with the number of rows and columns equal to the number of a-set degrees of freedom.

Created By: MAPOL

Entity: K1112

Entity Type: Subscripted Matrix

Description: An intermediate matrix required in the static aeroelastic trim analysis.

Matrix Form: A real rectangular matrix with the number of rows equal to the number of a-set degrees of freedom and the number of columns equal to the number of r-set degrees of freedom.

Created By: MAPOL

Notes:

1. The K1112 matrix is computed as the solution of
   [K11][K1112] = [AICS]
2. The matrix may be required in the sensitivity analysis and is therefore subscripted by boundary condition.

Entity: K12

Entity Type: Subscripted Matrix

Description: An intermediate matrix that is constructed as part of the solution of unrestrained structures.

Matrix Form: A real rectangular matrix with the number of rows equal to the number of a-set degrees of freedom and the number of columns equal to the number of r-set degrees of freedom.

Created By: MAPOL

Notes:

1. The matrix may be required in the sensitivity analysis and is therefore subscripted by boundary condition.

Entity: K21

Entity Type: Subscripted Matrix

Description: An intermediate matrix used in the reduction of the aerodynamic stiffness.

Matrix Form: The number of rows is equal to the number of degrees of freedom in the r-set and the number of columns is equal to the number of rows in the a-set.

Created By: MAPOL

Notes:

1. The matrix is created from the column merge of R32 and R31.
2. Since this matrix is required in the sensitivity analysis, it is subscripted by the boundary condition number.

Entity: LAMBDA

Entity Type: Relation

Description: Contains the results of real eigenvalue analysis for each modal analysis in each boundary condition.

Relation Attributes:

NAME	TYPE	DESCRIPTION	
NITER	I	Iteration number	
BCID	I	The boundary condition number	
MODENO	I	The mode number of the eigenvalue/eigenvector	
EXORD	I	The extraction order for the mode	
EIGVAL	R	The eigenvalue	
RFREQ	R	The modal frequency in rad/s	
CFREQ	R	The modal frequency in Hertz	
VECFLG	I	1	if a vector was generated for the mode
		0	if only the value was extracted
GMASS	R	The generalized mass associated with the mode	
GSTIFF	R	The generalized stiffness associated with the mode	

Created By: Module REIG

Notes:

1. The relation contains one tuple for each mode extracted in each eigenanalysis.
2. All eigenvalues for all boundary conditions at each design iteration are stored for retrieval in sensitivity evaluation.

Entity: LAMDAC

Entity Type: Relation

Description: Contains the results of complex eigenvalue analysis for each modal analysis in each boundary condition.

Relation Attributes:

NAME	TYPE	DESCRIPTION
BCID	I	The boundary condition number
MODENO	I	The mode number of the eigenvalue and eigenvector
EXORD	I	The extraction order for the mode
REIGVAL	R	The real part of the eigenvalue
IEIGVAL	R	The imaginary part of the eigenvalue
NFREQ	R	The natural frequency in Hertz
DFREQ	R	The damped frequency in Hertz
DPCOEF	R	The damping coefficient

Created By: Module CEIG

Notes:

1. The relation contains one tuple for each mode extracted in each eigenanalysis.

Entity: LDVLIST

Entity Type: Relation

Description: Contains the definition of the list of local design iterations as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I	Set identification number
ETYPE	C(8)	Element type
LAYRNUM	I	Layer number for composites or zero
DVSYMBL	C(8)	Designed dimension symbol selected fro D1 through D10 for BAR element cross section dimension; A for element area; T for element thickness; M for element mass; K for element stiffness.
EID	I	Element identification number

Created By: Module IFP

Entity: LHS

Entity Type: Subscripted Matrix

Description: This is essentially a matrix of rigid body mass values with the exact definition depending on the type of free-free analysis being performed.

Matrix Form: The dimension of the square matrix is equal to the number of degrees of freedom in the r-set.

Created By: MAPOL

Notes:

1. For an inertia relief analysis, LHS is equal to MRR.
2. For a static aeroelastic analysis, LHS is equal to MRR plus K21 times K1112.

Entity: LOAD

Entity Type: Relation

Description: Contains the definition of a static load that is a linear combination of loads defined by FORCE, MOMENT, FORCE1, MOMENT1, PLOAD, and GRAV entries.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
SCALE	R	Scale factor for combination
SCALEI	R	Scale factor for component load
LOADI	I>0	Set identification number of the component load

Created By: Module IFP

Notes:

1. The relation contains one tuple for each load set id specified in each unique SETID.

Entity: LOCLVAR

Entity Type: Relation

Description: Contains the relationship between local variables and global variables in the design problem.Acts as a pointer to the PTRANS matrix.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification
ETYPE1	C(8)	Element type
PTYPE	C(8)	Element property type
LAYRNUM	I≥0	Layer number for composites
PROW	I>0	Pointer to (P) row for this element
TMIN	R	Minimum value for physical property
TMAX	R	Maximum value for physical property
PID	I>0	Element property identification
PTYP	I 1,2,3	Flag indicating type of associated global variable
DVSYMBL	C(8)	Designed dimension symbol selected fro D1 through D10 for BAR element cross section dimension; A for element area; T for element thickness; M for element mass; K for element stiffness.

Created By: Module MAKEST

Notes:

1. This entity is used to create move limits on the physical design variables in the TCEVAL module.
2. The PTYP attribute indicates the linking option for the physical variable
   = 1 unique physical linking (DESELM)
   = 2 physical linking (DESVARP)
   = 3 shape function linking (DESVARS)

Entity: LSOO

Entity Type: Matrix

Description: Lower triangular portion of the decomposed KSOO matrix.

Matrix Form: Square real matrix having one row and column for each o-set degree of freedom in Generalized Dynamic Reduction.

Created By: DECOMP

Notes:

1. This matrix is formed for use by the FBS large matrix utility.
2. LSOO is computed only when there are k-set degrees of freedom in a generalized dynamic reduction analysis.

Entity: MAA

Entity Type: Matrix

Description: Mass matrix in the a-set derived from partitions of the MFF matrix (see MGG).

Entity: MAABAR

Entity Type: Matrix

Description: A partition of the MFF matrix (see MGG).

Entity: MACHLIST

Entity Type: Relation

Description: Contains the list of Mach numbers as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I	Set identification number
MACH	R>0.0	Mach number

Created By: Module IFP.

Entity: MASDRVA

Entity Type: Relation

Description: Contains the user function requested element mass sensitivity information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
MXCOL	I>0	Matrix column number in [MXMASDVA] for the sensitivity values

Created By: Module MSWGGRAD

Entity: MASRESP

Entity Type: Relation

Description: Contains the user function requested element mass values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module MSWGRESP

Entity: MASSEST

Entity Type: Relation

Description: Contains the element summary data for the MASS1 and MASS2 elements.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
SIL1	I≥0	Internal grid or scalar point id
SIL2	I≥0	Internal grid or scalar point id
COMPNT1	I≥0	Component of SIL1 to which the element is attached
COMPNT2	I ≥0	Component of SIL2 to which the element is attached
MASS	R	Mass value
DESIGN	I>0	Design flag

Created By: Module MAKEST

Notes:

1. A nonzero design flag denotes that the element is affected by a design variable.
2. This relation is built from the CMASS1 and CMASS2 relations along with associated property, design and grid relations.It contains one tuple for each scalar mass element in the problem.

Entity: MAT1

Entity Type: Relation

Description: Contains the material properties for linear isotropic materials as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
MID	KI>0	Material property identification
E	R	Young's Modulus
G	R	Shear Modulus
NU	R	Poisson's Ratio
RHO	R	Density
ALPHA	R	Thermal expansion coefficient
TREF	R	Thermal expansion reference temperature
DAMPING	R	Structural damping coefficient
ST	R	Tension stress allowable
SC	R	Compression stress allowable
SS	R	Shear stress allowable
MSCID	I≥0	Material coordinate system id

Created By: Module IFP

Entity: MAT2

Entity Type: Relation

Description: Contains the material properties for linear anisotropic materials for two-dimensional elements as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
MID	KI>0	Material identification number
G11, G12, G13	R	Components of the 6 x 6 symettric material properties matrix
G22, G23, G33	R	
RHO	R	Density
ALPH1	R	Thermal expansion coefficient vector
ALPH2	R	
ALPH12	R	
TREF	R	Thermal expansion reference temperature
DAMPING	R	Structural damping coefficient
ST	R	Tension stress allowable
SC	R	Compression stress allowable
SS	R	Shear stress allowable
MSCID	I≥0	Material coordinate system id

Created By: Module IFP

Entity: MAT8

Entity Type: Relation

Description: Contains the material properties for orthotropic materials for two-dimensional elements as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
MID	KI>0	Material identification number
E1	R≠0.0	Logitudinal modulus of elasticity
E2	R≠0.0	Transverse modulus of elasticity
NU12	R	Poisson's ratio
G12	R>0.0	In-plane shear modulus
G1Z	R≥0.0	Transverse shear modulus in 1-z plane
G2Z	R≥0.0	Transverse shear modulus in 2-z plane
RHO	R≥0.0	Mass density
ALPH1	R	Thermal expansion coefficient in 1-direction
ALPH2	R	Thermal expansion coefficient in 2-direction
TREF	R	Element reference temperature
XT	R≥ 0.0	Allowable longitudinal tension stress
XC	R	Allowable longitudinal compression stress
YT	R≥ 0.0	Allowable transverse tension stress
YC	R	Allowable transverse compression stress
SS	R≥ 0.0	Allowable in-plane shear stress
DAMPING	R	Structural damping value
F12	R	Tsai Wu tensor polynominal theory interaction term

Created By: Module IFP

Entity: MAT9

Entity Type: Relation

Description: Contains the material properties for orthotropic materials for three-dimensional elements as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
MID	KI>0	Material identification number
G11	R	Tensile modulus in the 1-direction
G12	R	Shear modulus in the 1-2 plane
G13	R	Shear modulus in the 1-3 plane
G14	R	Shear modulus in the 1-4 plane
G15	R	Shear modulus in the 1-5 plane
G16	R	Shear modulus in the 1-6 plane
G22	R	Tensile modulus in the 2-direction
G23	R	Shear modulus in the 2-3 plane
G24	R	Shear modulus in the 2-4 plane
G25	R	Shear modulus in the 2-5 plane
G26	R	Shear modulus in the 2-6 plane
G33	R	Tensile modulus in the 3-direction
G34	R	Shear modulus in the 3-4 plane
G35	R	Shear modulus in the 3-5 plane
G36	R	Shear modulus in the 3-6 plane
G44	R	Tensile modulus in the 4-direction
G45	R	Shear modulus in the 4-5 plane
G46	R	Shear modulus in the 4-6 plane
G55	R	Tensile modulus in the 5-direction
G56	R	Shear modulus in the 5-6 plane
G66	R	Tensile modulus in the 6-direction
RHO	R	Mass Density
ALPH1	R	Thermal expansion coefficient in 1-direction
ALPH2	R	Thermal expansion coefficient in 2-direction
ALPH3	R	Thermal expansion coefficient in 3-direction
ALPH4	R	Thermal expansion coefficient in 4-direction
ALPH5	R	Thermal expansion coefficient in 5-direction
ALPH6	R	Thermal expansion coefficient in 6-direction
TREF	R	Element reference temperature
GE	R	Structural damping coefficient

Created By: Module IFP

Entity: MDD

Entity Type: Matrix

Description: Mass matrix in the direct set.

Matrix Form: Square matrix with the number of rows and columns equal to the number of degrees of freedom in the d-set.

Created By: DMA

Entity: MELM

Entity Type: Unstructured

Description: An unstructured database entity that contains the matrix partitions of nondesigned mass and linearly designed mass.

Entity Structure:

1. If the element is a scalar element, the record contains the components of the connected grid point(s) (if any) and the value M.

MCODE	FORMAT OF RECORD
1	M
2	COMP1, 0, +–M,–+M
3	0,COMP1, +–M,–+M
4	+–M,–+M
5	COMP1, 0, M
6	COMP1, COMP2, +–M,–+M

or, the record contains a partition of the stiffness matrix with either one, three, or six entries for each node

KCODE	FORMAT OF RECORD
7	3 columns of 3 entries/node
10	3 columns of 1 entry/node (diagonal)

Created By: Module EMG

Notes:

1. This entity contains one record for each *strip* of each element mass matrix.A strip or partition is defined as all those columns of the element matrix associated with a pivot sil (the id of the first dof of a grid point or the id of a scalar point).
2. Refer to the DVCT relation for further details, as these two database entities are closely linked.
3. The matrix partitions are stored in the same precision as the MGG matrix.
4. The records related to nonlinear design mass are empty.
5. MELM and DMELM are used to generate all of the element mass sensitivity matrix partitions.
6. MELM and MELMD are used to generate all of the element mass sensitivity matrix partitions.

Entity: MELMD

Entity Type: Unstructured

Description: An unstructured database entity that contains the element nonlinear design mass matrix partitions.

Entity Structure:

Record: the record contains a partition of the stiffness matrix with either one, three, or six entries for each node

KCODE	FORMAT OF RECORD
7	3 columns of 3 entries/node
10	3 columns of 1 entry/node (diagonal)

Created By: Module EMG

Notes:

1. This entity contains one record for each *strip* of each element nonlinear design mass matrix.A strip or partition is defined as all those columns of the element matrix associated with a pivot sil (the id of the first dof of a grid point or the id of a scalar point).
2. Refer to the DVCTD relation for further details, as these two database entities are closely linked.
3. The matrix partitions are stored in the same precision as the MGG matrix.
4. MELMD and MELM are used to generate all of the element mass sensitivity matrix partitions.

Entity: MFF

Entity Type: Matrix

Description: A partition of the MNN matrix (see MGG).

Entity: MFORM

Entity Type: Relation

Description: Contains the mass matrix form as specified in the Bulk Data file.

Relation Attributes:

NAMES	TYPE	DESCRIPTION
VALUE	C(8)	The mass matrix form; either LUMPED or COUPLED.

Notes:

1. If this relation is empty, the LUMPED form will be used. If more than one tuple is defined, any tuple containing the "COUPLED" option will cause the coupled mass form to be used.

Entity: MGG

Entity Type: Matrix

Description: Contains the current global mass matrix for the design problem.

Matrix Form: A variable-size symmetric (possibly diagonal) matrix having one row and one column for each structural degree of freedom in the problem.

Created By: Module MAPOL

Notes:

1. The MGG matrix is formed in the second phase mass matrix assembly.

2. The MAPOL sequence supports the following partitions of the MGG matrix (see Theoretical Manual for the explicit formation of these matrices):

$$\mathbf{MGG} \rightarrow \begin{bmatrix} \varphi & \varphi \\ \varphi & \mathbf{MNN} \end{bmatrix}; \quad \mathbf{MNN} \rightarrow \begin{bmatrix} \varphi & \varphi \\ \varphi & \mathbf{MFF} \end{bmatrix}$$

$$\mathbf{MFF} \rightarrow \begin{bmatrix} \mathbf{MOO} & \mathbf{MOA} \\ \varphi & \mathbf{MAABAR} \end{bmatrix}$$

$$\mathbf{MAA} \rightarrow \begin{bmatrix} \mathbf{MRRBAR} & \varphi \\ \mathbf{MLR} & \mathbf{MLL} \end{bmatrix}$$

Entity: MHH

Entity Type: Subscripted Matrix

Description: Contains the modal mass output from the dynamic matrix assembly.

Matrix Form: A variable-sized matrix having one row and one column for each eigenvector computed in the real eigenanalysis.

Created By: Module DMA

Notes:

1. This matrix is needed for flutter constraint sensitivities so it is subscripted for each boundary condition.

2. INFO(11) contains a flag denoting whether the matrix is coupled or uncoupled
   0 Uncoupled
   1 Coupled

Entity: MII

Entity Type: Matrix

Description: Generalized mass matrix computed by the eigenanalysis module.

Matrix Form: Square diagonal matrix with the number of rows and columns equal to the number of modes retained by the eigenanalysis.

Created By: Module REIG

Notes:

1. Currently, this matrix is computed and not used; it is available for printout.

Entity: MKAERO1

Entity Type: Relation

Description: Contains a table of Mach numbers and reduced frequencies for unsteady aerodynamic matrix calculation as input from the bulk data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SYMXZ	I	Symmetry flag for xz-plane
SYMXY	I	Symmetry flag for xy-plane
MACHi i=1,...,6	R	Mach numbers
RFREQi i=1,...,8	R	Reduced frequencies

Created By: Module IFP

Entity: MKAERO2

Entity Type: Relation

Description: Contains mach number and reduced frequency pairs to be used in unsteady aerodynamic matrix generation.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SYMXZ	I	Symmetry flag for xz-plane
SYMXY	I	Symmetry flag for xy-plane
MACH	R≥0.0	Mach number
RFREQ	R≥0.0	Reduced frequency

Created By: Module IFP

Entity: MLL

Entity Type: Matrix

Description: A partition of the MAA matrix (see MGG).

Entity: MLR

Entity Type: Matrix

Description: A partition of the MAA matrix (see MGG).

Entity: MNN

Entity Type: Matrix

Description: The mass matrix in the n-set derived from partition of the MGG matrix (see MGG).

Entity: MOA

Entity Type: Matrix

Description: A partition of the MFF matrix (see MGG).

Entity: MODELIST

Entity Type: Relation

Description: Contains the list of normal modes for which outputs are requested as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I	Set identification number
MODE	I	Mode number

Created By: Module IFP

Entity: MOMENT

Entity Type: Relation

Description: Contains the definition of a static moment at a grid point as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
GRID1	I>0	Grid point at which the moment is applied
CID1	I≥0	Coordinate system identification
SCALE	R	Scale factor
N1, N2, N3	R	Components of the vector

Created By: Module IFP

Entity: MOMENT1

Entity Type: Relation

Description: Contains the definition of a moment applied at a grid point with the direction determined by a line connecting two grid points.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
GRID1	I>0	Grid point id at which the moment is applied
SCALE	R	Scale factor
GRID2	I>0	Grid point identification
GRID3	I>0	Grid point identification

Created By: Module IFP

Entity: MOO

Entity Type: Matrix

Description: A partition of the MFF matrix (see MGG).

Entity: MPC

Entity Type: Relation

Description: Contains the multipoint constraint data as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
DEPEND	I>0	Dependent grid or scalar point id
COMPNT1	I≥0	Component of DEPEND that is constrained
DEPCOEF	R	Coefficient of constraint for the dependent dof
GRID2	I>0	Grid or scalar point id
COMPNT2	I>0	Component of GRID2 that specifies a constraint
MPCCOEF	R	Coefficient of constraint

Created By: Module IFP

Notes:

1. The relation contains one tuple for each component constrained in each unique SETID.

Entity: MPCADD

Entity Type: Relation

Description: Contains the definition of a multipoint constraint set that is a union of sets contained in the MPC relation.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
MPCSETID	I>0	The SETID of the MPC relation tuples to be used

Created By: Module IFP

Entity: MPPARM

Entity Type: Realtion

Description: Contains the optimizer parameters and their new values for use in the ASTROS mathematical programming optimizer as input from the Bulk Data File.

NAME	TYPE	DESCRIPTION
PARAM	C(8)	Name of the parameter
INTPARM	I	Value of integer parameters
RSPPARM	R	Value of real parameters

Created By: Module IFP

Notes:

1. This relation is used in module DESIGN to provide for user specification of optimizer parameters.

Entity: MRR

Entity Type: Subscripted Matrix

Description: To reduce mass matrix for the structural model.

Matrix Form: A variable-sized matrix having one row and one column for each degree of freedom in the support set for the current boundary condition.

Created By: MAPOL

Notes:

1. This matrix is required to compute strength constraint sensitivities for unrestrained structures and trim parameter sensitivities for steady aerolastic optimization so it is subscripted for each boundary condition.

Entity: MRRBAR

Entity Type: Matrix

Description: A partition of the MAA matrix (see MGG).

Entity: MXDSPDVA

Entity Type: Matrix

Description: Matrix contains displacement response sensitivity to the design variables.

Matrix Form: A variable-sized matrix having one row for each design variable and one column for each requested displacement response.

Created By: MKAMAT

Entity: MXELMDVA

Entity Type: Matrix

Description: Matrix contains element stress and strain response sensitivity to the design variables.

Matrix Form: A variable-sized matrix having one row for each design variable and one column for each requested element stress / strain response.

Created By: MKAMAT

Entity: MXFCFDVA

Entity Type: Matrix

Description: Matrix contains steady aeroelastic flexible stability coefficient response sensitivity to the design variables.

Matrix Form: A variable-sized matrix having one row for each design variable and one column for each requested flexible stability coefficient response.

Created By: AEROEFFS

Entity: MXFDPDVA

Entity Type: Matrix

Description: Matrix contains flutter damping response sensitivity to the design variables.

Matrix Form: A variable-sized matrix having one row for each design variable and one column for each requested flutter damping response.

Created By: FLUTSENS

Entity: MXFFQDVA

Entity Type: Matrix

Description: Matrix contains flutter freqency response sensitivity to the design variables.

Matrix Form: A variable-sized matrix having one row for each design variable and one column for each requested flutter frequency response.

Created By: FLUTSENS

Entity: MXFRQDVA

Entity Type: Matrix

Description: Matrix contains normal mode response sensitivity to the design variables.

Matrix Form: A variable-sized matrix having one row for each design variable and one column for each requested normal mode response.

Created By: FREQSENS

Entity: MXFRTDVA

Entity Type: Matrix

Description: Matrix contains flutter root response sensitivity to the design variables.

Matrix Form: A variable-sized matrix having one row for each design variable and two columns for each requested flutter root response (the first column for the real part and the second column for the imaginary part).

Created By: MKAMAT

Entity: MXGDVDVA

Entity Type: Matrix

Description: Matrix contains global design variable sensitivity to the design variables.

Matrix Form: A variable-sized matrix having one row for each design variable and one column for each requested global design variable intrinsic.

Created By: GDVGRAD

Entity: MXMASDVA

Entity Type: Matrix

Description: Matrix contains element mass intrinsic sensitivity to the design variables.

Matrix Form: A variable-sized matrix having one row for each design variable and one column for each requested element mass intrinsic.

Created By: MSWGGRAD

Entity: MXTHKDVA

Entity Type: Matrix

Description: Matrix contains element thickness intrinsic sensitivity to the design variables.

Matrix Form: A variable-sized matrix having one row for each design variable and one column for each requested element thickness intrinsic.

Created By: MAKDFV

Entity: MXTRMDVA

Entity Type: Matrix

Description: Matrix contains steady aeroelastic trim parameter response sensitivity to the design variables.

Matrix Form: A variable-sized matrix having one row for each design variable and one column for each requested trim parameter response.

Created By: AEROSENS

Entity: MXWGHDVA

Entity Type: Matrix

Description: Matrix contains element weight intrinsic sensitivity to the design variables.

Matrix Form: A variable-sized matrix having one row for each design variable and one column for each requested element weight intrinsic.

Created By: MSWGGRAD

Entity: NLGLBSIG

Entity Type: Matrix

Description: Contains the stress and strain components in the element coordinate system for elements nonlinearly constrained through stress/strain constraint bulk data entries.

Matrix Form: A variable-size matrix having one row for each stress/strain component for each element subject to a nonlinear strength constraint and one column for each load condition within each boundary condition.The order of the matrix rows is in element id order of linearly constrained elements within each element type.The element types are currently processed in the following order:

(1) BAR; $\sigma_{a1}, \sigma_{a2}, \sigma_{a3}, \sigma_{a4}, \sigma_{b1}, \sigma_{b2}, \sigma_{b3}, \sigma_{b4}$
(2) QUAD4; $\sigma_x, \sigma_y, \tau_{xy}$
(3) TRIA3; $\sigma_x, \sigma_y, \tau_{xy}$

The columns are processed in load condition order for each boundary condition.

Created By: Module SCEVAL

Notes:

1. If no elements are nonlinearly constrained, this matrix will be empty.
2. Refer to the NLSMAT documentation for further details as NLGLBSIG is essentially:
   $[\mathbf{NLSMAT}]^t [\mathbf{u}_g]$
3. Each boundary condition's load conditions are appended onto the existing NLGLBSIG columns within the SCEVAL module.

Entity: NLSMAT

Entity Type: Matrix

Description: Contains the nonlinear portion of sensitivity of the stress and strain in the elements coordinate system to the global displacements.

Matrix Form: A variable-sized matrix having one column for every stress/strain term in each element that is nonlinearly constrained by a stress/strain constraint tuple or its stress/strain responses are required by user functions, and one row for every structural degree of freedom.The columns are stored in the order the nonlinearly constrained elements are processed in EMG.Relation NLSMTCOL has the matrix [NLSMAT] column information for each related element.

Created By: Module NLEMG

Notes:

1. This matrix is not built if all elements' stress or strain constraints are linear in the design variables.
2. NLSMAT and SMAT are used by SCEVAL module for constraint evaluation and MAKDFU for sensitivity evaluation.

Entity: NLSMTCOL

Entity Type: Relation

Description: Contains the matrix [NLSMAT] column information for the realted elements.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
ETYPE	C(8)	Element type
LAYERNUM	I≥0	Composite layer number
STRECOL	I>0	The first column number in [NLSMAT] for this element/layer stress
NCOLSTRE	I>0	The number of columns in [NLSMAT] for this element/layer stress
STRACOL	I>0	The first column number in [NLSMAT] for this element/layer strain
NCOLSTRA	I>0	The number of columns in [NLSMAT] for this element/layer strain

Created By: Module NLEMG

Entity: OAGRDDSP

Entity Type: Relation

Description: Contains the displacements on the aerodynamic boxes ("grids") for static aeroelasticity, flutter, transient/gust and blast disciplines that are requested for print or punch in Solution Control.

Relation Attributes:

NAME	TYPE	DESCRIPTION
NITER	I	Iteration number
BCID	I	The boundary condition number
DISC	I	Discipline type flag from CASE
SUBCASE	I	Subcase identification number from CASE relation
MODENO	I	Normal mode number for FLUTTER
CMPLX	I	Real or complex flag 1 if real displacement 2 if complex displacement
EXTID	I	External identification number of the aerodynamic box (See Remark 1)
INTID	I	Internal identification number of the aerodynamic box
RDISP	R	Real part of the normal displacement
IDISP	R	Imaginary part of the normal displacement

Created By: Many Modules

Notes:

1. The "grids" referred to by the EXTID are actually the aerodynamic box elements.Each of these elements is physically located at the centroid of a quadrilateral or triangular plate (the location of which is stored in GEOMSA or GEOMUA depending on the model).

2. The DISC flag also indicates which model is referred to by the results:
   SAERO refers to the planar static aero model
   FLUTTER, TRANSIENT, FREQUENCY and BLAST refer to the unsteady aero model

Entity: OAGRDLOD

Entity Type: Relation

Description: Contains the trimmed applied steady aerodynamic forces and pressures on the planar and nonplanar static aerodynamic boxes ("grids") that are requested for print or punch in Solution Control.

Relation Attributes:

NAME	TYPE	DESCRIPTION
NITER	I	Iteration number
BCID	I	The boundary condition number
DISC	I	Discipline type flag from CASE
SUBCASE	I	Subcase identification number (Normal mode number for FLUTTER)
LOADTYPE	C(8)	Label identifying the type of the load (See Remark 1)
EXTID	I	External identification number of the aerodynamic box (See Remark 2)
INTID	I	Internal identification number of the aerodynamic box
AREA	R	Area of the box
FORCE	R	Real part of the applied normal force
PRESS	R	Real part of the applied pressure

Created By: Many Modules

Notes:

1. The LOADTYPE is a text key that identifies the load terms. The following values are used:

APPLIED	User defined applied load from all disciplines except NPSAERO. For NPSAERO, the APPLIED load is equivalent to the RIGID load.The RIGID load is not stored.
RIGID	Trimmed rigid aerodynamic load from SAERO
FLEXIBLE	Trimmed flexible contribution to aerodynamic load from SAERO

2. The "grids" referred to by the EXTID are actually the aerodynamic box elements.Each of these elements is physically located at the centroid of a quadrilateral or triangular plate (the location of which is stored in GEOMSA or GEOMUA depending on the model).

3. The DISC flag also indicates which model is referred to by the results:
   NPSAERO refers to the nonplanar static aero model
   SAERO refers to the planar static aero model

Entity: OCEIGS

Entity Type: Relation

Description: Contains statistical information of complex eigenvalue analysis.

Relation Attributes:

NAME	TYPE	DESCRIPTION
METHOD	C(8)	Method of complex eigenvalue extraction
BCID	I	Boundary condition number
NLAMA	I	Number of eigenvalue
NVECTOR	I	number of eigenvectors
NOSTRT	I	Number of passes through the starting points
NOMOVS	I	Number of starting point moves
NODCMP	I	Number of decomposition
ITER	I	Total number of iterations
ITERM	I	Reason for termination

Created By: Module CEIG

Entity: OEIGS

Entity Type: Relation

Description: Contains statistical information of real eigenvalue analysis.

Relation Attributes:

NAME	TYPE	DESCRIPTION
METHOD	C(8)	Method of real eigenvalue extraction
NITER	I	Design iteration number
BCID	I	Boundary condition number
NLAMA	I	Number of eigenvalue
NVECTOR	I	number of eigenvectors
NEVER	I	Number of eigenvalue errors
NVER	I	Number of eigenvector errors
NOSTRT	I	Number of passes through the starting points
NOMOVS	I	Number of starting point moves
NODCMP	I	Number of decomposition
ITER	I	Total number of iterations
ITERM	I	Reason for termination
XMAX1	R	Maximum off diagonal mass term
ISTORE	I	The row number at which the maximum off diagonal mass term is located
JSTORE	I	The column number at which the maximum off diagonal mass term is located
IMSG	I	Number of off diagonal mass terms
TITLE	C(72)	Not used
SUBTITLE	C(72)	
LABEL	C(72)	

Created By: Module REIG

Entity: OEULBUCK

Entity Type: Relation

Description: Contains Euler buckling constraint output.

Relation Attributes:

NAME	TYPE	DESCRIPTION
BCID	I	Boundary condition number
DISC	I	Discipline flag
ITER	I	Design iteration number
SID	I	Constraint set identification number
SUBCASE	I	Subcase number
EID	I	Element identification number
ETYPE	C8)	Element type
BNDCON	C(8)	Boundary condition type
PAXIAL	R	Intermediate rsult in constraint computation
LAMBDA	R	Extracted eigenvalue
BKMODE	C(8)	Buckling mode
CVAL	R	Constraint value
LENGTH	R	Rod buckling length

Created By: Module EBKLEVAL

Entity: OGPWG

Entity Type: Relation

Description: Contains data from the grid point weight generation computations.

Relation Attributes:

NAME	TYPE	DESCRIPTION
NITER	I	Iteration number
BCID	I	Boundary condition number
GREF	I	Grid point identification (or zero)
XO	R	Basic coordinates of the reference point
YO	R	
ZO	R	
MO	R(36)	Mass matrix at the reference point
S	R(9)	Principal axes relative to basic system
MX	R	Mass in the x-axis direction
RX	R(3)	x,y,z coordinates of the x-axis c.g.
MY	R	Mass in the y-axis direction
RY	R(3)	x,y,z coordinates of the y-axis c.g.
MZ	R	Mass in the z-axis direction
RZ	R(3)	x,y,z coordinates of the z-axis c.g.
INERTIA	R(9)	Matrix of inertias
PINERTIA	R(3)	Principal inertias about x
Q	R(9)	Components of the principal axes

Created By: Module GPWG

Entity: OGRIDDSP

Entity Type: Relation

Description: Contains the displacements of the physical degrees of freedom that are requested for print or punch in Solution Control.

Relation Attributes:

NAME	TYPE	DESCRIPTION
NITER	I	Iteration number
BCID	I	The boundary condition number
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 4 Flutter 5 Transient 7 Buckling
SUBCASE	I	Subcase identification number
DISPTYPE	C(8)	Label identifying the type of the displacement (See Remark 1)
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
GRIDID	I	External identification number of the physical point
SIL	I	Internal identification number of the physical point
FLAG	I	Flag indicating whether the point is a grid point or a scalar point = 0 for extra points = 1 for scalar points = 6 for structural nodes
RDISP	R(6)	Real part of the displacement
IDISP	R(6)	Imaginary part of the displacement

Created By: Many Modules

Notes:

1. The DISPTYPE is a textual key that identifies the displacement terms.The following values are used:

DISPLACE	Displacements of the structural degrees of freedom
VELOCITY	Velocities of the structural degrees of freedom
ACCEL	Accelerations of the structural degrees of freedom

Entity: OGRIDLOD

Entity Type: Relation

Description: Contains the applied loads, reaction forces and other loads on the physical degrees of freedom that are requested for print or punch in Solution Control.

Relation Attributes:

NAME	TYPE	DESCRIPTION
NITER	I	Iteration number
BCID	I	The boundary condition number
DISC	I>0	Discipline type 1 Statics 2 Modes 3 Steady Aero 5 Transient 7 Buckling
SUBCASE	I	Subcase identification number
LOADTYPE	C(8)	Label identifying the type of the load (see remark 1)
CMPLX	I>0	Complex output identifier 1 if real response quantities 2 if complex response quantities
GRIDID	I	External identification number of the physical point
SIL	I	Internal identification number of the physical point
FLAG	I	Flag indicating whether the point is a grid point or a scalar point 0 for extra point 1 for scalar point 6 for structural nodes
RFORCE	R	Real part of the applied load
IFORCE	R	Imaginary part of the applied load

Created By: Many Modules

Notes:

1. The LOADTYPE is a textual key that identifies the load terms.The following values are used:

APPLIED	User defined applied load from all disciplines.For SAERO, the APPLIED load is computed and stored as the sum of RIGID, FLEXIBLE and INERTIA loads.
RIGID	Trimmed rigid aerodynamic load from SAERO
FLEXIBLE	Trimmed flexible contribution to aerodynamic load from SAERO
INERTIA	Inertia load contribution from SAERO and STATICS with inertia relief
SPC	SPC reaction forces for STATICS, SAERO, MODES, TRANSIENT and FREQUENCY.

Entity: OLOCALDV

Entity Type: Relation

Description: Contains the local design variable values that are requested for print or punch in Solution Control.

Relation Attributes:

NAME	TYPE	DESCRIPTION	
NITER	I	Iteration number	
ETYPE	C(8)	Element type selected from:	
		BAR	QUAD4
		ELAS	ROD
		MASS	SHEAR
		QDMEM1	TRIA3
		TRMEM	
EID	I>0	Element identification number	
LAYRNUM	I	Layer number (=0 if noncomposite)	
DVSYMBL	C(8)	Designed dimension symbol selected fro D1 through D10 for BAR element cross section dimension; A for element area; T for element thickness; M for element mass; K for element stiffness.	
T	R	Local design variable value (See Remark 2)	
I1	R	1st plane moment of inertia for BAR elements	
I2	R	2nd plane moment of inertia for BAR elements	
OPTION	I	Design variable linking option	
TMIN	R	Minimum value of physical property	
TMAX	R	Maximum value of physical property	
DVSYMBL	C(8)	PBAR1 cross-sectional symbol	

Created By: Module ACTCON

Notes:

1. Any local design variable that are requested for print or punch in Solution Control at any iteration will be stored in this relation.

2. For each element type, T, I1 and I2 have different meanings

BAR	T is element cross-sectional area I1 and I2 are related moments of inertia
CONM2	T is concentrated mass value I1 and I2 are not used
ELAS	T is spring stiffness I1 and I2 are not used
MASS	T is mass value I1 and I2 are not used

QDMEM1	T is element or layer thickness I1 and I2 are not used
QUAD4	T is element or layer thickness I1 and I2 are not used
ROD	T is element cross sectional area I1 and I2 are not used
SHEAR	T is element thickness I1 and I2 are not used
TRIA3	T is element or layer thickness I1 and I2 are not used
TRMEM	T is element or layer thickness I1 and I2 are not used

Entity: OMIT

Entity Type: Relation

Description: Contains the definition of the degrees of freedom that the user wishes to omit from the analysis through matrix reduction.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
GRID1	I>0	Grid or scalar point id
COMPNTS1	I≥0	Component of GRID1 to be omitted

Created By: Module IFP

Notes:

1. Used by the MKUSET module to build the USET relation.

Entity: OMIT1

Entity Type: Relation

Description: Contains the definition of the degrees of freedom that the user wishes to omit from the analysis through matrix reduction.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
COMPNTS1	I≥0	Component of GRID1 to be omitted
GRID1	I>0	Grid or scalar point id

Created By: Module IFP

Notes:

1. Used by the MKUSET module to build the USET relation.

Entity: OPNLBUCK

Entity Type: Relation

Description: Contains panel buckling constraint output.

Relation Attributes:

NAME	TYPE	DESCRIPTION
BCID	I	Boundary condition number
DISC	I	Discipline flag
ITER	I	Design iteration number
SID	I	Constraint set identification number
SUBCASE	I	Subcase number
EID	I	Element identification number
ETYPE	C(8)	Element type
NX	R	Element force
NY		
NXY		
SHIFT	R	Shifting points adopted by power method
LAMBDA	R	Extracted eigenvalue
BKMODE	C(8)	Buckling mode
CVAL	R	Constraint value
LENGTH	R	Panel buckling length
WIDTH	R	Panel buckling width
MTERM	I	Number of terms in sin series used for compting buckling load
NTERM	I	Number of terms in cos series used for compting buckling load

Created By: Module PBKLEVAL

Entity: OTL

Entity Type: Unstructured

Description: Contains a list of output times for each time step set.

Record:

1. Contains a list of the LIDs of the time step sets in the Bulk Data file.

i. Contains the output time list for the $(i-1)^{th}$ set ID.

Created By: Module PFBULK

Notes:

1. This entity is used in the OFPxxx modules.

Entity: OPTIMIZE

Entity Type: Relation

Description: Contains the optimization-dependent solution control requests as input in the solution control packet.

Relation Attributes:

NAME	TYPE	DESCRIPTION
CGRAPRNT	I(20)	Acceleration print selection (1) Print set identification number > 0 or 0 NONE –1 ALL –2 LAST -3 ACTIVE (2) Punch set identification number (3) Print form 0 Rectangular 1 Polar (4) Punch form (5) Print frequency set identification number (6) Punch frequency set identification number (7) Print iteration set identification number (8) Punch iteration set identification number (9) Print mode set identification number (10) Punch maode set identification number (11) Print time set identification number (12) Punch time set identification number (13)-(20) Unused
OBJID	I	Objective function identification number
DCONFID	I	Subcase-independent user function constraint identification number
OBJDIR	C(4)	MIN for MINIMIZE MAX for MAXIMIZE
DCONPRNT	I(20)	Design constraint print selection
GDESPRNT	I(20)	Global design variable print selection
KSNSPRNT	I(20)	Element stiffness senstivity print selection
LDESPRNT	I(20)	Local design variable print selection
MSNSPRNT	I(20)	Element mass senstivity print selection
OGRAPRNT	I(20)	Objective function gradient print selection
BULKPRNT	I(20)	Design model Bulk Data punch selection
HISTPRNT	I	Design iteration history print toggle
TITLE	C(72)	User label TITLE
SUBTITLE	C(72)	User label SUBTITLE
LABEL	C(72)	User label LABEL

Created By: Module Solution

Notes:

1. The format of the CGRAPRNT vector is typical of the format of all the print selection vectors.Additionally, the format for the print set Identification number in the CGRAPRNT vector is typical of that of the other set Identification numbers in the vector.

2. The CASE, JOB and OPTIMIZE relation entities together contain the solution control requests as input in the solution control packet.CASE contains the case-dependent parameters, JOB contains the case-independent requests and OPTIMIZE contains the optimization-dependent requests.

Entity: PA

Entity Type: Matrix

Description: External loads applied in the a-set derived from partitions of PF (see PG).

Entity: PAA

Entity Type: Matrix

Description: Rigid body aerodynamic load vectors derived from partitions of PAF (see PAF).

Entity: PAERO1

Entity Type: Relation

Description: Contains a list of associated bodies for panels used in Doublet-Lattice aerodynamics.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	I>0	Property identification number
BODIES	I(6)	Array attribute containing the identifications of associated bodies

Created By: Module IFP

Notes:

1. The BODIES identification numbers refer to CAERO2 relation tuples.

Entity: PAER02

Entity Type: Relation

Description: Contains the definition of the cross-sectional properties of Doublet-Lattice aerodynamic bodies as input from the bulk data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	I>0	Property identification
ORIENT	C(8)	Type of motion allowed for the body
WIDTH	R>0.0	Reference half width for the body
AR	R≥0.0	Aspect ratios for the body
LRSB	I>0	AEFACT identification number containing the half widths of slender bodies
LRIB	I>0	AEFACT identification number containing the half widths of interference bodies
LTH1	I≥0	AEFACT identification number that has the first array of theta values
LTH2	I≥0	AEFACT identification number that has the second array of theta values
THI1	I≥0	First interference element using the LTH1 theta distribution
THN1	I≥0	Last interference element using the LTH1 theta distribution
THI2	I≥0	First interference element using the LTH2 theta distribution
THN2	I≥0	Last interference element using the LTH2 theta distribution
THI3	I≥0	First interference element after THN2 that uses the LTH1 theta distribution
THN3	I≥0	Last interference element after THN2 that uses the LTH1 theta distribution

Created By: Module IFP

Entity: PAER06

Entity Type: Relation

Description: Contains the definition of analysis parameters for bodies in the aerodynamic model as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
BCID	I>0	Body component identification number
ACMPNT	C(8)	Component type (i.e.FUSEL)
CP	I≥0	Coordinate system in which geometry inputs are given
GROUP	I≥0	Group identification number
NRAD	I≥0	Number of equal radial cuts used to define body panels
LRAD	I≥0	AEFACT set identification number for the angular locations of body panels
AXIAL	I≥0	AEFACT set identification number for the axial locations of body panels

Created By: Module IFP

Entity: PAF

Entity Type: Matrix

Description: Rigid body load vectors multiplied by dynamic pressure.

Matrix Form: See AIRFRC for the dimensions.

Created By: MAPOL

Notes:

1. This matrix is the dynamic pressure times AIRFRC.
2. The MAPOL sequence supports the following partitions of the PAF matrix (see the Theoretical Manual for the explicit formation of these submatrices):

$$\mathbf{PAF} \rightarrow \begin{bmatrix} \mathbf{POARO} \\ \mathbf{PAA} \end{bmatrix}$$

$$\mathbf{PAA} \rightarrow \begin{bmatrix} \mathbf{PAL} \\ \mathbf{PARBAR} \end{bmatrix}$$

Entity: PAL

Entity Type: Matrix

Description: A partition of PAA (see PAF).

Entity: PAR

Entity Type: Subscripted Matrix

Description: An intermediate matrix formed during the performance of an aeroelastic trim analysis.

Matrix Form: The number of rows is equal to the number of degrees of freedom in the l-set while the number of columns is equal to the number of rigid body load vectors from AIRFRC.

Created By: MAPOL using GFBS

Notes:

1. PAR is the solution of:
   [KA11][PAR] = **[P1]**
2. Since PAR is needed in the sensitivity analysis, it is subscripted by boundary condition.

Entity: PARBAR

Entity Type: Matrix

Description: A partition of the PAA (see PAF).

Entity: PARL

Entity Type: Subscripted Matrix

Description: Contains the partitioning vector to partition those degrees of retained for analysis (a-set) into those reduced out (r-set) and those left over (l-set).

Matrix Form: A variable-sized single precision column vector having one row for each degree of freedom retained for analysis.Degrees of freedom in the reduce set are denoted by a real 0.0 and those left over by a real 1.0.

Created By: Module MKUSET

Notes:

1. The dimension of this subscripted matrix must be large enough for all optimization and analysis boundary conditions.
2. This vector is modified by the GDR modules if Generalized Dynamic Reduction is used.

Entity: PBAR

Entity Type: Relation

Description: Contains the property definition for the BAR element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	KI>0	Property identification number
MID1	I>0	Material property identification number of the MAT1 tuple
AREA	R>0.0	Element cross-sectional area
I1	R	Area moment of inertia in plane 1
I2	R	Area moment of inertia in plane 2
TORSION	R	Torsional constant
NSM	R≥0.0	Element nonstructural mass
TMIN	R	Minimum cross-sectional area in design
C1, C2, D1, D2	R	Element stress recovery coefficients
E1, E2, F1, F2	R	
KFACT1	R	Area factor for shear (plane 1)
KFACT2	R	Area factor for shear (plane 2)
I12	R	Area product of inertia
R1SQR	R	Multiplicative factor to determine I1 in design
R2SQR	R	Multiplicative factor to determine I2 in design
ALPHA	R	Exponential power associated with the design variable.

Created By: Module IFP

Entity: PBAR1

Entity Type: Relation

Description: Contains the property definition for the BAR element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	KI>0	Property identification number
MID	I>0	Material property identification number of the MAT1 tuple
SHAPE	C(8)	Element cross-section shape
D1	R≥0.0	Element cross-section dimension 1
D2	R≥0.0	Element cross-section dimension 2
D3	R≥0.0	Element cross-section dimension 3
D4	R≥0.0	Element cross-section dimension 4
D5	R≥0.0	Element cross-section dimension 5
D6	R≥0.0	Element cross-section dimension 6
D7	R≥0.0	Element cross-section dimension 7
D8	R≥0.0	Element cross-section dimension 8
D9	R≥0.0	Element cross-section dimension 9
D10	R≥0.0	Element cross-section dimension 10
NSM	R≥0.0	Non structural mass

Created By: Module IFP

Entity: PCAS

Entity Type: Unstructured

Description: Identifies active constraints for the current boundary condition.

Entity Structure: A single record of integers whose length is equal to the number of constraints active in the current boundary condition.

Created By: Module ABOUND

Notes:

1. There is one integer for each active constraint.The integer is set to the subcase number of the constraint (see the CONST relation).

Entity: PCOMP

Entity Type: Relation

Description: Contains the property definitions for a multiple ply composite material laminate as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	I>0	Property identification number
ZO	R	The distance from the plane of the grid points to the bottom surface
NSM	R≥0.0	nonstructural mass per unit area
SBOND	R>0.0	Allowable shear stress of bonding material
FAILCRIT	C(8)	Theory used to predict failure
TMIN	R	Minimum layer thicknesses for design
LOPT	C(8)	Laminate generation option
MIDI	I≥0	Ply material identification
THICKI	I≥0	Ply thickness
THETAI	R	Ply material orientation angle
SOUTI	C(8)	Flag for stress output

Created By: Module IFP

Notes:

1. This relation will contain one tuple for each ply in each unique PID.

Entity: PCOMPS

Entity Type: Unstructured

Description: Contains one record for each PCOMPi Bulk Data type entry. Data includes the PCOMPi entry and its intrinsic laminate property data.

Entity Structure:

RECORD	WORD	TYPE	DESCRIPTION
1	1-2	Text	PCOMP
	3	I>0	PID-Property identification number
	4	I>0	N-Number of layers
	5(11+4*N)	RSP	Remainder of PCOMP data
	(12+4*N)-(31*N+11)	RSP	Layer Property data
	(31*N+12)-(31*N+13)	RSP	Laminate Bending Inertia
	(31*N+14)-(31*N+15)	RSP	Laminate Neutral Surface Location
Words 3 through 31*N+15 are repeated for each PCOMP Bulk Data entry.			
2	1-2	Text	PCOMP1
	3	I>0	PID-Property identification number
	4	I>0	N-Numbers of layers
	5-(12+N)	RSP	Remainder of PCOMP1 data
	(13+N)-(37+N)	RSP	Layer property data
	(38+N)-(39+N)	RSP	Laminate Bending Inertia
	(40+N)-(41+N)	RSP	Laminate Neutral Surface Location
Words 3-41+N are repeated for each PCOMP1 Bulk Data entry.			
3	1-2	Text	PCOMP2
	3	I>0	PID-Property identification number
	4	I>0	N-Number of layers
	5-(11+2*N)	RSP	Remainder of PCOMP2 data
	(12+2*N)-(36+2*N)	RSP	Layer property data
	(37+2*N)-(38+2*N)	RSP	Laminate Bending Inertia
	(39+2*N)-(40+2*N)	RSP	Laminate Neutral Surface Location
Words 3-40+2*N are repeated for each PCOMP2 Bulk Data entry.			

Created By: Module EMG

Entity: PCOMP1

Entity Type: Relation

Description: Defines the property of a n-ply laminated composite material where all plies are composed of the same material and are of equal thickness.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	I>0	Property identification number
Z0	R	Offset of the element reference plane from the plane of grid points
NSM	R>0.0	nonstructural mass per unit area
SBOND	R>0.0	Allowable shear stress of the bending material.
FAILCRIT	C(8)	Failure theory to predict ply failure
TMIN	R>0.0	Minimum layer thickness for design
MID	I>0	Ply material identification
LOPT	C(8)	Lamination generation option
THICK	R>0.0	Ply thickness
THETAI	R	Ply material orientation angle

Created By: Module IFP

Notes:

1. This relation will contain one tuple for each ply for each unique PID.

Entity: PCOMP2

EntityType: Relation

Description: Defines the properties of a n-ply laminated composite material where all plies are of the same material.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	I>0	Property identification number
Z0	R	Offset of the element reference plane from the plane of grid points.
NSM	R>0.0	Nonstructural mass per unit area
SBOND	R>0.0	Allowable shear stress of the bonding material.
FAILCRIT	C(8)	Failure theory to predict ply failure
TMIN	R>0.0	Minimum layer thickness for design
MID	I> 0.0	Ply material identification

NAME	TYPE	DESCRIPTION
LOPT	C(8)	Lamination generation option
THICKI	R>0.0	Ply thickness
THETAI	R	Ply material orientation angle

Created By: Module IFP

Notes:

1. The relation will contain one tuple for each ply for each unique PID.

Entity: PDF

Entity Type: Matrix

Description: Applied loads matrix for frequency response analysis.

Matrix Form: Complex matrix with one column for each frequency at which frequency response results are to be computed.This matrix is applicable for both the direct and modal methods of solution so that the number of rows equal to the number of degrees of freedom in the d- or h-sets, depending on the method of solution.

Created By: Module DYNLOAD

Notes:

1. This matrix is also for applied gust loads if the gust discipline option of frequency response is selected.

Entity: PDLIST

EntityType: Relation

Description: Contains the panel buckling constraint sensitivity parameters.

NAME	TYPE	DESCRIPTION
NITER	I>0	Iteration number
BCID	I>0	Boundary condition identification number
DISFLAG	I>0	Discipline type flag from CASE relation (where appropriate)
PNUM	I>0	Pointer number from CONST for sensitivity computation
SID	I>0	Set identification number of panel buckling constraints
UPLOW	C(8)	Constraint type (Upper/Lower)
POWER	R	Internal constraint formulation factor
PID	I	Element property identification number
PTYPE	C8)	Element property type
MID	I	Element material identification number
THICK	R	Element thickness
DCVAL	R	Intermediate result in constraint computation
LAMBDA	R	Extracted eigenvalue
PD11	R	Intermediate results for sensitvity computation
PD12		
PD13		
PD22		
PD23		
PD33		

Created By: Module PBKLEVAL

Entity: PDT

Entity Type: Matrix

Description: Applied loads matrix for transient response analysis.

Matrix Form: Complex matrix with one column for each frequency at which transient response results are to be computed.This matrix is applicable for both the direct and modal methods of solution so that the number of rows equal to the number of degrees of freedom in the d- or h-sets, depending on the method of solution.

Created By: Module DYNLOAD

Entity: PELAS

Entity Type: Relation

Description: Contains the property data for scalar spring elements as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	KI	Property identification number
K	R	Spring constant
DAMPCOEF	R	Damping coefficient
STRSCOEF	R	Stress coefficient
TMIN	R	Minimum spring constant value for design

Created By: Module IPF

Entity: PF

Entity Type: Matrix

Description: External loads in the f-set derived from partitions of PN (see PG).

Entity: PFGLOAD

Entity Type: Matrix

Description: Applied loads matrix on the physical degrees of freedom for the frequency dependent loads in the current boundary condition.

Matrix Form: Complex rectangular matrix with one row for each physical degree of freedom and one column for each frequency step in each frequency analysis in the current boundary condition.

Created By: Module DYNLOAD

Notes:

1. This matrix is formed only if the LOAD print request for the FREQUENCY discipline is set for the current boundary condition.

Entity: PFOA

Entity Type: Subscripted Matrix

Description: Contains the partitioning vector to partition the free degrees of freedom (f-set) into the omitted degrees of freedom (o-set) and those retained for analysis (a-set).

Matrix Form: A variable-sized single-precision column vector containing one row for every free degree of freedom.Degrees of freedom in the o-set are denoted by real 0.0 and those in the a-set by real 1.0.

Created By: Module MKUSET

Notes:

1. The dimension of this subscripted matrix must be large enough for all optimization and analysis boundary conditions.
2. This matrix is modified by the GDR modules if Generalized Dynamic Reduction is used.

Entity: PG

Entity Type: Matrix

Description: Contains the global loads matrix for the current boundary condition.

Matrix Form: A variable-size matrix having one row for each structural degree of freedom in the model and one column for each load condition in the current boundary condition.

Created By: Module GTLOAD

Notes:

1. This matrix is flushed and re-formed for each boundary condition in the problem.
2. The MAPOL sequence supports the following partitions of the PG matrix (see Theoretical Manual for the explicit formation of these submatrices).

$$\mathbf{PG} \rightarrow \begin{bmatrix} \boldsymbol{\varphi} \\ \mathbf{PN} \end{bmatrix} \mathbf{PN} \rightarrow \begin{bmatrix} \mathbf{PS} \\ \mathbf{PF} \end{bmatrix}$$

$$\mathbf{PF} \rightarrow \begin{bmatrix} \mathbf{PO} \\ \mathbf{PA} \end{bmatrix} \mathbf{PA} \rightarrow \begin{bmatrix} \mathbf{PR} \\ \mathbf{PLBAR} \end{bmatrix}$$

Entity: PGA

Entity Type: Matrix

Description: Partitioning vector for active load cases.

Matrix Form: One column with the numbers of rows equal to the number of subcases for the current boundary condition.

Created By: Module ABOUND

Notes:

1. Active subcases are designated by a value of 1.0, inactive subcases by 0.0.

Entity: PGMN

Entity Type: Subscripted Matrix

Description: Contains the partitioning vector to partition the structural degrees of freedom (g-set) into the dependent multi-point constraint set (m-set) and the independent set (n- set).

Matrix Form: A variable-sized single precision column vector containing one row for each structural degree of freedom in the model.Degrees of freedom in the m-set are denoted by real 0.0 and those in the n-set by real 1.0.

Created By: Module MKUSET

Entity: PHIA

Entity Type: Matrix

Description: Contains the eigenvectors in the analysis degrees of freedom for each vector computed.

Matrix Form: A variable-sized vector having one column for each computed eigenvector and one row for each degree of freedom in the analysis set for the current boundary condition.

Created By: Module REIG

Notes:

1. See PHIG for data recovery.

Entity: PHIF

Entity Type: Matrix

Description: Normal modes in the f-set recovered from PHIA and PHIO (see PHIG).

Entity: PHIG

Entity Type: Subscripted Matrix

Description: Contains the eigenvectors in the global set computed in the REIG module.

Matrix Form: A variable-sized matrix having one column for each eigenvector computed and one row for each structural degree of freedom.

Created By: MAPOL

Notes:

1. The MAPOL sequence recovers this matrix in the following order:

   [PHIO] = **[GSUBO] [PHIA]**

   $$\begin{bmatrix} \mathbf{PHIA} \\ \mathbf{PHIO} \end{bmatrix} \rightarrow \mathbf{PHIF}$$

   $$\begin{bmatrix} \mathbf{YS} \\ \mathbf{PHIF} \end{bmatrix} \rightarrow \mathbf{PHIN}$$

   [UM*] = **[TMN] [PHIN]**

   $$\begin{bmatrix} \mathbf{UM} \\ \mathbf{PHIN} \end{bmatrix} \rightarrow \mathbf{PHIG}$$

   *UM contains modes in the m-set.The entity is reused in the MAPOL sequence.

Entity: PHIKH

Entity Type: Matrix

Description: Normal mode shapes splined to the aerodynamic panels.

Matrix Form: Real rectangular matrix with one row for each aerodynamic degree of freedom and one column for each normal mode.

Created By: Module QHHLGEN

Entity: PHIN

Entity Type: Matrix

Description: Modes in the n-set, recovered from PHIF (see PHIG).

Entity: PHIO

Entity Type: Matrix

Description: Mode shapes for omitted degrees of freedom (see PHIG).

Entity: PHIOK

Entity Type: Matrix

Description: Approximate mode shapes produced by generalized dynamic reduction.

Matrix Form: Real rectangular matrix with one row for each o-set degree of freedom and one column for each approximate mode shape.

Created By: Module GDR2

Notes:

1. This matrix is computed for generalized dynamic reduction and only if there are k-set degrees of freedom.

Entity: PIHEX

Entity Type: Relation

Description: Contains the property data for an isoparametric hexahedron element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	KI>0	Property identification number
MID	I>0	Material identification number
CID	I≥0	Identification number of the coordinate system in which the material referenced by MID is defined
NIP	I 2,3,4	Number of integration points along each edge of the element
AR	R>1.0	Maximum aspect ratio (ratio of longest to shortest edge) of the element
ALFA	0.0≤R≤180.0	Maximum angle in degrees between the normals of two subtriangles comprising a quadrilateral face
BETA	0.0≤R≤180.0	Maximum angle in degrees between the vector connecting a corner point to an adjacent midside point and the vector connecting that midside point and the other midside or corner point

Created By: Module IFP

Notes:

Entity: PLBAR

Entity Type: Matrix

Description: A partition of matrix PA (see PG).

Entity: PLIST

Entity Type: Relation

Description: Contains the property types and identification numbers associated with a design variable.

Relation Attributes:

NAME	TYPE	DESCRIPTION
LINKID	KI>0	Design variable identification
PTYPE	C(8)	Property relation identifier selected from: PROD, PCOMP, PCOMP1, PCOMP2, PSHEAR, PMASS, PQDMEM, PSHELL, PTRMEM, PELAS, PBAR
PID1	I>0	Property identification

Created By: Module IFP

Notes:

1. The PTYPE is the name of the relation in which the PID associated with the design variable is found.
2. This relation contains one tuple for each PID associated with each PTYPE listed in each unique LINKID.

Entity: PLISTM

Entity Type: Relation

Description: Contains the property types and identification numbers associated with a design variable.

Relation Attributes:

NAME	TYPE	DESCRIPTION
LINKID	KI>0	Design variable identification
PTYPE	C(8)	Property relation identifier selected from: PROD, PCOMP, PCOMP1, PCOMP2, PSHEAR, PMASS, PQDMEM, PSHELL, PTRMEM, PELAS, PBAR
PID1	I>0	Property identification number
DVSYMBL	C(8)	Designed dimension symbol selected from D1 through D10 for BAR element cross section dimension; A for element area; T for element thickness; M for element mass; K for element stiffness.

Created By: Module IFP

Notes:

1. The PTYPE is the name of the relation in which the PID associated with the design variable is found.
2. This relation contains one tuple for each PID associated with each PTYPE listed in each unique LINKID.

Entity: PLOAD

Entity Type: Relation

Description: Contains the load information defined over a triangular or quadrilateral region as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
SCALE	R	Scale factor
GRIDi i=1,...,4	I>0	Grid points defining region of load application

Created By: Module IFP

Notes:

1. The GRID4 entry is zero if a triangular region is defined.

Entity: PLOAD2

Entity Type: Relation

Description: Contains the uniform static pressure load information defined over a triangular or quadrilateral region as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
SCALE	R	Scale factor
EID	I>0	Element identification number

Created By: Module IFP

Entity: PLOAD4

Entity Type: Relation

Description: Contains the load information defined over a triangular or quadrilateral region as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
EID1	I>0	Element identification number
Pi i=1,...,4	R	Pressure at Grid point i
THRU	C(4)	"THRU" string for range definition of element IDs
EID2	I≥0	The last element identification number in a range definition
CID	I≥0	Coordinate system identification number
Vi i=1,...,3	R	Vector components in system CID that defines the direction of the GRID point loads generated by the pressure

Created By: Module IFP

Entity: PLYLIST

Entity Type: Relation

Description: Contains a list of composite layers as input in the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I>0	Set identification number
PLY	I>0	Ply number

Created By: Module IFP

Notes:

1. This relation contains one tuple for each ply in each set.

Entity: PMASS

Entity Type: Relation

Description: Contains the mass value of a scalar mass element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	KI>0	Property identification number
MASS	R	Mass value
TMIN	R>0.0	Minimum mass value for design

Created By: Module IFP

Entity: PMAXT

Entity Type: Matrix

Description: Contains the maximum thickness design variable based on the user's defined maximum (laminate) thickness.

$$[t] = [PMAXT]^{t}[v] + [VFIXD]$$

Matrix Form: A variable-sized single precision matrix having one column for each shape function designed laminate or element and one row for each global design variable.The terms in PMAXT are the sum of the PTRANS columns associated with one laminate (if composite).

Created By: Module MAKEST

Notes:

1. If a layered composite has some undesigned laminae, the VFIXD entity contains the terms needed to calculate the fixed contribution.

2. If no shape function linking is used, this matrix will have no columns.

Entity: PMINT

Entity Type: Matrix

Description: Contains the minimum thickness variable linking terms based on the user's defined minimum (laminate) thickness.

$$[t] = [PMINT]^{t}[v]$$

Matrix Form: A variable-size single precision matrix that has one column for each element designed by shape function linking and one row for each global design variable.The terms in PMINT are the PTRANS column for the shape function designed element divided by the user input minimum (laminate) thickness.

Created By: Module MAKEST

Notes:

1. If no shape function linking is used, this matrix will have no columns.

Entity: PN

Entity Type: Matrix

Description: External loads applied in the n-set derived from PG (see PG).

Entity: PNSF

Entity Type: Subscripted Matrix

Description: Contains the partitioning vector to partition the independent degrees of freedom (n-set) into the dependent single point constraint set (s-set) and the free degrees of freedom (f-set).

Matrix Form: A variable-sized single precision column vector containing one row for each independent degree of freedom.Degrees of freedom in the s-set are denoted by real 0.0 and those in the f-set by real 1.0.

Created By: Module MKUSET

Entity: PO

Entity Type: Matrix

Description: A partition of the PF matrix (see PG).

Entity: POARO

Entity Type: Subscripted Matrix

Description: Matrix of aerodynamic "unit" loads applied to omitted degrees of freedom.

Matrix Form: Real rectangular matrix with one row for each o-set degree of freedom and the same number of columns as the AIRFRC matrix.

Created By: MAPOL

Notes:

1. The Matrix may be required in the static aeroelastic sensitivity analysis and is therefore subscripted by the boundary condition.

Entity: PQDMEM1

Entity Type: Relation

Description: Contains the properties of the isoparametric quadrilateral membrane element as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	KI>0	Property identification number
MID1	I>0	Material identification number
THICK	R>0.0	Element thickness
NSM	R≥0	Element nonstructural mass
TMIN	R≥0	Minimum thickness for design

Created By: Module IFP

Entity: PR

Entity Type: Matrix

Description: A partition of the PA matrix (see PG).

Entity: PRAS

Entity Type: Unstructured

Description: Identifies active user function constraints required responses for the current boundary condition.

Entity Structure: A single record of integers whose length is equal to the number of responses required by active user function constraints in the current boundary condition.

Created By: Module ABOUND

Notes:

1. There is one integer for each active constraint.The integer is set to the subcase number of the constraint.

Entity: PROD

Entity Type: Relation

Description: Contains the property data for ROD elements as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	KI>0	Property identification number
MID1	I>0	Material identification number of a MAT1 tuple
AREA	R≥0.0	Element cross sectional area
TORSION	R≥0.0	Torsional constant
STRSCOEF	R	Stress recovery coefficient
NSM	R≥0.0	Element nonstructural mass
TMIN	R≥0.0	Minimum cross-sectional area for design

Created By: Module IFP

Entity: PS

Entity Type: Matrix

Description: A partition of the PN matrix (see PG).

Entity: PSHEAR

Entity Type: Relation

Description: Contains the property data for the shear panel as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	KI>0	Property identification number
MID1	I>0	Material identification number
THICK	R>0	Element thickness
NSM	R≥0.0	Element nonstructural mass
TMIN	R≥0.0	Minimum thickness for design

Created By: Module IFP

Entity: PSHELL

Entity Type: Relation

Description: Contains the membrane, bending, shear and coupling properties of thin two-dimensional elements as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	KI>0	Property identification number
MID1	I>0	Membrane material id
THICK	R>0	Element default thickness
MID2	I≥0	Bending material id
BENDSTIF	R	Bending stiffness parameter
MID3	I≥0	Transverse shear material id
TRNSVRS	R	Transverse shear thickness divided by the membrane thickness
NSM	R≥0.0	Element nonstructural mass
FZ1, FZ2	R	Fiber distances for stress computation
MID4	R≥0	Membrane-bending coupling material identification
CID2	I	Material coordinate system identification number
THETAM	R	Material orientation angle
CIDS	I	Stress recovery coordinate system
THETAS	R	Stress recovery orientation angle
OFFST1	I	Offset of the mid plane from the plane of the grid points
TMIN	R≥0.0	Minimum thickness for design

Created By: Module IFP

Entity: PTGLOAD

Entity Type: Matrix

Description: Applied loads matrix on the physical degrees of freedom for the time dependent loads in the current boundary condition.

Matrix Form: Real rectangular matrix with one row for each physical degree of freedom and one column for each time step in each transient analysis in the current coundary condition.

Created By: Module DYNLOAD

Notes:

1. This matrix is formed only if the LOAD print request for the transient discipline is set for the current boundary condition.

Entity: PTRANS

Entity Type: Matrix

Description: Contains the linking information for design variables if the model has design variables defined.

$$[t] = [PTRANS]^t[v]$$

Matrix Form: A variable-sized single precision matrix having one column for each local design variable and one row for each global design variable.

Created By: Module MAKEST

Notes:

1. This matrix is empty if the model contains no design variables.
2. A column of PTRANS is the sensitivity of the local variable to the global variable.

Entity: PTRMEM

Entity Type: Relation

Description: Contains the property data for the constant strain triangle as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
PID	KI>0	Property identification number
MID1	I>0	Material identification number of MAT1 or MAT2 tuple
THICK	R>0.0	Element thickness
NSM	R≥ 0.0	Element nonstructural mass
TMIN	R≥ 0.0	Minimum thickness for design

Created By: Module IFP

Entity: P1

Entity Type: Matrix

Description: Applied loads matrix created when there are unrestrained structural degrees of freedom.

Matrix Form: R, rectangular matrix with one row for each a-set degree of freedom and one column for each subcase or column in the PAF matrix, depending on whether a static analysis or a static aeroelastic analysis is being performed.

Created By: MAPOL

Entity: P2

Entity Type: Matrix

Description: Applied loads matrix created when there are unrestrained structural degrees of freedom.

Matrix Form: R, rectangular matrix with one row for each r-set degree of freedom and one column for each subcase or column in the PAF matrix, depending on whether a static analysis or a static aeroelastic analysis is being performed.

Created By: MAPOL

Entity: QDMM1EST

Entity Type: Relation

Description: Contains the element summary data for the isoparametric quadrilateral membrane element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
PID	I>0	Element property identification number
PTYPE	C(8)	Element property type
LAYRNUM	I≥0	Composite layer number
SILi i=1,...,4	I>0	Internal grid point id
CID	I≥0	Coordinate system defining material axis
THETA	R	Material orientation angle for anisotropic material behavior
MID1	I≥0	Material id of MAT1 or MAT2 tuple
THICK	R≥0.0	Element thickness
NSM	R≥0.0	Element nonstructural mass
COORD1	I≥0	External coordinate system id for displacements at SIL1
X1, Y1, Z1	R	Basic coordinates of SIL1
COORD2	I≥0	External coordinate system id for displacements at SIL2
X2, Y2, Z2	R	Basic coordinates of SIL2
COORD3	I≥0	External coordinate system id for displacements at SIL3
X3, Y3, Z3	R	Basic coordinates of SIL3
COORD4	I≥0	External coordinate system id for displacements at SIL4
X4, Y4, Z4	R	Basic coordinates of SIL4
SCON	I	Stress constraint flag
DESIGN	I	Design flag

NAME	TYPE	DESCRIPTION
STHRM	R(3)	Thermal stress terms for the constrained element
STHRMA	R(3)	Thermal strain terms for the constrained element
TREFTP	I≥0	Pointer to the TREF entity for thermal loads/stress evaluation of the designed element
NLFLAG	I≥0	Nonlinear design variable flag 0 nonlinear 1 NSM ≠ 0
ELRSPREQ	I	User function element response flag 1 Element response required 0 Element response not required

Created By: Module MAKEST

Notes:

1. This relation is built from the CQDMEM1, associated P-type and the basic grid point data.It contains one tuple for each quadrilateral membrane element in the problem.
2. A nonzero SCON flag denotes that the element is affected by a stress constraint.
3. A nonzero DESIGN flag denotes that the element is affected by a design variable.
4. LAYRNUM is zero for noncomposite elements.

Entity: QHHL

Entity Type: Matrix

Description: Matrix list of generalized unsteady aerodynamic coefficients.

Matrix Form: Complex rectangular matrix with one row for each retained mode shape and with the number of columns equal to the product of the number of retained mode shapes and the number of M-k pairs at which aerodynamics are required.

Created By: Module QHHLGEN

Notes:

1. The matrix may be required in the flutter sensitivity analysis and is therefore subscripted by boundary condition.

Entity: QHJL

Entity Type: Matrix

Description: Generalized aerodynamic data for the gust loads determination.

Matrix Form: A variable-sized matrix list.Each Mach number and reduced frequency required in the gust analysis creates a matrix with one row for each retained mode panel and one volume for each aerodynamic panel.

Created By: QHHLGEN

Notes:

1. See QJKL
2. The order of the matrices in the list is the order of M-k pairs in UNMK.

Entity: QKJL

Entity Type: Matrix

Description: Aerodynamic interpolation list containing data required for gust analysis.

Matrix Form: A variable-sized matrix list.There is an nk by nj matrix for each Mach number and reduced frequency required in the gust analysis.

Created By: Module AMP

Notes:

1. The order of the matrices in the list is the order of M-k pairs in UNMK.
2. One matrix QKJ is generated for each M-k pair associated with gust analyses.

Entity: QKKL

Entity Type: Matrix

Description: Matrix list of unsteady aerodynamic coefficients.

Matrix Form: Complex rectangular matrix with one row for each aerodynamic degree of freedom and with the number of columns equal to the product of the number of aerodynamic degrees of freedom and the number of M-k pairs at which aerodynamics are required.

Created By: Module AMP

Notes:

1. The matrix components of this list are generated from:

   $$[QKK] = [SJK][AJJT]^{-T} [[D1JK] + ik[D2JK]]$$

2. One matrix QKK is generated for each M-k pair associated with flutter or gust analyses.

Entity: QUAD4EST

Entity: Relation

Description: Contains the element summary data for the quadrilateral QUAD4 plate element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
PID	I>0	Element property identification number
PTYPE	C(8)	Element property type
LAYRNUM	I≥0	Composite layer number
SILi i=1,...,4	I>0	Internal grid point id i
TRATIOi i=1,...,4	R>0.0	Ratio of membrane thickness to element thickness for grid i
CID1	I≥0	Coordinate system defining material axis
THETAM	R	Material orientation angle
OFFST0	R	Initial offset of the element reference plane from the plane of grid points.
MID1	I≥0	Material identification number for membrane
THICK	R>0.0	Membrane thickness
MID2	I≥0	Material identification number for bending
BENDSTIF	R>0.0	Bending stiffness parameter
MID3	I≥0	Material identification number for transverse shear
TRNSVRS	R>0.0	Transverse shear thickness factor
NSM	R>0.0	nonstructural man
FZ1	R>0.0	Fiber distance for stress computation
FZ2	R>0.0	Fiber distance for stress computation
MID4	I≥0	Material identification number for membrane-bending coupling
CIDS	I≥0	Coordinate system defining stress output coordinate system
THETAS	R	Stress output orientation angle
COORD1	I	External coord system for SIL1
X1, Y1, Z1	R	Basic coordinates of SIL1
COORD2	I≥0	External coord system for SIL2
X2, Y2, Z2	R	Basic coordinates of SIL2
COORD3	I≥0	External coord system for SIL3
X3, Y3, Z3	R	Basic coordinates of SIL3
COORD4	I≥0	External coord system for SIL4
X4, Y4, Z4	R	Basic coordinates of SIL4
SCON	I	Stress constraint flag
DESIGN	I	Design flag
STHRM	R(3)	Thermal stress terms for the constrained element
STHRMA	R(3)	Thermal strain terms for the constrained element
TREFPT	I≥0	Pointer to the TREF entity for thermal loads/stress evaluation of the designed element
NLFLAG	I≥0	Nonlinear design variable flag 0 Linear design variable 1 Nonzero, nonstructural mass (NSM ≠ 0) 2 Nonlinear design stiffness 3 Nonlinear design stiffness and NSM ≠ 0 4 Nonlinear design stiffness and design mass 5 Nonlinear design stiffness and mass and NSM ≠ 0
CMPFLG	I≥0	Composite element type flag 0 Noncomposite element (1 entry for layer "0") 1 Nondesigned and unconstrained composite element (1 entry for layer "0" for equiv.single layer) 2 Nondesigned and constrained composite element (1 entry for layer "0" for equiv.single layer and *nlayer* entries at each layer) 3 Designed membrane composite element entries at each layer 4 Designed bending composite element (1st entry for equiv. single layer and entries at each layer)
ELTHK0	R>0.0	Initial user input membrane thickness
ELRSPREQ	I	User function element response flag 1 Element response required 0 Element response not required
LAYERPOS	I	This layer's position among all composite layers

Created By: Module MAKEST

Notes:

1. This relation is built from the CQUAD4, associated P-type and the basic grid point data.It contains one tuple for each isoparametric QUAD4 element in the problem.

2. The number of EST entries for a composite element could be equal to the number of layers, or to the number of layers + one, depending on the composite type.(See preceeding CMPFLG description)

Entity: RANDPS

Entity Type: Relation

Description: Contains the definition of load set power spectral density factors for use in Random analysis having the frequency dependent form.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Random analysis set identification number
EXCITID	I>0	Subcase identification number of excited load set
APPLYID	I>0	Subcase identification number of applied load set
X, Y	R	Components of complex number
TABRNDID	I≥0	Identification number of a TABRNDi entry

Created By: Module IFP

Entity: RBAR

Entity Type: Relation

Description: Contains the definition of a rigid bar element with six degrees of freedom at each end.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	MPC identification number
EID	I>0	Rigid bar element identification number
GA,GB	I>0	Grid point identification numbers of connection points.
CNA,CNB	I	Independent DOF in the global coordinate system for the elements at grid point GA and GB.
CMA,CMB	I	Dependent DOF in the global coordinate system assigned by the element at grid point GA and GB

Created By: Module IFP

Entity: RBE1

Entity Type: Relation

Description: Contains the definition of a rigid body connected to an arbitrary number of grid points.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	MPC identification number
EID	I>0	Rigid body element identification number
GXI	I>0	Grid point identification numbers at which dependent/independent DOF are assigned
CXI	I>0	Component numbers of dependent/independent DOF in the global coordinate system at grid points GXi
UMFLAG	C(4)	Character string indicating the start of the list of dependent degrees-of-freedom

Created By: Module IFP

Entity: RBE2

Entity Type: Relation

Description: Contains the definition of a rigid body whose independent degrees-of-freedom are specified at a single grid point and whose dependent degrees-of-freedom are specified at an arbitrary number of grid points.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	MPC identification number
EID	I>0	Rigid body element identification number
GN	I>0	Grid point identification number at which all six independent DOF are assigned
CM	I	Component numbers of dependent degrees-of-freedom in the global coordinate system assigned by the element at grid points GMi
GMI	I>0	Grid point identification number at which dependent DOF are assigned

Created By: Module IFP

Entity: RBE3

Entity Type: Relation

Description: Contains the definition of the motion of a reference grid point as the weighted average of motions at a set of other grid points.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	MPC identification number
EID	I>0	Rigid body element identification number
REFGRID	I>0	Reference grid point identification number
REFC	I	Component numbers of DOF in the global coordinate system that will be computed at REFGRID
QI	I	Integer field of either grid point ID or component number
QR	R	Real field of weighting factor
UMFLAG	C(4)	Character string indicating the start of the list of dependent DOF

Created By: Module IFP

Entity: RGCFRESP

Entity Type: Relation

Description: Contains the user function requested steady aeroelastic rigid stability coefficient response values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module SAERO

Entity: RHS

Entity Type: Subscripted Matrix

Description: A matrix used in the analysis of free-free structures that corresponds to load vectors applied to the supported degrees of freedom.

Matrix Form: The number of rows is equal to the number of degrees of freedom in the r-set while the number of columns varies by the type of analysis being performed.

Created By: MAPOL

Notes:

1. For an inertia relief analysis, RHS is equal to PR plus the transpose of D times PLBAR.
2. For a static aeroelastic analysis, RHS is equal to P2 minus K21 times PAR.
3. Since RHS may be needed in the sensitivity analysis, it is subscripted by boundary condition number.

Entity: RLOAD1

Entity Type: Relation

Description: Contains information on frequency dependent loads as defined in the RLOAD1 bulk data entry.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I>0	Set identification number
ILAG	I	Identification number for DLAGS
ITC	I	Identification number for TABLEDi(C)
ITD	I	Identification number for TABLEDi(D)

Created By: Module IFP

Notes:

1. The relation is used in FRLGA to generate dynamic loads.

Entity: RLOAD2

Entity Type: Relation

Description: Contains information to define frequency dependent dynamic loads in a form specified in the RLOAD2 bulk data entry.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I>0	Set identification number
ILAG	I	Identification number for DLAGS
TB	I	Identification number for TABLEDi(B)
TP	I	Identification number for TABLEDi(P)

Created By: Module IFP

Notes:

1. The relation is used in FRLGA to generate dynamic loads.

Entity: RODEST

Entity Type: Relation

Description: Contains the element summary data for the ROD element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
PID	I>0	Element property identification number
SIL1	I>0	Internal id of grid at end A
SIL2	I>0	Internal id of grid at end B
MID1	I>0	Material id of a MAT1 tuple
AREA	R≥0.0	Element cross-sectional area
J	R≥0.0	Torsional constant
C	R	Stress recovery coefficient
NSM	R≥0.0	Element nonstructural mass
COORD1	I≥0	External coordinate system id for displacements at end A
X1, Y1, Z1	R	Basic coordinates at end A
COORD2	I≥0	External coordinate system id for displacements at end B
X2, Y2, Z2	R	Basic coordinates at end B
SCON	I	Stress constraint flag
DESIGN	I	Design flag
STHRM	R	Thermal stress term for the constrained element
STHRMA	R	Thermal strain term for the constrained element
TREFPT	I≥0	Pointer to TREF entity for thermal stress evaluation and thermal loads evaluation
NLFLAG	I≥0	Nonlinear design variable flag 0 linear design variable 1 NSM ≠ 0
ELRSPREQ	I	User function element response flag 1 Element response required 2 Element response not required

Created By: Module MAKEST

Notes:

1. This relation is built from the CONROD, CROD, PROD and basic grid point relations.It contains one tuple for each ROD element in the problem.
2. A nonzero SCON flag denotes that the element is affected by a stress constraint.
3. A nonzero DESIGN flag denotes that the element is affected by a design variable.

Entity: RROD

Entity Type: Relation

Description: Contains the definition of a pin-ended rod that is rigid in extension.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	MPC identification number
EID	I>0	Rigid rod element identification number
GA,GB	I>0	Grid point identification numbers of connection points.
CMA,CMB	I	Component number of one dependent DOF in the global coordinate system assigned by the element at either grid point GA or GB

Created By: Module IFP

Entity: R21

Entity Type: Subscripted Matrix

Description: Intermediate matrix formed in the solution of structures that contain unrestrained degrees of freedom.

Matrix Form: Real rectangular matrix with one row for each r-set degree of freedom and one column for each a-set degree of freedom.

Created By: MAPOL

Notes:

1. R21 is the transpose of IFR.

Entity: R22

Entity Type: Matrix

Description: Intermediate matrix formed in the solution of structures that contain unrestrained degrees of freedom.

Matrix Form: Real square matrix with one row and column for each r-set degree of freedom.

Created By: MAPOL

Notes:

1. R22 is created from:
   [R22] = **[D]**^{T}**[MLR]** + **[MRRBAR]**

Entity: R31

Entity Type: Subscripted Matrix

Description: Intermediate matrix formed in the solution of static aeroelastic response.

Matrix Form: Real rectangular matrix with one row and column for each r-set degree of freedom and one column for each l-set degree of freedom.

Created By: MAPOL

Notes:

1. R31 is only computed for the steady aeroelastic analysis.
2. R31 is created from:
   [R31] = **[D]**^{T}**[KALL]** + **[KARL]**

Entity: R32

Entity Type: Subscripted Matrix

Description: Intermediate matrix formed in the solution of static aeroelastic response.

Matrix Form: Real square matrix with one row and column for each r-set degree of freedom.

Created By: MAPOL

Notes:

1. R32 is only computed for the steady aeroelastic analysis.
1. R32 is created from:
   [R32] = **[D]**^{T}**[KALR]** + **[KARR]**

Entity: SEQGP

Entity Type: Relation

Description: Contains the user selected resequencing requests for the grid and scalar points of the structural modes.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EXTID	I>0	Grid point identification number
SEQNUM	C(8)	Sequenced identification number (see beolw)

Created By: Module IFP

Notes:

1. EXTID is any grid or scalar point identification number which is to be reidentified for sequencing purposes.The sequence number is a special number which may have any of the following forms where X is a decimal integer digit — XXXX.X.X.X, XXXX.X.X, XXXX.X, or XXXX where any of the leading X's may be omitted.This string contains no imbedded blanks.The leading character will not be a decimal point.

Entity: SET1

Entity Type: Relation

Description: Contains a list of structural grid points to be used in splining loads from aerodynamic points to structural points and modes to be omitted from flutter analyses.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
GRIDI	I>0	Structural grid point id

Created By: Module IFP

Notes:

1. This relation contains one tuple for each grid point in each set.

Entity: SET2

Entity Type: Relation

Description: Contains the definition of a set of structural grid points in terms of aerodynamic elements.The set will be used to spline aero loads to the structure.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
SP1	R	Lower spanwise division
SP2	R	Upper spanwise division
CH1	R	Lower chordwise division
CH2	R	Upper chordwise division
ZMAX	R	Z-coordinate of upper surface
ZMIN	R	Z-coordinate of lower surface

Created By: Module IFP

Notes:

1. Tuples of this relation are referenced by the GRDSETID attribute of the SPLINE1 and SPLINE2 relations.

Entity: SHAPE

Entity Type: Relation

Description: Contains the element identification numbers and weighting factors specified on the SHAPE Bulk Data entry.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SHAPEID	I	Shape identification number
ETYPE1	C(8)	Element type selected from: CROD, CONROD, CSHEAR, CMASS1, CMASS2, CQDMEM1, CBAR, CQUAD4, CONM2, CTRIA3, CELAS1, CELAS2, CTRMEM
EID1	I	Element identification number
PREF	R	Design variable linking factor

Created By: Module IFP

Entity: SHAPEM

Entity Type: Relation

Description: Contains the element identification numbers and weighting factors specified on the SHAPEM Bulk Data entry.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SHAPEID	I	Shape identification number
ETYPE1	C(8)	Element type selected from: CROD, CONROD, CSHEAR, CMASS1, CMASS2, CQDMEM1, CBAR, CQUAD4, CONM2, CTRIA3, CELAS1, CELAS2, CTRMEM
EID1	I	Element identification number
DVSYMBL	C(8)	Designed dimension symbol selected from D1 through D10 for BAR element cross section dimension; A for element area; T for element thickness; M for element mass; K for element stiffness.
PREF	R	Design variable linking factor

Created By: Module IFP

Entity: SHEAREST

Entity Type: Relation

Description: Contains the element summary data for the shear panel.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
PID	I>0	Element property identification number
SILi i=1,...,4	I>0	Internal grid point id
MID1	I>0	Material id of a MAT1 tuple
THICK	R>0.0	Element thickness
NSM	R ≥ 0.0	Element nonstructural mass
COORD1	I≥0	External coordinate system id for displacements at SIL1
X1, Y1, Z1	R	Basic coordinates of SIL1
COORD2	I≥0	External coordinate system id for displacements at SIL2
X2, Y2, Z2	R	Basic coordinates of SIL2
COORD3	I≥0	External coordinate system id for displacements at SIL3
X3, Y3, Z3	R	Basic coordinates of SIL3
COORD4	I≥0	External coordinate system id for displacements at SIL4
X4, Y4, Z4	R	Basic coordinates of SIL4
SCON	I	Stress constrain flag
DESIGN	I	Design flag
NLFLAG	I≥0	Nonlinear design variable flag 0 linear design variable 1 NSM ≠ 0
ELRSPREQ	I	User function element response flag 1 Element response required 2 Element response not required

Created By: Module MAKEST

Notes:

1. This relation is built from the CSHEAR, associated P-type and the basic grid point relations.It contains one tuple for each shear panel in the problem.

2. A nonzero SCON flag denotes that the element is affected by a stress constraint.

3. A nonzero DESIGN flag denotes that the element is affected by a design variable.

Entity: SHPGEN

Entity Type: Relation

Description: Contains the design variable identification numbers, the list of associated elements and the shape to be generated by the Shape Generation Utility as specified on the SHPGEN Bulk Data entry.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SHAPEID	I>0	Design variable shape function identification number
ELMLID	I>0	ELEMLIST set identification number for associated elements
SHAPE	C(4)	Desired shape
CID	I	User defined coordinate system identification number
X0	R	X-coordinate in the basic system of the new origin for shape generation
Y0	R	Y-coordinate in the basic system of the new origin for shape generation
Z0	R	Z-coordinate in the basic system of the new origin for shape generation
DVSYMBL	C(8)	PBAR1 cross-sectional symbol

Created By: Module IFP

Entity: SKJ

Entity Type: Matrix

Description: Unsteady aerodynamic integration matrix list that translates pressures into forces and moments.

Matrix Form: Real rectangular matrix with one row for each aerodynamic degree of freedom and one column for each aerodynamic panel for each M-k pair.

Created By: Module UNSTEADY

Entity: SMAT

Entity Type: Matrix

Description: Contains the linear portion of the sensitivity of the stress and strain in the element's coordinate system to the global displacements.

Matrix Form: A variable-sized double precision matrix having one column for every stress/strain term in each linearly designed element that is constrained by a stress/strain constraint tuple or its stress/strain responses are required by user functions, and one row for every structural degree of freedom.The columns are stored in the order the elements are processed in EMG.Relation SMATCOL has matrix column information for each related elements.

Created By: Module EMG

Notes:

1. This matrix is not built if no linearly designed elements' stresses or strains are constrained.
2. SMAT and NLSMAT are used by SCEVAL module for constraint evaluation and MAKDFU for sensitivity evaluation.

Entity: SMATCOL

Entity Type: Relation

Description: Contains the matrix [SMAT] column information for all realted elements.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
ETYPE	C(8)	Element type
LAYERNUM	I≥0	Composite layer number
STRECOL	I>0	The first column number in [SMAT] for this element/layer stress
NCOLSTRE	I>0	The number of columns in [SMAT] for this element/layer stress
STRACOL	I>0	The first column number in [SMAT] for this element/layer strain
NCOLSTRA	I>0	The number of columns in [SMAT] for this element/layer strain

Created By: Module EMG

Entity: SMPLOD

Entity Type: Unstructured

Description: Simple load vector information.

Entity Structure: Record 1 contains three integers defining the number of (1) simple external loads, NEXTLD, (2) gravity loads, NGRAV, and (3) thermal loads, NTHERM, followed by a list of load identification numbers for each of the three groups in sorted order within each group.The second through NEXTLD + 1 records contain the external loads.

Created By: Module LODGEN

Entity: SPC

Entity Type: Relation

Description: Contains the definition of the single point constraints and enforced displacements as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
GRID1	I>0	Grid or scalar point id
COMPNTS1	I≥0	Components of GRID1 that are constrained
ENFDISP	R	The value of the enforced displacement at all coordinates specified by COMPNTS1

Created By: Module IFP

Notes:

1. This relation is used by the MKUSET module to build the single-point constraint set.

Entity: SPC1

Entity Type: Relation

Description: Contains the definition of the single point constraints as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
COMPNTS	I>0	Components to be constrained
GRIDI	I>0	Grid point id defining the constrained components

Created By: Module IFP

Notes:

1. This relation is used by the MKUSET module to build the single-point constraint set.
2. This relation will contain one tuple for each grid point specified in each unique set of COMPNTS; for example,

   COMPNTS = 236, grids 5,6, 8 and 9

   and

   COMPNTS = 134, grids 10, 20

   will result in 6 tuples.

Entity: SPCADD

Entity Type: Relation

Description: Contains the definition as input from the Bulk Data file of a single-point constraint sets as a union of SPC and / or of SPC1 sets.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
SPCSETID	I>0	Set id of a SPC or SPC1 tuple

Created By: Module IFP

Notes:

1. This relation is used by the MKUSET module to build the single-point constraint set.

Entity: SPLINE1

Entity Type: Relation

Description: Contains the definition of surface splines used for interpolating out-of-plane motion in aeroelastic analysis.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	KI>0	Element identification number
CP	I≥0	Coordinate system defining the plane of the spline
CAEROID	I>0	Aero element id
BOX1	I>0	First aero box to use the spline
BOX2	I>0	Last aero box to use the spline
GRDSETID	I>0	Set id of a SETi tuple defining the structural grids
FLEX	R	Linear attachment flexibility

Created By: Module IFP

Notes:

1. Aerodynamic boxes are numbered sequentially in chordwise strips.

Entity: SPLINE2

Entity Type: Relation

Description: Contains the definition of a beam spline for interpolating panels and bodies for steady and unsteady aeroelastic analysis.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
MACROID	I>0	The identification of the aerodynamic macroelement to be splined
BOX1,BOX2	I>0	The identification numbers of the first and last boxes on the macroelement to be interpolated using this spline
GRDSETID	I>0	The identification of a SETi entry which lists the structural grid points to which the spline is attached
FLEX	R≥ 0.0	Linear attachment flexibility
DTOR	R≥ 0.0	Torsional flexibility
CID	I	Rectangular coordinate system which defines the y-axis of the spline
DTHX,DTHY	R	Rotational attachment flexibility about the x-axis and y-axis

Created By: Module IFP

Entity: SPOINT

Entity Type: Relation

Description: Contains the identification numbers of those points to be used as scalar points.Input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EXTID	I>0	External point identification

Created By: Module IFP

Entity: STABCF

Entity Type: Relation

Description: Rigid body stability coefficients.

Relation Attributes:

NAME	TYPE	DESCRIPTION
MACHINDX	I	Mach number index of associated AIRFRC
PARM	C(8)	Character string identifying the configuration parameter.
SYMFLG	I	Symmetry flag for the parameter.
PARMVAL	R	Parameter value used to generate the "unit" forces.
CL	R	Lift coefficient
CD	R	Drag coefficient
CS	R	Sideforce coefficient
CMX	R	Rolling moment coefficient
CMY	R	Pitching moment coefficient
CMZ	R	Yawing moment coefficient

Created By: Module STEADY

Notes:

1. The SYMFLG values are:
   1 Symmetric
   -1 Antisymmetric

2. PARM identifies the physical variable whose perturbation generated the rigid coefficients.There are six accelerations and six configuration parameters whose names are reserved that have special meaning.Additional PARM values come from the set of all AESURF control surfaces defined and the PARM attribute contains the user supplied label.For a given MINDEX value, the AIRFRC matrix has one column (which may contain only zeros) for each entry in STABCF in the order of the STABCF relation.The PARM field is then:

PARM	VARIABLE
NX	Rigid body acceleration in drag/thrust direction (Produces no forces, but included for completeness to allow modification of AIRFRC columns to include nonzero terms)
NY	Rigid body acceleration in side force direction (Produces no forces, but included for completeness to allow modification of AIRFRC columns to include nonzero terms)
NZ	Rigid body acceleration in plunge direction (Produces no forces, but included for completeness to allow modification of AIRFRC columns to include nonzero terms)
PACCEL	Rigid body acceleration about the roll axis.(Produces no forces, but included for completeness to allow modification of AIRFRC columns to include nonzero terms)
QACCEL	Rigid body acceleration about the pitch axis.(Produces no forces, but included for completeness to allow modification of AIRFRC columns to include nonzero terms)
RACCEL	Rigid body acceleration about the yaw axis.(Produces no forces, but included for completeness to allow modification of AIRFRC columns to include nonzero terms)
THKCAM	Forces arising from the effects of only thickness and camber with all other configuration parameters set to zero.
ALPHA	Forces arising due to unit angle of attack.
BETA	Forces arising due to a unit yaw angle.
PRATE	Forces arising due to a unit roll rate.
QRATE	Forces arising due to a unit pitch rate.
RRATE	Forces arising due to a unit yaw rate
surface	Forces arising due to the unit deflection of the AESURF control surface named in the PARM field.

Entity: SUPORT

Entity Type: Relation

Description: Contains the definition of the set of points, as input from the Bulk Data file, at which the user desires determinate reactions to be applied to a free body.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
GRID1	I>0	Grid or scalar point identification
COMPNTS1	I≥0	Components of GRID1

Created By: Module IFP

Notes:

1. This relation will be used by the MKUSET relation to build the support set.

Entity: TABDMP1

Entity Type: Relation

Description: Contains modal structural damping tables for use in flutter analysis as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Set identification number
TYPE	C(4)	Damping type
FI	R>0.0	Frequency value
FBCD	C(4)	A character attribute to process SKIP requests
GI	R	Damping value
GBCD	C(4)	A character attribute to process SKIP requests

Created By: Module IFP

Entity: TABLED1

Entity Type: Relation

Description: Contains tabular function data for generating dynamic loads as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
TID	I	Table identification number
XI	R	Time (or frequency) for the tuple
YI	R	Response for this tuple
STRXF	C(4)	A character attribute to process skip requests
STRYI	C(4)	A character attribute to process skip requests

Created By: IFP

Notes:

1. The relation is used in subroutine PRTAB1 to define time or frequency dependent load.

Entity: TELM

Entity Type: Unstructured

Description: Contains the element thermal loads partitions for nondesigned and linearly designed elements if any thermal loads have been defined in the model.

Entity Structure:

Record:

i. Each record contains the thermal loads partitions for each nondesigned and linear designed element in the model if any thermal loads have been defined in the model.

Created By: Module EMG

Notes:

1. This entity contains one record for each partition of each element thermal loads matrix. A partition is that portion of the matrix connected to one pivot sil.
2. Refer to the DVCT relation documentation for further details.
3. The TELM terms are stored in the same precision as the PG matrix.
4. The records related to nonlinear designed elements are empty.
5. TELM and DTELM are used to generate all of the element thermal load sensitivity matrix partitions.
6. TELM and TELMD are used to generate all of the element thermal load matrix partitions.

Entity: TELMD

Entity Type: Unstructured

Description: Contains the element thermal loads partitions for nonlinear design elements if any thermal loads have been defined in the model.

Entity Structure:

Record:

i. Each record contains the thermal loads partitions for each nonlinear design element in the model if any thermal loads have been defined in the model.

Created By: Module NLEMG

Notes:

1. This entity contains one record for each partition of each nonlinear design element thermal loads matrix. A partition is that portion of the matrix connected to one pivot sil.
2. Refer to the DVCTD relation documentation for further details.
3. The TELMD terms are stored in the same precision as the PG matrix.
4. TELMD and TELM are used to generate all of the element thermal load matrix partitions.

Entity: TEMP

Entity Type: Relation

Description: Contains the grid point temperatures as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I	The set identification number
GRID1	I	The grid point id
TEMPVAL	R	The value of temperature assigned to GRID1

Created By: Module IFP

Entity: TEMPD

Entity Type: Relation

Description: Contains the default grid point temperature as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I	The set identification
TEMPDVAL	R	The default grid point temperature for the set SETID

Created By: Module IFP

Entity: TF

Entity Type: Relation

Description: Contains the definition of transfer functions as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I	Set identification number
GD	I	Grid, scalar or extra point id
CD	I	Component number of grid point GD
B0	R	Zeroth order coefficient
B1	R	First order coefficient
B2	R	Second order coefficient
GI	I	Grid, scalar or extra point id
CI	I	Component number of grid point GI
A0I	R	Zeroth order coefficient
A1I	R	First order coefficient
A2I	R	Second order coefficient

Created By: Module IFP

Entity: TFDATA

Entity Type: Unstructured

Description: Contains the collected transfer function data for all transfer function sets defined.

Entity Structure:

Record:

1. A list of all set identification numbers in sorted order

i. Contains the transfer function for the (i-1)th transfer function set.Each record has the following form:

WORD	VARIABLE	DESCRIPTION
1	SID	Set identification for the (i-1)th transfer function set
j	COL	Internal number of the matrix column affected by the transfer function
j+1	NROW	Number of terms defined in the column COL
j+2 to j+1+4*NROW		For each term in the column four words are stored: 1. Internal number of the matrix row 2. 0th order coefficient 3. 1st order coefficient 4. 2nd order coefficient in sorted row order

Created By: PFBULK

Notes:

1. This entity is used in DMA to assemble dynamic matrices.

2. The j index runs from 1 to NCOL for each column in the matrix that is affected by the transfer function terms in sorted column order.

Entity: TFIXED

Entity Type: Relation

Description: Contains the layer thicknesses of undesigned layers of designed composite elements.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
ETYPE	C(8)	Element type selected from: QDMEM1, QUAD4, TRIA3, or TRMEM
LAYRNUM	I>0	Layer number
T	R>0.0	Thickness

Created By: MAKEST

Notes:

1. These thicknesses are used in the evalation of thickness constraints and composite laminate constraints

Entity: THKDRVA

Entity Type: Relation

Description: Contains the user function requested element thickness sensitivity information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
MXCOL	I>0	Matrix column number in [MXTHKDVA] for the sensitivity values

Created By: Module MAKDFV

Entity: THKRESP

Entity Type: Relation

Description: Contains the user function requested element thickness values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module TCEVAL.

Entity: TIMELIST

Entity Type: Relation

Description: Contains the list of times for which outputs are requested as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I	Set identification number
TIME	R	Time value in consistent units

Created By: Module IFP

Entity: TLOAD1

Entity Type: Relation

Description: Contains information on time dependent loads as defined on the TLOAD1 bulk data entry.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	KI>0	Set identification number
IDEL	I>0	ID of the DLAGS set
TABL1	I	ID of the TABLED1 set

Created By: Module IFP

Notes:

1. The relation is used in module OFPLOAD to generate dynamic loads.

Entity: TLOAD2

Entity Type: Relation

Description: Contains information on time dependent loads as defined by the TLOAD2 bulk data entry.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	KI>0	Set identification number
IDEL	I>0	ID of the DLAGS set
T1	R≥0.0	Time constant
T2	R>T	Time constant
FREQ	R≥0.0	Frequency parameter
PHASE	R	Phase parameter
CTEXP	R	Exponential coefficient
GROWTH	R	Growth coefficient

Created By: Module IFP

Notes:

1. The relation is used in module OFPLOAD to generate dynamic loads.

Entity: TMN

Entity Type: Subscripted Matrix

Description: Contains the rigid constraint matrix relating the displacements at dependent degrees of freedom to those at the independent degrees of freedom.

Matrix Form: A variable-sized single precision matrix having one row for each dependent degree of freedom and one column for each independent degree of freedom. The rigid constraint matrix is built from MPC and rigid elements such that:

$$[u_m] = [TMN]\,[u_n]$$

Created By: Module MKUSET

Notes:

1. The dimension of this subscripted matrix must be large enough for all optimization and analysis boundary conditions.

2. If no multipoint constraints are defined, this matrix will have no columns.

Entity: TMP1

Entity Type: Matrix

Description: A scratch matrix used at various points in the MAPOL sequence for intermediate calculation.

Matrix Form: Application dependent.

Created By: MAPOL

Entity: TMP2

Entity Type: Matrix

Description: A scratch matrix used at various points in the MAPOL sequence for intermediate calculation.

Matrix Form: Application dependent.

Created By: MAPOL

Entity: TREF

Entity Type: Unstructured

Description: Contains the element reference temperature for each linear design element in the model.

Entity Structure:

Record:

1. Contains the reference temperature for each linear design element in the model.The temperatures are stored in the order the elements are processed.

Created By: Module EMG

Notes:

1. Elements are processed alphabetically by element type and numerically within each element type.

2. Entity is only created if TEMP or TEMPD bulk data entries exist.

3. The TREFPT attribute on the XXXEST relations points to the position in TREF for the associated reference temperature.

Entity: TREFD

Entity Type: Unstructured

Description: Contains the element reference temperature for each nonlinear design element in the model.

Entity Structure:

Record:

1. Contains the reference temperature for each nonlinear design element in the model.The temperatures are stored in the order the elements are processed.

Created By: Module NLEMG

Notes:

1. Elements are processed alphabetically by element type and numerically within each element type.

2. Entity is only created if TEMP or TEMPD bulk data entries exist.

3. The TREFPT attribute on the XXXEST relations points to the position in TREF for the associated reference temperature.

Entity: TRIM

Entity Type: Relation

Description: Contains the specified conditions for steady aeroelastic trim or nonplanar steady aerodynamic analysis as input from Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Trim set identification number
MACH	R>0.0	Mach number
QDP	R>0.0	Dynamic pressure
TRMTYP	C(8)	Type of trim desired
EFFID	I	Identification of CONEFFS bulk data entries which modify control surface effectiveness values
V0	R	Velocity
LABELI	C(8)	Label defining the aerodynamic trim parameters
FREEI	C(4)	Character string FREE
FIXI	R	Magnitude of the trim parameter

Created By: Module IFP and STEADY

Entity: TRIMDATA

Entity Type: Relation

Description: Contains the TRIM Bulk Data and related boundary condition, subcase and subscript information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SETID	I>0	Trim set identification number
MACH	R>0.0	Mach number
QDP	R>0.0	Dynamic pressure
TRMTYP	C(8)	Type of trim desired
EFFID	I	Identification of CONEFFS bulk data entries which modify control surface effectiveness values
V0	R	Velocity
LABELI	C(8)	Label defining the aerodynamic trim parameters
FREEI	C(4)	Character string FREE
FIXI	R	Magnitude of the trim parameter
BCID	I	Boundary condition identification number
MACHINDX	I	Mach number index for the current subcase
SYMMFLAG	I	Symmetry option for the Mach Number
SUBSCRPT	I	Subscript counter
SUBCASID	I	Subcase identification number

Created By: Module TRIMCHEK

Entity: TRIMDRVA

Entity Type: Relation

Description: Contains the user function requested steady aeroelastic trim parameter response sensitivity information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
MXCOL	I>0	Matrix column number in [MXTRMDVA] for the sensitivity values

Created By: Module AEROSENS

Entity: TRIMRESP

Entity Type: Relation

Description: Contains the user function requested steady aeroelastic trim parameter response values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module SAERO

Entity: TRIA3EST

Entity: Relation

Description: Contains the element summary data for the triangular TRIA3 element.

Relation Attributes:

NAME	TYPE	DESCRIPTION
EID	I>0	Element identification number
PID	I>0	Element property identification number
PTYPE	C8)	Element property type
LAYRNUM	I≥0	Composite layer number
SILi i=1,...,3	I>0	Internal grid point id i
TRATIOi 1=1,...,3	R>0.0	Ratio of membrane thickness to element thickness for grid i
CID1	I≥0	Coordinate system defining material axis
THETAM	R	Material orientation angle
OFFST0	R	Initial offset of the element reference plane from the plane of grid points.
MID1	I≥0	Material identification number for membrane
THICK	R>0.0	Membrane thickness
MID2	I≥0	Material identification number for bending
BENDSTIF	R>0.0	Bending stiffness parameter
MID3	I≥0	Material identification number for transverse shear
TRNSVRS	R>0.0	Transverse shear thickness factor
NSM	R>0.0	Nonstructural mass
FZ1	R>0.0	Fiber distance for stress computation
FZ2	R>0.0	Fiber distance for stress computation
MID4	I≥0	Material identification number for membrane-bending coupling
CIDS	I≥0	Coordinate system defining stress output coordinate system
THETAS	R	Stress output orientation angle
COORD1	I	External coord system for SIL1
X1, Y1, Z1	R	Basic coordinates of SIL1
COORD2	I≥0	External coord system for SIL2
X2, Y2, Z2	R	Basic coordinates of SIL2
COORD3	I≥0	External coord system for SIL3
X3, Y3, Z3	R	Basic coordinates of SIL3
SCON	I	Stress constraint flag
DESIGN	I	Design flag
STHRM	R(3)	Thermal stress terms for the constrained element
STHRMA	R(3)	Thermal strain terms for the constrained element
TREFPT	I≥0	Pointer to the TREF entity for thermal loads/stress evaluation of the designed element
NLFLAG	I≥0	Nonlinear design variable flag 0 inear design variable 1 Nonzero, nonstructural mass (NSM ≠ 0) 2 Nonlinear design stiffness 3 Nonlinear design stiffness and NSM ≠ 0 4 Nonlinear design stiffness and design mass 5 Nonlinear design stiffness and mass and NSM ≠ 0
ELRSPREQ	I	User function element response flag 1 Element response required 0 Element response not required
LAYERPOS	I	This layer's position among all composite layers
CMPFLG	I≥0	Composite element type flag 0 Noncomposite element (1 entry for layer "0") 1 Nondesigned and nonconstrained composite element (1 entry for layer "0" for equiv.single layer) 2 Nondesigned and constrained composite element (1 entry for layer "0" for equiv.single layer and *nlayer* entries at each layer) 3 Designed membrane composite element entries at each layer 4 Designed bending composite element (1st entry for equiv. single layer and entries at each layer)
ELTHK0	R>0.0	Initial user input membrane thickness

Created By: Module MAKEST

Notes:

1. This relation is built from the CTRIA3, associated P-type and the basic grid point data. It contains one tuple for each isoparametric TRIA3 element in the problem.

2. The number of EST entries for a composite element could be equal to the number of layers, or to the number of layers + one, depending on the composite type.(See preceeding CMPFLG description)

Entity: TRMEMEST

Entity Type: Relation

Description: Contains the element summary data for the constant strain triangular membrane element.

Relation Attributes:

NAME	TYPE	DESCRIPTION	
EID	KI>0	Element identification number	
PID	I>0	Element property identification number	
PTYPE	C(8)	Element property type	
LAYRNUM	I≥0	Composite layer number	
SILi i=1,...,3	I>0	Internal grid point id	
CID	I≥0	Coordinate system defining material axis	
THETA	R	Material orientation angle for anisotropic material behavior	
MID1	I>0	Material id of MAT1 tuple	
THICK	R>0.0	Element thickness	
NSM	R ≥ 0.0	Element nonstructural mass	
COORD1	I≥0	External coordinate system id for displacements at SIL1	
X1, Y1, Z1	R	External coordinate system id for displacements at SIL1	
COORD2	I≥0	External coordinate system id for displacements at SIL2	
X2, Y2, Z2	R	External coordinate system id for displacements at SIL2	
COORD3	I≥0	External coordinate system id for displacements at SIL3	
X3, Y3, Z3	R	External coordinate system id for displacements at SIL3	
SCON	I	Stress constraint flag	
DESIGN	I	Design flag	
STHRM	R(3)	Thermal stress terms for the constrained element	
STHRMA	R(3)	Thermal strain terms for the constrained element	
TREFPT	I≥0	Pointer to TREF entity used to evaluate thermal loads and thermal stresses	
NLFLAG	I≥0	Nonlinear design variable flag	
		0	linear
		1	NSM ≠ 0
ELRSPREQ	I	User function element response flag	
		1	Element response required
		0	Element response not required

Created By: Module MAKEST

Notes:

1. This relation is built from the CTRMEM, associated P-type and the basic grid point relations. It contains one tuple for each triangular membrane element in the problem.
2. A nonzero SCON flag denotes that the element is affected by a stress constraint.
3. A nonzero DESIGN flag denotes that the element is affected by a design variable.
4. LAYRNUM is zero for noncomposite elements.

Entity: TSTEP

Entity Type: Relation

Description: Contains time step information for the dynamic response as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I>0	Time step identification number
NDTI	I≥2	Number of time steps for this tuple
DELTAI	R>0.0	Time increment for this tuple
NOUTI	I	Skip factor for this tuple

Created By: Module IFP

Notes:

1. The response at every NOUTIth time step will be saved for output.

Entity: UA

Entity Type: Matrix

Description: Displacements in the a-set.

Matrix Form: A variable-size matrix having one row for each degree of freedom in the analysis set and one column for each load condition in the current boundary condition.

Created By: See Notes.

Notes:

1. This matrix is calculated using:
   [K11][UA] = **[P1]**
   if there is inertia relief,
   [UA] = **[K1112][AR]** + **[PAR][DELTA]**
   for static aeroelasticity, and
   [KAA][UA] = **[PA]**
   for static analysis without inertia relief.
2. See UG.

Entity: UBLASTG

Entity Type: Matrix

Description: Blast response quantities in the g-set.

Matrix Form: Real rectangular matrix with one row for each g-set degree of freedom and three columns (corresponding to displacement, velocity, and acceleration) for each time step at which transient calculations are retained.

Created By: MAPOL

Entity: UBLASTI

Entity Type: Matrix

Description: Blast response quantities in the i-set.

Matrix Form: Real rectangular matrix with one row for each retained mode and three columns (corresponding to displacement, velocity, and acceleration) for each time step at which transient calculations are retained.

Created By: BLASTDRV

Entity: UDLOLY

Entity Type: Unstructured

Description: Contains collected DLONLY information.

Record:

1. ID's of the NDIS DLONLY sets in sorted order.Contains data for the (i-1)th DLONLY set.The information on each of these records is:

WORD	VARIABLE	DESCRIPTION
j	LOAD	Load factor
j+1	ISIL	Internal ID of load component

Created By: Module PFBULK

Notes:

1. The number of words for the ith record is twice the number of load factors input for the associated set ID.

Entity: UF

Entity Type: Matrix

Description: Displacements in the f-set derived from UO and UA (see UG).

Entity: UFREQA

Entity Type: Matrix

Description: Matrix of frequency response quantities in the a-set.

Matrix Form: A complex rectangular matrix with one row for each a-set degree of freedom and three columns (corresponding to displacement, velocity, and acceleration) for each frequency at which frequency response output is required.

Created By: Module DYNRSP or MAPOL

Notes:

1. If the direct method of frequency response is used, UFREQ is computed in module DYNRSP.If the modal method is used, UFREQA is recovered using UFREQI and PHIA.

Entity: UFREQE

Entity Type: Matrix

Description: Matrix of frequency response quantities in the e-set.

Matrix Form: A complex rectangular matrix with one row for each e-set degree of freedom and three columns (corresponding to displacement, velocity, and acceleration) for each frequency at which frequency response output is required.

Created By: Module DYNRSP

Notes:

1. UFREQE is only computed in a frequency response analysis that includes extra points.

Entity: UFREQF

Entity Type: Matrix

Description: Matrix of frequency response quantities in the f-set.

Matrix Form: A complex rectangular matrix with one row for each f-set degree of freedom and three columns (corresponding to displacement, velocity, and acceleration) for each frequency at which frequency response output is required.

Created By: MAPOL

Entity: UFREQG

Entity Type: Matrix

Description: Matrix of frequency response quantities in the g-set.

Matrix Form: A complex rectangular matrix with one row for each g-set degree of freedom and three columns (corresponding to displacement, velocity, and acceleration) for each frequency at which frequency response output is required.

Created By: MAPOL

Entity: UFREQI

Entity Type: Matrix

Description: Matrix of frequency response quantities in the i-set.

Matrix Form: A complex rectangular matrix with one row for each i-set degree of freedom and three columns (corresponding to displacement, velocity, and acceleration) for each frequency at which frequency response output is required.

Created By: Module DYNRSP

Notes:

1. This matrix is only computed when the modal method of frequency response is invoked.

Entity: UFREQN

Entity Type: Matrix

Description: Matrix of frequency response quantities in the n-set.

Matrix Form: A complex rectangular matrix with one row for each n-set degree of freedom and three columns (corresponding to displacement, velocity, and acceleration) for each frequency at which frequency response output is required.

Created By: MAPOL

Entity: UG

Entity Type: Subscripted Matrix

Description: Displacements of the structural degrees of freedom in the g-set.

Matrix Form: A variable-sized matrix having one row for each structural degree of freedom and one column for each load condition in the boundary condition.

Created By: MAPOL

Notes:

1. The MAPOL sequence recovers this matrix in the following order (see the Theoretical Manual for the explicit form of this recovery):

$$\begin{bmatrix} \mathbf{UO} \\ \mathbf{UA} \end{bmatrix} \rightarrow \mathbf{UF}$$

$$\begin{bmatrix} \mathbf{YS} \\ \mathbf{UF} \end{bmatrix} \rightarrow \mathbf{UN}$$

$$\begin{bmatrix} \mathbf{UM} \\ \mathbf{UN} \end{bmatrix} \rightarrow \mathbf{UG}$$

Entity: UGA

Entity Type: Matrix

Description: "Active" displacements vectors for the current boundary condition.

Matrix Form: The matrix has one column for each active displacement vector and GSIZE rows.

Created By: MAPOL

Notes:

1. This matrix is obtained by partitioning UG using the PGA partitioning vector.

Entity: UGTKAB

Entity Type: Matrix

Description: A partition of the UGTKF matrix (see UGTKG).

Entity: UGTKA

Entity Type: Matrix

Description: Unsteady spline matrix in the a-set derived from UGTKF (see UGTKG).

Entity: UGTKF

Entity Type: Matrix

Description: Unsteady spline matrix in the f-set derived from UGTKN (see UGTKG).

Entity: UGTKG

Entity Type: Matrix

Description: Matrix containing the spline relations which relate the structural and unsteady aerodynamics models

Matrix Form: Real rectangular matrix with one row for each g-set degree of freedom and one column for each aerodynamic degree of freedom.

Created By: Module SPLINEU

Notes:

1. The MAPOL sequence supports the following partitions of the UGTKG matrix (see the Theoretical Manual for the exact formation of these matrices):

   $$\mathbf{[UGTKG]} \rightarrow \begin{bmatrix} \varphi \\ \mathbf{UGTKN} \end{bmatrix}$$

   $$\mathbf{[UGTKA]} = \mathbf{[UGTKAB]} + \mathbf{[GSUBO]}^{T}\mathbf{[UGTKO]}$$

Entity: UGTKN

Entity Type: Matrix

Description: Unsteady spline matrix in the n-set derived from UGTKG (see UGTKG).

Entity: UGTKO

Entity Type: Matrix

Description: Unsteady spline matrix in the o-set obtained as a partition of UGTKF (see UGTKG).

Entity: UM

Entity Type: Matrix

Description: Displacements in the m-set derived from UN and TMN (see UG).

Entity: UN

Entity Type: Matrix

Description: Displacements in the n-set derived from UF and YS (see UG).

Entity: UNMK

Entity Type: Unstructured

Description: Contains a global list of Mach number and reduced frequency pairs for which aerodynamic matrices were generated in the aerodynamic matrix lists.

Entity Structure:

RECORD	WORDS	DESCRIPTION
1	1-6	A one-word entry for each combination of symmetry options in the order noted containing the number of m-k pairs having the particular symmetry option
	7 Thru 6+4*nmk	Contains one four word entry for each aerodynamic matrix selected for generation by the MKAEROi entries of the following form: M, K, SYMXZ, SYMXY
2	1 Thru 2*BGRP	Contains the number of j degrees of freedom and the number of k degrees of freedom for each unsteady aerodynamic group

Created By: Module UNSTEADY

Notes:

1. Record 1 is sorted first by Mach number (M) and then by reduced frequency (k) within each M value for each combination of symmetry values. The symmetry options are treated in the following order:

ORDER	SYMXZ	SYMXY
1	-1	-1
2	-1	0
3	0	-1
4	0	0
5	1	-1
6	1	0

Entity: UO

Entity Type: Matrix

Description: Sensitivities of displacements in the o-set.

Matrix Form: A real rectangular matrix with one row for each o-set degree of freedom and one column for each active subcase times the number of design variables.

Created By: MAPOL

Notes:

1. For static aeroelastic analysis, UO is computed from:

   [UO] = **[GASUBO][DUAV]** + **[UOO]**

2. For inertia relief, UO is computed from:

   [UO] = **[GSUBO][DUAV]** + **[UOO]**

Entity: UOO

Entity Type: Matrix

Description: Intermediate displacement sensitivities of the o-set.

Matrix Form: A real rectangular matrix with one row for each o-set degree of freedom and one column for each active subcase times the number of design variables.

Created By: GFBS

Notes:

1. UOO is computed from:
   [KAOO][UOO] =
   [[DPOV] + **[POARO][DDELDV]]**
2. For inertia relief, UOO is computed from:
   [KAOO][UOO] =
   [[DPOV] + **[IFM][DUAD]]**

Entity: USET

Entity Type: Unstructured

Description: Contains the bit masks defining the structural sets to which the degrees of freedom belong.

Entity Structure:

Record:

i Each record contains the boundary condition id as the first word followed by one word for each dependent set containing the number of DOF in each dependent set.These are followed by one word for each degree of freedom containing the bit masks defining the structural sets to which they belong.

Created By: Module MKUSET

Notes:

1. This entity contains one record for each boundary condition in the problem.
2. The bit masks are used to generate matrix partitioning vectors.
3. The 11th word of the INFO array for this entity contains the number of degrees of freedom in the structural model (g- set size).
4. The USET header words have the following meaning:
   1 Boundary condition ID
   2 Number of m-set dof's
   3 Number of s-set dof's
   4 Number of o-set dof's
   5 Number of r-set dof's

Entity: UTRANA

Entity Type: Matrix

Description: Matrix of transient response quantities in the a-set.

Matrix Form: Complex rectangular matrix with one row for each a-set degree of freedom and three columns (corresponding to displacement, velocity, and acceleration) for each time step at which transient response output is required.

Created By: Module DYNRSP or MAPOL

Notes:

1. If the direct method of transient response is used, UTRANA is computed in module DYNRSP.If the modal method is used, UTRANA is recovered using UTRANI and PHIA.

Entity: UTRANE

Entity Type: Matrix

Description: Matrix of frequency response quantities in the e-set.

Matrix Form: Complex rectangular matrix with one row for each e-set degree of freedom and three columns (corresponding to displacement, velocity, and acceleration) for each time step at which transient response output is required.

Created By: Module DYNRSP

Entity: UTRANF

Entity Type: Matrix

Description: Matrix of frequency response quantities in the f-set.

Matrix Form: Complex rectangular matrix with one row for each f-set degree of freedom and three columns (corresponding to displacement, velocity, and acceleration) for each time step at which transient response output is required.

Created By: MAPOL

Entity: UTRANG

Entity Type: Matrix

Description: Matrix of frequency response quantities in the g-set.

Matrix Form: Complex rectangular matrix with one row for each g-set degree of freedom and three columns (corresponding to displacement, velocity, and acceleration) for each frequency at which frequency response output is required.

Created By: MAPOL

Entity: UTRANI

Entity Type: Matrix

Description: Matrix of frequency response quantities in the i-set.

Matrix Form: Complex rectangular matrix with one row for each i-set degree of freedom and three columns (corresponding to displacement, velocity, and acceleration) for each time step at which transient response output is required.

Created By: Module DYNRSP

Notes:

1. This matrix is only computed when the modal method of transient response analysis is invoked.

Entity: UTRANN

Entity Type: Matrix

Description: Matrix of frequency response quantities in the n-set.

Matrix Form: Complex rectangular matrix with one row for each n-set degree of freedom and three columns (corresponding to displacement, velocity, and acceleration) for each time step at which transient response output is required.

Created By: MAPOL

Entity: VELOLIST

Entity Type: Relation

Description: Contains the list of velocity values as input from the Bulk Data file.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I	Set identification number
VELOCITY	R>0.0	Velocity value

Created By: Module IFP.

Entity: VSDAMP

Entity Type: Relation

Description: Contains the specification of parameters used to generate viscous damping terms in the dynamic matrices.

Relation Attributes:

NAME	TYPE	DESCRIPTION
SID	I	Set identification number
GVAL	R	Damping value
OMEGA3	R	Cyclic frequency

Created By: Module IFP

Notes:

1. If both GVAL and OMEGA3 are nonzero, equivalent structural damping is used to generate the BDD and/or BHH entities.

2. If only GVAL is nonzero, structural damping is used for direct or modal frequency or flutter analyses.

Entity: WGHDRVA

Entity Type: Relation

Description: Contains the user function requested element weight sensitivity information.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
MXCOL	I>0	Matrix column number in [MXWGHDVA] for the sensitivity values

Created By: Module MSWGGRAD

Entity: WGHRESP

Entity Type: Relation

Description: Contains the user function requested element weight values.

Relation Attributes:

NAME	TYPE	DESCRIPTION
INSTANCE	I	User function instance number
POSITION	I(2)	Response position index
VALUE	R	Response value

Created By: Module MSWGRESP

Entity: YS

Entity Type: Subscripted Matrix

Description: Contains the column vector of enforced displacements of degrees of freedom constrained by single point constraints (see UG).

Matrix Form: A variable-sized single precision column vector having one row for each single point constraint degree of freedom.

Created By: Module MKUSET

Notes:

1. If no nonzero enforced displacements are specified for SPC'd degrees of freedom, this matrix will have no columns.

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