3. MODEL DATA

3.1 *SMT DATA xxx

The header identifies the SMT data format with version number *xxx* and appears as the first line of the data file.

3.2 ANALYSIS CONTROL

3.2.1 ANTYPE

The tag identifies the analysis type

ANTYPE	*Analysis Type*

Analysis Type

STATIC– for performing linear static analysis

FREEVIB– for performing free-vibration analysis

BUCKLING – performing linear buckling analysis

TRANSRESPONSE – for performing transient response analysis

FREQRESPONSE – for performing frequency response analysis

RANDOMRESPONSE – for performing random response analysis

VISCOELASTIC – for performing visco elastic analysis

NLSTATIC – for performing non-linear static analysis

STEADYSTATE -for performing heat transfer steady state analysis.

HTTRANSIENT – for performing heat transfer transient analysis

3.2.2 SOLDATA

The general data associated with an analysis type.

SOLDATA	*Dat1*	*Dat2*	*Dat3*	*Dat4*	….	….

The data items *Dat1, Dat2,…* depend on the type of analysis as described below

Static Analysis

Dat1 - To be specified as stress output is required or not in the results file.

(Default: Yes)

Free vibration Analysis

Dat1 - Number of vibration modes (Default: 20)

Dat2 - An optional real number α that will be used to modify the stiffness matrix K- > K + α M to avoid singularity in the computation of eigen values (Default is zero, in which case the software computes α internally)

Dat3 - Option for mass matrix (Default: 1)

0 - Lumped

1 – Consistent

2 – Coupled

Dat4 - Effective mass output (Default: No)

Dat5 - Start frequency (Default: 0)

Dat6 - End frequency (Default: 0)

Buckling Analysis

Dat1 - No of eigen values (Default: 10)

Dat2 - Stress computation (Default: Yes)

Transient Response Analysis

Dat1 - Number of eigen values (Default: 10)

Dat2 - Number of time steps (Default: 100)

Dat3 - Start Time (Default: 0)

Dat4 - End Time (Default: 1.0)

Dat5 - Time step

Dat6 - Option for mass matrix (Default: 0)

0 - Consistent

1 – Lumped

2 – Coupled

Dat7 - Stress computation (Default: No)

Dat8 - Node Ids

Frequency and Random Response Analysis

Dat1 - Option for response extraction (Auto/frequency steps)

Dat2 - Number of modes (Default: 20)

Dat3 - Option for mass matrix (Default: 1)

0-Consistent

1-Lumped

2- Coupled

Dat4 - Stress computation (Default: No)

Dat5 - Start frequency (Default: 10)

Dat6 - Maximum frequency (Default: 100)

Dat7 - Finer increment (Default: 1)

Dat8 - Coarser increment (Default: 10)

Dat9 - Node List

NOTES

1. A smaller value is generally specified for *Finer Increment* compared to *Coarser Increment* to generate more data points in the neighborhood of natural frequencies where peak responses are more probable.

Viscoelastic Analysis

Dat1 - Start time (Default: 0)

Dat2 - End time (Default: 10)

Dat3 - Number of time steps

Dat4 - Reference temperature

Dat5 - Thermal State

NL-static Analysis

Dat1 - Minimum load factor(Default:0.1)

Dat2 - Maximum load factor (Default: 1.0)

Dat3 - Max Iterations (Default: 20)

Dat4 - Tolerance (Default: 1e-4)

Dat5 - Stress output (Default: OFF)

Dat6 - Key word (Total)

Dat7 - Solution Method

HT-Transient Analysis

Dat1 - Initial Temperature

Dat2 - Total time

Dat3 - Time increment

Dat4 - Theta (Default: 0.67)

3.2.3 LINSOL

Linear solver type

LINSOL	*Solver Type*

Solver Type (Default: MULTIFRONTAL)

CHOLESKY	Cholesky solver
MULTIFRONTAL	Multi Frontal solver
CGSOLVER	Pre conditioned conjugate gradient solver

3.2.4 EIGSOL

Eigen solver type

EIGSOL	*Solver Type*

Solver Type (Default: LANCZOS)

LANCZOS	Lanczos solver
SSI	Progressive Simultaneous Iteration solver

3.3 INITDISP – Initial displacement

Initial displacement for transient response analysis

INITDISP	*ID*	*LCS ID*	*Data*	*Node Ids*

ID Identification number for initial displacement

LCS ID Identification number for local coordinate system

Data Displacement and rotation in X, Y, Z direction.

Node Ids List of nodes (See section 7.0)

3.4 INITVEL – Initial velocity

Initial velocity for transient response analysis

INITVEL	*ID*	*LCS ID*	*Data*	*Node Ids*

ID Identification number for initial displacement

LCS ID Identification number for local coordinate system

Data Velocity and angular velocity in X, Y, Z direction.

Node Ids List of nodes (See section 7.0)

3.5 DAMPING

Explicit damping as percentage of critical damping

DAMPING	*ID*	*N*	*Mode 1*	*Factor1*	*Mode 2*	*Factor2*	…

ID - Identification Number

N - Total number of damping factors

Mode *i* - Mode identification number for i^{th} mode

Factor *i* - Damping factor (percentage of critical damping) for i^{th} mode

3.6 NSUB – Number of Substructures

NSUB	*N*

N - Total number of substructures used for computation. If NSUB = 0, an optimum number substructures is automatically determined by the software

3.7 N - NODE

Data defining a node

N	*ID*	*X*	*Y*	*Z*	*T*	*Ext*

ID Identification number for the node (positive integer)

X X coordinate of the node

Y Y coordinate of the node

Z Z coordinate of the node

T Temperature data

Ext External/Internal status, if there are predefined substructures as indicated in the list of elements (Section 3.9).

EXT=1, if node is at the interface of two or more predefined substructures

EXT=0, otherwise

Eg :- N, 2, 20, 10.5, 0, 0, 0 for a node with ID = 2 and coordinates (**20.0, 10.5, 0.0)**

3.8 E - ELEMENT

Data defining an element

E	*ID*	*LCSID*	*TYPE*	*nNode*	*Connectivity*	*MATID*	*PROPID*

ID Identification number for the element (positive integer)

LCSID Identification number of the substructure, if any, to which the element belongs

TYPE A string identifier for the element type (Table I)

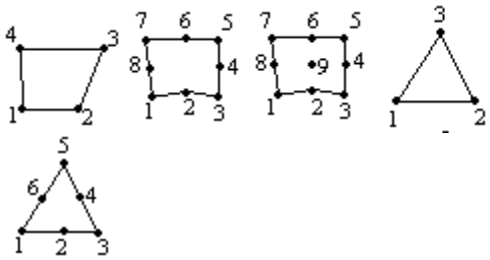
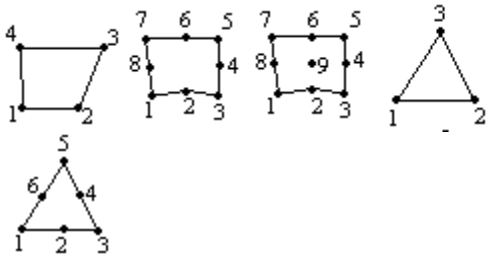
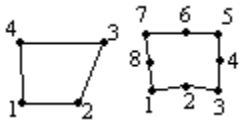
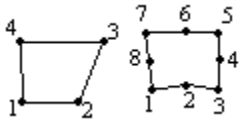
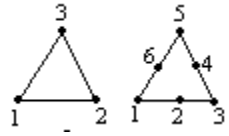
MATID Material ID for the element (positive integer)

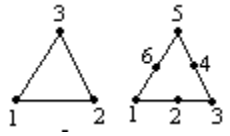
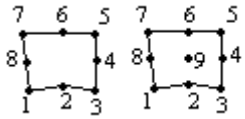
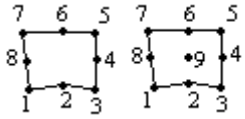
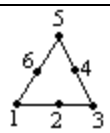
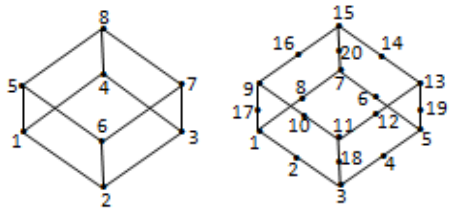
PROPID Property ID for the element (positive integer)

nNode Number of nodes for the element

Connectivity Nodal connectivity for the element in the order as shown in Table I

Identifier	**Element Type**	**Connectivity**
BEAM3D	3D Beam (2 Nodes – 6 DOF per node)	

TRUSS3D	Space Truss (2 Nodes – 3 DOF per node)	
CONROD	Truss with torsion (2 Nodes – 6 DOF per node)	
PSTRAIN	Plane Strain 3/6 node triangles, 4/8/9 node quadrilaterals DOFs: UX, UY	
PSTRESS	Plane Stress 3/6 node triangles 4/8/9 node quadrilaterals DOFs: UX, UY	
SHELL	Isotropic Quadrilateral Shell 4/8 node DOFs: UX, UY,UZ,RX,RY,RZ	
CSHELL	Layered Quadrilateral Shell 4/8 node DOFs: UX, UY,UZ,RX,RY,RZ	
TSHELL	Isotropic Triangular Shell 3/6 node DOFs: UX, UY,UZ,RX,RY,RZ	

CTSHELL	Layered Triangular Shell 3/6 node DOFs: UX, UY,UZ,RX,RY,RZ	
HPSTRAIN	Viscoelastic Quadrilateral Planestrain 8/9 node DOFs: UX, UY	
HAXISYM	Viscoelastic Quadrilateral Axisymmetric 8/9 nodes DOFs: UX, UY	
HPSTRIA	Viscoelastic Triangular Planestrain 6 nodes DOFs: UX, UY	
HAXITRIA	Viscoelastic Triangular Axisymmetric 6 nodes DOFs: UX, UY	
BRICK	Brick element 8/20 nodes DOFs: UX, UY, UZ	

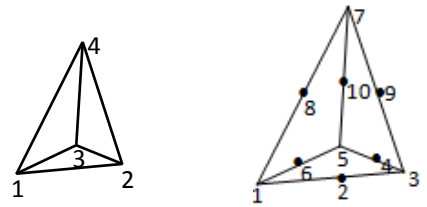
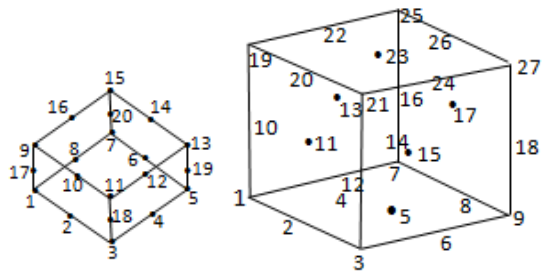
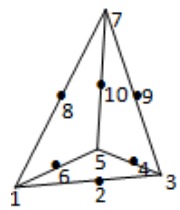
TETRA	Tetra element 4/10 nodes DOFs: UX, UY, UZ	
HBRICK	Viscoelastic Brick 20/27 nodes DOFs: UX, UY, UZ	
HTETRA	Viscoelastic Tetra 10 nodes DOFs: UX, UY, UZ	
RLINK	Rigid link	Note 2
TYING	Tying (Coupled displacements)	Note 1
SPRING1	Spring element (equivalent to CELAS2 element of NASTRAN)	Note 3
SPRING	Translational and torsional spring element	Note 4
MASS	Concentrated mass	Note 5
GAP	Gap elements	Note 6
GLUE	Glue elements	Note 7

TABLE I Element Types

Example

1. E, 10, 0, SHELL, 4, 1, 2, 8, 7, 12, 4

Defines a quadrilateral shell element (ID=10) with connectivity 1, 2, 8, 7

Material Id = 12

Physical property Id = 4

NOTE:

1. TYING defines coupled displacements. A typical data line for the TYING element is in the form

   E, 26, 0, TYING, 4 , 31, 0, 0, 123

   Which connects UX, UY and UZ degrees of freedom of node 31 are tied to corresponding DOFs of node 4. Element ID = 26 and LCS ID = 0.

2. A typical data line for the RLINK element is in the form

   E, 30, 0, RLINK , 23 ,10, 0, 0, 123

   Which connects the UX, UY and UZ DOFs of node 10 with the master node 23. Element ID = 30 and LCS ID = 0.

3. SPRING1 defines a scalar spring element that is equivalent to the CELAS2 element of NASTRAN. A typical data line for the SPRING1 element is in the form

   E, 250091, 0, **SPRING1**, 2 , 100001 ,100300, 1e+13, 1, 1

   which connects UX degrees of freedom (indicated by 1, 1) of the nodes 100001 and 100300, spring constant = 1e+13. Element ID = 250091

4. SPRING defines a translational or torsional spring element. A typical data line for the SPRING element is in the form

   E, 82, 0, **SPRING**, 2 ,53 ,54, 1e+08, 1, 0, 0, 0

   Element ID = 82, connects nodes 53 and 54, spring constant = 1e+8. The field after spring constant indicates whether it is translational (=0) or torsional (=1). The next

three fields specify a vector of the spring direction which is optional and it has to be specified if the element connects two coinciding nodes.

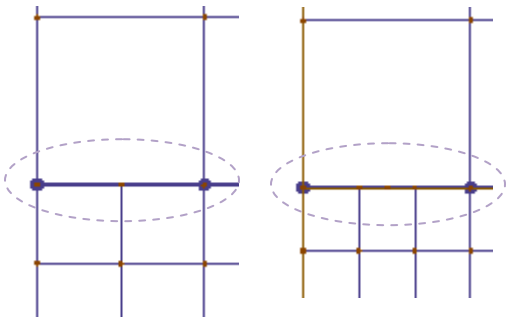
5. MASS defines a concentrated mass element. A typical data line for MASS element is in the form

   E, 39, 0, MASS , 31 ,MX = 1, MY = 2, MZ = 5,

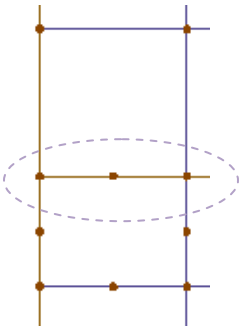
6. GAP defines gap element. A typical data line for GAP element is in the form

   E, 50, 0, GAP, 6 ,12, Y, 1

7. The GLUE element can be used for either connecting 4-node quadrilateral elements to 8-node quadrilaterals (or 3-node TRIA to 6-node TRIA), or connecting two mesh having different mesh-densities. A GLUE element is defined for every node-set identified along the specified path as shown below



(a) Glue Element connecting mesh of different densities



(b) Glue Element connecting elements of different orders

Eg:- E, 81, 0, GLUE, 3 ,45 ,198 ,34, 1, 1 ,1

3.9 LCS - LOCAL COORDINATE SYSTEM

The user defined local coordinate system must have an ID number greater than 2 and it may be Cartesian, Cylindrical or Spherical.

LCS	*ID*	*TYPE*	*o1*	*o2*	*o3*	*u1*	*u2*	*u3*	*v1*	*v2*	*v3*

ID Unique identification number. Note that LCS with IDs 0, 1 and 2 are pre-defined, where

=0 Global Cartesian (Default)

=1 Global Cylindrical

=2 Global Spherical

TYPE =0 Cartesian (Default)

=1 Cylindrical

=2 Spherical

o1,o2,o3 Origin (o1, o2, o3) of the local coordinate system. (Default: 0/0/0)

u1,u2, u3 components of local x-axis

v1,v2, v3 components of a vector that defines local xy plane

Eg:- LCS, 3, 0, 0, 2, 0, 1, 0, 0, 0, 1, 0 - an LCS (ID=3, Cartesian) with origin (0,2,0) and the vectors (1,0,0) and (0,1,0) defining the local xy-plane

3.10 BASEEXCITATION – Base Excitation

BASEEXCITATION	*ID*	*LCSID*	*DOF*	*A*	*Node Ids*

ID	Identification number for base excitation
LCS ID	Identification number for local coordinate system
DOF	Degree of freedom UX,UY,UZ,RX,RY or RZ
A	Acceleration data
Node Ids	List of nodes (See Section 7.0)

Eg:- BASEEXCITATION, 1, 0, UZ, 1, 1T211B21

3.11 AUTOPSD – Auto PSD for random response

Power spectral density function associated with loads for random response analysis

AUTOPSD	*ID*	*L*	*N*	*F1*	*U1*	*F2*	*U2*	…….	…..

ID	Identification number for Auto PSD
L	Load Identifier
N	Total number of data
F i	Frequency data in Hz
U i	Unit data

Eg:- AUTOPSD, 1, Pressure-1, 2, 45,50

3.12 FSIDATA – Data for fluid structure interaction

Details of fluid in contact with a structure for including the influence of fluid in modal computations

FSIDATA	*ID*	*Density*	*LCS ID*	*H*	*CF*

ID Identification number for data

Density Fluid density

LCS ID Identification number for local coordinate system

H Height

CF Faces in Contact with fluid

Eg:- FSIDATA, 1, 2.8e-9, 0, 10, ALL(F1)

3.13 SCALEMASS – Scale factor for mass computation

The mass of the structure is scaled by the scale factor during computations

SCALEMASS	*Data*

Data Scale factor for mass

Eg:- SCALEMASS, 15.5

3.14 INERTIARELIEF – Inertia Relief

INERTIARELIEF	*SupN1*	*Dof1*	*SupN2*	*Dof2*	*SupN3*	*Dof3*	*Ref*

SupN1 - *Support Node1*

Dof1	-	*Degree of freedom1*
SupN2	-	*Support Node2*
Dof2	-	*Degree of freedom2*
SupN3	-	*Support Node3*
Dof3	-	*Degree of freedom3*
Ref	-	*Reference point in X, Y, Z direction*