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SPAR DATA SET CONTENTS

Sally W. Cunningham

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National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia 23665

CONTENTS

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SUMMARY

The SPAR structural analysis system consists of a collection of processors for performing finite-element analysis. The data generated by each of these processors are stored in a data base library as two-dimensional tables or matrices called data sets. These data sets are identified by four-word names which are listed in the table of contents for the data base library.

This report documents the contents of the SPAR data sets. The creating SPAR processor, number of rows and columns, and definitions of each of the data items are documented for each data set. An example problem is included, with SPAR input and resulting table of contents. This information can be used to create new SPAR processors or to interface SPAR with another system.

INTRODUCTION

The SPAR computer software system is a collection of processors for performing finite-element structural analysis. The data generated by each processor is stored on a data base complex for use by subsequent processors. This data may be read by the user through SPAR data processors (ref. 1) or FORTRAN data handling utilities (ref. 2).

This report documents the contents of many of the SPAR data sets stored in the data base complex. An example problem for creating the data sets documented in this report is included, with the SPAR input and resulting table of contents listed. This data was collected in the course of writing an interface from SPAR to another data base complex, and represents the formalizing of a set of notes passed on by several users. This information can be used (1) to understand more clearly and to use more productively the existing processors in the SPAR system, (2) to develop new SPAR processors, or (3) to interface SPAR with another software system.

SPAR DATA SET CONTENTS

The SPAR software system, created by W. D. Whetstone, is composed of processors for performing finite-element structural analysis. The data from a SPAR run is saved in a data file organized as a "library." Each library file is composed of a number of datasets and a table of contents. These library files have names SPARLA through SPARLZ for Control Data; SPAR-A through SPAR-Z for Univac; or SPLA through SPLZ for PRIME or VAX; corresponding to SPAR library numbers 1 through 26. The data is automatically put in library 1 by the processors. This file may be renamed to another library name and may still be read using DCU or the data handling utilities.

The data are stored in 2-dimensional tables or matrices dimensioned (NI, NJ) called blocks. Each data set contains one or more blocks with NI rows and NJ columns. Following are lists of the contents of many SPAR data sets. The creating SPAR processor, number of rows and columns, and the definition of each of the data items are listed for each data set.

JDF1 BTAB 1 8

Created from TAB processor START card.
NJ = 1
NI = 18

Contents:

1. Total number of joints.
2. Number of joint degrees of freedom, both translations and rotations, constrained by START card.
3. Number of joint translational degrees of freedom not constrained.

4. 5. 6. 7. 8. 9.	A list of unconstrained joint degrees of freedom, filled in consecutively from position 4; unused values are zero. Example for d.o.f. 1, 2, and 6 unconstrained: 1,2,6,0,0,0
10. 11. 12. 13. 14. 15.	A list specifying the order of each unconstrained degree of freedom; zero if not active. Example for d.o.f. 1, 2, and 6 unconstrained: 1,2,0,0,0,3
16. 17. 18.	Not used.

JREF BTAB 2 6

Created from JREF in processor TAB.
NJ = Total number of joints
NI = 1

Contents:

Contains the Joint Reference Frame number for each joint, corresponding to the row number of dataset ALTR BTAB 2 4 which contains the definition of each Joint Reference Frame.

ALTR BTAB 2 4

Created from ALTREF in processor TAB.
NJ = Number of alternate reference frames
NI = 12

Contents of each entry:

$$\left.\begin{array}{rl} 1. & a_{11} \\ 2. & a_{21} \\ 3. & a_{31} \\ 4. & a_{12} \\ 5. & a_{22} \\ 6. & a_{32} \\ 7. & a_{13} \\ 8. & a_{23} \\ 9. & a_{33} \end{array}\right\} \text{Components of a coordinate transformation matrix}$$

$$\left.\begin{array}{rl} 10. & X_o \\ 11. & Y_o \\ 12. & Z_o \end{array}\right\} \text{Location of origin of alternate reference frame given in global coordinates}$$

Formula:

$$\begin{bmatrix} Xg \\ Yg \\ Zg \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} Xa \\ Ya \\ Za \end{bmatrix} + \begin{bmatrix} X_o \\ Y_o \\ Z_o \end{bmatrix}$$

coordinates in
global reference frame

coordinates in
alternate reference frame

NDAL 0 0

Created from TITLE card in processor TAB.

Contains title in text.

TEXT BTAB 2 2

Created from TEXT card(s) in processor TAB.

Contains data in text.

JLOC BTAB 2 5

Created from JLOC in processor TAB.
NJ = Number of joints
NI = 3

Contents:

J = 1,2,... Number of joints

I = X

Y

Z

Rectangular coordinates of each joint
in the global reference frame

MREF BTAB 2 7

Created from MREF in processor TAB.
NJ = Number of beam orientation entries
NI = 5

Contents of each entry:
(See reference 1 description of MREF input)

Format 1 (Default)
1. Beam axis NB
2. Global axis NG
3. 1 if cosine between NB and NG is positive, -1 if negative
4. Cosine of angle between NB and NG
5. 1. indicating format = 1

Format 2
1. X_1
2. X_2
3. X_3
4. I1 axis orientation
5. -1. indicating format = 2

MATC BTAB 2 2

Created from MATC in processor TAB.
NJ = Number of material types
NI = 10

Contents of each entry:
1. E = Modulus of elasticity
2. ν = Poisson's Ratio
3. $G = E/(2(1+\nu))$
4. ρ = Weight per unit volume
5. α_1 = Thermal expansion coefficient, direction $\overline{x}$
6. α_2 = Thermal expansion coefficient, direction $\overline{y}$
7. Θ = Angle between element reference frame (x,y) and $(\overline{x},\overline{y})$
8.
9. Not used
10.

BA BTAB 2 9

Created from E21 section properties in processor TAB.
NJ = Number of entries
NI = 31

Contents of each entry:
(See reference 1 description of DSY input of E21 section properties)

1. Element type indicator
2. } Not used
3.
4. I_1
5. α_1
6. I_2
7. α_2
8. a
9. f
10. f_1
11. z_1
12. z_2
13. θ
14. q_1
15. q_2
16. q_3
17. Number of points at which stresses are to be calculated
18. y_{11}
19. y_{12}
20. y_{21}
21. y_{22}
22. y_{31}
23. y_{32}
24. y_{41}
25. y_{42}
26. b_1
27. t_1
28. b_2
29. t_2
30. b_3
31. t_3

BC BTAB 2 11

Created from E23 section properties in processor TAB.
NJ = Number of entries
NI = 6

Contents of each entry:

1. Cross-sectional area of axial element
2. Cross-sectional area of axial element
3. } Not used.
4.
5.
6.

SA BTAB 2 13

Created from shell section properties in processor TAB.
NJ = Number of entries
Contents vary according to section type:
For MEMBRANE, PLATE, ISOTROPIC or UNCOUPLED section types
NI = 43

Contents of each entry:

1. Number indicating section type:
    1 = MEMBRANE
    2 = PLATE
    3 = ISOTROPIC or UNCOUPLED
2. Pointer to entry of NMAT containing material constants
3. Structural weight/area
4. d_{11}
5. d_{12}
6. d_{22}
7. d_{13}
8. d_{23}
9. d_{33}
10. d_{44}
11. d_{45}
12. d_{55}
13. d_{46}
14. d_{56}
15. d_{66}

flexibility coefficients

16-25. Not used.
26. f_{11}
27. f_{21}
28. f_{31}
29. f_{41}
30. f_{51}
31. f_{61}
32. f_{12}
33. f_{22}
34. f_{32}
35. f_{42}
36. f_{52}
37. f_{62}
38. f_{13}
39. f_{23}
40. f_{33}
41. f_{43}
42. f_{53}
43. f_{63}

stress coefficients

For COUPLED section types:
NI = 43

Contents of each entry:

1. Number indicating section type:
    4 = COUPLED
2. Pointer to entry of NMAT containing material constants
3. Structural weight/area
4. d_{11}
5. d_{12}
6. d_{22}
7. d_{13}
8. d_{23}
9. d_{33}
10. d_{14}
11. d_{24}
12. d_{34}
13. d_{44}
14. d_{15}
15. d_{25}
16. d_{35}
17. d_{45}
18. d_{55}
19. d_{16}
20. d_{26}
21. d_{36}
22. d_{46}
23. d_{56}
24. d_{66}

flexibility coefficients

25. Number of layers
26. f_{11}
27. f_{21}
28. f_{31}
29. f_{41}
30. f_{51}
31. f_{61}
32. f_{12}
33. f_{22}
34. f_{32}
35. f_{42}
36. f_{52}
37. f_{62}
38. f_{13}
39. f_{23}
40. f_{33}
41. f_{43}
42. f_{53}
43. f_{63}

stress coefficients

For LAMINATE section types:
NI = 25 + (18 times number of layers)

Contents of each entry:

1. Number indicating section type:
   5 = LAMINATE
2. Pointer to entry of NMAT containing material constants
3. Structural weight/area
4. d_{11}

$$\left.\begin{array}{ll} 5. & d_{12} \\ 6. & d_{22} \\ 7. & d_{13} \\ 8. & d_{23} \\ 9. & d_{33} \\ 10. & d_{14} \\ 11. & d_{24} \\ 12. & d_{34} \\ 13. & d_{44} \\ 14. & d_{15} \\ 15. & d_{25} \\ 16. & d_{35} \\ 17. & d_{45} \\ 18. & d_{55} \\ 19. & d_{16} \\ 20. & d_{26} \\ 21. & d_{36} \\ 22. & d_{46} \end{array}\right\} \text{flexibility coefficients}$$

23. d_{56}
24. d_{66}

25. Number of layers
26. g^1_{11}
27. g^1_{21}
28. g^1_{31}

$$\left.\begin{array}{ll} 29. & g^1_{12} \\ 30. & g^1_{22} \\ 31. & g^1_{32} \\ 32. & g^1_{13} \\ 33. & g^1_{23} \\ 34. & g^1_{33} \\ 35. & g^1_{14} \\ 36. & g^1_{24} \\ 37. & g^1_{34} \\ 38. & g^1_{15} \\ 39. & g^1_{25} \\ 40. & g^1_{35} \end{array}\right\} \text{layer stress recovery coefficients}$$

41. g^1_{16}
42. g^1_{26}
43. g^1_{36}

44-61. $g^2_{11}-g^2_{36}$ for 2nd layer

62-? Eighteen additional values for each successive layer.

CON ncon 0

ncon = Constraint case
Created from CON in processor TAB
NJ = Number of joints
NI = 1

Contents:
Each entry contains an integer representing the Joint Reference Frame number and constrained components for that joint. The bit pattern of each integer contains a 1 for constrained components, zero otherwise, stored in reverse order (6 to 1) with Joint Reference Frame number leading. For example:

A joint with components 1,2,3, and 5 zeroed out and JREF = 11 would have the integer 45333 stored:

$$\text{bit pattern} \rightarrow \underset{\text{JREF number}}{\underline{0.\;.\;.01011}}\quad \underbrace{\underset{6}{\underline{00}}\;\; \underset{5}{\underline{01}}\;\; \underset{4}{\underline{00}}\;\; \underset{3}{\underline{01}}\;\; \underset{2}{\underline{01}}\;\; \underset{1}{\underline{01}}}_{\text{joint motion components}}\;;$$

Component 1 (constrained) = 1 × 1 = 1
Component 2 (constrained) = 1 × 4 = 4
Component 3 (constrained) = 1 × 16 = 16
Component 4 (unconstrained) = 0 × 64 = 0
Component 5 (constrained) = 1 × 256 = 256
Component 6 (unconstrained) = 0 × 1024 = 0
JREF number = 11 = 11 × 4096 = + 45 056
Integer stored for this joint → 45 333

QJJT BTAB 2 9

Created in processor TAB.
NJ = Number of Joints
NI = 9

Contents of each entry:

1. a_{11}
2. a_{21}
3. a_{31}
4. a_{12}
5. a_{22}
6. a_{32}
7. a_{13}
8. a_{23}
9. a_{33}

Formula:

Each entry contains a 3 × 3 matrix to convert Alternate Reference Frame to Global Reference Frame for that joint.

$$\begin{bmatrix} Xg \\ Yg \\ Zg \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} Xa \\ Ya \\ Za \end{bmatrix}$$

coordinates in global reference frame

coordinates in alternate reference frame

DEF Exx y z

Exx = Element name
y = Type number (E21 = 1 through E44 = 12)
z = Number of joints/element
Created from element definitions in processor ELD.
NJ = Number of elements of this type
NI For 2-node elements = 18 columns
3-node elements = 15 columns
4-node elements = 16 columns

Contents of each entry:
1. Element number
2. Group number
3. Element number within group
4. Not used
5. N3 of corresponding dataset xx BTAB N3 N4
6. N4 where xx = BA,BB,SA...
7. Index of MATC containing material constants
8. Index section property dataset containing section properties.
9. Index of non-structural weight dataset (NSW)
10. Index of rigid link offset dataset (BRL)
11. Index of beam orientation dataset (MREF)
12. Not used
13. Joint #1
14. Joint #2
15. Joint #3
16. Joint #4
17. Not used
18. Not used

GD Exx y z

Exx = Element name
y = Type number (E21 = 1 through E44 = 12)
z = Number of joints/element
Created from element definitions in processor ELD.
NJ = Number of groups
NI = 2

Contents of each entry:
1. Total number of elements within group.
2. Cumulative total of last element in each group for more than one group.

GTIT Exx y z

Exx = Element name
y = Type number (E21 = 1 through E44 = 12)
z = Number of joints/element
Created from element definitions in processor ELD.
NJ = Number of groups
NI = 15

Contents of each entry:
15 words of title for each group.
Default is blanks.

DIR Exx y z

Exx = Element name
y = Type number (E21 = 1 through E44 = 12)
z = Number of joints/element
Created in processor ELD.
NJ = 1
NI = 20

Contents:
1. Number of nodes
2. Type number
3. Number of elements of this type
4. N4 in "xx BTAB N3 N4" where xx is BA,BC,SA...
5. Size of Exx EFIL for this element
6-20. Directory information for element data.

NS 0 0

Created in processor ELD.
NJ = Number of element types present
NI = 15

Contents:
Each entry contains directory information for corresponding element data.

ELTS NAME 0 0

Created in processor ELD.
NJ = 1
NI = Number of element types

Contains alphanumeric element name of each element used in the structure.

ELTS NNOD 0 0

Created in processor ELD.
NJ = Number of element types
NI = 1

Contains the number of nodes in each element type.

ELTS ISCT 0 0

Created in processor ELD.
NJ = Number of element types
NI = 1

Contains N4 of "xx BTAB N3 N4" where xx = BA,BC,SA...

KMAP y z

Created in processor TOPO.
This information is stored in blocks with the block length determined by a RESET control in the TOPO processor. Default block length is 896 words.

Contents:
Used by K, M, and KG to guide assembly of stiffness and mass matrices in the SPAR standard sparse-matrix format.

AMAP y z

Created in processor TOPO.
This information is stored in blocks with the block length determined by a RESET control in the TOPO processor. Default block length is 1792 words.

Contents:
Used by INV in factoring system matrices, such as the reduction of the stiffness matrix.

Exx EFIL y z

Exx = Element name
y = Type number (E 21 = 1 through E 44 = 12)
z = Number of joints/element
Created in processor E.
NJ = Number of elements of this type

Contents:
Each entry contains alphanumeric information packet with the following categories:

1. Integer information, corrected joint numbers, tables
2. Material constants
3. Geometrical details
4. Section properties
5. Intrinsic stiffness matrix
6. Stress recovery influence matrix
7. Internal stress resultants

DEM DIAG 0 0

Created in processor E.
NJ = Number of joints
NI = 6 minus number of joint motion components constrained on START card

Contains system mass matrix in diagonal form.

K SPAR ncon 0

ncon = constraint case
Created in processor K.
This information is stored in blocks with the block length determined by a RESET control in the K processor. Default block length is 2240 words.

Contains stiffness matrix composed of submatrices, each submatrix corresponding to the connection of one joint to another.

INV x ncon 0

x = First word of the name of the input stiffness matrix
ncon = Constraint case
Created in processor INV.
This information is stored in blocks with the block length determined by a RESET control in the INV processor. Default block length is 3584 words.

Contains factored system matrix.

CEM SPAR ncon 0

ncon = Constraint case
Created in processor M.
This information is stored in blocks with the block length determined by a RESET control in the M processor. Default block length is 2240 words.

Contains unconstrained system consistent mass matrices considering only the structural and nonstructural distributed mass associated with the elements.

CASE TITL iset

iset = Load set
Created in processor AUS.
Number of blocks = Number of load cases in this load set.

Contents:
Each block contains the title for the corresponding load case in text.

APPL FORC iset

iset = Load set
Created in processor AUS.
NJ = Number of joints
NI = 6 minus number of joint motion components constrained on START card.
Number of blocks = Number of load cases in this load set.

Contents:
Each entry contains applied forces and moments on that joint in each active direction.

APPL MOTI iset

iset = Load set
Created in processor AUS.
NJ = Number of joints
NI = 6 minus number of joint motion components constrained on START card.
Number of blocks = Number of load cases in this load set.

Contents:
Each entry contains applied motions on that joint in each active direction.

NODA TEMP iset

iset = Load set
Created in processor AUS part TABLE
NJ = Number of joints
NI = 1
Number of blocks = Number of load cases in this load set.

Contents:
Each block of data contains nodal temperatures for every joint in the structure. One block corresponds to one load case.

NODA PRES iset

iset = Load set
Created in processor AUS part TABLE
NJ = Number of joints
NI = 1
Number of blocks = Number of load cases in this load set.

Contents:
Each block of data contains nodal pressures for every joint in the structure. One block corresponds to one load case.

TEMP Exx iset icase

Exx = Element name
iset = Load set
icase = Load case within Load set
Created in processor AUS.
NJ = Number of elements of this type.

For 2-node elements:
Note: Not defined for E25 elements
NI = 3

Contents of each entry:

1. Average temperature of the element
2. Transverse gradient in direction 1
3. Transverse gradient in direction 2

For 3-node elements:

Note: Not defined for E32 elements
NI = 3

Contents of each entry:

1. Temperature at joint 1 of element
2. Temperature at joint 2 of element
3. Temperature at joint 3 of element

For 4-node elements:

Note: Not defined for E42 elements
NI = 4

Contents of each entry:

1. Temperature at joint 1 of element
2. Temperature at joint 2 of element
3. Temperature at joint 3 of element
4. Temperature at joint 4 of element

Formula:

$$\begin{array}{c}\text{Total effective}\\ \text{temperature at node n}\end{array} = \begin{array}{c}\text{Element temperature}\\ \text{at node n}\end{array} + \begin{array}{c}\text{Nodal temperature from block icase}\\ \text{of dataset "NODA TEMP iset"}\end{array}$$

DISL Exx iset icase

Exx = Element name
iset = Load set
icase = Load case within load set
Created in processor AUS
NJ = Number of elements of this type

For 2-node elements:

NI = 6

Contents of each entry:

1. Displacement in direction 1
2. Displacement in direction 2
3. Displacement in direction 3
4. Rotation about axis 1
5. Rotation about axis 2
6. Rotation about axis 3

These displacements and rotations are relative to a reference frame, parallel to the element's reference frame, and embedded in the terminus.

For E31 elements:
NI = 3

Contents of each entry:
1. Displacement of joint 2 in direction 1
2. Displacement of joint 3 in direction 1
3. Displacement of joint 3 in direction 2

For E32 elements:
NI = 6

Contents of each entry:
1. Displacement of joint 2 in direction 3
2. Rotation of joint 2 about axis 1
3. Rotation of joint 2 about axis 2
4. Displacement of joint 3 in direction 3
5. Rotation of joint 3 about axis 1
6. Rotation of joint 3 about axis 2

For E33 elements:
NI = 9

Contents of each entry:
1. Displacement of joint 2 in direction 1
2. Displacement of joint 3 in direction 1
3. Displacement of joint 3 in direction 2
4. Displacement of joint 2 in direction 3
5. Rotation of joint 2 about axis 1
6. Rotation of joint 2 about axis 2
7. Displacement of joint 3 in direction 3
8. Rotation of joint 3 about axis 1
9. Rotation of joint 3 about axis 2

For E41 elements:
NI = 6

Contents of each entry:
1. Displacement of joint 2 in direction 1
2. Displacement of joint 3 in direction 1
3. Displacement of joint 3 in direction 2
4. Displacement of joint 4 in direction 1
5. Displacement of joint 4 in direction 2
6. Displacement of joint 4 in direction 3

For E42 elements:
NI = 6

Contents of each entry:
1. Displacement of joint 2 in direction 3
2. Rotation of joint 2 about axis 1
3. Rotation of joint 2 about axis 2
4. Displacement of joint 3 in direction 3

5. Rotation of joint 3 about axis 1
6. Rotation of joint 3 about axis 2
7. Displacement of joint 4 in direction 3
8. Rotation of joint 4 about axis 1
9. Rotation of joint 4 about axis 2

For E43 elements:
NI = 14

Contents of each entry:
1. Displacement of joint 2 in direction 1
2. Displacement of joint 3 in direction 1
3. Displacement of joint 3 in direction 2
4. Displacement of joint 4 in direction 1
5. Displacement of joint 4 in direction 2
6. Displacement of joint 2 in direction 3
7. Rotation of joint 2 about axis 1
8. Rotation of joint 2 about axis 2
9. Displacement of joint 3 in direction 3
10. Rotation of joint 3 about axis 1
11. Rotation of joint 3 about axis 2
12. Displacement of joint 4 in direction 3
13. Rotation of joint 4 about axis 1
14. Rotation of joint 4 about axis 2

For E44 elements:
NI = 6

Contents of each entry:
1. Displacement of joint 2 in direction 1
2. Displacement of joint 3 in direction 1
3. Displacement of joint 3 in direction 2
4. Displacement of joint 4 in direction 1
5. Displacement of joint 4 in direction 2
6. Displacement of joint 4 in direction 3

PRES Exx iset icase

Exx = Element name
iset = Load set
icase = Load case within Load set
Created in processor AUS
NJ = Number of elements of this type

For 3-node elements:
Note: Not defined for 2-node elements.
NI = 3

Contents of each entry:
1. Pressure at joint 1
2. Pressure at joint 2
3. Pressure at joint 3

For 4-node elements:
NI = 4

Contents of each entry:
1. Pressure at joint 1
2. Pressure at joint 2
3. Pressure at joint 3
4. Pressure at joint 4

STAT DISP iset ncon

iset = Load set
ncon = Constraint case
Created in processor SSOL
NJ = Number of joints
NI = 6 minus number of joint motion components constrained on START card

Contents:
Each entry contains static displacements for that joint in each active direction.

STAT REAC iset ncon

iset = Load set
ncon = Constraint case
Created in processor SSOL
NJ = Number of joints
NI = 6 minus number of joint motion components constrained on START card

Contents:
Each entry contains static reactions for that joint in each active direction.

STRS E21 iset icase

iset = Load set
icase = Load case within set
Created in processor GSF.
NJ = Number of E21 elements
NI = 52

Contents of each entry:

1. Group number
2. Element number within group
3. Joint #1
4. Joint #2
5. Max. combined P/A + bending (tension)
6. Max. combined P/A + bending (compression)
7. P/A
8. Transverse shear stress, S_1
9. Transverse shear stress, S_2
10. Twist shear
11. Shear force, end 1, direction 1
12. Shear force, end 1, direction 2
13. Axial force, end 1, direction 3
14. Moment, end 1, direction 4
15. Moment, end 1, direction 5
16. Moment, end 1, direction 6
17. Shear force, end 2, direction 1
18. Shear force, end 2, direction 2
19. Axial force, end 2, direction 3
20. Moment, end 2, direction 4
21. Moment, end 2, direction 5
22. Moment, end 2, direction 6
23. ?
24. I_1
26. α_1
27. I_2
28. α_2
29. Area
30. f_1
31. f_2
32. z_1
33. z_2
34. θ
35. q_1
36. q_2
37. q_3
38. NY = number of points for stress
39. y_{11}
40. y_{12}
41. y_{21}
42. y_{22}
43. y_{31}
44. y_{32}
45. y_{41}
46. y_{42}
47. b_1
48. t_1
49. b_2
50. t_2
51. b_3
52. t_3

STRS E22 iset icase

iset = Load set
icase = Load case within set
Created in processor GSF
NJ = Number of E22 elements
NI = 16

Contents of each entry:

1. Group number
2. Element number within group
3. Joint #1
4. Joint #2
5. Force in direction 1 at joint 1
6. Force in direction 2 at joint 1
7. Force in direction 3 at joint 1
8. Moment about axis 1 at joint 1
9. Moment about axis 2 at joint 1
10. Moment about axis 3 at joint 1
11. Force in direction 1 at joint 2
12. Force in direction 2 at joint 2
13. Force in direction 3 at joint 2
14. Moment about axis 1 at joint 2
15. Moment about axis 2 at joint 2
16. Moment about axis 3 at joint 2

STRS E23 iset icase

iset = Load set
icase = Load case within set
Created in processor GSF.
NJ = Number of E23 elements
NI = 6

Contents of each entry:

1. Group number
2. Element number within group
3. Joint #1
4. Joint #2
5. Force in element
6. Stress in element

STRS E24 iset icase

iset = Load set
icase = Load case within set
Created in processor GSF
NJ = Number of E24 elements
NI = 18

Contents of each entry:

1. Group number
2. Element number within group
3. Joint #1
4. Joint #2
5. Axial force at joint 1
6. Transverse shear at joint 1
7. Moment at joint 1
8. Axial force at joint 2
9. Transverse shear at joint 2
10. Moment at joint 2
11. Axial stress at joint 1
12. Shear stress at joint 1
13. Bending stress on upper surface at joint 1
14. Bending stress on lower surface at joint 1
15. Axial stress at joint 2
16. Shear stress at joint 2
17. Bending stress on upper surface at joint 2
18. Bending stress on lower surface at joint 2

STRS E25 iset icase

iset = Load set
icase = Load case within set
Created in processor GSF.
NJ = Number of E25 elements
NI = 16

Contents of each entry:

1. Group number
2. Element number within group
3. Joint #1
4. Joint #2
5. Force in direction 1 at joint 1
6. Force in direction 2 at joint 1
7. Force in direction 3 at joint 1
8. Moment about axis 1 at joint 1
9. Moment about axis 2 at joint 1
10. Moment about axis 3 at joint 1
11. Force in direction 1 at joint 2
12. Force in direction 2 at joint 2
13. Force in direction 3 at joint 2
14. Moment about axis 1 at joint 2
15. Moment about axis 2 at joint 2
16. Moment about axis 3 at joint 2

STRS E31 iset icase

iset = Load set
icase = Load case within set
Created in processor GSF.
NJ = Number of E31 elements
NI = 11

Contents of each entry:

1. Group number
2. Element number within group
3. Joint #1
4. Joint #2
5. Joint #3
6. T_{11}
7. T_{22}
8. T_{12}
9. Tractive force in x-direction Nx
10. Tractive force in y-direction Ny
11. Shearing force Nxy

Formulae:

S_x = Nx/thickness
S_y = Ny/thickness
T_{xy} = Nxy/thickness

STRS E32 iset icase

iset = Load set
icase = Load case within set
Created in processor GSF.
NJ = Number of E32 elements
NI = 28

Contents of each entry:

1. Group number
2. Element number within group
3. Joint #1
4. Joint #2
5. Joint #3
6. ?
7. ?
8. ?
9. Mx Bending moment about x-axis at joint 1
10. My Bending moment about y-axis at joint 1
11. Mxy Twisting moment at joint 1
12. Qx Transverse shear in x-direction at joint 1
13. Qy Transverse shear in y-direction at joint 1
14. Mx Bending moment about x-axis at joint 2
15. My Bending moment about y-axis at joint 2
16. Mxy Twisting moment about joint 2
17. Qx Transverse shear in x-direction at joint 2
18. Qy Transverse shear in y-direction at joint 2
19. Mx Bending moment about x-axis at joint 3
20. My Bending moment about y-axis at joint 3
21. Mxy Twisting moment at joint 3
22. Qx Transverse shear in x-direction at joint 3
23. Qy Transverse shear in y-direction at joint 3
24. Mx Bending moment about x-axis at the center
25. My Bending moment about y-axis at the center
26. Mxy Twisting moment at the center
27. Qx Transverse shear in x-direction at the center
28. Qy Transverse shear in y-direction at the center

Formulae:

$$\begin{array}{lll} Sx = f_{4j}M_x & f_{41} = \ ? \ f_{51} = \ ? \ f_{61} = ? \\ Sy = f_{5j}M_y & f_{42} = f_{52} = -f_{62} = 6/(\text{thickness})^2 \\ Txy = f_{6j}M_{xy} & f_{43} = f_{53} = -f_{63} = -6/(\text{thickness})^2 \end{array}$$

STRS E33 iset icase

iset = Load set
icase = Load case within set
Created in processor GSF.
NJ = Number of E33 elements
NI = 31

Contents of each entry:

1. Group number
2. Element number within group
3. Joint #1
4. Joint #2
5. Joint #3
6. ?
7. ?
8. ?
9. Nx Tractive force in x-direction
10. Ny Tractive force in y-direction
11. Nxy Shearing force
12. Mx Bending moment about x-axis at joint 1
13. My Bending moment about y-axis at joint 1
14. Mxy Twisting moment at joint 1
15. Qx Transverse shear in x-direction at joint 1
16. Qy Transverse shear in y-direction at joint 1
17. Mx Bending moment about x-axis at joint 2
18. My Bending moment about y-axis at joint 2
19. Mxy Twisting moment at joint 2
20. Qx Transverse shear in x-direction at joint 2
21. Qy Transverse shear in y-direction at joint 2
22. Mx Bending moment about x-axis at joint 3
23. My Bending moment about y-axis at joint 3
24. Mxy Twisting moment at joint 3
25. Qx Transverse shear in x-direction at joint 3
26. Qy Transverse shear in y-direction at joint 3
27. Mx Bending moment about x-axis at the center
28. My Bending moment about y-axis at the center
29. Mxy Twisting moment at the center
30. Qx Transverse shear in x-direction at the center
31. Qy Transverse shear in y-direction at the center

Formulae:

$Sx = f_{1j}Nx + f_{4j}Mx$ $\qquad f_{ij} = 1/\text{thickness for } i \text{ and } j = 1,2,3$
$Sy = f_{2j}Ny + f_{5j}My$ $\qquad f_{42} = f_{52} = -f_{62} = 6/(\text{thickness})^2$
$Txy = f_{3j}Nxy + f_{6j}Mxy$ $\qquad f_{43} = f_{53} = -f_{63} = -6/(\text{thickness})^2$

STRS E41 iset icase

iset = Load set
icase = Load case within set
Created in processor GSF.
NJ = Number of E41 elements
NI = 23

Contents of each entry:
1. Group number
2. Element number within group
3. Joint #1
4. Joint #2
5. Joint #3
6. Joint #4
7. ?
8. ?
9. Nx Tractive force in x-direction at joint 1
10. Ny Tractive force in y-direction at joint 1
11. Nxy Shearing force at joint 1
12. Nx Tractive force in x-direction at joint 2
13. Ny Tractive force in y-direction at joint 2
14. Nxy Shearing force at joint 2
15. Nx Tractive force in x-direction at joint 3
16. Ny Tractive force in y-direction at joint 3
17. Nxy Shearing force at joint 3
18. Nx Tractive force in x-direction at joint 4
19. Ny Tractive force in y-direction at joint 4
20. Nxy Shearing force at joint 4
21. Nx Tractive force in x-direction at the center
22. Ny Tractive force in y-direction at the center
23. Nxy Shearing force at the center

Formulae:

Sx = Nx /thickness
Sy = Ny /thickness
Txy = Nxy/thickness

STRS E42 iset icase

iset = Load set
icase = Load case within set
Created in processor GSF.
NJ = Number of E42 elements
NI = 33

Contents of each entry:
1. Group number
2. Element number within group
3. Joint #1
4. Joint #2
5. Joint #3
6. Joint #4
7. ?
8. ?

9. Mx Bending moment about x-axis at joint 1
10. My Bending moment about y-axis at joint 1
11. Mxy Twisting moment at joint 1
12. Qx Transverse shear in x-direction at joint 1
13. Qy Transverse shear in y-direction at joint 1
14. Mx Bending moment about x-axis at joint 2
15. My Bending moment about y-axis at joint 2
16. Mxy Twisting moment about joint 2
17. Qx Transverse shear in x-direction at joint 2
18. Qy Transverse shear in y-direction at joint 2
19. Mx Bending moment about x-axis at joint 3
20. My Bending moment about y-axis at joint 3
21. Mxy Twisting moment at joint 3
22. Qx Transverse shear in x-direction at joint 3
23. Qy Transverse shear in y-direction at joint 3
24. Mx Bending moment about x-axis at joint 4
25. My Bending moment about y-axis at joint 4
26. Mxy Twisting moment at joint 4
27. Qx Transverse shear in x-direction at joint 4
28. Qy Transverse shear in y-direction at joint 4
29. Mx Bending moment about x-axis at the center
30. My Bending moment about y-axis at the center
31. Mxy Twisting moment at the center
32. Qx Transverse shear in x-direction at the center
33. Qy Transverse shear in y-direction at the center

Formulae:

$$Sx = f_{4j} Mx \qquad f_{42} = f_{52} = -f_{62} = 6/(\text{thickness})^2$$
$$Sy = f_{5j} My \qquad f_{43} = f_{53} = -f_{63} = -6/(\text{thickness})^2$$
$$Txy = f_{6j} Mxy$$

STRS E43 iset icase

iset = Load set
icase = Load case within set
Created in processor GSF
NJ = Number of E43 elements
NI = 48

Contents of each entry:
1. Group number
2. Element number within group
3. Joint #1
4. Joint #2
5. Joint #3
6. Joint #4
7. ?
8. ?

9. Nx Tractive force in x-direction at joint 1
10. Ny Tractive force in y-direction at joint 1
11. Nxy Shearing force at joint 1
12. Nx Tractive force in x-direction at joint 2
13. Ny Tractive force in y-direction at joint 2
14. Nxy Shearing force at joint 2
15. Nx Tractive force in x-direction at joint 3
16. Ny Tractive force in y-direction at joint 3
17. Nxy Shearing force at joint 3
18. Nx Tractive force in x-direction at joint 4
19. Ny Tractive force in y-direction at joint 4
20. Nxy Shearing force at joint 4
21. Nx Tractive force in x-direction at the center
22. Ny Tractive force in y-direction at the center
23. Nxy Shearing force at the center
24. Mx Bending moment about x-axis at joint 1
25. My Bending moment about y-axis at joint 1
26. Mxy Twisting moment at joint 1
27. Qx Transverse shear in x-direction at joint 1
28. Qy Transverse shear in y-direction at joint 1
29. Mx Bending moment about x-axis at joint 2
30. My Bending moment about y-axis at joint 2
31. Mxy Twisting moment at joint 2
32. Qx Transverse shear in x-direction at joint 2
33. Qy Transverse shear in y-direction at joint 2
34. Mx Bending moment about x-axis at joint 3
35. My Bending moment about y-axis at joint 3
36. Mxy Twisting moment at joint 3
37. Qx Transverse shear in x-direction at joint 3
38. Qy Transverse shear in y-direction at joint 3
39. Mx Bending moment about x-axis at joint 4
40. My Bending moment about y-axis at joint 4
41. Mxy Twisting moment at joint 4
42. Qx Transverse shear in x-direction at joint 4
43. Qy Transverse shear in y-direction at joint 4
44. Mx Bending moment about x-axis at the center
45. My Bending moment about y-axis at the center
46. Mxy Twisting moment at the center
47. Qx Transverse shear in x-direction at the center
48. Qy Transverse shear in y-direction at the center

Formulae:

$Sx = f_{1j}Nx + f_{4j}Mx$ $\quad$ $f_{ij} = 1/\text{thickness}$ for i and j = 1,2,3

$Sy = f_{2j}Ny + f_{5j}My$ $\quad$ $f_{42} = f_{52} = -f_{62} = 6/(\text{thickness})^2$

$Txy = f_{3j}Nxy + f_{6j}Mxy$ $\quad$ $f_{43} = f_{53} = -f_{63} = 6/(\text{thickness})^2$

STRS E44 iset icase

iset = Load set
icase = Load case within set
Created in processor GSF.
NJ = Number of E44 elements
NI = 8

Contents of each entry:

1. Group number
2. Element number within group
3. Joint #1
4. Joint #2
5. Joint #3
6. Joint #4
7. Element thickness
8. Shear stress

BUCK MODE iset ncon

iset = Load set
ncon = Constraint case
Created in processor EIG.
NJ = Number of joints
NI = 6 minus number of joint motion components constrained on START card
Number of blocks = Number of eigenvectors

Contents:
Each block of data contains an eigenvector corresponding to an eigenvalue stored in "BUCK EVAL." Data is stored for each joint in each active direction.

BUCK EVAL iset ncon

iset = Load set
ncon = Constraint case
Created in processor EIG
NJ = 1
NI = Number of eigenvalues

Contains frequency eigenvalues corresponding to each eigenvector in "BUCK MODE."

VIBR MODE iset ncon

iset = Load set
ncon = Constraint case
Created in processor EIG.
NJ = Number of joints
NI = 6 minus number of joint motion components constrained on START card
Number of blocks = Number of eigenvectors

Contents:
Each block of data contains one eigenvector corresponding to an eigenvalue stored in "VIBR EVAL." Data is stored for each joint in each active direction.

VIBR EVAL iset ncon

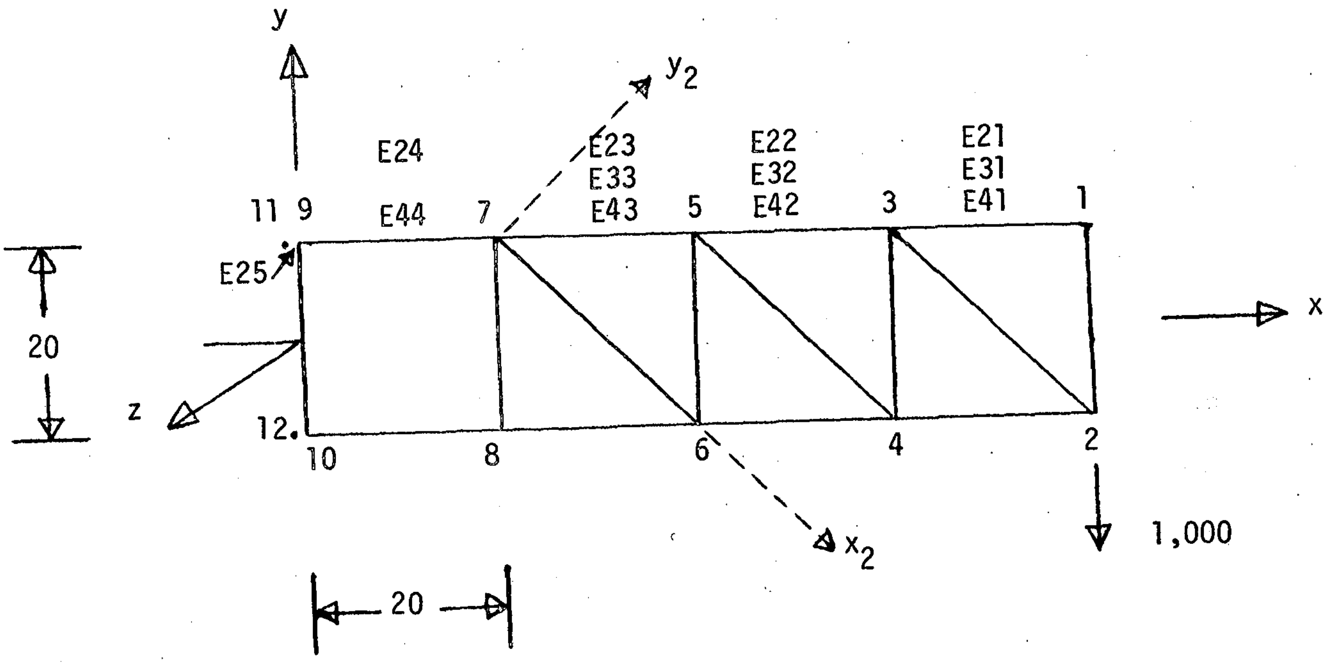
iset = Load set
ncon = Constraint case
Created in processor EIG.
NJ = 1
NI = Number of eigenvalues

Contains eigenvalues corresponding to each eigenvector in "VIBR MODE."

EXAMPLE PROBLEM

The sample problem contained in this section includes the necessary SPAR commands to create all the data sets documented in this report. The SPAR commands are listed so that the user may reproduce these data sets and examine their contents. The resulting table of contents is included to illustrate the SPAR's use of data sets.

STRUCTURAL MODEL



fix z, θ_x, θ_y

SPAR INPUT FILE

```
 [XQT TAB $
  START 12 3,4,5 $
  TEXT $
"   EXAMPLE TO ILLUSTRATE DATA SET CONTENTS
"   PREPARED BY GARY L. GILES  8-13-81.
  MATC $
     1  30.0+6  0.3  0.283  8.3-6 $
  NSW $
     1  23.0 $
  ALTREF $
     2 1 0.0 2 0.0 3 -45.0 20.0 10.0 0.0 $
  JLOC $
     1 80.0  10.0 0.0 0.0  10.0 0.0 5 2 $
     2 80.0 -10.0 0.0 0.0 -10.0 0.0 5 2 $
    11  0.0  10.0 0.0 $
    12  0.0 -10.0 0.0 $
  JREF $
     NREF=2;7 $
  MREF $
     FORMAT=1 $
     1  1  3  +1  1.0 $
     FORMAT=2 $
     2  1  1000.0 0.0  0.0 $
  BRL $
     1 1 0.0 1.0 0.0 1 0.0 1.0 0.0 $
  BA $
     BOX  1  1.0  0.1  0.5  0.05 $
  BB $
     1 11.0+3 $
       21.0   22.0+8 $
       31.0   32.0  33.0+8 $
       41.0   42.0  43.0  44.0+8 $
       51.0   52.0  53.0  54.0  55.0+8 $
       61.0   62.0  63.0  64.0  65.0  66.0+8 $
  BC $
     1  0.5 $
  BD $
     1  0.5  100.0  0.0  1.0  1.0  0.0 $
  SA $
     NMAT=1 $
     FORMAT=ISOTROPIC $
     1  0.01 $
  SB $
     1  0.01 $
  CON=1 $
     ZERO 1,2;11,12 $
  JSEQ $
     1/10,12,11 $
  RMASS $
```

```
     1   100 1.0,2.0,3.0 $
[XQT ELD $
 E21 $
     3   1 $
     4   2 $
     NREF=2 $
     1   2 $
 E31 $
     1   3   2 $
     4   2   3 $
 E41 $
     1   3   4   2 $
 E22 $
     5   3 $
     6   4 $
     NREF=2 $
     3   4 $
 E32 $
     3   5   4 $
     6   4   9 $
 E42 $
     3   5   6   4 $
 E23 $
     7   5 $
     8   6 $
     5   6 $
 E33 $
     5   7   6 $
     8   6   7 $
 E43 $
     5   7   8   6 $
 E24 $
     9   7 $
    10   8 $
     NREF=2 $
     7   8 $
     9  10 $
 E44 $
     7   9  10   8 $
 E25 $
    11   9 $
    12  10 $
[XQT E $
[XQT EKS $
[XQT TOPO $
[XQT K $
[XQT INV $
[XQT AUS $
     ALPHA;CASE TITL 1 $
1" SAMPLE TITLE FOR CASE 1 $
   SYSVEC;APPLIED FORCES 1 $
```

```
    CASE 1 $
    I=2;J=2;-1000.0 $
  SYSVEC;APPLIED MOTIONS 2 $
    I=2;J=1;-2.0 $
  TABLE;NODAL TEMPERATURES 2 $
    J=1,4;100.0 $
  TABLE;NODAL PRESSURES 2 $
    J=1,10;1.5 $
  ELDATA;TEMP E41 2 1 $
    G=1;E=1;100.0,200.0,300.0,400.0 $
  ELDATA;DISL E31 2 1 $
    G=1;E=1,2;0.1,0.2,0.3 $
  ELDATA;PRES E43 2 1 $
    G=1;E=1;0.1,0.2,0.3,0.4 $
[XQT EQNF $
  RESET SET=2 $
[XQT SSOL $
[XQT GSF $
  RESET EMBED=1 $
[XQT PSF $
[XQT KG $
[XQT EIG $
  RESET PROB=BUCK,INIT=15,NDYN=7,NREQ=2 $
[XQT M $
[XQT EIG $
  RESET PROB=VIBR,INIT=15,NDYN=7,NREQ=5 $
[XQT DCU $
    TOC 1
[XQT EXIT
```

```
TABLE OF CONTENTS, LIBRARY  1

                          E                              T    DATA SET NAME
SEQ      RR  DATE   TIME  R  WORDS    NJ NI*NJ  Y   N1   N2   N3     N4
  1       7 810820 151843 0     18     1    18  0 JDF1 BTAB    1      8
  2      -8 810820 151843 0     12    12    12  0 JREF BTAB    2      6
  3      -9 810820 151843 0     12     1    12  1 ALTR BTAB    2      4
  4      10 810820 151843 0     30     2    30  4 TEXT BTAB    2      1
  5      11 810820 151843 0     10     1    10  1 MATC BTAB    2      2
  6      12 810820 151843 0      1     1     1  1 NSW  BTAB    2      3
  7      13 810820 151843 0     24     2    24  1 ALTR BTAB    2      4
  8      14 810820 151843 0     36    12    36  1 JLOC BTAB    2      5
  9      15 810820 151843 0     12    12    12  0 JREF BTAB    2      6
 10      16 810820 151843 0     10     2    10  1 MREF BTAB    2      7
 11      17 810820 151843 0      8     1     8  1 BRL  BTAB    2      8
 12      18 810820 151843 0     31     1    31  1 BA   BTAB    2      9
 13      19 810820 151843 0     21     1    21  1 BB   BTAB    2     10
 14      20 810820 151843 0      6     1     6  1 BC   BTAB    2     11
 15      21 810820 151843 0      6     1     6  1 BD   BTAB    2     12
 16      22 810820 151843 0     43     1    43  1 SA   BTAB    2     13
 17      23 810820 151843 0      4     1     4  1 SB   BTAB    2     14
 18      24 810820 151843 0     12    12    12  0 CON            1      0
 19      25 810820 151843 0     12    12    12  0 JSEQ BTAB    2     17
 20      26 810820 151843 0     36    12    36  1 RMAS BTAB    2     18
 21      27 810820 151843 0    108    12   108  1 QJJT BTAB    2     19
 22      29 810820 151958 0     54    49   882  0 DEF  E21     1      2
 23      43 810820 151958 0      2     1     2  0 GD   E21     1      2
 24      44 810820 151958 0     15     1    15  4 GTIT E21     1      2
 25      45 810820 151958 0     20     1    20  0 DIR  E21     1      2
 26      46 810820 151958 0     30    59   885  0 DEF  E31     6      3
 27      60 810820 151958 0      2     1     2  0 GD   E31     6      3
 28      61 810820 151958 0     15     1    15  4 GTIT E31     6      3
 29      62 810820 151958 0     20     1    20  0 DIR  E31     6      3
 30      63 810820 151958 0     16    56   896  0 DEF  E41     9      4
 31      77 810820 151958 0      2     1     2  0 GD   E41     9      4
 32      78 810820 151958 0     15     1    15  4 GTIT E41     9      4
 33      85 810820 151958 0     20     1    20  0 DIR  E41     9      4
 34      86 810820 151958 0     54    49   882  0 DEF  E22     2      2
 35     100 810820 151958 0      2     1     2  0 GD   E22     2      2
 36     101 810820 151958 0     15     1    15  4 GTIT E22     2      2
 37     102 810820 151958 0     20     1    20  0 DIR  E22     2      2
 38     103 810820 151958 0     30    59   885  0 DEF  E32     7      3
 39     117 810820 151958 0      2     1     2  0 GD   E32     7      3
 40     118 810820 151958 0     15     1    15  4 GTIT E32     7      3
 41     119 810820 151958 0     20     1    20  0 DIR  E32     7      3
 42     120 810820 151958 0     16    56   896  0 DEF  E42    10      4
 43     134 810820 151958 0      2     1     2  0 GD   E42    10      4
 44     135 810820 151958 0     15     1    15  4 GTIT E42    10      4
 45     136 810820 151958 0     20     1    20  0 DIR  E42    10      4
```

```
46      137 810820 151958  0     54    49   882  0 DEF  E23    3    2
47      151 810820 151958  0      2     1     2  0 GD   E23    3    2
48      152 810820 151958  0     15     1    15  4 GTIT E23    3    2
49      153 810820 151958  0     20     1    20  0 DIR  E23    3    2
50      154 810820 151958  0     30    59   885  0 DEF  E33    8    3
51      168 810820 151958  0      2     1     2  0 GD   E33    8    3
52      169 810820 151958  0     15     1    15  4 GTIT E33    8    3
53      170 810820 151958  0     20     1    20  0 DIR  E33    8    3
54      171 810820 151958  0     16    56   896  0 DEF  E43   11    4
55      185 810820 151958  0      2     1     2  0 GD   E43   11    4
56      186 810820 151958  0     15     1    15  4 GTIT E43   11    4
57      187 810820 151958  0     20     1    20  0 DIR  E43   11    4
58      188 810820 151958  0     72    49   882  0 DEF  E24    4    2
59      202 810820 151958  0      2     1     2  0 GD   E24    4    2
60      203 810820 151958  0     15     1    15  4 GTIT E24    4    2
61      204 810820 151958  0     20     1    20  0 DIR  E24    4    2
62      205 810820 151958  0     16    56   896  0 DEF  E44   12    4
63      219 810820 151958  0      2     1     2  0 GD   E44   12    4
64      220 810820 151958  0     15     1    15  4 GTIT E44   12    4
65      227 810820 151958  0     20     1    20  0 DIR  E44   12    4
66      228 810820 151958  0     36    49   882  0 DEF  E25    5    2
67      242 810820 151958  0      2     1     2  0 GD   E25    5    2
68      243 810820 151958  0     15     1    15  4 GTIT E25    5    2
69      244 810820 151958  0     20     1    20  0 DIR  E25    5    2
70      245 810820 151958  0     12    12    12  4 ELTS NAME   0    0
71      246 810820 151958  0     12    12    12  0 ELTS NNOD   0    0
72      247 810820 151958  0     12    12    12  0 ELTS ISCT   0    0
73      248 810820 151958  0    180    12   180  0 NS           0    0
74      251 810820 152019  0    384     3   128  4 E21  EFIL   1    2
75      257 810820 152019  0    256     2   128  4 E31  EFIL   6    3
76      261 810820 152019  0    192     1   192  4 E41  EFIL   9    4
77      264 810820 152019  0    384     3   128  4 E22  EFIL   2    2
78      270 810820 152019  0    384     2   192  4 E32  EFIL   7    3
79      276 810820 152019  0    256     1   256  4 E42  EFIL  10    4
80      280 810820 152019  0    384     3   128  4 E23  EFIL   3    2
81      286 810820 152019  0    512     2   256  4 E33  EFIL   8    3
82      294 810820 152019  0    448     1   448  4 E43  EFIL  11    4
83      301 810820 152019  0    512     4   128  4 E24  EFIL   4    2
84      309 810820 152019  0    128     1   128  4 E44  EFIL  12    4
85      311 810820 152019  0    256     2   128  4 E25  EFIL   5    2
86      315 810820 152009  0     36    12    36 -1 DEM  DIAG   0    0
87      316 810820 152024  0    896    12   896  0 KMAP        35   10
88      330 810820 152024  0   1792    12  1792  0 AMAP        37   10
89      358 810820 152027  0   2240    12  2240  1 K    SPAR   9    0
90      393 810820 152028  0   3584    12  3584  1 INV  K      1    0
91      449 810820 152030  0     15     1    15  4 CASE TITL   1    1
92      450 810820 152030  0     36    12    36 -1 APPL FORC   1    1
93      451 810820 152030  0     36    12    36 -1 APPL MOTI   2    1
94      452 810820 152030  0     12    12    12 -1 NODA TEMP   2    1
95      453 810820 152030  0     12    12    12 -1 NODA PRES   2    1
96      454 810820 152030  0      4     1     4 -1 TEMP E41    2    1
```

```
 97     461 810820 152030   0       6     2     6 -1 DISL E31     2    1
 98     462 810820 152030   0       4     1     4 -1 PRES E43     2    1
 99     463 810820 152033   0      18     3    18 -1 IS   E21     2    1
100     464 810820 152033   0       6     2     6 -1 IS   E31     2    1
101     465 810820 152033   0       6     1     6 -1 IS   E41     2    1
102     466 810820 152033   0      18     3    18 -1 IS   E22     2    1
103     467 810820 152033   0      12     2    12 -1 IS   E32     2    1
104     468 810820 152033   0       9     1     9 -1 IS   E42     2    1
105     469 810820 152033   0      18     3    18 -1 IS   E23     2    1
106     470 810820 152033   0      18     2    18 -1 IS   E33     2    1
107     471 810820 152033   0      14     1    14 -1 IS   E43     2    1
108     472 810820 152033   0      24     4    24 -1 IS   E24     2    1
109     473 810820 152033   0       6     1     6 -1 IS   E44     2    1
110     474 810820 152033   0      12     2    12 -1 IS   E25     2    1
111     475 810820 152033   0      36    12    36 -1 EQNF FORC    2    1
112     476 810820 152045   0      36    12    36 -1 STAT DISP    1    1
113     477 810820 152045   0      36    12    36 -1 STAT REAC    1    1
114     478 810820 152048   0     156     3   156 -1 STRS E21     1    1
115     481 810820 152048   0      22     2    22 -1 STRS E31     1    1
116     482 810820 152048   0      23     1    23 -1 STRS E41     1    1
117     483 810820 152048   0      48     3    48 -1 STRS E22     1    1
118     484 810820 152048   0      56     2    56 -1 STRS E32     1    1
119     485 810820 152048   0      33     1    33 -1 STRS E42     1    1
120     486 810820 152048   0      18     3    18 -1 STRS E23     1    1
121     487 810820 152048   0      62     2    62 -1 STRS E33     1    1
122     488 810820 152048   0      48     1    48 -1 STRS E43     1    1
123     489 810820 152048   0      72     4    72 -1 STRS E24     1    1
124     491 810820 152048   0       8     1     8 -1 STRS E44     1    1
125     492 810820 152048   0      32     2    32 -1 STRS E25     1    1
126     493 810820 152113   0    2240    12  2240  1 KG   SPAR    9    0
127     528 810820 152117   0      15    15    15 -1 BUCK EVAL    1    1
128     529 810820 152117   0     540    12    36 -1 BUCK MODE    1    1
129     550 810820 152134   0    2240    12  2240  1 CEM  SPAR    9    0
130     585 810820 152138   0      15    15    15 -1 VIBR EVAL    1    1
131     586 810820 152138   0     540    12    36 -1 VIBR MODE    1    1
```

CONCLUDING REMARKS

The SPAR structural analysis system consists of a collection of processors for performing finite element analysis. The data generated by each of these processors is stored in a data file organized as a "library." Each data set, containing a two-dimensional table or matrix, is identified by a four-word name listed in the table of contents.

This report documents the contents of many of the SPAR data sets stored in the data base complex. The creating SPAR processor, number of rows and columns, and definitions of each of the data items, are listed for each data set. An example SPAR problem using these data sets is also presented. The SPAR input for the problem and resulting table of contents are included, so that the user may reproduce these data sets. This information can be used (1) to understand more clearly and to use more productively the existing processors in the SPAR system, (2) to develop new SPAR processors, or (3) to interface SPAR with another software system.

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2. Giles, Gary L.; and Haftka, Raphael T.: SPAR Data Handling Utilities. NASA TM-78701, September 1978.

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16. Abstract

The SPAR structural analysis system consists of a collection of processors for performing finite element analysis. The data generated by each of these processors is stored in a data file organized as a "Library." Each data set, containing a two-dimensional table or matrix, is identified by a four-word name listed in a table of contents.

This report documents the contents of the SPAR data sets stored in the data base complex. The creating SPAR processor, number of rows and columns, and definitions of each of the data items are listed for each data set. An example SPAR problem using these data sets is also presented. The SPAR input for the problem and resulting table of contents are included, so that the user may reproduce these data sets. This information can be used (1) to understand more clearly and to use more productively the existing processors in the SPAR system, (2) to develop new SPAR processors, or (3) to interface SPAR with another software system.

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