

## C. GAMBIT NEUTRAL FILE FORMAT

GAMBIT neutral files are ASCII files that can be used to import or export mesh data, boundary condition data (points, edges, or surfaces tagged with names) or solution-results data in a node- or cell-based format. The following sections describe the GAMBIT neutral file format. (**NOTE:** All record data formats are expressed according to Fortran conventions).

### C.1 General Format

#### C.1.1 Format Overview

##### Header and End-of-Section Records

Each section of a GAMBIT neutral file begins with a header record. The header record consists of a 20-character descriptor followed by a neutral-file version number. (**NOTE:** The Fortran-style format for the descriptor and version number is (A20,A20).) Each section ends with a record with the string, "ENDOFSECTION". For example, the following lines represent a valid set of data records for the *control information* section (see below) of a GAMBIT neutral file.

```

CONTROL INFO 1.2.1
** GAMBIT NEUTRAL FILE
Example
PROGRAM:           Gambit           VERSION:  1.2.1
  4 Jan 2000      13:07:49
      NUMNP      NELEM      NGRPS      NBSETS      NDFCD      NDFVL
        60         116         1         2           3         3
ENDOFSECTION

```

The inclusion of header and end-of-section records allows individual sections of a GAMBIT neutral file to be modified while maintaining backward compatibility. It also allows sections to be easily skipped if they are not relevant for a given model.

##### Blanks and Fixed-Field Format

Each record is formatted using fixed fields with at least one blank character between subsequent fields. The purpose of such formatting is to facilitate reading by programs of any language.

## Comment Records

Any record in the neutral file beginning with a “/” character is considered a comment record.

### C.1.2 Format Description

The following subsections describe the contents and valid data formats for each section in a GAMBIT neutral file.

#### Control Information

This section contains summary information for the neutral file.

#### Header Record Descriptor

CONTROL INFO

#### Record 1—Neutral-File Header

Format: (A)

| <i>Variable</i> | <i>Description</i>                          |
|-----------------|---|
| HEDNUT          | String of the form “** GAMBIT NEUTRAL FILE” |

#### Record 2—User-Defined Title

Format: (A80)

| <i>Variable</i> | <i>Description</i> |
|-----------------|--------------------|
| HED             | 80-character title |

**Record 3—Data Source and Revision Level**

**Format:** ('PROGRAM: ',A20, 5X,'VERSION: ',F5.2)

| <i>Variable</i> | <i>Description</i>                                |
|-----------------|---|
| PROGRAM         | Name of the program that created the neutral file |
| REVL            | Revision level                                    |

**Record 4—Date and Time Record**

**Format:** (*Unformatted*—DATE and TIME separated by a blank character)

| <i>Variable</i> | <i>Description</i>                          |
|-----------------|---|
| DATE            | Date (DD Mmm YYYY)—for example, 13 Dec 2001 |
| TIME            | Time (HH:MM:SS)—for example, 15:03:27       |

**Record 5—Problem Size-Parameter Headings**

**Format:** (5X,'NUMNP',5X,'NELEM',5X,'NGRPS',4X,  
'NBSETS',5X,'NDFCD',5X,'NDFVL')

Record 6—Problem Size Parameters

Format: (/6(1X, I9))

| <i>Variable</i> | <i>Description</i>                       |
|-----------------|--|
| NUMNP           | Total number of nodal points in the mesh |
| NELEM           | Total number of elements in the mesh     |
| NGRPS           | Number of element groups                 |
| NBSETS          | Number of boundary condition sets        |
| NDFCD           | Number of coordinate directions (2 or 3) |
| NDFVL           | Number of velocity components (2 or 3)   |

**Application/Solver Data (Optional)**

This section contains application and/or solver-dependent data.

Header Record Descriptor

APPLICATION DATA

Record 1—Application Identification

Format: (A20, F10.3)

| <i>Variable</i> | <i>Description</i>  |
|-----------------|---------------------|
| APPLIC          | 20-character string |
| VERSION         | Version number      |

Record 2—Solver-Dependent Flags Header

Format: (3I10)

| <i>Variable</i> | <i>Description</i>                        |
|-----------------|---|
| NISOLV          | Number of solver-dependent integer values |
| NRSOLV          | Number of solver-dependent real values    |
| NSSOLV          | Number of solver-dependent string values  |

Records 3 to End of Section—Solver-Dependent Flags

Format: ( (8I10:) / (4E20.12:) / (A/) )

| <i>Variable</i>            | <i>Description</i>              |
|----------------------------|---------------------------------|
| (ISOLVE (I) , I=1, NISOLV) | Solver-dependent integer values |
| (RSOLVE (I) , I=1, NRSOLV) | Solver-dependent real values    |
| (CSOLVE (I) , I=1, NSSOLV) | Solver-dependent string values  |

The flags listed above are solver-dependent flags the interpretation of which depends on the program that created the neutral file and the program that is reading the neutral file. Examples of such flags are as follows:

| <i>Flag</i> | <i>Description</i>  |
|-------------|---|
| ITIM        | Steady = 0; Transient = 1   |
| ITURB       | Laminar = 0; $k$ - $\varepsilon$ turbulence = 2   |
| IFREE       | Fixed mesh = 0; Deformable mesh = 1   |
| ICOMPR      | Incompressible = 0; Compressible = 2  |
| ITMP (N)    | Transport equation:<br>Solution not present = 0 ; Solution present = 1<br><br>N = 1; Energy equation (temperature)<br>N = I+1; Species equation I |

**Nodal Coordinates**

This section contains nodal point coordinate data. Each of the NUMNP nodes requires a separate record, therefore this section includes NUMNP+2 records.

**Header Record Descriptor**

NODAL COORDINATES

**Records 1 to NUMNP—Node Point Coordinate Data**

**Format:** (I10,3E20.11)

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| <i>Variable</i>    | <i>Description</i>  |
|--------------------|---|
| ND                 | Global node number (not required to be sequential or continuous.) |
| (X(I), I=1, NDFCD) | Nodal coordinates   |

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**Element/Cell Connectivity**

This section contains element and cell connectivity data. Each of the NELEM elements requires a separate data record, therefore this section includes NELEM+2 records.

**Header Record Descriptor**

ELEMENTS/CELLS

**Records 1 to NELEM—Node Point Coordinate Data**

**Format:** (I8, 1X, I2, 1X, I2, 1X, 7I8 : / (15X, 7I8 :))

| <i>Variable</i> | <i>Description</i>   |
|-----------------|--|
| NE              | Global element number (not required to be sequential or continuous)  |
| NTYPE           | Element geometry type: 1 = Edge<br>2 = Quadrilateral<br>3 = Triangle<br>4 = Brick<br>5 = Wedge (Prism)<br>6 = Tetrahedron<br>7 = Pyramid |
| NDP             | Number of nodes that define the element  |
| NODE            | List of nodes that define the element (see Section C.2 for ordering conventions)   |



**Element Group Information**

This section contains information for NGRPS element groups (entities or zones). Each element group is preceded by a separate header record.

**Header Record Descriptor**

ELEMENT GROUP

**Record 1—Element Group Control Information Record**

**Format:** ('GROUP: ', I10, ' ELEMENTS: ', I10, ' MATERIAL: ' I10, ' NFLAGS: ', I10)

| <i>Variable</i> | <i>Description</i>   |
|-----------------|--|
| NGP             | Element group number   |
| NELGP           | Number of elements in group  |
| MTYP            | Material type ( <b>NOTE:</b> Interpretation of this flag is solver-dependent.)<br>0 = Undefined<br>1 = Conjugate<br>2 = Fluid<br>3 = Porous<br>4 = Solid<br>5 = Deformable |
| NFLAGS          | Number of solver-dependent flags   |

**Record 2—Entity Type Record**

**Format:** (A32)

| <i>Variable</i> | <i>Description</i>                                    |
|-----------------|---|
| ELMMAT          | Identifying name of element group (or entity or zone) |

Record 3—Solver-Dependent Flags

These are solver-dependent flags the interpretation of which depends on the program that created the neutral file and the program used to read the neutral file.

Format: (10I8)

| <i>Variable</i>          | <i>Description</i>     |
|--------------------------|------------------------|
| (ISOLVE(I), I=1, NFLAGS) | Solver-dependent flags |

Records 4 to NELGP+4—Element Records

Each element group requires a separate record, therefore the file should include NELGP records of the following form.

Format: (10I8)

| <i>Variable</i>       | <i>Description</i>  |
|-----------------------|---|
| (NELT(I), I=1, NELGP) | Global/element/cell number of the I <sup>th</sup> element/<br>cell in the group |

**Boundary Conditions Sets (*Optional*)**

This section identifies and labels points, edges, and/or faces to which boundary conditions are to be applied. Each set of boundary conditions is preceded by a header and control record.

There are two types of boundary-condition sets. One provides a list of grid points; the other provides a list of element/cell faces.

**Header Record Descriptor**

BOUNDARY CONDITIONS

**Record 1—Boundary Condition Control Record**

**Format:** (A32, 8I10)

| <i>Variable</i> | <i>Description</i>                               |
|-----------------|--|
| NAME            | Name of boundary-condition set                   |
| ITYPE           | Data type (0 = node; 1 = element/cell)           |
| NENTRY          | Number of data records in boundary-condition set |
| NVALUES         | Number of values for each data record            |
| IBCODE1         | <i>(Optional)</i> Boundary condition code 1      |
| IBCODE2         | <i>(Optional)</i> Boundary condition code 2      |
| IBCODE3         | <i>(Optional)</i> Boundary condition code 3      |
| IBCODE4         | <i>(Optional)</i> Boundary condition code 4      |
| IBCODE5         | <i>(Optional)</i> Boundary condition code 5      |

All of the IBCODE entries listed above are optional and program-dependent. The following table lists the IBCODE1 values that correspond to various boundary-entity types.

| <i>IBCODE1 Value</i> | <i>Boundary Entity Type</i> |
|----------------------|-----------------------------|
| 0                    | UNSPECIFIED                 |
| 1                    | AXIS                        |
| 2                    | CONJUGATE                   |
| 3                    | CONVECTION                  |
| 4                    | CYCLIC                      |
| 5                    | DEAD                        |
| 6                    | ELEMENT_SIDE                |
| 7                    | ESPECIES                    |
| 8                    | EXHAUST_FAN                 |
| 9                    | FAN                         |
| 10                   | FREE_SURFACE                |
| 11                   | GAP                         |
| 12                   | INFLOW                      |
| 13                   | INLET                       |
| 14                   | INLET_VENT                  |
| 15                   | INTAKE_FAN                  |
| 16                   | INTERFACE                   |
| 17                   | INTERIOR                    |
| 18                   | INTERNAL                    |

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| <i>IBCODE1 Value</i> | <i>Boundary Entity Type</i> |
|----------------------|-----------------------------|
| 19                   | LIVE                        |
| 20                   | MASS_FLOW_INLET             |
| 21                   | MELT                        |
| 22                   | MELT_INTERFACE              |
| 23                   | MOVING_BOUNDARY             |
| 24                   | NODE                        |
| 25                   | OUTFLOW                     |
| 26                   | OUTLET                      |
| 27                   | OUTLET_VENT                 |
| 28                   | PERIODIC                    |
| 29                   | PLOT                        |
| 30                   | POROUS                      |
| 31                   | POROUS_JUMP                 |
| 32                   | PRESSURE                    |
| 33                   | PRESSURE_FAR_FIELD          |
| 34                   | PRESSURE_INFLOW             |
| 35                   | PRESSURE_INLET              |
| 36                   | PRESSURE_OUTFLOW            |
| 37                   | PRESSURE_OUTLET             |
| 38                   | RADIATION                   |
| 39                   | RADIATOR                    |

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| <i>IBCODE1 Value</i> | <i>Boundary Entity Type</i> |
|----------------------|-----------------------------|
| 40                   | RECIRCULATION_INLET         |
| 41                   | RECIRCULATION_OUTLET        |
| 42                   | SLIP                        |
| 43                   | SREACTION                   |
| 44                   | SURFACE                     |
| 45                   | SYMMETRY                    |
| 46                   | TRACTION                    |
| 47                   | TRAJECTORY                  |
| 48                   | VELOCITY                    |
| 49                   | VELOCITY_INLET              |
| 50                   | VENT                        |
| 51                   | WALL                        |
| 52                   | SPRING                      |

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Records 2 to NENTRY

The format for the remainder of records in this section depends on the value of the data type variable (ITYPE) on Record 1 as follows.

**Nodal Data (ITYPE=0)**

Format: (I10/ (4E20.12))

| <i>Variable</i>             | <i>Description</i> |
|-----------------------------|--------------------|
| NODE                        | Node number        |
| (VALUES (I) , I=1, NVALUES) | Nodal values       |

**Element/Cell Data (ITYPE=1)**

Format: (I10, I5/ (4E20.12))

| <i>Variable</i>             | <i>Description</i>   |
|-----------------------------|--|
| ELEM                        | Element/cell number  |
| ELEMENT TYPE                | Element type   |
| FACE                        | Face number (see Section C.2 for face-numbering conventions) |
| (VALUES (I) , I=1, NVALUES) | Element/cell values  |

**Non-Conformal Mesh Data (Optional)**

This section includes data on non-conformal mesh elements. This section can also appear in the solution-data section for the case when the non-conformal data is changing with the solution or even at every time step (for example, in a contact problem or a sliding-mesh problem).

Each set data is preceded by a header and control record.

**Header Record Descriptor**

FACE CONNECTIVITY

**Record 1—Non-Conformal Mesh Control Record**

Format: (I10)

| <i>Variable</i> | <i>Description</i>                       |
|-----------------|--|
| NFACE           | Number of face connectivity data records |

**Records 2 to NFACE+1—Non-Conformal Mesh Data Record**

The following record is repeated NFACE times in this section.

Format: (I10, I1, I2, NFACES\*(I9, I1))

where NFACES is the number of element faces abutting the master element face.

| <i>Variable</i> | <i>Description</i>                                   |
|-----------------|--|
| MELEM           | Master element number                                |
| MFACE           | Master element face number                           |
| NFACES          | Number of element faces abutting master element face |
| NELEM           | Element number of abutting element                   |
| NFACE           | Element face number                                  |



**Solution Vectors (*Optional*)**

This section is repeated for each time step. For a steady-state analysis, only one “time step” is present and KSTEP=1, TIME=0, and DT=0.

Solution vector records can appear in any order. Each solution vector must be preceded by the appropriate header record as described below. All headers are 20 characters in length. There are three basic types of solution vectors: scalar, vector, and tensor.

Each time step is bracketed by a header record consisting of the 20 character descriptor “TIMESTEPDATA” followed by a neutral-file version number. (NOTE: These data are entered in the Fortran-style format (A20,F10.3).) Each section ends with a record with the string “ENDOFTIMESTEP”.

**Record 1—Time-Step Control Information Record**

Format: ('TIMESTEP: ', I5, ' TIME: ', E15.7, ' INCRMNT: ', E15.7)

| <i>Variable</i> | <i>Description</i>      |
|-----------------|-------------------------|
| KSTEP           | Time-step number        |
| TIME            | Time value of time step |
| DT              | Time-step increment     |

Record 2—Vector/Tensor Solution Record

Format: (A20, 3I5)

| <i>Variable</i> | <i>Description</i>  |
|-----------------|---|
| RECORDTYPE      | 20-character descriptor starting in column 1<br><br>Example vector/tensor RECORDTYPE values are:<br>VELOCITY (velocity vector data)<br>COORDINATE (coordinate data for a moving-mesh problem) |
| ICELL           | Data basis type: 0 = node-based data<br>1 = cell-based data<br>2 = group-based data   |
| I Vect          | Data type: 0 = scalar data<br>1 = vector data<br>2 = tensor data  |
| NVECT           | Number of data values: Scalar data = 1<br>Vector/tensor data = N<br><br>(NOTE: Vector data should default to NDFVL.)  |

Records 3 to End of Section—Vector/Tensor Solution Record

Format: (I10, 3E20.12/ (4E20.12)

| <i>Variable</i>       | <i>Description</i>        |
|-----------------------|---------------------------|
| ND                    | Node/element/group number |
| VAL (I) , I=1, NVECT) | Vector components         |

Record 2—Scalar Solution Record

Format: (A20,3I5)

| <i>Variable</i> | <i>Description</i>  |
|-----------------|---|
| RECORDTYPE      | 20-character descriptor starting in column 1<br><br>Example scalar RECORDTYPE values are:<br>TEMPERATURE (temperature data)<br>KINETIC ENERGY (turbulent kinetic energy data)<br>DISSIPATION (turbulent dissipation data)<br>SPECIES nn (species nn data)<br>DENSITY (density data) |
| ICELL           | Data basis type: 0 = node-based data<br>1 = cell-based data<br>2 = group-based data   |
| IVECT           | Data type: 0 = scalar data<br>1 = vector data<br>2 = tensor data  |
| NVECT           | Number of data values: Scalar data = 1<br>Vector/tensor data = N<br><br>(NOTE: Vector data should default to NDFVL.)  |

Records 3 to (End of Section-1)—Scalar Solution Record

Format: (I10,E20.12)

| <i>Variable</i> | <i>Description</i>              |
|-----------------|---------------------------------|
| ND              | Node/element/group number       |
| VAL             | Scalar value at node/element ND |

End of Section Record—Time-Step Termination Record

Format: ('ENDOFTIMESTEP')

## C.2 Element Type and Node-Numbering Conventions

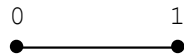
This section summarizes node-numbering conventions for GAMBIT neutral files. Each subsection includes a description and graphical representation of an edge, face, or volume element. Face- and volume-element subsections also include node-numbering definitions for edges and faces.

### C.2.1 Edge, 2-Node

#### Description

Linear edge element.

#### Graphical Representation

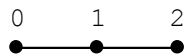


### C.2.2 Edge, 3-Node

#### Description

Edge element with mid-edge node.

#### Graphical Representation

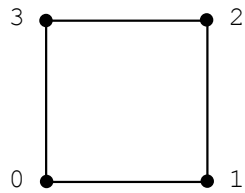


### C.2.3 Quad, 4-Node

#### Description

Linear quadrilateral element.

#### Graphical Representation



#### Edge Definitions

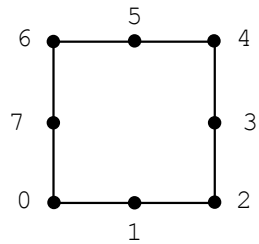
| <i>Edge</i> | <i>Nodes</i> |
|-------------|--------------|
| 1           | 0,1          |
| 2           | 1,2          |
| 3           | 2,3          |
| 4           | 3,0          |

### C.2.4 Quad, 8-Node

#### Description

Quadrilateral element with mid-edge nodes.

#### Graphical Representation



#### Edge Definitions

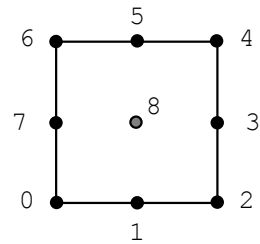
| <i>Edge</i> | <i>Nodes</i> |
|-------------|--------------|
| 1           | 0,1,2        |
| 2           | 2,3,4        |
| 3           | 4,5,6        |
| 4           | 6,7,0        |

### C.2.5 Quad, 9-Node

#### Description

Quadrilateral element with mid-edge nodes and mid-face node.

#### Graphical Representation



#### Edge Definitions

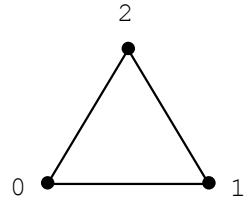
| <i>Edge</i> | <i>Nodes</i> |
|-------------|--------------|
| 1           | 0,1,2        |
| 2           | 2,3,4        |
| 3           | 4,5,6        |
| 4           | 6,7,0        |

### C.2.6 Triangle, 3-Node

#### Description

Linear triangular element.

#### Graphical Representation



#### Edge Definitions

| <i>Edge</i> | <i>Nodes</i> |
|-------------|--------------|
| 1           | 0,1          |
| 2           | 1,2          |
| 3           | 2,0          |

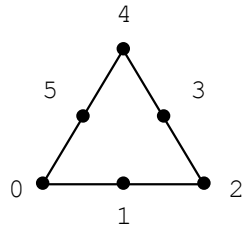


### C.2.7 Triangle, 6-Node

#### Description

Triangular element with mid-edge nodes.

#### Graphical Representation



#### Edge Definitions

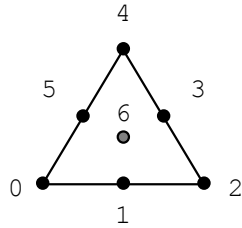
| <i>Edge</i> | <i>Nodes</i> |
|-------------|--------------|
| 1           | 0,1,2        |
| 2           | 2,3,4        |
| 3           | 4,5,0        |

### C.2.8 Triangle, 7-Node

#### Description

Triangular element with mid-edge nodes and mid-face node.

#### Graphical Representation



#### Edge Definitions

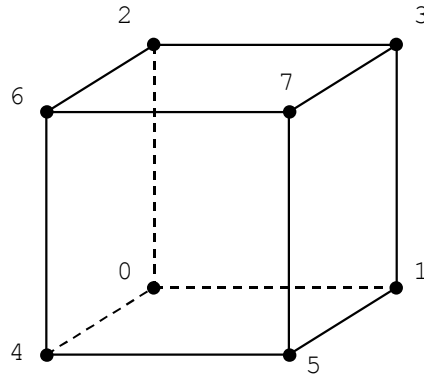
| <i>Edge</i> | <i>Nodes</i> |
|-------------|--------------|
| 1           | 0,1,2        |
| 2           | 2,3,4        |
| 3           | 4,5,0        |

### C.2.9 Brick, 8-Node

#### Description

Linear brick element.

#### Graphical Representation



#### Edge and Face Definitions

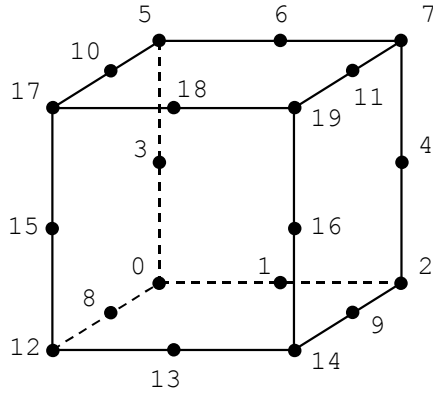
| <i>Edge</i> | <i>Nodes</i> | <i>Face</i> | <i>Nodes</i> |
|-------------|--------------|-------------|--------------|
| 1           | 0,4          | 1           | 0,1,5,4      |
| 2           | 0,1          | 2           | 1,3,7,5      |
| 3           | 1,5          | 3           | 3,2,6,7      |
| 4           | 4,5          | 4           | 2,0,4,6      |
| 5           | 1,3          | 5           | 1,0,2,3      |
| 6           | 3,7          | 6           | 4,5,7,6      |
| 7           | 5,7          |             |              |
| 8           | 2,3          |             |              |
| 9           | 2,6          |             |              |
| 10          | 6,7          |             |              |
| 11          | 0,2          |             |              |
| 12          | 4,6          |             |              |

**C.2.10 Brick, 20-Node**

**Description**

Brick element with mid-edge nodes.

**Graphical Representation**



**Edge and Face Definitions**

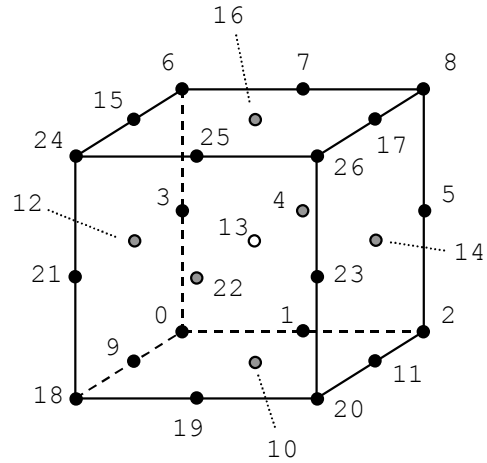
| <i>Edge</i> | <i>Nodes</i> | <i>Face</i> | <i>Nodes</i>            |
|-------------|--------------|-------------|-------------------------|
| 1           | 0,8,12       | 1           | 0,1,2,9,14,13,12,8      |
| 2           | 0,1,2        | 2           | 2,4,7,11,19,16,14,9     |
| 3           | 2,9,14       | 3           | 7,6,5,10,17,18,19,11    |
| 4           | 12,13,14     | 4           | 5,3,0,8,12,15,17,10     |
| 5           | 2,4,7        | 5           | 2,1,0,3,5,6,7,4         |
| 6           | 7,11,19      | 6           | 12,13,14,16,19,18,17,15 |
| 7           | 14,16,19     |             |                         |
| 8           | 5,6,7        |             |                         |
| 9           | 5,10,17      |             |                         |
| 10          | 17,18,19     |             |                         |
| 11          | 0,3,5        |             |                         |
| 12          | 12,15,17     |             |                         |

**C.2.11 Brick, 27-Node**

**Description**

Brick element with mid-edge nodes, mid-face nodes, and center node.

**Graphical Representation**



**Edge and Face Definitions**

(NOTE: Numbers in brackets indicate mid-face nodes.)

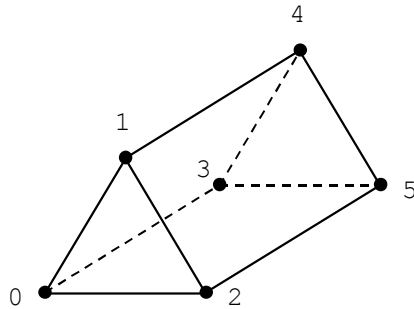
| <i>Edge</i> | <i>Nodes</i> | <i>Face</i> | <i>Nodes</i>                 |
|-------------|--------------|-------------|------------------------------|
| 1           | 0,9,18       | 1           | 0,1,2,11,20,19,18,9,(10)     |
| 2           | 0,1,2        | 2           | 2,5,8,17,26,23,20,11,(14)    |
| 3           | 2,11,20      | 3           | 8,7,6,15,24,25,26,17,(16)    |
| 4           | 18,19,20     | 4           | 6,3,0,9,18,21,24,15,(12)     |
| 5           | 2,5,8        | 5           | 2,1,0,3,6,7,8,5,(4)          |
| 6           | 8,17,26      | 6           | 18,19,20,23,26,25,24,21,(22) |
| 7           | 20,23,26     |             |                              |
| 8           | 6,7,8        |             |                              |
| 9           | 6,15,24      |             |                              |
| 10          | 24,25,26     |             |                              |
| 11          | 0,3,6        |             |                              |
| 12          | 18,21,24     |             |                              |

### C.2.12 Wedge, 6-Node

#### Description

Linear wedge element.

#### Graphical Representation



#### Edge and Face Definitions

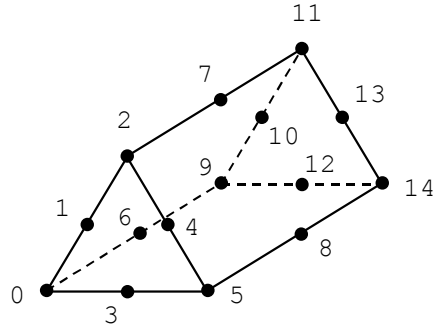
| <i>Edge</i> | <i>Nodes</i> | <i>Face</i> | <i>Nodes</i> |
|-------------|--------------|-------------|--------------|
| 1           | 0,1          | 1           | 0,1,4,3      |
| 2           | 1,2          | 2           | 1,2,5,4      |
| 3           | 2,0          | 3           | 2,0,3,5      |
| 4           | 3,4          | 4           | 0,2,1        |
| 5           | 4,5          | 5           | 3,4,5        |
| 6           | 5,3          |             |              |
| 7           | 0,3          |             |              |
| 8           | 1,4          |             |              |
| 9           | 2,5          |             |              |

**C.2.13 Wedge, 15-Node**

**Description**

Wedge element with mid-edge nodes.

**Graphical Representation**



**Edge and Face Definitions**

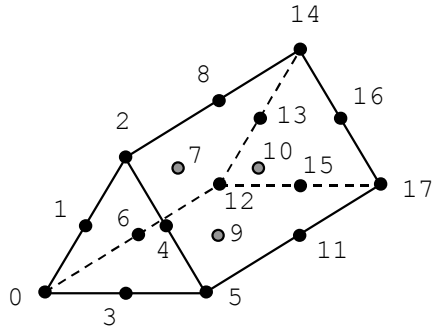
| <i>Edge</i> | <i>Nodes</i> | <i>Face</i> | <i>Nodes</i>       |
|-------------|--------------|-------------|--------------------|
| 1           | 0,1,2        | 1           | 0,1,2,7,11,10,9,6  |
| 2           | 2,4,5        | 2           | 2,4,5,8,14,13,11,7 |
| 3           | 5,3,0        | 3           | 5,3,0,6,9,12,14,8  |
| 4           | 9,10,11      | 4           | 0,3,5,4,2,1        |
| 5           | 11,13,14     | 5           | 9,10,11,13,14,12   |
| 6           | 14,12,9      |             |                    |
| 7           | 0,6,9        |             |                    |
| 8           | 2,7,11       |             |                    |
| 9           | 5,8,14       |             |                    |

**C.2.14 Wedge, 18-Node**

**Description**

Wedge element with mid-edge nodes and mid-face nodes on rectangular faces.

**Graphical Representation**



**Edge and Face Definitions**

(NOTE: Numbers in brackets indicate mid-face nodes.)

| <i>Edge</i> | <i>Nodes</i> | <i>Face</i> | <i>Nodes</i>             |
|-------------|--------------|-------------|--------------------------|
| 1           | 0,1,2        | 1           | 0,1,2,8,14,13,12,6,(7)   |
| 2           | 2,4,5        | 2           | 2,4,5,11,17,16,14,8,(10) |
| 3           | 5,3,0        | 3           | 5,3,0,6,12,15,17,11,(9)  |
| 4           | 12,13,14     | 4           | 0,3,5,4,2,1              |
| 5           | 14,16,17     | 5           | 12,13,14,16,17,15        |
| 6           | 17,15,12     |             |                          |
| 7           | 0,6,12       |             |                          |
| 8           | 2,8,14       |             |                          |
| 9           | 5,11,17      |             |                          |

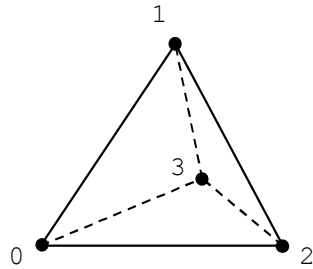


### C.2.15 Tetrahedron, 4-Node

#### Description

Linear tetrahedral element.

#### Graphical Representation



#### Edge and Face Definitions

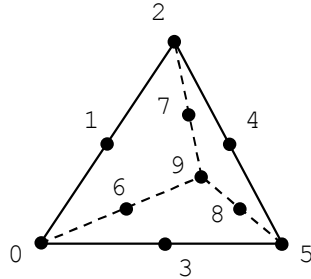
| <i>Edge</i> | <i>Nodes</i> | <i>Face</i> | <i>Nodes</i> |
|-------------|--------------|-------------|--------------|
| 1           | 0,1          | 1           | 1,0,2        |
| 2           | 1,2          | 2           | 0,1,3        |
| 3           | 2,0          | 3           | 1,2,3        |
| 4           | 0,3          | 4           | 2,0,3        |
| 5           | 1,3          |             |              |
| 6           | 2,3          |             |              |

### C.2.16 Tetrahedron, 10-Node

#### Description

Tetrahedral element with mid-edge nodes.

#### Graphical Representation



#### Edge and Face Definitions

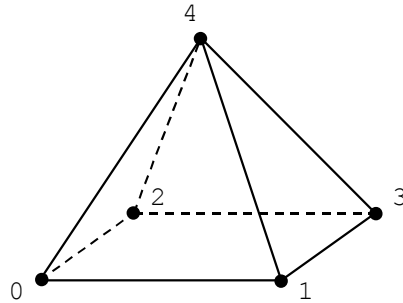
| <i>Edge</i> | <i>Nodes</i> | <i>Face</i> | <i>Nodes</i> |
|-------------|--------------|-------------|--------------|
| 1           | 0,1,2        | 1           | 2,1,0,3,5,4  |
| 2           | 2,4,5        | 2           | 0,1,2,7,9,6  |
| 3           | 5,3,0        | 3           | 2,4,5,8,9,7  |
| 4           | 0,6,9        | 4           | 5,3,0,6,9,8  |
| 5           | 2,7,9        |             |              |
| 6           | 5,8,9        |             |              |

**C.2.17 Pyramid, 5-Node**

**Description**

Linear pyramidal element.

**Graphical Representation**



**Edge and Face Definitions**

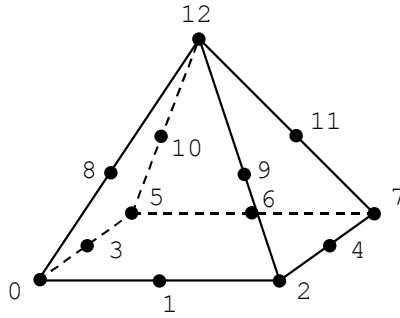
| <i>Edge</i> | <i>Nodes</i> | <i>Face</i> | <i>Nodes</i> |
|-------------|--------------|-------------|--------------|
| 1           | 0,1          | 1           | 0,2,3,1      |
| 2           | 1,3          | 2           | 0,1,4        |
| 3           | 3,2          | 3           | 1,3,4        |
| 4           | 2,0          | 4           | 3,2,4        |
| 5           | 0,4          | 5           | 2,0,4        |
| 6           | 1,4          |             |              |
| 7           | 3,4          |             |              |
| 8           | 2,4          |             |              |

**C.2.18 Pyramid, 13-Node**

**Description**

Pyramidal element with mid-edge nodes.

**Graphical Representation**



**Edge and Face Definitions**

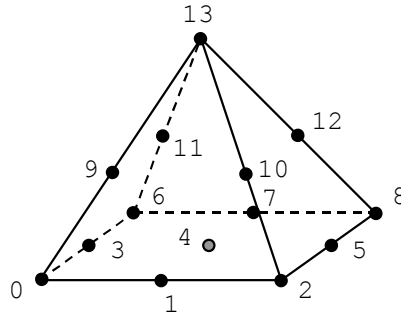
| <i>Edge</i> | <i>Nodes</i> | <i>Face</i> | <i>Nodes</i>    |
|-------------|--------------|-------------|-----------------|
| 1           | 0,1,2        | 1           | 0,3,5,6,7,4,2,1 |
| 2           | 2,4,7        | 2           | 0,1,2,9,12,8    |
| 3           | 7,6,5        | 3           | 2,4,7,11,12,9   |
| 4           | 5,3,0        | 4           | 7,6,5,10,12,11  |
| 5           | 0,8,12       | 5           | 5,3,0,8,12,10   |
| 6           | 2,9,12       |             |                 |
| 7           | 7,11,12      |             |                 |
| 8           | 5,10,12      |             |                 |

### C.2.19 Pyramid, 14-Node

#### Description

Pyramidal element with mid-edge nodes and mid-face node on rectangular face.

#### Graphical Representation



#### Edge and Face Definitions

(NOTE: Numbers in brackets indicate mid-face nodes.)

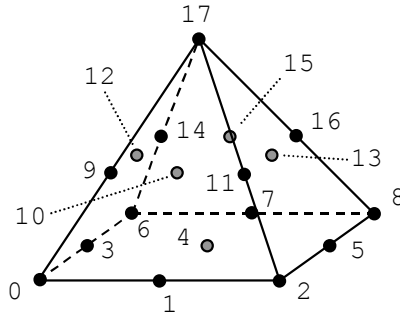
| <i>Edge</i> | <i>Nodes</i> | <i>Face</i> | <i>Nodes</i>        |
|-------------|--------------|-------------|---------------------|
| 1           | 0,1,2        | 1           | 0,3,6,7,8,5,2,1,(4) |
| 2           | 2,5,8        | 2           | 0,1,2,10,13,9       |
| 3           | 8,7,6        | 3           | 2,5,8,12,13,10      |
| 4           | 6,3,0        | 4           | 8,7,6,11,13,12      |
| 5           | 0,9,13       | 5           | 6,3,0,9,13,11       |
| 6           | 2,10,13      |             |                     |
| 7           | 8,12,13      |             |                     |
| 8           | 6,11,13      |             |                     |

### C.2.20 Pyramid, 18-Node

#### Description

Pyramidal element with mid-edge nodes and mid-face nodes on all faces.

#### Graphical Representation



#### Edge and Face Definitions

(NOTE: Numbers in brackets indicate mid-face nodes.)

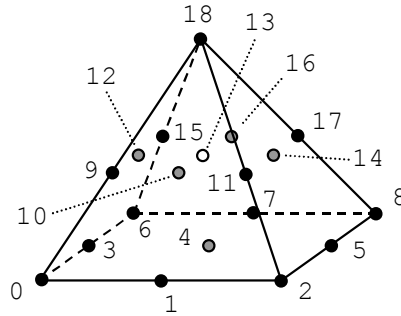
| <i>Edge</i> | <i>Nodes</i> | <i>Face</i> | <i>Nodes</i>        |
|-------------|--------------|-------------|---------------------|
| 1           | 0,1,2        | 1           | 0,3,6,7,8,5,2,1,(4) |
| 2           | 2,5,8        | 2           | 0,1,2,11,17,9,(10)  |
| 3           | 8,7,6        | 3           | 2,5,8,16,17,11,(13) |
| 4           | 6,3,0        | 4           | 8,7,6,14,17,16,(15) |
| 5           | 0,9,17       | 5           | 6,3,0,9,17,14,(12)  |
| 6           | 2,11,17      |             |                     |
| 7           | 8,16,17      |             |                     |
| 8           | 6,14,17      |             |                     |

### C.2.21 Pyramid, 19-Node

#### Description

Pyramidal element with mid-edge nodes, mid-face nodes, and a center node.

#### Graphical Representation



#### Edge and Face Definitions

(NOTE: Numbers in brackets indicate mid-face nodes.)

| <i>Edge</i> | <i>Nodes</i> | <i>Face</i> | <i>Nodes</i>        |
|-------------|--------------|-------------|---------------------|
| 1           | 0,1,2        | 1           | 0,3,6,7,8,5,2,1,(4) |
| 2           | 2,5,8        | 2           | 0,1,2,11,18,9,(10)  |
| 3           | 8,7,6        | 3           | 2,5,8,17,18,11,(14) |
| 4           | 6,3,0        | 4           | 8,7,6,15,18,17,(16) |
| 5           | 0,9,18       | 5           | 6,3,0,9,18,15,(12)  |
| 6           | 2,11,18      |             |                     |
| 7           | 8,17,18      |             |                     |
| 8           | 6,15,18      |             |                     |

### C.3 Example GAMBIT Neutral File

The following GAMBIT neutral file illustrates the data formats described in Section C.1, above.

```

CONTROL INFO 1.2.1
** GAMBIT NEUTRAL FILE
Example
PROGRAM:          Gambit          VERSION: 1.2.1
4 Jan 2000        13:07:49
  NUMNP          NELEM          NGRPS          NBSETS          NDFCD          NDFVL
    60            116            1              2              3              3
ENDOFSECTION
NODAL COORDINATES 1.2.1
  1  5.000000000e+00  5.000000000e+00  5.000000000e+00
  2  5.000000000e+00  5.000000000e+00 -5.000000000e+00
  3  5.000000000e+00  5.000000000e+00  0.000000000e+00
  4 -5.000000000e+00  5.000000000e+00 -5.000000000e+00
  5  0.000000000e+00  5.000000000e+00 -5.000000000e+00
  6 -5.000000000e+00  5.000000000e+00  5.000000000e+00
  7 -5.000000000e+00  5.000000000e+00  0.000000000e+00
  8  0.000000000e+00  5.000000000e+00  5.000000000e+00
  9  0.000000000e+00  5.000000000e+00  0.000000000e+00
 10  5.000000000e+00 -5.000000000e+00  5.000000000e+00
 11  5.000000000e+00 -5.000000000e+00 -5.000000000e+00
 12  5.000000000e+00 -5.000000000e+00  0.000000000e+00
 13  5.000000000e+00  4.000000000e+00 -5.000000000e+00
 14  5.000000000e+00  3.000000000e+00 -5.000000000e+00
 15  5.000000000e+00 -1.000000000e+00 -5.000000000e+00
 16  5.000000000e+00 -1.000000000e+00  5.000000000e+00
 17  5.000000000e+00  3.000000000e+00  5.000000000e+00
 18  5.000000000e+00  4.000000000e+00  5.000000000e+00
 19  5.000000000e+00  4.000000000e+00  0.000000000e+00
 20  5.000000000e+00  3.000000000e+00  0.000000000e+00
 21  5.000000000e+00 -1.0000357386e+00 -2.1429854082e+00
 22  5.000000000e+00 -1.0000142940e+00  2.1428045712e+00
 23 -5.000000000e+00 -5.000000000e+00 -5.000000000e+00
 24 -5.000000000e+00 -1.000000000e+00 -5.000000000e+00
 25 -5.000000000e+00  3.000000000e+00 -5.000000000e+00
 26 -5.000000000e+00  4.000000000e+00 -5.000000000e+00
 27 -5.000000000e+00 -5.000000000e+00  5.000000000e+00
 28 -5.000000000e+00 -5.000000000e+00  0.000000000e+00
 29 -5.000000000e+00  4.000000000e+00  5.000000000e+00
 30 -5.000000000e+00  3.000000000e+00  5.000000000e+00
 31 -5.000000000e+00 -1.000000000e+00  5.000000000e+00
 32 -5.000000000e+00  4.000000000e+00  0.000000000e+00
 33 -5.000000000e+00  3.000000000e+00  0.000000000e+00
 34 -5.000000000e+00 -9.9998719326e-01 -2.1429802624e+00
 35 -5.000000000e+00 -9.9999471598e-01  2.1428065305e+00
 36  0.000000000e+00 -5.000000000e+00 -5.000000000e+00
 37  0.000000000e+00 -5.000000000e+00  5.000000000e+00
 38 -1.4289352978e+00 -5.000000000e+00  1.4308811671e+00
 39  1.9997758876e+00 -5.000000000e+00  2.0015626884e+00
 40  1.4283714321e+00 -5.000000000e+00 -1.4272124905e+00
 41 -2.0001422982e+00 -5.000000000e+00 -1.9990784374e+00
 42  0.000000000e+00  4.000000000e+00 -5.000000000e+00
 43  0.000000000e+00  3.000000000e+00 -5.000000000e+00
 44  2.1429802623e+00 -9.9998719322e-01 -5.000000000e+00
 45 -2.1428065305e+00 -9.9999471596e-01 -5.000000000e+00
 46  0.000000000e+00  4.000000000e+00  5.000000000e+00
 47  0.000000000e+00  3.000000000e+00  5.000000000e+00
 48 -2.1429802624e+00 -9.9998719326e-01  5.000000000e+00
 49  2.1428065305e+00 -9.9999471598e-01  5.000000000e+00
 50  4.4312134385e-01 -2.6634261608e+00  3.1294517517e+00
 51  3.1295456886e+00 -2.6647951603e+00  4.4566029310e-01
 52  5.1142787933e-01 -2.6999440193e+00 -3.1325452328e+00
 53  1.3718595728e-03 -1.0109794140e+00  2.7755575616e-16
 54  3.4559090137e+00 -3.2225546837e+00 -3.4559490681e+00
 55  0.000000000e+00  3.000000000e+00  0.000000000e+00

```



```

56 -2.5000000000e+00 -5.3553391000e-01 2.5000000000e+00
57 2.5000000000e+00 -5.3553391000e-01 -2.5000000000e+00
58 -2.5000000000e+00 -5.3553391000e-01 -2.5000000000e+00
59 2.5000000000e+00 -5.3553391000e-01 2.5000000000e+00
60 0.0000000000e+00 4.0000000000e+00 0.0000000000e+00
ENDOFSECTION
ELEMENTS/CELLS 1.2.1
1 4 8 7 4 9 5 32 26 60
42
2 4 8 6 7 8 9 29 32 46
60
3 4 8 9 5 3 2 60 42 19
13
4 4 8 8 9 1 3 46 60 18
19
5 4 8 32 26 60 42 33 25 55
43
6 4 8 29 32 46 60 30 33 47
55
7 4 8 60 42 19 13 55 43 20
14
8 4 8 46 60 18 19 47 55 17
20
9 7 5 33 25 55 43 58
10 7 5 30 33 47 55 56
11 7 5 55 43 20 14 57
12 7 5 47 55 17 20 59
13 6 4 59 49 47 56
14 6 4 59 55 56 47
15 6 4 59 47 49 17
16 6 4 59 22 20 17
17 6 4 59 22 57 20
18 6 4 59 20 57 55
19 6 4 59 39 22 49
20 6 4 47 49 48 56
21 6 4 47 48 30 56
22 6 4 33 25 58 34
23 6 4 33 35 34 58
24 6 4 33 35 58 56
25 6 4 33 56 58 55
26 6 4 33 30 35 56
27 6 4 14 44 57 43
28 6 4 14 21 20 57
29 6 4 27 35 38 28
30 6 4 27 31 48 35
31 6 4 27 48 37 38
32 6 4 36 23 41 45
33 6 4 44 57 43 45
34 6 4 22 20 21 57
35 6 4 22 16 49 10
36 6 4 22 49 39 10
37 6 4 35 34 58 28
38 6 4 58 43 57 45
39 6 4 58 55 57 43
40 6 4 58 43 45 25
41 6 4 58 34 41 28
42 6 4 58 41 38 28
43 6 4 58 45 41 34
44 6 4 24 45 34 23
45 6 4 41 34 45 23
46 6 4 41 28 34 23
47 6 4 17 49 22 16
48 6 4 17 49 59 22
49 6 4 35 31 48 30
50 6 4 35 30 48 56
51 6 4 21 14 44 57
52 6 4 21 15 44 14
53 6 4 38 35 48 56
54 6 4 38 35 27 48
55 6 4 58 56 35 38
56 6 4 58 38 35 28

```

```

57 6 4 34 45 24 25
58 6 4 34 25 58 45
59 6 4 50 38 39 37
60 6 4 50 39 59 49
61 6 4 50 49 59 56
62 6 4 50 48 49 56
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64 6 4 50 38 48 56
65 6 4 50 37 48 38
66 6 4 51 39 40 12
67 6 4 51 59 39 22
68 6 4 51 57 59 22
69 6 4 51 57 22 21
70 6 4 51 21 22 12
71 6 4 52 58 57 45
72 6 4 52 41 58 45
73 6 4 52 45 36 41
74 6 4 52 57 44 45
75 6 4 52 45 44 36
76 6 4 52 36 40 41
77 6 4 53 50 59 56
78 6 4 53 58 38 56
79 6 4 53 38 50 56
80 6 4 53 52 51 40
81 6 4 53 40 51 39
82 6 4 53 40 38 41
83 6 4 53 41 52 40
84 6 4 53 39 38 40
85 6 4 53 39 50 38
86 6 4 53 58 41 38
87 6 4 53 58 52 41
88 6 4 53 51 52 57
89 6 4 53 52 58 57
90 6 4 53 58 56 55
91 6 4 53 59 55 56
92 6 4 53 59 51 57
93 6 4 53 58 55 57
94 6 4 53 59 57 55
95 6 4 54 21 44 57
96 6 4 54 44 52 57
97 6 4 54 36 44 11
98 6 4 54 36 52 44
99 6 4 54 15 44 21
100 6 4 54 15 21 11
101 6 4 54 44 15 11
102 6 4 54 40 36 11
103 6 4 54 52 36 40
104 6 4 54 51 52 40
105 6 4 54 52 51 57
106 6 4 54 57 51 21
107 6 4 54 12 51 40
108 6 4 54 21 51 12
109 6 4 54 12 40 11
110 6 4 54 21 12 11
111 6 4 37 39 49 10
112 6 4 37 39 50 49
113 6 4 53 50 39 59
114 6 4 53 39 51 59
115 6 4 22 39 12 10
116 6 4 22 39 51 12

```

ENDOFSECTION

ELEMENT GROUP 1.2.1

GROUP: 1 ELEMENTS: 116 MATERIAL: 2 NFLAGS: 1

fluid

```

0
1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60

```

```

61      62      63      64      65      66      67      68      69      70
71      72      73      74      75      76      77      78      79      80
81      82      83      84      85      86      87      88      89      90
91      92      93      94      95      96      97      98      99      100
101     102     103     104     105     106     107     108     109     110
111     112     113     114     115     116
ENDOFSECTION
BOUNDARY CONDITIONS 1.2.1
      element_side.1      1      14      0      6
3      4      3
4      4      3
7      4      3
8      4      3
100    6      3
110    6      3
115    6      4
35     6      2
47     6      4
16     6      3
28     6      1
52     6      2
34     6      1
70     6      3
ENDOFSECTION
BOUNDARY CONDITIONS 1.2.1
      node.2      0      16      0      24
27
23
4
6
29
30
31
28
24
25
26
7
32
33
34
35
ENDOFSECTION

```