Notes on importing FEM files to Poseidon

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Contents

1 Information on element and their relevant related entries

1.1 Contents of FQUS and FTRS: Flat Quadrilateral/Triangular Thin Shell

Figure 1: FQUS: Element node numbering on flat quadrilateral shell element.

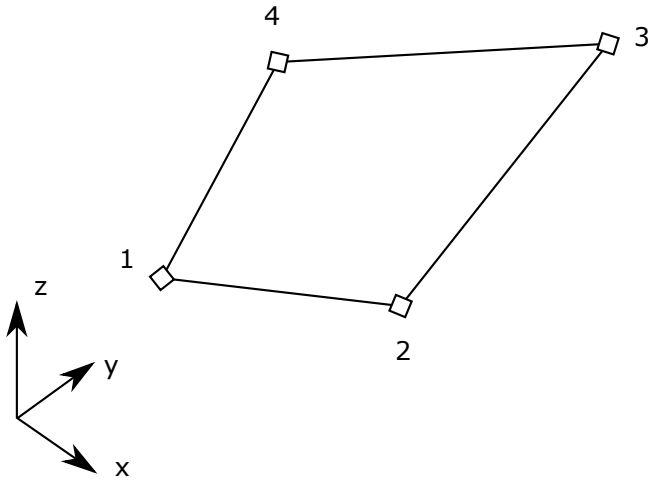
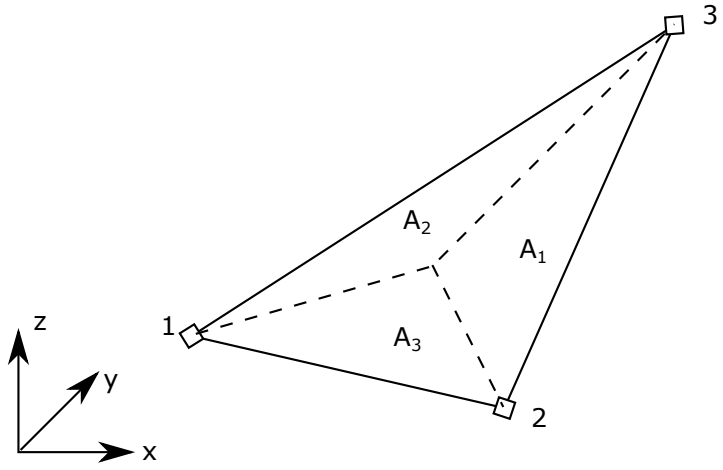


Figure 2: FTRS: Element node numbering and local area coordinates (A_1, A_2, and A_3) on flat triangular shell element.



1.1.1 GELMNT1: Element Data Definition (mandatory)

Table 1: GELMNT1 record layout

GELMNT1	ELNOX NODIN1	ELNO NODIN2	ELTYP NODIN3	ELTYAD (NODIN4)

- ELNOX: External element number (specified or controlled by user).
- ELNO: Internal element number (generated by program)
- ELTYP: 24 (FQUS), or 25 (FTRS).
- ELTYAD: Not used here.
- NODIN: Internal node numbers in the assembly, to which this element is connected.

  The sequence of the node numbers is in accordance with the local node numbering of the basic element.

  By 'internal node numbers' is meant the node numbering of the entire superelement of which the element ELNOX is a part. The internal node number refers to the node number generated by the program. The program-defined element number ranges from 1 up to number of elements. The sequence of the records will correspond to the program-defined element numbering, ELNO.

  4 entries for FQUS, 3 entries for FTRS.

1.1.2 GNODE Correspondence between External and Internal Node Numbering and Number of Degrees of Freedom of Each Node (mandatory)

Table 2: GELMNT1 record layout

GNODE	NODEX	NODENO	NDOF	ODOF

There will be one record with the identifier GNODE for each node. The sequence of the records will correspond to the internal node number, NODENO.

Example: NDOF 3, =ODOF =135 means 3 degrees of freedom in x, z and Ry direction respectively in the superelement's coordinate system, unless a local nodal coordinate system is specified (see the BNDOF and BNTRCOS record).

- NODEX: External node number (specified or controlled by user).
- NODENO: Internal node number defined by the program (may be generated by internal node numbering optimalizer). The internal node numbers range from 1 up to number of nodes.
- NDOF: Number of degrees of freedom of nodal point NODENO.
- ODOF: Order of degrees of freedom. NDOF digits.

1.1.3 GCOORD Nodal Coordinates (mandatory)

Table 3: GCOORD record layout

GCOORD	NODENO	XCOORD	YCOORD	ZCOORD

- NODENO: Program defined (internal) node number
- XCOORD: Cartesian X-coordinates of node NODENO.
- YCOORD: Cartesian Y-coordinates of node NODENO.
- ZCOORD: Cartesian Z-coordinates of node NODENO.

1.1.4 GELREF1: Reference to Element Data (mandatory)

Table 4: GELREF1 record layout

GELREF1	ELNO MINTNO GEONO/OPT GEONO (1) ... ECCNO (N)	MATNO STRANO FIXNO/OPT ... FIXNO (1) TRANSNO (1)	ADDNO STRENO ECCNO/OPT GEONO (N) ECCNO (1) ...	INTNO STREPONO TRANSNO/OPT FIXNO (1) ... TRANSNO (N)

- ELNO: Internal element number (generated by the program).
- MATNO: Material number
  - $= 0$ no material data attached to the element
- ADDNO: Additional data type number, i.e. number referring to additional data specification
  - $= 0$ no additional data attached to the element
- INTNO: *not used here*
- MINTNO: Integration station reference number for mass and damping matrices. Integration station, see INTNO.

  MINTNO $= 0$: Default values of the analysis program are employed.
- STRANO: Initial strain number, i.e. number referring to the specification of initial strains. The data type containing these data is not yet defined.
- STRENO: Initial stress number, i.e. number referring to the specification of initial stresses. The data type containing these data is not yet defined.
- STREPONO: *not used here*
- GEONO_OPT: Geometry reference number or option for geometry reference number specified later in this record sequence.
  - > 0: The geometry reference number (the same for all nodes in the element). GEONO (1), ..., GEONO (N) will not be specified.

    As FQUS, and FTRS do not allow thickness variation, this is the recommended entry type. Otherwise a mean thickness has to be calculated.
  - $= -1$: Reference numbers to geometry data are specified later in this record sequence for all nodes, i.e. all GEONO (1), ..., GEONO (N) will be given.
- FIXNO_OPT: Fixation reference number or option for fixation reference numbers specified later in this record sequence. The meaning assigned to the values of FIXNO_OPT corresponds to those for GEONO_OPT.
- ECCNO_OPT: Eccentricity reference number or option for eccentricity reference numbers specified later in this record sequence. The meaning assigned to the values of ECCNO_OPT corresponds to those for GEONO_OPT.
- TRANSNO_OPT: Reference number for local coordinate system specification or option for specification of local nodal coordinate systems later in this record sequence. Refers to GUNIVEC or BNTRCOS record. The meaning assigned to the values of TRANSNO_OPT corresponds to those for GEONO_OPT.

- GEONO: Geometry reference number for the local nodes of the element.
- FIXNO:Number referring to the specification of degree of fixation (Data type BELFIX). FIXNO (0) is the reference number for the 1st local node of the element, FIXNO ($i-1$) will be the reference number for the i 'th local node.
- ECCNO: Eccentricity number for the local nodes of the element, i.e. number referring to the specification of eccentricities.
- TRANSNO: Number referring to the specification of the local element coordinate system for the local nodes of the element. Refers to BNTRCOS or GUNIVEC record depending on element type.

1.1.5 GELTH: Thickness of Two-dimensional Elements (mandatory)

Table 5: GELTH record layout

GELTH	GEONO	TH	NINT	

- GEONO: Geometry type number, i.e. referenced to by GELREF1.
- TH: Thickness of the element, measured in a specific node.
- NINT: Number of integration points through thickness.

1.1.6 one of (mandatory)

1.1.6.1 MISOSEL: Isotropy, Linear Elastic Structural Analysis

Table 6: MISOSEL record layout

MISOSEL	MATNO DAMP	YOUNG ALPHA	POISS *DUMMY*	RHO YIELD

- MATNO: Material number, i.e. reference number referenced to by the element specification.
- YOUNG: Young's modulus.
- POISS: Poisson's ratio.
- RHO: Density.
- DAMP: Specific damping.
- ALPHA: Thermal expansion coefficient.
- *DUMMY*: *undocumented*
- YIELD: Yield stress.

1.1.6.2 MORSMEL: Anisotropy, Linear Elastic Structural Analysis, 2-D Membrane Elements and 2-D Thin Shell Elements *Not supported by Poseidon import*

1.1.7 MTRMEL: Local Transformation of the Axes of Anisotropy, 2-D Membrane Elements and 2-D Thin Shell Elements

Not supported by Poseidon import

1.1.8 BEUSLO: Elements with Surface Loads

Table 7: BEUSLO record layout

BEUSLO	LLC	LOTYP	COMPLX	LAYER
	ELNO	NDOF	INTNO	SIDE
	RLOAD1	RLOAD2	...	...
	RLOAD(NDOF)	ILOAD1	...	ILOAD(NDOF)

If phase shift is not specified, i.e. COMPLX $= 0$, the fields or positions ILOAD1, ILOAD2, etc. are left out.

Normal pressure means that only one pressure component is specified for each node, and this pressure component is acting normal to the surface.

For volume elements a positive value means normal pressure directed into the element. For shell elements, a positive value means normal pressure in the local z-direction.

- LLC: Local load case number (positive integer number).
- LOTYP: Load type.

  Only LOTYP $= 1$ is really supported by FQUS and FTRS as only pressures actibg perpendicular to the element surface can be used. Other componets are ignored with LOTYP $= 2$.

  - $= 1$: normal pressure, conservative load
  - $= 2$: load given in component form, conservative load
- COMPLX: Phase shift definition.
  - $= 0$: no phase shift
  - $= 1$: phase shift
- LAYER: Layer number for elements with more than one layer. If LAYER equals 0, the surface load will be positioned in the shell layer (in opposition to a stiffener layer). If more than one shell layer and LAYER equals 0, the programs shall stop and give an error message. For elements which are treated as one layer in the load calculations (e.g. the sandwich element in SESTRA), LAYER does not have any meaning.
- ELNO: Internal element number (generated by the program).
- NDOF:
  - If LOTYP $= 1$: number of nodes of the specified element side
  - If LOTYP $= 2$: number of translational degrees of freedom of the specified element side
- INTNO: Integration station reference number. Referring to record GELINT. This reference is usually not used ($= 0$). It means that the program performing the load calculation chooses integration points.
- SIDE: Side definition

  For shell elements:
  - $= 1$: loads referred to element side where $z = -1$
  - $= 2$: loads referred to element side where $z = 0$
  - $= 3$: loads referred to element side where $z = 1$
- RLOADi: The real part of the load with respect to the i th degree of freedom or i th node of the element side.

- ILOADi: The imaginary part of the load with respect to the i th degree of freedom or i th node of the element side.

  If LOTYP $= 3$, RLOAD $= \pm 1.0$ indicating which side the element pressure comes from. (+1 indicates shell element SIDE $= 1$ ($z = -1$), -1 indicates shell element SIDE $= 3$ ($z = 1$)). For solids when LOTYP $= 3$, RLOAD must be +1.0.

1.1.9 BELL02: Elements with Line Loads, Solid, 3-D Shell, 2-D Shell-, Membrane and Curved Beam Elements

Not supported by Poseidon import

1.1.10 BEISTE: Elements with Initial Strain Due to Thermal Expansion

Not supported by Poseidon import

1.1.11 BGRAV: Gravitational Load (Constant of Gravity)

Not supported by Poseidon import

1.1.12 BNACCL0: Nodes with Acceleration Load

Not supported by Poseidon import

1.2 Contents of BEAS: 3-D, 2 Node Beam

1.2.1 GELMNT1: Element Data Definition (mandatory)

Table 8: GELMNT1 record layout

GELMNT1	ELNOX NODIN1	ELNO NODIN2	ELTYP	ELTYAD

- ELNOX: External element number (specified or controlled by user).
- ELNO: Internal element number (generated by program)
- ELTYP: 15.
- ELTYAD: Additional information related to element type.
  - For two noded beam elements used to specify structural / non-structural elements:

    $= 0$: Structural beam

    $= 1$: Non structural beam
- NODIN: Internal node numbers in the assembly, to which this element is connected.

  The sequence of the node numbers is in accordance with the local node numbering of the basic element.

  By *internal node numbers* is meant the node numbering of the entire superelement of which the element ELNOX is a part. The internal node number refers to the node number generated by the program. The program-defined element number ranges from 1 up to number of elements. The sequence of the records will correspond to the program-defined element numbering, ELNO.

1.2.2 GBEAMG: General Beam Element Data (mandatory)

Table 9: GBEAMG record layout

GBEAMG	GEONO IY WYMIN SHCENY	*void* IZ WZMIN SHCENZ	AREA IYZ SHARY SY	IX WXMIN SHARZ SZ

- GEONO: Geometry number, referenced to on GELREF1.
- AREA: Cross section area.
- IX: Torsional moment of inertia about the shear center.
- IY: Moment of inertia about the y axis $= \int z^2 dA$.
- IZ: Moment of inertia about the z axis $= \int y^2 dA$.
- IYZ; Product of inertia about y and z axis $= \int yz dA$. -

WXMIN: Minimum torsional section modulus about shear center ($= IX/rmax$ for a PIPE element).

- WYMIN: Minimum sectionmodulus about y axis $= IY/zmax$.
- WZMIN: Minimum sectionmodulus about z axis $= IZ/ymax$.
- SHARY: Shear area in the direction of y axis. If zero, shear is not included.
- SHARZ: Shear area in the direction of z axis. If zero, shear is not included.
- SHCENY: Shear center location y component.
- SHCENZ: Shear center location z component
- SY: Static area moment about y -axis $= \int z dA$.
- SZ: Static area moment about z -axis $= \int y dA$.

1.2.3 GELREF1: Reference to Element Data (mandatory)

Table 10: GELREF1 record layout

GELREF1	ELNO MINTNO GEONO/OPT GEONO (1) ... ECCNO (N)	MATNO STRANO FIXNO/OPT ... FIXNO (1) TRANSNO (1)	ADDNO STRENO ECCNO/OPT GEONO (N) ECCNO (1) ...	INTNO STREPONO TRANSNO/OPT FIXNO (1) ... TRANSNO (N)

- ELNO: Internal element number (generated by the program).
- MATNO: Material number
  - $= 0$ no material data attached to the element
- ADDNO: Additional data type number, i.e. number referring to additional data specification
  - $= 0$ no additional data attached to the element

- INTNO: Integration station reference number for stiffness matrix, i.e. number referring to the specification of integration stations. An integration station is defined as:
  - an assembly of integration points over a cross section of a 1-dimensional (beam or bar) element,
  - an assembly of integration points on a line through the thickness of a 2-dimensional element,
  - one single integration point for a 3-dimensional element. For further explanation see record GELINT.

  INTNO $= 0$: Default values of the analysis program are employed.
- MINTNO: Integration station reference number for mass and damping matrices. Integration station, see INTNO.

  MINTNO $= 0$: Default values of the analysis program are employed.
- STRANO: Initial strain number, i.e. number referring to the specification of initial strains. The data type containing these data is not yet defined.
- STRENO: Initial stress number, i.e. number referring to the specification of initial stresses. The data type containing these data is not yet defined.
- STREPONO: Stresspoint specification reference number. See record GELSTRP for further information.
- GEONO_OPT: Geometry reference number or option for geometry reference number specified later in this record sequence.

  BEAS supports constant cross section only.
  - > 0: The geometry reference number (the same for all nodes in the element). GEONO (1), ..., GEONO (N) will not be specified.
  - $= 0$: No geometry data is given, i.e. neither here nor on GEONO (1), ..., GEONO (N).
  - $= -1$: Reference numbers to geometry data are specified later in this record sequence for all nodes, i.e. all GEONO (1), ..., GEONO (N) will be given.
- FIXNO_OPT: Fixation reference number or option for fixation reference numbers specified later in this record sequence. The meaning assigned to the values of FIXNO_OPT corresponds to those for GEONO_OPT.
- ECCNO_OPT: Eccentricity reference number or option for eccentricity reference numbers specified later in this record sequence. The meaning assigned to the values of ECCNO_OPT corresponds to those for GEONO_OPT.
- TRANSNO_OPT: Reference number for local coordinate system specification or option for specification of local nodal coordinate systems later in this record sequence. Refers to GUNIVEC or BNTRCOS record. The meaning assigned to the values of TRANSNO_OPT corresponds to those for GEONO_OPT.
- GEONO: Geometry reference number for the local nodes of the element.
- FIXNO:Number referring to the specification of degree of fixation (Data type BELFIX). FIXNO (0) is the reference number for the 1st local node of the element, FIXNO ($i-1$) will be the reference number for the i 'th local node.
- ECCNO: Eccentricity number for the local nodes of the element, i.e. number referring to the specification of eccentricities.
- TRANSNO: Number referring to the specification of the local element coordinate system for the local nodes of the element. Refers to BNTRCOS or GUNIVEC record depending on element type.

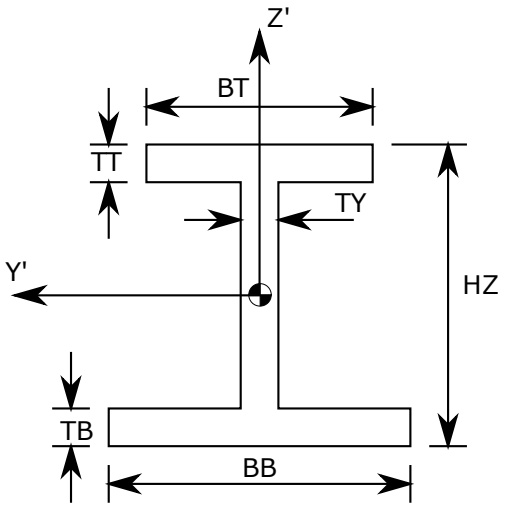
1.2.4 One of

1.2.4.1 GIORH: Cross Section Type I or H Beam

Table 11: GIORH record layout

GIORH	GEONO	HZ	TY	BT
	TT	BB	TB	SFY
	SFZ	NLOBYT	NLOBYB	NLOBZ

Figure 3: GIORH cross section dimensions.



- GEONO: Beam stress type number, i.e. reference number used for element data definition of cross sectional properties of beams.
- HZ: Height of beam at current location
- TY: Thickness of beam web
- BT: Width of top flange
- TT: Thickness of top flange
- BB: Width of bottom flange
- TB: Thickness of bottom flange
- SFY: Factor modifying the shear area calculated by the preprocessor program such that the modified shear area is

$$SHARY(MOD) = SHARY(PROG) \cdot SFY \tag{1}$$

  (The shear areas on GBEAMG are SHARY(MOD)).
- SFZ: Factor modifying the shear area calculated by the preprocessor program such that the modified shear area is

$$SHARZ(MOD) = SHARZ(PROG) \cdot SFY \tag{2}$$

  (The shear areas on GBEAMG are SHARZ(MOD)).
- NLOBYT: Number of integration points in top flange (optional)
- NLOBYB: Number of integration points in bottom flange (optional)
- NLOBZ: Number of integration points in beam web (optional)

1.2.4.2 GUSYI: Cross Section Type Unsymmetrical I-Beam

1.2.4.3 GCHAN: Cross Section Type Channel Beam

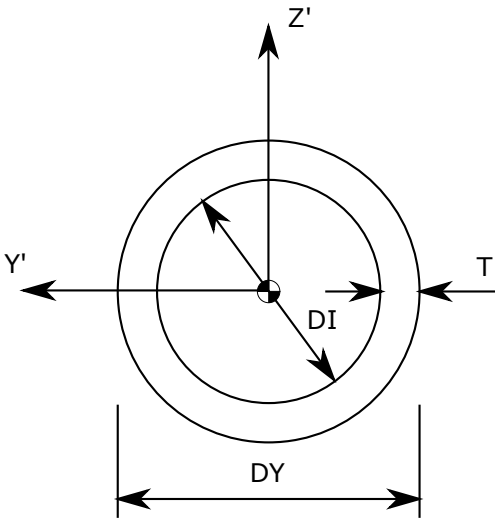
1.2.4.4 GBOX: Cross Section Type Box Beam

1.2.4.5 GPIPE: Cross Section Type Tube

Table 12: GIORH record layout

GPIPE	GEONO SFY	DI SFZ	DY NDIR	T NRAD

Figure 4: GPIPE cross section dimensions.



- GEONO: Geometry type number, i.e. reference number used for element data definition of geometry properties (Cross sectional properties) of beams.
- DI: Inner diameter of tube.
- DY: Outer diameter of tube (mandatory).
- T: Thickness of tube (not necessary if DI is given).
- SFY: Factor modifying the shear area calculated by the preprocessor program such that the modified shear area is

$$SHARY(MOD) = SHARY(PROG) \cdot SFY \tag{3}$$

  (The shear area on GBEAMG is SHARY(MOD)).
- SFZ: Factor modifying the shear area calculated by the preprocessor program such that the modified shear area is

$$SHARZ(MOD) = SHARZ(PROG) \cdot SFZ \tag{4}$$

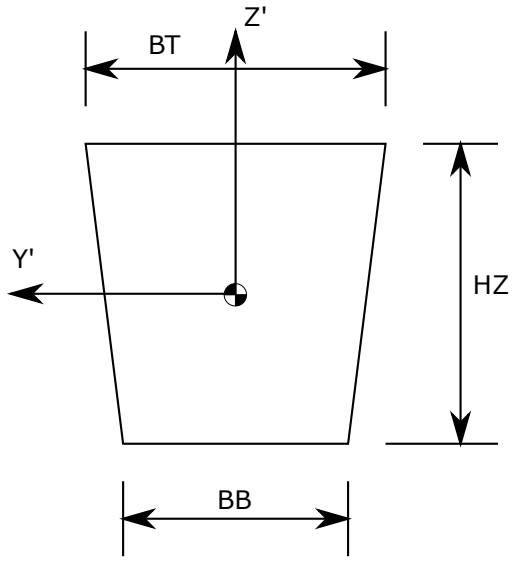
  (The shear area on GBEAMG os SHARZ(MOD)).
- NCIR: Number of integration points in circumferential direction (optional)
- NRAD: Number of integration points in radial direction (optional)

1.2.4.6 GBARM: Cross Section Type Massive Bar

Table 13: GBARM record layout

GBARM	GEONO SFY	HZ SFZ	BT NLOBY	BB NLOBZ

Figure 5: GBARM cross section dimensions.



- GEONO: Geometry type number, i.e. reference number used for element data definition of geometry properties (Cross sectional properties) of beams.
- HZ: Height of beam.
- BT: Width of bar at top. For massive bars which are not able to have different widths at top and bottom this variable is used as the width of the beam.
- BB: Width of bar at bottom.
- SFY: Factor modifying the shear area calculated by the preprocessor program such that the modified shear area is

$$SHARY(MOD) = SHARY(PROG) \cdot SFY \tag{5}$$

  (The shear area on GBEAMG is SHARY(MOD)).
- SFZ: Factor modifying the shear area calculated by the preprocessor program such that the modified shear area is

$$SHARZ(MOD) = SHARZ(PROG) \cdot SFZ \tag{6}$$

  (The shear area on GBEAMG is SHARZ(MOD)).
- NLOBY: Number of integration points in Y' direction (optional)
- NLOBZ: Number of integration points in Z' direction (optional)

1.2.4.7 GTONP: Cross Section T on Plate

1.2.4.8 GDOBO: Section Type Double Bottom

1.2.5 MISOSEL: Isotropy, Linear Elastic Structural Analysis (mandatory)

Table 14: MISOSEL record layout

MISOSEL	MATNO DAMP	YOUNG ALPHA	POISS *DUMMY*	RHO YIELD

- MATNO: Material number, i.e. reference number referenced to by the element specification.
- YOUNG: Young's modulus.
- POISS: Poisson's ratio.
- RHO: Density.
- DAMP: Specific damping.
- ALPHA: Thermal expansion coefficient.
- *DUMMY*: *undocumented*
- YIELD: Yield stress.

1.2.6 GUNIVEC: Specification of Local Element Coordinate System (mandatory)

Table 15: MISOSEL record layout

GUNIVEC	TRANSNO	UNIX	UNIY	UNIZ

The GUNIVEC records are used for beam elements only, i.e. basic element types 2, 15 and 23. Other basic element types may refer to BNTRCOS records. No ambiguity thus exists if both a GUNIVEC and BNTRCOS record have same TRANSNO, but they should preferably have separate numbering (TRANSNO) to avoid possible program problems.

- TRANSNO: Unit vector number, referenced to on record GELREF1.
- UNIX: x component of Unit vector given in superelement coordinate system along the local z-axis (reference axis in z-direction) of the element in the particular node.
- UNIY: y component of Unit vector given in superelement coordinate system along the local z-axis (reference axis in z-direction) of the element in the particular node.
- UNIZ: z component of Unit vector given in superelement coordinate system along the local z-axis (reference axis in z-direction) of the element in the particular node.

1.2.7 GECCEN: Eccentricities

Table 16: GECCEN record layout

GECCEN	ECCNO	EX	EY	EZ

- ECCNO: Eccentricity number, referenced to on record GELREF1.
- EX: x component of eccentricity vector given in superelement coordinate system, the vector points from the global node towards the local element node.
- EY: y component of eccentricity vector given in superelement coordinate system, the vector points from the global node towards the local element node.
- EZ: z component of eccentricity vector given in superelement coordinate system, the vector points from the global node towards the local element node.

1.2.8 BEDRAG1: Hydrodynamic Drag and Damping from Wave Load Program

Not supported by Poseidon import

1.2.9 BEMASS1: Hydrodynamic added Mass from Wave Load Program

Not supported by Poseidon import

1.2.10 BELOAD1: Beams with Line Loads

Not supported by Poseidon import

1.2.11 BGRAV: Gravitational Load (Constant of Gravity)

Not supported by Poseidon import

1.2.12 BNACCL0: Nodes with Acceleration Load

Not supported by Poseidon import

1.2.13 BEISTE: Elements with Initial Strain Due to Thermal Expansion

Not supported by Poseidon import

1.2.14 BELFIX: Flexible Joint/Hinge

Table 17: BELFIX record layout

BELFIX	FIXNO A(1) A(5)	OPT A(2) A(6)	TRANO A(3)	*void* A(4)

- FIXNO: Fixation number to a node.

  FIXNO is referenced to from GELREF.

- OPT:
  - = FIXATION: A(i) = ai is a value between 0 and 1, and gives the degree of fixation (connectivity) to degree of freedom number i in the node. The extreme values of a is described by:
    - a = 0, fully released
    - a = 1, fully connected
  - = SPRING: A(i) = Ci is the interelement elastic spring stiffness to degree of freedom number i in the node. The degrees of freedom which are neither flexible nor free will be given Ci = -1 (instead of Ci = ∞). The relation between Ci and ai is

    ai = Ci / (kii + Ci) ≥ 0.0

    where kii is the diagonal term of the element stiffness matrix corresponding to degree of freedom number i of the current node.

- TRANO:
  - = -1: The fixation/flexibility (=A(i)) is given in the superelement coordinate system.
  - =0: A(i) is given in the local element coordinate system

  - >0: A(i) is given in a local coordinate system defined by TRANO, which refers to a transformation matrix given on record BNTRCOS. The transformation matrix is defined by transformation from global to local system.

- A: See above (under the explanation of OPT).