

# C++ IO support for various FEM exchange file formats

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## 1 Supported FEM file formats

Not all functionality defined for the exchange file formats is supported. The supported subset is currently mainly defined by the functionality supported in GLFrame rspt. the BMF file format.

More detailed information on supported functionality can be found in the according directories in the doc subdirectory.

### 1.1 NASTRAN Bulk Data Format (BDF)

#### 1.1.1 BDF Cards supported

	Name	Description	Read	Write
General	MAT1	Material definition	✓	⋮
	GRID	Grid nodes	✓	⋮
Elements	CTRIA3	3 node shaped shell elements	✓	⋮
	CQUAD4	4 node shaped shell elements	✓	⋮
	CBEAM	Complex beams	✓	⋮
	CBAR	Simple beams	✓	✓
	CROD	Trusses	✓	⋮
	properties			
Element	PSHELL	Properties for CTRIA3, and CQUAD4	✓	⋮
	PBEAM	Integral properties for CBEAM	✓	⋮
	PBEAML	Properties for CBEAM describing cross section	✓	⋮
	PBAR	Integral properties for CBAR	✓	⋮
	PBARL	Properties for CBAR describing cross section	✓	⋮
	PROD	Properties for CROD	✓	⋮
Load	LOAD	Load case combination	✓	⋮
	FORCE	Forces on Nodes	✓	✓
	MOMENT	Moments on Nodes	✓	✓
Misc	ENDDATA	Marker for end of input file	✓	✓

## 1.2 DNV GL Seasam Input Interface File (FEM)

### 1.2.1 FEM Cards supported

	Name	Description	Read	Write	Page <sup>1</sup>
General	DATE	Date and Program Information	✓	✓	4-2
	GCOORD	Nodal Coordinates	✓	✓	6-56
	GNODE	Correspondence between External and Internal Node Numbering, and Number of Degrees of Freedom of Each Node	✓	✓	6-80
	IDENT	Identification of Superelements	✓	✓	4-3
	IEND	End of a Superelement	✓	✓	4-4
Elements	GELMNT1	Element Data Definition	☹	☹	6-65
	GELREF1	Reference to Element Data	☹	☹	6-66
Element properties	GBARM	Cross Section Type Massive Bar	☹	☹	6-48
	GBEAMG	General Beam Element Data	☹	☹	6-49
	GECCEN	Eccentricities	☹	☹	6-61
	GELTH	Thickness of Two-dimensional Elements	☹	☹	6-70
	GIORH	Cross Section Type I or H Beam	☹	☹	6-71
	GLSEC	Cross Section Type L-Section	☹	☹	6-76
	GPIPE	Cross Section Type Tube	☹	☹	6-81
Load	BLDEP	Nodes with Linear Dependence	☹	☹	6-27
	BNBCD	Nodes with Boundary Conditions	☹	☹	6-30
	BNDISPL	Nodes with Prescribed Displacements and Accelerations	☹	☹	6-31
	BNLOAD	Nodes with Loads	☹	☹	6-35
	MGSPRNG	Element to Ground	☹	☹	6-103
Misc	GSETMEMB	Set (group) of Nodes or Elements (Members)	☹	☹	6-84
	GUNIVEC	Specification of Local Element Coordinate System	☹	☹	6-92
	MISOSEL	Isotropy, Linear Elastic Structural Analysis	☹	☹	6-115
	TDSETNAM	Name and Description of a Set (group)	☹	☹	4-7
	TEXT	User supplied Text	✓	✓	4-10
	TDLOAD	<b>not documented</b>			

### 1.2.2 Element Types

Table 5.1 List of existing Element Types ✓

Typ <sup>2</sup>	Name	N. <sup>3</sup>	Description of Element	Ref.	4	5	6	7	8	Other <sup>9</sup>
1			Not yet defined							
2	BEPS	2	2-D, 2 Node Beam	3,5	✓			✓	☹	
3	CSTA	3	Plane Constant Strain Triangle	2,4		✓	✓	✓		
4			Not yet defined	3						
5	RPBQ	4	Rect. Plate. Bending Modes	3						

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<sup>1</sup>References page in "Technical Report: Sesam Input Interface File, File Description", Document id: 89-7012, Revision Number 9 / 01 November 1996

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Typ <sup>10</sup>	Name	N. <sup>11</sup>	Description of Element	Ref.	12	13	14	15	16	Other <sup>17</sup>
6	ILST	6	Plane Lin. Strain Triangle	2		✓	✓			
7			Not yet defined							
8	IQQE	8	Plane Quadrilateral Mem- brane Element	2		✓	✓			
9	LQUA	4	Plane Quadrilateral Mem- brane Element	2,4		✓	✓	✓	⋮	
10	TESS	2	Truss Element	2,4	✓	✓	✓	✓	⋮	
11	GMAS	1	1-Noded Mass-Matrix			✓	✓		⋮	
12	GLMA	2	2-Noded Mass-Matrix				✓			
13	GLDA	2	2-Noded Damping-Matrix							
14			Not yet defined							
15	BEAS	2	3-D, 2 Node Beam	2,4	✓	✓	✓	✓	⋮	FR, LA, PL, PR, WA
16	AXIS	2	Axial Spring		✓	✓	✓	✓ <sup>18</sup>	⋮	FR
17	AXDA	2	Axial Damper		✓	✓	✓		⋮	
18	GSPR	1	Spring to Ground	4	✓	✓	✓	✓	⋮	FR
19	GDAM	1	Damper to Ground		✓	✓	✓		⋮	
20	IHEX	20	Isoparametric Hexahedron	2		✓	✓	✓		FR
21	LHEX	8	Linear Hexahedron	2,4		✓	✓	✓		FR
22	SECB	3	Subparametric Curved Beam	2						
23	BTSS	3	General Curved Beam	2		✓	✓			PL, PR
24	FQUS	4	Flat Quadrilateral Thin Shell	4		✓	✓			PL, PR
24	FFQ	4	Free Formulation Quadri- lateral Shell	5				✓		
25	FTRS	3	Flat Triangular Thin Shell	4		✓	✓			PL
25	FFTR	3	Free Formulation Triangu- lar Shell	5				✓		
26	SCTS	6	Subparametric Curved Tri- angular Thick Shell	2		✓	✓			PL
27	MCTS	6	Subparam. Curved Triang. Thick Sandwich Elem.	2 <sup>19</sup>		✓	✓			
28	SCQS	8	Subparametric Curved Quadrilateral Thick Shell	2		✓	✓			PL, PR
29	MCQS	8	Subparam. Curved Quadr. Thick Sandwich Elem.	2 <sup>11</sup>		✓	✓			
30	IPRI	15	Isoparametric Triangular Prism	2		✓	✓	✓		
31	ITET	10	Isoparametric Tetrahedron	2			✓			
32	TPRI	6	Triangular Prism	2,4		✓	✓	✓		
33	TETR	4	Tetrahedron	2			✓			
34	LCTS	6	Subparam. Layered Curved Triangular Thick Shell	2 <sup>11</sup>		✓	✓			
35	LCQS	8	Subparam. Layered Curved Quadrilat. Thick Shell	2 <sup>11</sup>		✓	✓			
36	TRS1	18	2nd Order Hexahed. Tran- sition Elem., Solid / Shell	6			✓			PR

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Typ <sup>10</sup>	Name	N. <sup>11</sup>	Description of Element	Ref.	12	13	14	15	16	Other <sup>17</sup>
37	TRS2	15	2nd Order Hexahed. Transition Elem., Solid / Shell	6			✓			PR
38	TRS3	12	2nd Order Hexahed. Transition Elem., Solid / Shell	6			✓			PR
39			Not yet defined							
40	GLSH	2	General Spring / Shim Element	20	✓		✓		☹	
41	AXCS	3	Axisymmetric Constant Strain Triangle	7,5		✓	✓	✓		
42	AXLQ	4	Axisymmetric Quadrilateral	7,5		✓	✓	✓		
43	AXLS	6	Axisymmetric Linear Strain Triangle	7		✓	✓			
44	AXQQ	8	Axisymmetric Linear Strain Quadrilateral	7		✓	✓			
45	PILS	1	Pile / Soil	4	✓			✓		
46	PCAB	2	Plane Cable-Bar Element	4	✓			✓		
47	PSPR	1	Plane Spring Element	4	✓			✓		
48		4	4-node Contact Element with triangular Shape	4				✓		
49		2	2-Noded Link Element	4				✓		
50			Not yet defined							
51	CTCP	2	2-Noded Contact Element							
52	CTCL	4	4-Noded Contact Element							
53	CTAL	4	4-Noded Axisymmetric Contact Element							
54	CTCC	6	6-Noded Contact Element							
55	CTAQ	6	6-Noded (3+3) Axisymmetric Contact Element			✓				
56	CTLQ	8	8-Noded (4+4) Contact Element	8,9						PR
57	CTCQ	16	16-Noded (8+8) Contact Element	8,9		✓				PR
58	CTMQ	18	18-Noded (9+9) Contact Element	8,9						PR
59			Not yet defined							
60			Not yet defined							
61	HCQS	9	9-Noded Shell Element			✓				PR
62			Not yet defined							
63			Not yet defined							
64			Not yet defined							
65			Not yet defined							
66	SLQS	8	Semiloof Quadrilateral Curved Thin Shell (32 d.o.fs)							
67	SLTS	6	Semiloof Triangular Curved Thin Shell (24 d.o.fs)							
68	SLCB	3	Semiloof Curved Beam (11 d.o.fs)							
69			Not yet defined							
70	MATR	n	General Matrix Element with arbitrary no. of nodes (n)					✓		SP

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Typ <sup>10</sup>	Name	N. <sup>11</sup>	Description of Element	Ref.	<sup>12</sup>	<sup>13</sup>	<sup>14</sup>	<sup>15</sup>	<sup>16</sup>	Other <sup>17</sup>
...										
100	GHEX	21	General Hexahedron				✓			
...										
163	GHEX	27	General Hexahedron				✓			

<sup>2</sup>ELTYP

<sup>3</sup>Number of nodes

<sup>4</sup>Included in program PREFRAME

<sup>5</sup>Included in program PREFEM

<sup>6</sup>Included in program SESTRA

<sup>7</sup>Included in program ADVANCE

<sup>8</sup>Included in program Poseidon

<sup>9</sup>**FR** = FRAMEWORK, **LA** = LAUNCH, **PL** = PLATEWORK, **PR** = PRETUBE, **SP** = SPLICE, **WD** = WADAM, **WJ** = WAJAC

<sup>10</sup>Temporarily ADVANCE interprets Axisl Spring as link element, ignoring the material reference. The 6 matrix numbers are given in direct input to ADVANCE.

<sup>11</sup>The element subroutines are the same as for the subparametric curved thick shells (SCQS and SCTS).

<sup>12</sup>As General Spring it is just a 2-noded spring (12x12 matrix) which may be in a local coordinate system. As a shim element the preprocessor(s) will only insert stiffness in the local x- and y-direction. In the analysis program(s), shim members and general springs are treated exactly in the same manner.