TrueGrid®User's Guide For MPACT®

by

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Introduction

MPACT[®] is a three-dimensional Finite Element simulation code. The focus in this manual will be on those features in **True***Grid*[®] that are specific to creating a **MPACT**[®] input file. The **True***Grid*[®] User's Manual covers the creation of a mesh and will not be covered in this manual. This manual is incomplete in another sense because it cannot be used as a substitute for a working knowledge of **MPACT**[®].

The output files generated for **MPACT**[®] and the information below is based on the document **MPACT Model Data Base Interface Reference Manual** and discussions with Pedro Marcal.

Conventions Used In This Document

Different fonts are used through out this manual to indicate their meaning. A keyword command or literal is highlighted in **bold**. A symbol to be substituted with a literal or a number is *italicized*. A computer example uses the Courier font.

Command List for MPACT Output

The following is a list of **True***Grid*[®] commands that can be used to produce features that are unique to an **MPACT**[®] file.

MPACT[®] feature

choose MPACT [®] output format
change the root name of the output files
change to first order elements (default)
change to second order elements
merge nodes (merge phase only)
write the output file (merge phase only)
create a part
create beams within a part
create beams along a 3D curve
create beams 1 at a time

TrueGrid® commands

mpact mof linear triquadratic t, tp, stp write block, cylinder ibm, jbm, kbm bm beam

Boundary Conditions, Loads, and Properties

Boundary conditions, loads, properties, and analysis options are not created in **True***Grid*[®]. These properties are assigned within **MPACT**[®].

MDB Output Files

It is required that the **mpact** command be issued before any parts are generated. This is so that **True***Grid*[®] knows to save topological data along with the parts to write the GEO file. For this reason, the **readmesh** command cannot be used, since there is no topology found in other mesh files.

The entities such as nodes, solid elements, shells, and beams will be written to the output file with the suffix ".fe" (FE file).

The BODYELEMENT, FACEELEMENT, and LINEELEMENT data are written to the file with a ".geo" suffix (GEO file). Also, the FaceElFace, EdgeElSide, FaceNode, EdgeNode, and VertexNode cards are written to the ".geo" or geometry file. This data is based on the block topology of the parts generated in **TrueGrid**[®]. All of the brick elements formed in a part will be found in a BODYELEMENT card, one for each part. All of the shell elements generated in a part will be listed in a FACEELEMENT card, one for each part. All of the beam elements formed in a part will be listed in a LINEELEMENT card, one for each part. Faces, edges, and vertices will reflect the block topology of each part. The intent is to give you control on the regions that you might need to identify when applying boundary conditions or loads in **MPACT**[®].

At this time the data file (DAT file) is not produced by **True***Grid*[®].

The default root name for the output files is "trugrdo" (i.e. trugrdo.fe and trugrdo.geo) which can be switched using the **mof** command.

Elements Types

The default (**linear** command) first order element types are 8-noded hexahedral (HEXA8) brick elements, 3-noded triangular shell elements (SHELL3) or 4-noded quad shell elements (SHELL4), and 2-noded beam (BEAM) elements.

Second order elements can be generated by issuing the **triquadratic** command prior to any part commands (**block** or **cylinder**). Do not use the **quadratic** command. The **quadratic** command will cause the generation of 20-noded hexa brick elements and 8-noded quad shell elements which will be ignored when the output file is written.

The second order element types are 27-noded hexahedral (HEXA27) brick elements, 6-noded triangular shell elements (SHELL6) or 4-noded quad shell elements (SHELL9), and 3-noded beam (BEAM3) elements.

There is a caveat with second order triangular shell elements. While in the merge phase, you will see that these elements have a center node. When the elements are written to the output files, these nodes disappear. This means that the node numbering in the **MPACT**[®] MDB files will differ from what

will appear in **True***Grid*[®] graphics. This center node is necessary because of the nature of the **True***Grid*[®] parts.

Use the **block** or **cylinder** commands to create shell or brick elements. Beams can be embedded into the brick or shell parts using the **ibm**, **jbm**, or **kbm** commands. Alternatively, the **bm** command can be used in the merge phase to form beam elements along a 3D curve. As a last resort, use the deprecated **beam** part command to form beams, 1 at a time.

When merging nodes in the merge phase, be sure that no brick elements have collapsed or degenerate edges due to merging, since these elements would be illegal and **True***Grid*[®] will give you a warning message when thee output files are written. The only degenerate or collapsed edge that is allowed is with a quad shell element where one edge has been collapsed to form a triangle.

Example 1 - First Order HEXA

TrueGrid® Input

mof lhexa
mpact
block 1 2; 1 2; 1 2; 1 2; 1 2; 1 2;
merge
writ

lhexa.fe output file

/* MPACT Fi	nite	Element	Data File	. Generate	ed by TrueG	rid
Total Noc	les =	1	8 Total .	Elems =	⊥ *	
node		⊥. 1	⊥ • 1	1.		
node	2	⊥• 1	⊥ • 2	∠ • 1		
node	2	⊥• 1	Z • 2	⊥ • 2		
node	4 5	⊥• 2	∠ • 1	2 • 1		
node	5	2.	⊥• 1	1 • 2		
node	0 7	2.	1 • 2	2.		
node	8	2.	2.	2		
HEXA8	1	1	2 · 5	- • 7	1	
6	-	8	2	4	±	
lhexa.geo output	t file					
FaceNada		1	1	2	2	4
FaceNode		⊥ 2	⊥ 1 2	Z	5	4
FaceNode		2	1 Z 5	6	7	8
FaceElFace		2	1 0	0	/	0
FaceNode		3	1	2	5	6
FaceElFace		4	1 1		0	Ū.
FaceNode		4	3	4	7	8
FaceElFace		5	1 4			
FaceNode		5	1	3	5	7
FaceElFace		6	1 5			
FaceNode		6	2	4	6	8
EdgeElSide		1	1	1	3 3	
EdgeNode		1	1	3	0 1 0	
EdgeElSide		2	1		2 12	
EdgeNode		2	1	2	A 7	
EdgeLISIde		3	1 2	Ζ	4 /	
EdgeRode		3	ے 1	4 2	/ 11	
EdgeNode		ч Д	⊥ ````````````````````````````````````	<u>_</u>	7 11	
EdgeElSide		5	1	5	69	
EdgeNode		5	5	6		

3

EdgeElSide	6	1	5	7	1
EdgeNode	6	5	7		
EdgeElSide	7	1	6	8	5
EdgeNode	7	6	8		
EdgeElSide	8	1	7	8	10
EdgeNode	8	7	8		
EdgeElSide	9	1	1	5	4
EdgeNode	9	1	5		
EdgeElSide	10	1	2	6	8
EdgeNode	10	2	6		
EdgeElSide	11	1	3	7	2
EdgeNode	11	3	7		
EdgeElSide	12	1	4	8	6
EdgeNode	12	4	8		
VertexNode	1	1			
VertexNode	2	2			
VertexNode	3	3			
VertexNode	4	4			
VertexNode	5	5			
VertexNode	6	6			
VertexNode	7	7			
VertexNode	8	8			

Example 2 - First Order Quad

TrueGrid® Input

mof lquads
mpact
block 1 2;1 2;-1;1 2 1 2 0
merge
write

lquad.fe output file

/* MPACT	Finite	Element	Data File.	Generated b	by TrueGrid
Total N	Nodes =		4 Total E	lems =	1 */
node	1	1.	1.	0.E+00	
node	2	1.	2.	0.E+00	
node	3	2.	1.	0.E+00	
node	4	2.	2.	0.E+00	
SHELL4	1	1	1	3	2

lquad.geo output file

/* MPACT	Geo	File.	Gene	erated	by	True	Grid	.*/				
FaceEleme	ent		1		1	-						
FaceNode		1		1			2			3		4
EdgeElSic	le	1		1		1			2	1		
EdgeNode		1		1			2					
EdgeElSic	le	2		1		1			3	3		
EdgeNode		2		1			3					
EdgeElSic	le	3		1		2			4	4		
EdgeNode		3		2			4					
EdgeElSic	le	4		1		3			4	2		
EdgeNode		4		3			4					
VertexNoc	le		1		1							
VertexNoc	le		2		2							
VertexNoc	le		3		3							
VertexNoc	le		4		4							

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Example 3 - First Order Triangle

TrueGrid® Input

mof ltri
mpact
block 1 2;1 2;-1;1 2 1 2 0
pb 2 1 1 2 2 1 y 1.5
merge
stp .001
write

ltri.fe output file

/* MPACT	Finite	Element	Data File.	Generated	by TrueGrid
Total N	Nodes =		3 Total E	lems =	1 */
node	1	1.	1.	0.E+00	
node	2	1.	2.	0.E+00	
node	3	2.	1.5	0.E+00	
SHELL3	1	1	1	3	2

ltri.geo output file

/* MPACT Geo	File.	Generated	by True	Grid.*/		
FaceElement		1	1			
FaceNode	1	1		2		3
EdgeElSide	1	1	1		3	1
EdgeNode	1	1		3		
EdgeElSide	2	1	1		2	3
EdgeNode	2	1		2		
EdgeElSide	3	1	2		3	2
EdgeNode	3	2		3		
VertexNode		1	1			
VertexNode		2	2			
VertexNode		3	3			

Example 4 - First Order Beams

TrueGrid® Input

mof lbeam
mpact
block 1 2;1 2;-1;1 2 1 2 0
ibm 1 1 1 2 2 1 2 1 1 j 1;
mate 0
merge
writ

lbeam.fe output file

/* MPACT	Finite	Element	Data File.	Generated	by	TrueGrid
Total 1	Nodes =		4 Total E	lems =		2 */
node	1	1.	1.	0.E+00		
node	2	1.	2.	0.E+00		
node	3	2.	1.	0.E+00		
node	4	2.	2.	0.E+00		
BEAM	1	1	1	3		
BEAM	2	1	2	4		

lbeam.geo output file

//* MPACT Geo	File.	Generated	by	TrueGrid.*/
LineElement		1	1	
LineElement		2	2	

.....

Example 5 - Second Order HEXA

TrueGrid® Input

mof qhexa
triquadratic
mpact
block 1 2; 1 2; 1 2; 1 2; 1 2; 1 2;
merge
write

qhexa.fe output file

/* MPACT	Finite	Element	Data File. Gen	erated	by Tr	ueGrid
Total N	lodes =		27 Total Elems	=		1 */
node	1	1.	1.	1.		
node	2	1.	1.	1.5		
node	3	1.	1.	2.		
node	4	1.	1.5	1.		
node	5	1.	1.5	1.5		
node	6	1.	1.5	2.		
node	7	1.	2.	1.		
node	8	1.	2.	1.5		
node	9	1.	2.	2.		
node	10	1.5	1.	1.		
node	11	1.5	1.	1.5		
node	12	1.5	1.	2.		
node	13	1.5	1.5	1.		
node	14	1.5	1.5	1.5		
node	15	1.5	1.5	2.		
node	16	1.5	2.	1.		
node	17	1.5	2.	1.5		
node	18	1.5	2.	2.		
node	19	2.	1.	⊥.		
node	20	2.	⊥.	1.5		
node	21	2.	⊥.	2.		
node	22	2.	1.5	⊥.		
node	23	2.	1.5	1.5		
node	24	2.	1.5	∠.		
node	25	2.	2.	⊥. 1 ⊏		
node	26	2.	2.	1.5		
node	<u>ر ک</u>	Ζ.	Ζ.	2.		0 F
HEXAZ /	T	T	19			20
			10	13		
			1 2 0	4		26
			∠∪ 11	23 17		∠ 10 1 7
				14 5		⊥ / 0
			Z	С		ð

21	24	27
12	15	18
3	6	9

qhexa.geo output file

/* MPACT	Geo	File.	Gene	rated	by	TrueGrid.*	/	
BodyEleme	nt	1	T	1	Э	L		
FaceLIFac	e	⊥ 1		⊥ 1	3	2	З	Л
racenoue 5	6	Т	7	Т		Ζ.	5	4
5	0	8	,	g				
FaceElFac	e	2		1	2			
FaceNode	.0	2		19	-	20	21	22
23	24		25	20		20		
		26		27				
FaceElFac	e	3		1	0			
FaceNode		3		1		2	3	10
11	12		19					
		20		21				
FaceElFac	e	4		1	1			
FaceNode		4		7		8	9	16
17	18		25					
		26		27				
FaceElFac	e	5		1	4			
FaceNode		5		1		4	7	10
13	16		19	0.5				
		22		25	-			
FaceElFac	e	6			5	C	0	1.0
FaceNode	10	6	0.1	3		6	9	$\perp Z$
10	ΤO	24	Ζ⊥	27				
FdaaFlSid		24 1		2 / 1		1	<u>а</u> а	
EdgeNode		1		1		2	3 3	
EdgeElSid	٩	2		1		1	7 12	
EdgeNode		2		1		4	7	
EdgeElSid	e	3		1		.3	9 1 1	
EdgeNode		3		- 3		6	9	
EdgeElSid	le	4		1		7	97	
EdgeNode		4		7		8	9	
EdgeElSid	le	5		1		19	21 9	
EdgeNode		5		19		20	21	
EdgeElSid	le	6		1		19	25 1	
EdgeNode		6		19		22	25	
EdgeElSid	le	7		1		21	27 5	
EdgeNode		7		21		24	27	
EdgeElSid	le	8				25	27 10	
EdgeNode		8		25		26	27	
EageElSid	le	9		Ţ		\perp	19 12	

......

EdgeNode	9		1	10	19
EdgeElSide	10		1	3	21 9
EdgeNode	10		3	12	21
EdgeElSide	11		1	7	25 2
EdgeNode	11		7	16	25
EdgeElSide	12		1	9	27 6
EdgeNode	12		9	18	27
VertexNode		1	1		
VertexNode		2	3		
VertexNode		3	7		
VertexNode		4	9		
VertexNode		5	19		
VertexNode		6	21		
VertexNode		7	25		
VertexNode		8	27		

Example 6 - Second Order Quad

TrueGrid® Input

mof qquads
mpact
triquadratics
block 1 2;1 2;-1;1 2 1 2 0
merge
write

qquads.fe output file

/* MPACT	Finite	Element	Data File.	Generated	by TrueGrid
Total N	Nodes =		9 Total E	lems =	1 */
node	1	1.	1.	0.E+00	
node	2	1.	1.5	0.E+00	
node	3	1.	2.	0.E+00	
node	4	1.5	1.	0.E+00	
node	5	1.5	1.5	0.E+00	
node	6	1.5	2.	0.E+00	
node	7	2.	1.	0.E+00	
node	8	2.	1.5	0.E+00	
node	9	2.	2.	0.E+00	
SHELL9	1	1	1	4	7
			2	5	8
			3	6	9

qquads.geo output file

/* MPACT FaceNode	Geo	File. 1	Genera	ated 1	by	True	Grid.*/ 2		3	4
5	6	±	7	-			2		0	1
		8		9						
EdgeElSic	le	1		1		1		3	1	
EdgeNode		1		1			2		3	
EdgeElSic	le	2		1		1		7	3	
EdgeNode		2		1			4		7	
EdgeElSic	le	3		1		3		9	4	
EdgeNode		3		3			6		9	
EdgeElSic	le	4		1		7		9	2	
EdgeNode		4		7			8		9	
VertexNoc	le		1		1					
VertexNoc	le		2		3					
VertexNoc	le		3		7					
VertexNoc	le		4		9					

Example 7 - Second Order Triangle

TrueGrid® Input

mof qtri
mpact
triquadratic
block 1 2;1 2;-1;1 2 1 2 0
pb 2 1 1 2 2 1 y 1.5
merge
stp .001
write

qtri.fe output file

/* MPACT	Finite	Element	Data File.	Generated	by TrueGrid
Total N	lodes =		6 Total E	lems =	1 */
node	1	1.	1.	0.E+00	
node	2	1.	1.5	0.E+00	
node	3	1.	2.	0.E+00	
node	4	1.5	1.25	0.E+00	
node	5	1.5	1.75	0.E+00	
node	6	2.	1.5	0.E+00	
SHELL6	1	1	3	2	1
			5	4	6

qtri.geo output file

/* MPACT Geo	File.	Generated b	y TrueGrid.*/			
FaceNode	1	1	2		3	4
5 6						
EdgeElSide	1	1	1	6	1	
EdgeNode	1	1	4		6	
EdgeElSide	2	1	1	3	3	
EdgeNode	2	1	2		3	
EdgeElSide	3	1	3	6	2	
EdgeNode	3	3	5		6	
VertexNode		1	1			
VertexNode		2	3			
VertexNode		3				

Example 8 - Second Order Beams

TrueGrid® Input

mof qbeam
mpact
triquadratic
block 1 2;1 2;-1;1 2 1 2 0
ibm 1 1 1 2 2 1 2 1 1 j 1 ;
mate 0
merge
write

qbeam.fe output file

/* MPACT	Finite	Element	Data File.	Generated	by	TrueGrid
Total	Nodes =		6 Total E	lems =		2 */
node	1	1.	1.	0.E+00		
node	2	1.	2.	0.E+00		
node	3	1.5	1.	0.E+00		
node	4	1.5	2.	0.E+00		
node	5	2.	1.	0.E+00		
node	6	2.	2.	0.E+00		
BEAM3	1	1	1	3		5
BEAM3	2	1	2	4		6

qbeam.geo output file

/*	MPACT	Geo	File.	Generated	by	TrueGrid.*/
Lir	neEleme	ent		1	1	L
Lir	neEleme	ent		2	2	2

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