MESH DESCRIPTION

Number of Nodes, Elements:

175 7

Node, Coordinate:

1	2.00000000000000	1.93187242818700
2	1.76120520924400	1.72454204567700
3	1.86573409679200	1.65017491276000
4	2.00000000000000	1.63449889434050
5	1.82005808982600	1.33247665689700
6	1.17697813929400	1.00000000000000
7	1.70703741325450	1.00000000000000
8	1.76228836091900	1.11579561406500
9	1.00000000000000	1.26932527930700
10	1.49144566763100	1.73073137949700
11	1.43211664011600	2.00000000000000
12	1.00000000000000	2.00000000000000
13	2.00000000000000	2.00000000000000
14	1.00000000000000	1.00000000000000
15	1.83320634778600	1.34484244385600
16	2.00000000000000	1.35190228676500
17	2.00000000000000	1.00000000000000
18	1.79604817176000	1.69975300137100
19	1.83089113427600	1.67496395706600
20	1.91048939786100	1.64489499151600
21	1.95524469893100	1.63961507027200
22	2.00000000000000	1.68392469555500
23	2.00000000000000	1.73351424208100
24	2.00000000000000	1.78310378860800
25	2.00000000000000	1.83269333513400
26	1.96020086820700	1.89731736443600
27	1.92040173641500	1.86276230068400
28	1.88060260462200	1.82820723693200
29	1.84080347282900	1.79365217318000
30	1.80100434103700	1.75909710942800
31	1.28118581272600	1.00000000000000
32	1.38539348615700	1.00000000000000
33	1.48960115958800	1.00000000000000
34	1.73015243368500	1.05789780703260
35	1.78154493722100	1.18802262834300
36	1.80080151352300	1.26024964262000
37	1.72818952546400	1.28497999162600
38	1.63632096110200	1.23748332635500
39	1.54445239674100	1.18998666108400
40	1.45258383237900	1.14248999581300
41	1.36071526801800	1.09499333054210
42	1.26884670365600	1.04749666527110
43	1.09828913352630	1.36160649934500
44	1.19657826705300	1.45388771938300

45	1.29486740057900	1.54616893942100
46	1.39315653410500	1.63845015945900
47	1.46178115387400	1.86536568974800
48	1.32408748008700	2.00000000000000
49	1.21605832005800	2.00000000000000
50	1.10802916002900	2.00000000000000
51	1.00000000000000	1.75644175976900
52	1.00000000000000	1.63449889434050
53	1.00000000000000	1.50300111871750
54	1.00000000000000	1.39110439942200
55	1.62632543843800	1.72763671258700
56	1.85802916002900	2.00000000000000
57	1.70703741325450	2.00000000000000
58	2.00000000000000	1.50300111871750
59	1.60536589435000	1.60210173428300
60	1.71928612106800	1.47347208907000
61	1.79867767096700	1.00000000000000
62	1.89933883548400	1.00000000000000
63	2.00000000000000	1.11730076225500
64	2.00000000000000	1.23460152451000
65	1.91660317389300	1.34837236531100
66	1.85802916002900	1.00000000000000
67	1.58394815655350	1.00000000000000
68	1.43211664011600	1.00000000000000
69	1.32408748008700	1.00000000000000
70	1.21605832005800	1.00000000000000
71	1.10802916002900	1.00000000000000
72	2.00000000000000	1.88025188077250
73	2.00000000000000	1.75644175976900
74	2.00000000000000	1.39110439942200
75	2.00000000000000	1.26932527930700
76	1.17697813929400	2.00000000000000
77	1.28118581272600	2.00000000000000
78	1.38539348615700	2.00000000000000
79	1.48960115958800	2.00000000000000
80	1.58394815655350	2.00000000000000
81	1.79867767096700	2.00000000000000
82	1.89933883548400	2.00000000000000
83	1.00000000000000	1.11730076225500
84	1.00000000000000	1.23460152451000
85	1.00000000000000	1.35190228676500
86	1.00000000000000	1.68392469555500
87	1.00000000000000	1.73351424208100
88	1.00000000000000	1.78310378860800
89	1.00000000000000	1.83269333513400
90	1.00000000000000	1.88025188077250
91	1.00000000000000	1.93187242818700
92	1.91874487389700	1.77392276740400
93	1.89548562269700	1.77605683654100
94	1.87206945436800	1.76359924030400
95	1.85477071230400	1.73988798154500

96	1.84822458047100	1.71127647290000
97	1.85418508960700	1.68543114500400
98	1.87105512610300	1.66927723259600
99	1.89431437730300	1.66714316345900
100	1.91773054563200	1.67960075969600
101	1.93502928769600	1.70331201845500
102	1.94157541952900	1.73192352710000
103	1.93561491039300	1.75776885499600
104	1.76416682999400	1.15724959856500
105	1.75337412908400	1.18307209298200
106	1.72844064290400	1.20051525533800
107	1.69604727894200	1.20490520436800
108	1.66487381291000	1.19506565677300
109	1.64327314985800	1.17363311138600
110	1.63703317000600	1.14635040143500
111	1.64782587091600	1.12052790701800
112	1.67275935709600	1.10308474466200
113	1.70515272105800	1.09869479563200
114	1.73632618709000	1.10853434322700
115	1.75792685014200	1.12996688861400
116	1.07486083929780	1.77216610127700
117	1.08626088117380	1.75004407381900
118	1.11112245436800	1.73608268718500
119	1.14278392042000	1.73402288365100
120	1.17276161507000	1.74441658590800
121	1.19302303924600	1.76447880983200
122	1.19813916070200	1.78883389872300
123	1.18673911882600	1.81095592618100
124	1.16187754563200	1.82491731281500
125	1.13021607958000	1.82697711634900
126	1.10023838493000	1.81658341409200
127	1.07997696075410	1.79652119016800
128	1.81478308487600	1.81854647762100
129	1.83125411971400	1.84104561708800
130	1.83329498666600	1.87130306007400
131	1.82035883708000	1.90121134916500
132	1.79591190179100	1.92275658245300
133	1.76650471736600	1.93016573207700
134	1.74001691512400	1.92145352237900
135	1.72354588028600	1.89895438291200
136	1.72150501333400	1.86869693992600
137	1.73444116292000	1.83878865083500
138	1.75888809820900	1.81724341754700
139	1.78829528263400	1.80983426792300
140	1.45901865533900	1.42051730815400
141	1.46870220946200	1.38777648384800
142	1.50410829403500	1.35967748170500
143	1.55574987728900	1.34374940665800
144	1.60978963869500	1.34426017355100
145	1.65174766782700	1.36107292280900
146	1.67038134466100	1.38968269184600

147	1.66069779053800	1.42242351615200
148	1.62529170596500	1.45052251829500
149	1.57365012271100	1.46645059334200
150	1.51961036130500	1.46593982644900
151	1.47765233217300	1.44912707719100
152	1.73542605973000	1.60394372348100
153	1.74016010100600	1.57103159894600
154	1.76936859445500	1.53979908741200
155	1.81522514784400	1.51861491512100
156	1.86544253472500	1.51315536393100
157	1.90656504683800	1.52488331617500
158	1.92757394027000	1.55065627651900
159	1.92283989899400	1.58356840105400
160	1.89363140554500	1.61480091258800
161	1.84777485215600	1.63598508487900
162	1.79755746527500	1.64144463606900
163	1.75643495316200	1.62971668382500
164	1.95024687556700	1.14280419348400
165	1.92415901444500	1.17046873624300
166	1.88128172100400	1.18043021448200
167	1.83310393139500	1.17001945814900
168	1.79253484543700	1.14202602099800
169	1.77044491695000	1.10395072190600
170	1.77275312443300	1.06599580651610
171	1.79884098555500	1.03833126375660
172	1.84171827899600	1.02836978551840
173	1.88989606860500	1.03878054185090
174	1.93046515456300	1.06677397900220
175	1.95255508305000	1.10484927809400

Element, Material No., Node, Connectivity:

1	1	19	2	18	19
3	20	21	4	22	23
73	24	25	72	1	26
27	28	29	30		
2	1	20	6	70	31
69	32	68	33	67	7
34	8	35	36	5	37
38	39	40	41	42	
3	1	26	9	43	44
45	46	10	47	11	78
48	77	49	76	50	12
91	90	89	88	51	87
86	52	53	54	85	
4	1	18	47	10	55
2	30	29	28	27	26
1	13	82	56	81	57
80	79	11			
5	1	21	46	45	44
43	9	84	83	14	71
6	42	41	40	39	38
37	5	15	60	59	10

6 1 16 15 65 16
74 58 4 21 20 3
19 18 2 55 10 59
60
7 1 16 34 7 61
66 62 17 63 64 75
16 65 15 5 36 35
8

Particulate Connectivity:

1 2 12 92 93 94
95 96 97 98 99 100
101 102 103
2 2 12 104 105 106
107 108 109 110 111 112
113 114 115
3 2 12 116 117 118
119 120 121 122 123 124
125 126 127
4 2 12 128 129 130
131 132 133 134 135 136
137 138 139
5 2 12 140 141 142
143 144 145 146 147 148
149 150 151
6 2 12 152 153 154
155 156 157 158 159 160
161 162 163
7 2 12 164 165 166
167 168 169 170 171 172
173 174 175

Crack Connectivity:

1 0
2 0
3 0
4 0
5 0
6 0
7 0

Particulate Geometry:

1 5.750000000000000E-002 4.410000000000000E-002
65.5000000000000 1.89490000000000 1.72160000000000
1
1 6.380000000000000E-002 5.330000000000000E-002
4.90000000000000 1.70060000000000 1.15180000000000
1
1 6.220000000000000E-002 4.690000000000000E-002
187.700000000000 1.13650000000000 1.78050000000000
1
1 6.360000000000000E-002 5.310000000000000E-002
306.000000000000 1.77740000000000 1.87000000000000
1

```
        1  0.106800000000000       6.200000000000000E-002
  171.700000000000        1.56470000000000        1.40510000000000
        1
        1  9.970000000000000E-002  6.090000000000000E-002
  164.500000000000        1.83150000000000        1.57730000000000
        1
        1  9.669999999999999E-002  7.149999999999999E-002
  23.4000000000000        1.86150000000000        1.10440000000000
        1
```

Crack Geometry:

```
        0  0.000000000000000E+000  0.000000000000000E+000
 0.000000000000000E+000   1.00000000000000        1.00000000000000
        0  0.000000000000000E+000  0.000000000000000E+000
 0.000000000000000E+000   1.00000000000000        1.00000000000000
        0  0.000000000000000E+000  0.000000000000000E+000
 0.000000000000000E+000   1.00000000000000        1.00000000000000
        0  0.000000000000000E+000  0.000000000000000E+000
 0.000000000000000E+000   1.00000000000000        1.00000000000000
        0  0.000000000000000E+000  0.000000000000000E+000
 0.000000000000000E+000   1.00000000000000        1.00000000000000
        0  0.000000000000000E+000  0.000000000000000E+000
 0.000000000000000E+000   1.00000000000000        1.00000000000000
        0  0.000000000000000E+000  0.000000000000000E+000
 0.000000000000000E+000   1.00000000000000        1.00000000000000
```

Material Properties

2 ⟶ **No. of Materials**

70.,0.35 ⟶ **Material 1** **Elastic Modulus (GPa)** **Poisson Ratio**

165.,0.27 ⟶ **Material 2** **Elastic Modulus (GPa)** **Poisson Ratio**

```
20     -----------
1,3,4            |
0,3,4            |
0,3,2            |
1,3,4            |
0,3,4            |
0,3,2            |
1,3,4            |
0,3,4            |
0,3,2            |
1,3,4            |  ---------->  Reciprocal Terms
0,3,4            |
0,3,2            |
1,3,4            |
0,3,4            |
0,3,2            |
1,3,4            |
0,3,4            |
0,3,2            |
1,3,4            |
0,3,4            |
0,3,2  -----------
1      -----------
```

63 |
63 |
63 |
63 | → **Beta Parameters**
63 |
63 |
63 ----------
1st boundary
45
12, 1, 0,0.0,0.0 → **Node Number, Apply to X (Boolean), Apply to Y (Boolean), X-displacement, Y-displacement**
91, 1, 0,0.0,0.0
90, 1, 0,0.0,0.0
89, 1, 0,0.0,0.0
88, 1, 0,0.0,0.0
51, 1, 0,0.0,0.0
87, 1, 0,0.0,0.0
86, 1, 0,0.0,0.0
52, 1, 0,0.0,0.0
53, 1, 0,0.0,0.0
54, 1, 0,0.0,0.0
85, 1, 0,0.0,0.0
9, 1, 0,0.0,0.0
84, 1, 0,0.0,0.0
83, 1, 0,0.0,0.0
14, 1, 1,0.0,0.0
71, 0, 1,0.0,0.0
6, 0, 1,0.0,0.0
70, 0, 1,0.0,0.0
31, 0, 1,0.0,0.0
69, 0, 1,0.0,0.0
32, 0, 1,0.0,0.0
68, 0, 1,0.0,0.0
33, 0, 1,0.0,0.0
67, 0, 1,0.0,0.0
7, 0, 1,0.0,0.0
6, 0, 1,0.0,0.0
66, 0, 1,0.0,0.0
62, 0, 1,0.0,0.0
17, 1, 1,0.1,0.0
63, 1, 0,0.1,0.0
64, 1, 0,0.1,0.0
75, 1, 0,0.1,0.0
16, 1, 0,0.1,0.0
74, 1, 0,0.1,0.0
58, 1, 0,0.1,0.0
4, 1, 0,0.1,0.0
22, 1, 0,0.1,0.0
23, 1, 0,0.1,0.0
73, 1, 0,0.1,0.0
24, 1, 0,0.1,0.0
25, 1, 0,0.1,0.0

72, 1, 0,0.1,0.0
1, 1, 0,0.1,0.0
13, 1, 0,0.1,0.0
2ND BOUNDARY → **Force Boundary Conditions**
0
4TH BOUNDARY
0 100000.0D0

macroscpoic strains
3,0.000
1,0.1
3,0.

REPEATABILITY BOUNDARY
0