

## BAB VI

### KESIMPULAN DAN SARAN

#### 6.1. Kesimpulan

Berdasarkan hasil analisis data dan pembahasan, dapat diambil kesimpulan sebagai berikut:

1. Analisis *Finite Element Method (FEM) Non Linear* dengan Abaqus 6.14 *Student Edition* dapat memberikan ilustrasi trayektori tegangan yang terjadi pada balok tinggi-T beton bertulang.
2. Kuat geser ultimit balok tinggi-T beton bertulang dari hasil eksperimen yang telah dilakukan peneliti lain ( $V_{u \text{ EXP}}$ ) dibandingkan dengan hasil prediksi dari model persamaan yang diusulkan ( $V_{u \text{ STM}}$ ) memberikan nilai STD sebesar 0.278 dan Mean sebesar 1.297. Nilai Mean  $> 1.0$  menunjukkan bahwa prediksi dari persamaan yang diusulkan memberikan hasil yang aman dan bisa diterima. Nilai korelasi R sebesar 0.985 menunjukkan bahwa persamaan yang diusulkan konsisten memprediksi eksperimen.
3. Model persamaan yang diusulkan sanggup untuk mendesain balok tinggi-T beton bertulang dengan variasi parameter, seperti kuat tekan beton, jumlah dan jarak pemasangan tulangan badan, angka rasio lengan geser per tinggi efektif ( $a/d$ ), lebar badan balok, lebar sayap balok dan tebal sayap balok.

## 6.2. Saran

Dari hasil penelitian ini terdapat beberapa hal yang dapat dijadikan saran, antara lain:

1. Perlu lebih banyak lagi hasil eksperimen yang dikumpulkan untuk dijadikan dasar mendapatkan parameter dan fungsi yang tidak diketahui sehingga hasilnya lebih konservatif.
2. Dikarenakan data sekunder yang dikumpulkan jumlahnya sangat terbatas maka perlu dilakukan eksperimen untuk pengujian kuat geser ultimit balok tinggi-T dengan variasi parameter yang terukur, seperti kuat tekan beton, jumlah dan jarak pemasangan tulangan badan, angka rasio lengan geser per tinggi efektif ( $a/d$ ), lebar badan balok, lebar sayap balok dan tebal sayap balok. Sehingga dapat dilihat pengaruh dari parameter tersebut terhadap kuat geser ultimit balok tinggi-T.
3. Persamaan yang diusulkan masih terbatas, yaitu hanya untuk beton konvensional dan mutu beton normal. Sehingga perlu dilakukan penelitian untuk memprediksi kuat geser ultimit balok tinggi-T beton bertulang jenis dan mutu beton berbeda.
4. Diperlukan berbagai pengembangan metode *STM* lain untuk memprediksi kuat geser ultimit balok tinggi-T beton bertulang, sehingga hasilnya dapat dibandingkan dengan hasil prediksi dari persamaan yang diusulkan dalam penelitian ini.

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**LAMPIRAN**

Lampiran 1. Input *Analisis Finite Element Non Linear* dengan Abaqus 6.14 *Student Edition*

\*Heading

\*\* Job name: Job43 Model name: Model-1

\*\* Generated by: Abaqus/CAE Student Edition 6.14-2

\*Preprint, echo=NO, model=NO, history=NO, contact=NO

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\*\* PARTS

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\*Part, name=BALOK


\*End Part

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\*Part, name=GABUNGAN

\*Node

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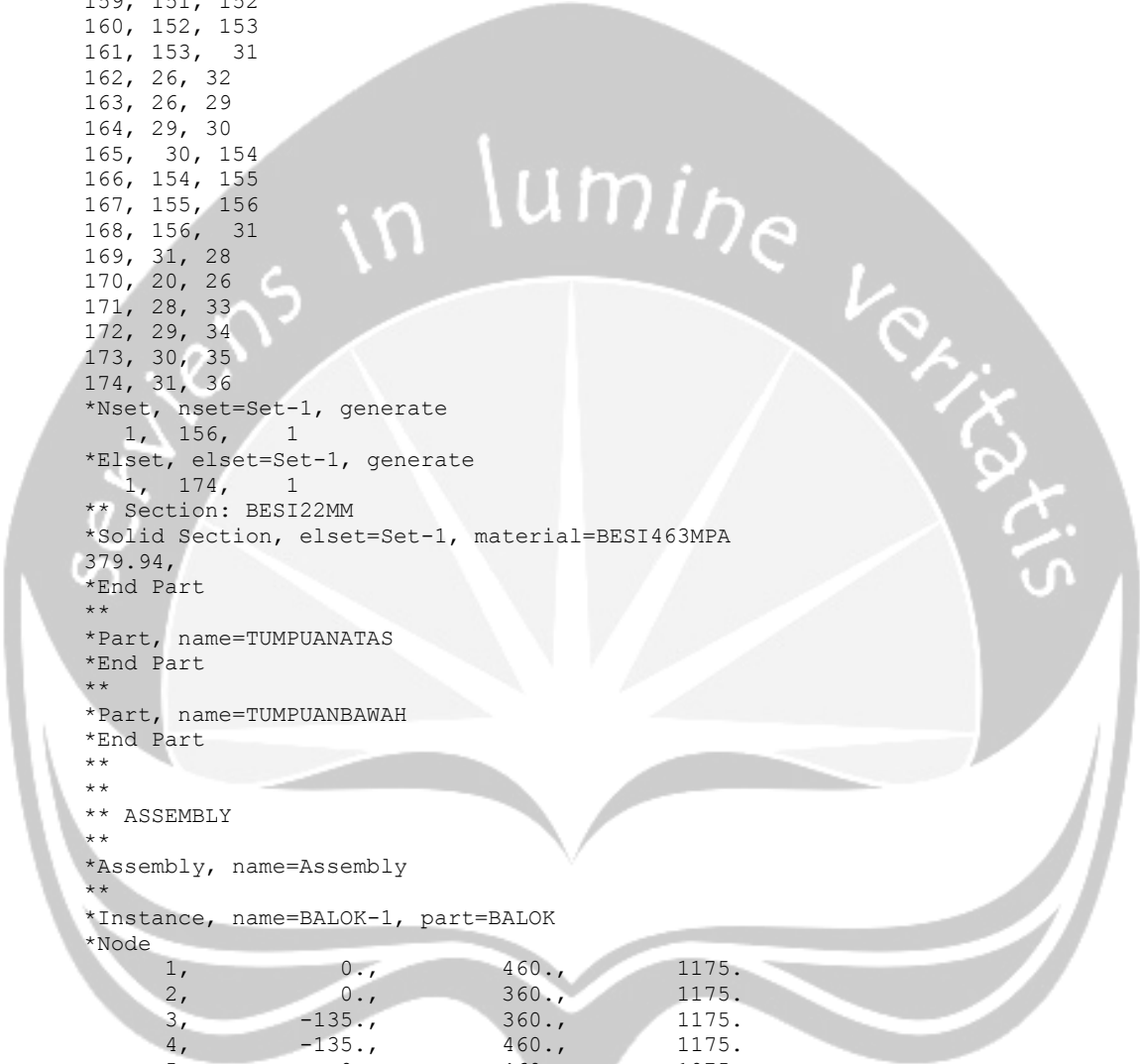
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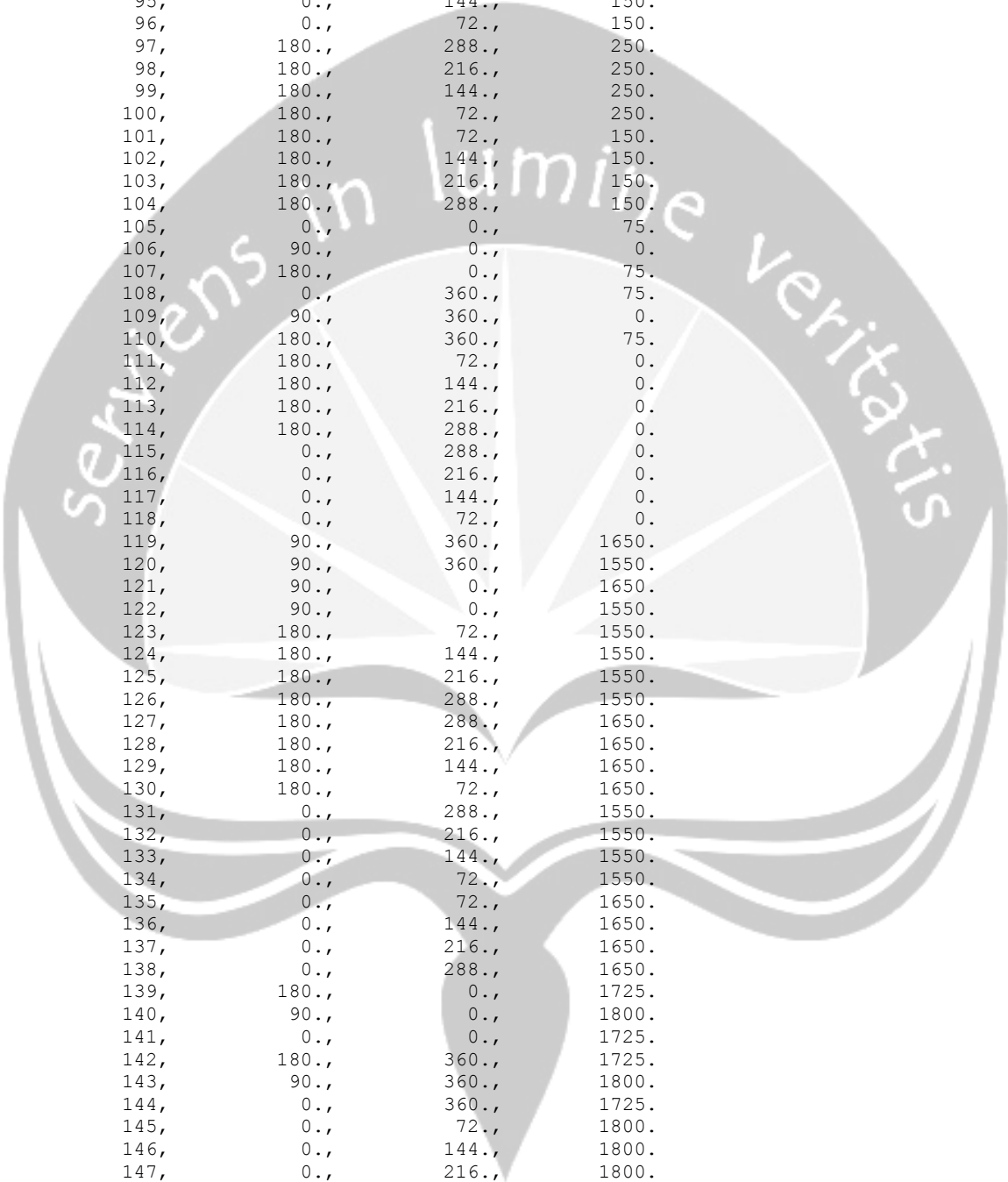


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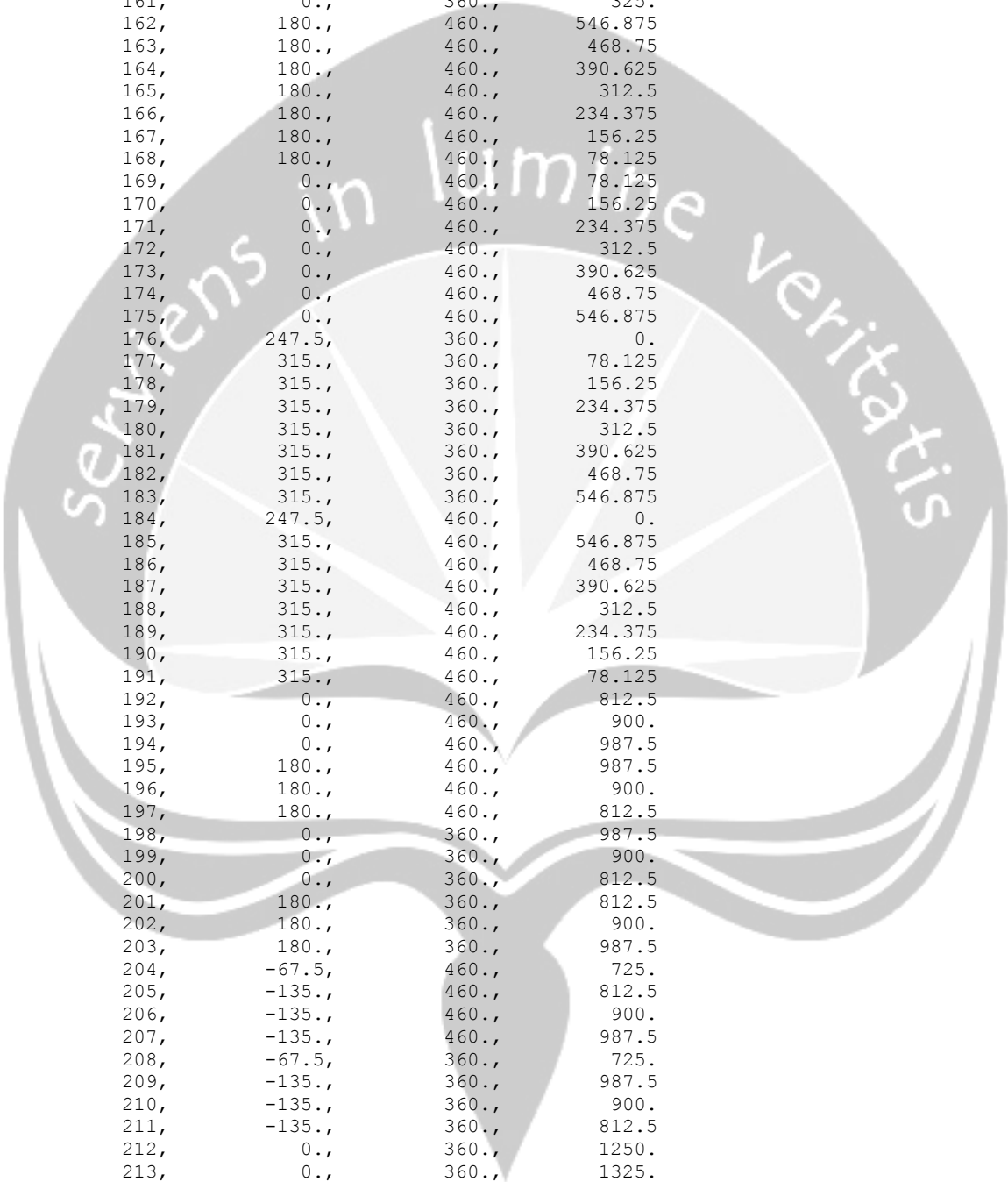
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82,	90.,	360.,	1175.
83,	90.,	460.,	1075.
84,	90.,	360.,	1075.
85,	90.,	0.,	150.
86,	90.,	0.,	250.
87,	90.,	360.,	150.
88,	90.,	360.,	250.
89,	0.,	72.,	250.



90,	0.,	144.,	250.
91,	0.,	216.,	250.
92,	0.,	288.,	250.
93,	0.,	288.,	150.
94,	0.,	216.,	150.
95,	0.,	144.,	150.
96,	0.,	72.,	150.
97,	180.,	288.,	250.
98,	180.,	216.,	250.
99,	180.,	144.,	250.
100,	180.,	72.,	250.
101,	180.,	72.,	150.
102,	180.,	144.,	150.
103,	180.,	216.,	150.
104,	180.,	288.,	150.
105,	0.,	0.,	75.
106,	90.,	0.,	0.
107,	180.,	0.,	75.
108,	0.,	360.,	75.
109,	90.,	360.,	0.
110,	180.,	360.,	75.
111,	180.,	72.,	0.
112,	180.,	144.,	0.
113,	180.,	216.,	0.
114,	180.,	288.,	0.
115,	0.,	288.,	0.
116,	0.,	216.,	0.
117,	0.,	144.,	0.
118,	0.,	72.,	0.
119,	90.,	360.,	1650.
120,	90.,	360.,	1550.
121,	90.,	0.,	1650.
122,	90.,	0.,	1550.
123,	180.,	72.,	1550.
124,	180.,	144.,	1550.
125,	180.,	216.,	1550.
126,	180.,	288.,	1550.
127,	180.,	288.,	1650.
128,	180.,	216.,	1650.
129,	180.,	144.,	1650.
130,	180.,	72.,	1650.
131,	0.,	288.,	1550.
132,	0.,	216.,	1550.
133,	0.,	144.,	1550.
134,	0.,	72.,	1550.
135,	0.,	72.,	1650.
136,	0.,	144.,	1650.
137,	0.,	216.,	1650.
138,	0.,	288.,	1650.
139,	180.,	0.,	1725.
140,	90.,	0.,	1800.
141,	0.,	0.,	1725.
142,	180.,	360.,	1725.
143,	90.,	360.,	1800.
144,	0.,	360.,	1725.
145,	0.,	72.,	1800.
146,	0.,	144.,	1800.
147,	0.,	216.,	1800.
148,	0.,	288.,	1800.
149,	180.,	288.,	1800.
150,	180.,	216.,	1800.
151,	180.,	144.,	1800.
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153,	90.,	460.,	0.
154,	180.,	360.,	325.
155,	180.,	360.,	400.

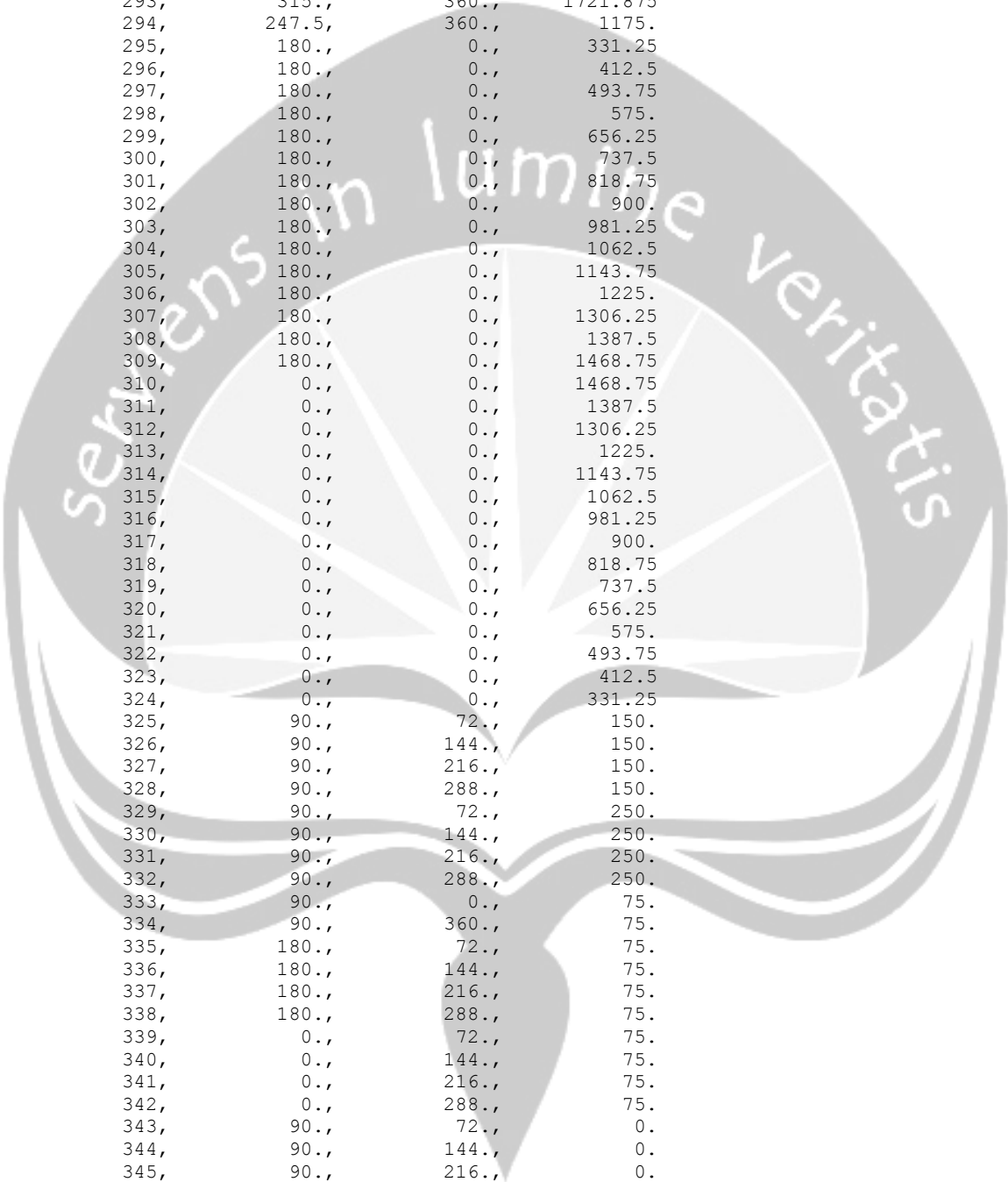


156,	180.,	360.,	475.
157,	180.,	360.,	550.
158,	0.,	360.,	550.
159,	0.,	360.,	475.
160,	0.,	360.,	400.
161,	0.,	360.,	325.
162,	180.,	460.,	546.875
163,	180.,	460.,	468.75
164,	180.,	460.,	390.625
165,	180.,	460.,	312.5
166,	180.,	460.,	234.375
167,	180.,	460.,	156.25
168,	180.,	460.,	78.125
169,	0.,	460.,	78.125
170,	0.,	460.,	156.25
171,	0.,	460.,	234.375
172,	0.,	460.,	312.5
173,	0.,	460.,	390.625
174,	0.,	460.,	468.75
175,	0.,	460.,	546.875
176,	247.5,	360.,	0.
177,	315.,	360.,	78.125
178,	315.,	360.,	156.25
179,	315.,	360.,	234.375
180,	315.,	360.,	312.5
181,	315.,	360.,	390.625
182,	315.,	360.,	468.75
183,	315.,	360.,	546.875
184,	247.5,	460.,	0.
185,	315.,	460.,	546.875
186,	315.,	460.,	468.75
187,	315.,	460.,	390.625
188,	315.,	460.,	312.5
189,	315.,	460.,	234.375
190,	315.,	460.,	156.25
191,	315.,	460.,	78.125
192,	0.,	460.,	812.5
193,	0.,	460.,	900.
194,	0.,	460.,	987.5
195,	180.,	460.,	987.5
196,	180.,	460.,	900.
197,	180.,	460.,	812.5
198,	0.,	360.,	987.5
199,	0.,	360.,	900.
200,	0.,	360.,	812.5
201,	180.,	360.,	812.5
202,	180.,	360.,	900.
203,	180.,	360.,	987.5
204,	-67.5,	460.,	725.
205,	-135.,	460.,	812.5
206,	-135.,	460.,	900.
207,	-135.,	460.,	987.5
208,	-67.5,	360.,	725.
209,	-135.,	360.,	987.5
210,	-135.,	360.,	900.
211,	-135.,	360.,	812.5
212,	0.,	360.,	1250.
213,	0.,	360.,	1325.
214,	0.,	360.,	1400.
215,	0.,	360.,	1475.
216,	-67.5,	360.,	1800.
217,	-135.,	360.,	1721.875
218,	-135.,	360.,	1643.75
219,	-135.,	360.,	1565.625
220,	-135.,	360.,	1487.5
221,	-135.,	360.,	1409.375




222,	-135.,	360.,	1331.25
223,	-135.,	360.,	1253.125
224,	0.,	460.,	1721.875
225,	0.,	460.,	1643.75
226,	0.,	460.,	1565.625
227,	0.,	460.,	1487.5
228,	0.,	460.,	1409.375
229,	0.,	460.,	1331.25
230,	0.,	460.,	1253.125
231,	-67.5,	460.,	1800.
232,	-135.,	460.,	1253.125
233,	-135.,	460.,	1331.25
234,	-135.,	460.,	1409.375
235,	-135.,	460.,	1487.5
236,	-135.,	460.,	1565.625
237,	-135.,	460.,	1643.75
238,	-135.,	460.,	1721.875
239,	180.,	360.,	1250.
240,	180.,	360.,	1325.
241,	180.,	360.,	1400.
242,	180.,	360.,	1475.
243,	90.,	460.,	1800.
244,	180.,	460.,	1721.875
245,	180.,	460.,	1643.75
246,	180.,	460.,	1565.625
247,	180.,	460.,	1487.5
248,	180.,	460.,	1409.375
249,	180.,	460.,	1331.25
250,	180.,	460.,	1253.125
251,	-67.5,	360.,	625.
252,	-135.,	360.,	546.875
253,	-135.,	360.,	468.75
254,	-135.,	360.,	390.625
255,	-135.,	360.,	312.5
256,	-135.,	360.,	234.375
257,	-135.,	360.,	156.25
258,	-135.,	360.,	78.125
259,	-67.5,	360.,	0.
260,	-67.5,	460.,	625.
261,	-135.,	460.,	78.125
262,	-135.,	460.,	156.25
263,	-135.,	460.,	234.375
264,	-135.,	460.,	312.5
265,	-135.,	460.,	390.625
266,	-135.,	460.,	468.75
267,	-135.,	460.,	546.875
268,	-67.5,	460.,	0.
269,	315.,	460.,	812.5
270,	315.,	460.,	900.
271,	315.,	460.,	987.5
272,	315.,	360.,	987.5
273,	315.,	360.,	900.
274,	315.,	360.,	812.5
275,	247.5,	360.,	1075.
276,	247.5,	460.,	1075.
277,	247.5,	460.,	1800.
278,	315.,	460.,	1721.875
279,	315.,	460.,	1643.75
280,	315.,	460.,	1565.625
281,	315.,	460.,	1487.5
282,	315.,	460.,	1409.375
283,	315.,	460.,	1331.25
284,	315.,	460.,	1253.125
285,	247.5,	460.,	1175.
286,	247.5,	360.,	1800.
287,	315.,	360.,	1253.125

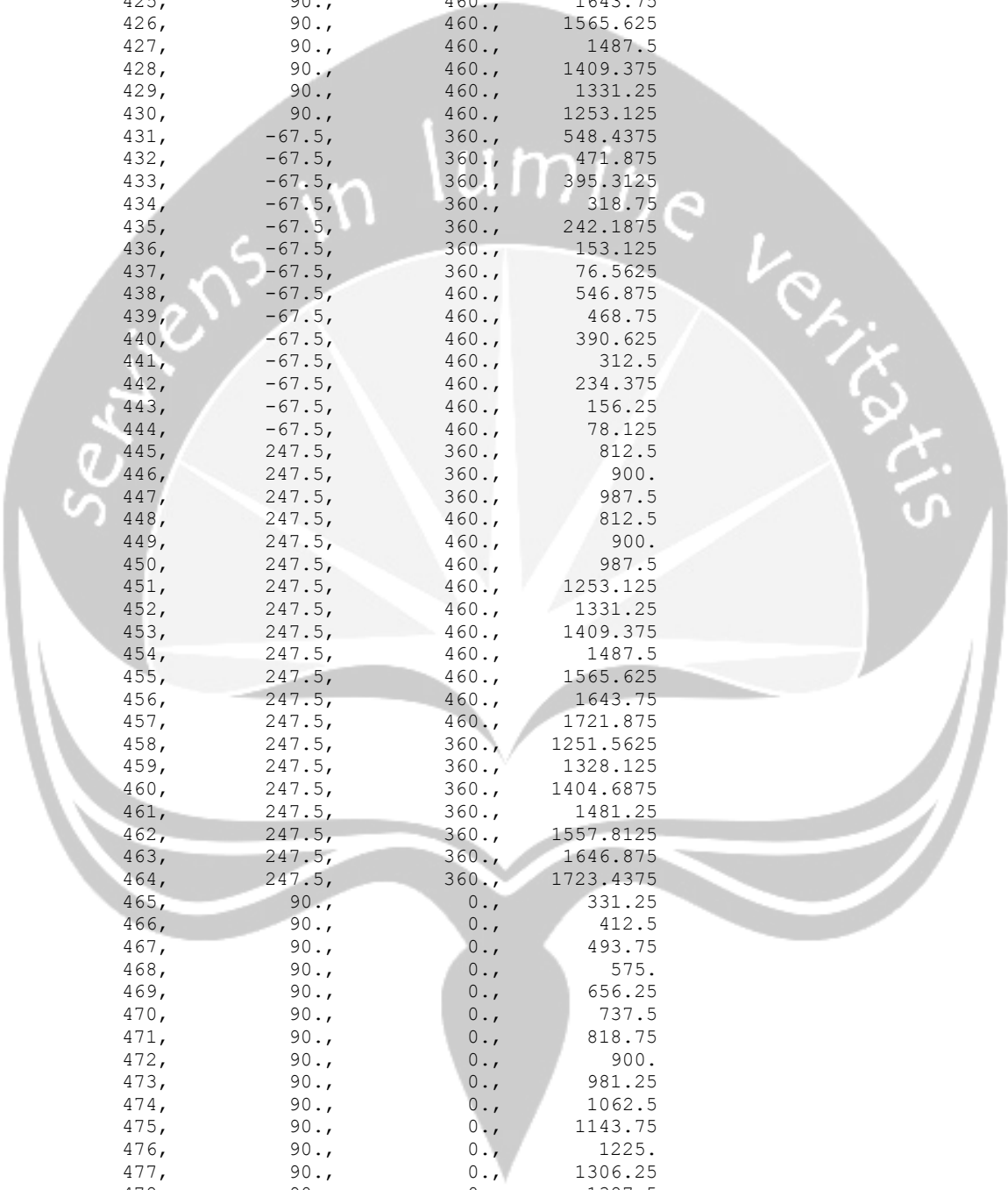




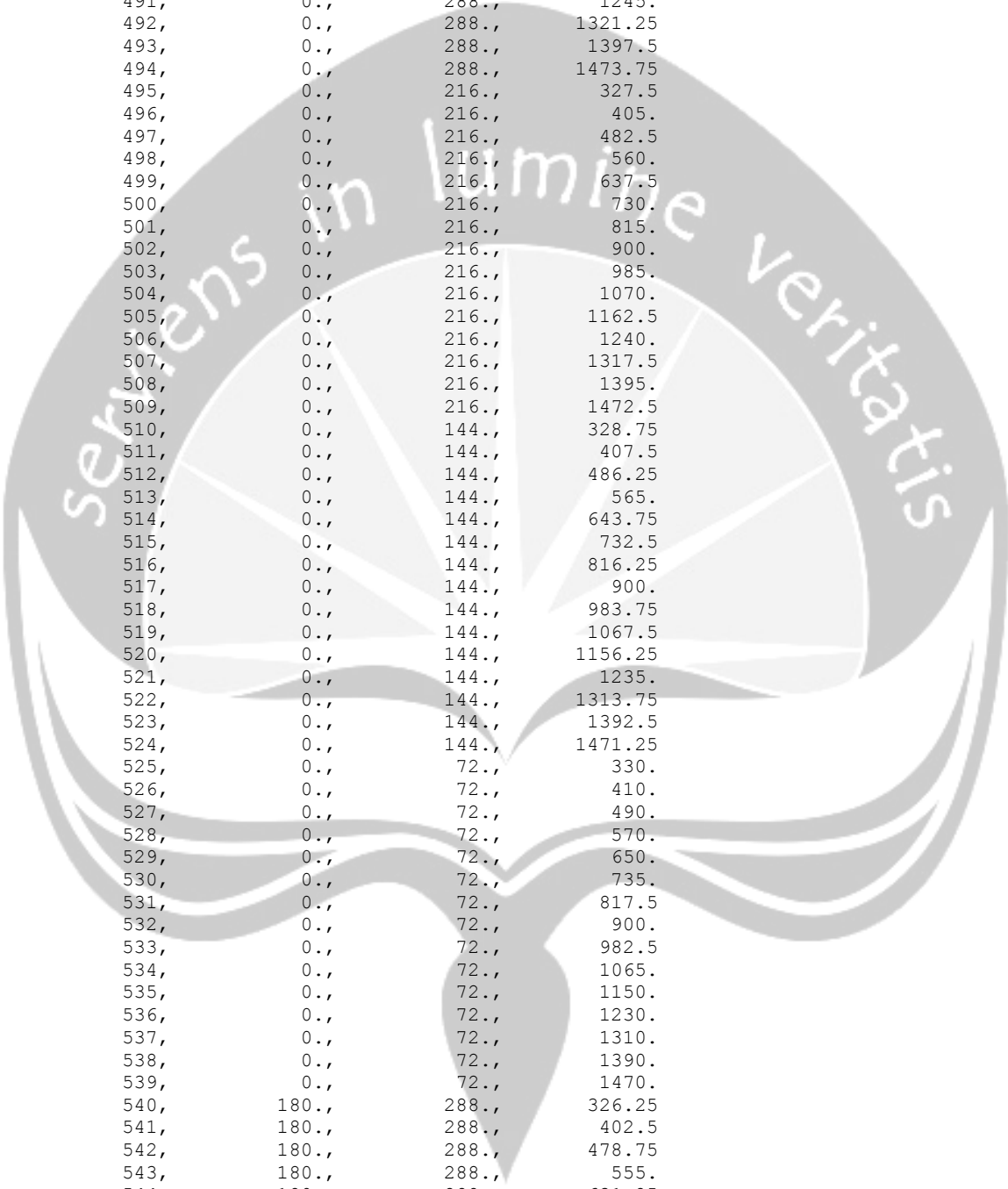
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291,	315.,	360.,	1565.625
292,	315.,	360.,	1643.75
293,	315.,	360.,	1721.875
294,	247.5,	360.,	1175.
295,	180.,	0.,	331.25
296,	180.,	0.,	412.5
297,	180.,	0.,	493.75
298,	180.,	0.,	575.
299,	180.,	0.,	656.25
300,	180.,	0.,	737.5
301,	180.,	0.,	818.75
302,	180.,	0.,	900.
303,	180.,	0.,	981.25
304,	180.,	0.,	1062.5
305,	180.,	0.,	1143.75
306,	180.,	0.,	1225.
307,	180.,	0.,	1306.25
308,	180.,	0.,	1387.5
309,	180.,	0.,	1468.75
310,	0.,	0.,	1468.75
311,	0.,	0.,	1387.5
312,	0.,	0.,	1306.25
313,	0.,	0.,	1225.
314,	0.,	0.,	1143.75
315,	0.,	0.,	1062.5
316,	0.,	0.,	981.25
317,	0.,	0.,	900.
318,	0.,	0.,	818.75
319,	0.,	0.,	737.5
320,	0.,	0.,	656.25
321,	0.,	0.,	575.
322,	0.,	0.,	493.75
323,	0.,	0.,	412.5
324,	0.,	0.,	331.25
325,	90.,	72.,	150.
326,	90.,	144.,	150.
327,	90.,	216.,	150.
328,	90.,	288.,	150.
329,	90.,	72.,	250.
330,	90.,	144.,	250.
331,	90.,	216.,	250.
332,	90.,	288.,	250.
333,	90.,	0.,	75.
334,	90.,	360.,	75.
335,	180.,	72.,	75.
336,	180.,	144.,	75.
337,	180.,	216.,	75.
338,	180.,	288.,	75.
339,	0.,	72.,	75.
340,	0.,	144.,	75.
341,	0.,	216.,	75.
342,	0.,	288.,	75.
343,	90.,	72.,	0.
344,	90.,	144.,	0.
345,	90.,	216.,	0.
346,	90.,	288.,	0.
347,	90.,	288.,	1650.
348,	90.,	216.,	1650.
349,	90.,	144.,	1650.
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352,	90.,	216.,	1550.
353,	90.,	144.,	1550.



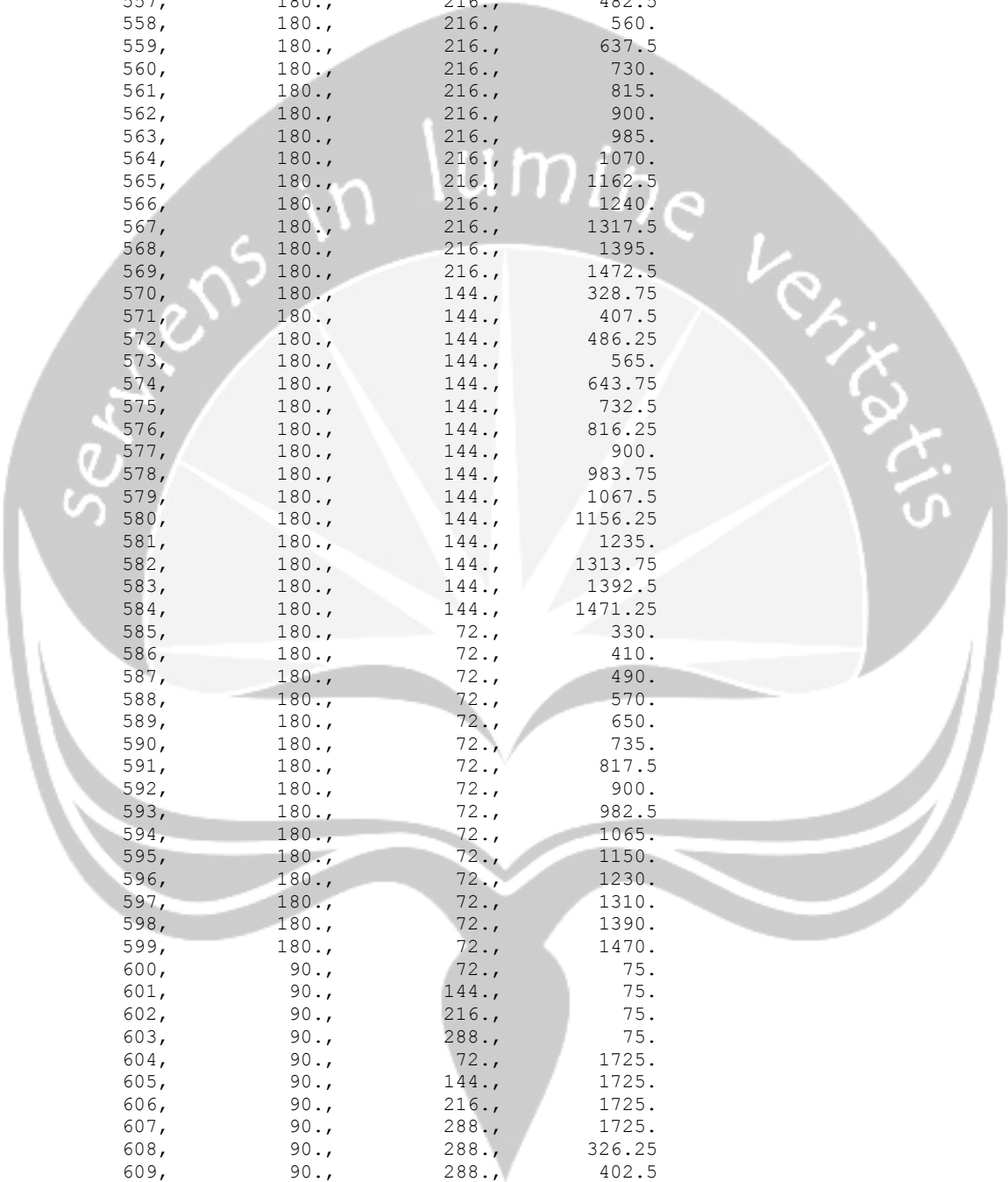
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358,	0.,	144.,	1725.
359,	0.,	216.,	1725.
360,	0.,	288.,	1725.
361,	180.,	72.,	1725.
362,	180.,	144.,	1725.
363,	180.,	216.,	1725.
364,	180.,	288.,	1725.
365,	90.,	72.,	1800.
366,	90.,	144.,	1800.
367,	90.,	216.,	1800.
368,	90.,	288.,	1800.
369,	90.,	360.,	550.
370,	90.,	360.,	475.
371,	90.,	360.,	400.
372,	90.,	360.,	325.
373,	90.,	460.,	546.875
374,	90.,	460.,	468.75
375,	90.,	460.,	390.625
376,	90.,	460.,	312.5
377,	90.,	460.,	234.375
378,	90.,	460.,	156.25
379,	90.,	460.,	78.125
380,	247.5,	360.,	548.4375
381,	247.5,	360.,	471.875
382,	247.5,	360.,	395.3125
383,	247.5,	360.,	318.75
384,	247.5,	360.,	242.1875
385,	247.5,	360.,	153.125
386,	247.5,	360.,	76.5625
387,	247.5,	460.,	546.875
388,	247.5,	460.,	468.75
389,	247.5,	460.,	390.625
390,	247.5,	460.,	312.5
391,	247.5,	460.,	234.375
392,	247.5,	460.,	156.25
393,	247.5,	460.,	78.125
394,	90.,	460.,	812.5
395,	90.,	460.,	900.
396,	90.,	460.,	987.5
397,	90.,	360.,	812.5
398,	90.,	360.,	900.
399,	90.,	360.,	987.5
400,	-67.5,	460.,	987.5
401,	-67.5,	460.,	900.
402,	-67.5,	460.,	812.5
403,	-67.5,	360.,	987.5
404,	-67.5,	360.,	900.
405,	-67.5,	360.,	812.5
406,	-67.5,	360.,	1251.5625
407,	-67.5,	360.,	1328.125
408,	-67.5,	360.,	1404.6875
409,	-67.5,	360.,	1481.25
410,	-67.5,	360.,	1557.8125
411,	-67.5,	360.,	1646.875
412,	-67.5,	360.,	1723.4375
413,	-67.5,	460.,	1253.125
414,	-67.5,	460.,	1331.25
415,	-67.5,	460.,	1409.375
416,	-67.5,	460.,	1487.5
417,	-67.5,	460.,	1565.625
418,	-67.5,	460.,	1643.75
419,	-67.5,	460.,	1721.875



420,	90.,	360.,	1475.
421,	90.,	360.,	1400.
422,	90.,	360.,	1325.
423,	90.,	360.,	1250.
424,	90.,	460.,	1721.875
425,	90.,	460.,	1643.75
426,	90.,	460.,	1565.625
427,	90.,	460.,	1487.5
428,	90.,	460.,	1409.375
429,	90.,	460.,	1331.25
430,	90.,	460.,	1253.125
431,	-67.5,	360.,	548.4375
432,	-67.5,	360.,	471.875
433,	-67.5,	360.,	395.3125
434,	-67.5,	360.,	318.75
435,	-67.5,	360.,	242.1875
436,	-67.5,	360.,	153.125
437,	-67.5,	360.,	76.5625
438,	-67.5,	460.,	546.875
439,	-67.5,	460.,	468.75
440,	-67.5,	460.,	390.625
441,	-67.5,	460.,	312.5
442,	-67.5,	460.,	234.375
443,	-67.5,	460.,	156.25
444,	-67.5,	460.,	78.125
445,	247.5,	360.,	812.5
446,	247.5,	360.,	900.
447,	247.5,	360.,	987.5
448,	247.5,	460.,	812.5
449,	247.5,	460.,	900.
450,	247.5,	460.,	987.5
451,	247.5,	460.,	1253.125
452,	247.5,	460.,	1331.25
453,	247.5,	460.,	1409.375
454,	247.5,	460.,	1487.5
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456,	247.5,	460.,	1643.75
457,	247.5,	460.,	1721.875
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461,	247.5,	360.,	1481.25
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463,	247.5,	360.,	1646.875
464,	247.5,	360.,	1723.4375
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466,	90.,	0.,	412.5
467,	90.,	0.,	493.75
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469,	90.,	0.,	656.25
470,	90.,	0.,	737.5
471,	90.,	0.,	818.75
472,	90.,	0.,	900.
473,	90.,	0.,	981.25
474,	90.,	0.,	1062.5
475,	90.,	0.,	1143.75
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477,	90.,	0.,	1306.25
478,	90.,	0.,	1387.5
479,	90.,	0.,	1468.75
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483,	0.,	288.,	555.
484,	0.,	288.,	631.25
485,	0.,	288.,	727.5



486,	0.,	288.,	813.75
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488,	0.,	288.,	986.25
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491,	0.,	288.,	1245.
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494,	0.,	288.,	1473.75
495,	0.,	216.,	327.5
496,	0.,	216.,	405.
497,	0.,	216.,	482.5
498,	0.,	216.,	560.
499,	0.,	216.,	637.5
500,	0.,	216.,	730.
501,	0.,	216.,	815.
502,	0.,	216.,	900.
503,	0.,	216.,	985.
504,	0.,	216.,	1070.
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511,	0.,	144.,	407.5
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523,	0.,	144.,	1392.5
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529,	0.,	72.,	650.
530,	0.,	72.,	735.
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542,	180.,	288.,	478.75
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546,	180.,	288.,	813.75
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548,	180.,	288.,	986.25
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565,	180.,	216.,	1162.5
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567,	180.,	216.,	1317.5
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572,	180.,	144.,	486.25
573,	180.,	144.,	565.
574,	180.,	144.,	643.75
575,	180.,	144.,	732.5
576,	180.,	144.,	816.25
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580,	180.,	144.,	1156.25
581,	180.,	144.,	1235.
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586,	180.,	72.,	410.
587,	180.,	72.,	490.
588,	180.,	72.,	570.
589,	180.,	72.,	650.
590,	180.,	72.,	735.
591,	180.,	72.,	817.5
592,	180.,	72.,	900.
593,	180.,	72.,	982.5
594,	180.,	72.,	1065.
595,	180.,	72.,	1150.
596,	180.,	72.,	1230.
597,	180.,	72.,	1310.
598,	180.,	72.,	1390.
599,	180.,	72.,	1470.
600,	90.,	72.,	75.
601,	90.,	144.,	75.
602,	90.,	216.,	75.
603,	90.,	288.,	75.
604,	90.,	72.,	1725.
605,	90.,	144.,	1725.
606,	90.,	216.,	1725.
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610,	90.,	288.,	478.75
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614,	90.,	288.,	813.75
615,	90.,	288.,	900.
616,	90.,	288.,	986.25
617,	90.,	288.,	1072.5

618,	90.,	288.,	1168.75
619,	90.,	288.,	1245.
620,	90.,	288.,	1321.25
621,	90.,	288.,	1397.5
622,	90.,	288.,	1473.75
623,	90.,	216.,	327.5
624,	90.,	216.,	405.
625,	90.,	216.,	482.5
626,	90.,	216.,	560.
627,	90.,	216.,	637.5
628,	90.,	216.,	730.
629,	90.,	216.,	815.
630,	90.,	216.,	900.
631,	90.,	216.,	985.
632,	90.,	216.,	1070.
633,	90.,	216.,	1162.5
634,	90.,	216.,	1240.
635,	90.,	216.,	1317.5
636,	90.,	216.,	1395.
637,	90.,	216.,	1472.5
638,	90.,	144.,	328.75
639,	90.,	144.,	407.5
640,	90.,	144.,	486.25
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642,	90.,	144.,	643.75
643,	90.,	144.,	732.5
644,	90.,	144.,	816.25
645,	90.,	144.,	900.
646,	90.,	144.,	983.75
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648,	90.,	144.,	1156.25
649,	90.,	144.,	1235.
650,	90.,	144.,	1313.75
651,	90.,	144.,	1392.5
652,	90.,	144.,	1471.25
653,	90.,	72.,	330.
654,	90.,	72.,	410.
655,	90.,	72.,	490.
656,	90.,	72.,	570.
657,	90.,	72.,	650.
658,	90.,	72.,	735.
659,	90.,	72.,	817.5
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662,	90.,	72.,	1065.
663,	90.,	72.,	1150.
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665,	90.,	72.,	1310.
666,	90.,	72.,	1390.
667,	90.,	72.,	1470.

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351, 275, 276, 285, 294, 64, 63, 66, 68
352, 24, 23, 21, 22, 275, 276, 285, 294
*Nset, nset=Set-1, generate
  1, 667, 1
*Elset, elset=Set-1, generate
  1, 352, 1
** Section: BALOK
*Solid Section, elset=Set-1, material=BETON2245MPA
/
*End Instance
**
*Instance, name=TUMPUANBAWAH-1, part=TUMPUANBAWAH
  0., -50., 150.
*Node
  1, 180., 0., 50.
  2, 0., 0., 50.
  3, 0., 0., 0.
  4, 180., 0., 0.
  5, 0., 50., 50.
  6, 0., 50., 0.
  7, 180., 50., 0.
  8, 180., 50., 50.
  9, 180., 0., 100.
  10, 0., 0., 100.
  11, 180., 50., 100.
  12, 0., 50., 100.
  13, 90., 0., 50.
  14, 90., 0., 0.
  15, 90., 50., 50.
  16, 90., 50., 0.
  17, 90., 0., 100.
  18, 90., 50., 100.
*Element, type=C3D8R
  1, 8, 15, 16, 7, 1, 13, 14, 4
  2, 15, 5, 6, 16, 13, 2, 3, 14
  3, 5, 15, 18, 12, 2, 13, 17, 10
  4, 15, 8, 11, 18, 13, 1, 9, 17
*Nset, nset=Set-1, generate
  1, 18, 1
*Elset, elset=Set-1, generate
  1, 4, 1
** Section: TUMPUAN
*Solid Section, elset=Set-1, material=BESI463MPA
/
*End Instance
**
*Instance, name=TUMPUANBAWAH-2, part=TUMPUANBAWAH
  0., -50., 1550.
*Node
  1, 180., 0., 50.
  2, 0., 0., 50.
  3, 0., 0., 0.
  4, 180., 0., 0.
  5, 0., 50., 50.
  6, 0., 50., 0.
  7, 180., 50., 0.
  8, 180., 50., 50.
  9, 180., 0., 100.
  10, 0., 0., 100.
  11, 180., 50., 100.
  12, 0., 50., 100.

```

```

13,      90.,      0.,      50.
14,      90.,      0.,      0.
15,      90.,      50.,      50.
16,      90.,      50.,      0.
17,      90.,      0.,      100.
18,      90.,      50.,      100.
*Element, type=C3D8R
1, 8, 15, 16, 7, 1, 13, 14, 4
2, 15, 5, 6, 16, 13, 2, 3, 14
3, 5, 15, 18, 12, 2, 13, 17, 10
4, 15, 8, 11, 18, 13, 1, 9, 17
*Nset, nset=Set-1, generate
1, 18, 1
*Elset, elset=Set-1, generate
1, 4, 1
** Section: TUMPUAN
*Solid Section, elset=Set-1, material=BESI463MPA
,
*End Instance
**
*Instance, name=TUMPUANATAS-1-lin-2-1, part=TUMPUANATAS
0.,      460.,      625.
*Node
1,      180.,      0.,      100.
2,      90.,      0.,      100.
3,      0.,      0.,      100.
4,      180.,      0.,      0.
5,      90.,      0.,      0.
6,      0.,      0.,      0.
7,      180.,      50.,      100.
8,      90.,      50.,      100.
9,      0.,      50.,      100.
10,     180.,      50.,      0.
11,     90.,      50.,      0.
12,     0.,      50.,      0.
*Element, type=C3D8R
1, 7, 8, 11, 10, 1, 2, 5, 4
2, 8, 9, 12, 11, 2, 3, 6, 5
*Nset, nset=Set-1, generate
1, 12, 1
*Elset, elset=Set-1
1, 2
** Section: TUMPUAN
*Solid Section, elset=Set-1, material=BESI463MPA
,
*End Instance
**
*Instance, name=TUMPUANATAS-1-lin-2-1-lin-2-1, part=TUMPUANATAS
0.,      460.,      1075.
*Node
1,      180.,      0.,      100.
2,      90.,      0.,      100.
3,      0.,      0.,      100.
4,      180.,      0.,      0.
5,      90.,      0.,      0.
6,      0.,      0.,      0.
7,      180.,      50.,      100.
8,      90.,      50.,      100.
9,      0.,      50.,      100.
10,     180.,      50.,      0.
11,     90.,      50.,      0.
12,     0.,      50.,      0.
*Element, type=C3D8R
1, 7, 8, 11, 10, 1, 2, 5, 4
2, 8, 9, 12, 11, 2, 3, 6, 5
*Nset, nset=Set-1, generate

```

```

1, 12, 1
*Elset, elset=Set-1
1, 2
** Section: TUMPUAN
*Solid Section, elset=Set-1, material=BESI463MPA
,
*End Instance
**
*Instance, name=GABUNGAN-1, part=GABUNGAN
0., -40., 100.
*End Instance
**
*Node
1, 90., 510., 675.
*Node
2, 90., 510., 1125.
*Nset, nset=Set-4
1,
*Nset, nset=Set-5
2,
*Nset, nset=Set-6, instance=TUMPUANBAWAH-2
1, 2, 13
*Elset, elset=Set-6, instance=TUMPUANBAWAH-2, generate
1, 4, 1
*Nset, nset=Set-7, instance=TUMPUANBAWAH-1
1, 2, 13
*Elset, elset=Set-7, instance=TUMPUANBAWAH-1, generate
1, 4, 1
*Nset, nset=Set-8, instance=TUMPUANBAWAH-1
1, 2, 13
*Nset, nset=Set-8, instance=TUMPUANBAWAH-2
1, 2, 13
*Elset, elset=Set-8, instance=TUMPUANBAWAH-1, generate
1, 4, 1
*Elset, elset=Set-8, instance=TUMPUANBAWAH-2, generate
1, 4, 1
*Nset, nset=Set-9, instance=TUMPUANBAWAH-1
1, 2, 13
*Nset, nset=Set-9, instance=TUMPUANBAWAH-2
1, 2, 13
*Elset, elset=Set-9, instance=TUMPUANBAWAH-1, generate
1, 4, 1
*Elset, elset=Set-9, instance=TUMPUANBAWAH-2, generate
1, 4, 1
*Nset, nset=Set-10, instance=TUMPUANBAWAH-1
1, 2, 13
*Elset, elset=Set-10, instance=TUMPUANBAWAH-1, generate
1, 4, 1
*Nset, nset=Set-11, instance=TUMPUANBAWAH-2
1, 2, 13
*Elset, elset=Set-11, instance=TUMPUANBAWAH-2, generate
1, 4, 1
*Nset, nset=Set-12
1, 2
*Nset, nset=Set-13, instance=TUMPUANBAWAH-1
1, 2, 13
*Nset, nset=Set-13, instance=TUMPUANBAWAH-2
1, 2, 13
*Elset, elset=Set-13, instance=TUMPUANBAWAH-1, generate
1, 4, 1
*Elset, elset=Set-13, instance=TUMPUANBAWAH-2, generate
1, 4, 1
*Nset, nset=Set-14
1, 2
*Nset, nset=Set-15, instance=TUMPUANATAS-1-lin-2-1, generate
10, 12, 1

```

```

*Nset, nset=Set-15, instance=TUMPUANATAS-1-lin-2-1-lin-2-1, generate
  7, 9, 1
*Elset, elset=Set-15, instance=TUMPUANATAS-1-lin-2-1
  1, 2
*Elset, elset=Set-15, instance=TUMPUANATAS-1-lin-2-1-lin-2-1
  1, 2
*Nset, nset=Set-16, instance=TUMPUANBAWAH-2
  1, 2, 13
*Elset, elset=Set-16, instance=TUMPUANBAWAH-2, generate
  1, 4, 1
*Nset, nset=Set-17, instance=TUMPUANBAWAH-1
  1, 2, 13
*Elset, elset=Set-17, instance=TUMPUANBAWAH-1, generate
  1, 4, 1
*Nset, nset=Set-18
  1, 2
*Nset, nset=m_Set-1, instance=GABUNGAN-1, generate
  1, 156, 1
*Elset, elset=m_Set-1, instance=GABUNGAN-1, generate
  1, 174, 1
*Nset, nset=m_Set-2
  1,
*Nset, nset=m_Set-3
  2,
*Elset, elset=_m_Surf-3_S4, internal, instance=BALOK-1
  3, 4
*Surface, type=ELEMENT, name=m_Surf-3
  _m_Surf-3_S4, S4
*Elset, elset=_m_Surf-5_S4, internal, instance=BALOK-1
  7, 8
*Surface, type=ELEMENT, name=m_Surf-5
  _m_Surf-5_S4, S4
*Elset, elset=_m_Surf-7_S2, internal, instance=BALOK-1
  9, 10
*Surface, type=ELEMENT, name=m_Surf-7
  _m_Surf-7_S2, S2
*Elset, elset=_m_Surf-9_S2, internal, instance=BALOK-1
  47, 48
*Surface, type=ELEMENT, name=m_Surf-9
  _m_Surf-9_S2, S2
*Elset, elset=_s_Surf-1_S1, internal, instance=TUMPUANATAS-1-lin-2-1
  1, 2
*Surface, type=ELEMENT, name=s_Surf-1
  _s_Surf-1_S1, S1
*Elset, elset=_s_Surf-2_S1, internal, instance=TUMPUANATAS-1-lin-2-1-lin-2-1
  1, 2
*Surface, type=ELEMENT, name=s_Surf-2
  _s_Surf-2_S1, S1
*Elset, elset=_s_Surf-3_S2, internal, instance=TUMPUANATAS-1-lin-2-1
  1, 2
*Surface, type=ELEMENT, name=s_Surf-3
  _s_Surf-3_S2, S2
*Elset, elset=_s_Surf-5_S2, internal, instance=TUMPUANATAS-1-lin-2-1-lin-2-1
  1, 2
*Surface, type=ELEMENT, name=s_Surf-5
  _s_Surf-5_S2, S2
*Elset, elset=_s_Surf-7_S1, internal, instance=TUMPUANBAWAH-1, generate
  1, 4, 1
*Surface, type=ELEMENT, name=s_Surf-7
  _s_Surf-7_S1, S1
*Elset, elset=_s_Surf-9_S1, internal, instance=TUMPUANBAWAH-2, generate
  1, 4, 1
*Surface, type=ELEMENT, name=s_Surf-9
  _s_Surf-9_S1, S1
** Constraint: Constraint-1
*Embedded Element

```

```

m_Set-1
** Constraint: Constraint-2
*Coupling, constraint name=Constraint-2, ref node=m_Set-2, surface=s_Surf-1
*Kinematic
** Constraint: Constraint-3
*Coupling, constraint name=Constraint-3, ref node=m_Set-3, surface=s_Surf-2
*Kinematic
** Constraint: Constraint-4
*Tie, name=Constraint-4, adjust=yes
s_Surf-3, m_Surf-3
** Constraint: Constraint-5
*Tie, name=Constraint-5, adjust=yes
s_Surf-5, m_Surf-5
** Constraint: Constraint-6
*Tie, name=Constraint-6, adjust=yes
s_Surf-7, m_Surf-7
** Constraint: Constraint-7
*Tie, name=Constraint-7, adjust=yes
s_Surf-9, m_Surf-9
*End Assembly
**
** MATERIALS
**
*Material, name=BESI447MPA
*Elastic
210000., 0.3
*Plastic
743.,0.
*Material, name=BESI463MPA
*Elastic
240000., 0.3
*Plastic
642.,0.
*Material, name=BETON2245MPA
*Elastic
22700., 0.2
*Concrete Damaged Plasticity
30., 0.1, 1.16, 0.7, 0.
*Concrete Compression Hardening
22.45,0.
*Concrete Tension Stiffening
2.,0.
**
** BOUNDARY CONDITIONS
**
** Name: BC-1 Type: Displacement/Rotation
*Boundary
Set-16, 1, 1
Set-16, 2, 2
** Name: BC-2 Type: Displacement/Rotation
*Boundary
Set-17, 2, 2
** -----
**
** STEP: Step1
**
*Step, name=Step1, nlgeom=YES, inc=20000
*Static
0.01, 100., 0.001, 100.
**
** BOUNDARY CONDITIONS
**
** Name: BC-3 Type: Displacement/Rotation
*Boundary
Set-18, 2, 2, -10.
**

```



```
** OUTPUT REQUESTS
**
*Restart, write, frequency=0
**
** FIELD OUTPUT: F-Output-1
**
*Output, field
*Node Output
CF, RF, U
*Element Output, directions=YES
E, EE, ER, IE, LE, NE, PE, PEEQ, PEEQMAX, PEEQT, PEMAG, PEQC, S, SALPHA, SE,
SEE
SEP, SEPE, SPE, THE, VE, VEEQ
**
** HISTORY OUTPUT: H-Output-1
**
*Output, history, variable=PRESELECT
*End Step
```

