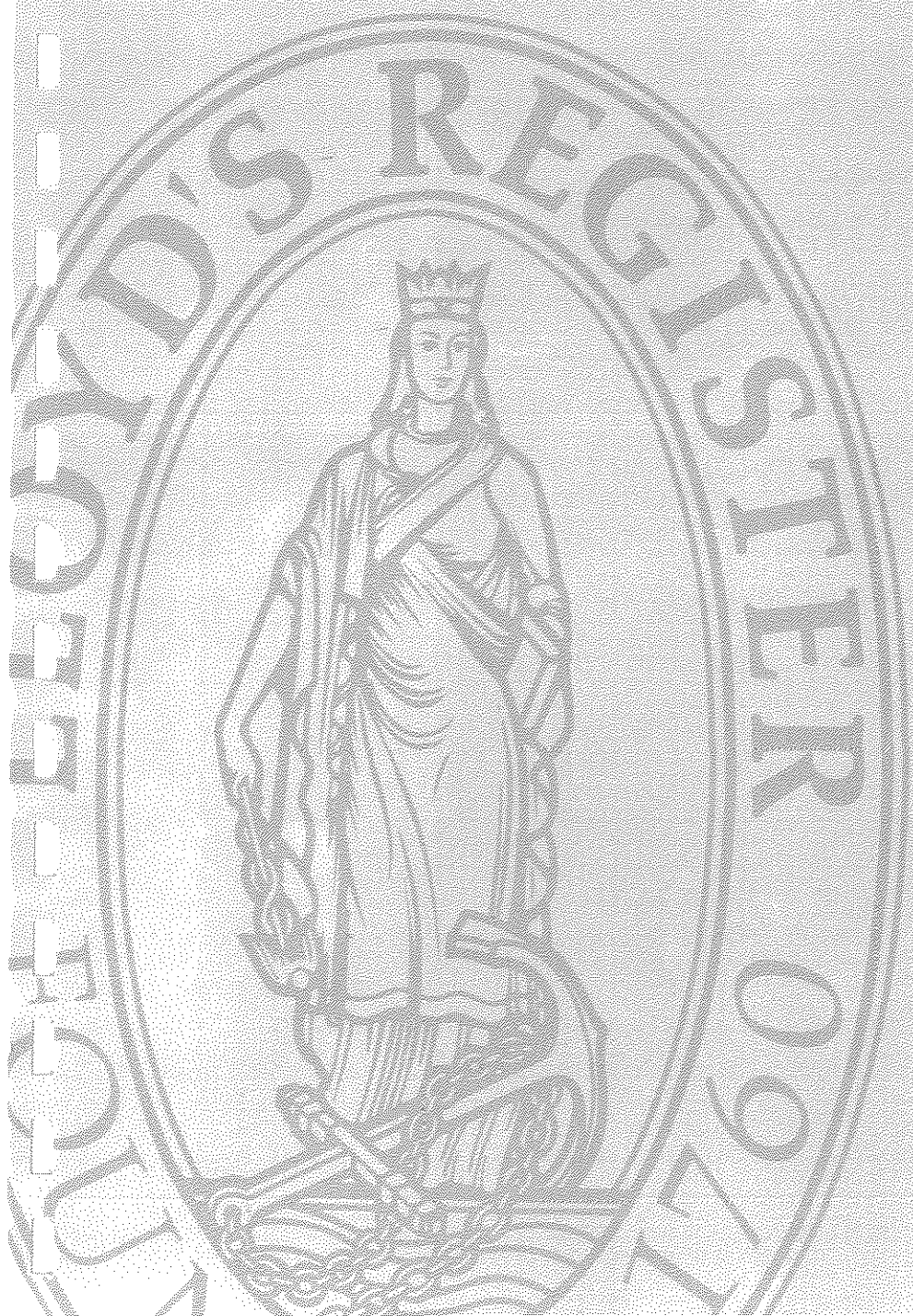


Lloyd's
Register



PRELIMINARY REPORT

STUDY INTO THE STRENGTH RELIABILITY OF OFFSHORE STRUCT.

PLATFORM No 3 a LIFTED PLATFORM in SHALLOW WATER

OD/TR/93017

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-
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INTRODUCTION

The purpose of the project is to estimate the deterministic and probablistic collapse strengths of three selected existing fixed steel platforms subject to wave and wind loading.

This preliminary report comprises three deterministic collapse analyses of the lifted shallow water platform (see Section 3c of the proposed study document dated May 1993). The first analysis begins with all members fully effective whereas the second is performed with a leading diagonal brace fully released at one end. The third analysis is carried out with the same leading diagonal member restricted at end two to an interaction ratio of 0.75. A further analysis is almost complete in which this leading diagonal member is restricted to 0.5 IR.

These analysis and others planned (some in progress) will show the effect of undetected member failures (see Section 4 of Proposal Document).

DESCRIPTION OF PLATFORM No 3 a LIFTED PLATFORM in SHALLOW WATER

This platform, located in the Southern North Sea, is a 6-leg welded steel structure with ungrouted piles driven within the legs and two skirt piles. The skirt piles are grouted into sleeves attached to the leg by tubular members. The jacket has 4 horizontal braced levels and the deck is supported above the jacket by unbraced legs stabbed into the tops of the leg piles.

The structural idealisation of the structure is shown in Appendix A (see Figures A 1 to A 18). The complete finite element model including the deck structure has 263 grids and 455 members. The environmental and other criteria used in the static analysis are as follows:-

Platform location: Southern North Sea

Morison Coefficients: $C_d = 0.6$ generally

$= 0.7$ Seabed to LAT (ie marine growth zone)

$C_m = 2.0$

Marine Growth: Account was taken of the marine growth accumulation by

increasing the radius of members within the following zones:

Seabed to just below the -8m level 50mm increase in radius

Just below the -8m level to LAT 100mm increase in radius

Corrosion Allowance: Structural thickness of members between el -3m,

and el. +5.5m (LAT) is reduced by 12mm

Structural thickness of members at el + 6m

reduced by 6mm.

Water Depth: 36.6m to LAT

Tidal Rise to MHWS 1.9m

Storm Surge 2.1m

Water Depth Tolerance $\pm 1.0m$

DESCRIPTION OF PLATFORM No 3 a LIFTED PLATFORM in SHALLOW WATER (cont)

Appurtenances: Caged ladder at deck legs A1, A2, C1, C2

Top of jacket walkway between legs A2, B2

Conductors: 2 * 0.508m diameter

6 * 0.762m diameter

Caissons:

2 * 0.610m diameter

2 * 0.610m diameter

2 * 0.407m diameter

Termination

el. -12.0 m

el. -12.0 m

el. -9.0 m

Risers:

1 * 0.610m diameter

1 * 0.254m diameter

1 * 0.060m diameter

1 * 0.254m diameter

1 * 0.060m diameter

Anodes:

Drag coefficients below LAT factored by 1.08

to allow for anodes

Foundation:

1.0m global scour assumed

STATIC ANALYSIS

The static analysis consists of 8 storm cases 101-108 plus a still water case 109. Table 1 gives the details of these combined cases and Figure 1 shows the wave directions. Each storm combined case comprises a wave case with change of buoyancy due to the wave action only, a still water case having the same water depth with full buoyancy, deckloads, self weight and wind loading.

The members and joints are checked according to the AMERICAN PETROLEUM Institute RP2A 19 Edition CODE OF PRACTICE.

The members and joints with the 40 highest interaction ratios are presented in Tables 2 and 3 respectively.

Waveloading directions

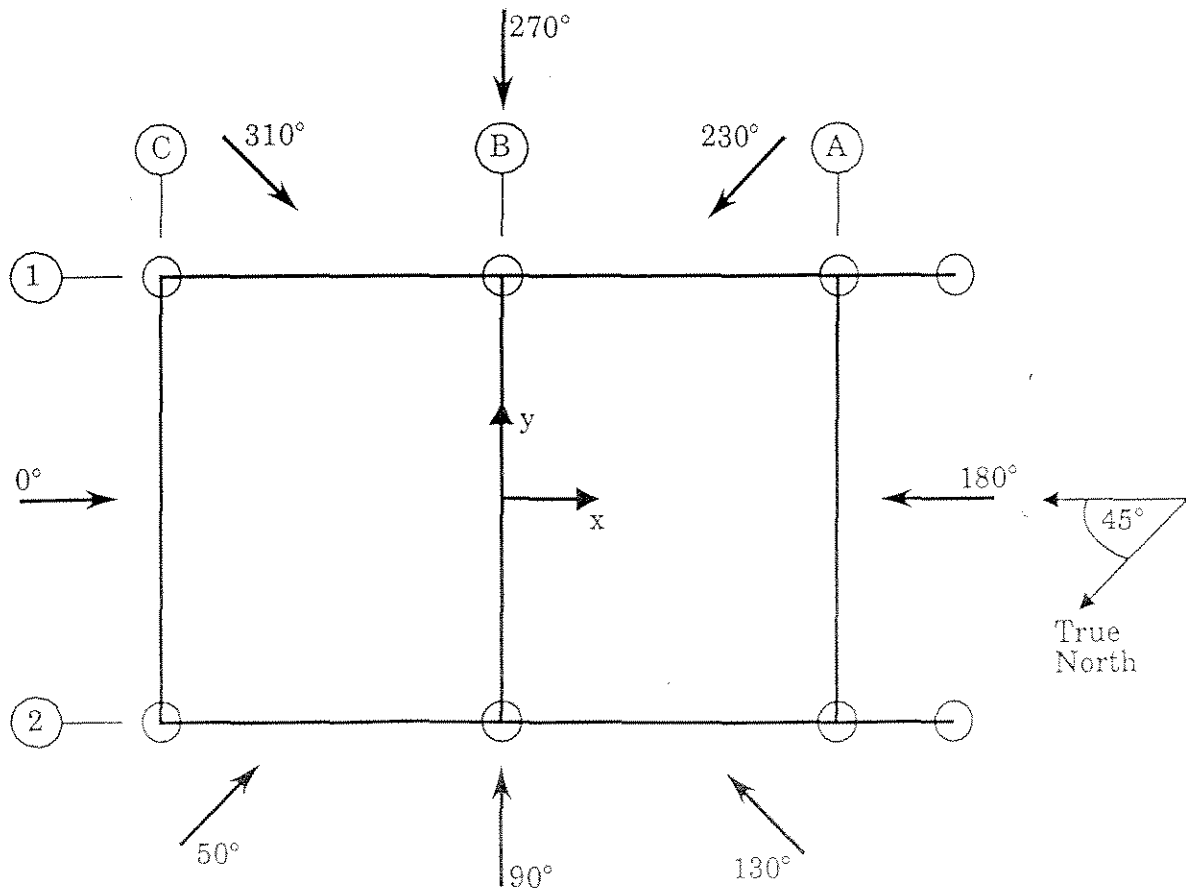


Figure 1

MODEL NAME: Platform No 3 Lifted Platform in Shallow Water
 UNITS: Length - m Force - kN

TABLE 1 SHEET 1

COMBINED LOAD CASE DEFINITIONS

Case	Factor	Loading case title		Factor	Set	Load Set Title
101	1.000	0 DEGREE STORM	Storm	1.000	1	Stokes wave theory , PARTIAL BUOYANCY D=35.8/HT=17.7/WO=0/CO=0/TI=13.5
				1.000	10	STILL WATER CASE D = 35.80
				1.000	11	DECKLOADS
				1.000	12	0 DEGREE STORM WINDLOAD
				1.000	14	JACKET WEIGHT
102	1.000	50 DEGREE STORM	Storm	1.000	2	Stokes wave theory , PARTIAL BUOYANCY D=35.8/HT=17.7/WO=50/CO=50/TI=13.5
				1.000	10	STILL WATER CASE D = 35.80
				1.000	11	DECKLOADS
				1.000	12	0 DEGREE STORM WINDLOAD
				1.000	14	JACKET WEIGHT
0.770	13	90 DEGREE STORM WINDLOAD				
103	1.000	90 DEGREE STORM	Storm	1.000	3	Stokes wave theory , PARTIAL BUOYANCY D=35.8/HT=17.7/WO=90/CO=90/TI=13.5
				1.000	10	STILL WATER CASE D = 35.80
				1.000	11	DECKLOADS
				1.000	14	JACKET WEIGHT
				1.000	13	90 DEGREE STORM WINDLOAD
104	1.000	130 DEGREE STORM	Storm	1.000	4	Stokes wave theory , PARTIAL BUOYANCY D=35.8/HT=17.7/WO=130/CO=130/TI=13.5
				1.000	10	STILL WATER CASE D = 35.80
				1.000	11	DECKLOADS
				1.000	14	JACKET WEIGHT
				0.770	13	90 DEGREE STORM WINDLOAD
-0.640	12	0 DEGREE STORM WINDLOAD				
105	1.000	180 DEGREE STORM	Storm	1.000	5	Stokes wave theory , PARTIAL BUOYANCY D=35.8/HT=17.7/WO=180/CO=180/TI=13.5
				1.000	10	STILL WATER CASE D = 35.80
				1.000	11	DECKLOADS
				1.000	14	JACKET WEIGHT
				-1.000	12	0 DEGREE STORM WINDLOAD
D - Water depth HT - Wave height WO - Wave angle CO - Current angle TI - Wave Period						

TABLE 1 SHEET 2

Case	Factor	Loading case title	Factor	Set	Load Set Title
106	1.000	230 DEGREE STORM Storm	1.000 1.000 1.000 1.000 -0.640 -0.770	6 10 11 14 12 13	Stokes wave theory , PARTIAL BUOYANCY D=35.8/HT=17.7/WO=230/CO=230/TI=13.5 STILL WATER CASE D = 35.80 DECKLOADS JACKET WEIGHT 0 DEGREE STORM WINDLOAD 90 DEGREE STORM WINDLOAD
107	1.000	270 DEGREE STORM Storm	1.000 1.000 1.000 1.000 -1.000	7 10 11 14 13	Stokes wave theory , PARTIAL BUOYANCY D=35.8/HT=17.7/WO=270/CO=270/TI=13.5 STILL WATER CASE D = 35.80 DECKLOADS JACKET WEIGHT 90 DEGREE STORM WINDLOAD
108	1.000	310 DEGREE STORM Storm	1.000 1.000 1.000 1.000 -0.770 0.640	8 10 11 14 13 12	Stokes wave theory , PARTIAL BUOYANCY D=35.8/HT=17.7/WO=310/CO=310/TI=13.5 STILL WATER CASE D = 35.80 DECKLOADS JACKET WEIGHT 90 DEGREE STORM WINDLOAD 0 DEGREE STORM WINDLOAD
109	1.000	STILL WATER CASE Operational	1.000 1.000 1.000	9 11 14	STILL WATER CASE D = 38.70 DECKLOADS JACKET WEIGHT
D - Water depth HT - Wave height WO - Wave angle CO - Current angle TI - Wave Period					

AISC Check Summary

TABLE 2

MEMBER No.	STATION POSITION	CASE No.	INTERACTION RATIO	C-T FLAG
230	0.00	107	0.980	(C)
51	1.00	103	0.975	(C)
78	0.25	101	0.955	(C)
315	1.00	103	0.950	(C)
77	0.25	101	0.913	(C)
231	1.00	102	0.883	(C)
225	1.00	107	0.882	(C)
65	1.00	107	0.873	(C)
64	1.00	107	0.869	(C)
283	0.25	104	0.852	(C)
193	0.25	106	0.841	(C)
39	1.00	103	0.806	(C)
88	0.00	102	0.799	(C)
87	0.00	108	0.796	(C)
323	0.00	106	0.794	(C)
153	1.00	103	0.791	(C)
71	0.25	105	0.788	(C)
192	0.25	104	0.782	(C)
351	0.00	101	0.764	(C)
56	0.00	103	0.763	(C)
12	0.75	103	0.762	(C)
11	1.00	103	0.753	(C)
70	0.25	105	0.753	(C)
151	1.00	103	0.745	(C)
284	1.00	104	0.722	(C)
142	0.25	102	0.710	(C)
41	0.50	107	0.709	(C)
224	1.00	103	0.708	(C)
74	0.25	103	0.707	(C)
148	0.00	103	0.703	(C)
57	0.00	103	0.698	(C)
152	1.00	107	0.694	(C)
249	0.25	107	0.673	(C)
55	0.25	103	0.673	(C)
273	1.00	103	0.673	(C)
42	0.75	107	0.667	(C)
244	1.00	108	0.665	(C)
263	0.75	107	0.664	(C)
24	1.00	103	0.654	(C)
172	0.75	103	0.650	(C)

JOINT NO.	BRACE NO.	CASE NO.	CLASSIFICATION			INTERACTION RATIO	
			%K	%X	%YT	BENDING	OVERALL
161	282	108	0.0	0.0	100.0	0.425	0.994
154	275	102	0.0	0.0	100.0	0.376	0.921
148	241	108	0.0	0.0	100.0	0.731	0.904
89	78	101	64.4	6.4	29.2	0.003	0.829
37	48	102	0.0	0.0	100.0	0.502	0.762
10	64	107	30.5	0.0	69.5	0.001	0.725
146	172	103	73.4	0.0	26.6	0.009	0.715
37	52	103	0.0	0.0	100.0	0.345	0.681
40	52	103	0.0	0.0	100.0	0.375	0.664
36	47	101	0.0	1.6	98.4	0.378	0.645
135	171	107	71.9	0.0	28.1	0.002	0.640
32	74	103	36.2	0.0	63.8	0.001	0.611
89	71	105	95.4	0.0	4.6	0.002	0.603
93	90	107	74.9	0.0	25.1	0.005	0.571
197	263	107	22.5	0.0	77.5	0.009	0.560
64	89	107	82.4	0.0	17.6	0.003	0.555
160	281	108	0.0	0.0	100.0	0.209	0.554
89	165	101	100.0	0.0	0.0	0.001	0.553
14	71	105	34.3	0.0	65.7	0.000	0.551
155	276	102	0.0	0.0	100.0	0.214	0.537
186	256	103	20.9	0.0	79.1	0.003	0.534
10	70	105	34.6	0.0	65.4	0.000	0.527
89	159	105	100.0	0.0	0.0	0.000	0.519
87	74	103	74.4	0.0	25.6	0.001	0.505
87	77	101	61.1	7.5	31.3	0.001	0.503
146	263	107	100.0	0.0	0.0	0.002	0.501
162	249	107	50.2	0.0	49.8	0.006	0.492
31	45	107	0.0	99.9	0.1	0.006	0.483
48	87	108	0.0	0.0	100.0	0.115	0.478
49	88	102	0.0	0.0	100.0	0.096	0.472
135	256	103	100.0	0.0	0.0	0.000	0.471
46	60	108	0.0	0.0	100.0	0.009	0.456
36	53	107	0.0	36.3	63.7	0.153	0.452
134	230	107	25.3	74.7	0.0	0.093	0.449
39	65	107	33.1	0.0	66.9	0.002	0.445
188	315	103	10.9	89.1	0.0	0.042	0.443
47	61	102	0.0	0.0	100.0	0.004	0.438
32	44	101	0.0	0.0	100.0	0.032	0.435
30	43	101	0.0	0.0	100.0	0.030	0.432
42	78	101	30.2	0.0	69.8	0.001	0.430

GENERAL METHODS OF ANALYSIS

The strength requirements in the existing design codes for offshore platforms are component based and take no account of the redundancy of the design. The codes are also deterministic, with characteristic values and factors of safety being included to allow for the uncertainty of the design procedure.

Two separate analyses will be undertaken in this particular study. The first part investigates the reserve of strength existing in platforms due to the robustness of the design and the second part replaces the safety factors and characteristic values by statistical distributions in order to estimate the stochastic strength of the design.

The strengths of members and joints in the non-linear collapse analyses will be given by the component strength formulae existing in the API 19th Edition code. The same dummy pile properties will be used throughout the analysis. Load redistribution due to increased wave and wind contributions necessitates yielding along appropriate load paths of critical members to maintain the member or joint on the strength failure boundary. Since both the design code component strength requirement and the non-linear collapse analyses are based on the same member and joint strength formulae a comparison of the results will give a meaningful indication of the robustness of the design. Additional non-linear collapse analyses will be undertaken with chosen critical members assumed damaged in order to, further investigate the safety of design.

An assessment of the stochastic strength of the structure will be made using LR's Level 3 Reliability Analysis Program. The distribution of the member strength utilisation in critical zones obtained from the non-linear collapse analyses will be used in conjunction with the existing statistical data on member strength formula to obtain this result.

RESULTS OF THE DETERMINISTIC COLLAPSE ANALYSES

Combined case chosen for these analyses

Combined case 108 with a wave and wind angle of 310 degrees (see Figure 1) was chosen for the collapse analysis since this case resulted in the highest interaction ratio (see Table 3). Figure 2 is a plot of the undeformed structure and deformed structure due to combined loading case 108.

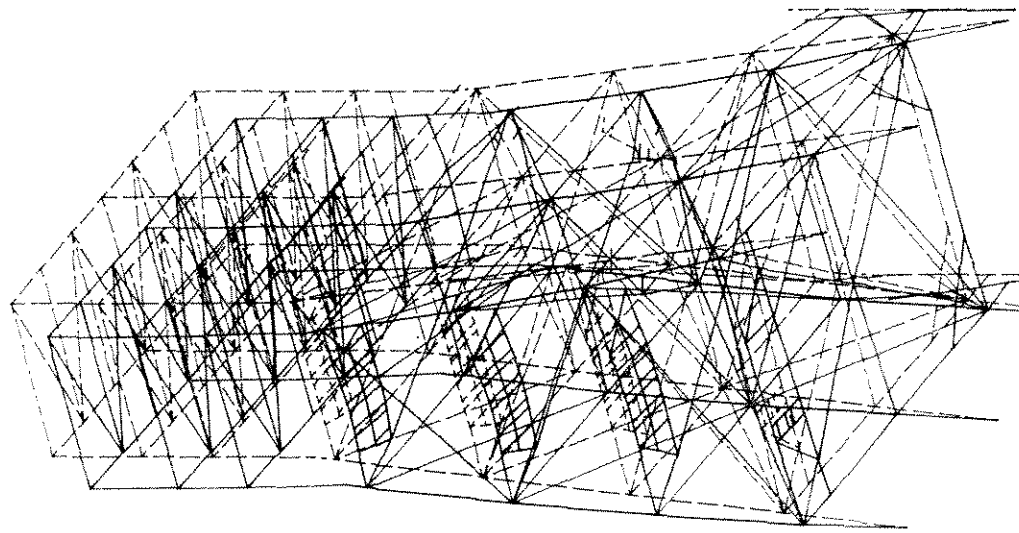
The chosen critical member assumed damaged is member 65 a leading diagonal member on ROW A see Appendix A

The following deterministic collapse analyses have been performed with

- a) all members effective
- b) member 65 completely released at end 1 ie node 39
- c) member 65 with yielding set to give an interaction ratio of 0.75 at end 2 ie node 53.

and the results of these are presented in the next three sections.

The analyses were terminated when a leg member reached an interaction ratio of approximately unity.



NODAL DISP:310DEG COMB CASE. ENVIRONMENTAL*1. MAX DISP=.13M

Figure 2

a) Results of collapse analysis with all members effective

i) Figure a.1: the lines and arrows in red indicate the axial and moments yield paths respectively.

An arrow indicates that a bending moment has reached yield at the member end. It does not differentiate between rotation about member local y or z or both. This information is available in Table a.1

ii) Table a.1 lists the displacements and forces along the Yield Paths at member ends. Appendix B gives the member local y axis thus identifying the bending moments ROTY AND ROTZ. (Member local x direction is always along the length of the member).

iii) Plots of undeformed and deformed structure at varying factors of

Figure a.2: wave and wind loading * 1.2

Figure a.3: " " " * 1.55

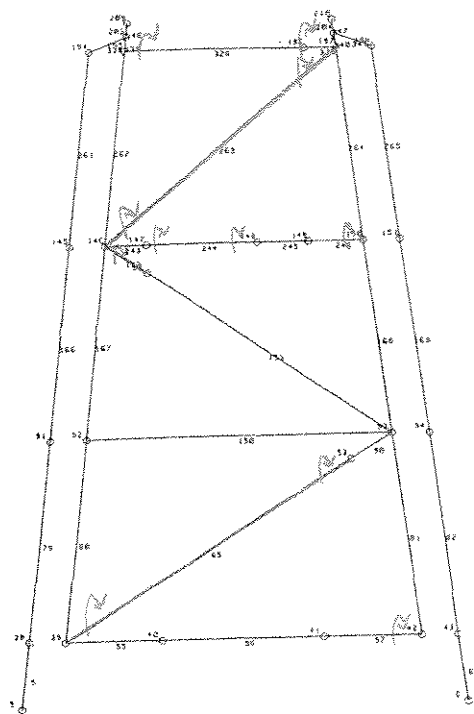
Figure a.4: " " " * 1.75

Figure a.5: " " " * 2.245

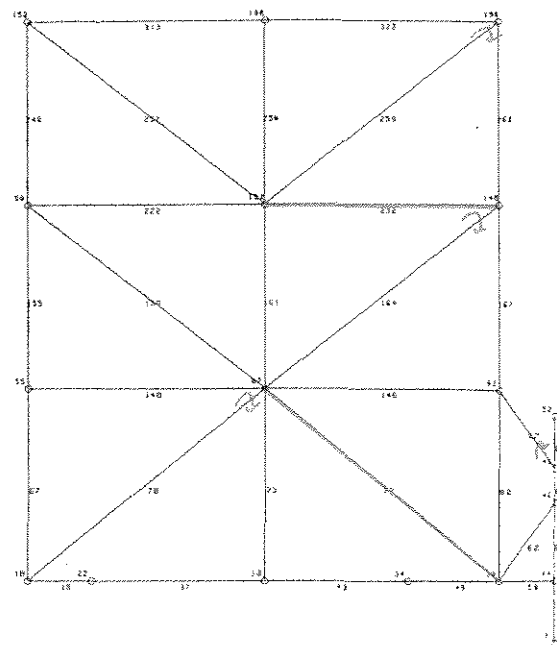
The deformations have been magnified by 40

iv) Table a.2: Member strength result at wave and wind * 2.245

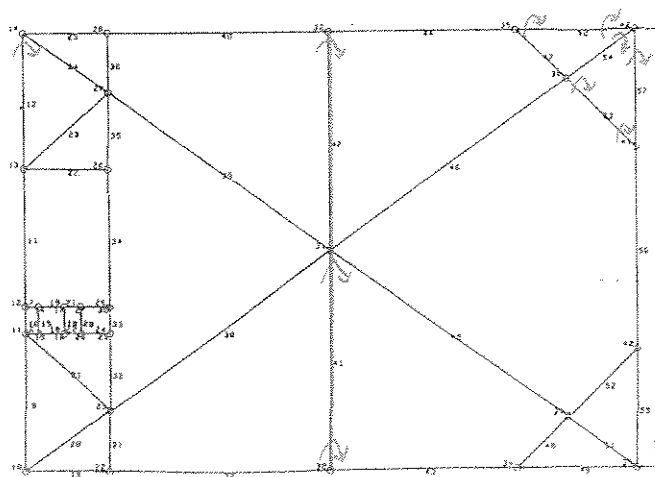
v) Table a.3: Joint strength result at wave and wind * 2.245



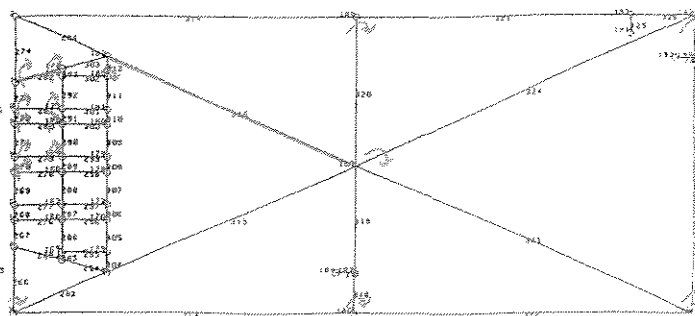
Row A



Row 2



El. -36.6



El. +6.0

```

MODEL NAME: UM2PS1_13          Date: 14-DEC-93          Page No: 1
- DAMAGED STRUCTURE STRESS ANALYSIS -
Details of damage in file name: T88
Loading from Combination load file name: T87$D
Card title: 310 DEGREE EXTREME STORM - WAVE & WIND * 2.245

```

DISPLACEMENTS AND FORCES ALONG YIELD PATHS AT MEMBER ENDS

*** against stress indicates accuracy of 5 sig figs not obtained
 *** against deflections indicates that plastic yielding direction is suspect

Member No	Node No	Dof	Displacement or rotation		Force or Moment		
			Joint	Member end	Required	Achieved	
241	148	ROTY	0.2707E-01	0.3217E-01	0.1450E+03	0.1450E+03	
282	161	DISPX	0.3967E-01	0.2777E-01	-0.9300E+03	-0.9300E+03	
282	161	ROTY	0.3160E-02	-0.9024E-02	0.2130E+02	0.2130E+02	
282	173	ROTY	0.2005E-02	-0.5827E-03	-0.5700E+03	-0.5700E+03	
225	129	ROTZ	-0.8645E-02	-0.2024E-02	0.1500E+02	0.1500E+02	
77	39	DISPX	-0.9303E-01	-0.1344E+00	-0.7010E+04	-0.7010E+04	
87	48	ROTZ	-0.1465E-01	-0.1314E-01	0.3276E+04	0.3276E+04	
230	134	DISPX	0.4423E+00	0.4127E+00	-0.1370E+04	-0.1370E+04	
230	134	ROTZ	0.4505E-02	0.1124E-01	0.5400E+02	0.5400E+02	
230	137	ROTZ	-0.3295E-02	0.1289E-01	-0.3000E+02	-0.3000E+02	
65	39	DISPX	-0.1271E+00	-0.3013E+00	-0.8040E+04	-0.8040E+04	
65	39	ROTY	-0.1534E-01	-0.8788E-02	-0.5450E+03	-0.5450E+03	
65	39	ROTZ	-0.2204E-02	-0.4716E-02	-0.4000E+03	-0.4000E+03	
65	53	ROTY	-0.1471E-01	0.2042E-02	0.1500E+03	0.1500E+03	
65	53	ROTZ	0.8256E-02	0.1184E-02	0.1700E+03	0.1700E+03	
78	42	DISPX	-0.4860E-01	-0.8819E-01	-0.5960E+04	-0.5960E+04	
***	78	42	ROTY	0.5024E-02	0.4260E-02	0.0000E+00	0.1788E-04***
78	89	ROTY	0.4443E-02	0.2619E-02	-0.3000E+03	-0.3000E+03	
78	89	ROTZ	-0.9743E-02	-0.7048E-02	-0.1600E+03	-0.1600E+03	
281	160	ROTY	0.4672E-02	-0.2349E-02	0.1860E+03	0.1860E+03	
281	171	ROTY	0.5277E-02	-0.4810E-03	-0.1933E+03	-0.1933E+03	
64	10	DISPX	-0.1390E+00	-0.3133E+00	-0.9505E+04	-0.9505E+04	
64	10	ROTY	-0.1661E-01	-0.6286E-02	-0.2140E+03	-0.2140E+03	
64	52	ROTY	-0.1438E-01	-0.2307E-02	0.1800E+03	0.1800E+03	
280	159	ROTY	0.4462E-02	-0.1925E-02	0.1950E+03	0.1950E+03	
280	170	ROTY	0.4154E-02	-0.1455E-03	-0.2000E+03	-0.2000E+03	
244	147	ROTY	-0.1004E-01	0.6272E-02	-0.2500E+03	-0.2500E+03	
244	147	ROTZ	-0.6149E-02	-0.3013E-01	-0.2620E+03	-0.2620E+03	
244	148	ROTZ	0.2707E-01	-0.2431E-01	0.3680E+03	0.3680E+03	
42	31	DISPX	-0.1437E+00	-0.1539E+00	-0.3560E+04	-0.3560E+04	
42	32	ROTY	-0.1551E-01	0.5367E-03	0.4000E+02	0.4000E+02	
143	85	ROTZ	-0.7864E-02	-0.3437E-02	0.3000E+02	0.3000E+02	
152	87	DISPX	-0.2992E+00	-0.4928E+00	-0.6372E+04	-0.6372E+04	
***	152	87	ROTY	-0.1613E-01	-0.4731E-02	0.0000E+00	0.3473E-03***
152	87	ROTZ	-0.2908E-02	-0.5295E-02	-0.2000E+03	-0.2000E+03	
152	96	ROTY	-0.1016E-01	-0.1959E-03	0.1400E+03	0.1400E+03	
152	96	ROTZ	0.3653E-03	0.2191E-02	-0.7500E+02	-0.7500E+02	
41	30	DISPX	-0.1272E+00	-0.1346E+00	-0.3550E+04	-0.3550E+04	
41	30	ROTY	-0.1559E-01	-0.4964E-02	-0.2000E+02	-0.2000E+02	
41	31	ROTY	0.8812E-03	-0.3346E-02	-0.2000E+02	-0.2000E+02	
144	87	DISPX	-0.3549E+00	-0.3775E+00	-0.2630E+04	-0.2630E+04	
144	87	ROTY	-0.1613E-01	0.2051E-02	-0.1300E+03	-0.1300E+03	
144	88	ROTY	0.1572E-02	0.4886E-02	0.7000E+02	0.7000E+02	
54	42	ROTZ	-0.9493E-02	-0.8101E-02	-0.7640E+03	-0.7640E+03	
279	158	ROTY	0.1825E-02	-0.2793E-02	0.1760E+03	0.1760E+03	
279	169	ROTY	0.1194E-02	0.4505E-03	-0.1988E+03	-0.1988E+03	
172	97	DISPX	0.2940E+00	0.4660E+00	0.8100E+04	0.8100E+04	
172	146	ROTY	-0.1327E-01	0.5574E-02	0.1000E+02	0.1000E+02	
249	99	DISPX	-0.4128E+00	-0.5592E+00	-0.5910E+04	-0.5910E+04	
249	99	ROTY	-0.1041E-01	-0.3609E-02	-0.5000E+03	-0.5000E+03	

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MODEL NAME: UM2PS1_13                      Date: 14-DEC-93      Page No: 2
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- DAMAGED STRUCTURE STRESS ANALYSIS -
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Details of damage in file name: T88
Loading from Combination load file name: T87$D
Card title: 310 DEGREE EXTREME STORM - WAVE & WIND * 2.245
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DISPLACEMENTS AND FORCES ALONG YIELD PATHS AT MEMBER ENDS

*** against stress indicates accuracy of 5 sig figs not obtained
 *** against deflections indicates that plastic yielding direction is suspect

	Member No	Node No	Dof	Displacement or rotation		Force or Moment	
				Joint	Member end	Required	Achieved
	249	99	ROTZ	-0.3426E-02	-0.5186E-02	-0.1000E+03	-0.1000E+03
	249	162	ROTZ	-0.2691E-02	-0.5500E-03	-0.4800E+03	-0.4800E+03
	232	132	DISPX	0.1992E+00	0.1858E+00	-0.4220E+04	-0.4220E+04
	246	150	ROTY	-0.1305E-01	0.7804E-03	0.2000E+03	0.2000E+03
	246	150	ROTZ	0.1210E-01	0.2839E-01	-0.4590E+03	-0.4590E+03
	147	88	DISPX	0.3401E+00	0.3126E+00	-0.7450E+03	-0.7450E+03
	52	37	ROTY	-0.7552E-02	-0.5188E-02	-0.1067E+03	-0.1067E+03
	52	37	ROTZ	-0.6951E-03	-0.4429E-03	0.1300E+03	0.1300E+03
	52	40	ROTY	0.1377E-02	0.9235E-03	-0.7680E+02	-0.7680E+02
	52	40	ROTZ	-0.1427E-02	-0.5626E-04	-0.8970E+02	-0.8970E+02
	53	36	ROTY	-0.5607E-02	-0.2661E-02	-0.1272E+03	-0.1272E+03
	53	41	ROTZ	-0.3625E-02	-0.5439E-02	0.1350E+03	0.1350E+03
	233	135	DISPX	0.2050E+00	0.1950E+00	-0.3638E+04	-0.3638E+04
	233	135	ROTY	0.2851E-02	0.2100E-02	0.8000E+02	0.8000E+02
***	233	150	ROTZ	0.1184E-01	0.8679E-02	0.0000E+00	-0.1022E-04***
	256	135	DISPX	0.4134E+00	0.5565E+00	0.7070E+04	0.7070E+04
	256	186	ROTY	-0.6956E-02	0.7087E-02	0.1900E+03	0.1900E+03
	316	183	DISPX	0.4896E+00	0.4866E+00	-0.1000E+04	-0.1000E+04
	74	32	DISPX	0.1420E+00	0.2750E+00	0.1084E+05	0.1084E+05
	74	32	ROTY	-0.1551E-01	-0.1409E-01	-0.1288E+04	-0.1288E+04
	74	87	ROTY	-0.1613E-01	-0.7334E-02	0.1360E+04	0.1360E+04
	151	64	DISPX	0.3356E+00	0.4673E+00	0.1085E+05	0.1085E+05
***	151	64	ROTY	-0.1505E-01	-0.4588E-02	0.0000E+00	-0.2144E-04***
	151	95	ROTY	-0.7340E-02	-0.5625E-03	0.4220E+03	0.4220E+03
***	151	95	ROTZ	0.2550E-02	0.1120E-02	0.0000E+00	0.4841E-04***
	231	134	ROTY	-0.1760E-02	-0.1159E-01	0.9400E+03	0.9400E+03
	231	139	ROTY	0.3251E-01	0.1129E-01	-0.9380E+03	-0.9380E+03
	70	87	ROTY	0.3778E-02	0.3451E-02	-0.3850E+03	-0.3850E+03
	70	87	ROTZ	-0.1064E-01	-0.4639E-02	-0.8950E+02	-0.8950E+02
	227	132	ROTY	-0.1252E-01	-0.1957E-02	-0.1000E+04	-0.1000E+04
	263	146	DISPX	-0.4077E+00	-0.6007E+00	-0.3780E+04	-0.3780E+04
***	263	146	ROTY	-0.1327E-01	-0.8168E-02	0.0000E+00	-0.5112E-04***
	263	146	ROTZ	-0.2372E-02	-0.7335E-02	-0.4000E+03	-0.4000E+03
	263	197	ROTY	-0.9411E-02	0.3829E-02	0.4900E+03	0.4900E+03
	263	197	ROTZ	0.5271E-02	0.5762E-02	-0.2000E+02	-0.2000E+02
	173	99	ROTY	-0.1041E-01	0.1768E-02	-0.7860E+03	-0.7860E+03
	318	186	ROTY	-0.6956E-02	0.2627E-02	-0.7100E+03	-0.7100E+03
	57	42	ROTY	-0.1559E-01	-0.9768E-02	0.6030E+03	0.6030E+03
	159	89	DISPX	-0.1058E+00	-0.1101E+00	-0.5488E+04	-0.5488E+04
	159	89	ROTY	0.4443E-02	0.4224E-02	0.4000E+02	0.4000E+02
	329	197	ROTY	-0.9411E-02	-0.5467E-02	0.1596E+04	0.1596E+04
	324	188	ROTY	-0.2051E-02	-0.3220E-02	0.8690E+03	0.8690E+03
	278	157	ROTY	0.4900E-04	-0.1259E-02	0.1992E+03	0.1992E+03
	320	189	ROTY	-0.7520E-02	-0.4292E-02	0.1088E+04	0.1088E+04
	12	14	ROTY	0.1739E-01	0.1570E-01	-0.8317E+03	-0.8317E+03
	259	195	ROTZ	-0.5997E-02	-0.4215E-02	-0.4780E+03	-0.4780E+03
	328	195	ROTY	-0.9677E-02	-0.7862E-02	-0.1494E+04	-0.1493E+04
	164	146	ROTY	0.2437E-02	-0.1040E-02	-0.1960E+03	-0.1960E+03
	180	107	ROTZ	0.1442E-02	0.1898E-02	-0.8300E+03	-0.8300E+03
	266	153	ROTY	-0.7191E-02	-0.6552E-02	-0.1645E+04	-0.1645E+04

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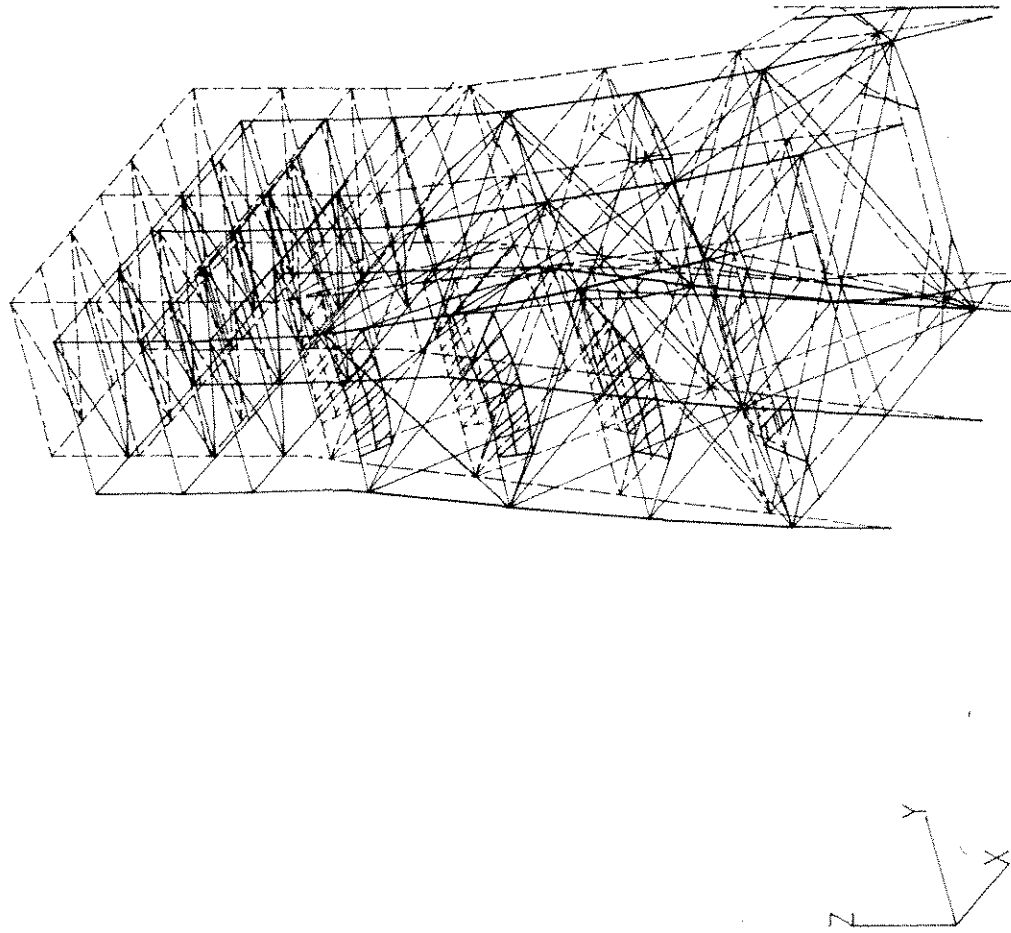
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! MODEL NAME: UM2PS1_13          Date: 14-DEC-93      Page No: 3    !
!                               !                      !
!           - DAMAGED STRUCTURE STRESS ANALYSIS -      !
!                               !                      !
! Details of damage in file name: T88                  !
! Loading from Combination load file name: T87$D       !
! Card title: 310 DEGREE EXTREME STORM - WAVE & WIND * 2.245 !
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DISPLACEMENTS AND FORCES ALONG YIELD PATHS AT MEMBER ENDS

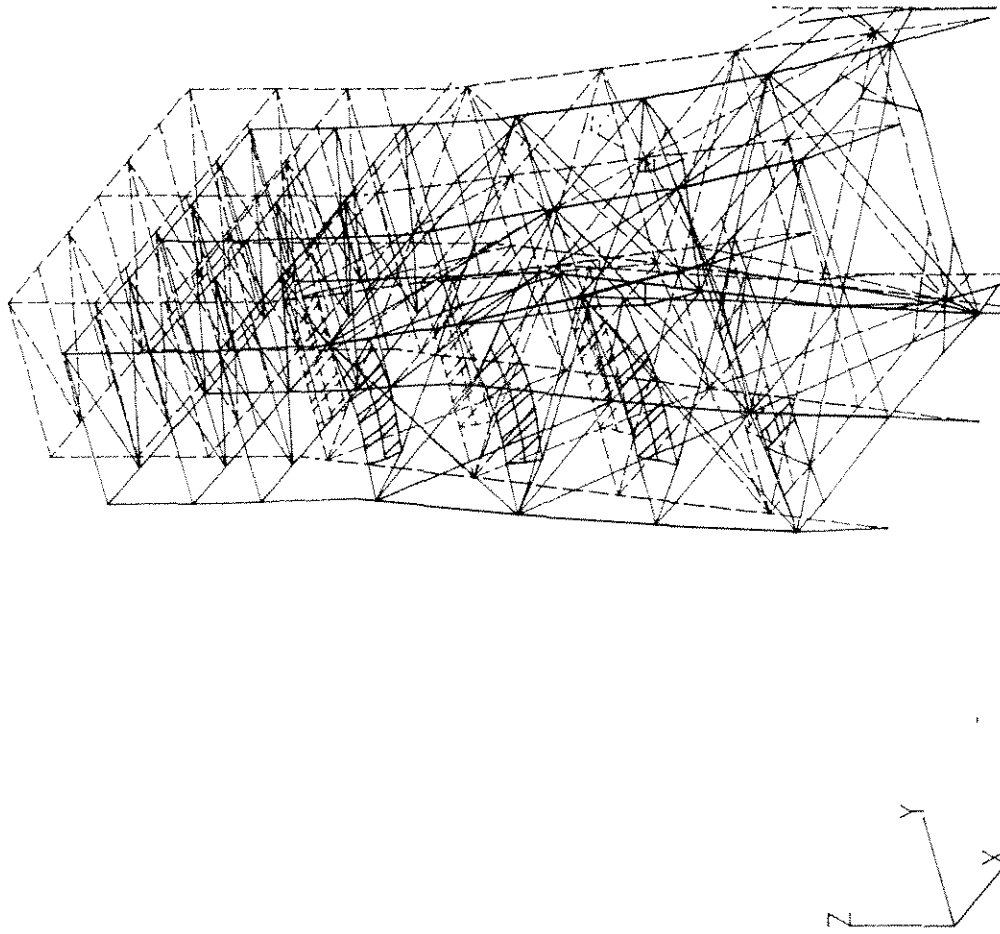
*** against stress indicates accuracy of 5 sig figs not obtained
 *** against deflections indicates that plastic yielding direction is suspect

Member No	Node No	Dof	Displacement or rotation		Force or Moment	
			Joint	Member end	Required	Achieved
145	89	ROTY	-0.1503E-01	-0.9219E-02	0.2000E+03	0.2000E+03
312	183	ROTY	-0.2748E-03	-0.2142E-03	0.4840E+03	0.4840E+03



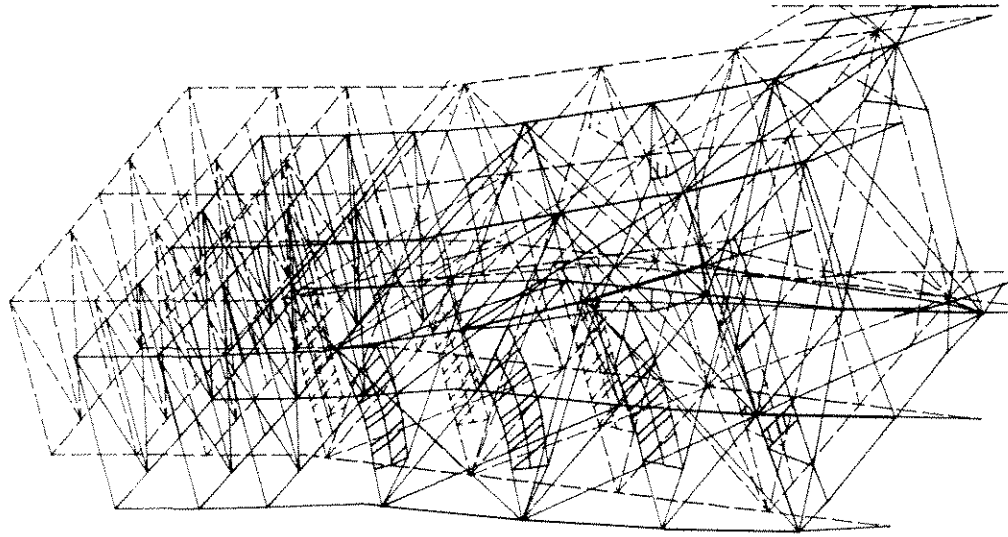
NODAL DISP: 310DEG COMB CASE. ENVIRONMENTAL*1.2 MAX DISP=.16M

Figure a.2



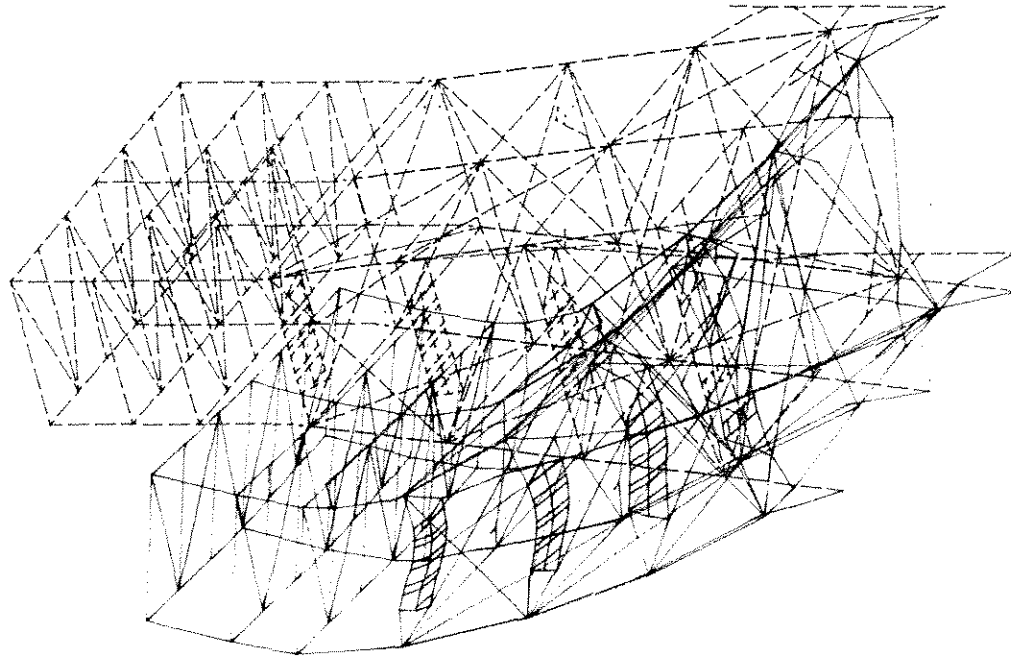
NODAL DISP: 310DEG COMB CASE. ENVIRONMENTAL*1.55 MAX DISP=.21M

Figure a.3



NODAL DISP: 310DEG COMB CASE. ENVIRONMENTAL*1.75 MAX DISP = .24M

Figure a.4



NODAL DISP: 310DEG COMB CASE. ENVIRONMENTAL*2.245 MAX DISP = .79M

Figure a.5

AISC Check Summary

TABLE a.2

	MEMBER No.	STATION POSITION	CASE No.	INTERACTION	RATIO	C-T FLAG
leg --->	266	0.00	101	1.004	*	(C)
member	250	0.75	101	1.003	*	(C)
	65	0.50	101	1.001	*	(C)
	256	0.50	101	1.001	*	(T)
	70	0.50	101	1.001	*	(T)
	164	1.00	101	1.001	*	(T)
	281	1.00	101	1.000	*	(C)
	173	0.25	101	1.000	*	(C)
	78	0.50	101	1.000	*	(C)
	233	0.50	101	1.000	*	(C)
	232	0.50	101	1.000	*	(C)
	259	1.00	101	1.000	*	(T)
	279	1.00	101	1.000	*	(T)
	64	0.50	101	1.000	*	(C)
	312	1.00	101	1.000		(T)
	151	0.50	101	1.000		(T)
	159	0.50	101	1.000		(C)
	180	1.00	101	0.999		(C)
	263	0.50	101	0.998		(C)
	57	1.00	101	0.998		(T)
	12	1.00	101	0.997		(T)
	9	0.00	101	0.997		(T)
	230	0.25	101	0.997		(C)
	282	1.00	101	0.996		(C)
	158	0.50	101	0.995		(C)
	249	0.75	101	0.994		(C)
	152	0.50	101	0.993		(C)
	145	0.75	101	0.992		(C)
	274	1.00	101	0.990		(T)
	153	0.25	101	0.990		(T)
	280	0.00	101	0.988		(T)
	278	0.00	101	0.986		(T)
	244	0.00	101	0.985		(C)
	77	0.50	101	0.985		(C)
	329	1.00	101	0.984		(T)
	144	0.25	101	0.983		(C)
	320	1.00	101	0.982		(C)
	74	1.00	101	0.979		(T)

MEMBER STRENGTH RESULTS FOR DAMAGED STRUCTURE
 ENVIRONMENTAL LOADING * 2.245
 ALL MEMBERS EFFECTIVE

JOINT NO.	BRACE NO.	CASE NO.	CLASSIFICATION			INTERACTION BENDING	RATIO OVERALL	
			%K	%X	%YT			
158	279	101	0.0	0.0	100.0	0.924	1.005	**
37	52	101	0.0	36.3	63.7	0.787	1.001	**
157	278	101	0.0	0.0	100.0	0.993	1.000	**
32	74	101	41.4	0.0	58.6	0.053	1.000	**
161	282	101	0.0	0.0	100.0	0.021	0.999	
36	53	101	0.0	0.0	100.0	0.892	0.999	
146	172	101	64.4	0.0	35.6	0.073	0.987	
160	281	101	0.0	0.0	100.0	0.971	0.978	
41	53	101	0.0	0.0	100.0	0.799	0.967	
40	52	101	0.0	0.0	100.0	0.658	0.967	
159	280	101	0.0	0.0	100.0	0.935	0.955	
89	71	101	79.7	0.0	20.3	0.009	0.927	
10	70	101	46.3	0.0	53.7	0.012	0.897	
37	48	101	0.0	100.0	0.0	0.875	0.881	
10	64	101	25.7	0.0	74.3	0.005	0.857	
135	171	101	69.1	0.0	30.9	0.027	0.855	
183	312	101	77.5	0.0	22.5	0.436	0.849	
89	165	101	100.0	0.0	0.0	0.041	0.841	
146	164	101	62.2	0.0	37.8	0.030	0.817	
173	293	101	0.0	0.0	100.0	0.863	0.794	
195	259	101	47.3	0.0	52.7	0.047	0.777	
46	60	101	0.0	0.0	100.0	0.029	0.776	
87	74	101	74.4	0.0	25.6	0.025	0.772	
14	71	101	51.1	0.0	48.9	0.003	0.757	
30	37	101	0.0	0.0	100.0	0.047	0.750	
64	151	101	100.0	0.0	0.0	0.006	0.739	
189	320	101	0.0	0.0	100.0	0.133	0.736	
64	89	101	99.8	0.0	0.2	0.011	0.731	
186	256	101	60.6	0.0	39.4	0.036	0.722	
89	159	101	100.0	0.0	0.0	0.018	0.719	
142	239	101	0.0	0.0	100.0	0.713	0.718	
162	249	101	48.8	0.0	51.2	0.070	0.715	
99	170	101	86.3	0.0	13.7	0.013	0.693	
135	256	101	100.0	0.0	0.0	0.015	0.692	
89	78	101	94.0	0.0	6.0	0.006	0.690	
32	40	101	0.0	7.9	92.1	0.013	0.677	
188	323	101	0.0	80.9	19.1	0.124	0.676	
186	322	101	0.0	23.8	76.2	0.115	0.675	

JOINT STRENGTH RESULTS FOR DAMAGED STRUCTURE
ENVIRONMENTAL LOADING * 2.245
ALL MEMBERS EFFECTIVE

b) Results of collapse analysis with

member 65 completely released at end 1 at node 39

- i) Figure b.1: the lines and arrows in red indicate the axial and moments yield paths respectively.

An arrow indicates that a bending moment has reached yield at the member end. It does not differentiate between rotation about member local y or z or both. This information is available in Table b.1

- ii) Table b.1 lists the displacements and forces along the Yield Paths at member ends. Appendix B gives the member local y axis thus identifying the bending moments ROTY AND ROTZ. (Member local x direction is always along the length of the member).

- iii) Plots of undeformed and deformed structure at varying factors of

Figure b.2: wave and wind loading * 1.2

Figure b.3: " " " * 1.5

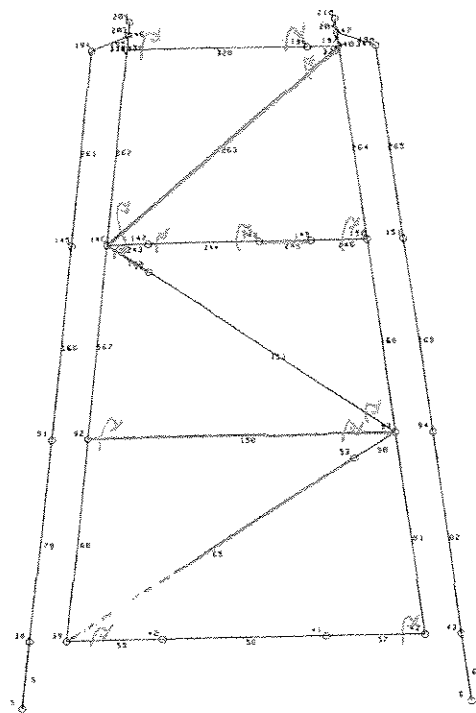
Figure b.4: " " " * 1.7

Figure b.5: " " " * 2.175

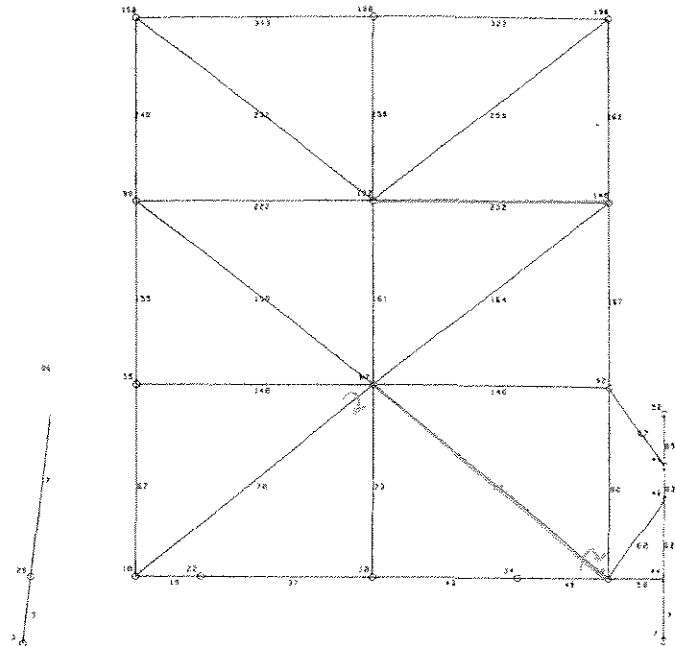
The deformations have been magnified by 40

- iv) Table b.2: Member strength result at wave and wind * 2.175

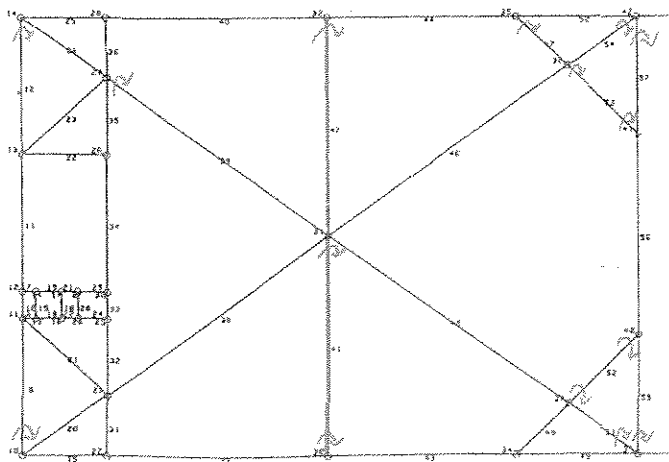
- v) Table b.3: Joint strength result at wave and wind * 2.175



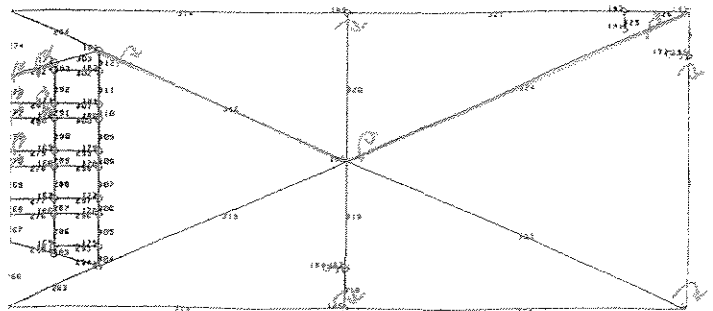
Row A



Row 2



El-36.6



El. +6.0

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MODEL NAME: UM2PS1_17                      Date: 16-DEC-93      Page No: 1
- DAMAGED STRUCTURE STRESS ANALYSIS -
Details of damage in file name: U51
Loading from Combination load file name: U50$D
Card title: 310 DEG STORM  WIND & WAVE * 2.175
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DISPLACEMENTS AND FORCES ALONG YIELD PATHS AT MEMBER ENDS

*** against stress indicates accuracy of 5 sig figs not obtained
 *** against deflections indicates that plastic yielding direction is suspect

	Member No	Node No	Dof	Displacement or rotation		Force or Moment	
				Joint	Member end	Required	Achieved
***	65	39	DISPX	-0.1357E+00	-0.4722E+00	0.0000E+00	0.6184E-02***
	65	39	DISPY	-0.8281E-01	-0.1003E+01	0.0000E+00	0.3801E-05
***	65	39	DISPZ	0.6543E-01	-0.8512E-01	0.0000E+00	0.1382E-04***
***	65	39	ROTX	0.2757E-02	0.9504E-02	0.0000E+00	-0.1055E-04***
***	65	39	ROTY	-0.2092E-01	-0.7476E-02	0.0000E+00	-0.2411E-03***
***	65	39	ROTZ	-0.2046E-02	0.3572E-01	0.0000E+00	-0.1014E-02***
	241	148	ROTY	0.4243E-01	0.5399E-01	0.1450E+03	0.1450E+03
	148	88	DISPX	-0.1141E+00	-0.1425E+00	-0.9850E+03	-0.9850E+03
	148	88	ROTY	0.7283E-03	-0.2036E-01	0.1000E+02	0.1000E+02
	148	88	ROTZ	-0.7773E-03	-0.4546E-02	-0.1000E+02	-0.1000E+02
	148	93	ROTY	0.1625E-01	0.1275E-01	-0.5000E+02	-0.5000E+02
	231	134	DISPX	-0.1369E+00	-0.1653E+00	-0.8430E+03	-0.8430E+03
	231	134	ROTY	-0.1321E-02	-0.2922E-01	0.4500E+03	0.4500E+03
	231	139	ROTY	0.4579E-01	-0.2607E-02	-0.5700E+03	-0.5700E+03
	54	42	ROTZ	-0.1228E-01	-0.8732E-02	-0.7150E+03	-0.7150E+03
	282	161	DISPX	0.2328E-01	0.1286E-01	-0.1020E+04	-0.1020E+04
***	282	161	ROTY	0.1551E-02	-0.1005E-01	0.0000E+00	0.2623E-04***
	282	161	ROTZ	-0.4802E-02	-0.6215E-02	0.0000E+00	-0.7165E-05
	282	173	ROTY	0.4244E-03	-0.1738E-02	-0.5350E+03	-0.5350E+03
	42	32	DISPX	-0.1867E+00	-0.1701E+00	-0.3390E+04	-0.3390E+04
	42	32	ROTY	-0.1829E-01	-0.1859E-02	0.1200E+03	0.1200E+03
	244	147	ROTY	-0.1153E-01	0.1730E-01	-0.7300E+02	-0.7300E+02
	244	147	ROTZ	-0.1000E-01	-0.4291E-01	-0.5000E+03	-0.5000E+03
	244	148	ROTZ	0.4243E-01	-0.4298E-01	0.3800E+03	0.3800E+03
	53	36	ROTY	-0.1144E-01	-0.5858E-03	-0.1050E+03	-0.1050E+03
	53	41	ROTZ	-0.3726E-02	-0.8034E-02	0.8000E+02	0.8000E+02
	150	92	DISPX	-0.4456E+00	-0.5095E+00	-0.2000E+04	-0.2000E+04
	150	92	ROTY	-0.1769E-01	-0.8001E-02	-0.3700E+03	-0.3700E+03
	150	93	ROTY	-0.2127E-01	-0.4810E-02	0.3750E+03	0.3750E+03
	150	93	ROTZ	0.1625E-01	0.5639E-02	0.0000E+00	-0.2634E-05
	78	42	DISPX	-0.5264E-01	-0.9069E-01	-0.6005E+04	-0.6005E+04
***	78	42	ROTZ	-0.2540E-01	-0.1807E-01	0.0000E+00	-0.2434E-03***
	144	87	ROTY	-0.1807E-01	-0.4920E-02	-0.4350E+03	-0.4350E+03
	144	88	DISPX	0.4376E+00	-0.3755E+00	-0.1705E+04	-0.1705E+04
	144	88	ROTY	0.3159E-02	0.8673E-02	0.9900E+02	0.9900E+02
	77	39	DISPX	-0.8457E-01	-0.1198E+00	-0.6950E+04	-0.6950E+04
***	77	39	ROTY	0.3432E-02	0.1205E-02	0.0000E+00	0.1347E-04***
***	77	39	ROTZ	-0.1331E-01	-0.1232E-01	0.0000E+00	0.1448E-04***
	152	87	DISPX	-0.3110E+00	-0.5348E+00	-0.7154E+04	-0.7154E+04
***	152	87	ROTY	-0.1807E-01	-0.4638E-02	0.0000E+00	0.4029E-04***
	152	96	ROTY	-0.9511E-02	-0.2406E-02	0.2800E+03	0.2800E+03
	281	160	ROTY	0.3077E-02	-0.3689E-02	0.1720E+03	0.1720E+03
	281	171	ROTY	0.3462E-02	-0.1380E-02	-0.1850E+03	-0.1850E+03
	316	183	DISPX	0.4969E+00	0.4963E+00	-0.1140E+04	-0.1140E+04
***	316	183	ROTZ	-0.4319E-02	0.4056E-03	0.0000E+00	-0.2579E-04***
	64	10	ROTY	-0.1881E-01	-0.1087E-01	-0.7400E+03	-0.7400E+03
	64	52	DISPX	-0.3725E+00	-0.1634E+00	-0.8160E+04	-0.8160E+04
	64	52	ROTY	-0.1529E-01	-0.1067E-02	0.2600E+03	0.2600E+03
	64	52	ROTZ	-0.2265E-02	-0.1317E-02	-0.1490E+03	-0.1490E+03
	263	146	ROTY	-0.1284E-01	-0.9563E-02	-0.6350E+03	-0.6350E+03

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! MODEL NAME: UM2PS1_17                      Date: 16-DEC-93      Page No: 2
!
!           - DAMAGED STRUCTURE STRESS ANALYSIS -
!
! Details of damage in file name: U51
! Loading from Combination load file name: U50$D
! Card title: 310 DEG STORM   WIND & WAVE * 2.175
!
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DISPLACEMENTS AND FORCES ALONG YIELD PATHS AT MEMBER ENDS

*** against stress indicates accuracy of 5 sig figs not obtained
 *** against deflections indicates that plastic yielding direction is suspect

	Member No	Node No	Dof	Displacement or rotation		Force or Moment	
				Joint	Member end	Required	Achieved
	263	197	DISPX	-0.6917E+00	-0.4925E+00	-0.4495E+04	-0.4495E+04
	263	197	ROTY	-0.4697E-02	-0.2599E-02	0.1380E+04	0.1380E+04
	263	197	ROTZ	0.5924E-02	0.3142E-02	0.8000E+02	0.8000E+02
	232	132	DISPX	0.1753E+00	0.1659E+00	-0.4225E+04	-0.4225E+04
	41	30	DISPX	-0.1249E+00	-0.1532E+00	-0.3210E+04	-0.3210E+04
***	41	30	ROTY	-0.1655E-01	-0.3974E-02	0.0000E+00	0.1473E-03***
	41	31	ROTY	0.3559E-03	-0.1073E-02	-0.1000E+03	-0.1000E+03
	280	159	ROTY	0.2810E-02	-0.2433E-02	0.1980E+03	0.1980E+03
	280	170	ROTY	0.2458E-02	-0.9890E-03	-0.2000E+03	-0.2000E+03
	153	93	ROTY	-0.2127E-01	-0.1046E-01	-0.7400E+03	-0.7400E+03
	153	93	ROTZ	-0.1418E-01	-0.9412E-02	0.3100E+03	0.3100E+03
	246	150	ROTY	-0.9080E-02	-0.7635E-02	0.5350E+03	0.5350E+03
	246	150	ROTZ	0.1455E-01	0.4328E-01	-0.4650E+03	-0.4650E+03
	172	146	DISPX	0.5673E+00	0.4231E+00	0.8670E+04	0.8670E+04
	172	146	ROTY	-0.1284E-01	0.2399E-02	0.4890E+03	0.4890E+03
	172	146	ROTZ	0.6456E-03	0.5932E-02	-0.2210E+03	-0.2210E+03
	52	37	ROTY	-0.9746E-02	-0.4452E-02	-0.1250E+03	-0.1250E+03
	52	40	ROTZ	-0.2931E-02	-0.1790E-02	-0.1150E+03	-0.1150E+03
	74	32	ROTY	-0.1829E-01	-0.6754E-02	-0.5580E+03	-0.5580E+03
	74	32	ROTZ	-0.1818E-02	-0.3919E-02	-0.2500E+03	-0.2500E+03
	74	87	DISPX	0.3142E+00	0.1868E+00	0.1139E+05	0.1139E+05
	74	87	ROTY	-0.1807E-01	-0.1024E-01	0.1330E+04	0.1330E+04
	324	188	DISPX	-0.1070E+00	-0.1087E+00	-0.9500E+03	-0.9500E+03
	324	188	ROTY	-0.3181E-02	-0.1543E-01	0.6400E+03	0.6400E+03
	324	197	ROTY	0.8777E-02	0.1207E-01	0.7700E+03	0.7700E+03
	256	186	DISPX	0.6178E+00	0.4641E+00	0.7350E+04	0.7350E+04
	256	186	ROTY	-0.6590E-02	0.6193E-02	0.3150E+03	0.3150E+03
	225	129	DISPX	0.4627E+00	0.4479E+00	-0.1175E+04	-0.1175E+04
	225	129	ROTZ	-0.7346E-02	-0.2556E-02	0.6000E+02	0.6000E+02
	143	85	DISPX	0.3672E+00	0.3505E+00	-0.9290E+03	-0.9290E+03
	143	85	ROTZ	-0.7284E-02	-0.4159E-02	0.5000E+02	0.5000E+02
	233	150	ROTZ	0.1434E-01	0.1183E-02	0.6000E+02	0.6000E+02
	249	99	DISPX	-0.4472E+00	-0.5827E+00	-0.6565E+04	-0.6565E+04
	249	99	ROTY	-0.9587E-02	-0.1885E-02	-0.2700E+03	-0.2700E+03
	249	162	ROTY	-0.5583E-02	-0.2660E-02	0.4900E+03	0.4900E+03
	151	64	DISPX	0.3674E+00	0.5107E+00	0.1037E+05	0.1037E+05
	151	64	ROTY	-0.1628E-01	-0.8146E-02	-0.3750E+03	-0.3750E+03
	151	95	ROTY	-0.5944E-02	0.5315E-03	0.5150E+03	0.5150E+03
	57	42	ROTY	-0.2581E-01	-0.1433E-01	0.8400E+03	0.8400E+03
	279	158	ROTY	0.2681E-03	-0.3504E-02	0.1750E+03	0.1750E+03
	318	186	ROTY	-0.6590E-02	0.5485E-02	-0.6350E+03	-0.6350E+03
	165	89	ROTZ	-0.1146E-01	-0.1387E-01	-0.7250E+03	-0.7250E+03
	165	150	ROTZ	0.5685E-02	0.1603E-02	0.5500E+03	0.5500E+03
	227	132	ROTY	-0.1400E-01	-0.2254E-02	-0.1060E+04	-0.1060E+04
	173	99	ROTY	-0.9587E-02	-0.4355E-03	-0.9850E+03	-0.9850E+03
	55	39	ROTY	-0.2092E-01	-0.1699E-01	-0.8400E+03	-0.8400E+03
	230	134	ROTZ	0.4836E-02	0.9654E-02	0.7000E+02	0.7000E+02
	230	137	ROTZ	0.2121E-02	0.1011E-01	-0.1000E+03	-0.1000E+03
	12	14	ROTY	0.2003E-01	0.1705E-01	-0.8700E+03	-0.8700E+03
	39	27	ROTZ	-0.5866E-02	-0.1578E-02	0.1500E+03	0.1500E+03

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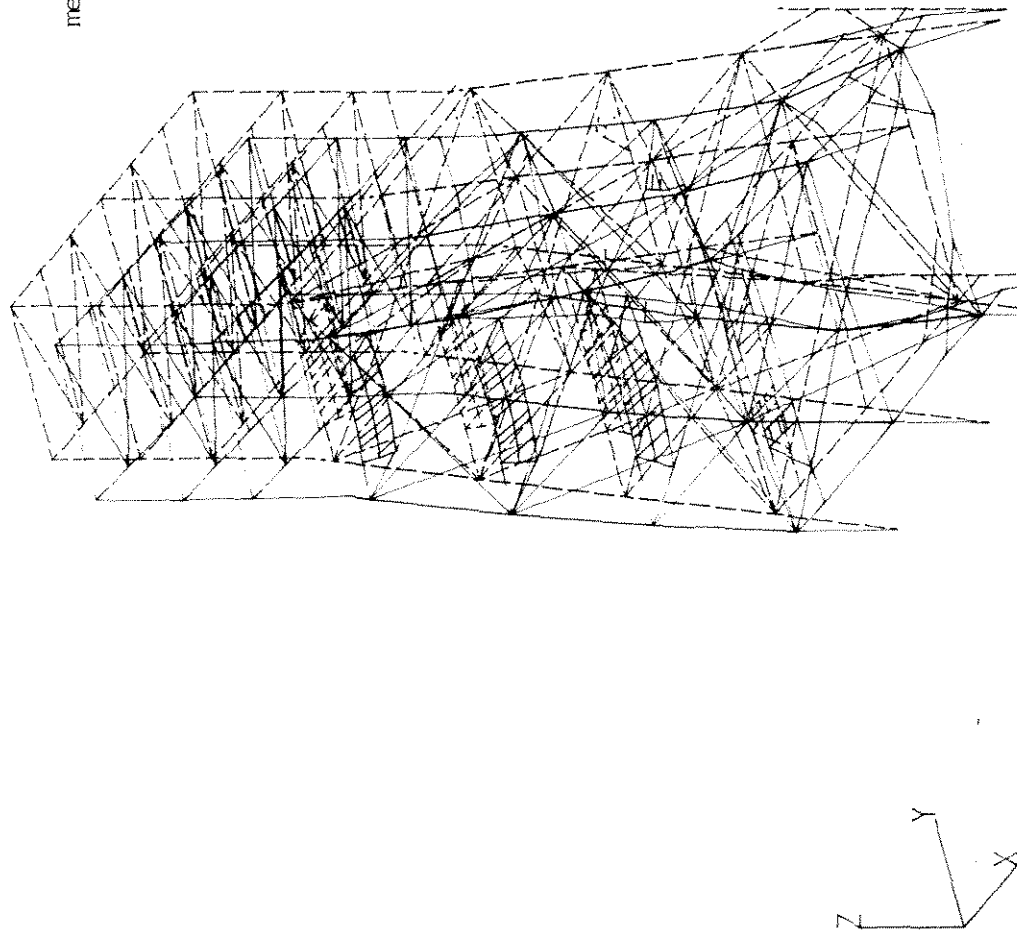
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!           - DAMAGED STRUCTURE STRESS ANALYSIS -           !
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! Details of damage in file name: U51                       !
! Loading from Combination load file name: U50$D           !
! Card title: 310 DEG STORM   WIND & WAVE * 2.175         !
!-----!

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DISPLACEMENTS AND FORCES ALONG YIELD PATHS AT MEMBER ENDS

*** against stress indicates accuracy of 5 sig figs not obtained
 *** against deflections indicates that plastic yielding direction is suspect

Member No	Node No	Dof	Displacement or rotation		Force or Moment	
			Joint	Member end	Required	Achieved
47	35	ROTZ	-0.5028E-02	-0.5418E-02	-0.5850E+03	-0.5850E+03
70	87	ROTZ	-0.1252E-01	-0.1031E-01	-0.5900E+03	-0.5900E+03
245	148	DISPX	-0.6602E+00	-0.7234E+00	-0.1300E+04	-0.1300E+04
9	10	ROTY	0.1881E-01	0.1688E-01	0.9300E+03	0.9300E+03
328	195	ROTY	-0.7845E-02	-0.2987E-02	-0.1245E+04	-0.1245E+04
328	196	ROTY	0.5214E-02	0.8504E-02	0.1060E+04	0.1060E+04
71	14	DISPX	0.1066E+00	0.1096E+00	0.9160E+04	0.9160E+04
51	39	ROTY	-0.1502E-01	-0.1440E-01	0.3700E+03	0.3700E+03
320	189	ROTY	-0.7449E-02	-0.6160E-02	0.1230E+04	0.1230E+04
147	92	ROTZ	-0.1053E-01	-0.9771E-02	-0.7450E+03	-0.7450E+03
278	157	ROTY	-0.1406E-02	-0.1646E-02	0.2000E+03	0.2000E+03



NODAL DISP:310DEG COMB CASE. ENVIRONMENTAL*1.2 MAX DISP=.21M

Figure b.2

member 65 fully released at end 1

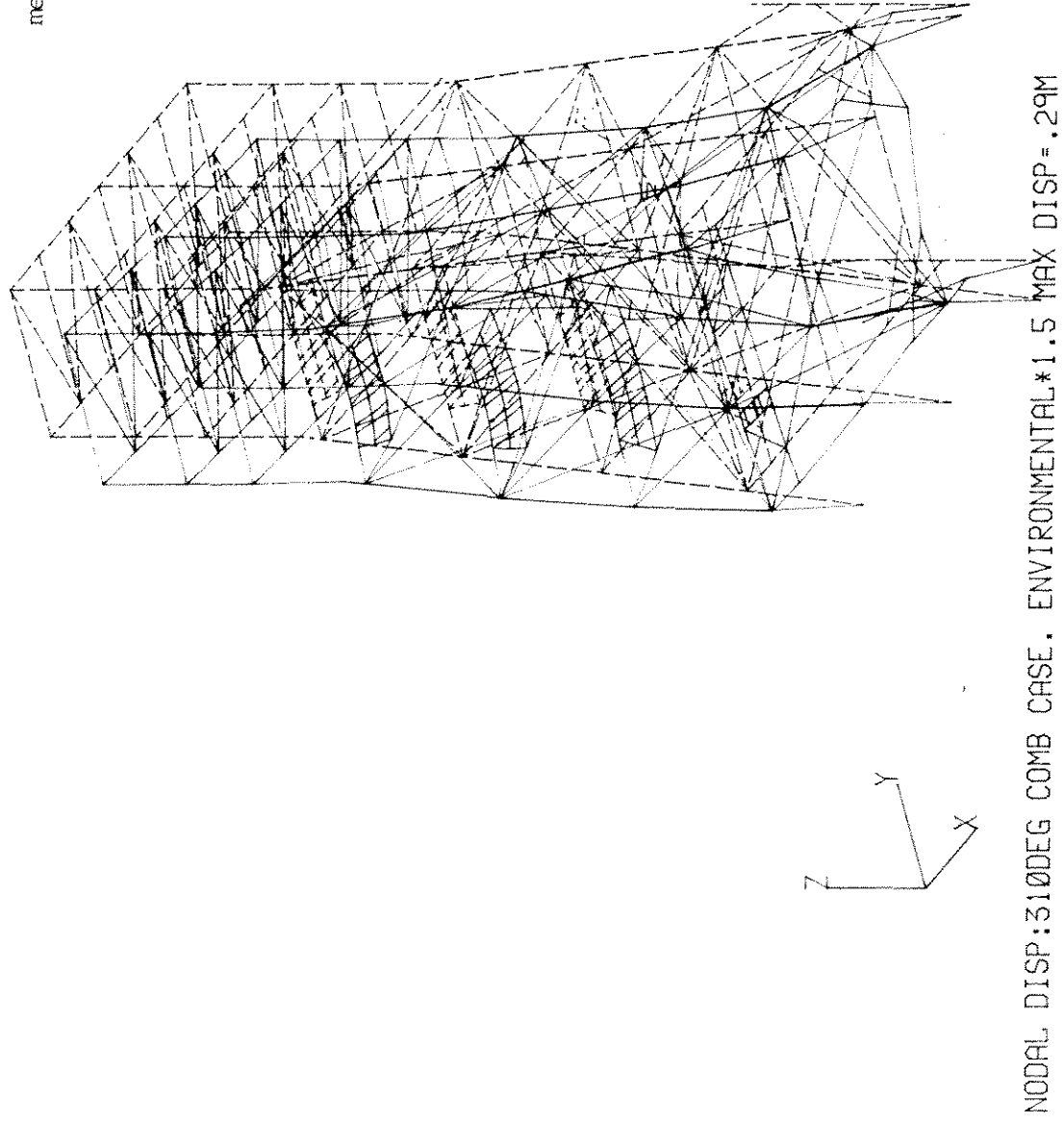
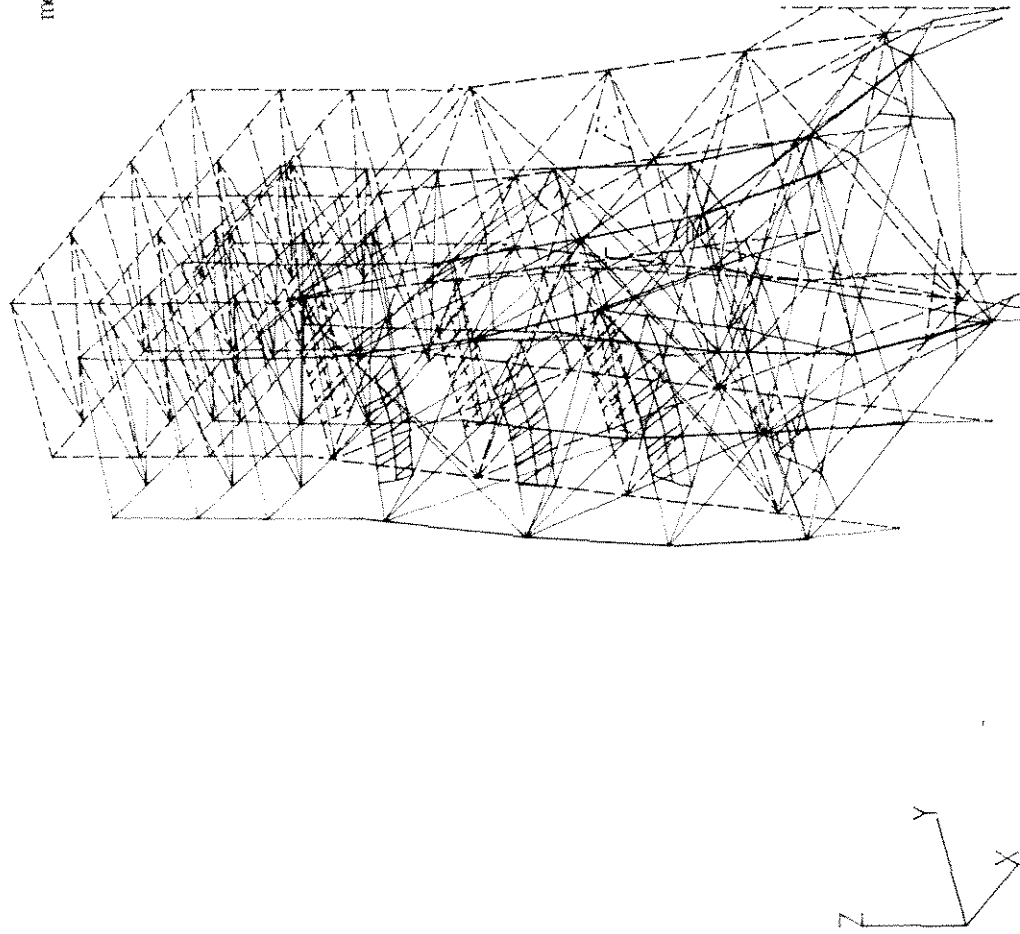


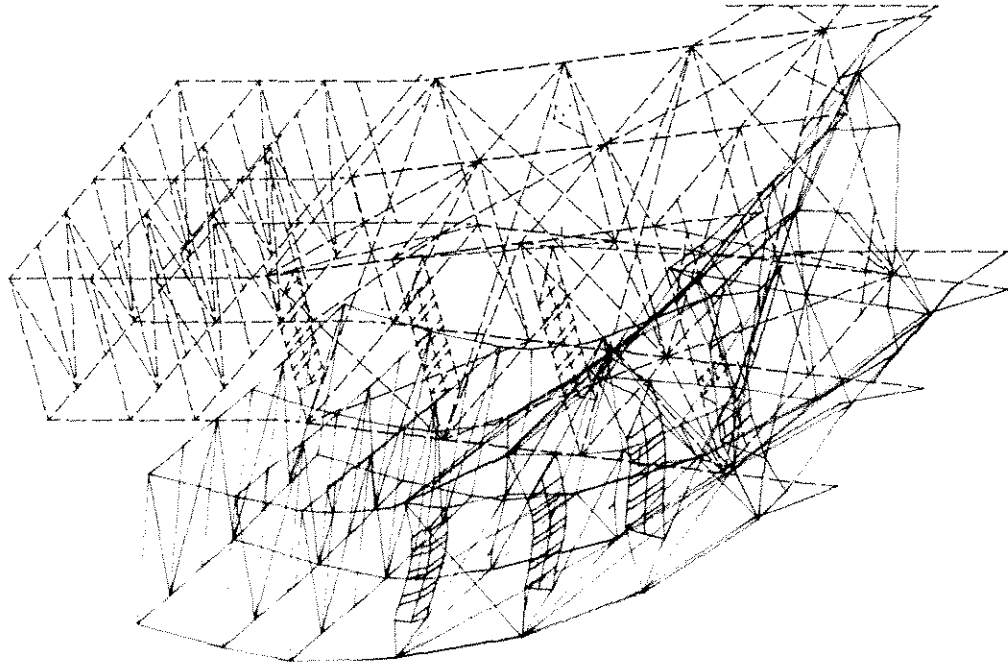
Figure b.3



NODAL DISP:310DEG COMB CASE. ENVIRONMETAL*1.7 MAX DISP=.39M

Figure b.4

member 65 fully released at end 1



NODAL DISP:310DEG COMB CASE. ENVIRONMENTAL*2.175 MAX DISP=.92M

Figure b.5

	MEMBER No.	STATION POSITION	CASE No.	INTERACTION	RATIO	C-T FLAG
	159	0.50	101	1.004	*	(C)
	165	0.75	101	1.003	*	(T)
	64	0.25	101	1.003	*	(C)
	91	0.00	101	1.003	*	(C)
	266	0.00	101	1.003	*	(T)
leg --->	250	0.50	101	1.003	*	(C)
member	78	0.50	101	1.003	*	(C)
	74	1.00	101	1.002	*	(T)
	231	0.75	101	1.002	*	(C)
	249	0.50	101	1.001	*	(C)
	280	0.00	101	1.001	*	(T)
	70	1.00	101	1.001	*	(T)
	256	0.50	101	1.001	*	(T)
	151	0.50	101	1.000	*	(T)
	41	1.00	101	0.999		(C)
	51	0.75	101	0.999		(C)
	47	0.00	101	0.999		(T)
	152	0.50	101	0.999		(C)
	9	0.00	101	0.999		(T)
	148	0.50	101	0.999		(C)
	233	0.75	101	0.998		(C)
	12	1.00	101	0.998		(T)
	225	0.50	101	0.997		(C)
	232	0.50	101	0.997		(C)
	153	0.25	101	0.995		(T)
	173	0.25	101	0.995		(C)
	150	0.75	101	0.995		(C)
	263	0.50	101	0.995		(C)
	144	0.25	101	0.994		(C)
	328	0.00	101	0.994		(C)
	279	1.00	101	0.992		(T)
	278	0.00	101	0.992		(T)
	77	0.50	101	0.989		(C)
	156	0.25	101	0.989		(C)
	320	1.00	101	0.988		(C)
	57	0.75	101	0.987		(C)
	143	0.50	101	0.986		(C)
	42	0.75	101	0.986		(C)
	147	0.75	101	0.985		(C)

MEMBER STRENGTH RESULTS FOR DAMAGED STRUCTURE.
 ENVIRONMENTAL LOADING * 2.175
 MEMBER 65 fully released at end 1.

JOINT NO.	BRACE NO.	CASE NO.	CLASSIFICATION			INTERACTION BENDING	RATIO OVERALL
			%K	%X	%YT		
89	71	101	72.7	9.7	17.6	0.012	1.001 **
146	172	101	59.8	0.0	40.2	0.015	0.999
159	280	101	0.0	0.0	100.0	0.969	0.999
89	165	101	88.0	12.0	0.0	0.076	0.985
161	282	101	0.0	0.0	100.0	0.000	0.982
135	171	101	56.9	0.0	43.1	0.047	0.981
32	74	101	37.8	0.0	62.2	0.012	0.978
37	52	101	0.0	27.0	73.0	0.790	0.975
36	53	101	0.0	0.0	100.0	0.764	0.973
157	278	101	0.0	0.0	100.0	0.977	0.955
158	279	101	0.0	0.0	100.0	0.889	0.948
40	52	101	0.0	0.0	100.0	0.709	0.927
37	48	101	0.0	100.0	0.0	0.939	0.916
183	312	101	78.4	0.0	21.6	0.453	0.850
142	239	101	0.0	0.0	100.0	0.873	0.850
87	74	101	68.1	0.0	31.9	0.025	0.845
41	53	101	0.0	0.0	100.0	0.418	0.801
14	71	101	44.6	0.0	55.4	0.002	0.793
10	64	101	27.9	0.0	72.1	0.022	0.789
150	165	101	64.4	0.0	35.6	0.052	0.768
89	159	101	100.0	0.0	0.0	0.032	0.762
162	249	101	48.0	0.0	52.0	0.057	0.758
10	70	101	39.5	0.0	60.5	0.000	0.741
160	281	101	0.0	0.0	100.0	0.818	0.740
146	164	101	64.5	0.0	35.5	0.009	0.740
186	322	101	0.0	29.8	70.2	0.141	0.738
186	256	101	60.9	0.0	39.1	0.034	0.736
197	263	101	0.0	0.0	100.0	0.084	0.719
89	78	101	100.0	0.0	0.0	0.012	0.717
64	151	101	90.0	0.0	10.0	0.007	0.713
195	259	101	54.6	0.0	45.4	0.037	0.700
135	256	101	100.0	0.0	0.0	0.021	0.695
99	170	101	88.3	0.0	11.7	0.016	0.688
219	363	101	0.0	99.9	0.1	0.233	0.665
189	320	101	0.0	0.0	100.0	0.171	0.654
30	37	101	0.0	0.0	100.0	0.090	0.649
135	233	101	95.3	0.0	4.7	0.136	0.643
219	362	101	0.0	100.0	0.0	0.204	0.642
148	241	101	0.0	0.0	100.0	0.396	0.640

JOINT STRENGTH RESULTS FOR DAMAGED STRUCTURE.
 ENVIRONMENTAL LOADING * 2.175
 MEMBER 65 fully released at end 1.

c) Results of collapse analysis

member 65 with yielding set to give an interaction ratio

of 0.75 at end 2 ie node 53

- i) Figure c.1: the lines and arrows in red indicate the axial and moments yield paths respectively.

An arrow indicates that a bending moment has reached yield at the member end. It does not differentiate between rotation about member local y or z or both. This information is available in Table c.1

- ii) Table c.1 lists the displacements and forces along the Yield Paths at member ends. Appendix B gives the member local y axis thus identifying the bending moments ROTY AND ROTZ. (Member local x direction is always along the length of the member).

- iii) Plots of undeformed and deformed structure at varying factors of

Figure c.2: wave and wind loading * 1.25

Figure c.3: " " " * 1.55

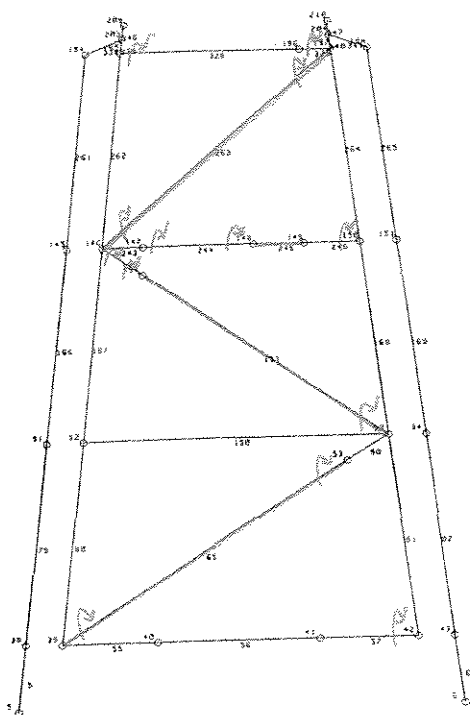
Figure c.4: " " " * 1.75

Figure c.5: " " " * 2.235

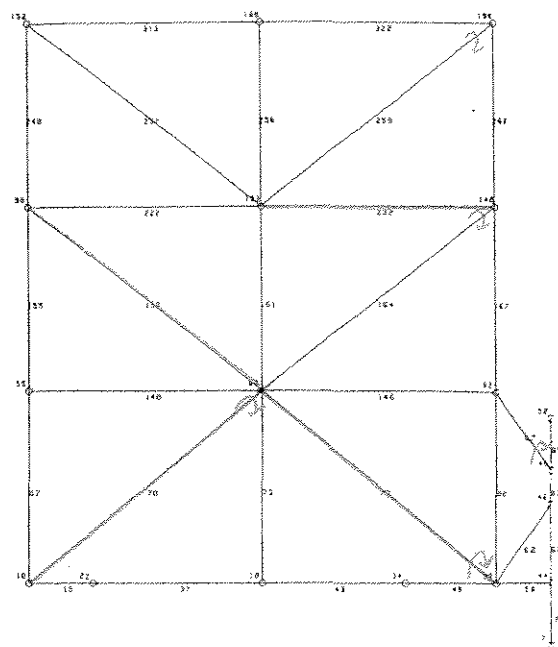
The deformations have been magnified by 40

- iv) Table c.2: Member strength result at wave and wind * 2.235

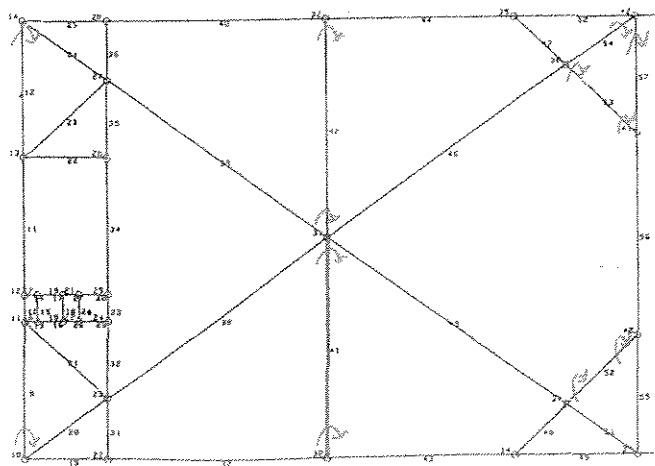
- v) Table c.3: Joint strength result at wave and wind * 2.235



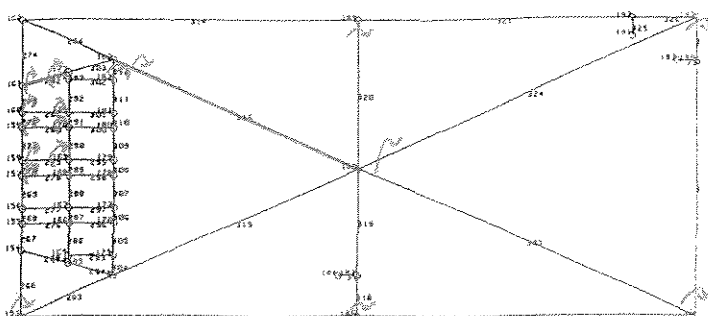
Row A



Row 2



El. -36.6



El. +6.0

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MODEL NAME: UM2PS1_15          Date: 10-DEC-93      Page No: 1
- DAMAGED STRUCTURE STRESS ANALYSIS -
Details of damage in file name: X57
Loading from Combination load file name: X56$D
Card title: 310 DEG STORM 2.235 * WAVE&WIND

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DISPLACEMENTS AND FORCES ALONG YIELD PATHS AT MEMBER ENDS

*** against stress indicates accuracy of 5 sig figs not obtained
 *** against deflections indicates that plastic yielding direction is suspect

Member No	Node No	Dof	Displacement or rotation		Force or Moment	
			Joint	Member end	Required	Achieved
241	148	ROTY	0.3421E-01	0.3646E-01	0.2300E+03	0.2300E+03
282	161	DISPX	0.2543E-01	0.1255E-01	-0.7850E+03	-0.7850E+03
282	161	ROTY	0.4857E-02	-0.6766E-02	0.8500E+02	0.8500E+02
282	173	ROTY	0.3794E-02	0.5902E-03	-0.5750E+03	-0.5750E+03
225	129	DISPX	0.4436E+00	0.4318E+00	-0.1150E+04	-0.1150E+04
225	129	ROTZ	-0.7935E-02	-0.1373E-02	0.4000E+02	0.4000E+02
77	39	DISPX	-0.9374E-01	-0.1398E+00	-0.6945E+04	-0.6945E+04
77	39	ROTY	0.4299E-02	0.3517E-02	0.1700E+03	0.1700E+03
87	48	ROTZ	-0.1486E-01	-0.1296E-01	0.3385E+04	0.3385E+04
65	39	DISPX	-0.1286E+00	-0.3077E+00	-0.7500E+04	-0.7500E+04
65	39	ROTY	-0.1550E-01	-0.1182E-01	-0.9200E+03	-0.9200E+03
65	53	ROTY	-0.1418E-01	0.2939E-02	0.2300E+03	0.2300E+03
65	53	ROTZ	0.8910E-02	-0.6190E-05	0.1350E+03	0.1350E+03
78	42	DISPX	-0.4787E-01	-0.8381E-01	-0.6155E+04	-0.6155E+04
78	42	ROTZ	-0.1718E-01	-0.1666E-01	0.1050E+03	0.1050E+03
281	160	ROTY	0.6265E-02	-0.1457E-02	0.1750E+03	0.1750E+03
281	171	ROTY	0.7080E-02	0.6832E-03	-0.1850E+03	-0.1850E+03
64	10	DISPX	-0.1413E+00	-0.3224E+00	-0.9575E+04	-0.9575E+04
64	10	ROTY	-0.1709E-01	-0.4966E-02	-0.2000E+02	-0.2000E+02
64	52	ROTY	-0.1542E-01	-0.1878E-02	0.4000E+02	0.4000E+02
263	146	DISPX	-0.3930E+00	-0.5725E+00	-0.3940E+04	-0.3940E+04
263	146	ROTZ	-0.1381E-02	-0.7038E-02	-0.3500E+03	-0.3500E+03
263	197	ROTY	-0.7898E-02	-0.3887E-02	0.1450E+04	0.1450E+04
263	197	ROTZ	0.6397E-02	0.6884E-02	-0.2000E+02	-0.2000E+02
280	159	ROTY	0.6056E-02	-0.8587E-03	0.1900E+03	0.1900E+03
280	170	ROTY	0.5791E-02	0.1315E-02	-0.2000E+03	-0.2000E+03
244	147	ROTY	-0.8855E-02	0.8265E-02	-0.2100E+03	-0.2100E+03
244	147	ROTZ	-0.3248E-02	-0.3562E-01	-0.1600E+03	-0.1600E+03
244	148	ROTZ	0.3421E-01	-0.2868E-01	0.3100E+03	0.3100E+03
42	31	ROTY	0.2672E-03	0.6571E-03	-0.1500E+02	-0.1500E+02
42	32	ROTY	-0.1493E-01	0.3160E-03	0.5000E+02	0.5000E+02
143	85	DISPX	0.3417E+00	0.3246E+00	-0.9400E+03	-0.9400E+03
143	85	ROTZ	-0.8021E-02	-0.5977E-02	0.3000E+02	0.3000E+02
152	87	DISPX	-0.2850E+00	-0.4798E+00	-0.6665E+04	-0.6665E+04
152	87	ROTY	-0.1595E-01	-0.8184E-02	-0.3900E+03	-0.3900E+03
152	96	ROTY	-0.8728E-02	-0.1551E-02	0.4400E+03	0.4400E+03
41	30	DISPX	-0.1175E+00	-0.1402E+00	-0.3260E+04	-0.3260E+04
41	30	ROTY	-0.1474E-01	-0.6366E-02	-0.7500E+02	-0.7500E+02
41	31	ROTY	0.2672E-03	-0.2052E-02	-0.7500E+02	-0.7500E+02
144	87	DISPX	-0.3360E+00	-0.3669E+00	-0.2030E+04	-0.2030E+04
144	87	ROTY	-0.1595E-01	0.7069E-02	-0.1450E+03	-0.1450E+03
144	88	ROTY	-0.4147E-02	0.1016E-01	0.8000E+02	0.8000E+02
54	42	ROTZ	-0.9736E-02	-0.8077E-02	-0.7700E+03	-0.7700E+03
316	183	DISPX	0.4935E+00	0.4782E+00	-0.1600E+03	-0.1600E+03
316	183	ROTZ	-0.2776E-02	-0.6904E-04	0.7000E+02	0.7000E+02
232	132	DISPX	0.2102E+00	0.1925E+00	-0.4135E+04	-0.4135E+04
246	150	ROTY	-0.1144E-01	-0.4174E-02	0.3650E+03	0.3650E+03
246	150	ROTZ	0.1294E-01	0.3337E-01	-0.4200E+03	-0.4200E+03
231	134	ROTY	-0.2314E-03	-0.1346E-01	0.9250E+03	0.9250E+03
231	139	ROTY	0.3781E-01	0.9404E-02	-0.9250E+03	-0.9250E+03


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MODEL NAME: UM2PS1_15                      Date: 10-DEC-93      Page No: 2
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- DAMAGED STRUCTURE STRESS ANALYSIS -
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Details of damage in file name: X57
Loading from Combination load file name: X56$D
Card title: 310 DEG STORM 2.235 * WAVE&WIND
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DISPLACEMENTS AND FORCES ALONG YIELD PATHS AT MEMBER ENDS

*** against stress indicates accuracy of 5 sig figs not obtained
 *** against deflections indicates that plastic yielding direction is suspect

	Member No	Node No	Dof	Displacement or rotation		Force or Moment	
				Joint	Member end	Required	Achieved
	279	158	ROTY	0.3376E-02	-0.1732E-02	0.1700E+03	0.1700E+03
	279	169	ROTY	0.2744E-02	0.1706E-02	-0.1950E+03	-0.1950E+03
	53	36	ROTY	-0.5752E-02	-0.2536E-02	-0.1300E+03	-0.1300E+03
	53	41	ROTZ	-0.3777E-02	-0.5376E-02	0.1600E+03	0.1600E+03
***	172	146	ROTY	-0.1168E-01	0.3968E-02	0.1000E+02	0.1000E+02***
	172	146	ROTZ	-0.1678E-02	0.6334E-02	-0.1000E+02	-0.1000E+02
	230	134	DISPX	0.4297E+00	0.4091E+00	-0.1375E+04	-0.1375E+04
	230	134	ROTZ	0.5215E-02	0.1051E-01	0.4000E+02	0.4000E+02
	230	137	ROTZ	-0.4625E-02	0.1238E-01	-0.5000E+01	-0.5000E+01
	249	99	DISPX	-0.4284E+00	-0.5910E+00	-0.5520E+04	-0.5520E+04
***	249	99	ROTY	-0.1144E-01	-0.1683E-02	-0.5000E+01	-0.5000E+01***
	249	99	ROTZ	-0.2751E-02	-0.5403E-02	-0.1000E+03	-0.1000E+03
	249	162	ROTY	-0.7616E-02	-0.1778E-03	0.1000E+03	0.1000E+03
	249	162	ROTZ	-0.1461E-02	0.3286E-02	-0.2500E+03	-0.2500E+03
	52	37	ROTY	-0.8189E-02	-0.4361E-02	-0.8000E+02	-0.8000E+02
	52	40	ROTZ	-0.1471E-02	-0.2816E-03	-0.1000E+03	-0.1000E+03
	153	93	DISPX	0.2807E+00	0.4275E+00	0.8850E+04	0.8850E+04
	153	93	ROTY	-0.1531E-01	-0.1038E-01	-0.3600E+03	-0.3600E+03
	256	135	DISPX	0.4039E+00	0.5511E+00	0.6905E+04	0.6905E+04
	256	135	ROTY	-0.1158E-01	-0.9790E-02	-0.2700E+03	-0.2700E+03
	256	135	ROTZ	-0.2537E-02	-0.5785E-02	-0.2400E+03	-0.2400E+03
	256	186	ROTY	-0.7441E-02	0.5619E-02	0.2200E+03	0.2200E+03
	256	186	ROTZ	-0.1308E-02	0.2769E-02	-0.2500E+03	-0.2500E+03
	151	64	DISPX	0.3415E+00	0.4908E+00	0.1002E+05	0.1002E+05
	151	64	ROTY	-0.1566E-01	-0.9655E-02	-0.4850E+03	-0.4850E+03
	151	64	ROTZ	-0.2287E-02	-0.4017E-02	-0.3050E+03	-0.3050E+03
	151	95	ROTY	-0.7727E-02	0.1191E-02	0.5150E+03	0.5150E+03
	70	10	DISPX	0.6048E-01	0.6468E-01	0.9955E+04	0.9955E+04
	70	87	ROTY	0.4187E-02	0.2547E-02	-0.2900E+03	-0.2900E+03
	70	87	ROTZ	-0.9932E-02	-0.4736E-02	-0.2150E+03	-0.2150E+03
	147	88	ROTZ	-0.5170E-02	0.5196E-02	0.5000E+02	0.5000E+02
	147	92	ROTZ	-0.8459E-02	0.4416E-02	-0.1500E+03	-0.1500E+03
	74	32	DISPX	0.1383E+00	0.2574E+00	0.1084E+05	0.1084E+05
	74	87	ROTY	-0.1595E-01	-0.5936E-02	0.1255E+04	0.1255E+04
	245	148	DISPX	-0.5309E+00	-0.5439E+00	-0.1775E+04	-0.1775E+04
	233	135	DISPX	0.1936E+00	0.1901E+00	-0.3705E+04	-0.3705E+04
	233	150	ROTZ	0.1273E-01	0.8439E-02	0.2000E+02	0.2000E+02
	173	99	ROTY	-0.1144E-01	0.1985E-02	-0.8150E+03	-0.8150E+03
	57	42	ROTY	-0.1588E-01	-0.9625E-02	0.5950E+03	0.5950E+03
	164	146	ROTY	0.2499E-02	0.5851E-03	-0.3200E+03	-0.3200E+03
	259	195	ROTZ	-0.4473E-02	-0.3078E-02	-0.4600E+03	-0.4600E+03
	318	186	ROTY	-0.7441E-02	0.1582E-02	-0.7700E+03	-0.7700E+03
	320	189	ROTY	-0.8088E-02	-0.4359E-02	0.1115E+04	0.1115E+04
	278	157	ROTY	0.1563E-02	-0.2137E-03	0.1950E+03	0.1950E+03
	227	132	ROTY	-0.1301E-01	-0.7712E-02	-0.1335E+04	-0.1335E+04
	324	188	ROTY	-0.9081E-04	-0.1671E-02	0.8650E+03	0.8650E+03
	266	153	ROTY	-0.7808E-02	-0.4443E-02	-0.1555E+04	-0.1555E+04
	12	14	ROTY	0.1767E-01	0.1562E-01	-0.8300E+03	-0.8300E+03
	158	87	DISPX	-0.1589E+00	-0.1616E+00	-0.5265E+04	-0.5265E+04
	180	107	ROTY	-0.1694E-02	-0.1272E-04	0.6600E+03	0.6600E+03

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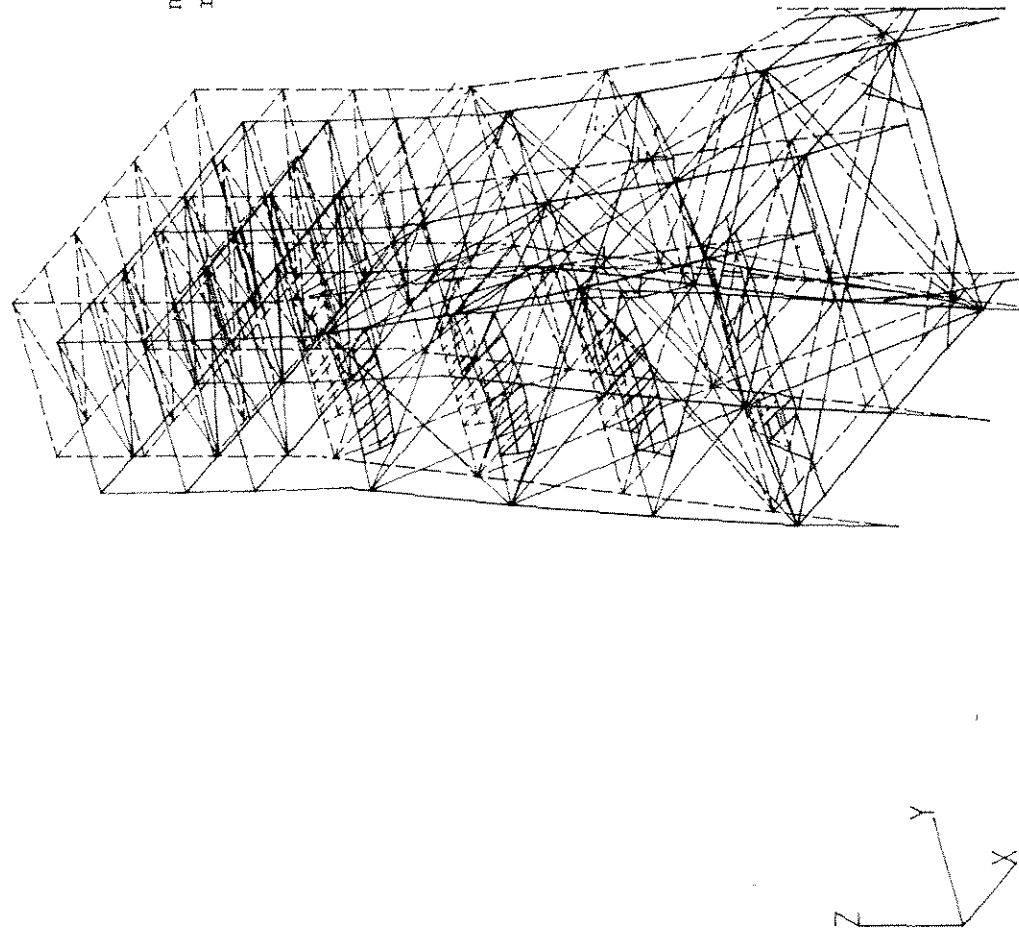
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Loading from Combination load file name: X56$D
Card title: 310 DEG STORM  2.235 * WAVE&WIND
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DISPLACEMENTS AND FORCES ALONG YIELD PATHS AT MEMBER ENDS

*** against stress indicates accuracy of 5 sig figs not obtained
 *** against deflections indicates that plastic yielding direction is suspect

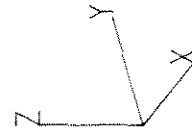
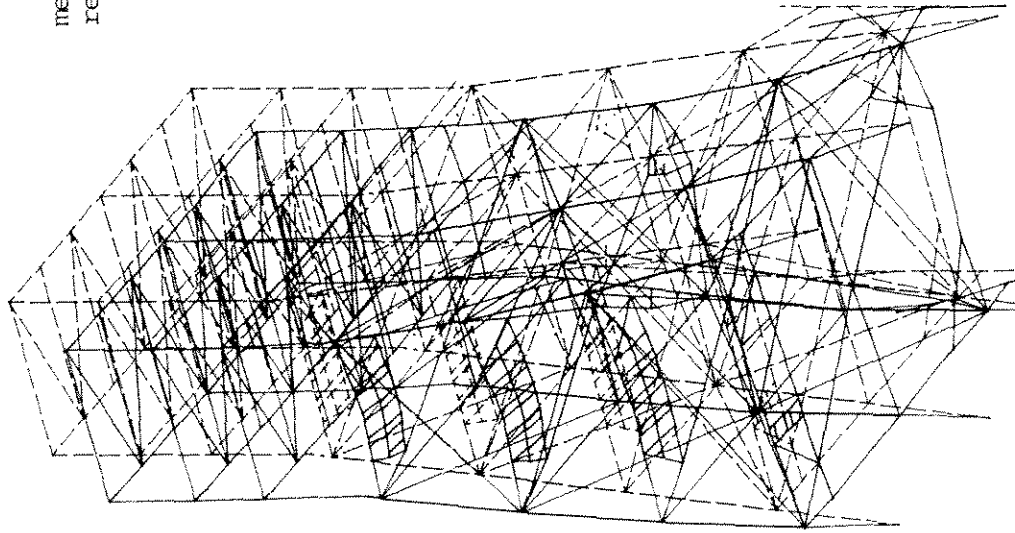
Member No	Node No	Dof	Displacement or rotation		Force or Moment	
			Joint	Member end	Required	Achieved
9	10	ROTY	0.1709E-01	0.1630E-01	0.8900E+03	0.8900E+03
274	162	ROTY	-0.7616E-02	-0.7337E-02	0.1230E+04	0.1230E+04
329	197	ROTY	-0.7898E-02	-0.6305E-02	0.1580E+04	0.1580E+04
328	195	ROTY	-0.9016E-02	-0.7178E-02	-0.1420E+04	-0.1420E+04
312	183	ROTY	0.1355E-02	0.1667E-02	0.4650E+03	0.4650E+03
145	89	ROTY	-0.1468E-01	-0.1450E-01	0.1800E+03	0.1800E+03



NODAL DISP:310DEG COMB CASE. ENVIRONMENTAL*1.25 MAX DISP=.16M

member 65 interaction ratio
restricted to 0.75 at end 2

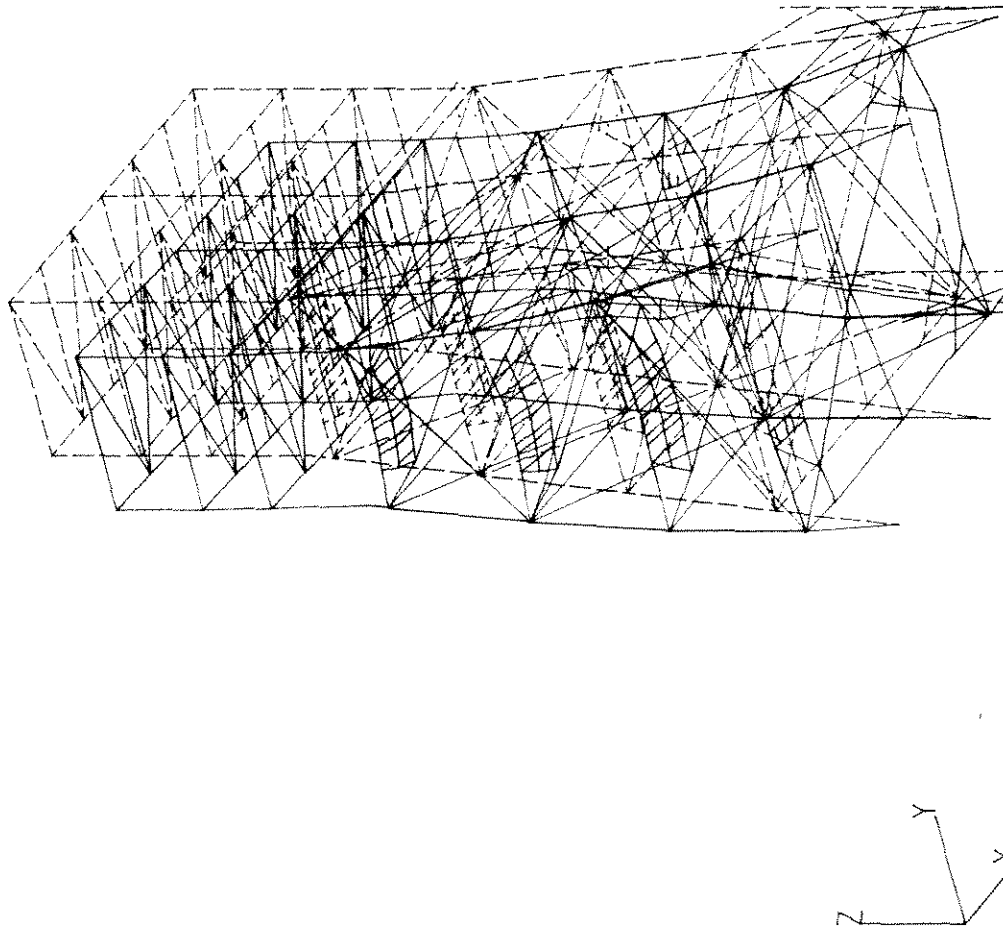
Figure c.2



member 65 interaction ratio
restricted to 0.75 at end 2

NODAL DISP:310DEG COMB CASE. ENVIRONMENTAL*1.55 MAX DISP=.21M

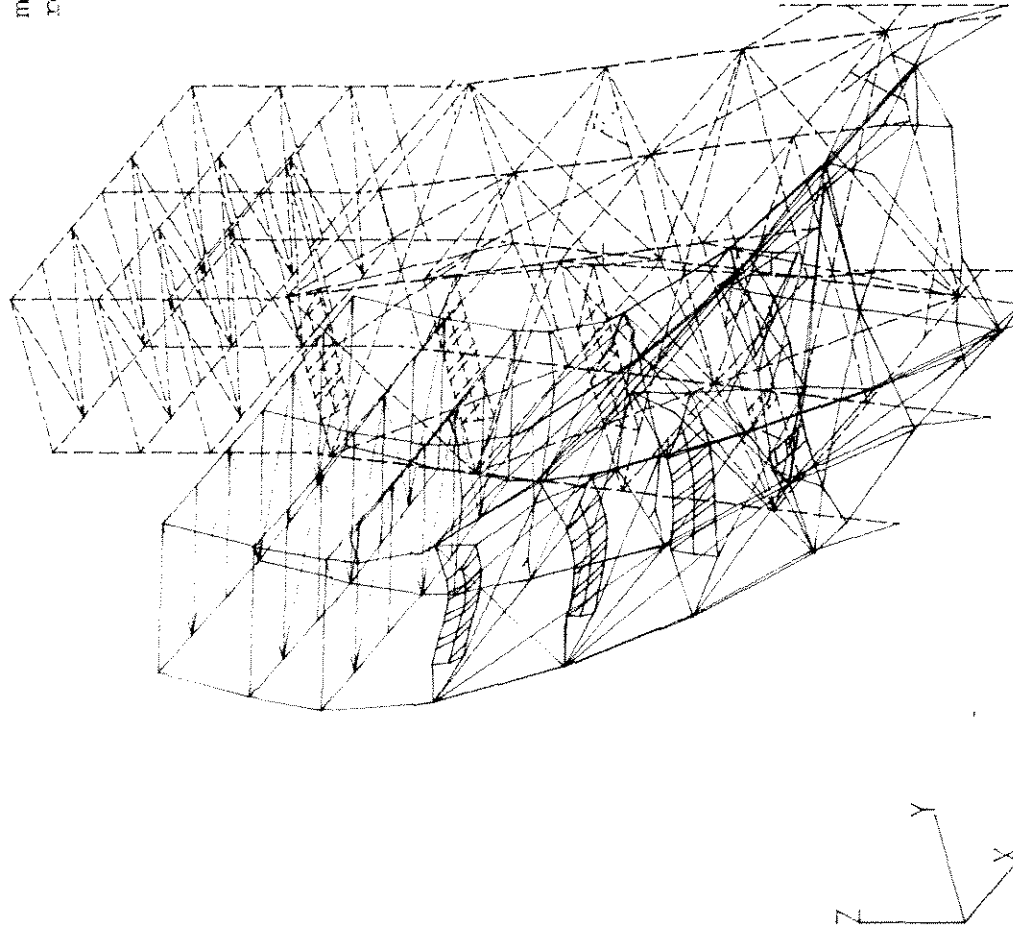
Figure c.3



NODAL DISP:310DEG COMB CASE. ENVIRONMENTAL*1.75 MAX DISP=.25M

member 65 interaction ratio
restricted to 0.75 at end 2

Figure c.4



member 65 interaction ratio
restricted to 0.75 at end 2

NODAL DISP:310DEG COMB CASE. ENVIRONMENTAL*2.235 MAX DISP=.78M

Figure c.5

	MEMBER No.	STATION POSITION	CASE No.	INTERACTION	RATIO	C-T FLAG
	233	0.50	101	1.004	*	(C)
	65	0.25	101	1.004	*	(C)
	64	0.50	101	1.004	*	(C)
	78	0.25	101	1.003	*	(C)
	153	0.50	101	1.003	*	(T)
	54	1.00	101	1.002	*	(T)
	328	0.00	101	1.001	*	(C)
	151	0.50	101	1.001	*	(T)
	152	0.50	101	1.000	*	(C)
	249	0.50	101	1.000		(C)
	245	1.00	101	1.000		(C)
leg --->	250	0.75	101	0.999		(C)
member	274	1.00	101	0.999		(T)
	70	0.50	101	0.999		(T)
	9	0.00	101	0.997		(T)
	256	0.50	101	0.997		(T)
	12	1.00	101	0.996		(T)
	57	1.00	101	0.996		(T)
	147	0.25	101	0.995		(C)
	230	0.25	101	0.994		(C)
	164	1.00	101	0.994		(T)
	329	1.00	101	0.994		(C)
	41	0.50	101	0.994		(C)
	145	0.75	101	0.993		(C)
	87	0.00	101	0.992		(C)
	263	0.50	101	0.991		(C)
	259	1.00	101	0.991		(T)
	158	0.50	101	0.991		(C)
	320	1.00	101	0.990		(C)
	280	1.00	101	0.990		(T)
	77	0.25	101	0.988		(C)
	312	1.00	101	0.986		(T)
	266	0.00	101	0.986		(C)
	281	1.00	101	0.985		(C)
	279	1.00	101	0.983		(T)
	324	0.00	101	0.983		(T)
	74	0.00	101	0.981		(T)
	232	0.50	101	0.980		(C)
	301	0.00	101	0.979		(C)

MEMBER STRENGTH RESULTS FOR DAMAGED STRUCTURE.
 ENVIRONMENTAL LOADING * 2.235
 MEMBER 65 Restricted to an
 Interaction Ratio of 0.75

JOINT NO.	BRACE NO.	CASE NO.	CLASSIFICATION			INTERACTION BENDING	RATIO OVERALL
			%K	%X	%YT		
161	282	101	0.0	0.0	100.0	0.150	1.000
32	74	101	43.2	0.0	56.8	0.057	0.998
40	52	101	0.0	0.0	100.0	0.770	0.994
41	53	101	0.0	0.0	100.0	0.881	0.981
37	52	101	0.0	9.0	91.0	0.782	0.975
158	279	101	0.0	0.0	100.0	0.887	0.970
36	53	101	0.0	0.0	100.0	0.878	0.949
157	278	101	0.0	0.0	100.0	0.969	0.941
160	281	101	0.0	0.0	100.0	0.893	0.938
159	280	101	0.0	0.0	100.0	0.914	0.935
146	172	101	57.2	0.0	42.8	0.000	0.927
135	171	101	67.1	0.0	32.9	0.048	0.926
89	71	101	79.7	0.0	20.3	0.011	0.901
173	293	101	0.0	0.0	100.0	0.950	0.898
10	70	101	42.9	0.0	57.1	0.004	0.879
89	165	101	100.0	0.0	0.0	0.055	0.876
10	64	101	26.7	0.0	73.3	0.005	0.859
183	312	101	76.6	0.0	23.4	0.462	0.856
146	164	101	59.4	0.0	40.6	0.016	0.818
46	60	101	0.0	0.0	100.0	0.030	0.795
87	74	101	70.6	0.0	29.4	0.023	0.793
37	48	101	0.0	100.0	0.0	0.856	0.778
89	78	101	97.0	0.0	3.0	0.030	0.772
186	322	101	0.0	31.8	68.2	0.117	0.766
89	159	101	100.0	0.0	0.0	0.031	0.741
195	259	101	56.9	0.0	43.1	0.047	0.733
189	320	101	0.0	0.0	100.0	0.140	0.730
30	37	101	0.0	0.0	100.0	0.062	0.724
172	302	101	0.0	0.0	100.0	0.536	0.707
64	89	101	98.2	0.0	1.8	0.007	0.697
14	71	101	52.5	0.0	47.5	0.001	0.696
64	151	101	100.0	0.0	0.0	0.006	0.685
142	239	101	0.0	0.0	100.0	0.661	0.680
135	256	101	100.0	0.0	0.0	0.008	0.665
197	263	101	0.0	0.0	100.0	0.093	0.659
186	256	101	58.4	0.0	41.6	0.010	0.658
99	170	101	86.8	0.0	13.2	0.018	0.657
32	40	101	0.0	6.9	93.1	0.012	0.655
150	165	101	67.3	0.0	32.7	0.018	0.654

JOINT STRENGTH RESULTS FOR DAMAGED STRUCTURE.
 ENVIRONMENTAL LOADING * 2.235
 MEMBER 65 Restricted to an
 Interaction Ratio of 0.75

OBSERVATIONS AND FURTHER WORK ON PLATFORM No 3

The deterministic collapse analyses so far performed on this platform have involved over 120 axial and moment restrictions see Tables a.1, b.1 and c.1.

Although member 65 is a leading diagonal in Row A and therefore constitutes a major member, its total release at end one reduces the final factor on the environmental loading from 2.245 with all members fully effective to 2.175, whilst restricting it at end two to an interaction ratio of 0.75 results in a final factor of 2.235.

Two further analyses are almost complete. They are member 65 restricted to an interaction ratio of 0.5 at end 2 and a major horizontal brace fully released at end one.

APPENDIX A: FINITE ELEMENT MODEL.

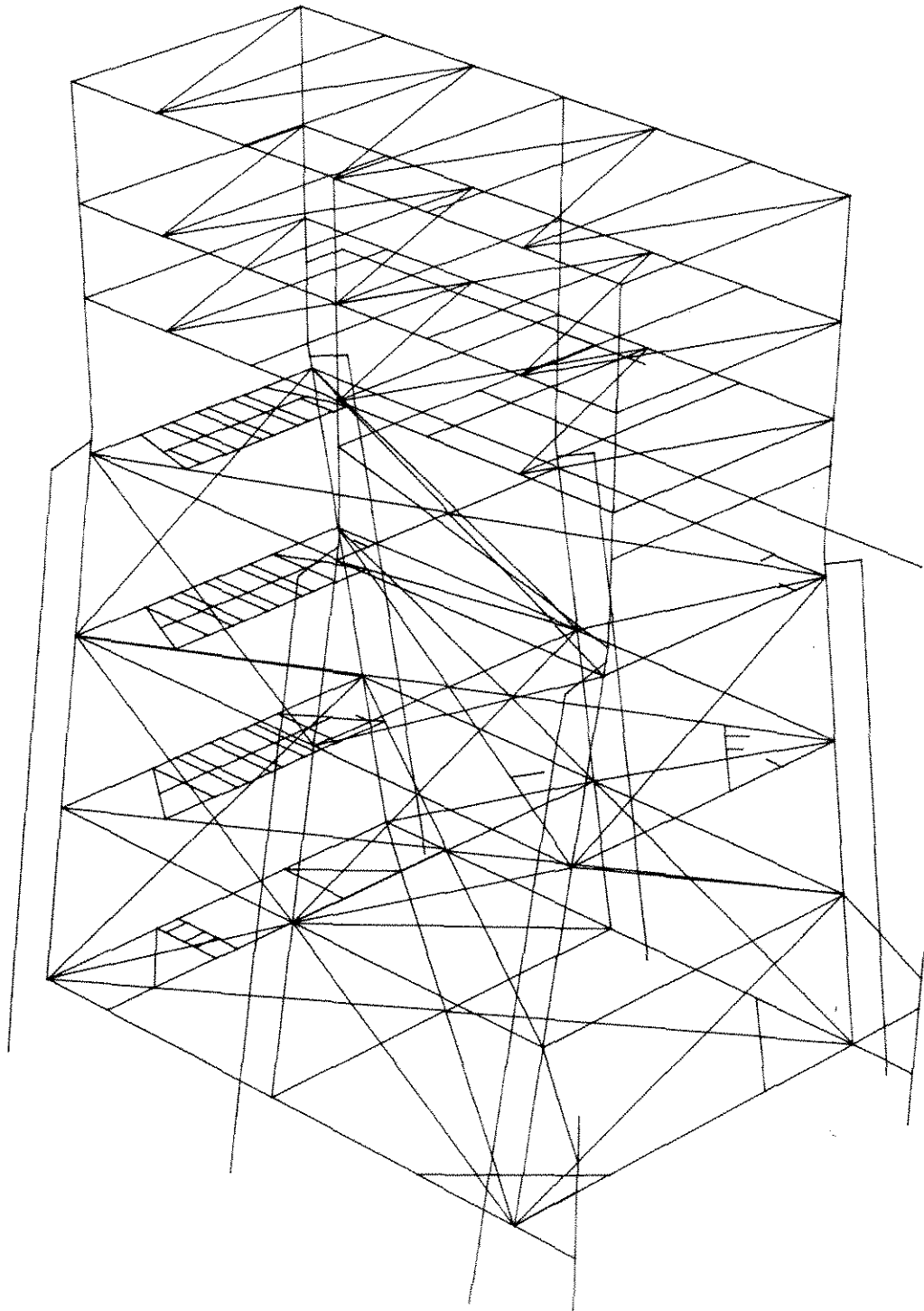


FIGURE R 1

UMH :

ROW A

STRUCTURAL PLOT

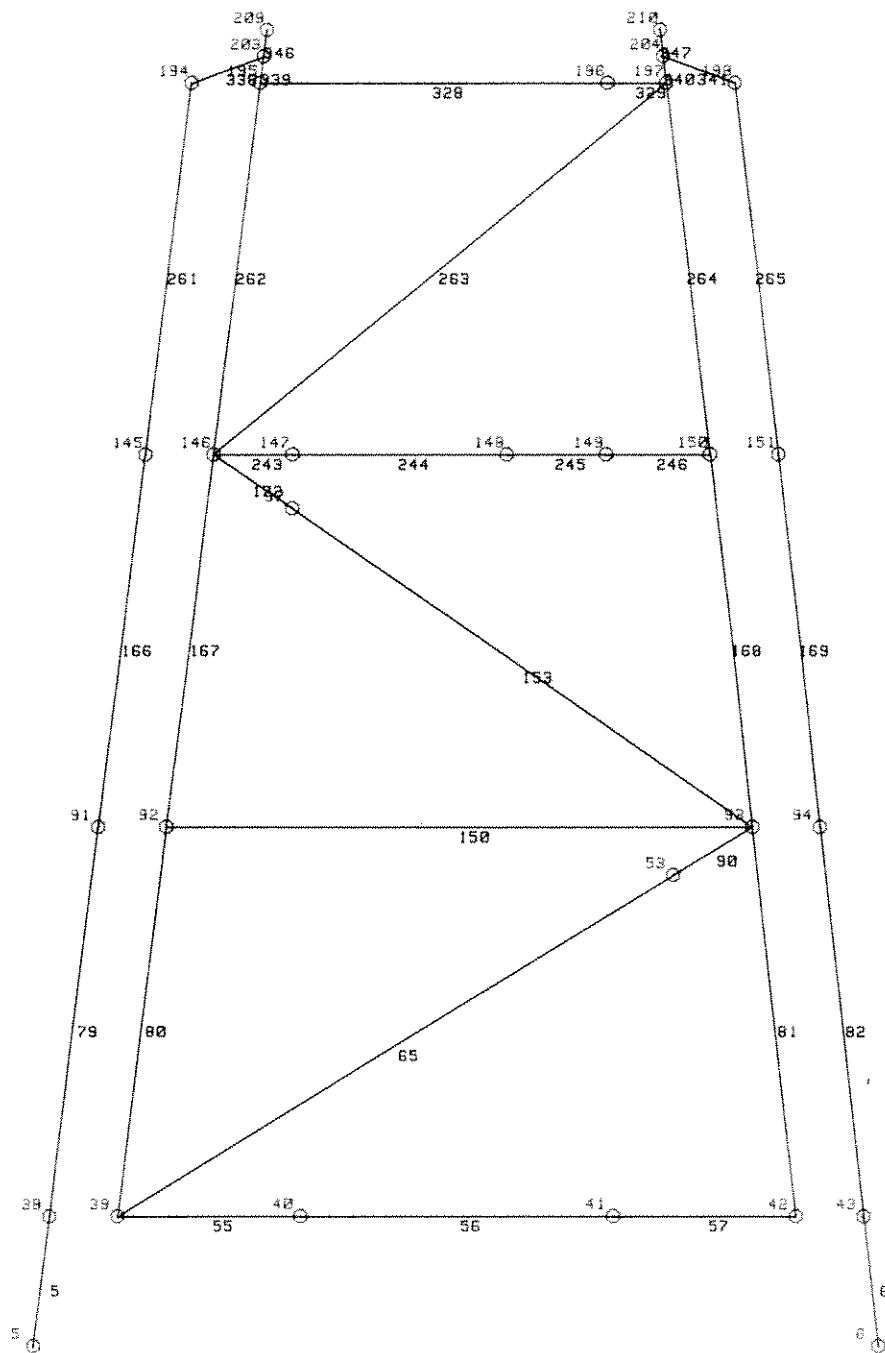


FIGURE A 2

UMH :

STRUCTURAL PLOT

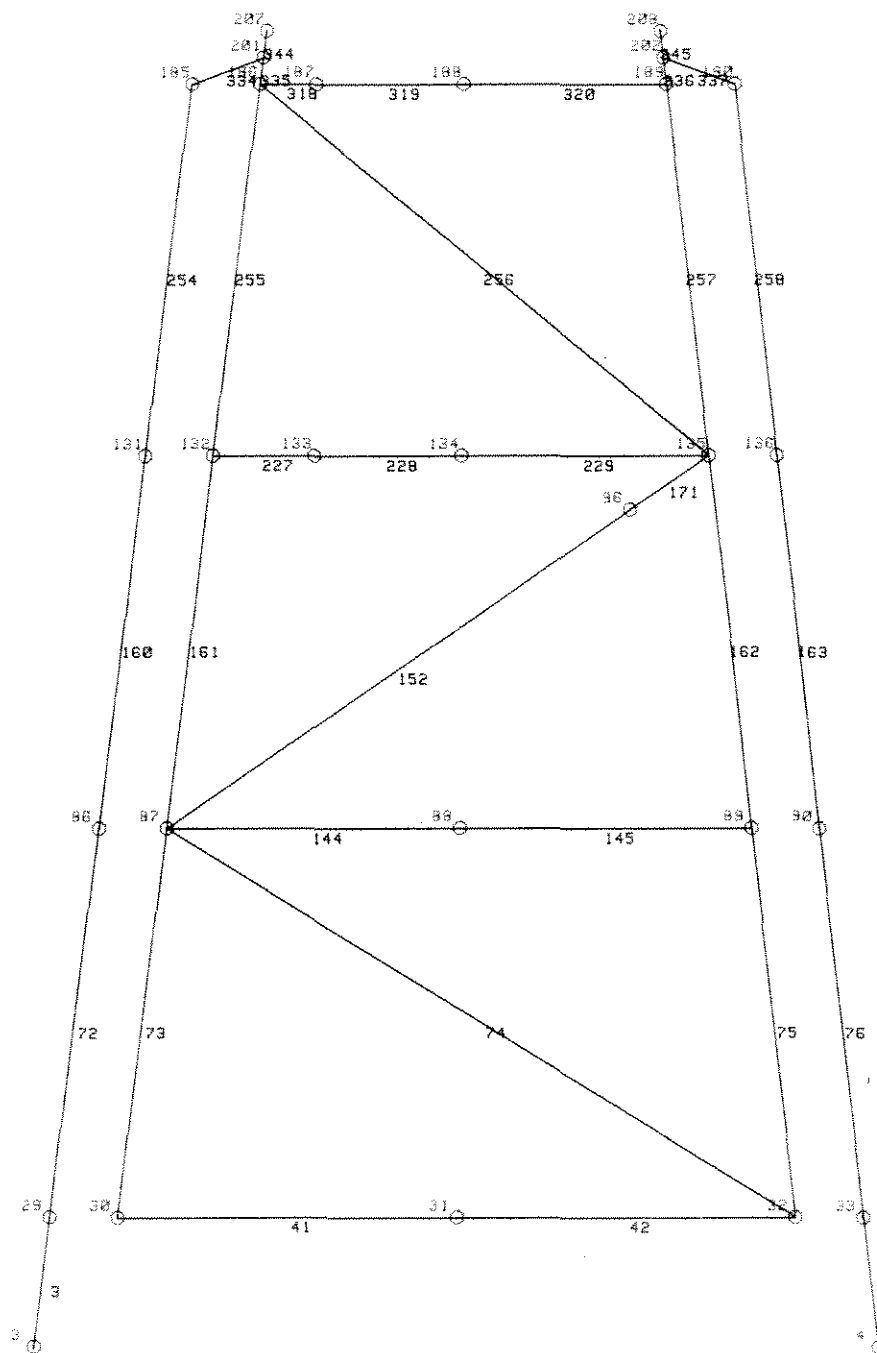


FIGURE A 3



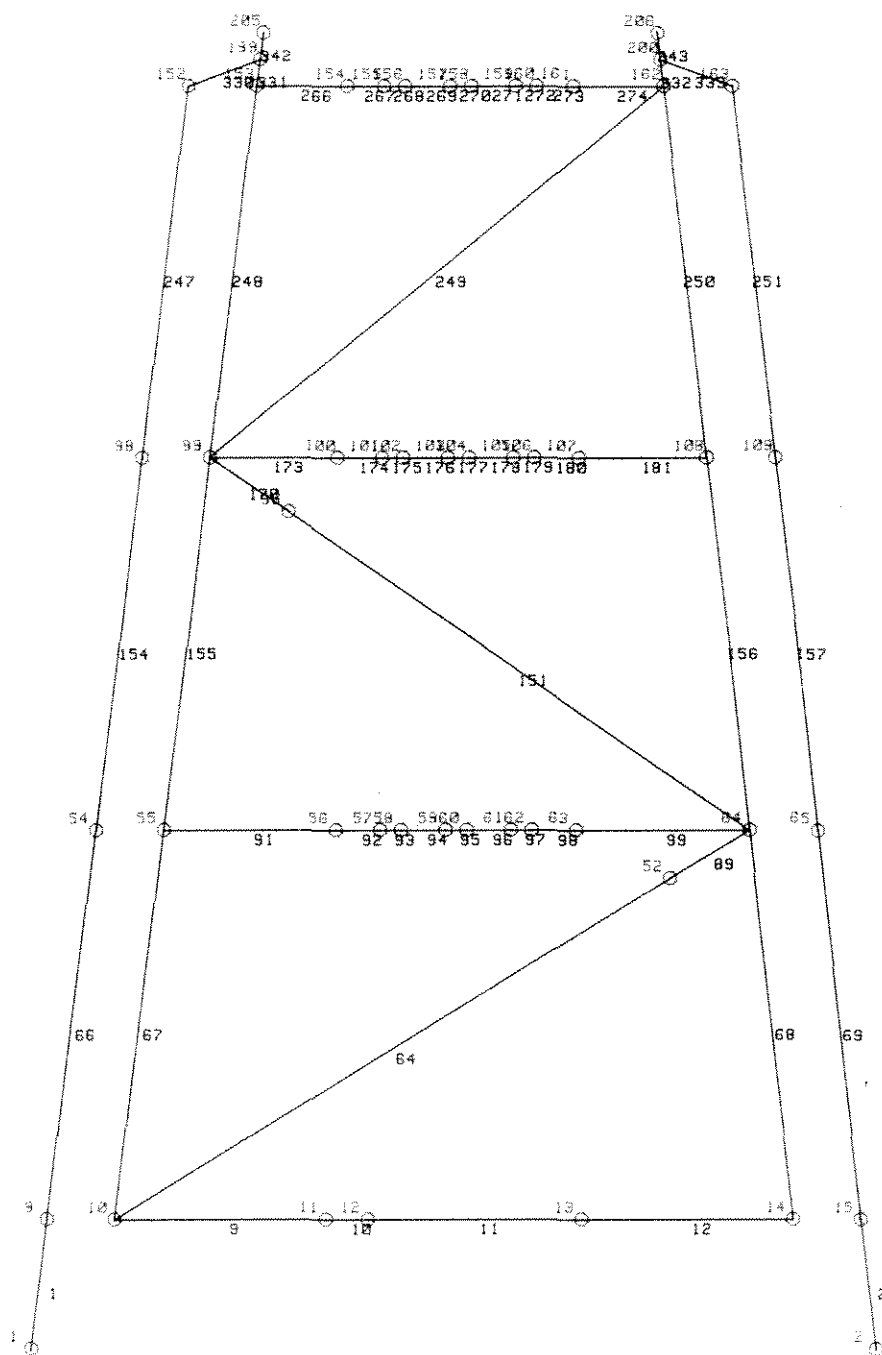


FIGURE A 4

UMH :

ROW 1

STRUCTURAL PLOT

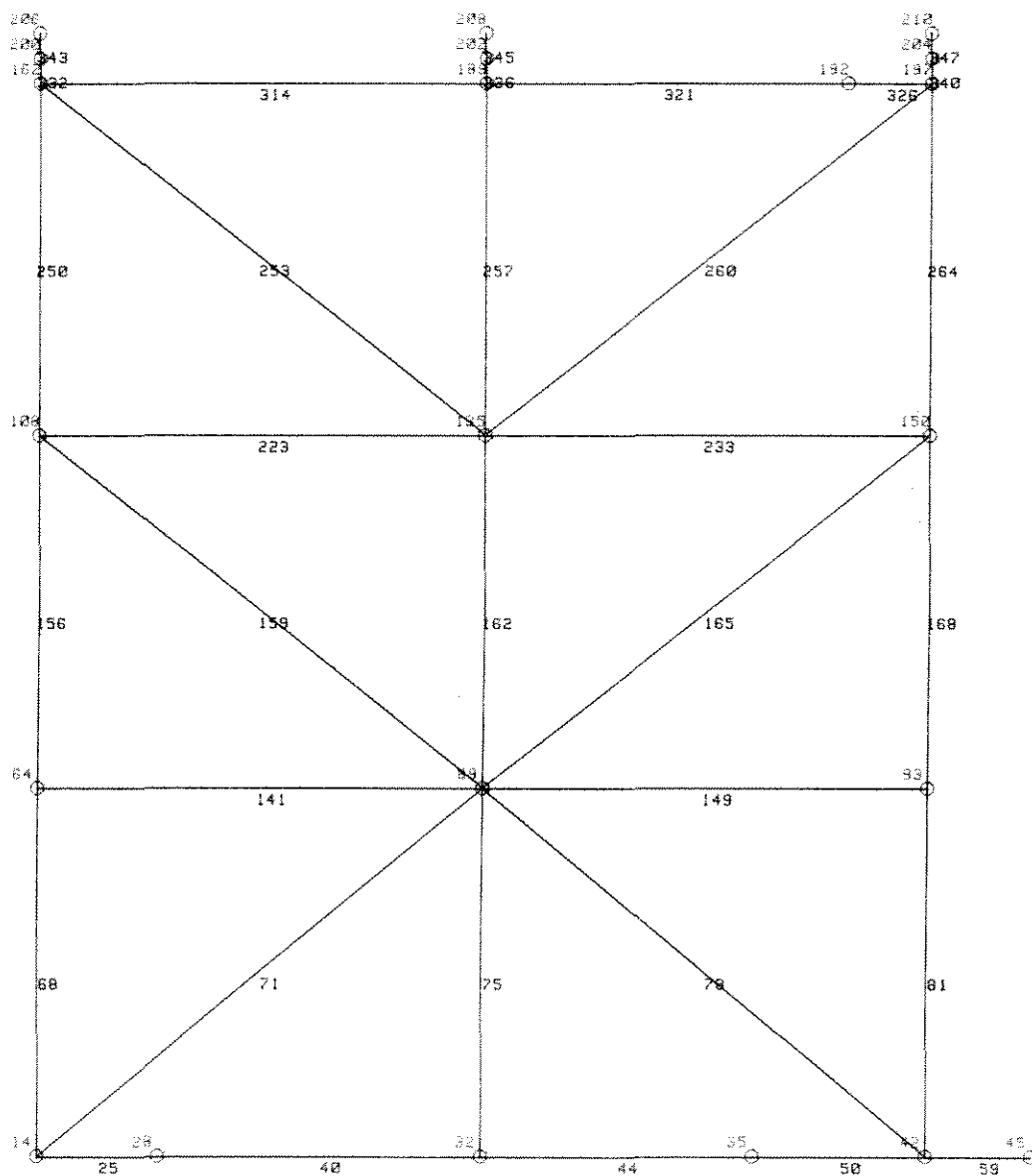


FIGURE A 5

UMH :

ROW 2

STRUCTURAL PLOT

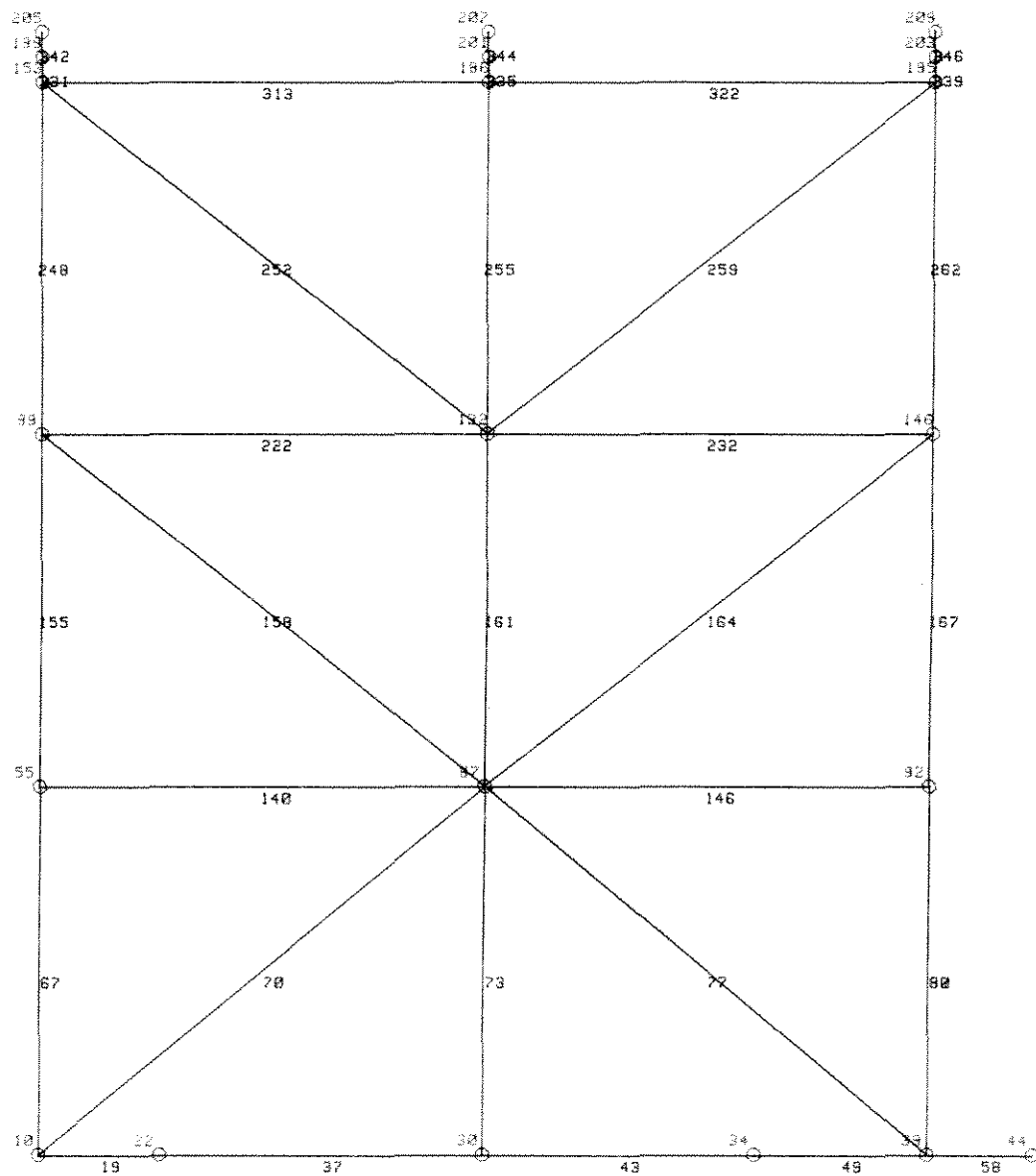


FIGURE A 6

UMH :

EL. -36.6

STRUCTURAL PLOT

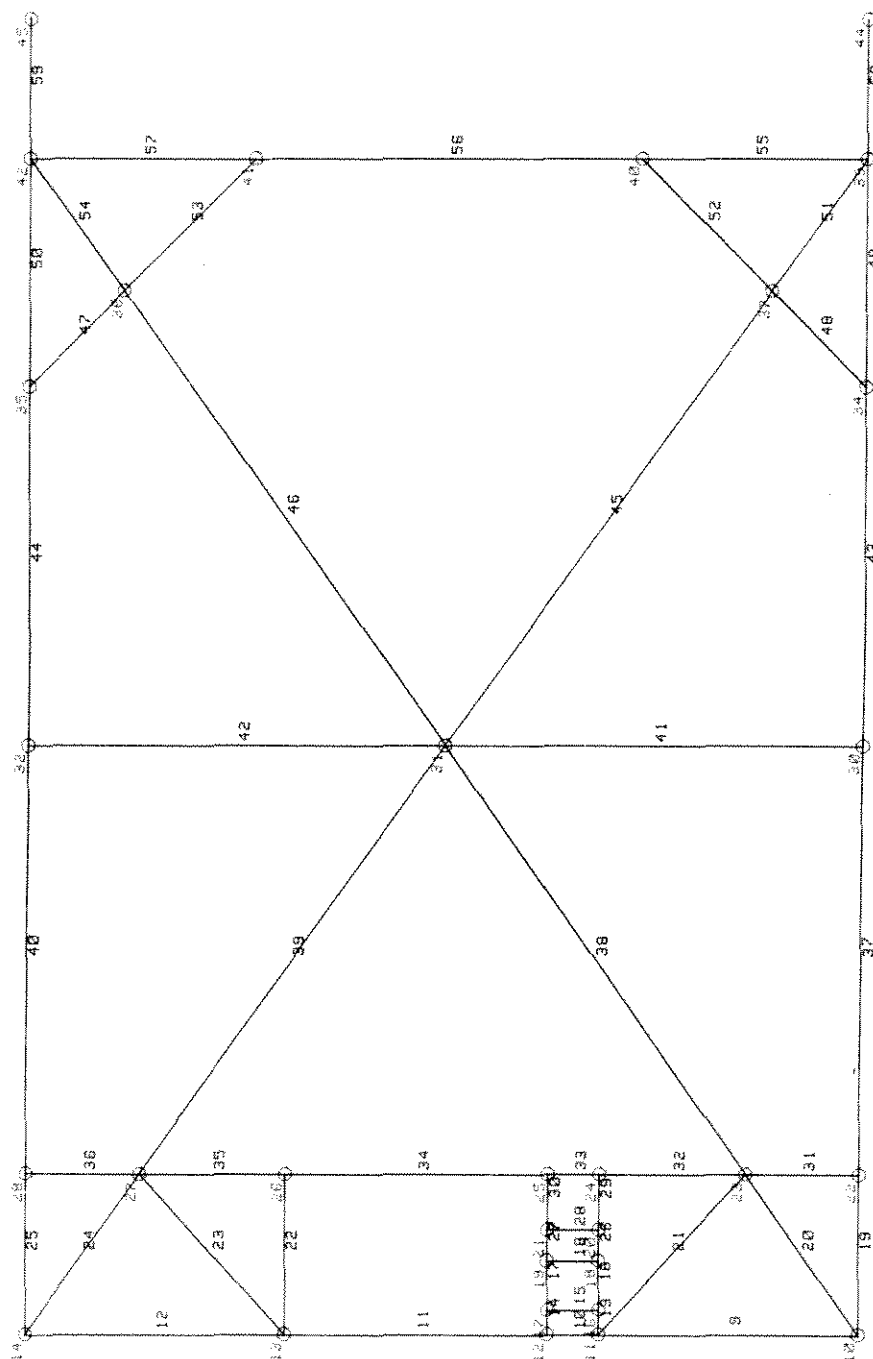


FIGURE R 7

UMH

EL. -22.0

STRUCTURAL PLOT

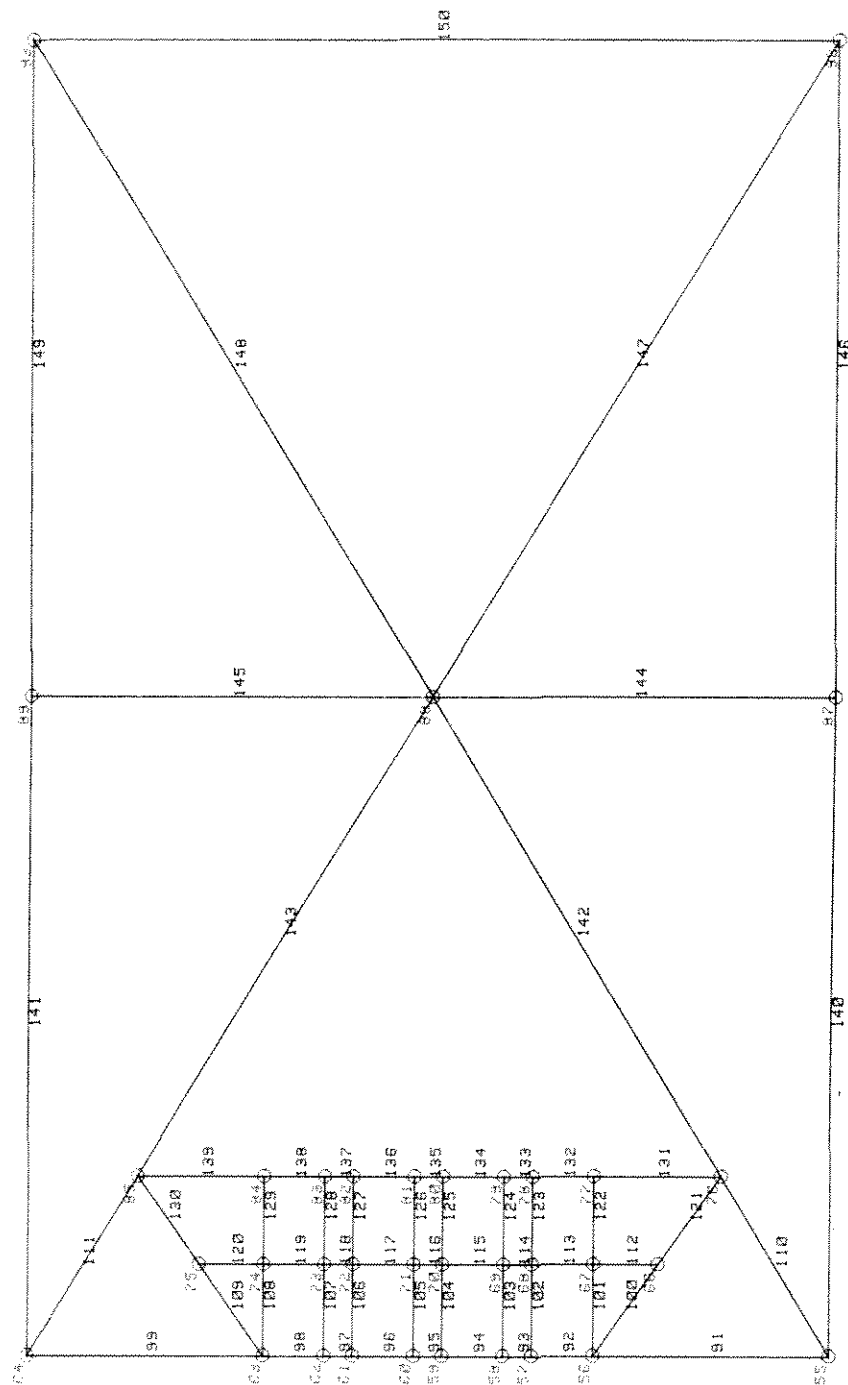


FIGURE A 8

UMH

EL. -8.0

STRUCTURAL PLOT

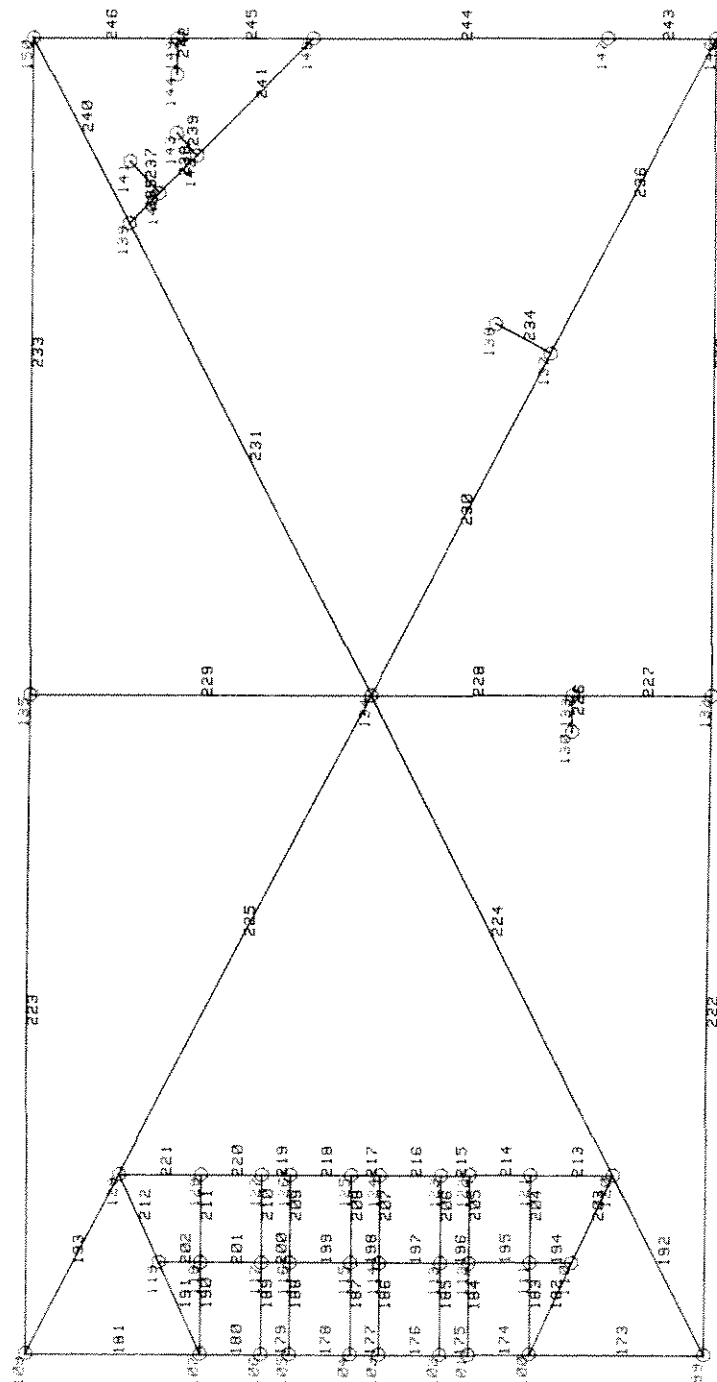


FIGURE A 9



UMH :

EL. +6.0

STRUCTURAL PLOT

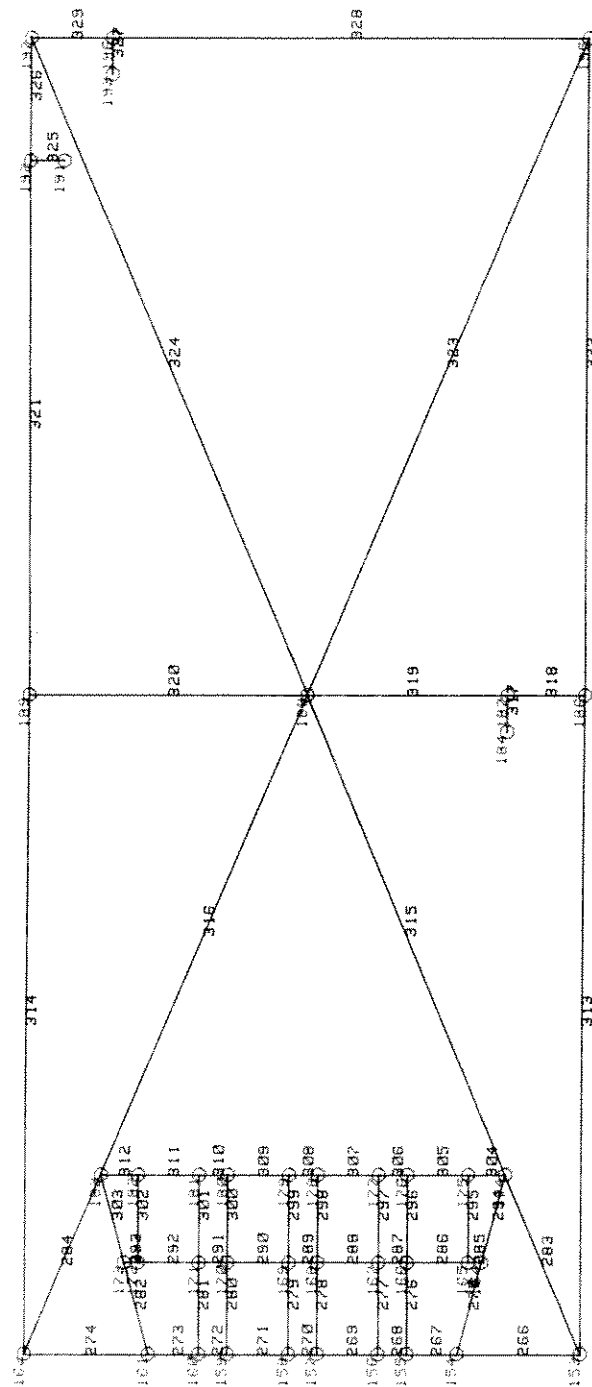


FIGURE A 10



UMH

DECK ROW A

STRUCTURAL PLOT

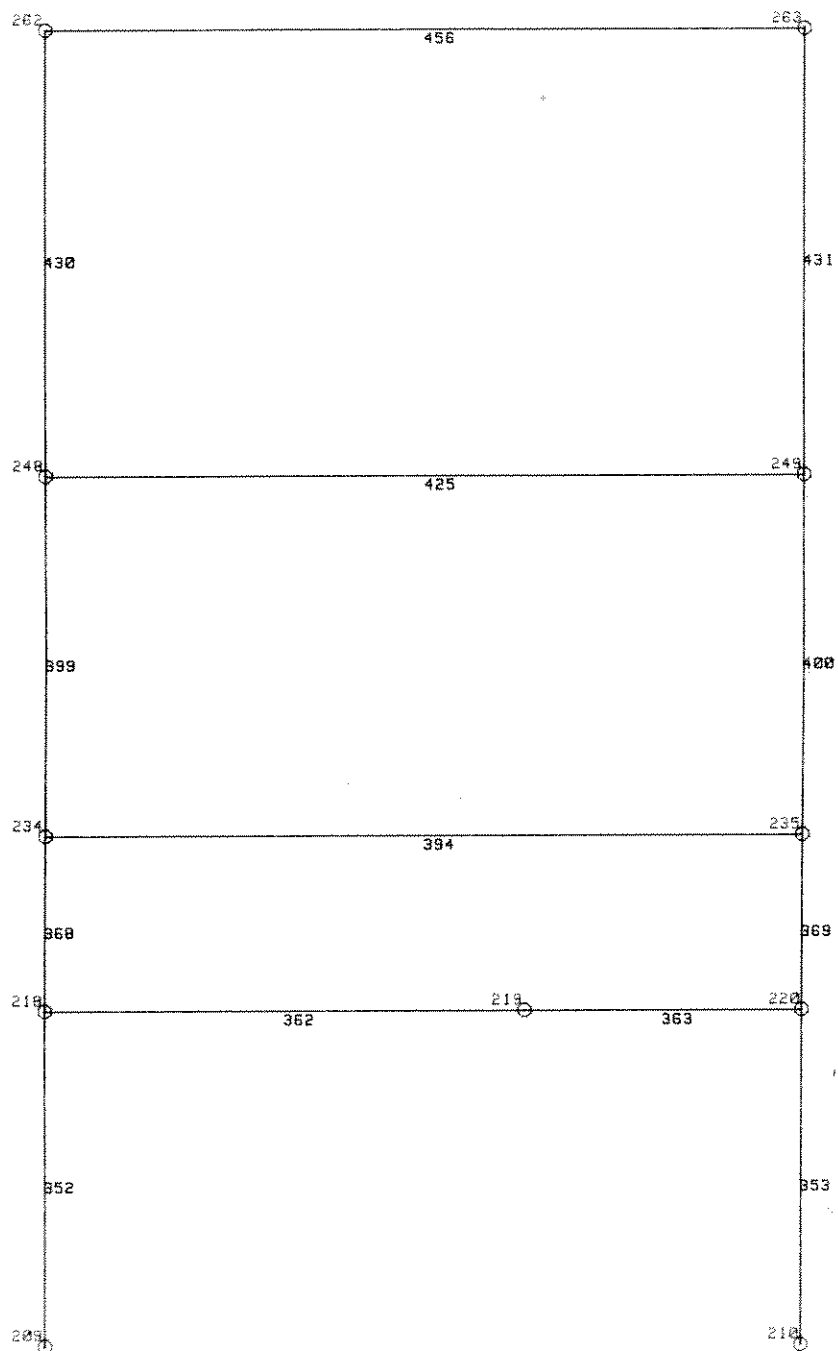


FIGURE A 11

UMH :

DECK ROW B

STRUCTURAL PLOT

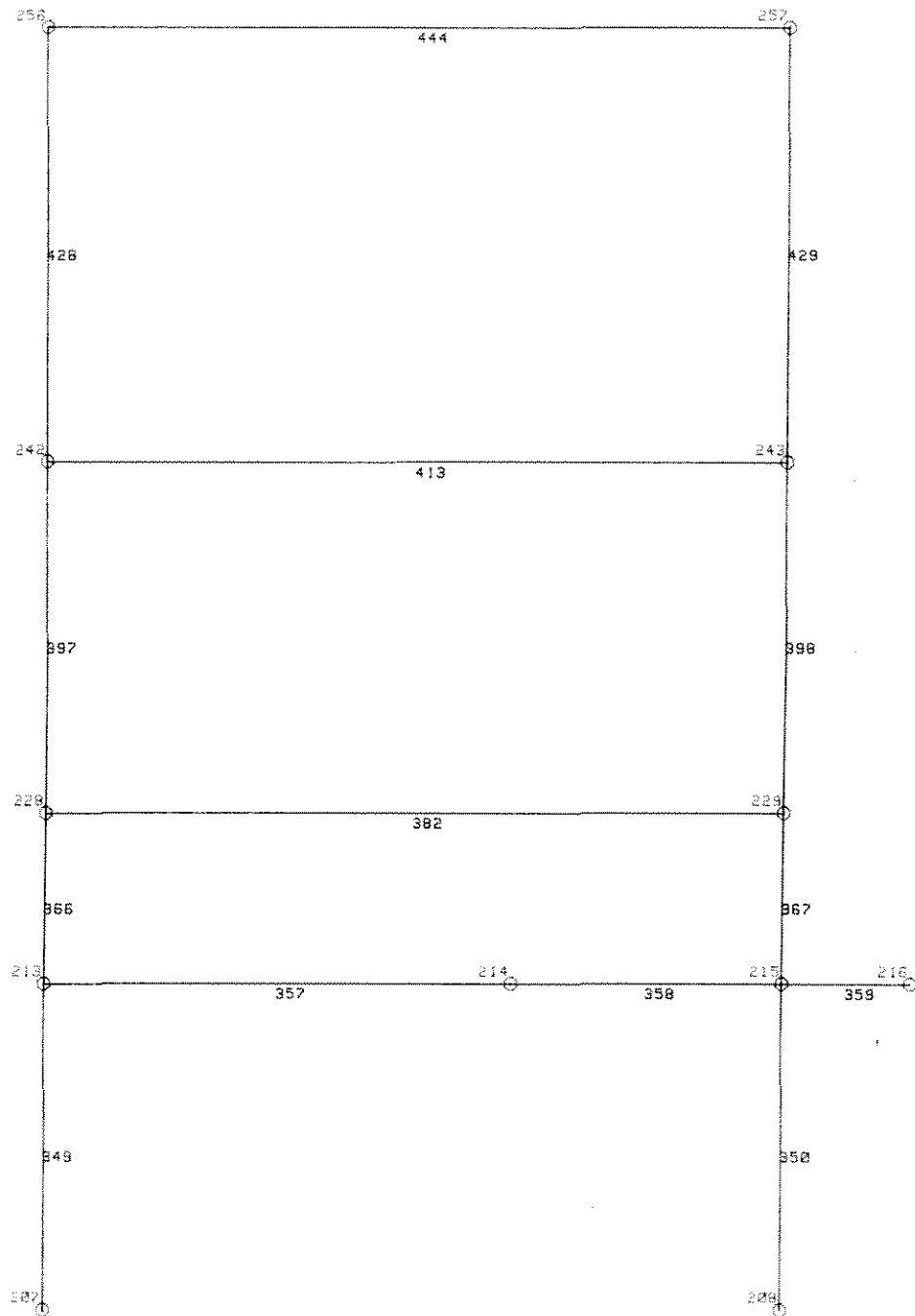


FIGURE A 12

UMH :

DECK ROW C

STRUCTURAL PLOT

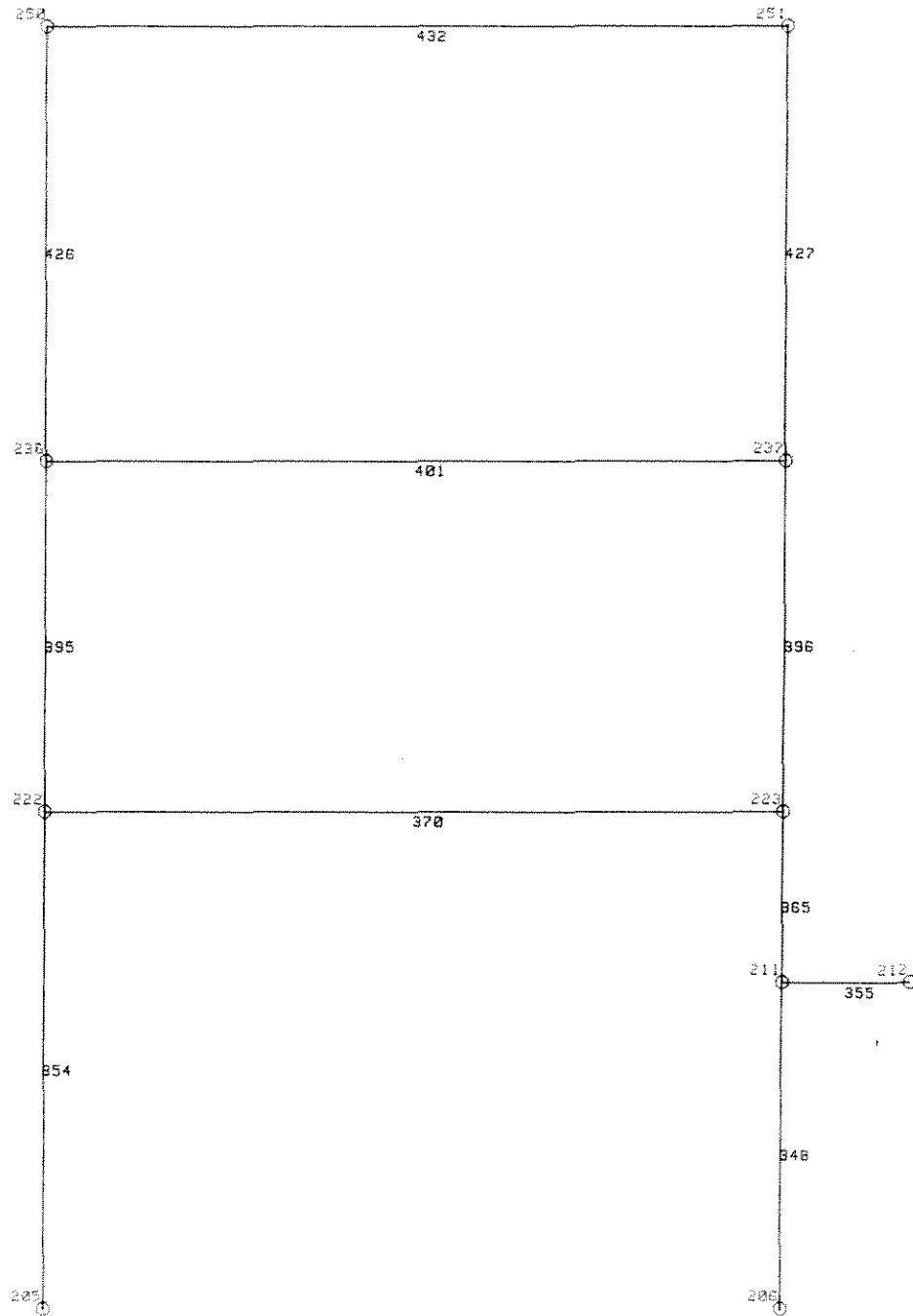


FIGURE A 13

UMH :

DECK ROW 1

STRUCTURAL PLOT

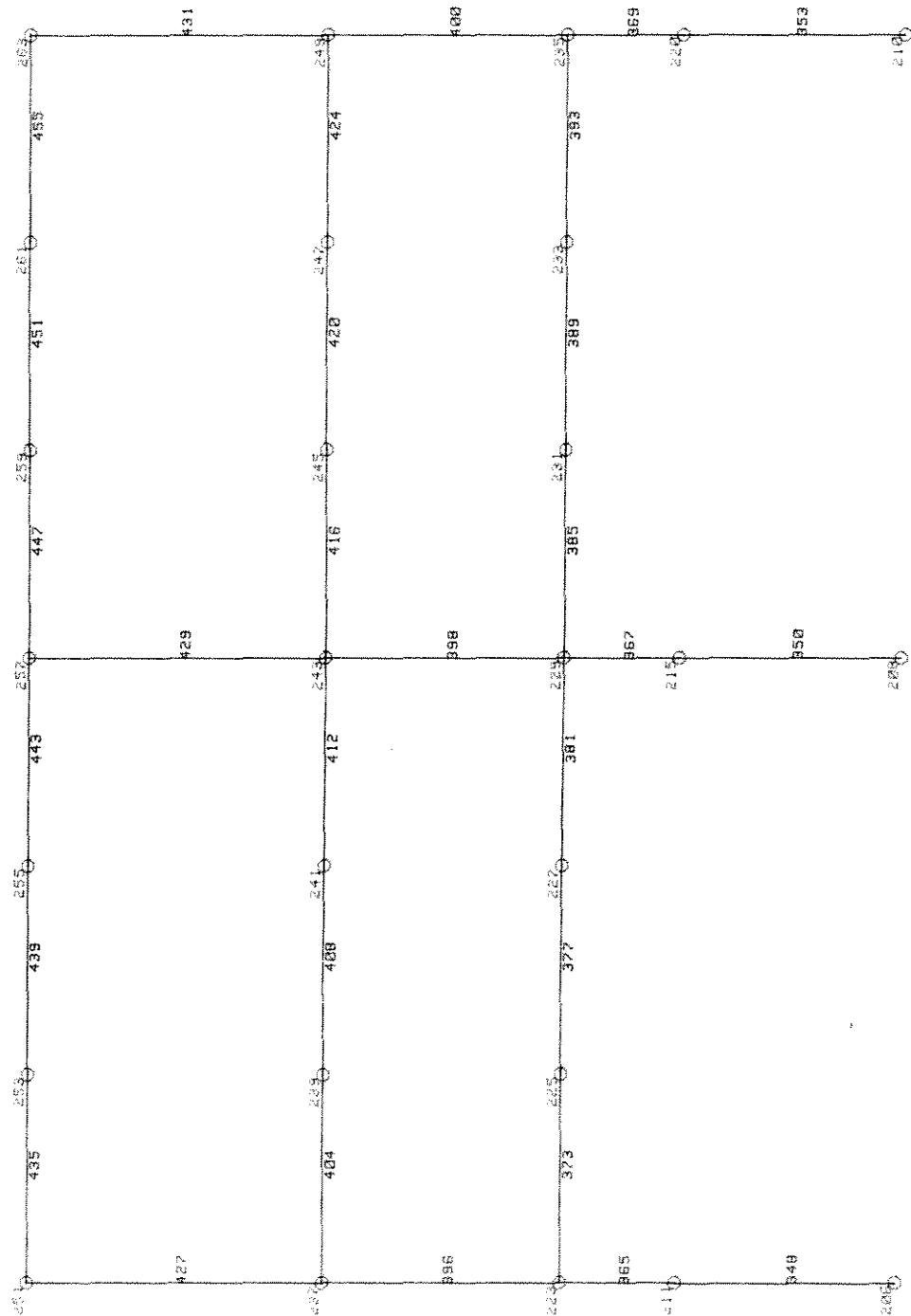


FIGURE A 14

UMH

DECK ROW 2

STRUCTURAL PLOT

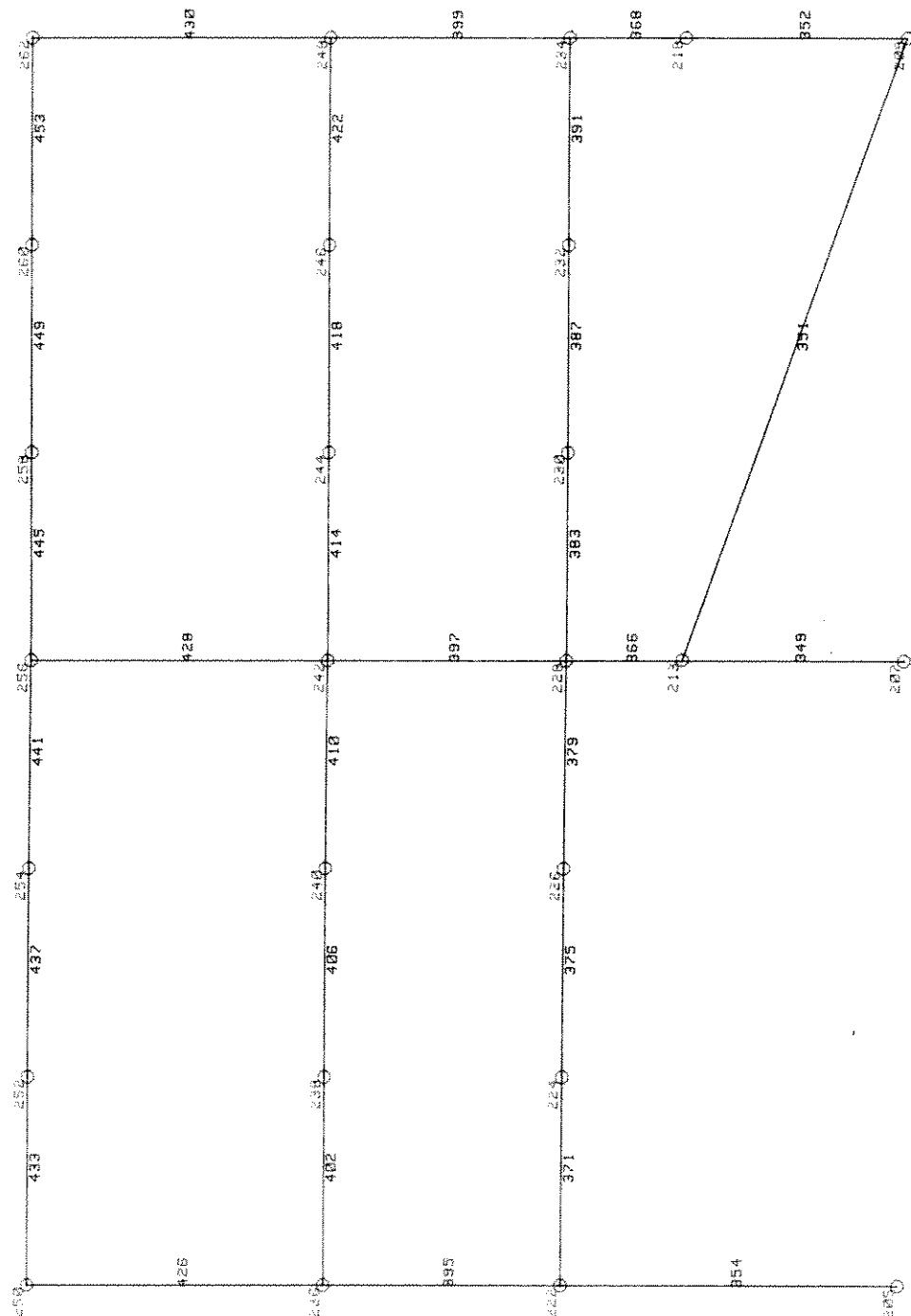


FIGURE R 15

UMH :

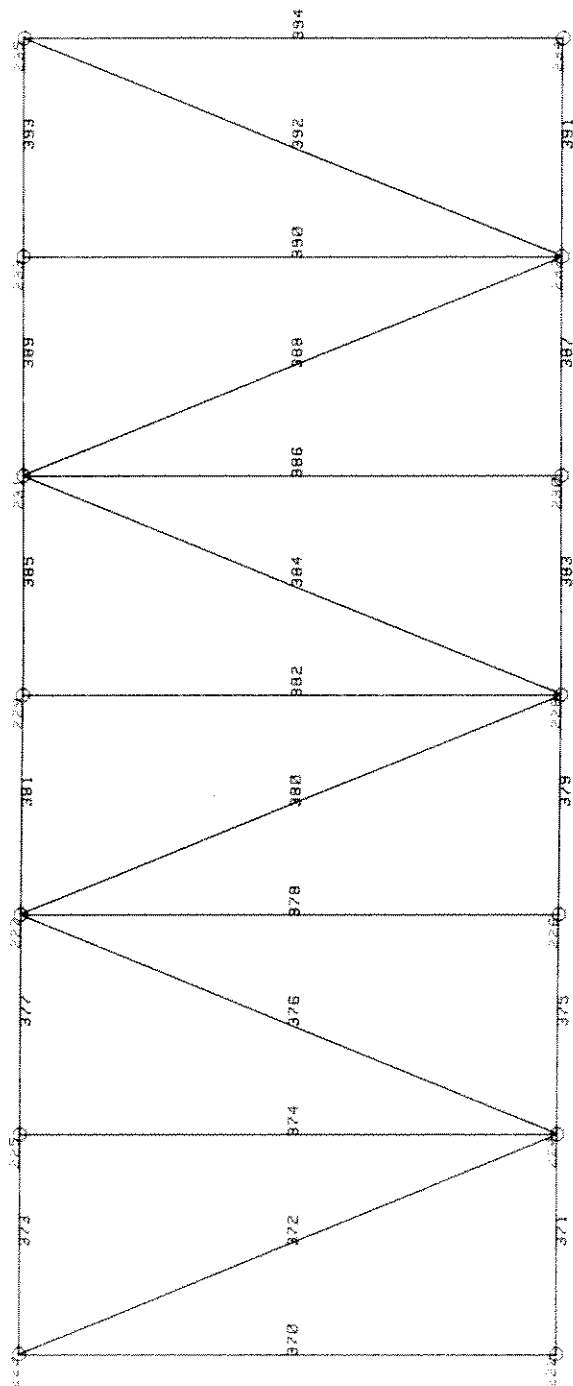
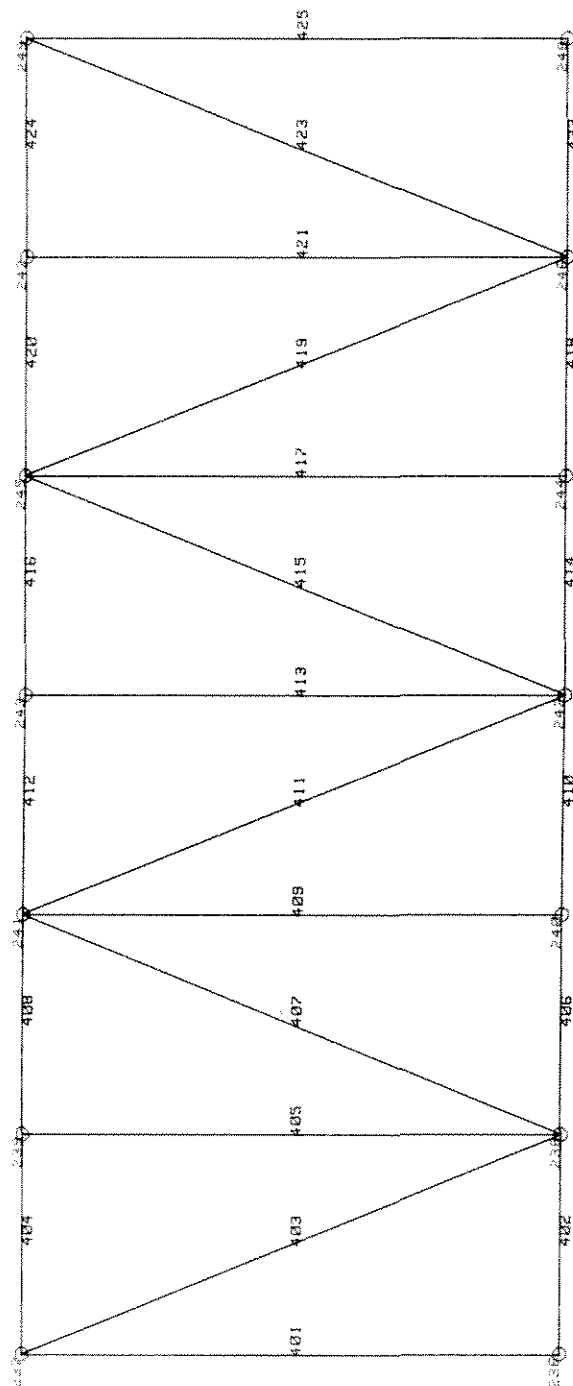


FIGURE A 16

UMH :

D LEVEL 7

STRUCTURAL PLOT



D LEVEL 8

STRUCTURAL PLOT

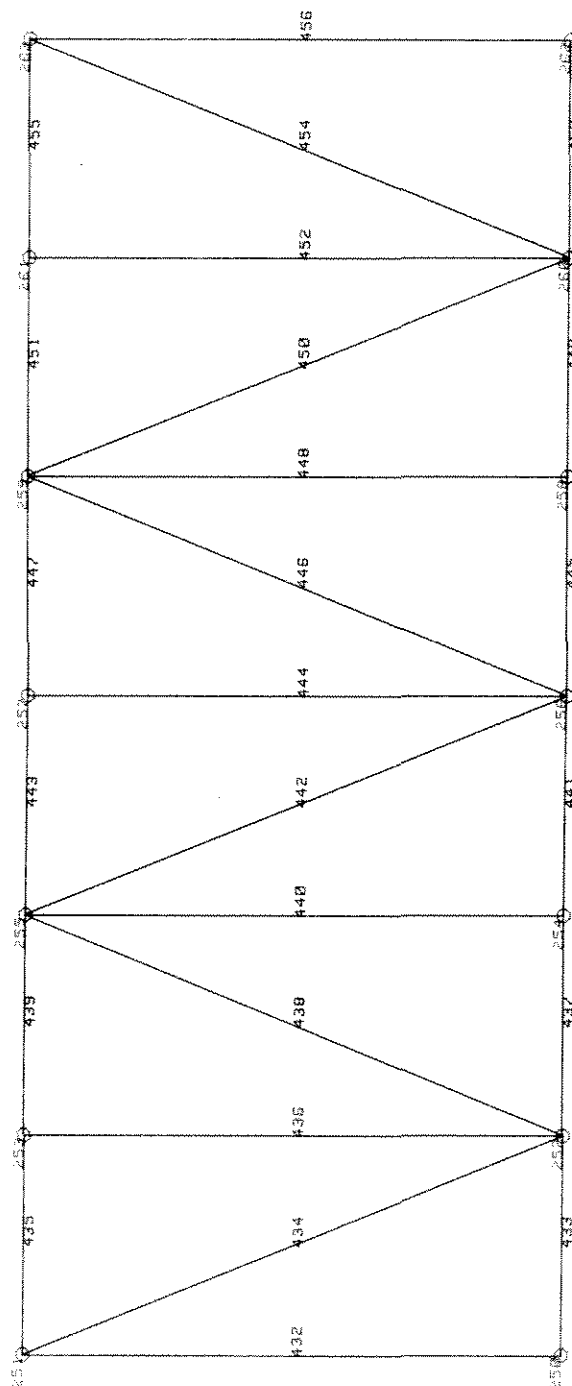


FIGURE A 18



UMH :

APPENDIX B: MEMBER LOCAL y DIRECTION.

DIRECTION OF MEMBER / LOCAL Y AXIS

Name of Platform : UM2PS1_10

Units : Stress = kN/Sq. m

Memb Number	LY	MY	NY	Memb Number	LY	MY	NY
1	0.000	0.992	-0.122	2	0.000	0.992	0.122
3	0.000	0.992	-0.122	4	0.000	0.992	0.122
5	0.000	0.992	-0.122	6	0.000	0.992	0.122
7	1.000	0.000	0.000	8	1.000	0.000	0.000
9	1.000	0.000	0.000	10	-1.000	0.000	0.000
11	-1.000	0.000	0.000	12	1.000	0.000	0.000
13	0.000	0.000	1.000	14	0.000	0.000	1.000
15	0.000	0.000	1.000	16	0.000	0.000	1.000
17	0.000	0.000	1.000	18	0.000	0.000	1.000
26	0.000	0.000	1.000	27	0.000	0.000	1.000
28	0.000	0.000	1.000	19	0.000	1.000	0.000
20	0.586	-0.811	0.000	21	0.681	0.732	0.000
31	1.000	0.000	0.000	29	0.000	0.000	1.000
32	0.000	0.000	1.000	30	0.000	0.000	1.000
33	0.000	0.000	1.000	22	0.000	0.000	1.000
34	0.000	0.000	1.000	23	0.681	-0.732	0.000
24	-0.586	-0.811	0.000	35	0.000	0.000	1.000
25	0.000	-1.000	0.000	36	1.000	0.000	0.000
37	0.000	0.992	-0.122	38	0.000	0.000	1.000
39	0.000	0.000	1.000	41	-1.000	0.000	0.000
40	0.000	0.992	0.122	42	-1.000	0.000	0.000
43	0.000	0.992	-0.122	44	0.000	0.992	0.122
45	0.000	0.000	1.000	48	-0.707	0.707	0.000
46	0.000	0.000	1.000	47	-0.707	-0.707	0.000
49	0.000	1.000	0.000	51	-0.586	-0.811	0.000
52	-0.707	0.707	0.000	55	-1.000	0.000	0.000
53	-0.707	-0.707	0.000	56	-1.000	0.000	0.000
50	0.000	-1.000	0.000	54	0.586	-0.811	0.000
57	-1.000	0.000	0.000	58	0.000	0.000	1.000
59	0.000	0.000	1.000	60	0.000	1.000	0.000
61	0.000	1.000	0.000	62	1.000	0.000	0.000
63	1.000	0.000	0.000	64	-1.000	0.000	0.000
65	-1.000	0.000	0.000	66	0.000	0.992	-0.122
67	0.000	0.992	-0.122	68	0.000	0.992	0.122
69	0.000	0.992	0.122	70	0.000	0.992	-0.122
71	0.000	0.992	0.122	72	0.000	0.992	-0.122
73	0.000	0.992	-0.122	74	-1.000	0.000	0.000
75	0.000	0.992	0.122	76	0.000	0.992	0.122
77	0.000	0.992	-0.122	78	0.000	0.992	0.122
79	0.000	0.992	-0.122	80	0.000	0.992	-0.122
81	0.000	0.992	0.122	82	0.000	0.992	0.122
83	1.000	0.000	0.000	84	1.000	0.000	0.000
85	1.000	0.000	0.000	86	1.000	0.000	0.000
87	0.116	0.974	-0.194	88	-0.116	0.974	0.194
89	-1.000	0.000	0.000	90	-1.000	0.000	0.000
91	-1.000	0.000	0.000	92	-1.000	0.000	0.000
93	-1.000	0.000	0.000	94	-1.000	0.000	0.000
95	-1.000	0.000	0.000	96	-1.000	0.000	0.000
97	-1.000	0.000	0.000	98	-1.000	0.000	0.000
99	-1.000	0.000	0.000	100	0.000	0.000	1.000
101	0.000	0.000	1.000	112	0.000	0.000	1.000
102	0.000	0.000	1.000	113	0.000	0.000	1.000
103	0.000	0.000	1.000	114	0.000	0.000	1.000
104	0.000	0.000	1.000	115	0.000	0.000	1.000

DIRECTION OF MEMBER / LOCAL Y AXIS

Memb Number	LY	MY	NY	Memb Number	LY	MY	NY
105	0.000	0.000	1.000	116	0.000	0.000	1.000
106	0.000	0.000	1.000	117	0.000	0.000	1.000
107	0.000	0.000	1.000	118	0.000	0.000	1.000
108	0.000	0.000	1.000	119	0.000	0.000	1.000
109	0.000	0.000	1.000	120	0.000	0.000	1.000
110	0.000	0.000	1.000	121	0.000	0.000	1.000
122	0.000	0.000	1.000	131	0.000	0.000	1.000
123	0.000	0.000	1.000	132	0.000	0.000	1.000
124	0.000	0.000	1.000	133	0.000	0.000	1.000
125	0.000	0.000	1.000	134	0.000	0.000	1.000
126	0.000	0.000	1.000	135	0.000	0.000	1.000
127	0.000	0.000	1.000	136	0.000	0.000	1.000
128	0.000	0.000	1.000	137	0.000	0.000	1.000
129	0.000	0.000	1.000	138	0.000	0.000	1.000
111	0.000	0.000	1.000	130	0.000	0.000	1.000
139	0.000	0.000	1.000	140	0.000	0.992	-0.122
142	0.000	0.000	1.000	143	0.000	0.000	1.000
144	-1.000	0.000	0.000	141	0.000	0.992	0.122
145	-1.000	0.000	0.000	146	0.000	0.992	-0.122
147	0.000	0.000	1.000	148	0.000	0.000	1.000
149	0.000	0.992	0.122	150	-1.000	0.000	0.000
151	-1.000	0.000	0.000	152	-1.000	0.000	0.000
153	-1.000	0.000	0.000	154	0.000	0.992	-0.122
155	0.000	0.992	-0.122	156	0.000	0.992	0.122
157	0.000	0.992	0.122	158	0.000	0.992	-0.122
159	0.000	0.992	0.122	160	0.000	0.992	-0.122
161	0.000	0.992	-0.122	162	0.000	0.992	0.122
163	0.000	0.992	0.122	164	0.000	0.992	-0.122
165	0.000	0.992	0.122	166	0.000	0.992	-0.122
167	0.000	0.992	-0.122	168	0.000	0.992	0.122
169	0.000	0.992	0.122	170	-1.000	0.000	0.000
171	-1.000	0.000	0.000	172	-1.000	0.000	0.000
173	-1.000	0.000	0.000	174	-1.000	0.000	0.000
175	-1.000	0.000	0.000	176	-1.000	0.000	0.000
177	-1.000	0.000	0.000	178	-1.000	0.000	0.000
179	-1.000	0.000	0.000	180	-1.000	0.000	0.000
181	-1.000	0.000	0.000	182	0.000	0.000	1.000
183	0.000	0.000	1.000	194	0.000	0.000	1.000
184	0.000	0.000	1.000	195	0.000	0.000	1.000
185	0.000	0.000	1.000	196	0.000	0.000	1.000
186	0.000	0.000	1.000	197	0.000	0.000	1.000
187	0.000	0.000	1.000	198	0.000	0.000	1.000
188	0.000	0.000	1.000	199	0.000	0.000	1.000
189	0.000	0.000	1.000	200	0.000	0.000	1.000
190	0.000	0.000	1.000	201	0.000	0.000	1.000
191	0.000	0.000	1.000	202	0.000	0.000	1.000
192	0.000	0.000	1.000	203	0.000	0.000	1.000
204	0.000	0.000	1.000	213	0.000	0.000	1.000
205	0.000	0.000	1.000	214	0.000	0.000	1.000
206	0.000	0.000	1.000	215	0.000	0.000	1.000
207	0.000	0.000	1.000	216	0.000	0.000	1.000
208	0.000	0.000	1.000	217	0.000	0.000	1.000
209	0.000	0.000	1.000	218	0.000	0.000	1.000
210	0.000	0.000	1.000	219	0.000	0.000	1.000
211	0.000	0.000	1.000	220	0.000	0.000	1.000
193	0.000	0.000	1.000	212	0.000	0.000	1.000
221	0.000	0.000	1.000	222	0.000	0.992	-0.122
226	0.000	0.000	1.000	227	-1.000	0.000	0.000
224	0.000	0.000	1.000	225	0.000	0.000	1.000

DIRECTION OF MEMBER / LOCAL Y AXIS

Memb Number	LY	MY	NY	Memb Number	LY	MY	NY
228	-1.000	0.000	0.000	223	0.000	0.992	0.122
229	-1.000	0.000	0.000	230	0.000	0.000	1.000
234	0.000	0.000	1.000	231	0.000	0.000	1.000
235	0.000	0.000	1.000	237	0.000	0.000	1.000
238	0.000	0.000	1.000	239	0.000	0.000	1.000
232	0.000	0.992	-0.122	236	0.000	0.000	1.000
243	-1.000	0.000	0.000	241	0.000	0.000	1.000
244	-1.000	0.000	0.000	242	0.000	0.000	1.000
245	-1.000	0.000	0.000	233	0.000	0.992	0.122
240	0.000	0.000	1.000	246	-1.000	0.000	0.000
247	0.000	0.992	-0.122	248	0.000	0.992	-0.122
249	-1.000	0.000	0.000	250	0.000	0.992	0.122
251	0.000	0.992	0.122	252	0.000	0.992	-0.122
253	0.000	0.992	0.122	254	0.000	0.992	-0.122
255	0.000	0.992	-0.122	256	-1.000	0.000	0.000
257	0.000	0.992	0.122	258	0.000	0.992	0.122
259	0.000	0.992	-0.122	260	0.000	0.992	0.122
261	0.000	0.992	-0.122	262	0.000	0.992	-0.122
263	-1.000	0.000	0.000	264	0.000	0.992	0.122
265	0.000	0.992	0.122	266	-1.000	0.000	0.000
267	-1.000	0.000	0.000	268	-1.000	0.000	0.000
269	-1.000	0.000	0.000	270	-1.000	0.000	0.000
271	-1.000	0.000	0.000	272	-1.000	0.000	0.000
273	-1.000	0.000	0.000	274	-1.000	0.000	0.000
275	0.000	0.000	1.000	285	0.000	0.000	1.000
276	0.000	0.000	1.000	286	0.000	0.000	1.000
277	0.000	0.000	1.000	287	0.000	0.000	1.000
278	0.000	0.000	1.000	288	0.000	0.000	1.000
279	0.000	0.000	1.000	289	0.000	0.000	1.000
280	0.000	0.000	1.000	290	0.000	0.000	1.000
281	0.000	0.000	1.000	291	0.000	0.000	1.000
292	0.000	0.000	1.000	282	0.000	0.000	1.000
293	0.000	0.000	1.000	283	0.000	0.000	1.000
294	0.000	0.000	1.000	295	0.000	0.000	1.000
304	0.000	0.000	1.000	296	0.000	0.000	1.000
305	0.000	0.000	1.000	297	0.000	0.000	1.000
306	0.000	0.000	1.000	298	0.000	0.000	1.000
307	0.000	0.000	1.000	299	0.000	0.000	1.000
308	0.000	0.000	1.000	300	0.000	0.000	1.000
309	0.000	0.000	1.000	301	0.000	0.000	1.000
310	0.000	0.000	1.000	302	0.000	0.000	1.000
311	0.000	0.000	1.000	284	0.000	0.000	1.000
303	0.000	0.000	1.000	312	0.000	0.000	1.000
313	0.000	0.992	-0.122	317	0.000	0.000	1.000
318	-1.000	0.000	0.000	315	0.000	0.000	1.000
316	0.000	0.000	1.000	319	-1.000	0.000	0.000
314	0.000	0.992	0.122	320	-1.000	0.000	0.000
321	0.000	0.992	0.122	325	0.000	0.000	1.000
322	0.000	0.992	-0.122	323	0.000	0.000	1.000
327	0.000	0.000	1.000	328	-1.000	0.000	0.000
324	0.000	0.000	1.000	326	0.000	0.992	0.122
329	-1.000	0.000	0.000	330	0.000	0.992	-0.122
331	0.000	0.992	-0.122	332	0.000	0.992	0.122
333	0.000	0.992	0.122	334	0.000	0.992	-0.122
335	0.000	0.992	-0.122	336	0.000	0.992	0.122
337	0.000	0.992	0.122	338	0.000	0.992	-0.122
339	0.000	0.992	-0.122	340	0.000	0.992	0.122
341	0.000	0.992	0.122	342	0.000	0.992	-0.122
343	0.000	0.992	0.122	344	0.000	0.992	-0.122

DIRECTION OF MEMBER / LOCAL Y AXIS

Memb Number	LY	MY	NY	Memb Number	LY	MY	NY
345	0.000	0.992	0.122	346	0.000	0.992	-0.122
347	0.000	0.992	0.122	348	1.000	0.000	0.000
349	1.000	0.000	0.000	350	1.000	0.000	0.000
351	0.000	1.000	0.000	352	1.000	0.000	0.000
353	1.000	0.000	0.000	354	1.000	0.000	0.000
355	0.000	0.000	1.000	356	0.000	0.000	1.000
357	0.000	0.000	1.000	358	0.000	0.000	1.000
359	0.000	0.000	1.000	360	0.000	0.000	1.000
361	0.000	0.000	1.000	362	0.000	0.000	1.000
363	0.000	0.000	1.000	364	0.000	0.000	1.000
365	1.000	0.000	0.000	366	1.000	0.000	0.000
367	1.000	0.000	0.000	368	1.000	0.000	0.000
369	1.000	0.000	0.000	370	0.000	0.000	1.000
371	0.000	0.000	1.000	372	0.000	0.000	1.000
373	0.000	0.000	1.000	374	0.000	0.000	1.000
375	0.000	0.000	1.000	376	0.000	0.000	1.000
377	0.000	0.000	1.000	378	0.000	0.000	1.000
379	0.000	0.000	1.000	380	0.000	0.000	1.000
381	0.000	0.000	1.000	382	0.000	0.000	1.000
383	0.000	0.000	1.000	384	0.000	0.000	1.000
385	0.000	0.000	1.000	386	0.000	0.000	1.000
387	0.000	0.000	1.000	388	0.000	0.000	1.000
389	0.000	0.000	1.000	390	0.000	0.000	1.000
391	0.000	0.000	1.000	392	0.000	0.000	1.000
393	0.000	0.000	1.000	394	0.000	0.000	1.000
395	1.000	0.000	0.000	396	1.000	0.000	0.000
397	1.000	0.000	0.000	398	1.000	0.000	0.000
399	1.000	0.000	0.000	400	1.000	0.000	0.000
401	0.000	0.000	1.000	402	0.000	0.000	1.000
403	0.000	0.000	1.000	404	0.000	0.000	1.000
405	0.000	0.000	1.000	406	0.000	0.000	1.000
407	0.000	0.000	1.000	408	0.000	0.000	1.000
409	0.000	0.000	1.000	410	0.000	0.000	1.000
411	0.000	0.000	1.000	412	0.000	0.000	1.000
413	0.000	0.000	1.000	414	0.000	0.000	1.000
415	0.000	0.000	1.000	416	0.000	0.000	1.000
417	0.000	0.000	1.000	418	0.000	0.000	1.000
419	0.000	0.000	1.000	420	0.000	0.000	1.000
421	0.000	0.000	1.000	422	0.000	0.000	1.000
423	0.000	0.000	1.000	424	0.000	0.000	1.000
425	0.000	0.000	1.000	426	1.000	0.000	0.000
427	1.000	0.000	0.000	428	1.000	0.000	0.000
429	1.000	0.000	0.000	430	1.000	0.000	0.000
431	1.000	0.000	0.000	432	0.000	0.000	1.000
433	0.000	0.000	1.000	434	0.000	0.000	1.000
435	0.000	0.000	1.000	436	0.000	0.000	1.000
437	0.000	0.000	1.000	438	0.000	0.000	1.000
439	0.000	0.000	1.000	440	0.000	0.000	1.000
441	0.000	0.000	1.000	442	0.000	0.000	1.000
443	0.000	0.000	1.000	444	0.000	0.000	1.000
445	0.000	0.000	1.000	446	0.000	0.000	1.000
447	0.000	0.000	1.000	448	0.000	0.000	1.000
449	0.000	0.000	1.000	450	0.000	0.000	1.000
451	0.000	0.000	1.000	452	0.000	0.000	1.000
453	0.000	0.000	1.000	454	0.000	0.000	1.000
455	0.000	0.000	1.000	456	0.000	0.000	1.000