Magneplane International • Massachusetts Institute of Technology
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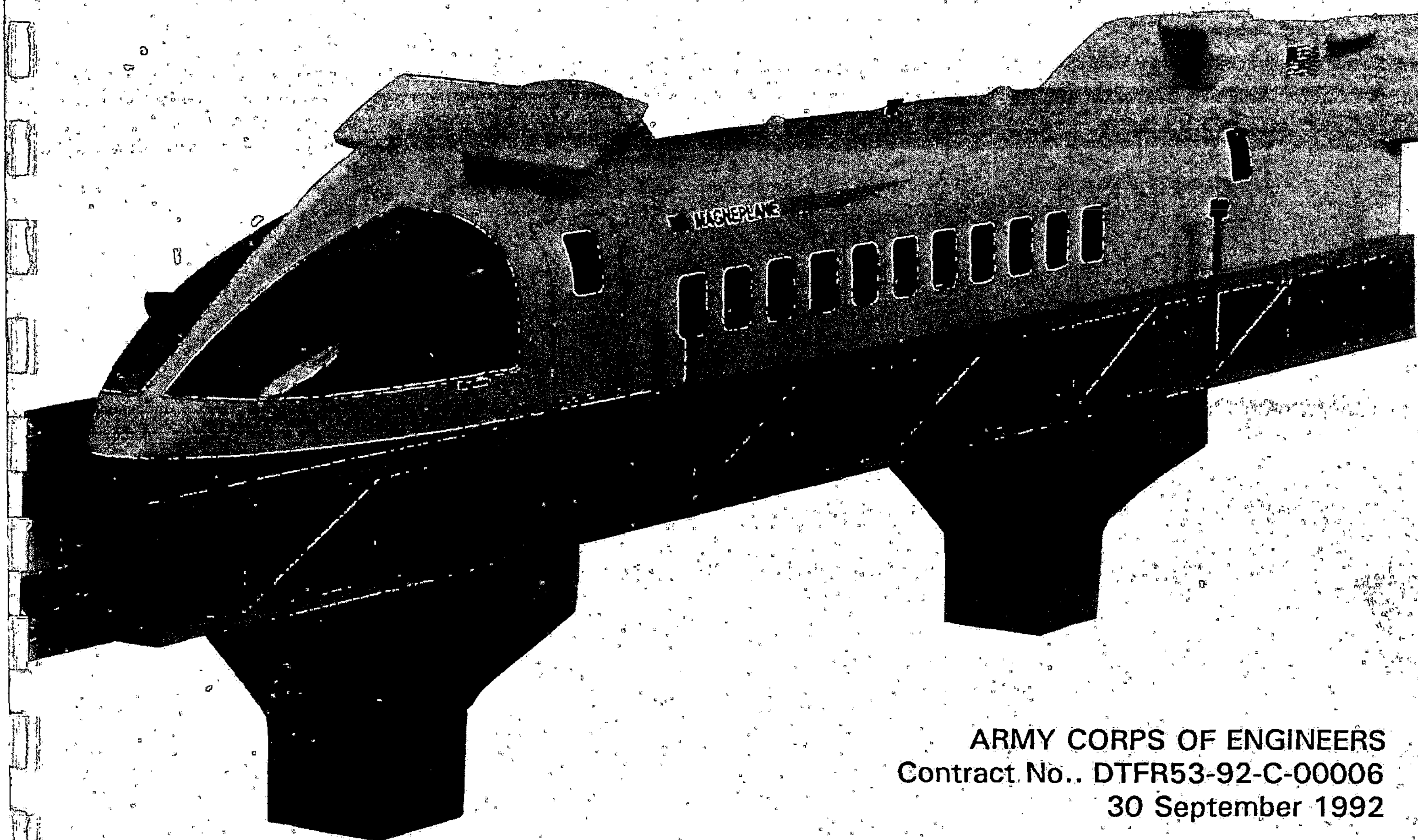
Failure Analysis Associates • Bromwell & Carrier
Beech Aircraft Corporation • Process Systems International

SYSTEM CONCEPT DEFINITION REPORT
for the
NATIONAL MAGLEV INITIATIVE

Volume
7A

SUPPLEMENT C: BACKUP MATERIALS FOR MAGWAY STRUCTURE - PART 1 OF 2



ARMY CORPS OF ENGINEERS
Contract No.. DTFR53-92-C-00006
30 September 1992

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Jet Aviation Terminal, Hanscom Field West
Bedford, Massachusetts 01730
phone: 617 274 8750; fax: 617 274 8747

11 - Advanced Systems

INDEX TO VOLUMES

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A Raytheon Company

MAGNEPLANE INTERNATIONAL

SYSTEM CONCEPT DEFINITION REPORT

SUPPLEMENT C

Backup Material - Magway Structure

Contents

30 September 1992
UE&C
Western Operations
6869.002

FORM 5007 REV. 7/79 GENERAL COMPUTATION SHEET

(DISCIPLINE) United Engineers & Constructors A Raytheon Company

NAME OF COMPANY MI / MIT UNIT/S

SUBJECT MAGNEPLANE

CALC. SET NO.		REV	COMP. BY	CHK'D. BY
PRELIM.		0	PARKER	
FINAL			DATE 9-30-92	DATE
VOID.				
SHEET	OF		DATE	DATE
J.O 6869002				

MAGNEPLANE INTERNATIONAL - SYSTEM CONCEPT DEFINITION REPORT

SUPPLEMENT C
BACKUP MATERIAL-MAGWAY STRUCTURE

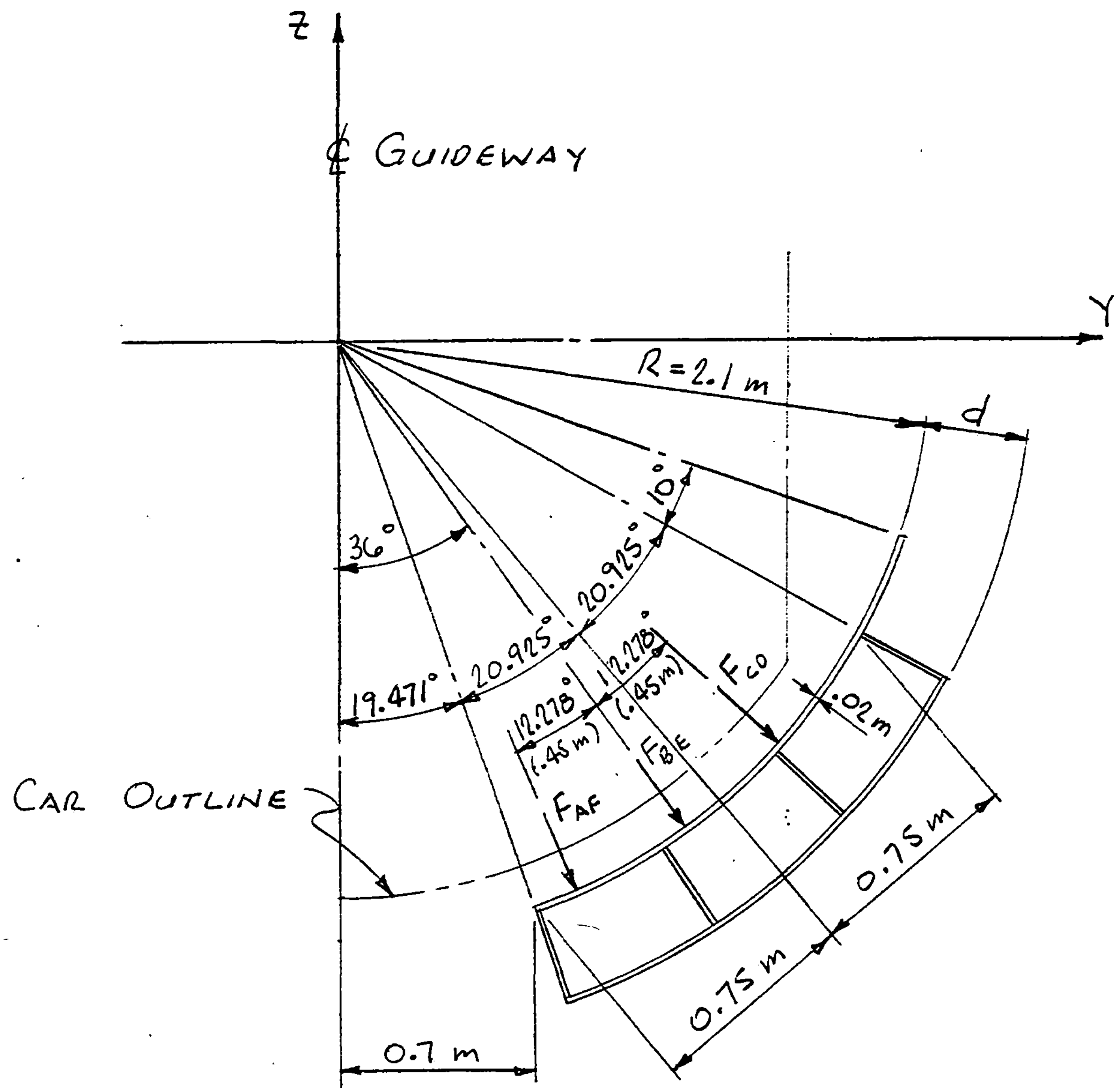
LEVITATION PLATES (Report reference section 3.2.2.b)

The following pages provide backup calculations for the levitation plate box beams. Please refer to section 3.2.2.b of the report for further discussion and summary of results.

Contents:

United Engineers & Constructors
A Raytheon Company
Stearns-Roger Division

PAGE LB-1
JOB NO. 6869002 DATE 3/30/92 BY RJC CH'K
CUSTOMER MIT MI PROJECT MAGLEV
SUBJECT GUIDEWAY SHEET SECTION

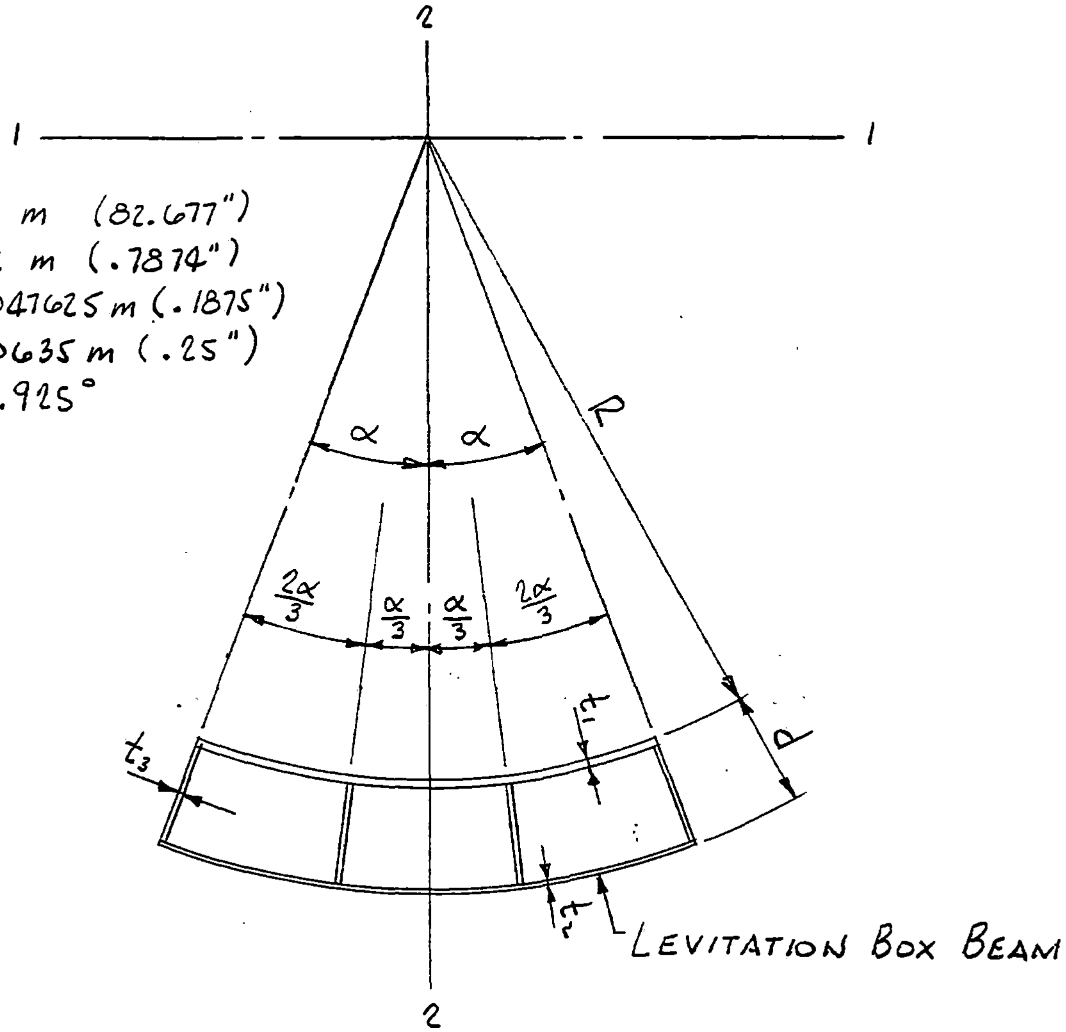


SECTION THRU GUIDEWAY

(SHOWING LEVITATION BOX BEAM)

FORM 62-114/A0388175

$R = 2.1$ m (82.677")
$t_1 = .02$ m (.7874")
$t_2 = .0047625$ m (.1875")
$t_3 = .00635$ m (.25")
$\alpha = 20.925°$



GUIDEWAY SHEET SECTION

MAT'L: ALUMINUM ALLOY 6061-T6.

PHYSICAL AND MECHANICAL PROPERTIES:

$\gamma = 26600\ N/m^3$ (.098 LB/IN^3)
$E = 6.895 \times 10^{10}\ N/m^2$ (10×10^6 psi)
$\sigma_u = 3.103 \times 10^8\ N/m^2$ (45000 psi)
$\sigma_y = 2.758 \times 10^8\ N/m^2$ (40000 psi)
$\nu = 0.3$

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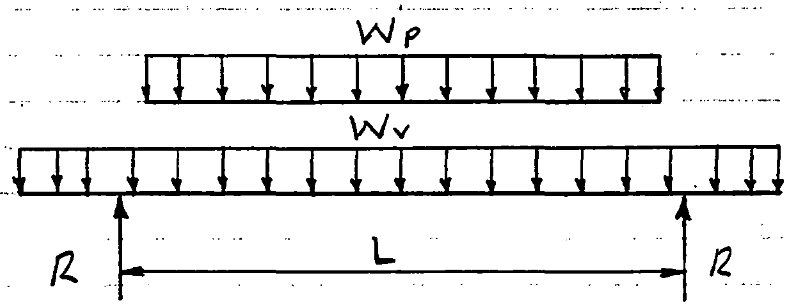
JOB NO. 6869002 DATE 3/30/92 BY RJC CH'K
CUSTOMER MIT MI PROJECT MAGLEV
SUBJECT GUIDEWAY SHEET SECTION

VEHICLE LOADING ON GUIDEWAY



W_p = PASSENGER WEIGHT
W_v = VEHICLE WEIGHT
L = CENTER-TO-CENTER SPACING OF BOGIES
R = REACTION AT BOGIE = $.5(W_p + W_v)$

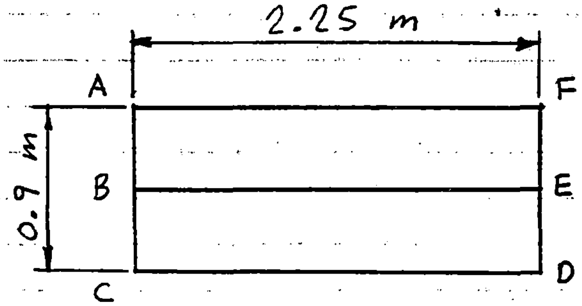
140 PASSENGER VEHICLE

W_p = 14061 kg (31000 LB)
W_v = 35834 kg (79000 LB)
L = 28.651 m (94 FT)
R = 24948 kg (55000 LB)

45 PASSENGER VEHICLE

W_p = 4536 kg (10000 LB)
W_v = 20412 kg (45000 LB)
L = 13.106 m (43 FT)
R = 12474 kg (27500 LB)

LEVITATION COIL MODULES



LOAD FOOTPRINT

THE LOADS ARE PERPENDICULAR TO THE GUIDEWAY ALONG EACH OF THE LINES ABOVE (SEE SKETCH ON PG. 1).
THE LOADS ARE ASSUMED DISTRIBUTED OVER A WIDTH OF APPROXIMATELY 0.2 m ALONG EACH OF THE LINES.

140 PASSENGER VEHICLE

$F_{AF} = F_{CD} = 12706$ N
$F_{BE} = 89548$ N
$F_{AB} = F_{BC} = 9076$ N
$F_{FE} = F_{ED} = 9076$ N

$\Sigma F = 151264$ N
$2(2 \times 151264 \times \cos 36°) = 489500$ N
(110000 LB)

45 PASSENGER VEHICLE

$F_{AF} = F_{CD} = 6353$ N
$F_{BE} = 44774$ N
$F_{AB} = F_{BC} = 4538$ N
$F_{FE} = F_{ED} = 4538$ N

$\Sigma F = 75632$ N
$2(2 \times 75632 \times \cos 36°) = 244750$ N
(55000 LB)

United Engineers & Constructors
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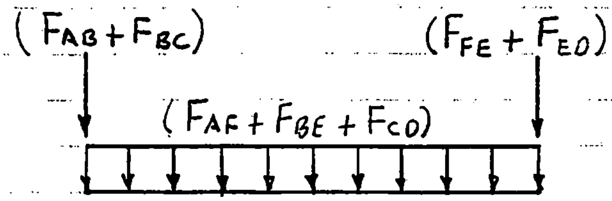
PAGE LB-5

JOB NO. 6869002 DATE 3/30/92 BY RJC CH'K

CUSTOMER MIT MI PROJECT MAGLEV

SUBJECT GUIDEWAY SHEET SECTION

LOAD DISTRIBUTION ON GUIDEWAY



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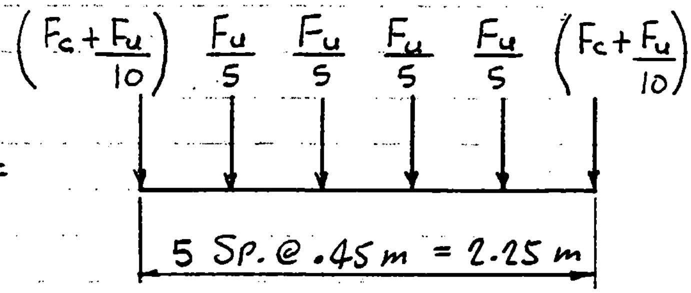

$F_c = F_{AB} + F_{BC} = F_{FE} + F_{ED}$

$F_u = F_{AF} + F_{BE} + F_{CD}$

ACTUAL LOADING   EQUIVALENT LOADING

140 PASSENGER VEHICLE

$F_c = 18152$ N

$F_u = 114960$ N

$F_c + F_u/10 = 29648$ N

$F_u/5 = 22992$ N

45 PASSENGER VEHICLE

$F_c = 9076$ N

$F_u = 57480$ N

$F_c + F_u/10 = 14824$ N

$F_u/5 = 11496$ N

FORM 62-114/A0388175i

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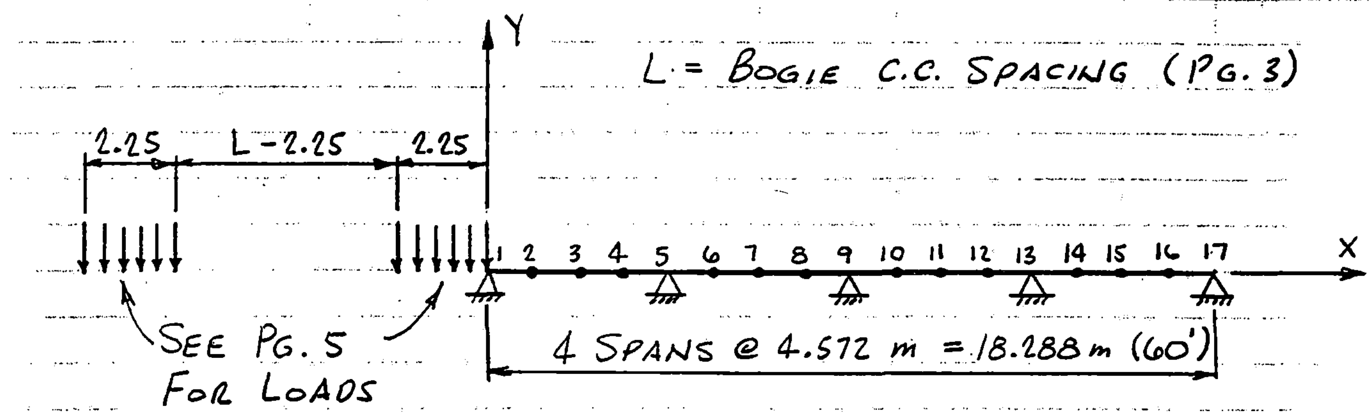
PAGE 2B-6

JOB NO. 6869002 DATE 4/2/92 BY RJC CH'K

CUSTOMER MIT MI PROJECT MAGLEV

SUBJECT GUIDEWAY SHEET SECTION



THE GUIDEWAY SHEET SECTION WILL BE ANALYZED AS A FOUR SPAN CONTINUOUS BEAM ACTED UPON BY THE MOVING CONCENTRATED LOADS SHOWN ABOVE. THE LOADS ARE ASSUMED TO MOVE FROM LEFT TO RIGHT AT A VELOCITY OF 134 m/s (300 mph). A ZERO DAMPING RATIO WILL CONSERVATIVELY BE ASSUMED.

THE ANALYSIS WILL BE PERFORMED USING A UE&C MODIFIED VERSION OF THE PROGRAM "DYNACB" OBTAINED FROM PAUL R. JOHNSTON OF FAILURE ANALYSIS ASSOCIATES.

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Stearns-Roger Division

JOB NO. 6869002 DATE 4/2/92 BY RJC CH'K
CUSTOMER MIT MI PROJECT MAGLEV
SUBJECT GUIDEWAY SHEET SECTION

DESIGN CRITERIA

1. MAXIMUM BEAM DYNAMIC DEFLECTION WILL BE LIMITED TO SPAN LENGTH DIVIDED BY 2000.

2. THE MAXIMUM ALLOWABLE STRESS RANGE FOR FATIGUE CONSIDERATIONS IS TAKEN FROM THE FOLLOWING REFERENCE:
"ALUMINUM CONSTRUCTION MANUAL", 5TH ED., SECTION 3, ENGINEERING DATA FOR ALUMINUM STRUCTURES.

   FROM TABLE 4.8.1b, THE GUIDEWAY SHEET SECTION COMES UNDER THE GENERAL CONDITION OF "BUILT-UP MEMBERS" AND THE SITUATION "BASE METAL AND WELD METAL IN MEMBERS, WITHOUT ATTACHMENTS, BUILT-UP OF PLATES OR SHAPES CONNECTED BY CONTINUOUS FULL- OR PARTIAL-PENETRATION GROOVE WELDS OR CONTINUOUS FILLET WELDS PARALLEL TO THE DIRECTION OF APPLIED STRESS."

   THE ALLOWABLE STRESS RANGE UNDER STRESS CATEGORY "B" FOR OVER 2×10^6 CYCLES IS, FROM TABLE 4.8.1a, EQUAL TO 6 KSI (4.137×10^7 N/m^2).

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JOB NO. 6869002 DATE 4/2/92 BY RJC CH'K

CUSTOMER MIT MI PROJECT MAGLEV

SUBJECT GUIDEWAY SHEET SECTION

SUMMARY OF RESULTS ($d = .4064$ m)

1) 140 PASSENGER VEHICLE (SEE PG'S A-1 TO A-20)

a) MAX. DEFLECTION = .0021906 m (NODE 3)
$\ell/2000 = 4.572/2000 = .002286 \text{ m} > .0021906$

b) MAX. STRESS RANGE
FOR ELEM. 2
$\Delta M = 98257 - (-27159) = 125416$ N-m
$\sigma_R = 125416/.00374417 = 3.350 \times 10^7$ N/m^2
$< 4.137 \times 10^7$

2) 45 PASSENGER VEHICLE (SEE PG'S A-21 TO A-39)

a) MAX. DEFLECTION = .0010688 m (NODE 3)

b) MAX. STRESS RANGE
FOR ELEM. 2
$\Delta M = 48671 - (-12863) = 61534$ N-m
$\sigma_R = 61534/.00374417 = 1.643 \times 10^7$ N/m^2

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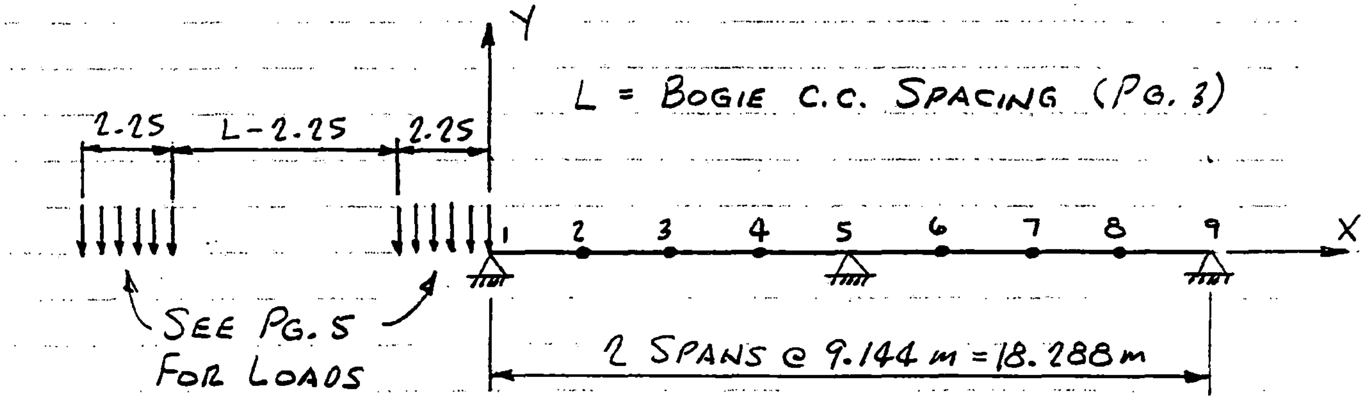
JOB NO. 6869002 DATE 4/16/92 BY RJC CH'K

CUSTOMER MIT M.I. PROJECT MAGLEV

SUBJECT GUIDEWAY SHEET SECTION

DESIGN FOR TWO 9.144 m (30') SPANS



SUMMARY OF RESULTS (d = .8128 m)

1) 140 PASSENGER VEHICLE (SEE PG'S A-40 TO A-54)

a) MAX. DEFLECTION = .0043611 m (NODE 7)
$l/2000 = 9.144/2000 = .004572 \text{ m} > .0043611$

b) MAX. STRESS RANGE
FOR ELEM. 2
$\Delta M = 251450 - (-81734) = 333184 \text{ N-m}$
$\sigma_R = 333184/.01029009 = 3.238 \times 10^7 \text{ N/m}^2$
$< 4.137 \times 10^7$

2) 45 PASSENGER VEHICLE (SEE PG'S A-55 TO A-68)

a) MAX. DEFLECTION = .0022842 m (NODE 7)

b) MAX. STRESS RANGE
$\Delta M = 132310 - (-38682) = 170992 \text{ N-m}$
$\sigma_R = 170992/.01029009 = 1.662 \times 10^7 \text{ N/m}^2$

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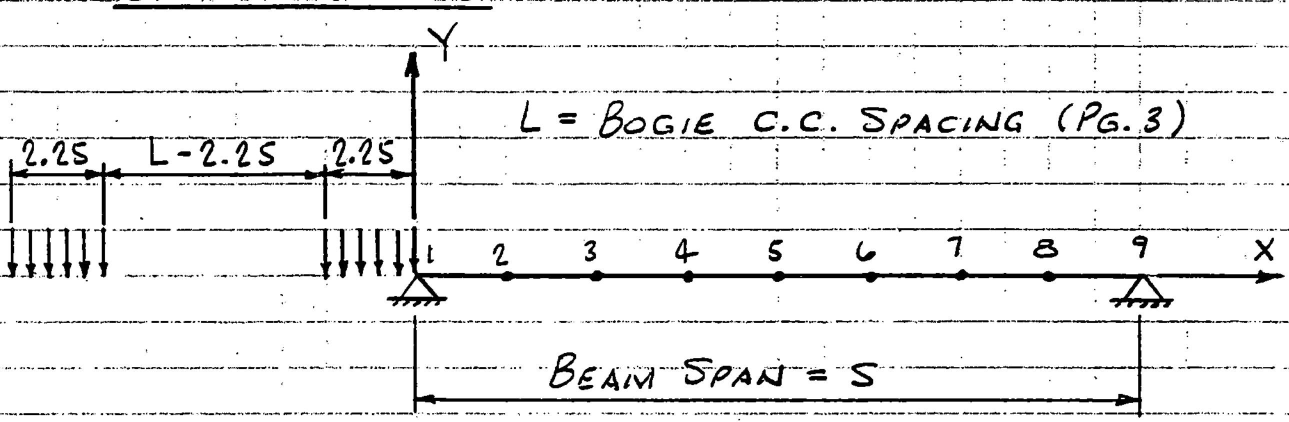
JOB NO. 6869002 DATE 6/25/92 BY RJC CH'K

CUSTOMER MIT MI PROJECT MAGLEV

SUBJECT GUIDEWAY SHEET SECTION

DESIGN FOR 13.716 m (45') & 18.288 m (60') SINGLE SPANS



FROM PRIOR ANALYSES IT IS APPARENT THAT THE LOADS FROM THE 140 PASSENGER VEHICLE CONTROL THE DESIGN. THEREFORE USE $L = 28.651$ m.

SUMMARY OF RESULTS

1) SPAN, $S = 13.716$ m (SEE PG'S A-69 TO A-79)
   REQ'D $d = 1.3208$ m

   MAX. DEFLECTION = .0066517 m (NODE 5)
   $S/2000 = 13.716/2000 = .006858 \text{ m} > .0066517$

   MAX. STRESS RANGE
   FOR ELEM. 4
   $\Delta M = 519830 - (-114710) = 634540$ N-m
   $\sigma_R = 634540/.02213769 = 2.866 \times 10^7 \text{ N/m}^2 < 4.137 \times 10^7 \text{ N/m}^2$

2) SPAN, $S = 18.288$ m (SEE PG'S A-80 TO A-90)
   REQ'D $d = 1.7272$ m
   INCREASE THICKNESS, t_3, OF WEB PLATES TO .0079375 m (.3125 in). SEE PG. 2 FOR DETAILS.

FORM 62-114/A0388175i

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JOB NO. 6869002 DATE 6/25/92 BY RJC CH'K
CUSTOMER MIT MI PROJECT MAGLEV
SUBJECT GUIDEWAY SHEET SECTION

MAX. DEFLECTION = .0090300 m (NODE 5)
$S/2000 = 18.288/2000 = .0091440\ m > .0090300$

MAX. STRESS RANGE
FOR ELEM. 4
$\Delta M = 723650 - (-316030) = 1039680\ N\text{-}m$
$\sigma_R = 1039680/.03728075 = 2.789 \times 10^7\ N/m^2$
$< 4.137 \times 10^7\ N/m^2$

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JOB NO. UB69002 DATE 9/21/92 BY RJC CH'K
CUSTOMER MIT MI PROJECT MAGLEV
SUBJECT GUIDEWAY SHEET SECTION

CHECK ADEQUACY OF BEAM DEPTH ($d = .8128$ m)
FOR SINGLE 9.144 m (30') SPAN:

USE MODEL SHOWN ON PG. 10 WITH $S = 9.144$ m.
USE PROPERTIES OF "MODIFIED" CROSS-SECTION
(SEE PG. A-91 FOR DETAILS).

<u>SUMMARY OF RESULTS</u> (PG'S A-92 TO A-101)

MAX. DEFLECTION = .0060105 m (NODE 5)
$S/2000 = 9.144/2000 = .004572$ m $< .0060105$ <u>N.G.</u>

MAX. STRESS RANGE
FOR ELEM. 4
$\Delta M = 334260 - (-59729) = 393989$ N-m
$\sigma_R = 393989/.01076877 = 3.659 \times 10^7$ N/m^2
$< 4.137 \times 10^7$ N/m^2 <u>OK</u>

FORM 62-114/A0388175i

Section Properties For Guideway Sheet Cross-section (D=.4064 m)

Radius To Inside Of Guideway Sheet, R -	2.100000E+00
Half Angle, ALPHA ---------------------	2.092483E+01
Depth Of Section, D -------------------	4.064000E-01
Thickness Of Guideway Sheet, T1 -------	2.000000E-02
Thickness Of Outer Sheet, T2 ----------	4.762500E-03
Thickness Of Web Plates, T3 -----------	6.350000E-03

Section Properties:

Cross-sectional Area ------------------	4.922755E-02
Centroidal Location In 1-1 Direction --	0.000000E+00
Centroidal Location In 2-2 Direction --	2.163617E+00

Bending About Centroidal Axis Parallel To 1-1 Axis:

Moment Of Inertia ---------------------	1.283436E-03
Section Modulus (Inside) --------------	6.350096E-03
Section Modulus (Outside) -------------	3.744168E-03

Bending About Centroidal Axis Parallel To 2-2 Axis:

Moment Of Inertia ---------------------	1.199579E-02
Section Modulus -----------------------	1.340098E-02

PROGRAM DYNACB

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

STRUCTURAL PARAMETERS

NN	NE	NRN	E	RHO
17	16	5	6.8950E+10	2.7126E+03

NODAL COORDINATES

NODE	X
1	0.0000E+00
2	1.1430E+00
3	2.2860E+00
4	3.4290E+00
5	4.5720E+00
6	5.7150E+00
7	6.8580E+00
8	8.0010E+00
9	9.1440E+00
10	1.0287E+01
11	1.1430E+01
12	1.2573E+01
13	1.3716E+01
14	1.4859E+01
15	1.6002E+01
16	1.7145E+01
17	1.8288E+01

ELEMENT INFORMATION

ELEM.	J	K	AX	ZI	EL
1	1	2	4.9228E-02	1.2834E-03	1.1430E+00
2	2	3	4.9228E-02	1.2834E-03	1.1430E+00
3	3	4	4.9228E-02	1.2834E-03	1.1430E+00
4	4	5	4.9228E-02	1.2834E-03	1.1430E+00
5	5	6	4.9228E-02	1.2834E-03	1.1430E+00
6	6	7	4.9228E-02	1.2834E-03	1.1430E+00
7	7	8	4.9228E-02	1.2834E-03	1.1430E+00
8	8	9	4.9228E-02	1.2834E-03	1.1430E+00
9	9	10	4.9228E-02	1.2834E-03	1.1430E+00
10	10	11	4.9228E-02	1.2834E-03	1.1430E+00
11	11	12	4.9228E-02	1.2834E-03	1.1430E+00
12	12	13	4.9228E-02	1.2834E-03	1.1430E+00
13	13	14	4.9228E-02	1.2834E-03	1.1430E+00
14	14	15	4.9228E-02	1.2834E-03	1.1430E+00
15	15	16	4.9228E-02	1.2834E-03	1.1430E+00
16	16	17	4.9228E-02	1.2834E-03	1.1430E+00

NODAL RESTRAINTS

NODE	NR1	NR2
1	1	0
5	1	0
9	1	0
13	1	0
17	1	0

NUMBER OF DEGREES OF FREEDOM: NDF = 29
NUMBER OF NODAL RESTRAINTS: NNR = 5

OUTPUT KEY FOR MODAL ANALYSIS: IMO = 0

STIFFNESS MATRIX DECOMPOSED

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

MODE	FREQUENCY (Hz)
1	6.1189E+01
2	7.1391E+01
3	9.5625E+01
4	1.2360E+02
5	2.4566E+02
6	2.6677E+02
7	3.1162E+02
8	3.6013E+02
9	5.6062E+02
10	5.9309E+02
11	6.6070E+02
12	7.3072E+02
13	1.0864E+03
14	1.1335E+03
15	1.2407E+03
16	1.3680E+03
17	1.7268E+03
18	1.8288E+03
19	2.0228E+03
20	2.2432E+03
21	2.7306E+03
22	2.9143E+03
23	3.2297E+03
24	3.5800E+03
25	4.0909E+03
26	4.3620E+03
27	4.6759E+03
28	4.8978E+03
29	4.9783E+03

LB-A-4

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

*** LOADING NUMBER 1 OF 1 ***

DYNAMIC PARAMETERS

ISOLVE	NTS	DT	DAMPR
1	1000	5.0000E-04	0.0000E+00

INITIAL CONDITIONS

NNID	NNIV
0	0

APPLIED ACTIONS

NLN	NEL	IML
0	0	12

MOVING LOADS

P	VOP	AOP	SPACING
-2.9648E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.9648E+04	1.3411E+02	0.0000E+00	2.6401E+01
-2.9648E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.9648E+04	1.3411E+02	0.0000E+00	0.0000E+00

GROUND ACCELERATIONS

IGA
0

DIRECT NUMERICAL INTEGRATION

ALPHA = -0.1000 BETA = 0.3025 GAMMA = 0.6000

OUTPUT SELECTION

IWR	IPL	NNO	NEO	NRO
2	1	4	7	5

NODES (DISPL.): 3 7 11 15

ELEMENTS: 2 4 6 8 10 12 14

NODES (REACT.): 1 5 9 13 17

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

*** LOADING NUMBER 1 OF 1 ***

DISPLACEMENT TIME HISTORY FOR NODE 3

	UY	ROTZ
MAXIMUM	7.7914E-04	2.3099E-04
TIME OF MAXIMUM	2.6850E-01	1.6000E-02
MINIMUM	-2.1906E-03	-6.4497E-05
TIME OF MINIMUM	2.3900E-01	3.5500E-02

DISPLACEMENT TIME HISTORY FOR NODE 7

	UY	ROTZ
MAXIMUM	8.6354E-04	1.4713E-04
TIME OF MAXIMUM	2.4050E-01	8.9000E-02
MINIMUM	-1.5271E-03	-1.8851E-04
TIME OF MINIMUM	5.8500E-02	2.6500E-02

DISPLACEMENT TIME HISTORY FOR NODE 11

	UY	ROTZ
MAXIMUM	7.1649E-04	1.8183E-04
TIME OF MAXIMUM	1.2400E-01	1.2600E-01
MINIMUM	-1.6541E-03	-1.5143E-04
TIME OF MINIMUM	3.0700E-01	6.1500E-02

DISPLACEMENT TIME HISTORY FOR NODE 15

	UY	ROTZ
MAXIMUM	7.8645E-04	6.4285E-05
TIME OF MAXIMUM	3.0750E-01	3.3000E-01
MINIMUM	-2.0233E-03	-2.3428E-04
TIME OF MINIMUM	1.2700E-01	3.4950E-01

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

*** LOADING NUMBER 1 OF 1 ***

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 2

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	6.7590E+04	1.4386E+04	4.7194E+04	9.8257E+04
TIME OF MAXIMUM	2.3900E-01	2.6700E-01	1.7000E-02	2.3900E-01
MINIMUM	-1.6146E+04	-8.0682E+04	-2.7389E+04	-2.7159E+04
TIME OF MINIMUM	8.5000E-03	2.3700E-01	2.4750E-01	2.6850E-01

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 4

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	7.5129E+03	3.8136E+04	1.2077E+05	1.5057E+04
TIME OF MAXIMUM	4.1250E-01	2.6850E-01	3.4000E-02	9.0000E-02
MINIMUM	-9.4995E+04	-5.0090E+04	-9.9227E+03	-6.4427E+04
TIME OF MINIMUM	2.5500E-02	2.4250E-01	4.1250E-01	2.5500E-02

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 6

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	7.5455E+04	4.8969E+04	3.6134E+04	7.5059E+04
TIME OF MAXIMUM	5.9500E-02	2.4050E-01	5.1000E-02	5.8000E-02
MINIMUM	-1.7811E+04	-4.8720E+04	-3.6067E+04	-3.1092E+04
TIME OF MINIMUM	3.0600E-01	2.6950E-01	6.8000E-02	2.4050E-01

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 8

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	2.2804E+04	3.9787E+04	1.1839E+05	2.0799E+04
TIME OF MAXIMUM	2.4000E-01	3.0550E-01	2.8150E-01	2.6500E-02
MINIMUM	-7.8409E+04	-4.6472E+04	-2.4090E+04	-5.3558E+04
TIME OF MINIMUM	5.9500E-02	2.8000E-01	2.3950E-01	6.2000E-02

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 10

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	7.9483E+04	3.5486E+04	3.5418E+04	7.9460E+04
TIME OF MAXIMUM	9.3500E-02	2.7900E-01	8.5000E-02	3.0700E-01
MINIMUM	-1.9860E+04	-4.6647E+04	-3.5771E+04	-2.5502E+04
TIME OF MINIMUM	1.2500E-01	3.0400E-01	3.1600E-01	3.4700E-01

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 12

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	1.6123E+04	4.5017E+04	1.1334E+05	1.5250E+04
TIME OF MAXIMUM	2.8050E-01	1.2450E-01	1.0200E-01	6.0000E-02
MINIMUM	-7.8229E+04	-4.7845E+04	-1.8167E+04	-6.4102E+04
TIME OF MINIMUM	3.0700E-01	3.1050E-01	2.8100E-01	1.2550E-01

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 14

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	9.0035E+04	3.8438E+04	2.7211E+04	9.2233E+04
TIME OF MAXIMUM	1.2800E-01	3.0850E-01	1.1900E-01	1.2600E-01
MINIMUM	-7.6539E+03	-4.8044E+04	-4.6574E+04	-2.7344E+04
TIME OF MINIMUM	2.7350E-01	1.2400E-01	3.5000E-01	3.0750E-01

LB-A-7

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

*** LOADING NUMBER 1 OF 1 ***

REACTION FORCE TIME HISTORY FOR NODE 1

	FY	MZ
MAXIMUM	1.0492E+05	8.3370E+01
TIME OF MAXIMUM	1.7000E-02	2.1000E-02
MINIMUM	-1.3019E+04	-1.6493E+02
TIME OF MINIMUM	2.6700E-01	5.0000E-04

REACTION FORCE TIME HISTORY FOR NODE 5

	FY	MZ
MAXIMUM	1.4819E+05	8.0835E+01
TIME OF MAXIMUM	3.9000E-02	2.6900E-01
MINIMUM	-2.0927E+04	-1.3258E+02
TIME OF MINIMUM	9.0000E-02	2.4800E-01

REACTION FORCE TIME HISTORY FOR NODE 9

	FY	MZ
MAXIMUM	1.4276E+05	8.9151E+01
TIME OF MAXIMUM	7.4500E-02	6.4500E-02
MINIMUM	-2.8991E+04	-1.2240E+02
TIME OF MINIMUM	2.6500E-02	8.5000E-02

REACTION FORCE TIME HISTORY FOR NODE 13

	FY	MZ
MAXIMUM	1.4550E+05	7.9421E+01
TIME OF MAXIMUM	1.1100E-01	3.3700E-01
MINIMUM	-2.1541E+04	-1.2763E+02
TIME OF MINIMUM	6.0000E-02	1.0250E-01

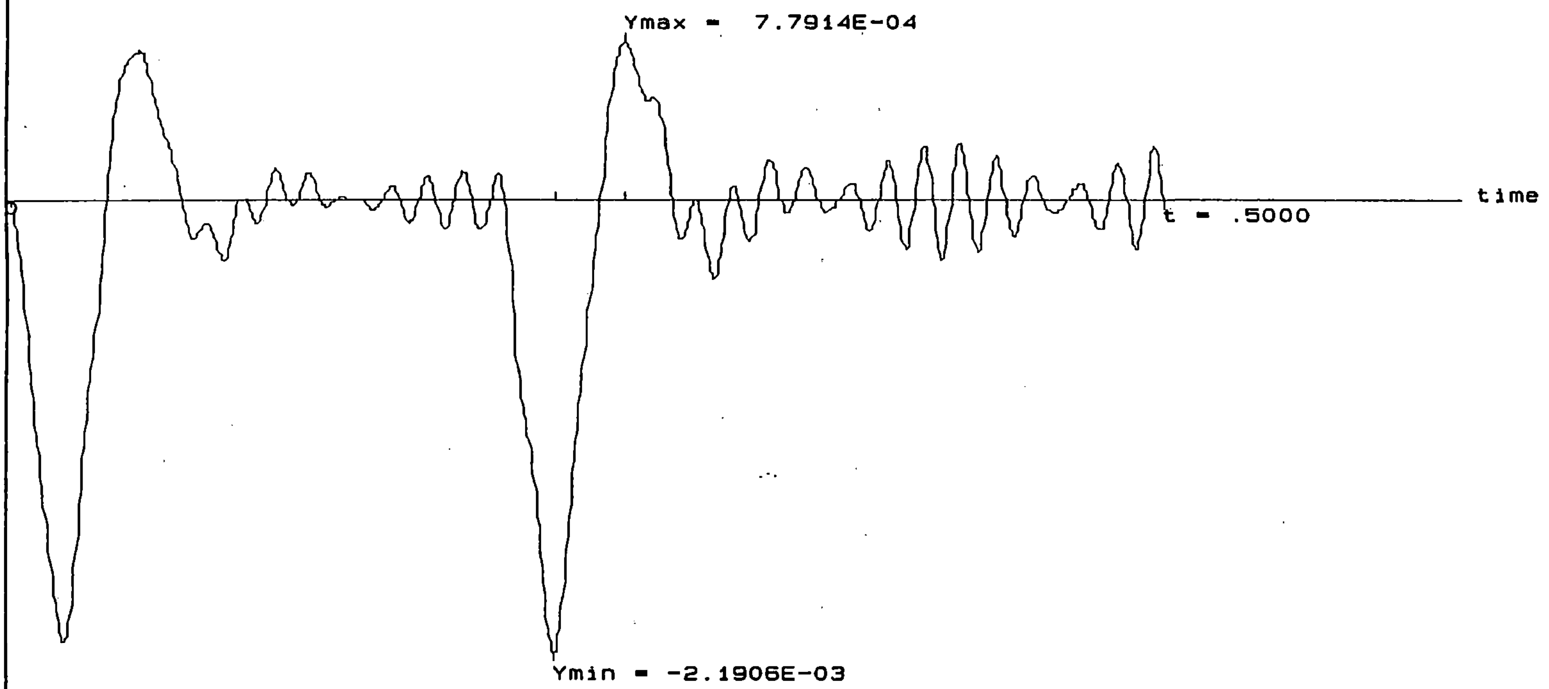
REACTION FORCE TIME HISTORY FOR NODE 17

	FY	MZ
MAXIMUM	1.1083E+05	7.9729E+01
TIME OF MAXIMUM	3.4950E-01	3.4600E-01
MINIMUM	-1.3365E+04	-1.6884E+02
TIME OF MINIMUM	3.0700E-01	1.5300E-01

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Node = 3

Displacement : Ymin = -2.1906E-03 (t = .2390) Ymax = 7.7914E-04 (t = .2685)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

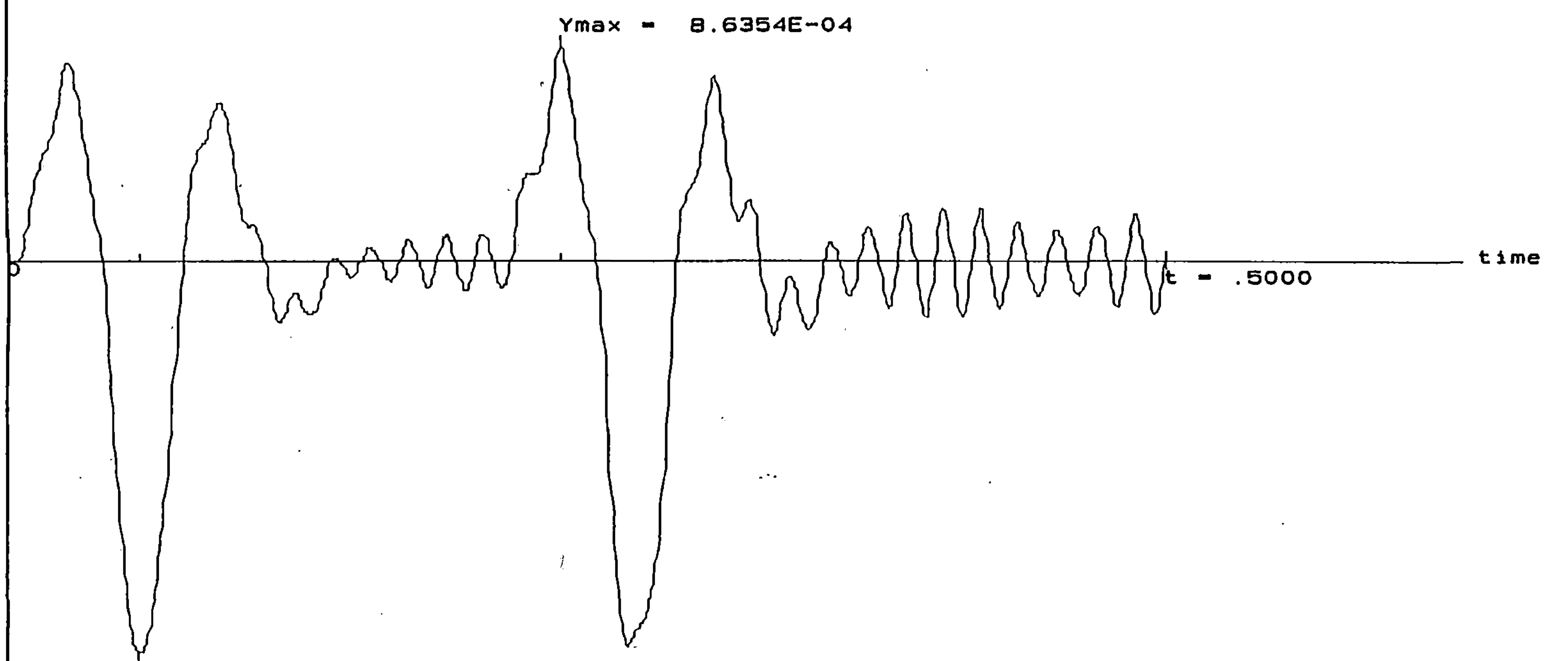
Date: 4/ 1/1992
Time: 15: 7: 42

C8-A-8

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Node = 7

Displacement : Ymin = -1.5271E-03 (t = .0585) Ymax = 8.6354E-04 (t = .2405)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

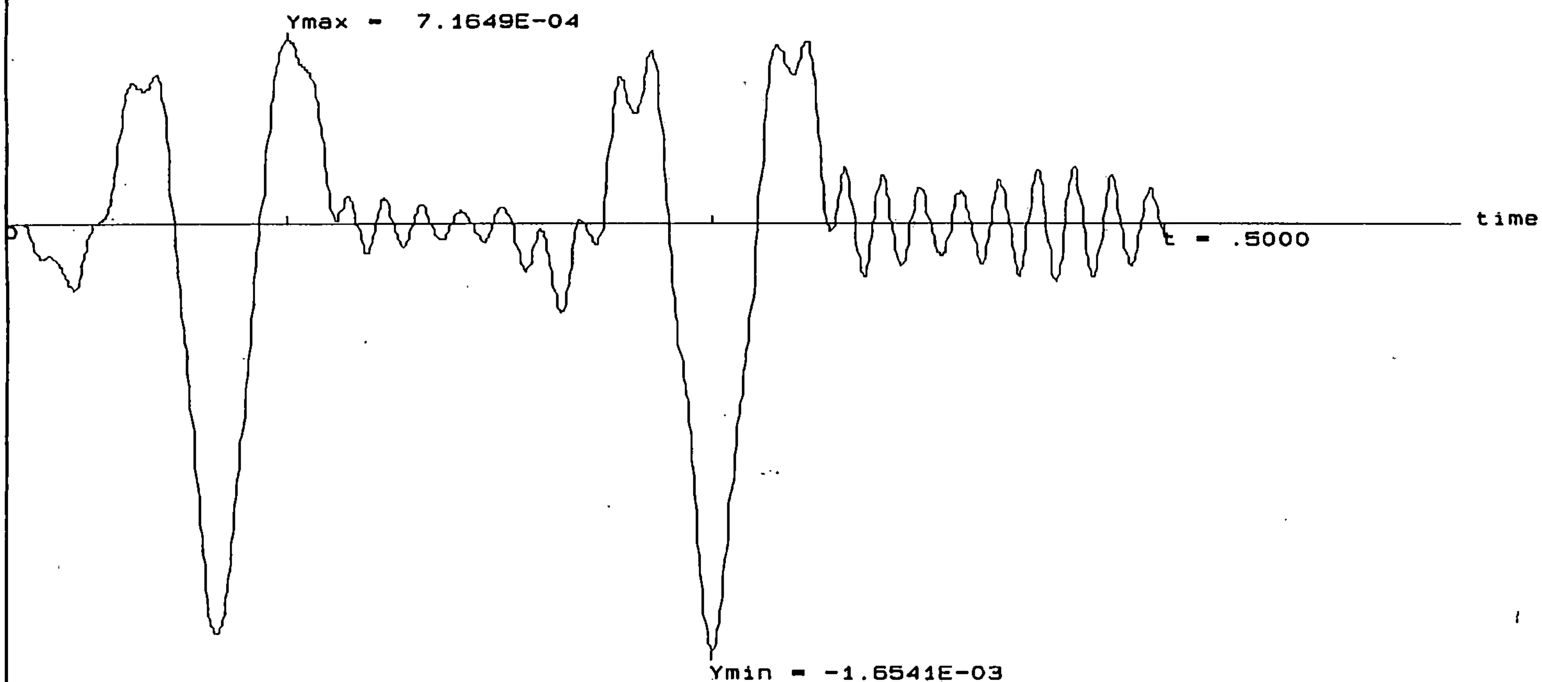
Date: 4/ 1/1992
Time: 15: 7: 42

LB-A-9

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Node = 11

Displacement : Ymin = -1.6541E-03 (t = .3070) Ymax = 7.1649E-04 (t = .1240)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

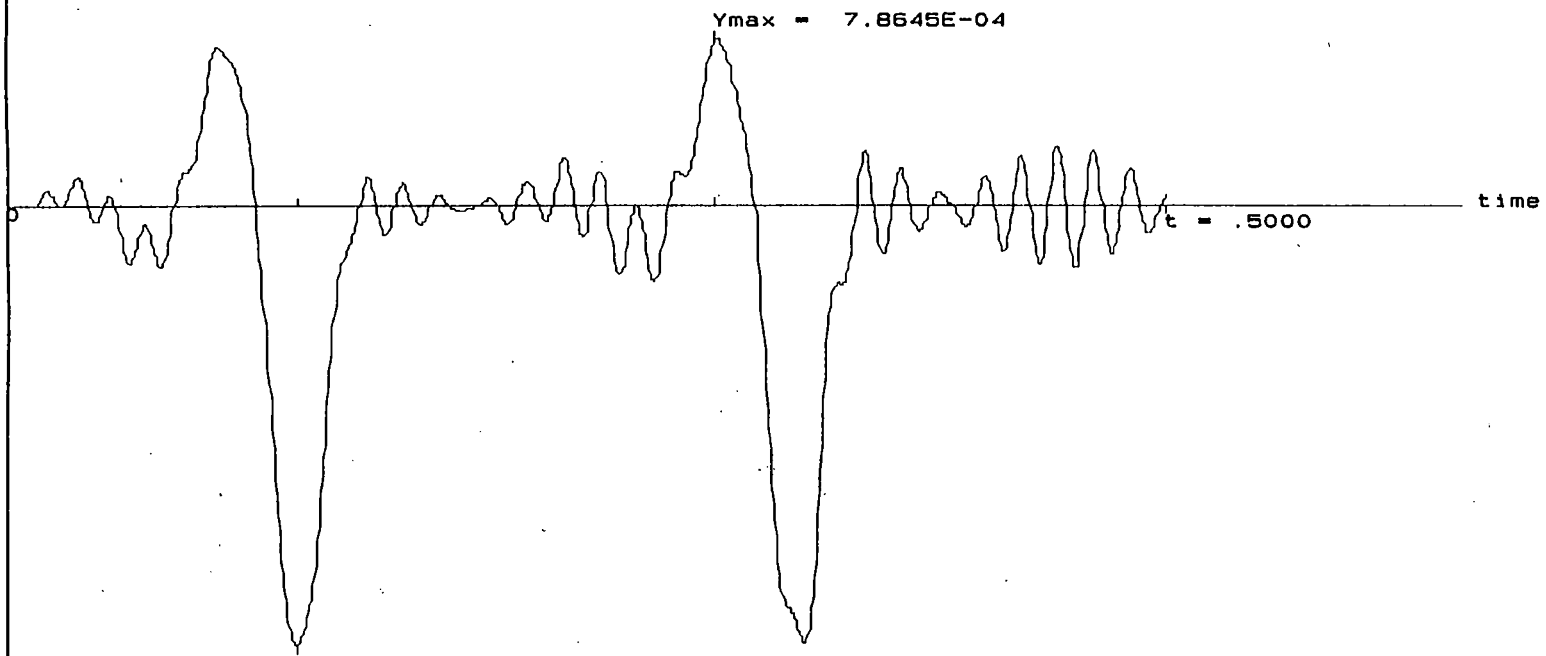
Date: 4/ 1/1992
Time: 15: 7: 42

LB-A-10

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Node = 15

Displacement : Ymin = -2.0233E-03 (t = .1270) Ymax = 7.8645E-04 (t = .3075)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

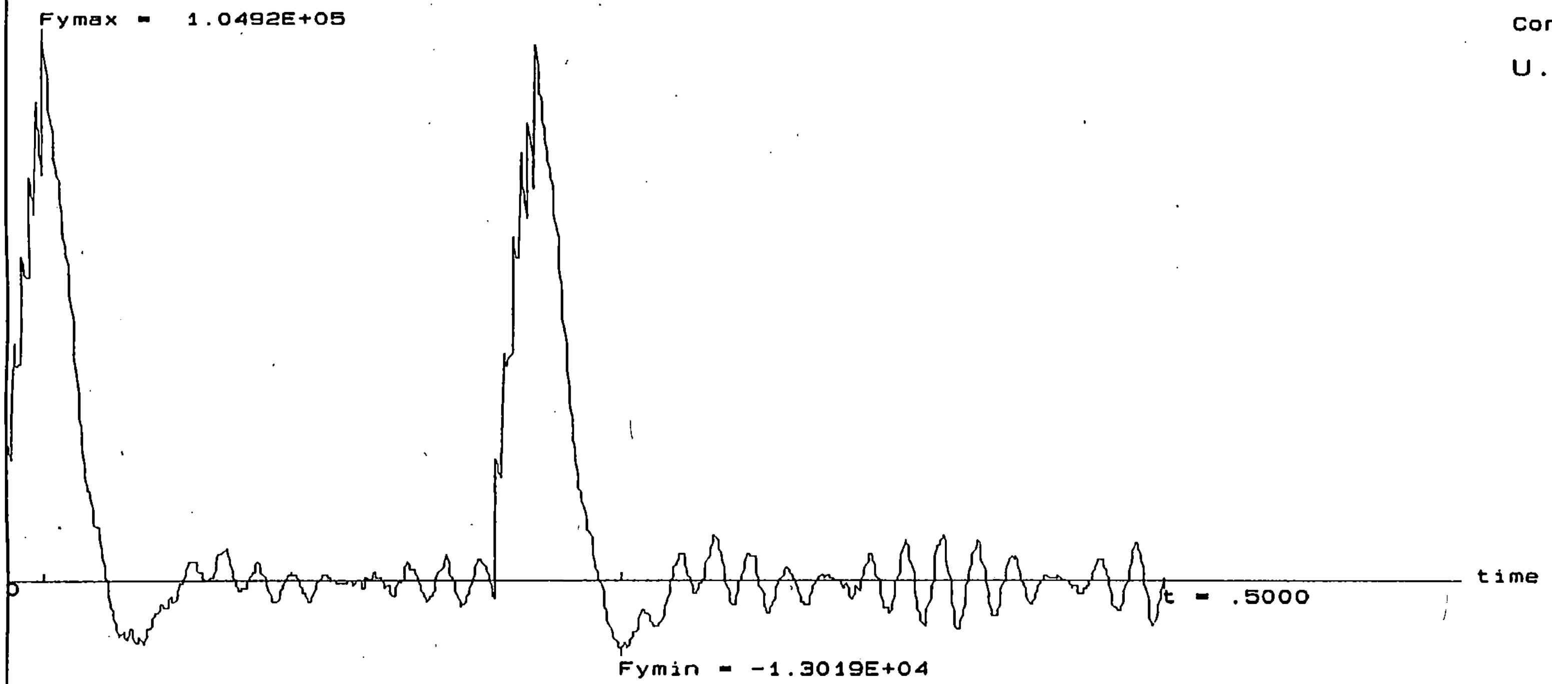
Date: 4/ 1/1992
Time: 15: 7: 42

A-11

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Node = 1

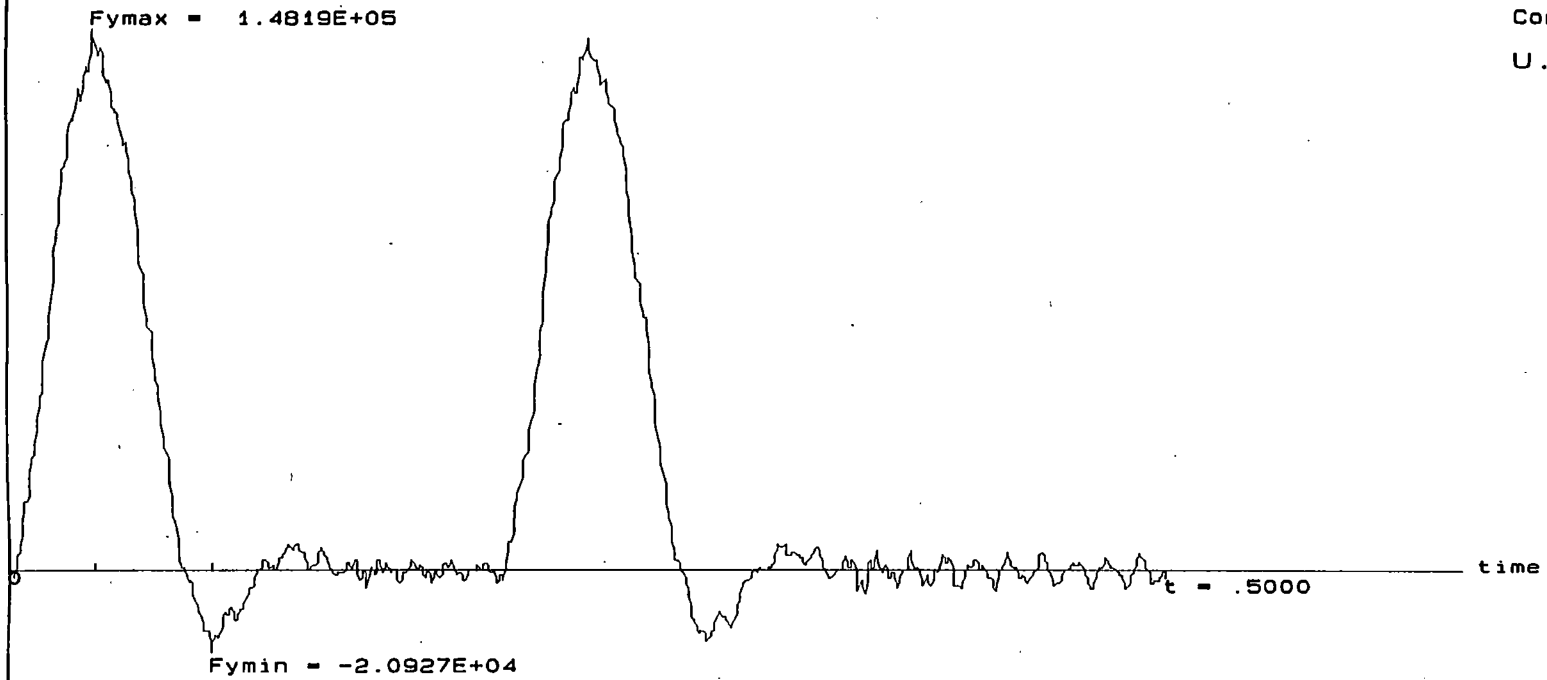
Reaction : Fymin = -1.3019E+04 (t = .2670) Fymax = 1.0492E+05 (t = .0170)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 7: 42

LB-A-12

DYNACB
Dynamic Analysis
of
Continuous Beams
U.E. & C.



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Node = 5

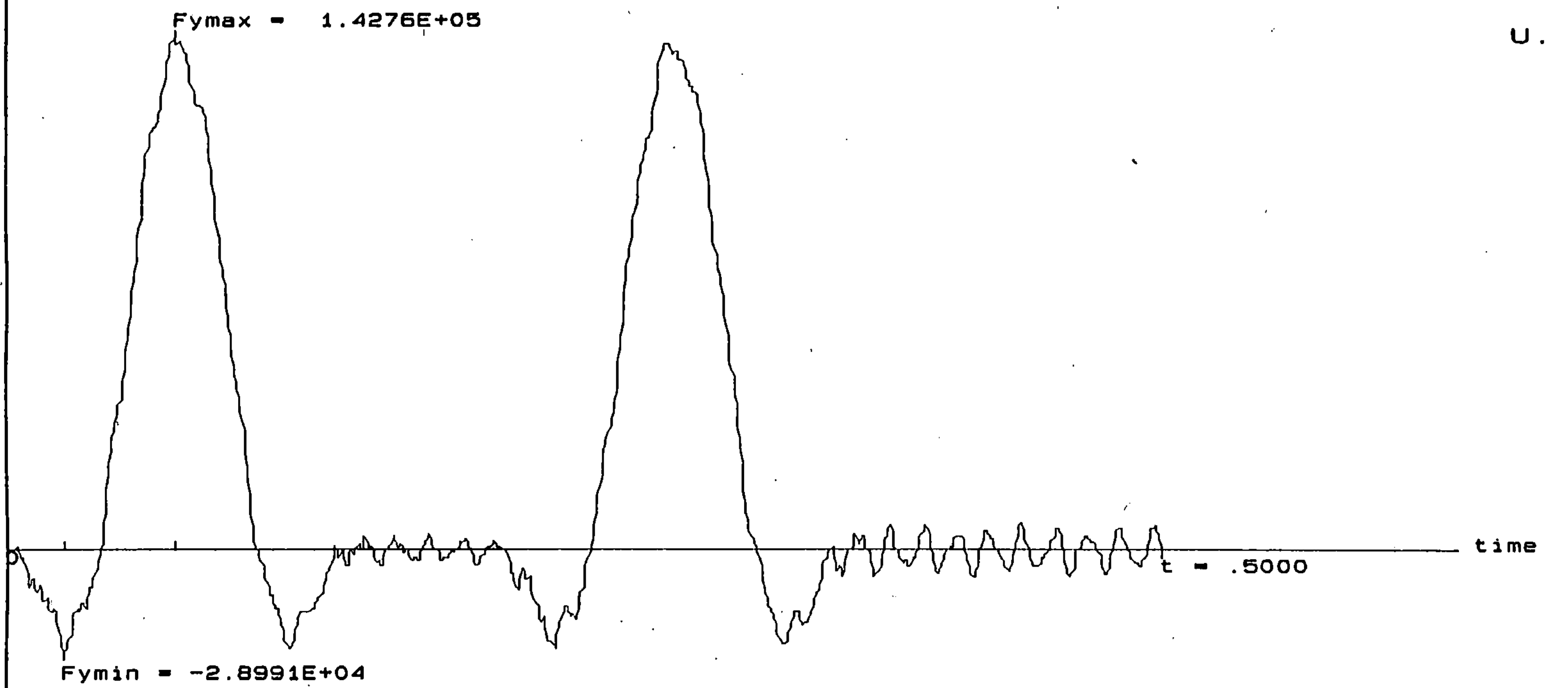
Reaction : Fymin = -2.0927E+04 (t = .0900) Fymax = 1.4819E+05 (t = .0390)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 7: 42

LB-A-13

DYNACB
Dynamic Analysis
of
Continuous Beams
U.E. & C.



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

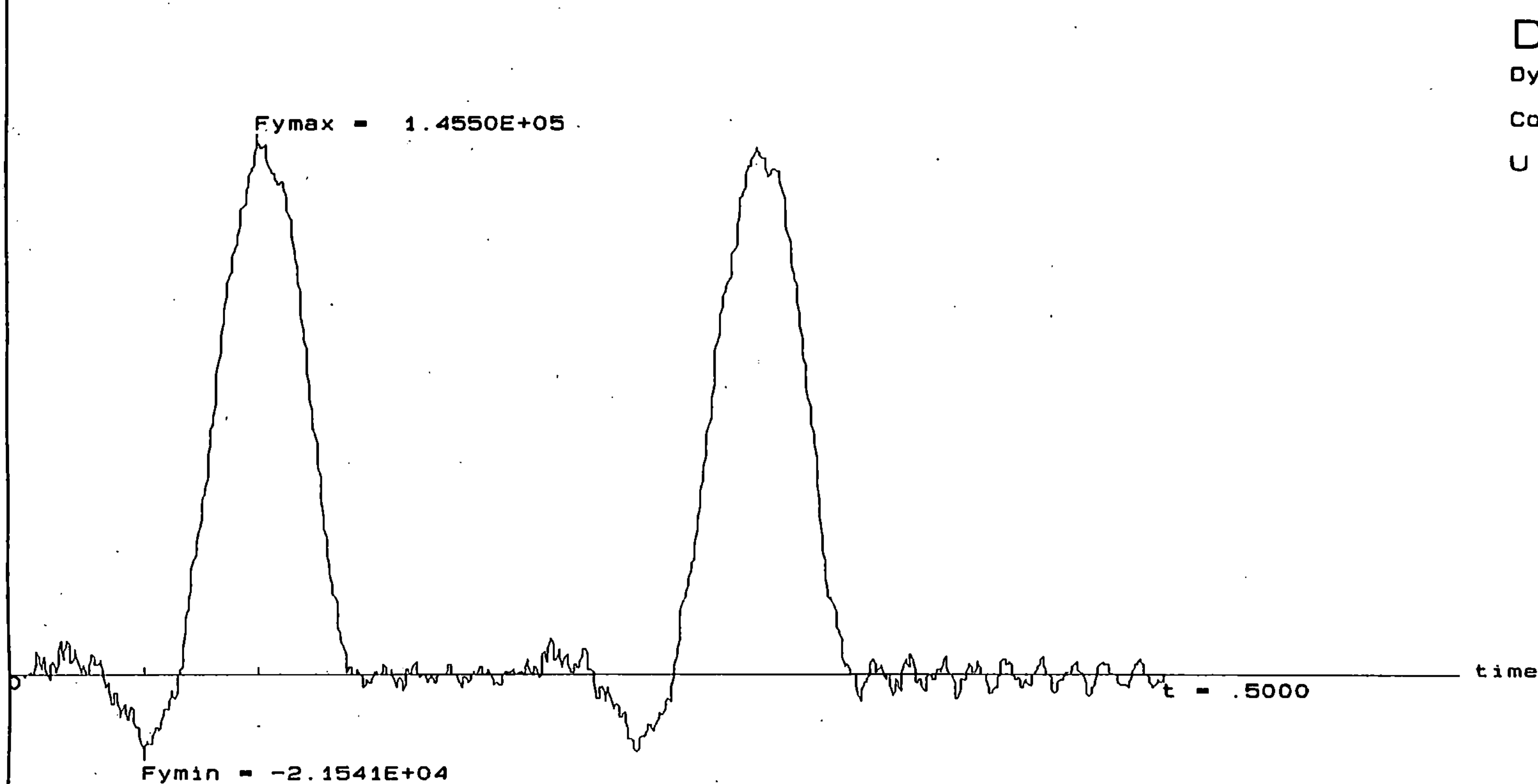
Results at Node = 9

Reaction : Fymin = -2.8991E+04 (t = .0265) Fymax = 1.4276E+05 (t = .0745)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 7: 42

LB-A-14



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Node = 13

Reaction : Fymin = -2.1541E+04 (t = .0600) Fymax = 1.4550E+05 (t = .1110)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

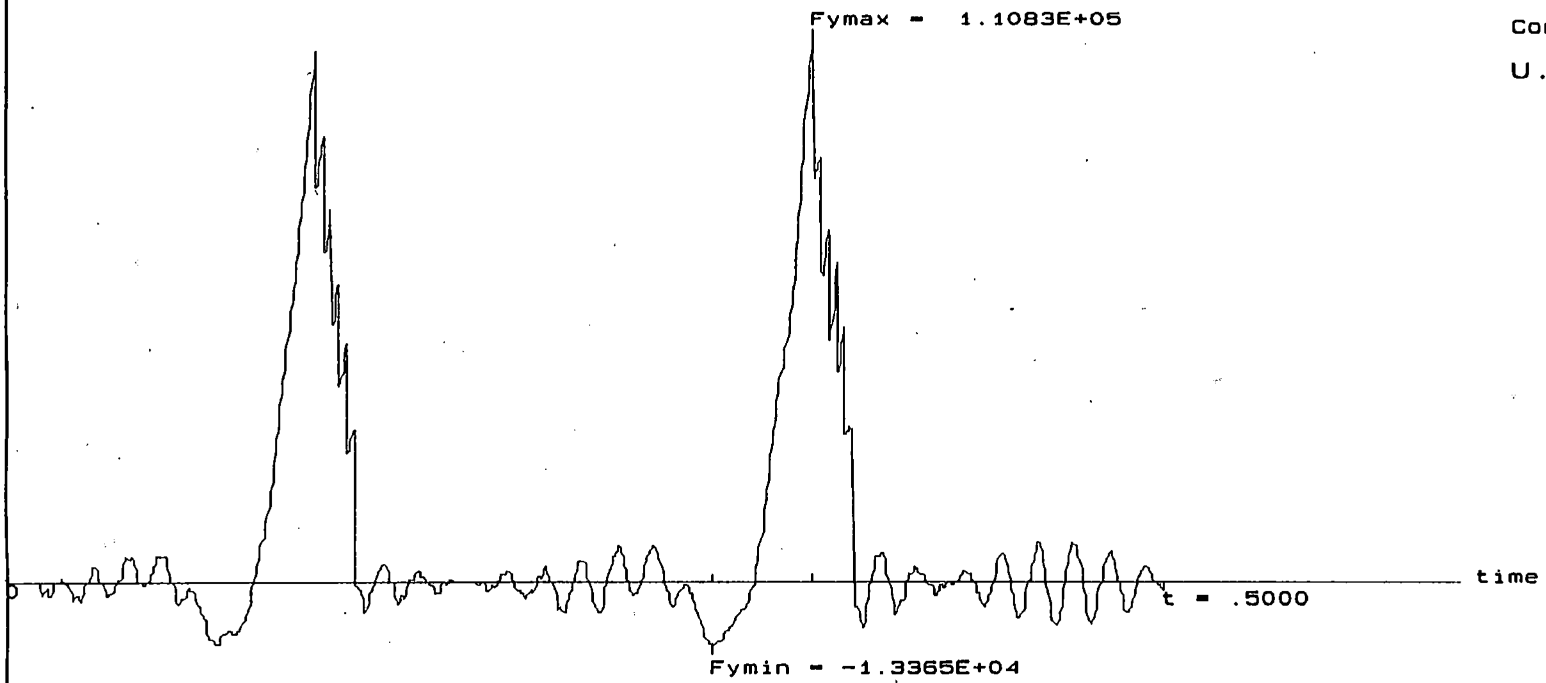
Date: 4/ 1/1992
Time: 15: 7: 42

A-15

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

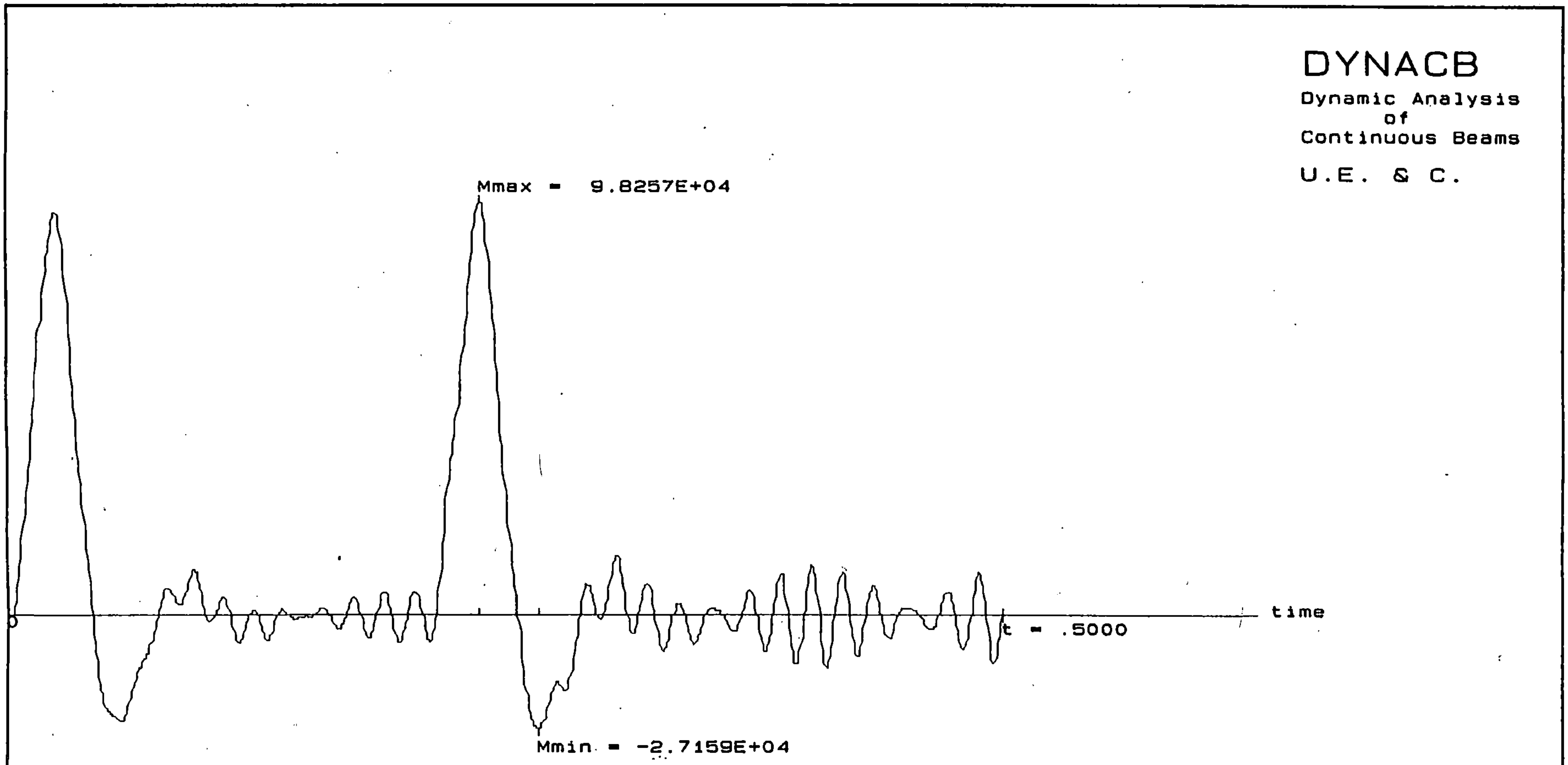
Results at Node = 17

Reaction : Fymin = -1.3365E+04 (t = .3070) Fymax = 1.1083E+05 (t = .3495)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 7: 42

LB-A-16



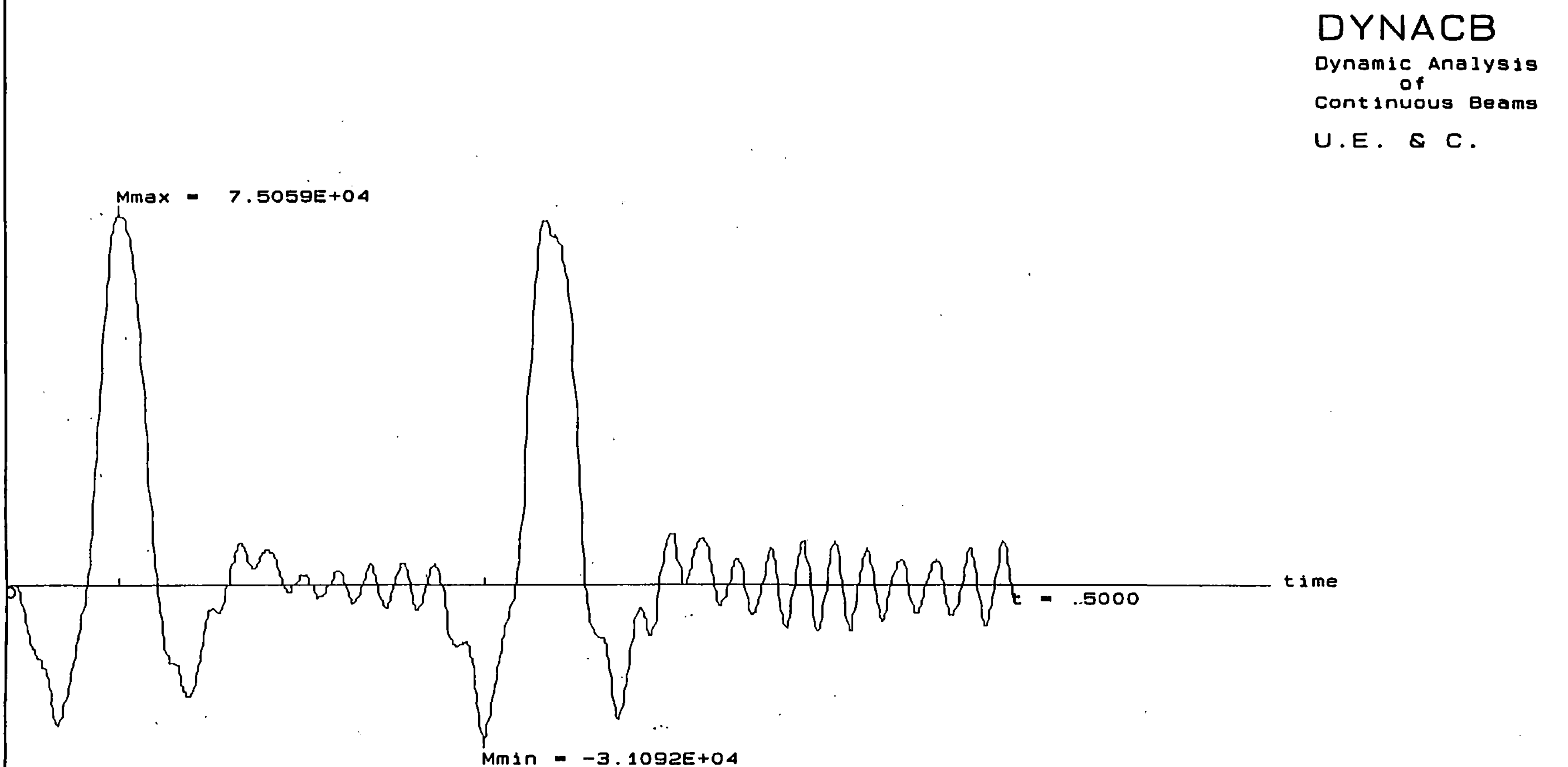
Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Elem = 2 (End Node)

Bending Moment : Mmin = -2.7159E+04 (t = .2685) Mmax = 9.8257E+04 (t = .2390)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 7: 42



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Elem = 6 (End Node)

Bending Moment : Mmin = -3.1092E+04 (t = .2405) Mmax = 7.5059E+04 (t = .0580)

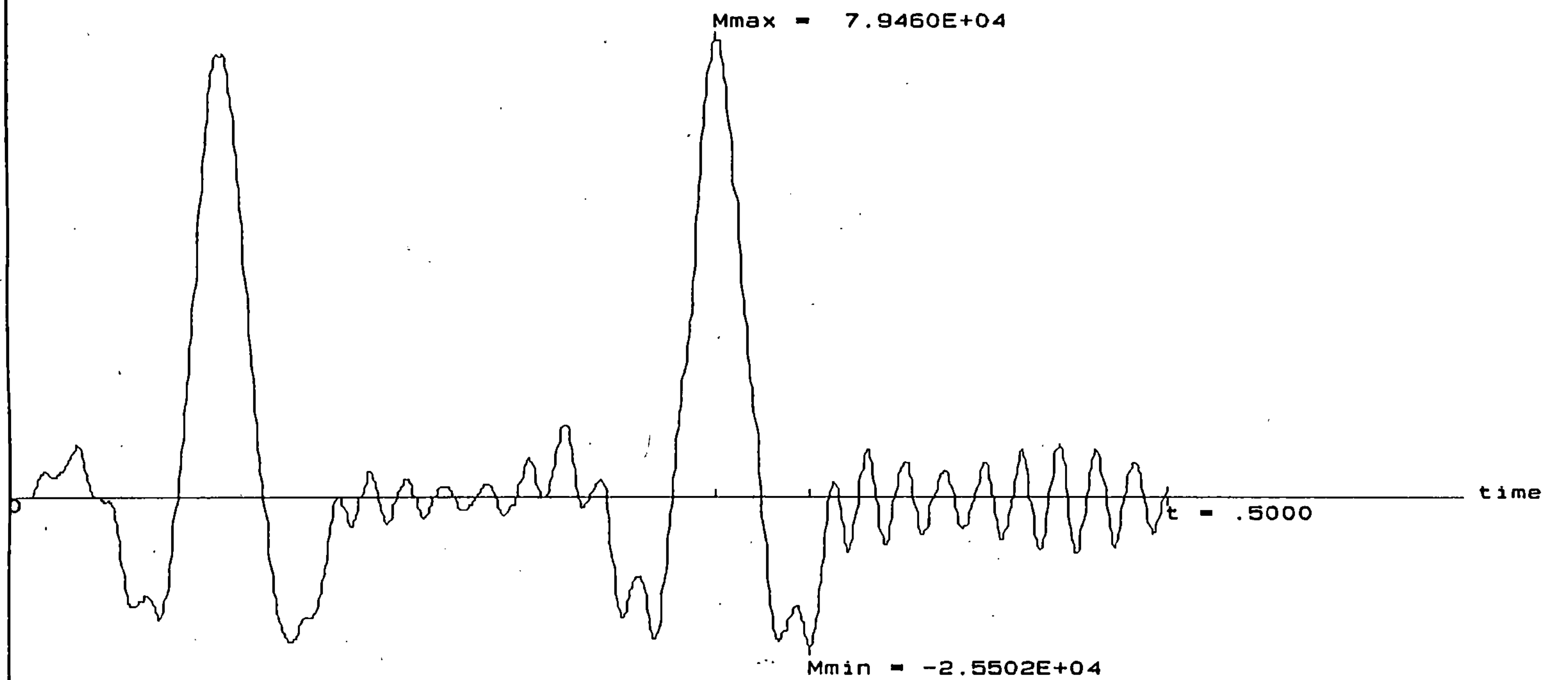
Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 7: 42

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Elem = 10 (End Node)

Bending Moment : Mmin = -2.5502E+04 (t = .3470) Mmax = 7.9460E+04 (t = .3070)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

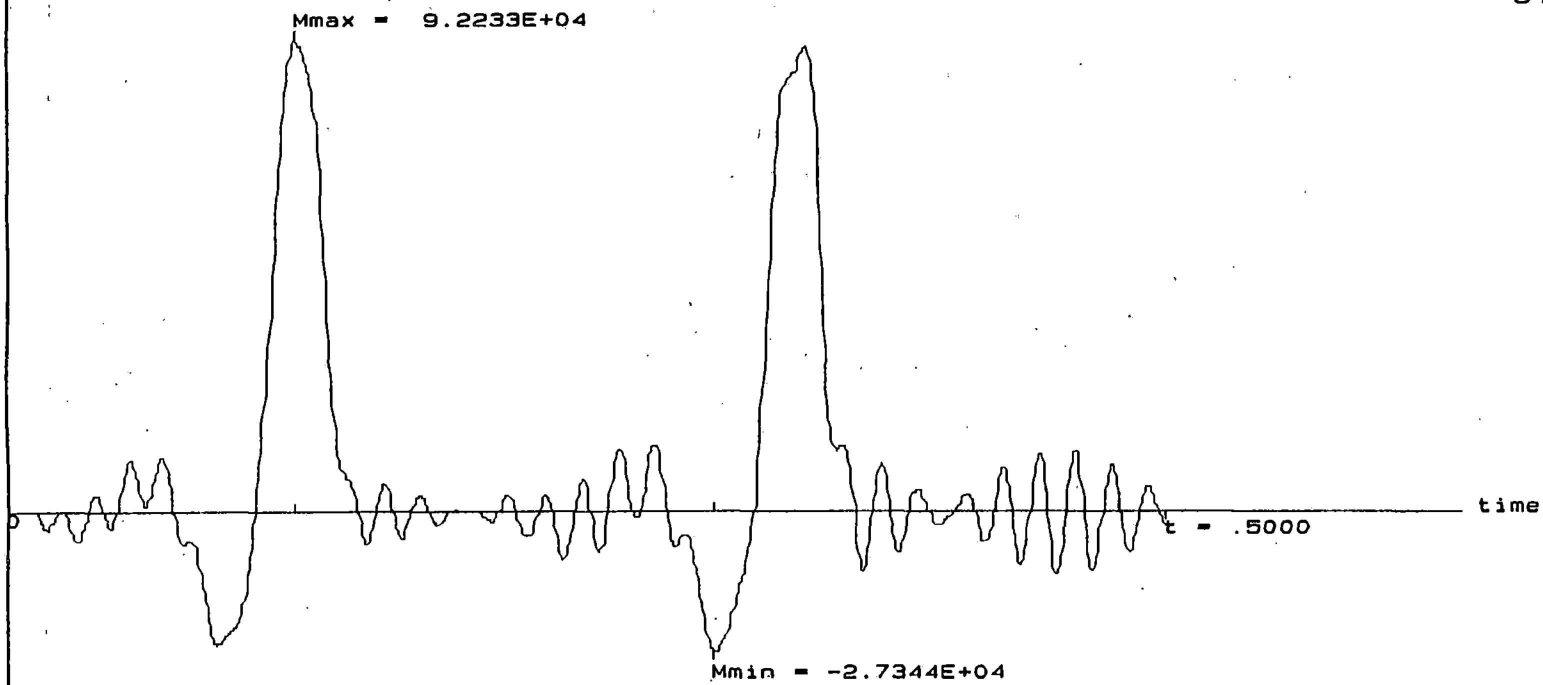
Date: 4/ 1/1992
Time: 15: 7: 42

CB-A-19

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Elem = 14 (End Node)

Bending Moment : Mmin = -2.7344E+04 (t = .3075) Mmax = 9.2233E+04 (t = .1260)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 7: 42

LB-A-20

LB - A - 21

PROGRAM DYNACB

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

STRUCTURAL PARAMETERS

NN	NE	NRN	E	RHO
17	16	5	6.8950E+10	2.7126E+03

NODAL COORDINATES

NODE	X
1	0.0000E+00
2	1.1430E+00
3	2.2860E+00
4	3.4290E+00
5	4.5720E+00
6	5.7150E+00
7	6.8580E+00
8	8.0010E+00
9	9.1440E+00
10	1.0287E+01
11	1.1430E+01
12	1.2573E+01
13	1.3716E+01
14	1.4859E+01
15	1.6002E+01
16	1.7145E+01
17	1.8288E+01

ELEMENT INFORMATION

ELEM.	J	K	AX	ZI	EL
1	1	2	4.9228E-02	1.2834E-03	1.1430E+00
2	2	3	4.9228E-02	1.2834E-03	1.1430E+00
3	3	4	4.9228E-02	1.2834E-03	1.1430E+00
4	4	5	4.9228E-02	1.2834E-03	1.1430E+00
5	5	6	4.9228E-02	1.2834E-03	1.1430E+00
6	6	7	4.9228E-02	1.2834E-03	1.1430E+00
7	7	8	4.9228E-02	1.2834E-03	1.1430E+00
8	8	9	4.9228E-02	1.2834E-03	1.1430E+00
9	9	10	4.9228E-02	1.2834E-03	1.1430E+00
10	10	11	4.9228E-02	1.2834E-03	1.1430E+00
11	11	12	4.9228E-02	1.2834E-03	1.1430E+00
12	12	13	4.9228E-02	1.2834E-03	1.1430E+00
13	13	14	4.9228E-02	1.2834E-03	1.1430E+00
14	14	15	4.9228E-02	1.2834E-03	1.1430E+00
15	15	16	4.9228E-02	1.2834E-03	1.1430E+00
16	16	17	4.9228E-02	1.2834E-03	1.1430E+00

NODAL RESTRAINTS

NODE	NR1	NR2
1	1	0
5	1	0
9	1	0
13	1	0
17	1	0

NUMBER OF DEGREES OF FREEDOM: NDF = 29
NUMBER OF NODAL RESTRAINTS: NNR = 5

OUTPUT KEY FOR MODAL ANALYSIS: IMO = 0

STIFFNESS MATRIX DECOMPOSED

LB-A-22

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

MODE	FREQUENCY (Hz)
1	6.1189E+01
2	7.1391E+01
3	9.5625E+01
4	1.2360E+02
5	2.4566E+02
6	2.6677E+02
7	3.1162E+02
8	3.6013E+02
9	5.6062E+02
10	5.9309E+02
11	6.6070E+02
12	7.3072E+02
13	1.0864E+03
14	1.1335E+03
15	1.2407E+03
16	1.3680E+03
17	1.7268E+03
18	1.8288E+03
19	2.0228E+03
20	2.2432E+03
21	2.7306E+03
22	2.9143E+03
23	3.2297E+03
24	3.5800E+03
25	4.0909E+03
26	4.3620E+03
27	4.6759E+03
28	4.8978E+03
29	4.9783E+03

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

*** LOADING NUMBER 1 OF 1 ***

DYNAMIC PARAMETERS

ISOLVE	NTS	DT	DAMPR
1	1000	5.0000E-04	0.0000E+00

INITIAL CONDITIONS

NNID	NNIV
0	0

APPLIED ACTIONS

NLN	NEL	IML
0	0	12

MOVING LOADS

P	VOP	AOP	SPACING
-1.4824E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.4824E+04	1.3411E+02	0.0000E+00	1.0856E+01
-1.4824E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.4824E+04	1.3411E+02	0.0000E+00	0.0000E+00

GROUND ACCELERATIONS

IGA
0

DIRECT NUMERICAL INTEGRATION

ALPHA = -0.1000 BETA = 0.3025 GAMMA = 0.6000

OUTPUT SELECTION

IWR	IPL	NNO	NEO	NRO
2	1	4	7	5

NODES (DISPL.): 3 7 11 15

ELEMENTS: 2 4 6 8 10 12 14

NODES (REACT.): 1 5 9 13 17

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

*** LOADING NUMBER 1 OF 1 ***

DISPLACEMENT TIME HISTORY FOR NODE 3

	UY	ROTZ
MAXIMUM	3.7110E-04	1.1849E-04
TIME OF MAXIMUM	1.5500E-01	1.1400E-01
MINIMUM	-1.0688E-03	-3.2249E-05
TIME OF MINIMUM	2.5500E-02	3.5500E-02

DISPLACEMENT TIME HISTORY FOR NODE 7

	UY	ROTZ
MAXIMUM	3.9743E-04	7.7812E-05
TIME OF MAXIMUM	2.7000E-02	1.8750E-01
MINIMUM	-7.6354E-04	-1.2299E-04
TIME OF MINIMUM	5.8500E-02	1.2450E-01

DISPLACEMENT TIME HISTORY FOR NODE 11

	UY	ROTZ
MAXIMUM	3.6181E-04	1.2033E-04
TIME OF MAXIMUM	2.1950E-01	1.2600E-01
MINIMUM	-8.2670E-04	-7.7695E-05
TIME OF MINIMUM	1.9100E-01	1.5950E-01

DISPLACEMENT TIME HISTORY FOR NODE 15

	UY	ROTZ
MAXIMUM	3.9748E-04	3.5397E-05
TIME OF MAXIMUM	1.9000E-01	2.1400E-01
MINIMUM	-9.7457E-04	-1.2158E-04
TIME OF MINIMUM	2.2250E-01	1.3650E-01

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

*** LOADING NUMBER 1 OF 1 ***

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 2

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	3.3006E+04	7.0212E+03	2.3661E+04	4.8671E+04
TIME OF MAXIMUM	2.5500E-02	1.5600E-01	1.1450E-01	1.2450E-01
MINIMUM	-8.0731E+03	-3.9441E+04	-1.3491E+04	-1.2863E+04
TIME OF MINIMUM	8.5000E-03	2.3500E-02	3.4000E-02	1.5550E-01

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 4

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	4.2967E+03	1.8630E+04	6.0386E+04	7.9010E+03
TIME OF MAXIMUM	2.0000E-01	1.5350E-01	3.4000E-02	1.8850E-01
MINIMUM	-4.8180E+04	-2.4606E+04	-5.4849E+03	-3.5040E+04
TIME OF MINIMUM	1.2300E-01	2.9000E-02	2.0000E-01	1.2300E-01

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 6

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	3.7728E+04	2.4902E+04	1.8067E+04	3.7530E+04
TIME OF MAXIMUM	5.9500E-02	1.2500E-01	5.1000E-02	5.8000E-02
MINIMUM	-8.9354E+03	-2.4085E+04	-1.8033E+04	-1.4121E+04
TIME OF MINIMUM	1.9000E-01	1.5350E-01	6.8000E-02	2.7000E-02

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 8

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	1.4475E+04	1.9681E+04	5.7983E+04	2.0408E+04
TIME OF MAXIMUM	1.2450E-01	1.9050E-01	6.8000E-02	1.2450E-01
MINIMUM	-3.9204E+04	-2.3060E+04	-1.5004E+04	-2.7407E+04
TIME OF MINIMUM	5.9500E-02	1.6400E-01	1.2600E-01	1.8700E-01

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 10

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	3.9742E+04	1.7687E+04	1.7709E+04	3.9716E+04
TIME OF MAXIMUM	9.3500E-02	6.1500E-02	8.5000E-02	1.9000E-01
MINIMUM	-1.2851E+04	-2.2832E+04	-1.8841E+04	-1.2613E+04
TIME OF MINIMUM	1.2400E-01	1.8800E-01	2.0000E-01	2.1900E-01

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 12

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	7.7461E+03	2.2546E+04	5.6660E+04	8.2685E+03
TIME OF MAXIMUM	1.6500E-01	2.2150E-01	1.0200E-01	1.5800E-01
MINIMUM	-3.8674E+04	-2.3515E+04	-8.8215E+03	-3.5130E+04
TIME OF MINIMUM	1.9100E-01	9.7000E-02	1.6600E-01	1.2450E-01

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 14

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	4.4998E+04	1.8930E+04	1.3913E+04	4.4578E+04
TIME OF MAXIMUM	1.2800E-01	1.9150E-01	2.1700E-01	2.2350E-01
MINIMUM	-4.8932E+03	-2.4177E+04	-2.3666E+04	-1.4077E+04
TIME OF MINIMUM	1.5800E-01	2.1900E-01	2.3400E-01	1.9000E-01

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

*** LOADING NUMBER 1 OF 1 ***

REACTION FORCE TIME HISTORY FOR NODE 1

	FY	MZ
MAXIMUM	5.2461E+04	4.4531E+01
TIME OF MAXIMUM	1.7000E-02	1.1900E-01
MINIMUM	-6.3952E+03	-8.2464E+01
TIME OF MINIMUM	1.5600E-01	5.0000E-04

REACTION FORCE TIME HISTORY FOR NODE 5

	FY	MZ
MAXIMUM	7.7339E+04	3.9829E+01
TIME OF MAXIMUM	1.3700E-01	5.5500E-02
MINIMUM	-1.0944E+04	-6.4778E+01
TIME OF MINIMUM	1.8850E-01	1.3200E-01

REACTION FORCE TIME HISTORY FOR NODE 9

	FY	MZ
MAXIMUM	7.2393E+04	4.4575E+01
TIME OF MAXIMUM	1.7100E-01	6.4500E-02
MINIMUM	-2.8162E+04	-6.5116E+01
TIME OF MINIMUM	1.2450E-01	1.8300E-01

REACTION FORCE TIME HISTORY FOR NODE 13

	FY	MZ
MAXIMUM	7.6109E+04	4.1540E+01
TIME OF MAXIMUM	1.1100E-01	1.2350E-01
MINIMUM	-1.1481E+04	-6.6541E+01
TIME OF MINIMUM	1.5800E-01	2.1700E-01

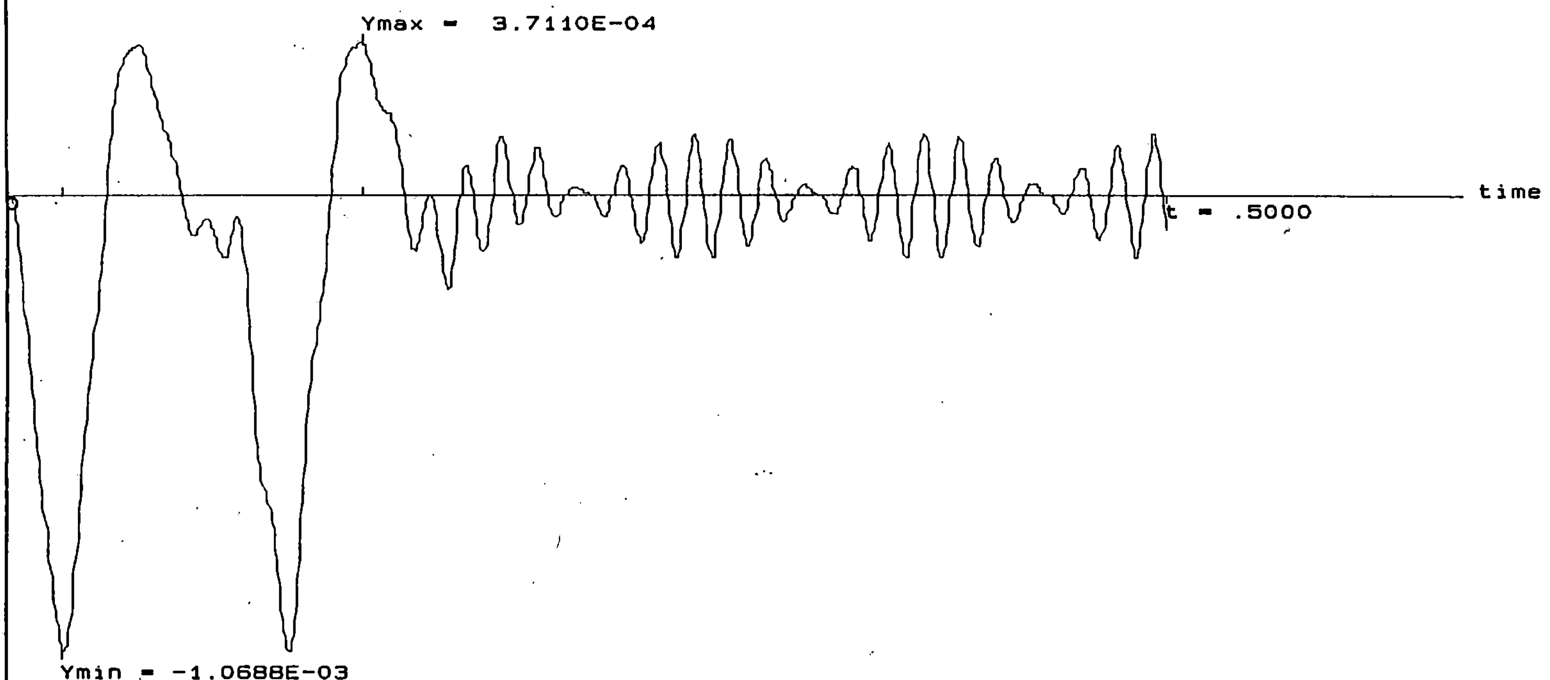
REACTION FORCE TIME HISTORY FOR NODE 17

	FY	MZ
MAXIMUM	5.7247E+04	4.4305E+01
TIME OF MAXIMUM	2.3400E-01	1.3250E-01
MINIMUM	-7.0964E+03	-8.1971E+01
TIME OF MINIMUM	1.8950E-01	1.5300E-01

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Node = 3

Displacement : Ymin = -1.0688E-03 (t = .0255) Ymax = 3.7110E-04 (t = .1550)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 25: 28

DYNACB

Dynamic Analysis
of
Continuous Beams

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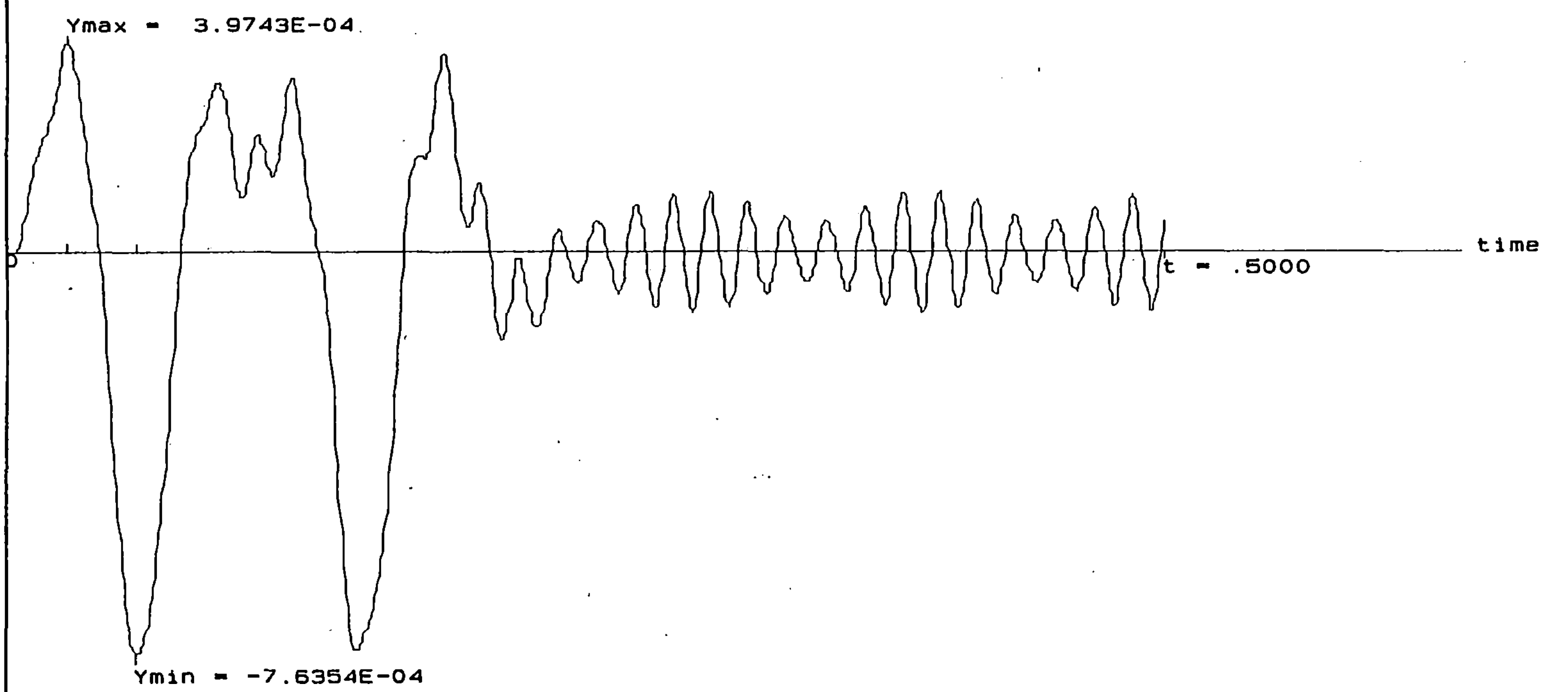


Beam Fundamental Natural Frequency = 6.1189E+01 Hz

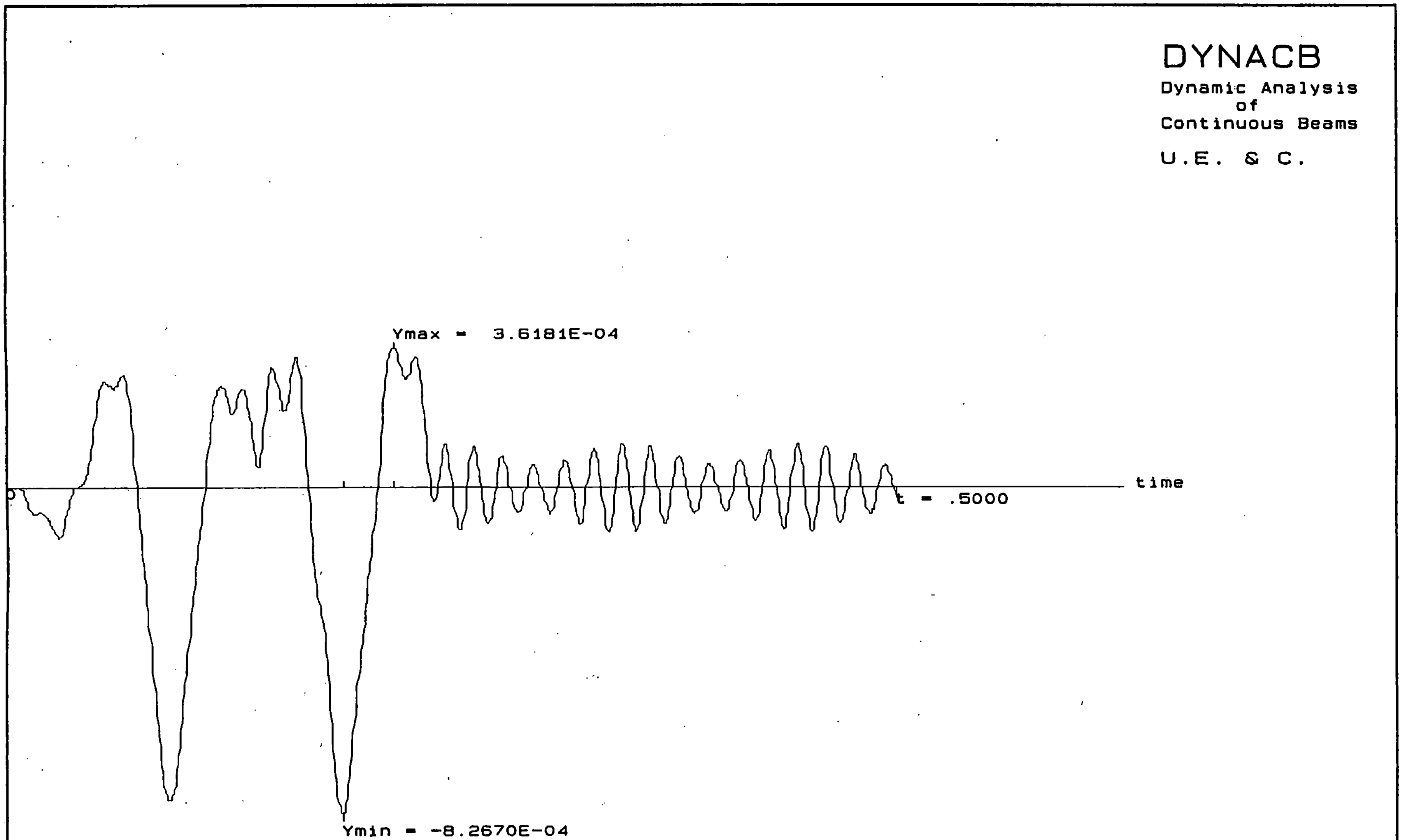
Results at Node = 7

Displacement : Ymin = -7.6354E-04 (t = .0585) Ymax = 3.9743E-04 (t = .0270)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 25: 28

LB-A-28



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

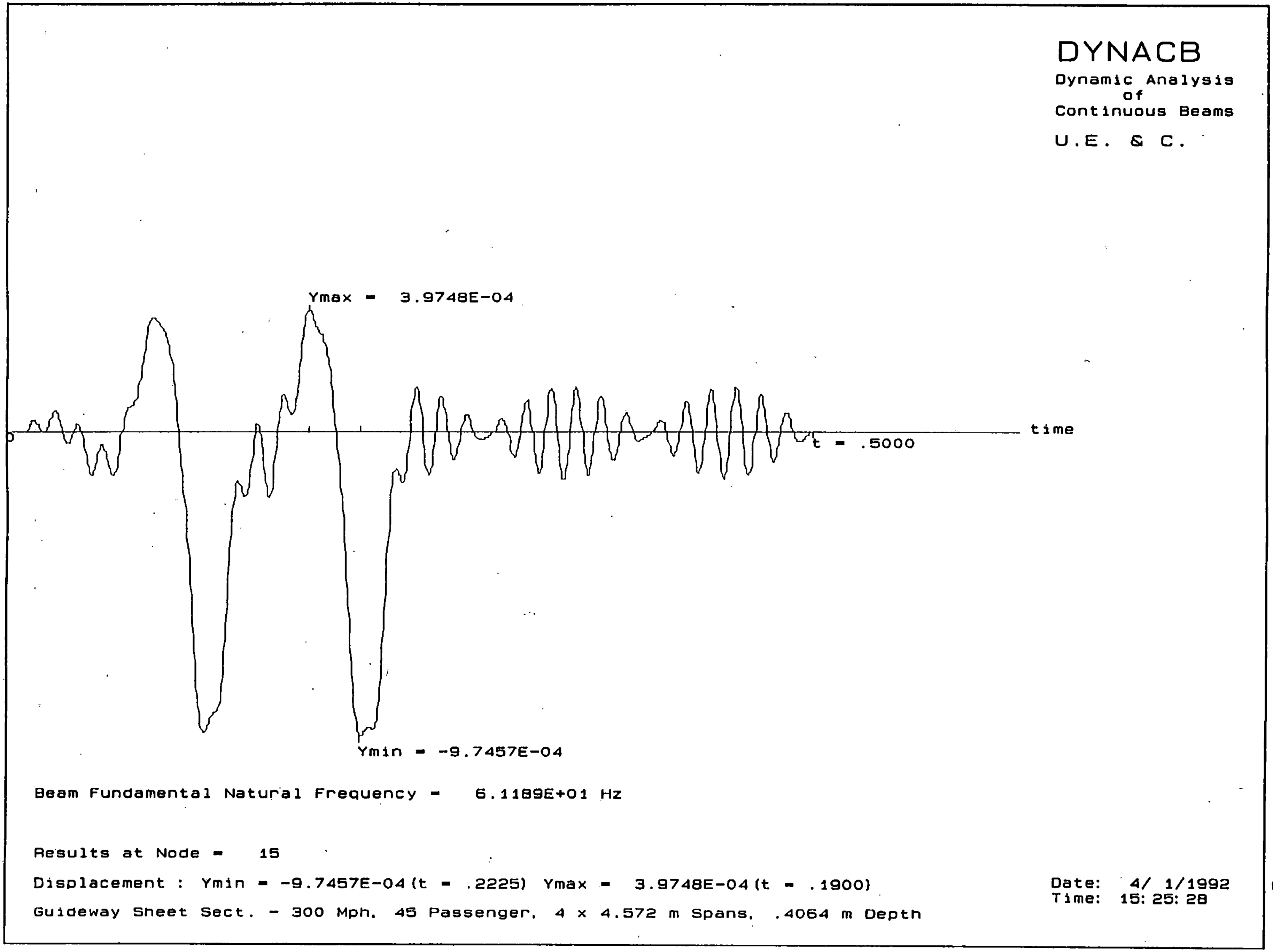
Results at Node = 11

Displacement : Ymin = -8.2670E-04 (t = .1910) Ymax = 3.6181E-04 (t = .2195)

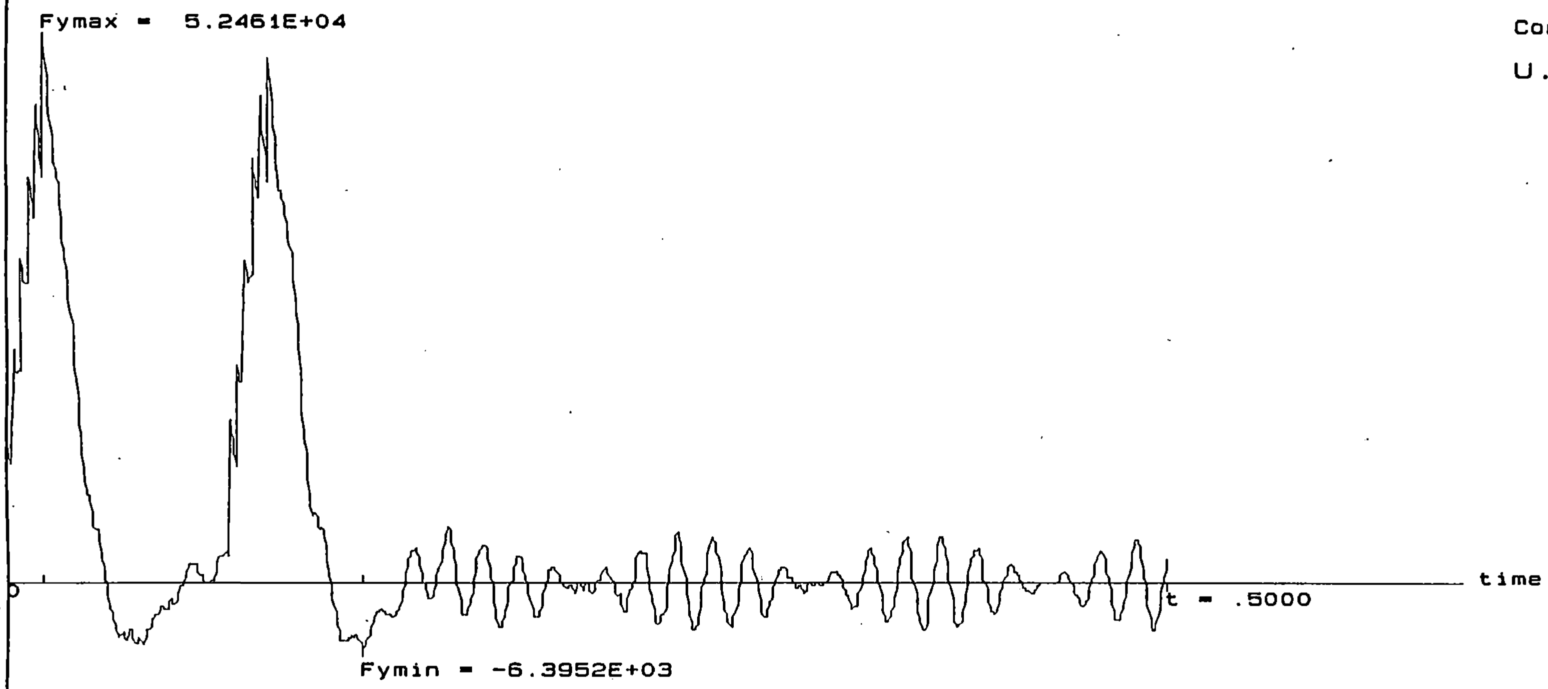
Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 25: 28

6B-A-29


DYNACB
Dynamic Analysis
of
Continuous Beams
U.E. & C.
Ymax = 3.9748E-04
time
t = .5000
Ymin = -9.7457E-04
Beam Fundamental Natural Frequency = 6.1189E+01 Hz
Results at Node = 15
Displacement : Ymin = -9.7457E-04 (t = .2225) Ymax = 3.9748E-04 (t = .1900)
Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth
Date: 4/ 1/1992
Time: 15: 25: 28

LB-A-30



DYNACB

Dynamic Analysis of Continuous Beams

U.E. & C.

Beam Fundamental Natural Frequency = 6.1189E+01 Hz

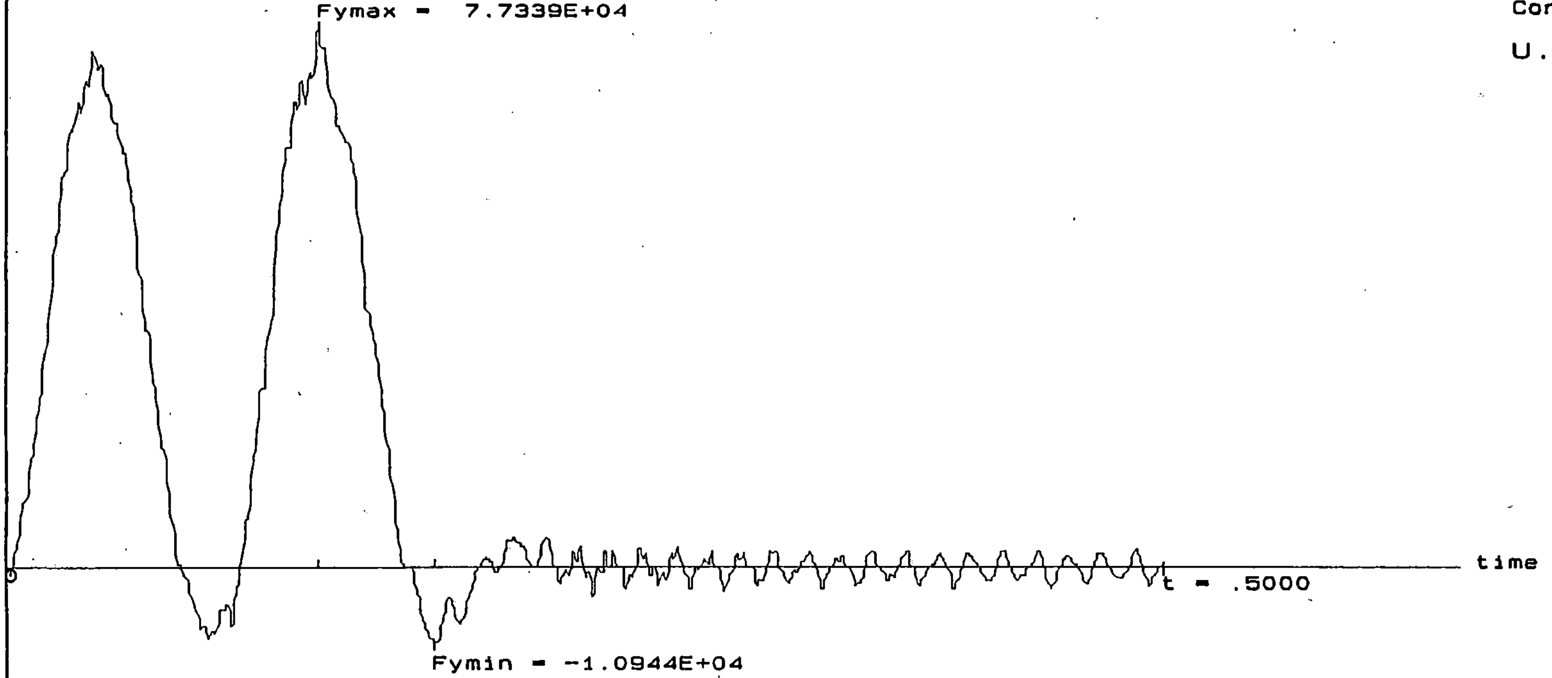
Results at Node = 1

Reaction : Fymin = -6.3952E+03 (t = .1560) Fymax = 5.2461E+04 (t = .0170)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 25: 28

CB-A-31



DYNACB
Dynamic Analysis
of
Continuous Beams
U.E. & C.

Beam Fundamental Natural Frequency = 6.1189E+01 Hz

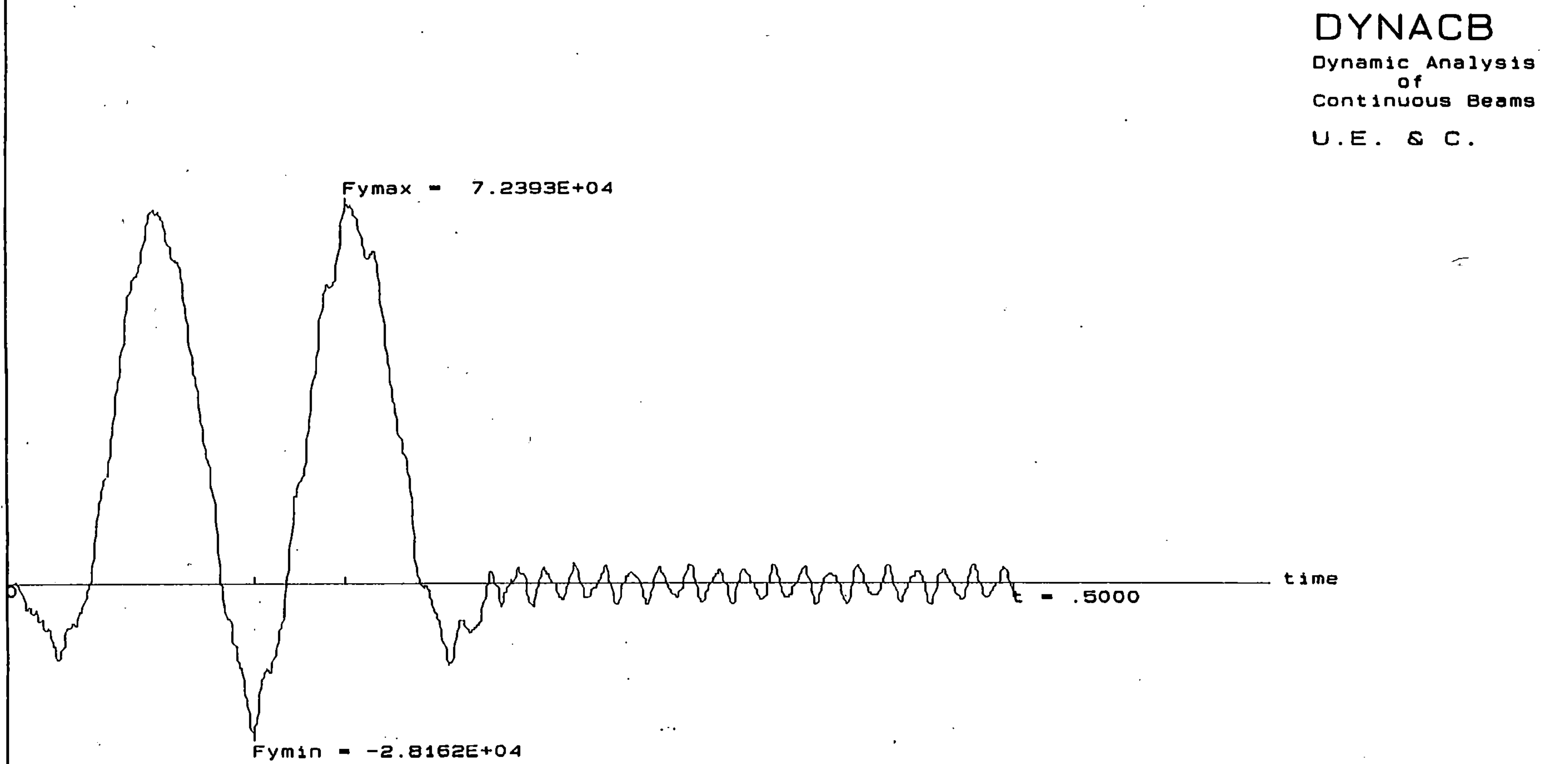
Results at Node = 5

Reaction : Fymin = -1.0944E+04 (t = .1885) Fymax = 7.7339E+04 (t = .1370)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 25: 28

LB-A-32



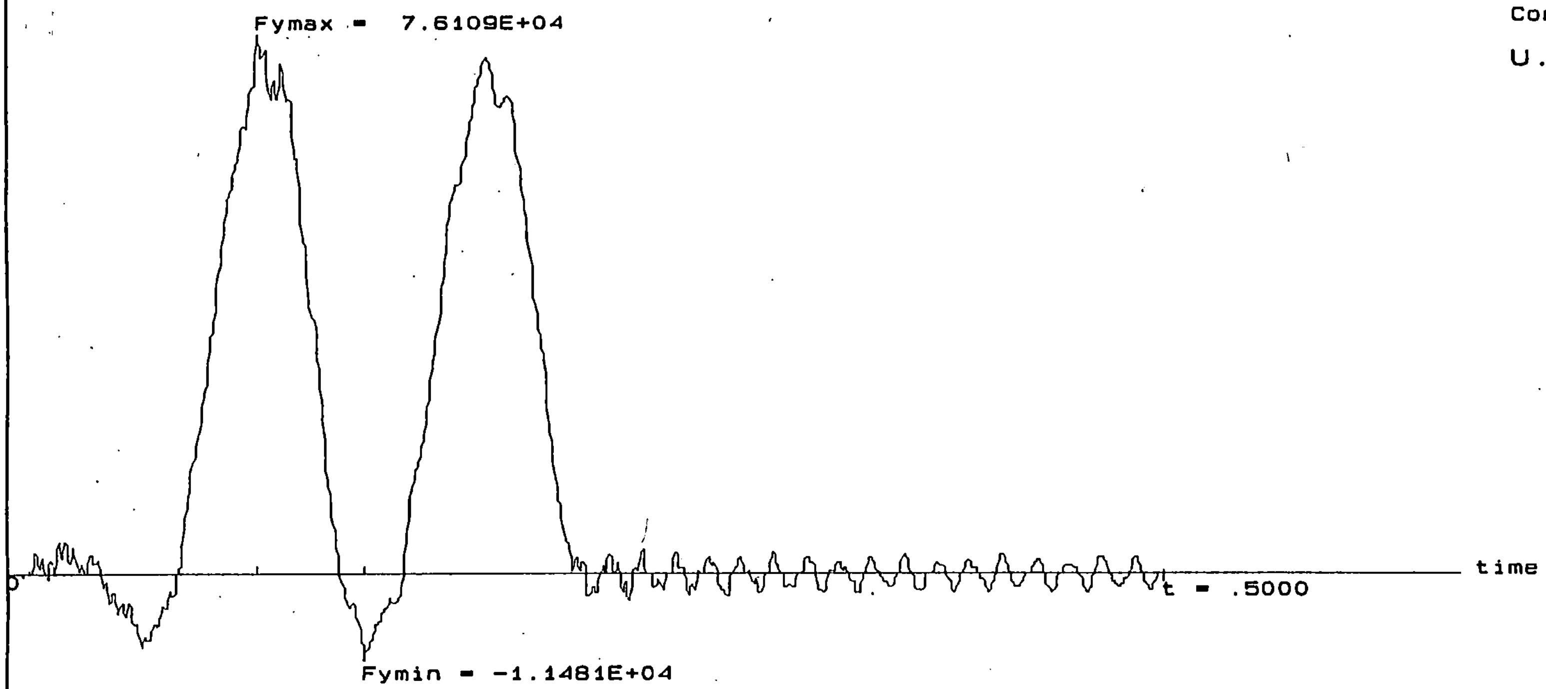
Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Node = 9

Reaction : Fymin = -2.8162E+04 (t = .1245) Fymax = 7.2393E+04 (t = .1710)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 25: 28



DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.

Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Node = 13

Reaction : Fymin = -1.1481E+04 (t = .1580) Fymax = 7.6109E+04 (t = .1110)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

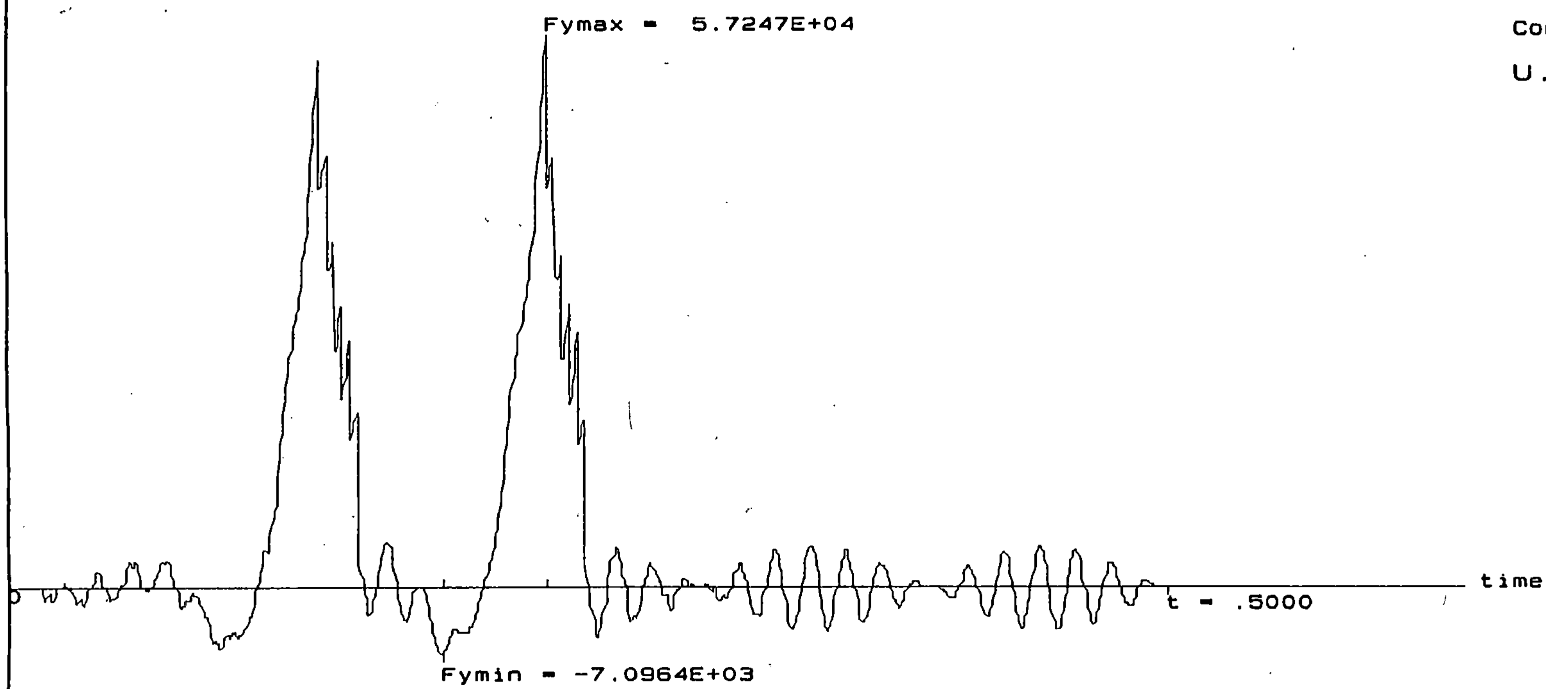
Date: 4/ 1/1992
Time: 15: 25: 28

73-A-34

DYNACB

Dynamic Analysis of Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Node = 17

Reaction : Fymin = -7.0964E+03 (t = .1895) Fymax = 5.7247E+04 (t = .2340)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

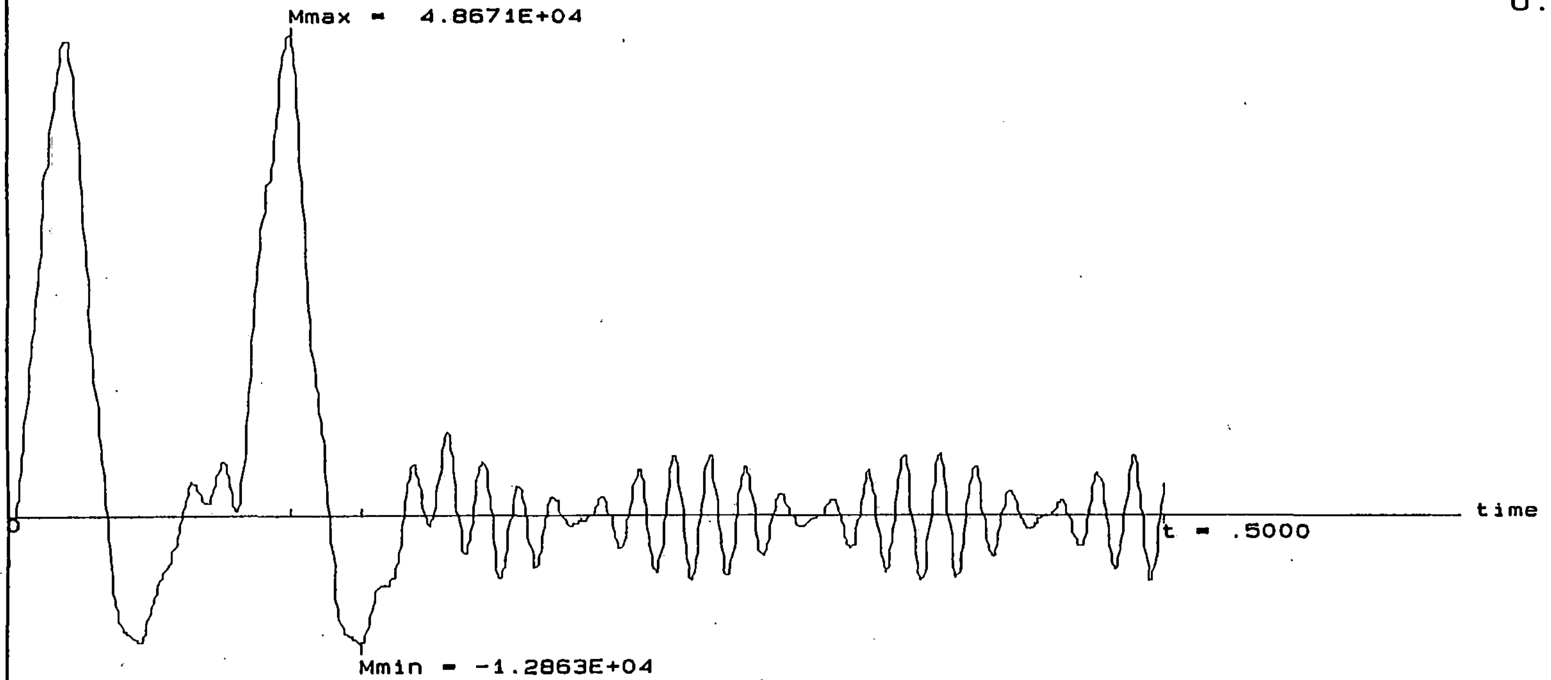
Date: 4/ 1/1992
Time: 15: 25: 28

LB-A-35

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Elem = 2 (End Node)

Bending Moment : Mmin = -1.2863E+04 (t = .1555) Mmax = 4.8671E+04 (t = .1245)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 25: 28

LB - A-36

DYNACB

Dynamic Analysis
of
Continuous Beams

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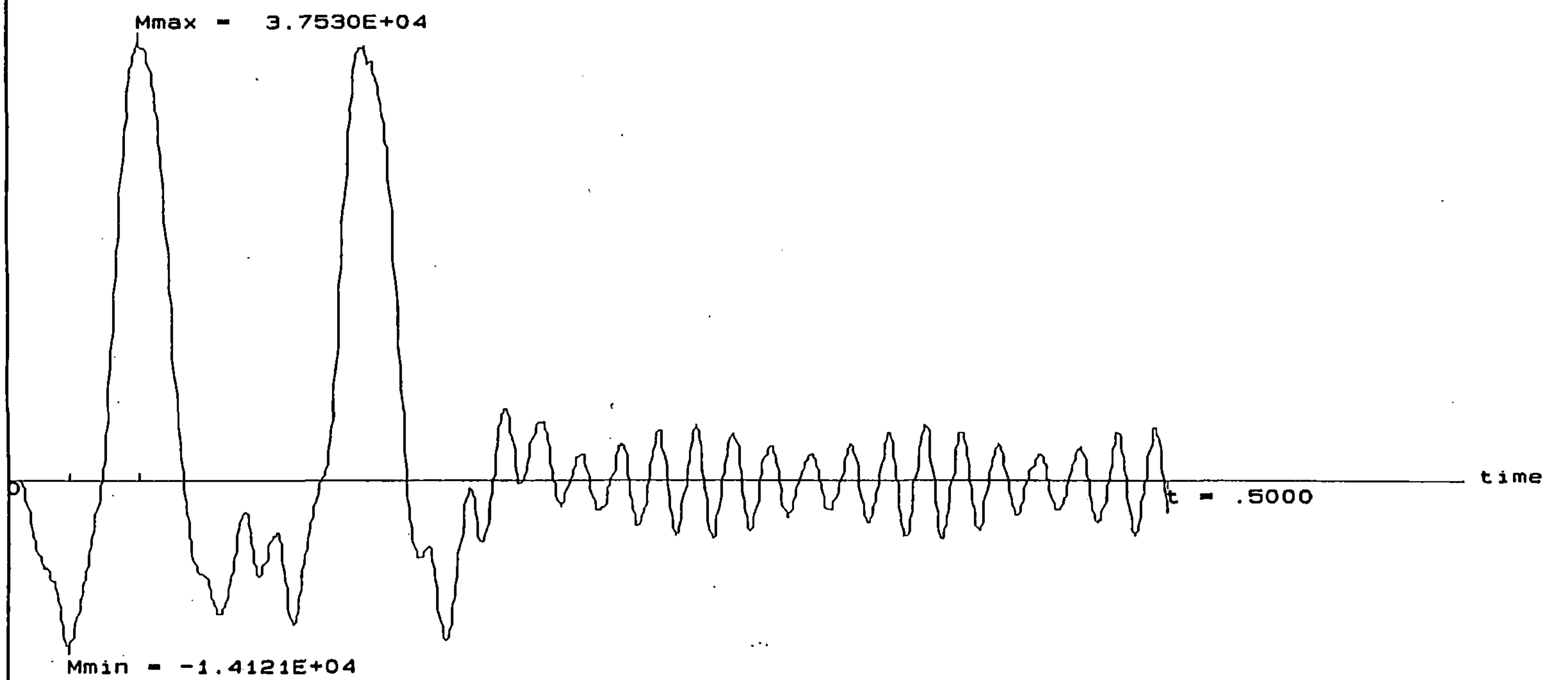


Beam Fundamental Natural Frequency = 6.1189E+01 Hz

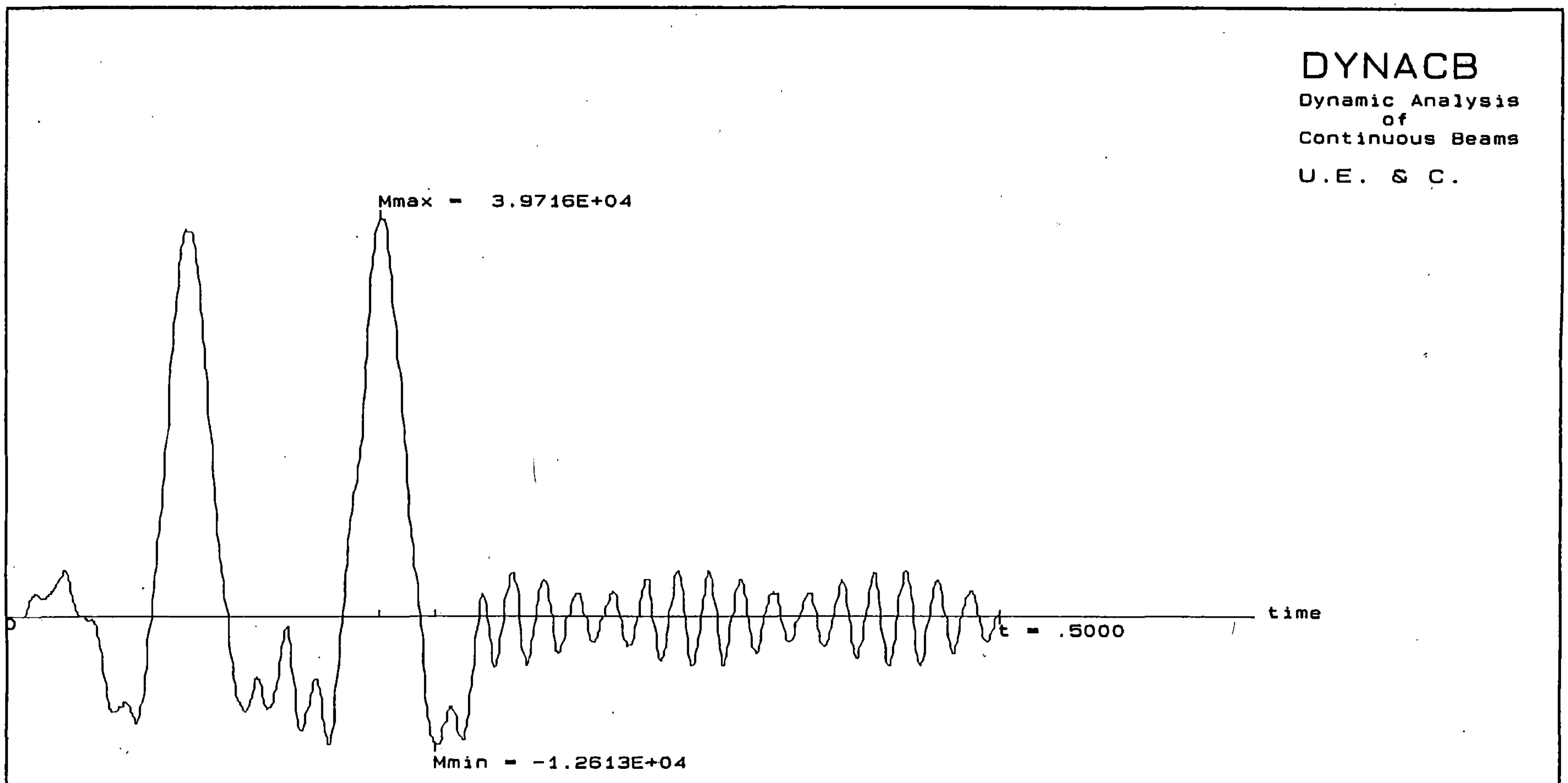
Results at Elem = 6 (End Node)

Bending Moment : Mmin = -1.4121E+04 (t = .0270) Mmax = 3.7530E+04 (t = .0580)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 25: 28

26-A-37



Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Elem = 10 (End Node)

Bending Moment : Mmin = -1.2613E+04 (t = .2190) Mmax = 3.9716E+04 (t = .1900)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15:25:28

LG-A-38

DYNACB

Dynamic Analysis
of
Continuous Beams

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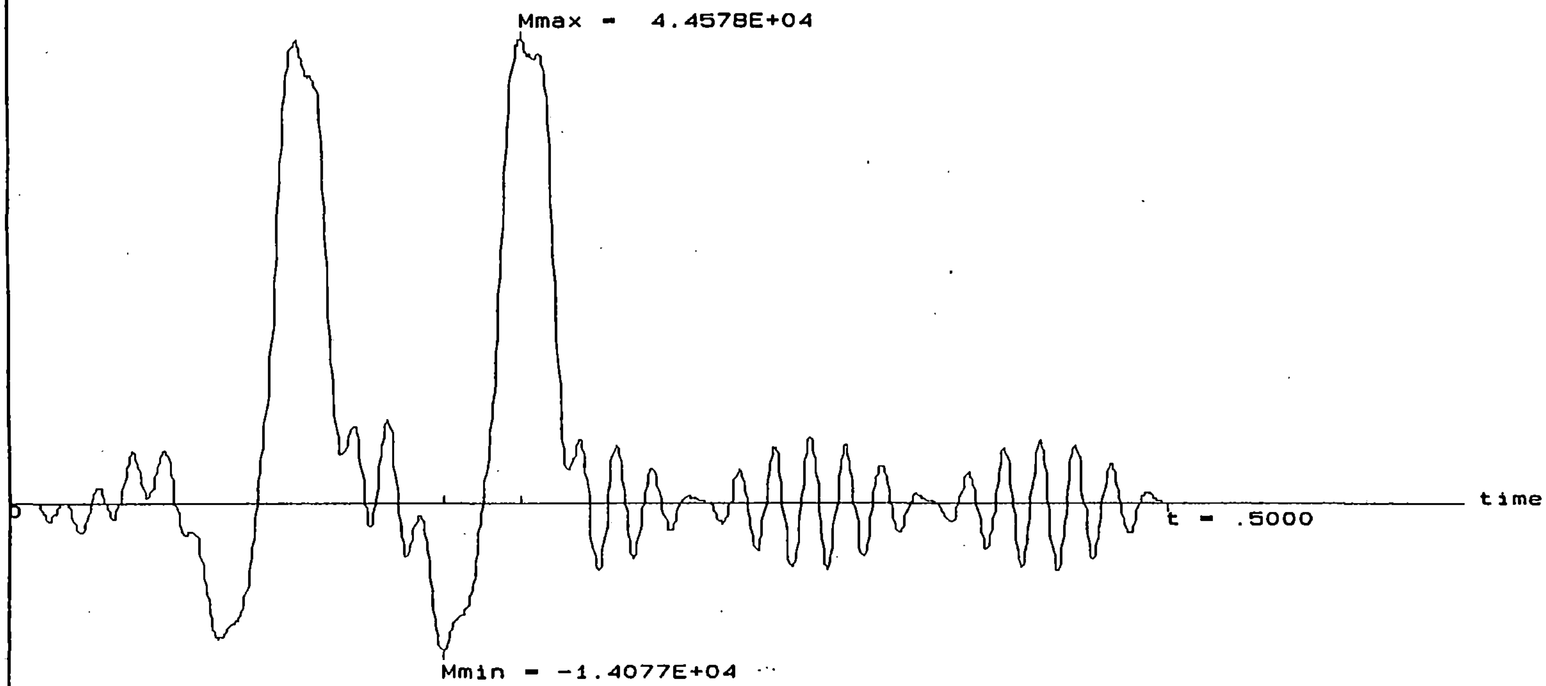

Beam Fundamental Natural Frequency = 6.1189E+01 Hz

Results at Elem = 14 (End Node)

Bending Moment : Mmin = -1.4077E+04 (t = .1900) Mmax = 4.4578E+04 (t = .2235)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 4 x 4.572 m Spans, .4064 m Depth

Date: 4/ 1/1992
Time: 15: 25: 28

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LB - A - 40

Section Properties For Guideway Sheet Cross-section (D=.8128 m)

Radius To Inside Of Guideway Sheet, R -	2.100000E+00
Half Angle, ALPHA ---------------------	2.092483E+01
Depth Of Section, D -------------------	8.128000E-01
Thickness Of Guideway Sheet, T1 -------	2.000000E-02
Thickness Of Outer Sheet, T2 ----------	4.762500E-03
Thickness Of Web Plates, T3 -----------	6.350000E-03

Section Properties:

Cross-sectional Area ------------------	6.096382E-02
Centroidal Location In 1-1 Direction --	0.000000E+00
Centroidal Location In 2-2 Direction --	2.311073E+00

Bending About Centroidal Axis Parallel To 1-1 Axis:

Moment Of Inertia ---------------------	6.191831E-03
Section Modulus (Inside) --------------	1.771280E-02
Section Modulus (Outside) -------------	1.029009E-02

Bending About Centroidal Axis Parallel To 2-2 Axis:

Moment Of Inertia ---------------------	1.872723E-02
Section Modulus -----------------------	1.800201E-02

LB-A-41

PROGRAM DYNACB

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

STRUCTURAL PARAMETERS

NN	NE	NRN	E	RHO
9	8	3	6.8950E+10	2.7126E+03

NODAL COORDINATES

NODE	X
1	0.0000E+00
2	2.2860E+00
3	4.5720E+00
4	6.8580E+00
5	9.1440E+00
6	1.1430E+01
7	1.3716E+01
8	1.6002E+01
9	1.8288E+01

ELEMENT INFORMATION

ELEM.	J	K	AX	ZI	EL
1	1	2	6.0964E-02	6.1918E-03	2.2860E+00
2	2	3	6.0964E-02	6.1918E-03	2.2860E+00
3	3	4	6.0964E-02	6.1918E-03	2.2860E+00
4	4	5	6.0964E-02	6.1918E-03	2.2860E+00
5	5	6	6.0964E-02	6.1918E-03	2.2860E+00
6	6	7	6.0964E-02	6.1918E-03	2.2860E+00
7	7	8	6.0964E-02	6.1918E-03	2.2860E+00
8	8	9	6.0964E-02	6.1918E-03	2.2860E+00

NODAL RESTRAINTS

NODE	NR1	NR2
1	1	0
5	1	0
9	1	0

NUMBER OF DEGREES OF FREEDOM: NDF = 15
NUMBER OF NODAL RESTRAINTS: NNR = 3

OUTPUT KEY FOR MODAL ANALYSIS: IMO = 0

STIFFNESS MATRIX DECOMPOSED

6B-A-42

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

MODE	FREQUENCY (Hz)
1	3.0193E+01
2	4.7185E+01
3	1.2122E+02
4	1.5377E+02
5	2.7663E+02
6	3.2601E+02
7	5.3605E+02
8	6.1221E+02
9	8.5204E+02
10	9.9813E+02
11	1.3474E+03
12	1.5937E+03
13	2.0186E+03
14	2.3072E+03
15	2.4565E+03

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

DYNAMIC PARAMETERS

ISOLVE	NTS	DT	DAMPR
1	1000	5.0000E-04	0.0000E+00

INITIAL CONDITIONS

NNID	NNIV
0	0

APPLIED ACTIONS

NLN	NEL	IML
0	0	12

MOVING LOADS

P	V0P	A0P	SPACING
-2.9648E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.9648E+04	1.3411E+02	0.0000E+00	2.6401E+01
-2.9648E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.9648E+04	1.3411E+02	0.0000E+00	0.0000E+00

GROUND ACCELERATIONS

IGA
0

DIRECT NUMERICAL INTEGRATION

ALPHA = -0.1000 BETA = 0.3025 GAMMA = 0.6000

OUTPUT SELECTION

IWR	IPL	NNO	NEO	NRO
2	1	2	3	3

NODES (DISPL.): 3 7

ELEMENTS: 2 4 6

NODES (REACT.): 1 5 9

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

DISPLACEMENT TIME HISTORY FOR NODE 3

	UY	ROTZ
MAXIMUM	1.9067E-03	2.9152E-04
TIME OF MAXIMUM	1.1400E-01	3.0500E-02
MINIMUM	-4.2984E-03	-1.1257E-04
TIME OF MINIMUM	2.5250E-01	6.0500E-02

DISPLACEMENT TIME HISTORY FOR NODE 7

	UY	ROTZ
MAXIMUM	1.8398E-03	1.1300E-04
TIME OF MAXIMUM	2.5350E-01	3.0650E-01
MINIMUM	-4.3611E-03	-2.9185E-04
TIME OF MINIMUM	1.1450E-01	3.3650E-01

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 2

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	8.9934E+04	4.4232E+04	6.9916E+04	2.5145E+05
TIME OF MAXIMUM	3.4000E-02	1.1250E-01	2.4750E-01	2.5450E-01
MINIMUM	-2.6480E+04	-2.1492E+05	-4.3094E+04	-8.1734E+04
TIME OF MINIMUM	1.7000E-02	3.0500E-02	5.1000E-02	1.1400E-01

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 4

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	9.7899E+03	1.0765E+05	1.4398E+05	1.9200E+03
TIME OF MAXIMUM	2.8200E-01	1.1450E-01	6.8000E-02	2.1800E-01
MINIMUM	-1.0836E+05	-1.3396E+05	-5.2179E+03	-1.3219E+05
TIME OF MINIMUM	2.6450E-01	5.9500E-02	1.7400E-01	2.6000E-01

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 6

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	1.0836E+05	1.0545E+05	4.2317E+04	2.5327E+05
TIME OF MAXIMUM	3.1600E-01	2.5450E-01	3.1550E-01	1.1250E-01
MINIMUM	-9.5851E+03	-1.3336E+05	-6.9348E+04	-7.8453E+04
TIME OF MINIMUM	2.9850E-01	3.0700E-01	1.1950E-01	2.5300E-01

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

REACTION FORCE TIME HISTORY FOR NODE 1

	FY	MZ
MAXIMUM	1.2821E+05	1.5067E+02
TIME OF MAXIMUM	2.3050E-01	2.3750E-01
MINIMUM	-2.0264E+04	-2.1629E+02
TIME OF MINIMUM	1.1200E-01	1.0000E-03

REACTION FORCE TIME HISTORY FOR NODE 5

	FY	MZ
MAXIMUM	1.4642E+05	1.4416E+02
TIME OF MAXIMUM	2.9350E-01	3.0700E-01
MINIMUM	-3.7045E+03	-1.6060E+02
TIME OF MINIMUM	2.1800E-01	7.2000E-02

REACTION FORCE TIME HISTORY FOR NODE 9

	FY	MZ
MAXIMUM	1.2528E+05	1.2896E+02
TIME OF MAXIMUM	1.3600E-01	3.4350E-01
MINIMUM	-1.9826E+04	-1.8669E+02
TIME OF MINIMUM	2.5500E-01	3.6350E-01

DYNACB

Dynamic Analysis
of
Continuous Beams

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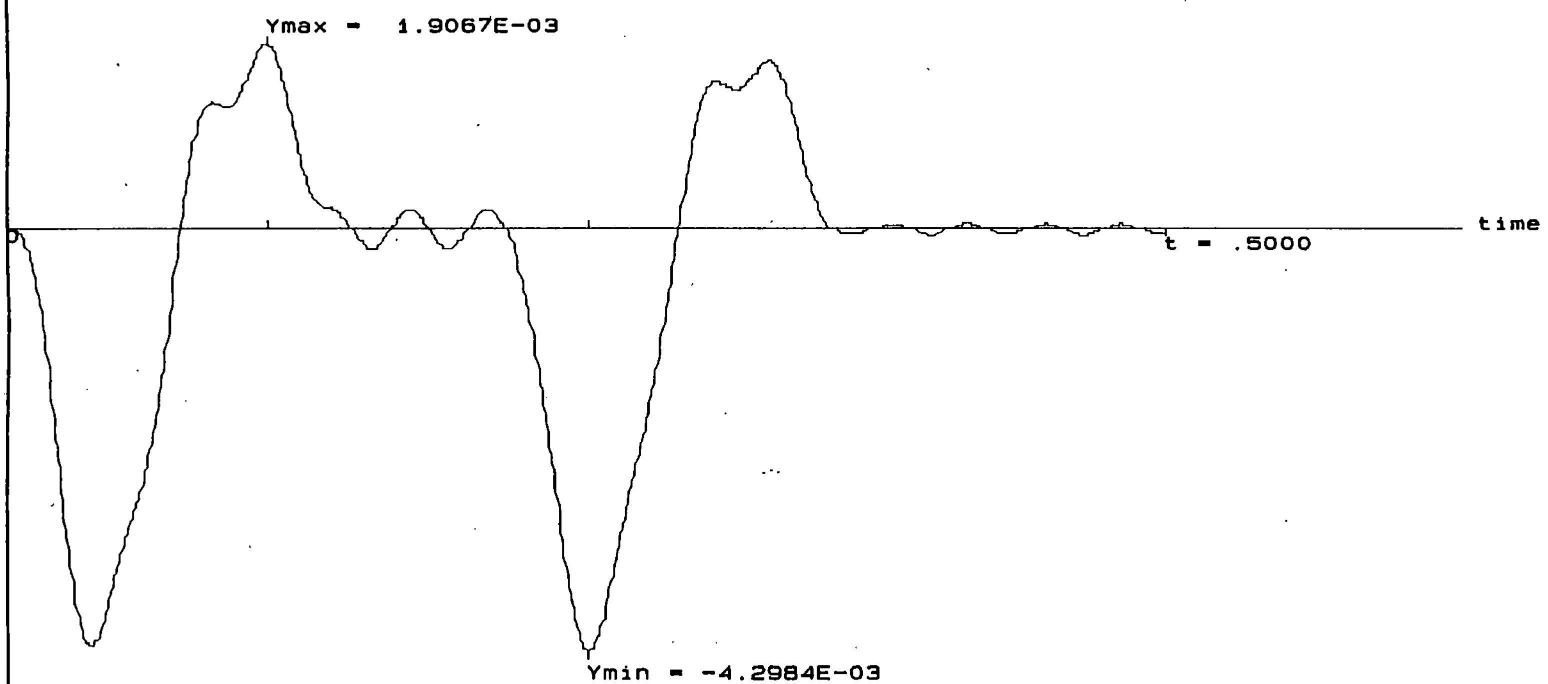

Beam Fundamental Natural Frequency = 3.0193E+01 Hz

Results at Node = 3

Displacement : Ymin = -4.2984E-03 (t = .2525) Ymax = 1.9067E-03 (t = .1140)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 4/16/1992
Time: 10:14:49

LB-A-47

DYNACB

Dynamic Analysis
of
Continuous Beams

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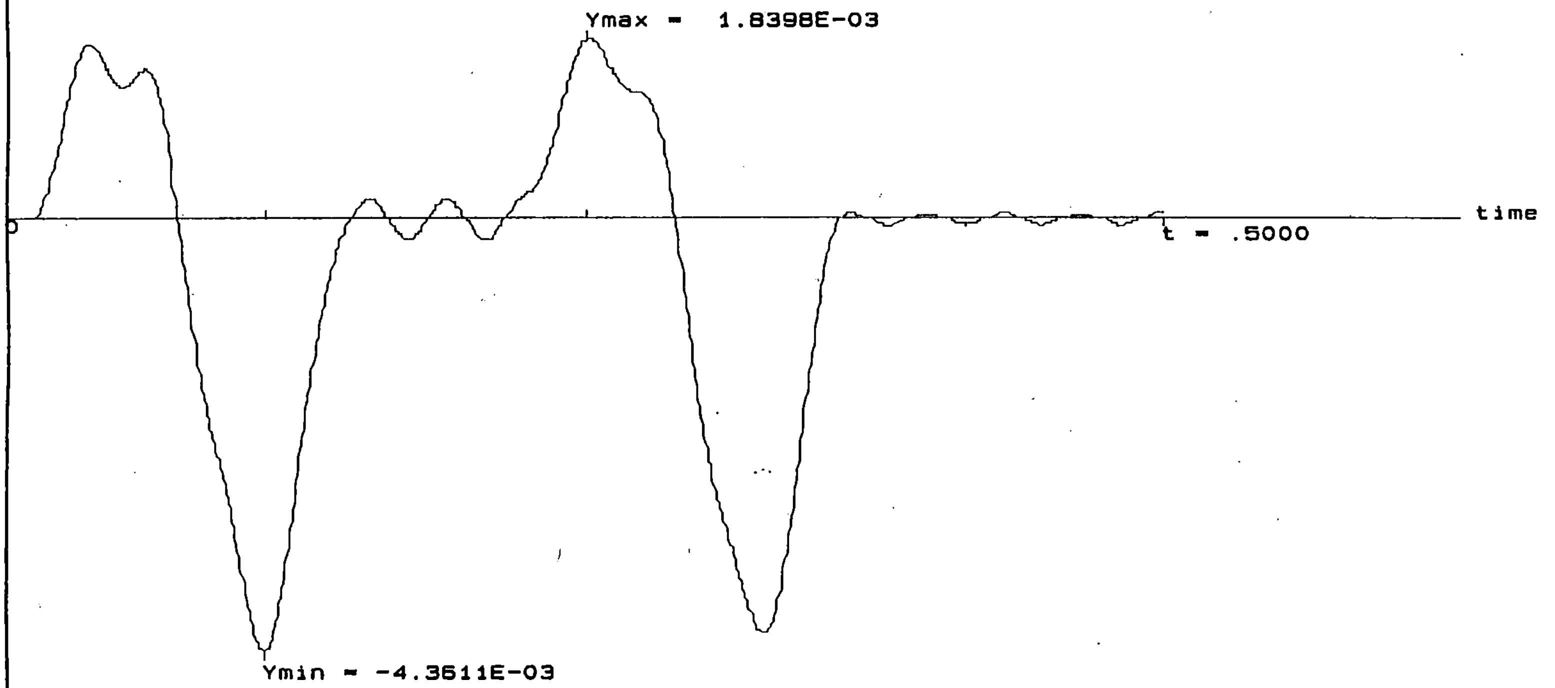


Beam Fundamental Natural Frequency = 3.0193E+01 Hz

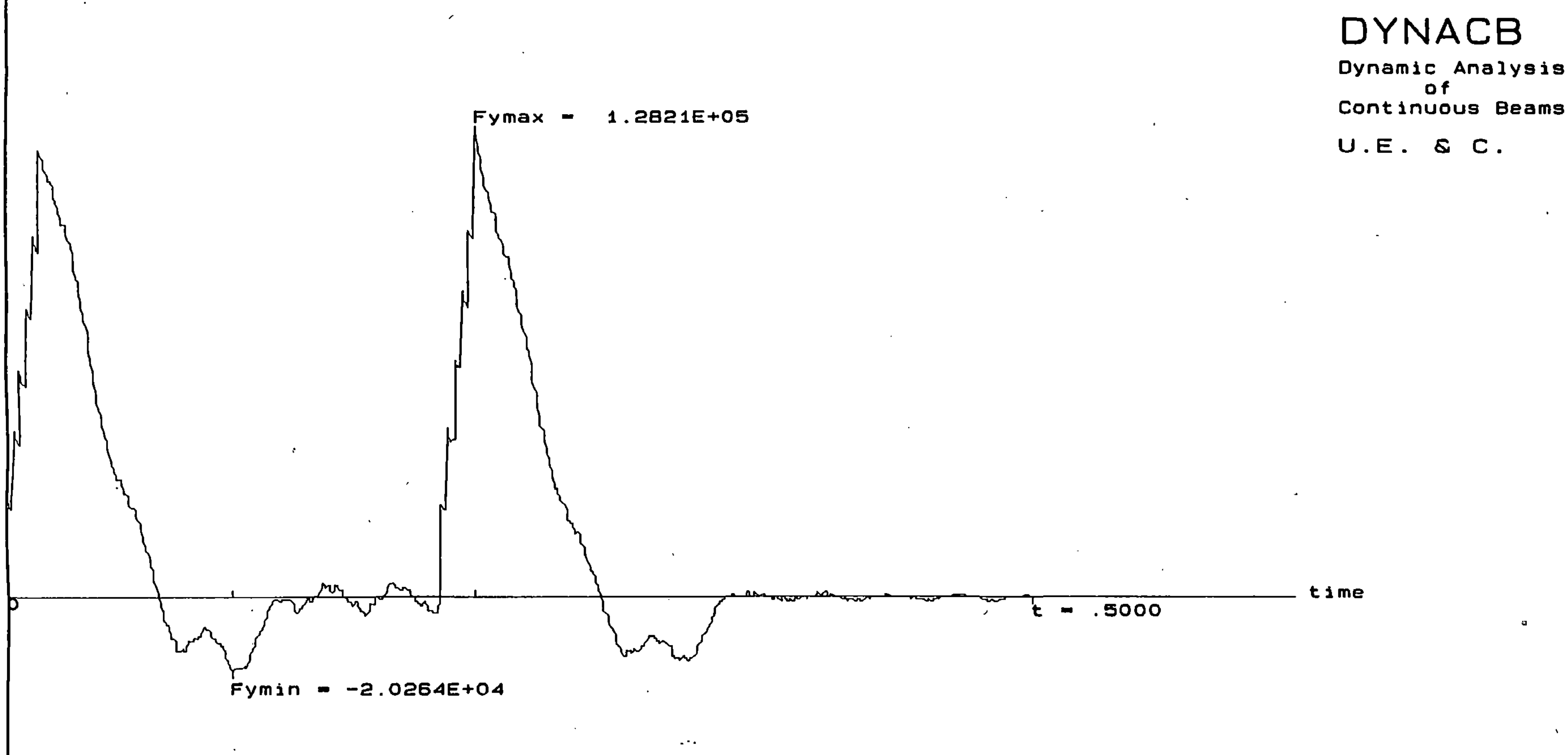
Results at Node = 7

Displacement : Ymin = -4.3611E-03 (t = .1145) Ymax = 1.8398E-03 (t = .2535)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 4/16/1992
Time: 10:14:49

CB-A-48



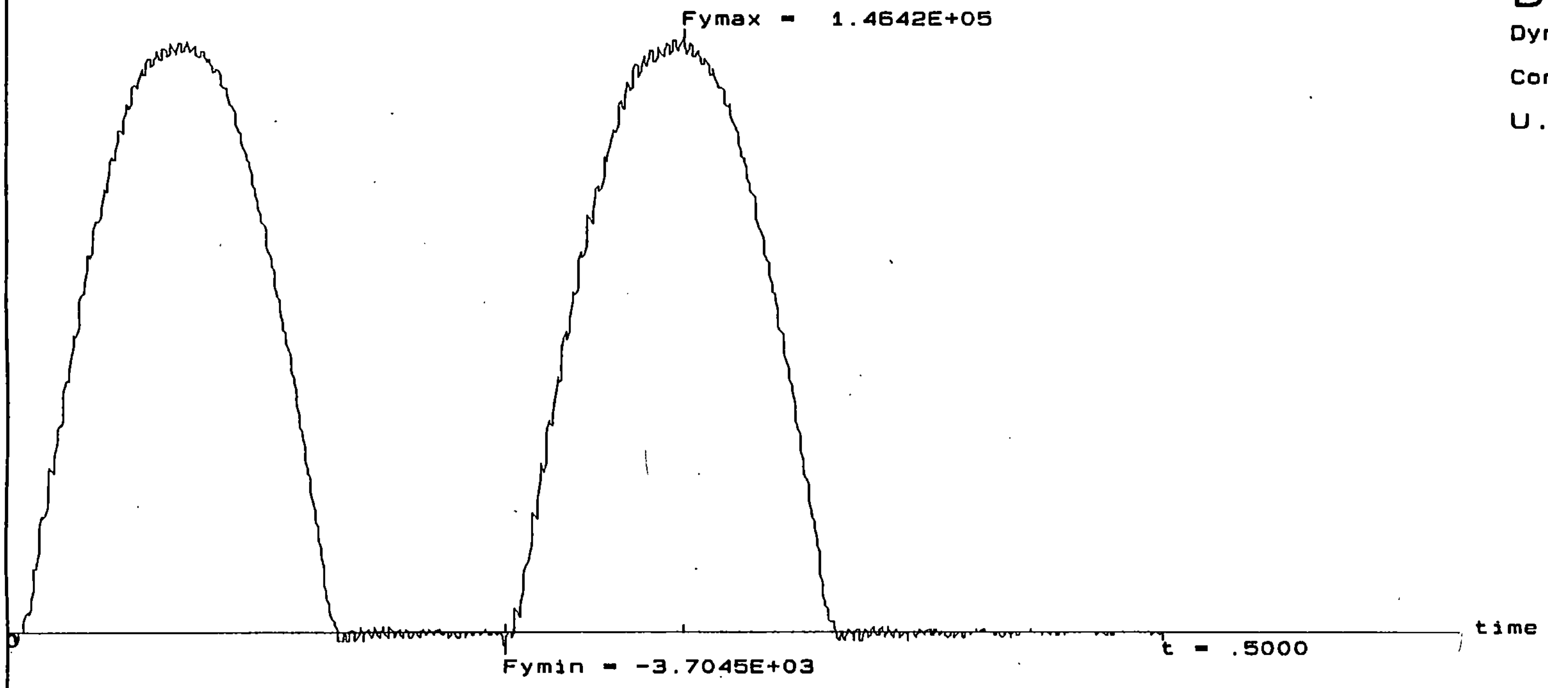
Beam Fundamental Natural Frequency = 3.0193E+01 Hz

Results at Node = 1

Reaction : Fymin = -2.0264E+04 (t = .1120) Fymax = 1.2821E+05 (t = .2305)

Guideway Sheet Sect. - 300 Mph. 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 4/16/1992
Time: 10: 24: 7



DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.

Beam Fundamental Natural Frequency = 3.0193E+01 Hz

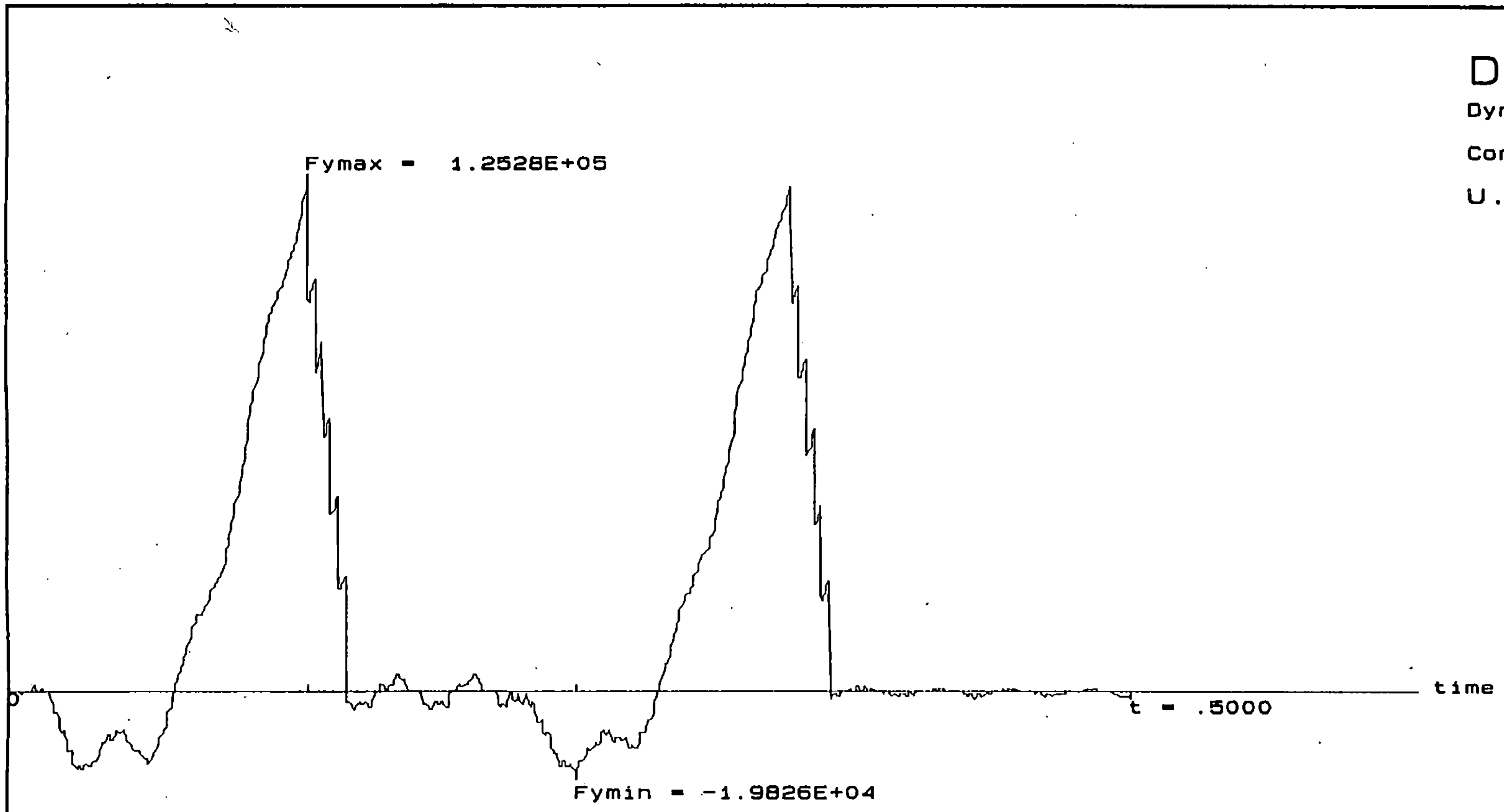
Results at Node = 5

Reaction : Fymin = -3.7045E+03 (t = .2180) Fymax = 1.4642E+05 (t = .2935)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 4/16/1992
Time: 10:24: 7

05-A-67



Beam Fundamental Natural Frequency = 3.0193E+01 Hz

Results at Node = 9

Reaction : Fymin = -1.9826E+04 (t = .2550) Fymax = 1.2528E+05 (t = .1360)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

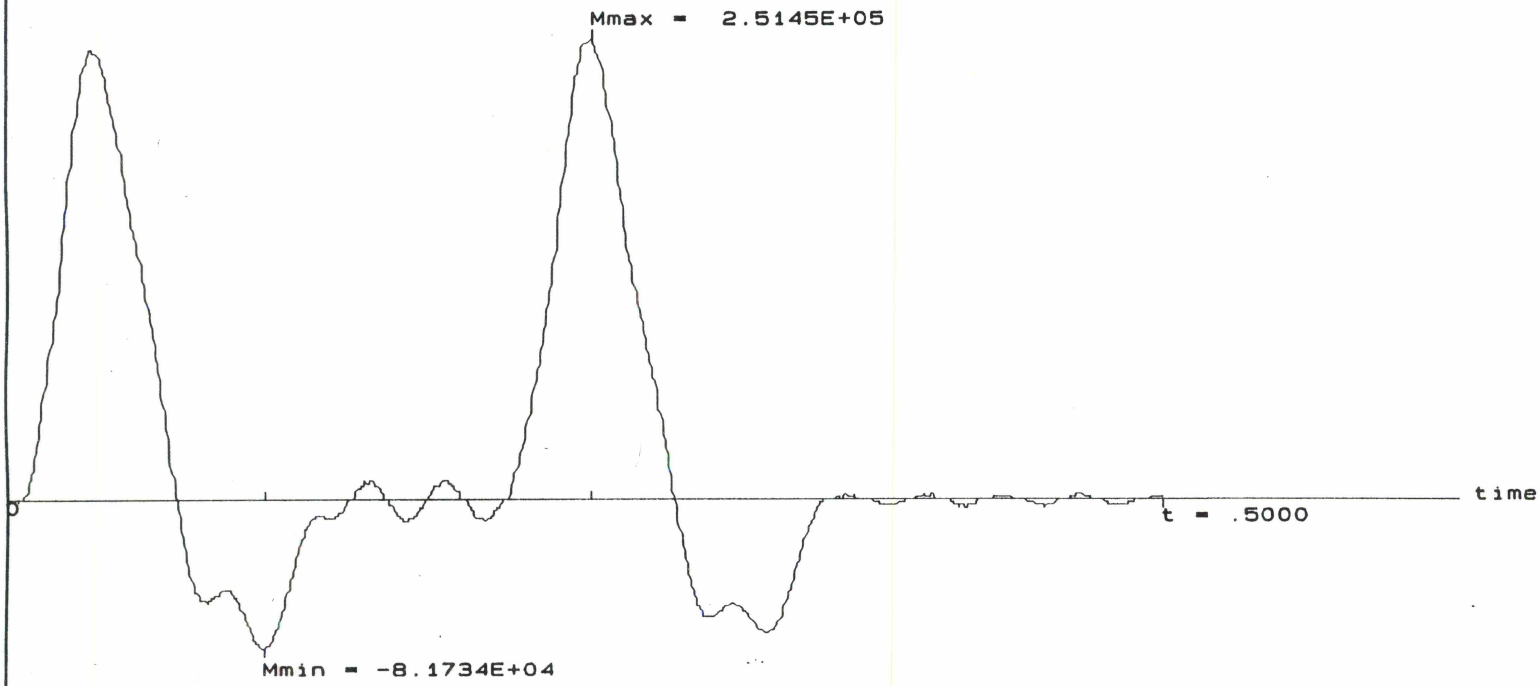
Date: 4/16/1992
Time: 10: 24: 7

15-A-70

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0193E+01 Hz

Results at Elem = 2 (End Node)

Bending Moment : Mmin = -8.1734E+04 (t = .1140) Mmax = 2.5145E+05 (t = .2545)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 4/16/1992
Time: 10: 14: 49

LB-A-52

DYNACB
Dynamic Analysis
of
Continuous Beams

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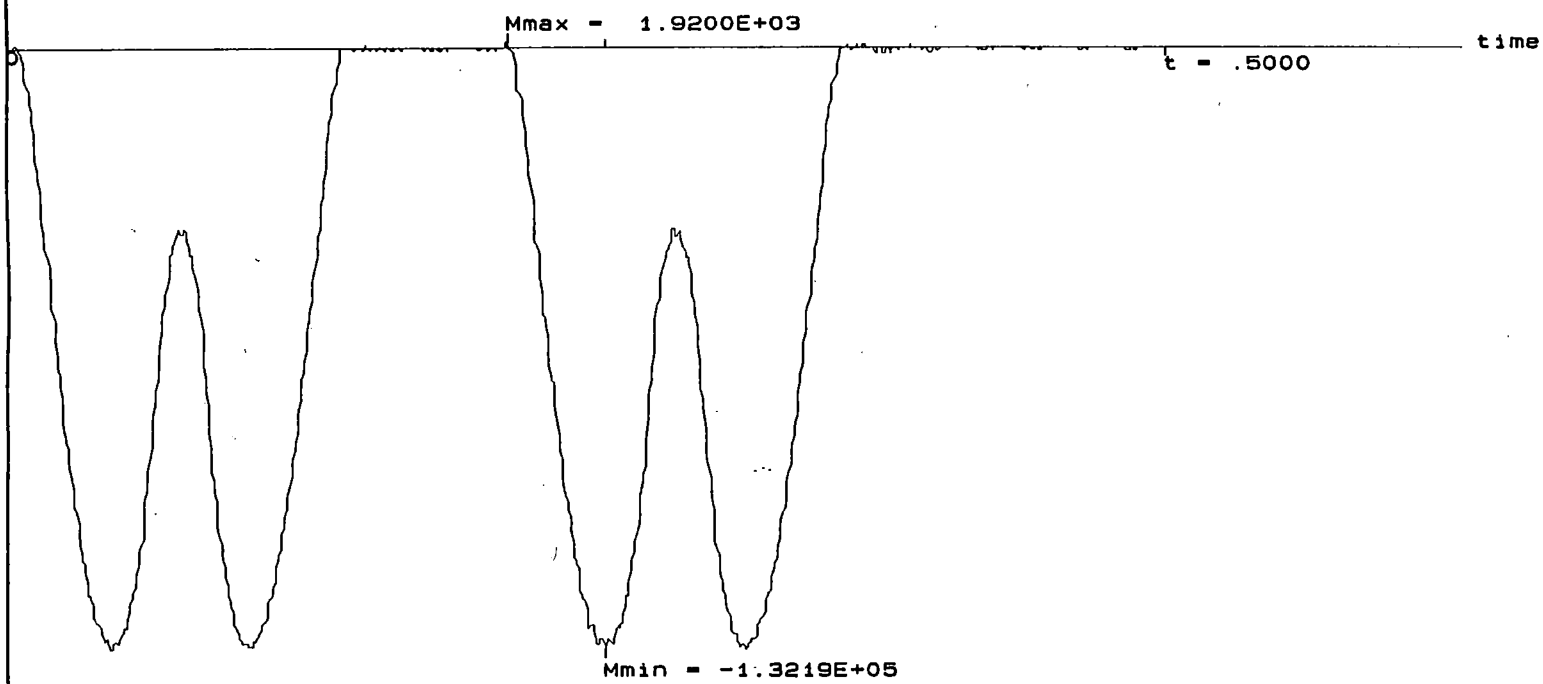


Beam Fundamental Natural Frequency = 3.0193E+01 Hz

Results at Elem = 4 (End Node)

Bending Moment : Mmin = -1.3219E+05 (t = .2600) Mmax = 1.9200E+03 (t = .2180)

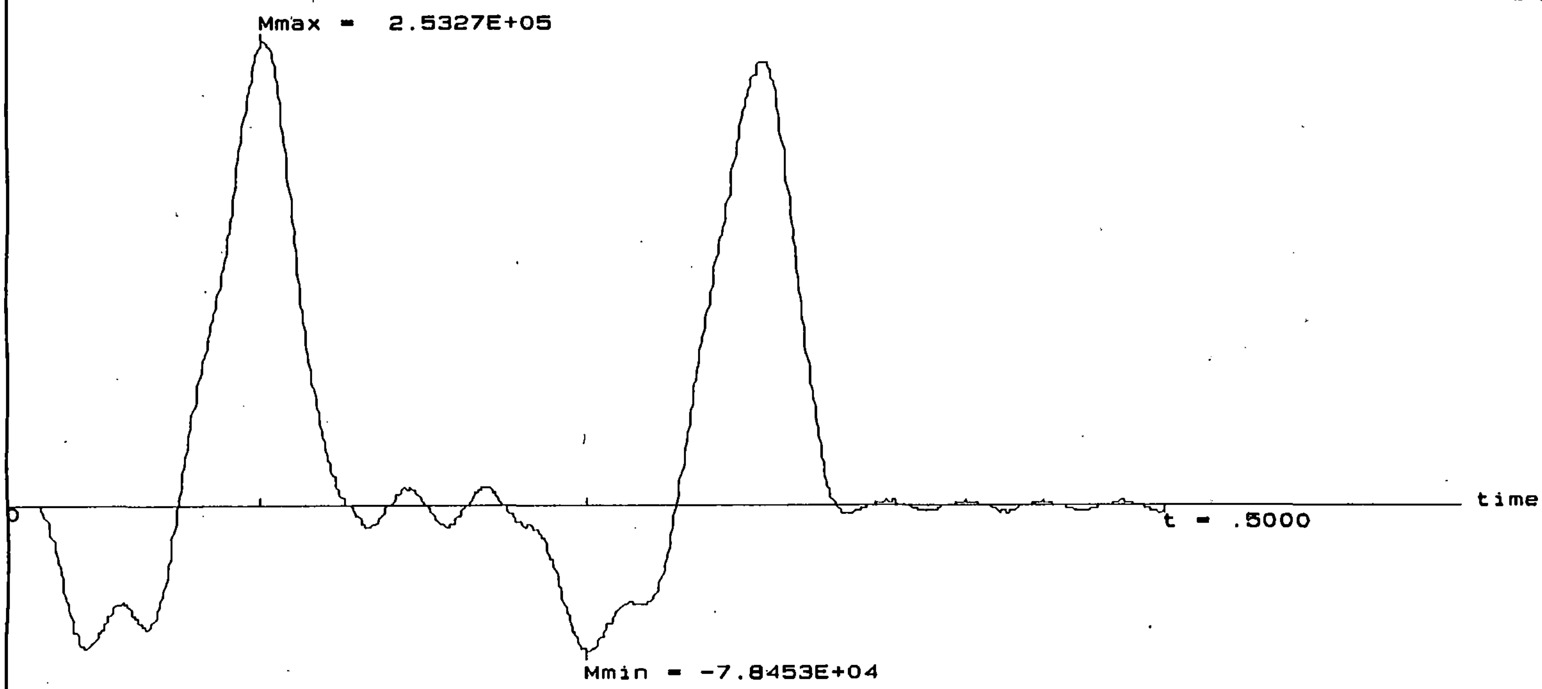
Guideway Sheet Sect. - 300 Mph, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 4/16/1992
Time: 10: 14: 49

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0193E+01 Hz

Results at Elem = 6 (End Node)

Bending Moment : Mmin = -7.8453E+04 (t = .2530) Mmax = 2.5327E+05 (t = .1125)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 4/16/1992
Time: 10:14:49

LB-A-54

LB - A - 55

PROGRAM DYNACB

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

STRUCTURAL PARAMETERS

NN	NE	NRN	E	RHO
9	8	3	6.8950E+10	2.7126E+03

NODAL COORDINATES

NODE	X
1	0.0000E+00
2	2.2860E+00
3	4.5720E+00
4	6.8580E+00
5	9.1440E+00
6	1.1430E+01
7	1.3716E+01
8	1.6002E+01
9	1.8288E+01

ELEMENT INFORMATION

ELEM.	J	K	AX	ZI	EL
1	1	2	6.0964E-02	6.1918E-03	2.2860E+00
2	2	3	6.0964E-02	6.1918E-03	2.2860E+00
3	3	4	6.0964E-02	6.1918E-03	2.2860E+00
4	4	5	6.0964E-02	6.1918E-03	2.2860E+00
5	5	6	6.0964E-02	6.1918E-03	2.2860E+00
6	6	7	6.0964E-02	6.1918E-03	2.2860E+00
7	7	8	6.0964E-02	6.1918E-03	2.2860E+00
8	8	9	6.0964E-02	6.1918E-03	2.2860E+00

NODAL RESTRAINTS

NODE	NR1	NR2
1	1	0
5	1	0
9	1	0

NUMBER OF DEGREES OF FREEDOM: NDF = 15
NUMBER OF NODAL RESTRAINTS: NNR = 3

OUTPUT KEY FOR MODAL ANALYSIS: IMO = 0

STIFFNESS MATRIX DECOMPOSED

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

MODE	FREQUENCY (Hz)
1	3.0193E+01
2	4.7185E+01
3	1.2122E+02
4	1.5377E+02
5	2.7663E+02
6	3.2601E+02
7	5.3605E+02
8	6.1221E+02
9	8.5204E+02
10	9.9813E+02
11	1.3474E+03
12	1.5937E+03
13	2.0186E+03
14	2.3072E+03
15	2.4565E+03

LB-A-57

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

DYNAMIC PARAMETERS

ISOLVE	NTS	DT	DAMPR
1	1000	5.0000E-04	0.0000E+00

INITIAL CONDITIONS

NNID	NNIV
0	0

APPLIED ACTIONS

NLN	NEL	IML
0	0	12

MOVING LOADS

P	VOP	AOP	SPACING
-1.4824E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.4824E+04	1.3411E+02	0.0000E+00	1.0856E+01
-1.4824E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.1496E+04	1.3411E+02	0.0000E+00	4.5000E-01
-1.4824E+04	1.3411E+02	0.0000E+00	0.0000E+00

GROUND ACCELERATIONS

IGA
0

DIRECT NUMERICAL INTEGRATION

ALPHA = -0.1000 BETA = 0.3025 GAMMA = 0.6000

OUTPUT SELECTION

IWR	IPL	NNO	NEO	NRO
2	1	2	3	3

NODES (DISPL.): 3 7

ELEMENTS: 2 4 6

NODES (REACT.): 1 5 9

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

DISPLACEMENT TIME HISTORY FOR NODE 3

	UY	ROTZ
MAXIMUM	1.0585E-03	1.8545E-04
TIME OF MAXIMUM	2.1050E-01	1.2350E-01
MINIMUM	-2.1241E-03	-5.7446E-05
TIME OF MINIMUM	3.7000E-02	1.5900E-01

DISPLACEMENT TIME HISTORY FOR NODE 7

	UY	ROTZ
MAXIMUM	8.9763E-04	5.7233E-05
TIME OF MAXIMUM	3.6000E-02	1.8950E-01
MINIMUM	-2.2842E-03	-1.8770E-04
TIME OF MINIMUM	2.1100E-01	1.2600E-01

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 2

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	4.4967E+04	2.6699E+04	3.8287E+04	1.2302E+05
TIME OF MAXIMUM	3.4000E-02	2.1050E-01	1.3150E-01	3.7500E-02
MINIMUM	-2.2348E+04	-1.0746E+05	-2.1547E+04	-4.5918E+04
TIME OF MINIMUM	1.1450E-01	3.0500E-02	5.1000E-02	2.1050E-01

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 4

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	4.6257E+03	5.7088E+04	7.2719E+04	7.1221E+02
TIME OF MAXIMUM	6.8000E-02	2.1150E-01	1.6550E-01	4.0000E-03
MINIMUM	-5.3737E+04	-7.0975E+04	-4.5090E+03	-9.1957E+04
TIME OF MINIMUM	5.1000E-02	1.5900E-01	3.0550E-01	1.2400E-01

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 6

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	5.3643E+04	5.1255E+04	2.0902E+04	1.3231E+05
TIME OF MAXIMUM	2.0000E-01	3.7500E-02	1.9950E-01	2.1000E-01
MINIMUM	-4.4635E+03	-6.2547E+04	-3.8070E+04	-3.8682E+04
TIME OF MINIMUM	8.5000E-02	9.5500E-02	1.1950E-01	1.5900E-01

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

REACTION FORCE TIME HISTORY FOR NODE 1

	FY	MZ
MAXIMUM	6.1977E+04	7.4298E+01
TIME OF MAXIMUM	1.7000E-02	1.2150E-01
MINIMUM	-1.2373E+04	-1.0814E+02
TIME OF MINIMUM	2.1050E-01	1.0000E-03

REACTION FORCE TIME HISTORY FOR NODE 5

	FY	MZ
MAXIMUM	7.2941E+04	8.5138E+01
TIME OF MAXIMUM	8.0000E-02	1.5700E-01
MINIMUM	-1.5420E+03	-8.5230E+01
TIME OF MINIMUM	2.4500E-01	1.6950E-01

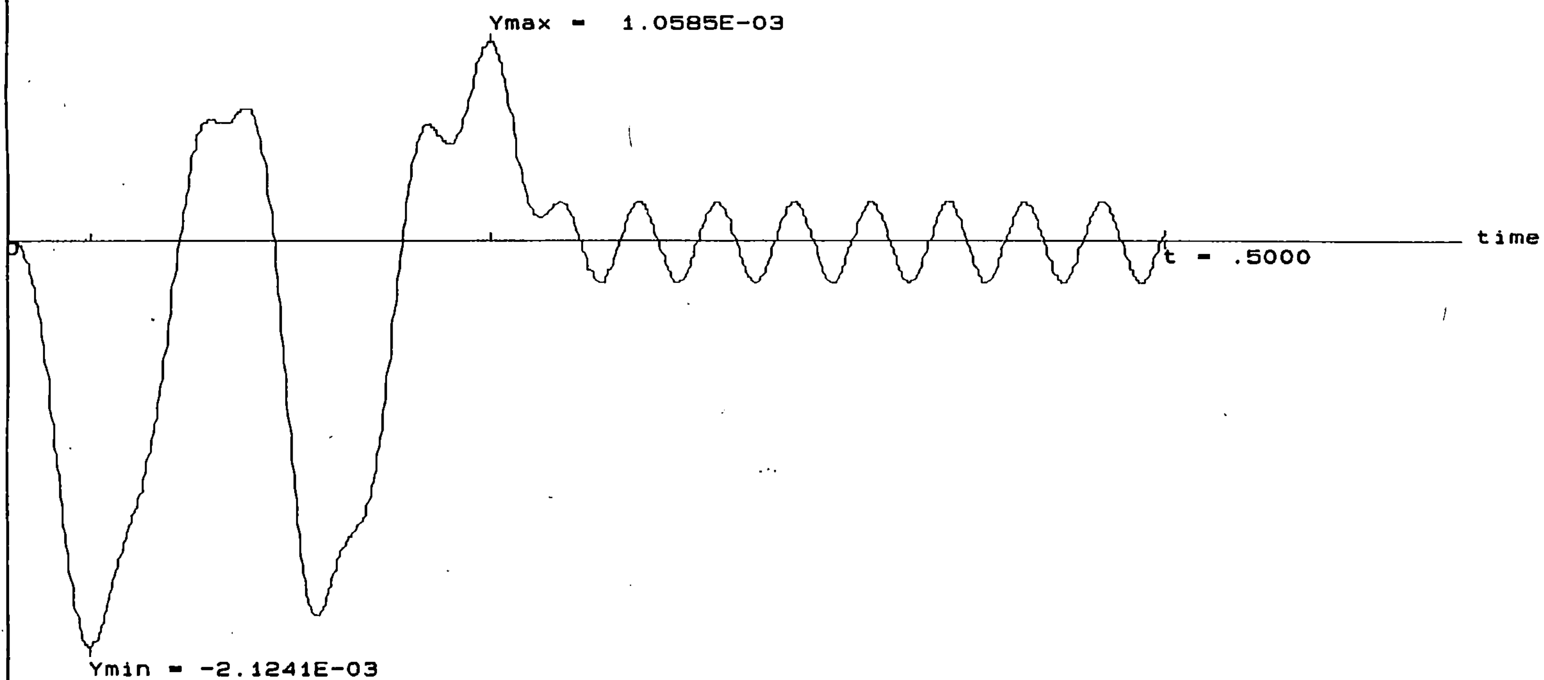
REACTION FORCE TIME HISTORY FOR NODE 9

	FY	MZ
MAXIMUM	6.3305E+04	7.3740E+01
TIME OF MAXIMUM	2.3400E-01	1.2650E-01
MINIMUM	-1.0354E+04	-1.0428E+02
TIME OF MINIMUM	1.6300E-01	2.4750E-01

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0193E+01 Hz

Results at Node = 3

Displacement : Ymin = -2.1241E-03 (t = .0370) Ymax = 1.0585E-03 (t = .2105)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

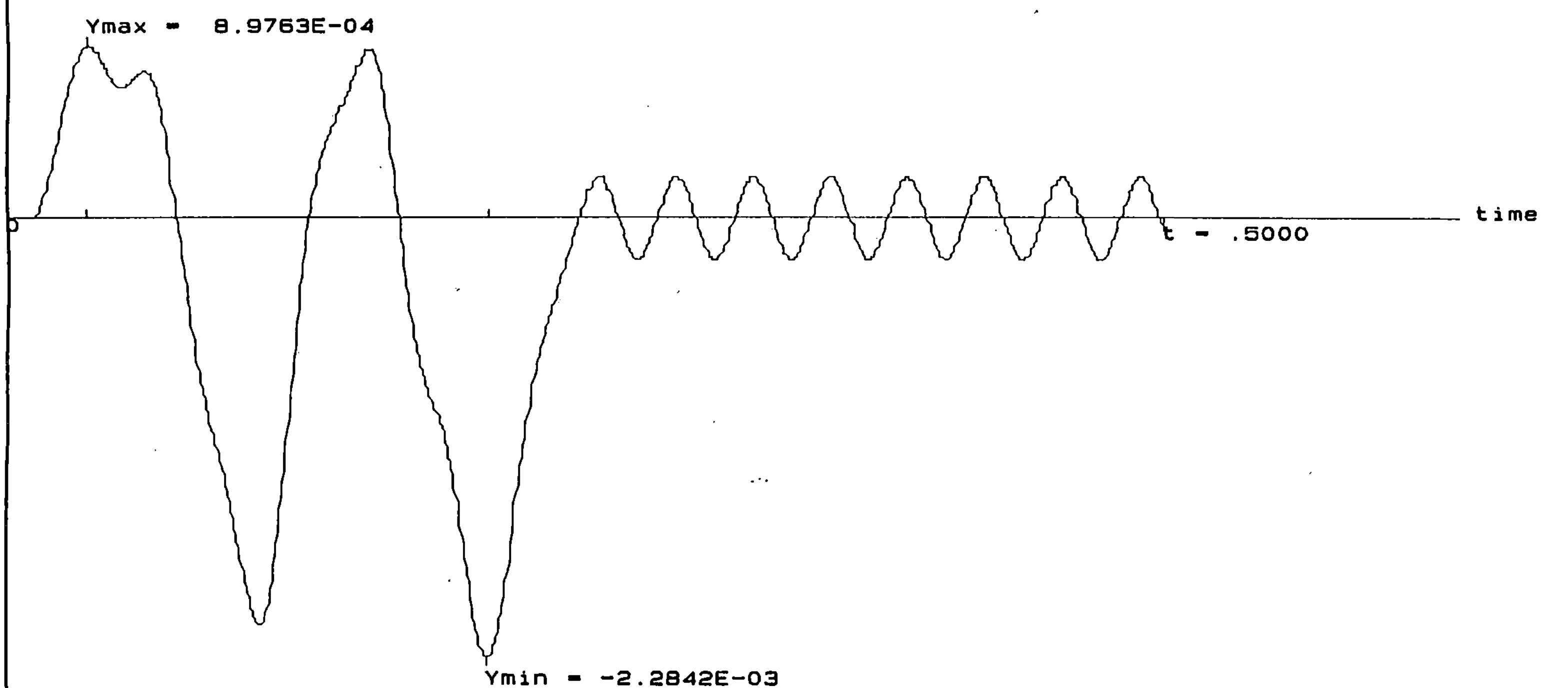
Date: 4/16/1992
Time: 13: 10: 52

LB-A-61

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0193E+01 Hz

Results at Node = 7

Displacement : Ymin = -2.2842E-03 (t = .2110) Ymax = 8.9763E-04 (t = .0360)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

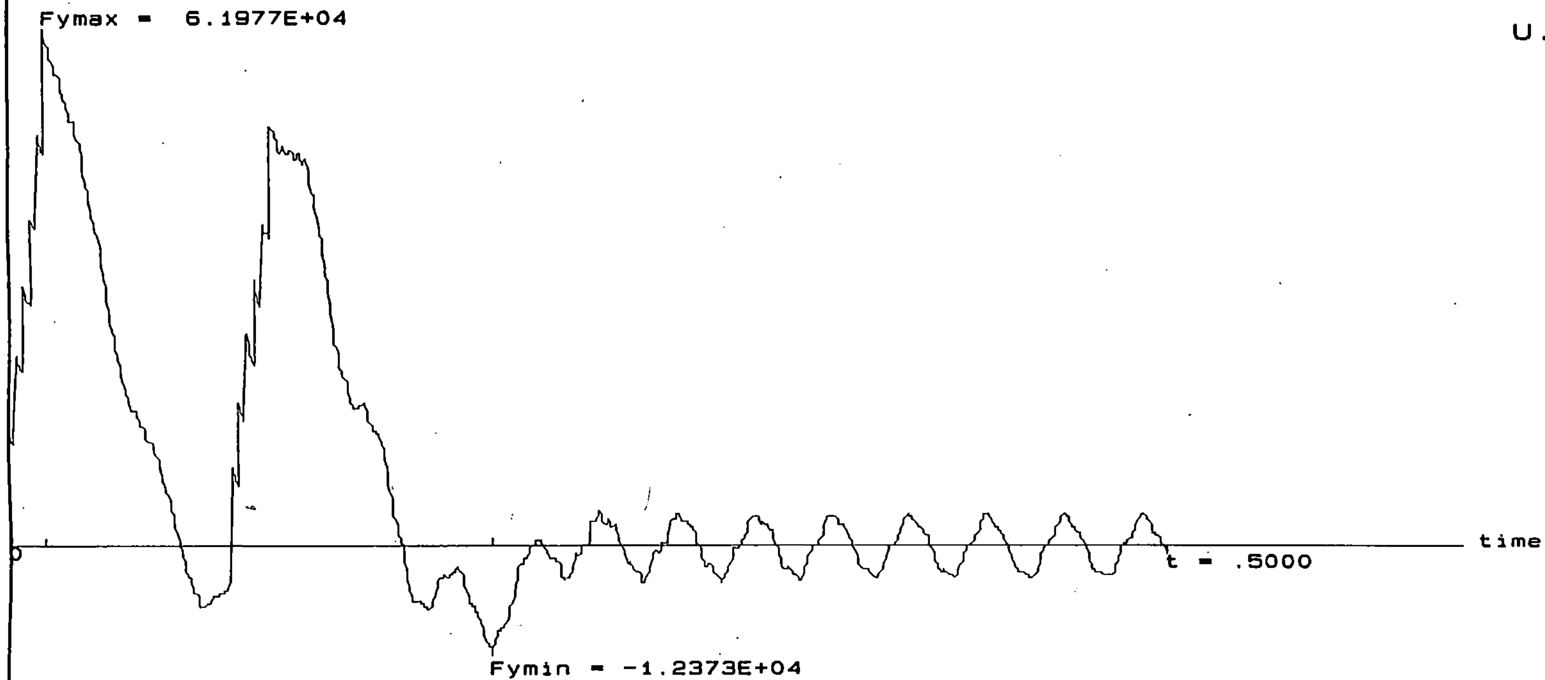
Date: 4/16/1992
Time: 13:10:52

LB-A-62

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0193E+01 Hz

Results at Node = 1

Reaction : Fymin = -1.2373E+04 (t = .2105) Fymax = 6.1977E+04 (t = .0170)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

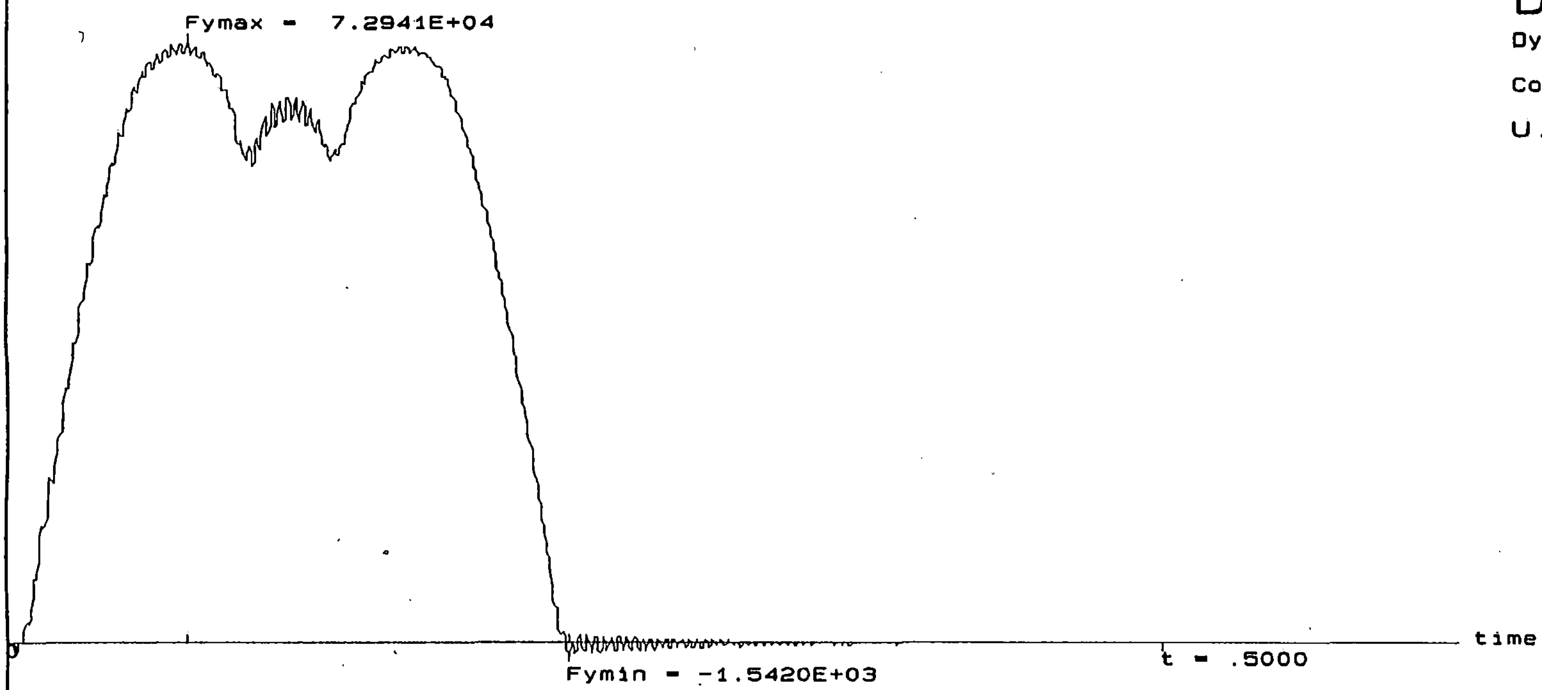
Date: 4/16/1992
Time: 13:10:52

LB-A-63

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0193E+01 Hz

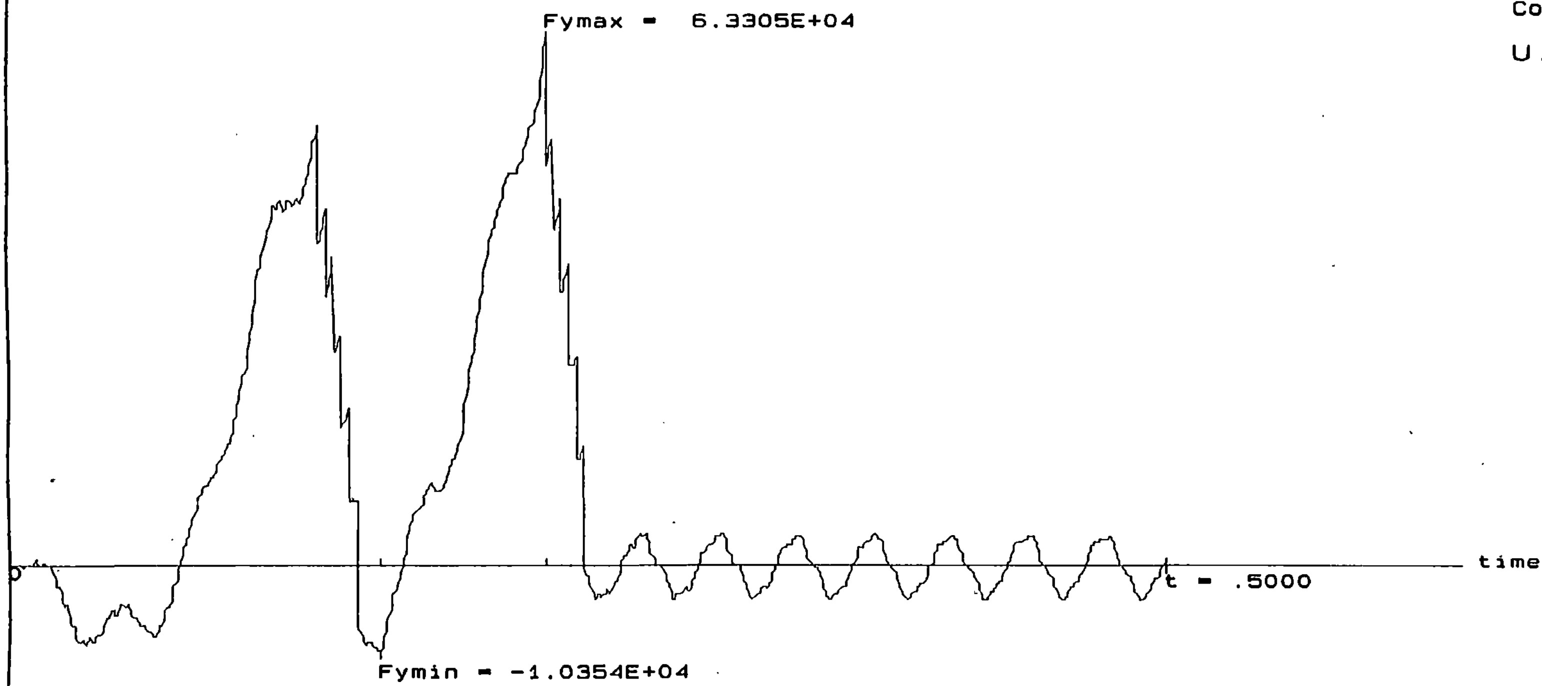
Results at Node = 5

Reaction : Fymin = -1.5420E+03 (t = .2450) Fymax = 7.2941E+04 (t = .0800)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 4/16/1992
Time: 13: 10: 52

65-A-64



DYNACB
Dynamic Analysis
of
Continuous Beams
U.E. & C.

Beam Fundamental Natural Frequency = 3.0193E+01 Hz

Results at Node = 9

Reaction : Fymin = -1.0354E+04 (t = .1630) Fymax = 6.3305E+04 (t = .2340)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

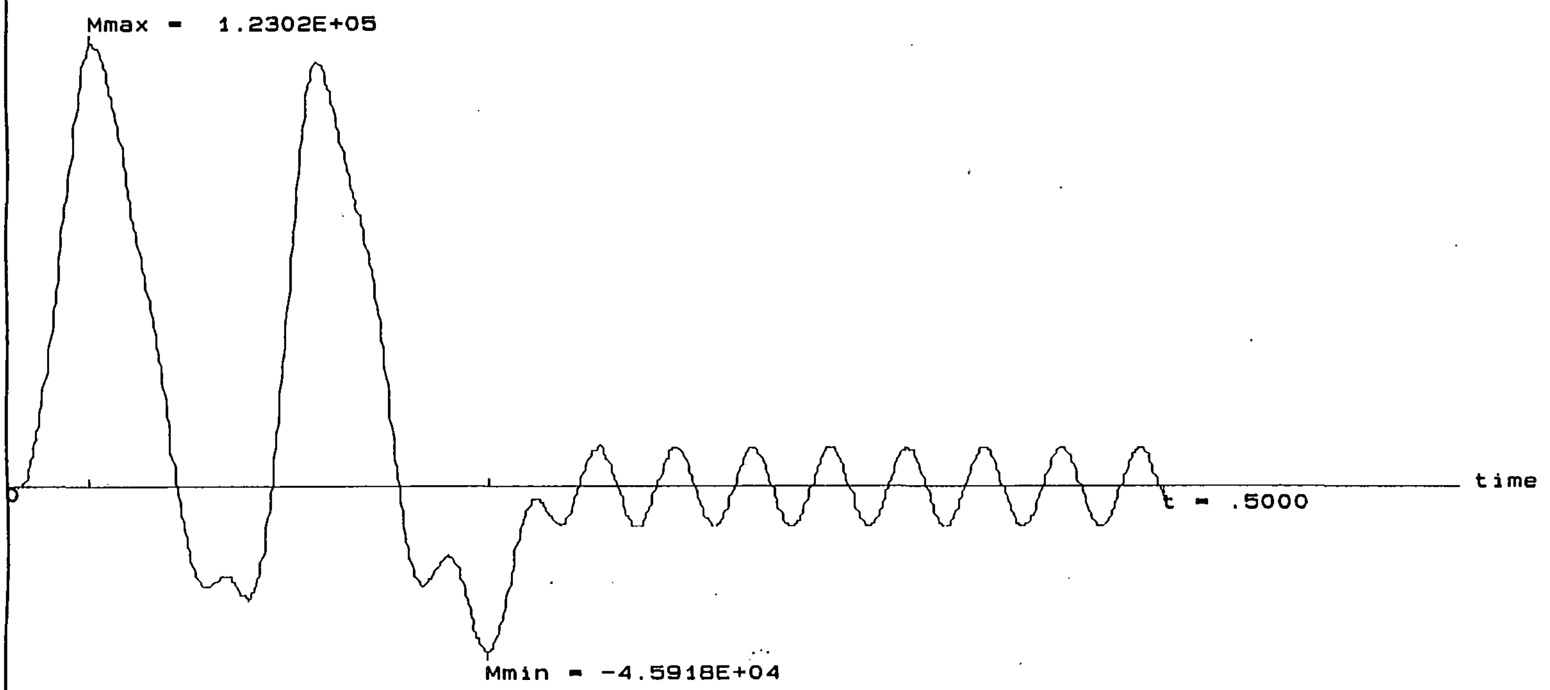
Date: 4/16/1992
Time: 13: 10: 52

LB-A-65

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0193E+01 Hz

Results at Elem = 2 (End Node)

Bending Moment : Mmin = -4.5918E+04 (t = .2105) Mmax = 1.2302E+05 (t = .0375)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

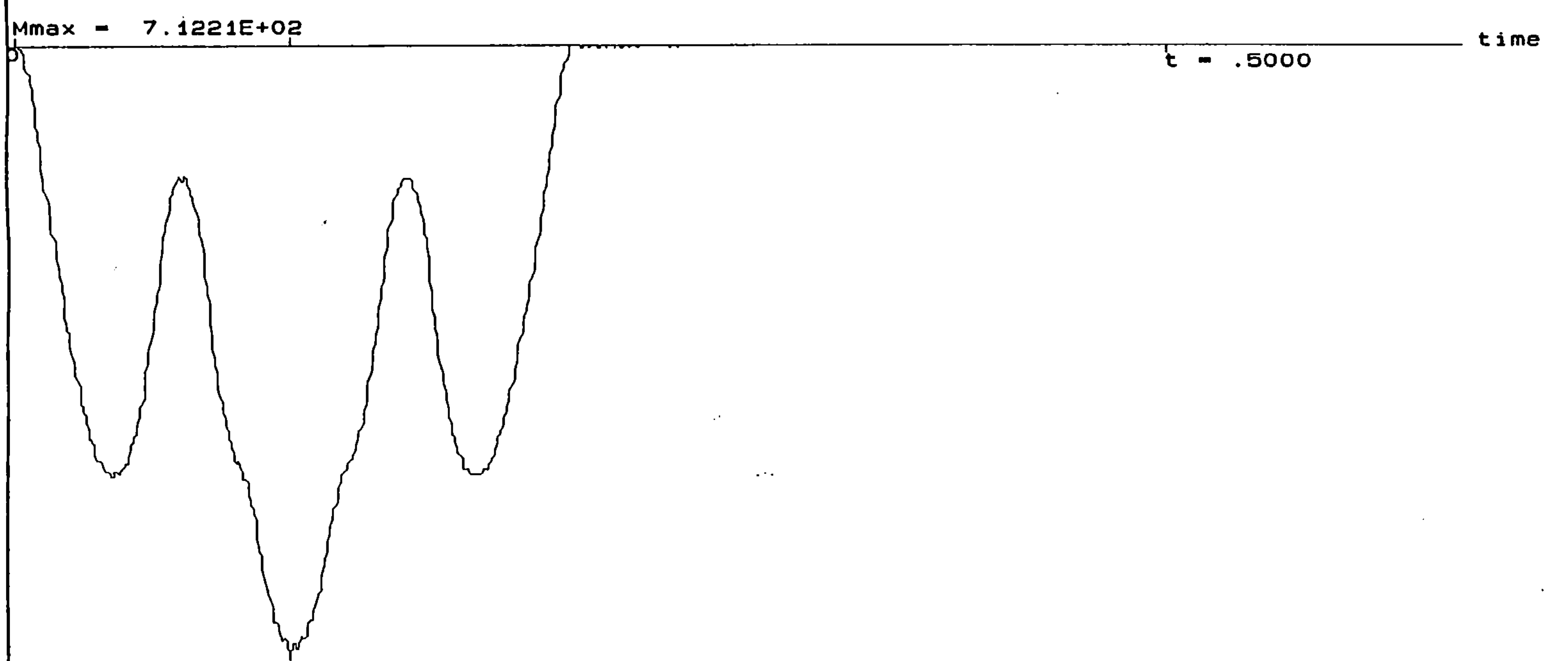
Date: 4/16/1992
Time: 13: 10: 52

LB-A-66

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0193E+01 Hz

Results at Elem = 4 (End Node)

Bending Moment : Mmin = -9.1957E+04 (t = .1240) Mmax = 7.1221E+02 (t = .0040)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

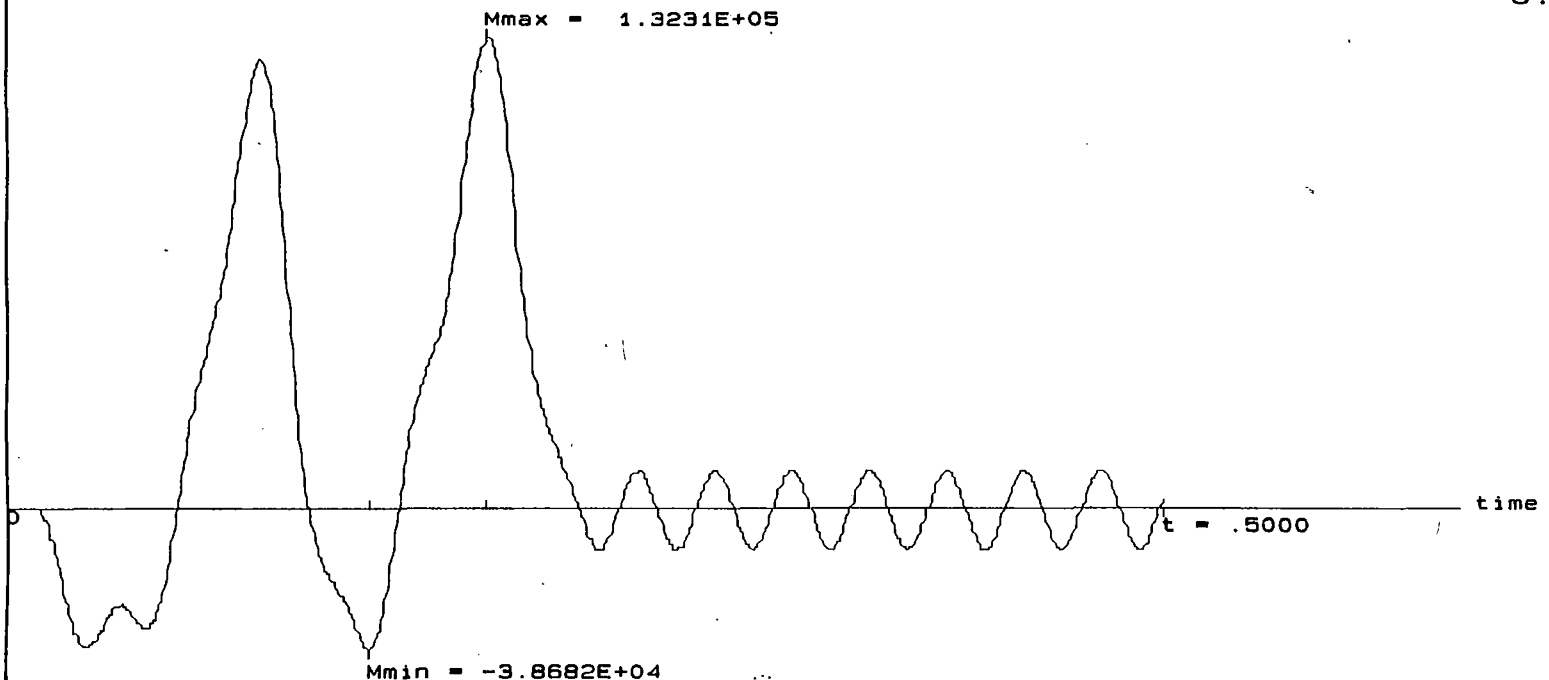
Date: 4/16/1992
Time: 13: 10: 52

2B-A-67

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0193E+01 Hz

Results at Elem = 6 (End Node)

Bending Moment : Mmin = -3.8682E+04 (t = .1590) Mmax = 1.3231E+05 (t = .2100)

Guideway Sheet Sect. - 300 Mph, 45 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 4/16/1992
Time: 13:10:52

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[redacted]

LG-A-69

Section Properties For Guideway Sheet Cross-section (D=1.3208 m)

```
Radius To Inside Of Guideway Sheet, R -  2.100000E+00
Half Angle, ALPHA ---------------------  2.092483E+01
Depth Of Section, D -------------------  1.320800E+00
Thickness Of Guideway Sheet, T1 -------  2.000000E-02
Thickness Of Outer Sheet, T2 ----------  4.762500E-03
Thickness Of Web Plates, T3 -----------  6.350000E-03
```

Section Properties:

```
Cross-sectional Area ------------------  7.563414E-02
Centroidal Location In 1-1 Direction --  0.000000E+00
Centroidal Location In 2-2 Direction --  2.527070E+00
```

Bending About Centroidal Axis Parallel To 1-1 Axis:

```
Moment Of Inertia ---------------------  1.978513E-02
Section Modulus (Inside) --------------  3.498294E-02
Section Modulus (Outside) -------------  2.213769E-02
```

Bending About Centroidal Axis Parallel To 2-2 Axis:

```
Moment Of Inertia ---------------------  3.022898E-02
Section Modulus -----------------------  2.474308E-02
```

4B - A - 70

PROGRAM DYNACB

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 13.716 m Span, 1.3208 m Depth

STRUCTURAL PARAMETERS

NN	NE	NRN	E	RHO
9	8	2	6.8950E+10	2.7126E+03

NODAL COORDINATES

NODE	X
1	0.0000E+00
2	1.7145E+00
3	3.4290E+00
4	5.1435E+00
5	6.8580E+00
6	8.5725E+00
7	1.0287E+01
8	1.2002E+01
9	1.3716E+01

ELEMENT INFORMATION

ELEM.	J	K	AX	ZI	EL
1	1	2	7.5634E-02	1.9785E-02	1.7145E+00
2	2	3	7.5634E-02	1.9785E-02	1.7145E+00
3	3	4	7.5634E-02	1.9785E-02	1.7145E+00
4	4	5	7.5634E-02	1.9785E-02	1.7145E+00
5	5	6	7.5634E-02	1.9785E-02	1.7145E+00
6	6	7	7.5634E-02	1.9785E-02	1.7145E+00
7	7	8	7.5634E-02	1.9785E-02	1.7145E+00
8	8	9	7.5634E-02	1.9785E-02	1.7145E+00

NODAL RESTRAINTS

NODE	NR1	NR2
1	1	0
9	1	0

NUMBER OF DEGREES OF FREEDOM: NDF = 16
NUMBER OF NODAL RESTRAINTS: NNR = 2

OUTPUT KEY FOR MODAL ANALYSIS: IMO = 0

STIFFNESS MATRIX DECOMPOSED

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 13.716 m Span, 1.3208 m Depth

MODE	FREQUENCY (Hz)
1	2.1530E+01
2	8.6143E+01
3	1.9402E+02
4	3.4584E+02
5	5.4324E+02
6	7.8925E+02
7	1.0878E+03
8	1.5294E+03
9	1.9041E+03
10	2.4310E+03
11	3.0709E+03
12	3.8442E+03
13	4.7583E+03
14	5.7592E+03
15	6.6378E+03
16	7.0085E+03

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 13.716 m Span, 1.3208 m Depth

*** LOADING NUMBER 1 OF 1 ***

DYNAMIC PARAMETERS

ISOLVE	NTS	DT	DAMPR
1	1000	5.0000E-04	0.0000E+00

INITIAL CONDITIONS

NNID	NNIV
0	0

APPLIED ACTIONS

NLN	NEL	IML
0	0	12

MOVING LOADS

P	VOP	AOP	SPACING
-2.9648E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.9648E+04	1.3411E+02	0.0000E+00	2.6401E+01
-2.9648E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.9648E+04	1.3411E+02	0.0000E+00	0.0000E+00

GROUND ACCELERATIONS

IGA
0

DIRECT NUMERICAL INTEGRATION

ALPHA = -0.1000 BETA = 0.3025 GAMMA = 0.6000

OUTPUT SELECTION

IWR	IPL	NNO	NEO	NRO
2	1	1	1	2

NODES (DISPL.): 5

ELEMENTS: 4

NODES (REACT.): 1 9

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 13.716 m Span, 1.3208 m Depth

*** LOADING NUMBER 1 OF 1 ***

DISPLACEMENT TIME HISTORY FOR NODE 5

	UY	ROTZ
MAXIMUM	1.5866E-03	1.6281E-04
TIME OF MAXIMUM	1.1750E-01	2.4750E-01
MINIMUM	-6.6517E-03	-1.6132E-04
TIME OF MINIMUM	2.7800E-01	2.9900E-01

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 13.716 m Span, 1.3208 m Depth

*** LOADING NUMBER 1 OF 1 ***

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 4

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	8.4047E+04	1.0352E+05	6.1841E+04	5.1983E+05
TIME OF MAXIMUM	2.6900E-01	1.6400E-01	5.1000E-02	2.7500E-01
MINIMUM	-4.4708E+04	-5.1257E+05	-6.2600E+04	-1.1471E+05
TIME OF MINIMUM	2.5150E-01	4.6000E-02	6.8000E-02	1.1700E-01

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Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 13.716 m Span, 1.3208 m Depth

*** LOADING NUMBER 1 OF 1 ***

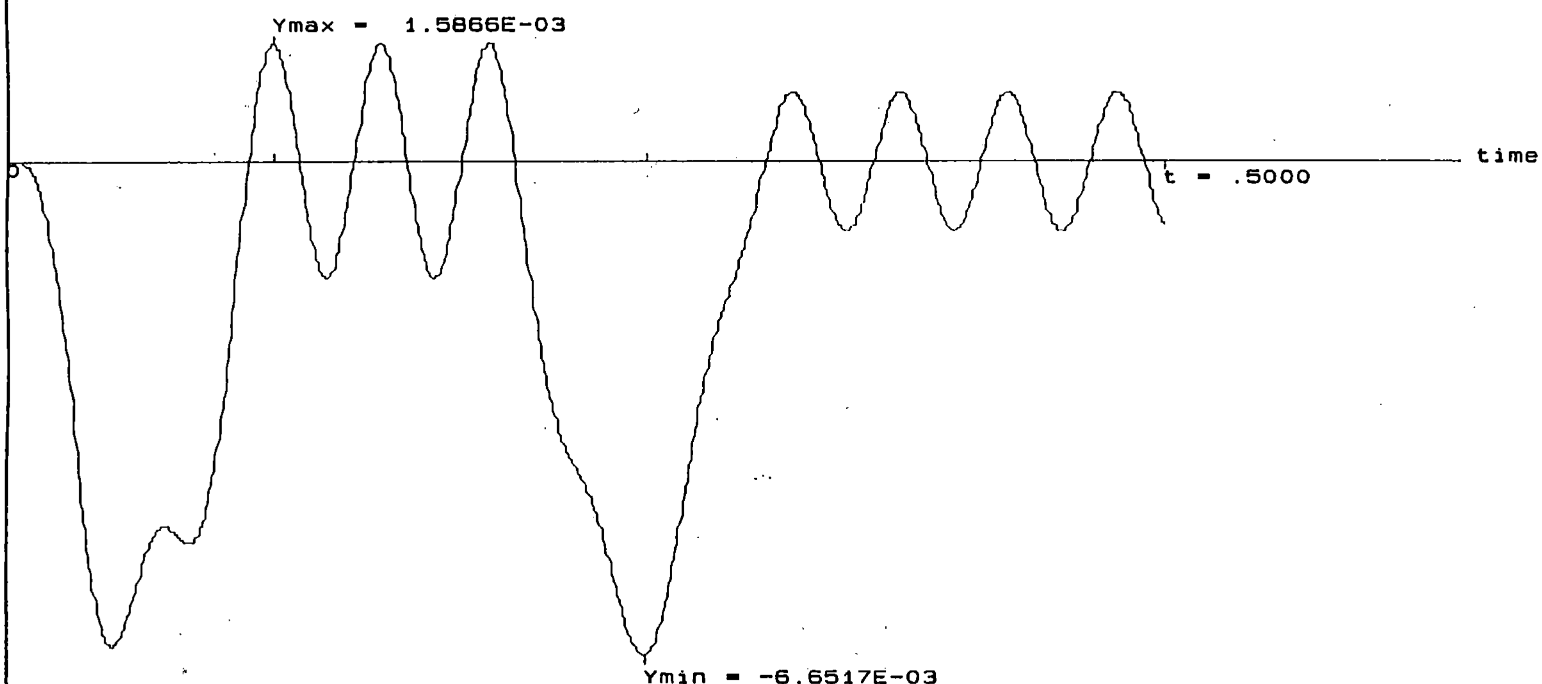
REACTION FORCE TIME HISTORY FOR NODE 1

	FY	MZ
MAXIMUM	1.4822E+05	1.1075E+02
TIME OF MAXIMUM	2.3250E-01	2.3650E-01
MINIMUM	-2.6060E+04	-1.8236E+02
TIME OF MINIMUM	1.6250E-01	5.0000E-04

REACTION FORCE TIME HISTORY FOR NODE 9

	FY	MZ
MAXIMUM	1.4304E+05	1.0048E+02
TIME OF MAXIMUM	9.5000E-02	3.0850E-01
MINIMUM	-2.7900E+04	-1.8657E+02
TIME OF MINIMUM	1.1950E-01	1.1900E-01

DYNACB
Dynamic Analysis
of
Continuous Beams
U.E. & C.



Beam Fundamental Natural Frequency = 2.1530E+01 Hz

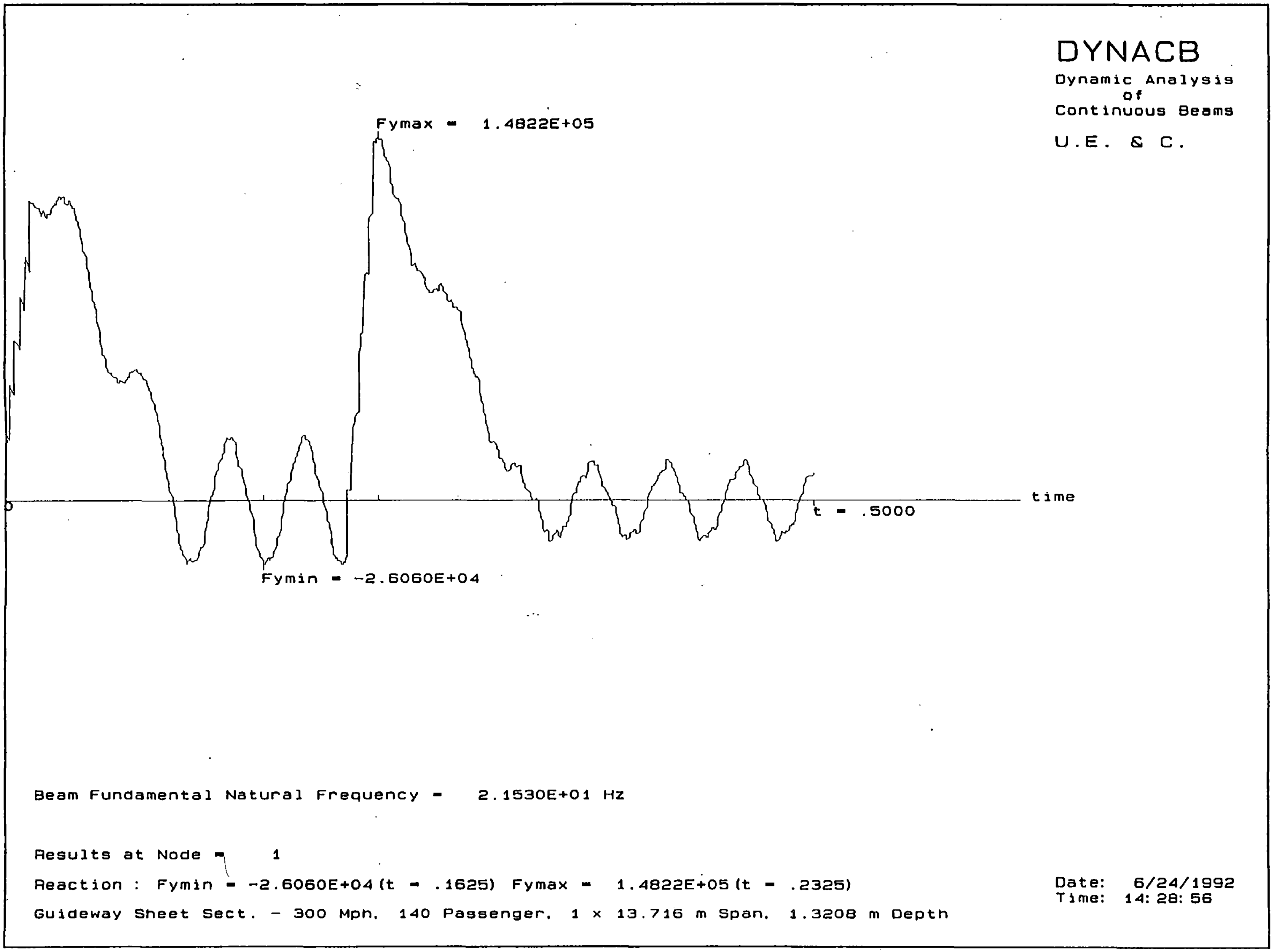
Results at Node = 5

Displacement : Ymin = -6.6517E-03 (t = .2780) Ymax = 1.5866E-03 (t = .1175)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 13.716 m Span, 1.3208 m Depth

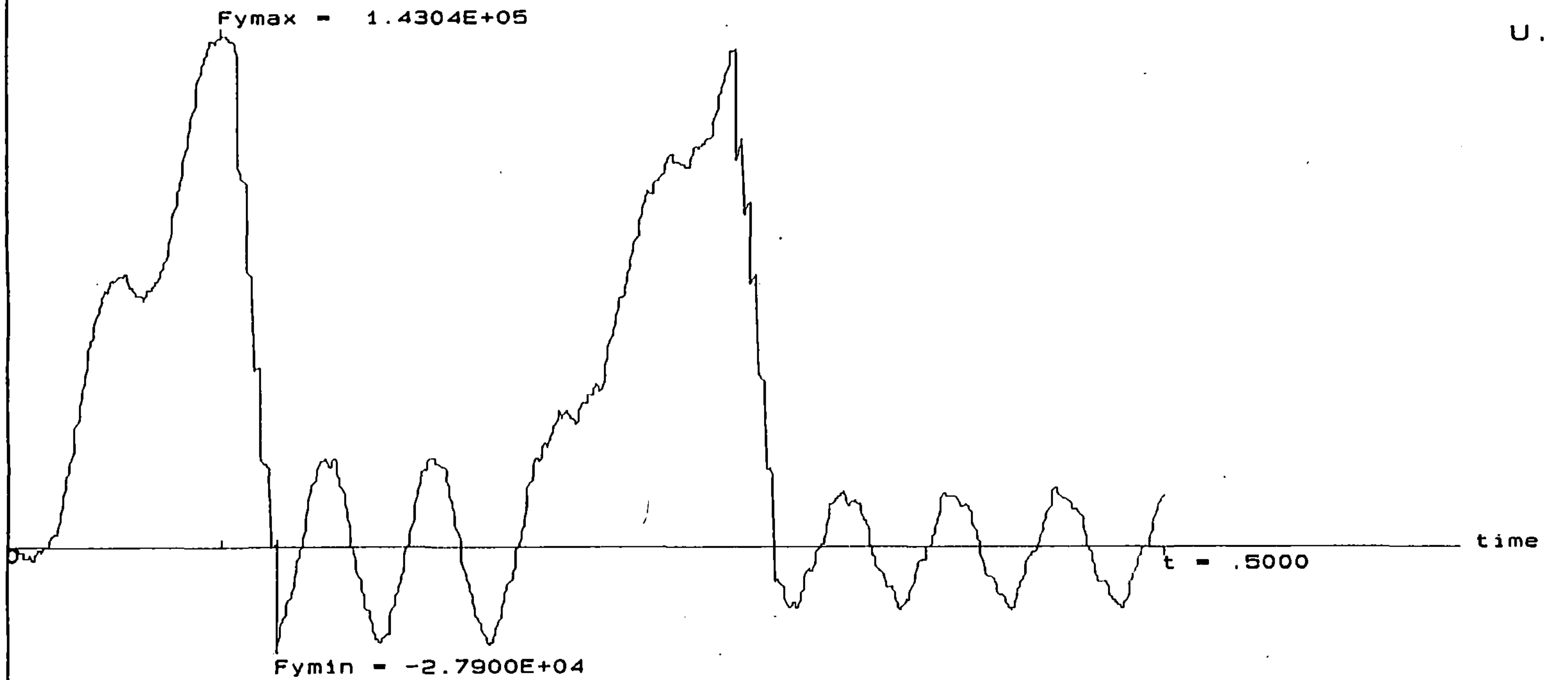
Date: 6/24/1992
Time: 14:28:56

LB-A-76



DYNACB
Dynamic Analysis
of
Continuous Beams
U.E. & C.
Fymax = 1.4822E+05
Fymin = -2.6060E+04
time
t = .5000
Beam Fundamental Natural Frequency = 2.1530E+01 Hz
Results at Node = 1
Reaction : Fymin = -2.6060E+04 (t = .1625) Fymax = 1.4822E+05 (t = .2325)
Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 13.716 m Span, 1.3208 m Depth
Date: 6/24/1992
Time: 14:28:56

LB-A-77



DYNACB
Dynamic Analysis
of
Continuous Beams
U.E. & C.

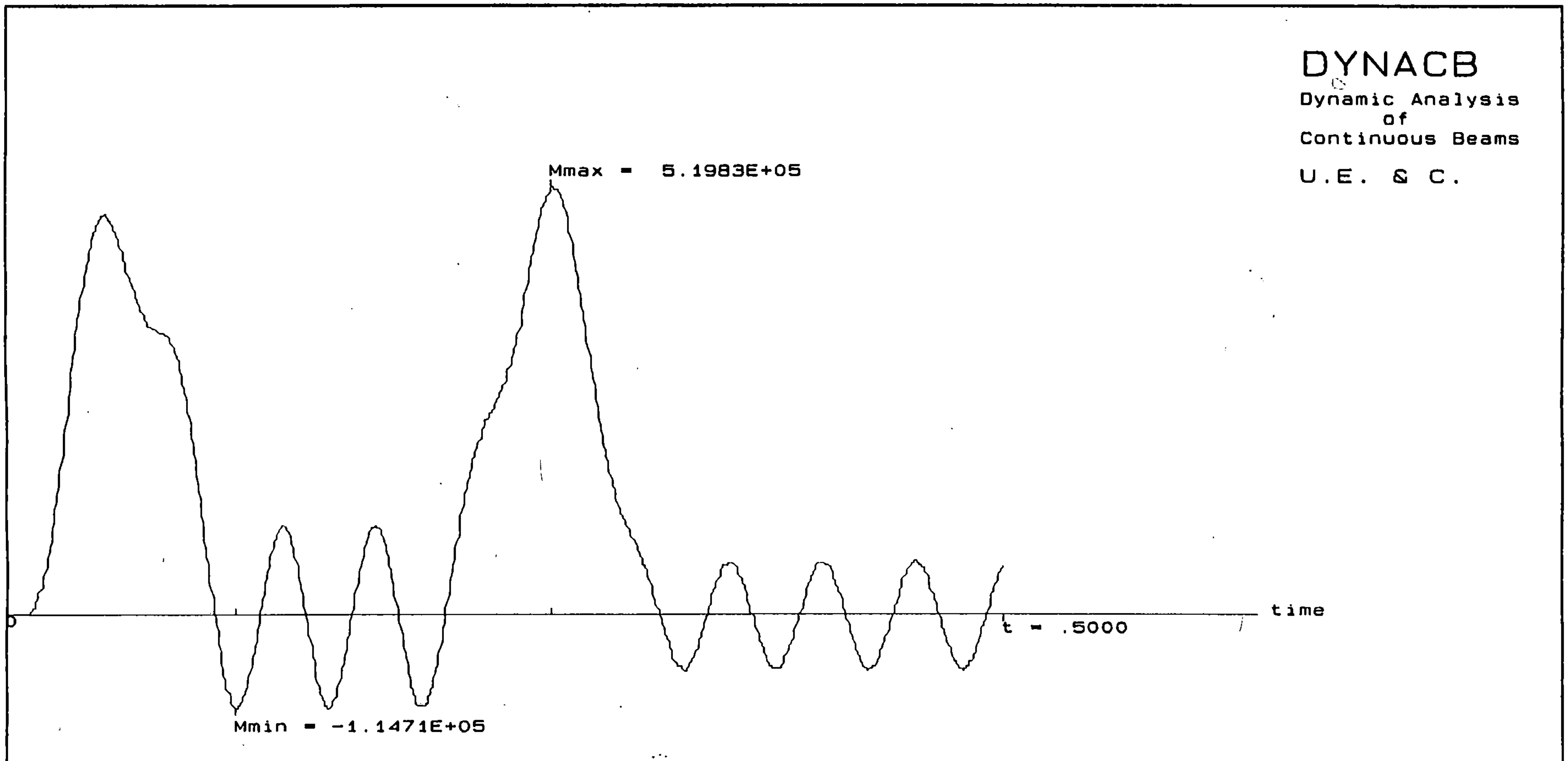
Beam Fundamental Natural Frequency = 2.1530E+01 Hz

Results at Node = 9

Reaction : Fymin = -2.7900E+04 (t = .1195) Fymax = 1.4304E+05 (t = .0950)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 13.716 m Span, 1.3208 m Depth

Date: 6/24/1992
Time: 14:28:56



Beam Fundamental Natural Frequency = 2.1530E+01 Hz

Results at Elem = 4 (End Node)

Bending Moment : Mmin = -1.1471E+05 (t = .1170) Mmax = 5.1983E+05 (t = .2750)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 13.716 m Span, 1.3208 m Depth

Date: 6/24/1992
Time: 14:28:56

LB-A-79

Section Properties For Guideway Sheet Cross-section (D=1.7272 m)

Radius To Inside Of Guideway Sheet, R -	2.100000E+00
Half Angle, ALPHA ---------------------	2.092483E+01
Depth Of Section, D -------------------	1.727200E+00
Thickness Of Guideway Sheet, T1 -------	2.000000E-02
Thickness Of Outer Sheet, T2 ----------	4.762500E-03
Thickness Of Web Plates, T3 -----------	7.937500E-03

Section Properties:

Cross-sectional Area ------------------	9.818088E-02
Centroidal Location In 1-1 Direction --	0.000000E+00
Centroidal Location In 2-2 Direction --	2.730453E+00

Bending About Centroidal Axis Parallel To 1-1 Axis:

Moment Of Inertia ---------------------	4.088755E-02
Section Modulus (Inside) --------------	5.317332E-02
Section Modulus (Outside) -------------	3.728075E-02

Bending About Centroidal Axis Parallel To 2-2 Axis:

Moment Of Inertia ---------------------	4.924599E-02
Section Modulus -----------------------	3.602864E-02

LB-A-81

PROGRAM DYNACB

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 18.288 m Span, 1.7272 m Depth

STRUCTURAL PARAMETERS

NN	NE	NRN	E	RHO
9	8	2	6.8950E+10	2.7126E+03

NODAL COORDINATES

NODE	X
1	0.0000E+00
2	2.2860E+00
3	4.5720E+00
4	6.8580E+00
5	9.1440E+00
6	1.1430E+01
7	1.3716E+01
8	1.6002E+01
9	1.8288E+01

ELEMENT INFORMATION

ELEM.	J	K	AX	ZI	EL
1	1	2	9.8181E-02	4.0888E-02	2.2860E+00
2	2	3	9.8181E-02	4.0888E-02	2.2860E+00
3	3	4	9.8181E-02	4.0888E-02	2.2860E+00
4	4	5	9.8181E-02	4.0888E-02	2.2860E+00
5	5	6	9.8181E-02	4.0888E-02	2.2860E+00
6	6	7	9.8181E-02	4.0888E-02	2.2860E+00
7	7	8	9.8181E-02	4.0888E-02	2.2860E+00
8	8	9	9.8181E-02	4.0888E-02	2.2860E+00

NODAL RESTRAINTS

NODE	NR1	NR2
1	1	0
9	1	0

NUMBER OF DEGREES OF FREEDOM: NDF = 16
NUMBER OF NODAL RESTRAINTS: NNR = 2

OUTPUT KEY FOR MODAL ANALYSIS: IMO = 0

STIFFNESS MATRIX DECOMPOSED

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 18.288 m Span, 1.7272 m Depth

MODE	FREQUENCY (Hz)
1	1.5281E+01
2	6.1138E+01
3	1.3770E+02
4	2.4545E+02
5	3.8556E+02
6	5.6015E+02
7	7.7207E+02
8	1.0855E+03
9	1.3514E+03
10	1.7253E+03
11	2.1795E+03
12	2.7284E+03
13	3.3771E+03
14	4.0875E+03
15	4.7111E+03
16	4.9742E+03

LG-A-83

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 18.288 m Span, 1.7272 m Depth

*** LOADING NUMBER 1 OF 1 ***

DYNAMIC PARAMETERS

ISOLVE	NTS	DT	DAMPR
1	1000	5.0000E-04	0.0000E+00

INITIAL CONDITIONS

NNID	NNIV
0	0

APPLIED ACTIONS

NLN	NEL	IML
0	0	12

MOVING LOADS

P	VOP	AOP	SPACING
-2.9648E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.9648E+04	1.3411E+02	0.0000E+00	2.6401E+01
-2.9648E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.9648E+04	1.3411E+02	0.0000E+00	0.0000E+00

GROUND ACCELERATIONS

IGA
0

DIRECT NUMERICAL INTEGRATION

ALPHA = -0.1000 BETA = 0.3025 GAMMA = 0.6000

OUTPUT SELECTION

IWR	IPL	NNO	NEO	NRO
2	1	1	1	2

NODES (DISPL.): 5

ELEMENTS: 4

NODES (REACT.): 1 9

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 18.288 m Span, 1.7272 m Depth

*** LOADING NUMBER 1 OF 1 ***

DISPLACEMENT TIME HISTORY FOR NODE 5

	UY	ROTZ
MAXIMUM	3.7687E-03	1.5068E-04
TIME OF MAXIMUM	3.6350E-01	2.5800E-01
MINIMUM	-9.0300E-03	-1.4955E-04
TIME OF MINIMUM	2.6400E-01	3.1600E-01

LB - A - 85

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 18.288 m Span, 1.7272 m Depth

*** LOADING NUMBER 1 OF 1 ***

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 4

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	9.2745E+04	2.9969E+05	6.4830E+04	7.2365E+05
TIME OF MAXIMUM	6.8000E-02	3.6350E-01	6.8000E-02	2.6550E-01
MINIMUM	-3.9360E+04	-8.0487E+05	-6.9784E+04	-3.1603E+05
TIME OF MINIMUM	5.1000E-02	2.6500E-01	2.9900E-01	3.6300E-01

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 18.288 m Span, 1.7272 m Depth

*** LOADING NUMBER 1 OF 1 ***

REACTION FORCE TIME HISTORY FOR NODE 1

	FY	MZ
MAXIMUM	1.6616E+05	1.2942E+02
TIME OF MAXIMUM	2.5800E-01	2.5000E-02
MINIMUM	-5.8407E+04	-1.9676E+02
TIME OF MINIMUM	4.9500E-01	1.0000E-03

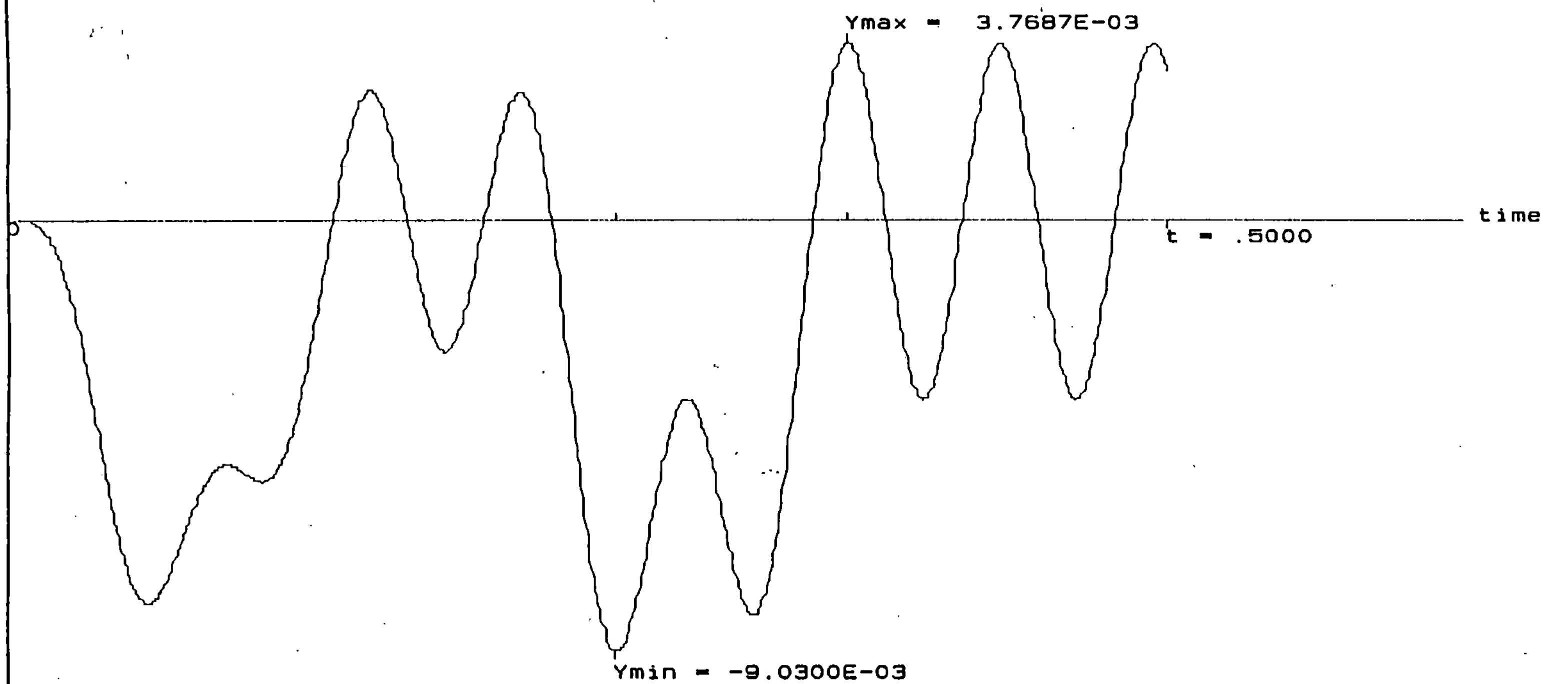
REACTION FORCE TIME HISTORY FOR NODE 9

	FY	MZ
MAXIMUM	1.7267E+05	1.2822E+02
TIME OF MAXIMUM	3.3050E-01	1.2850E-01
MINIMUM	-5.1543E+04	-1.9016E+02
TIME OF MINIMUM	4.2500E-01	1.4950E-01

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 1.5281E+01 Hz

Results at Node = 5

Displacement : Ymin = -9.0300E-03 (t = .2640) Ymax = 3.7687E-03 (t = .3635)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 18.288 m Span, 1.7272 m Depth

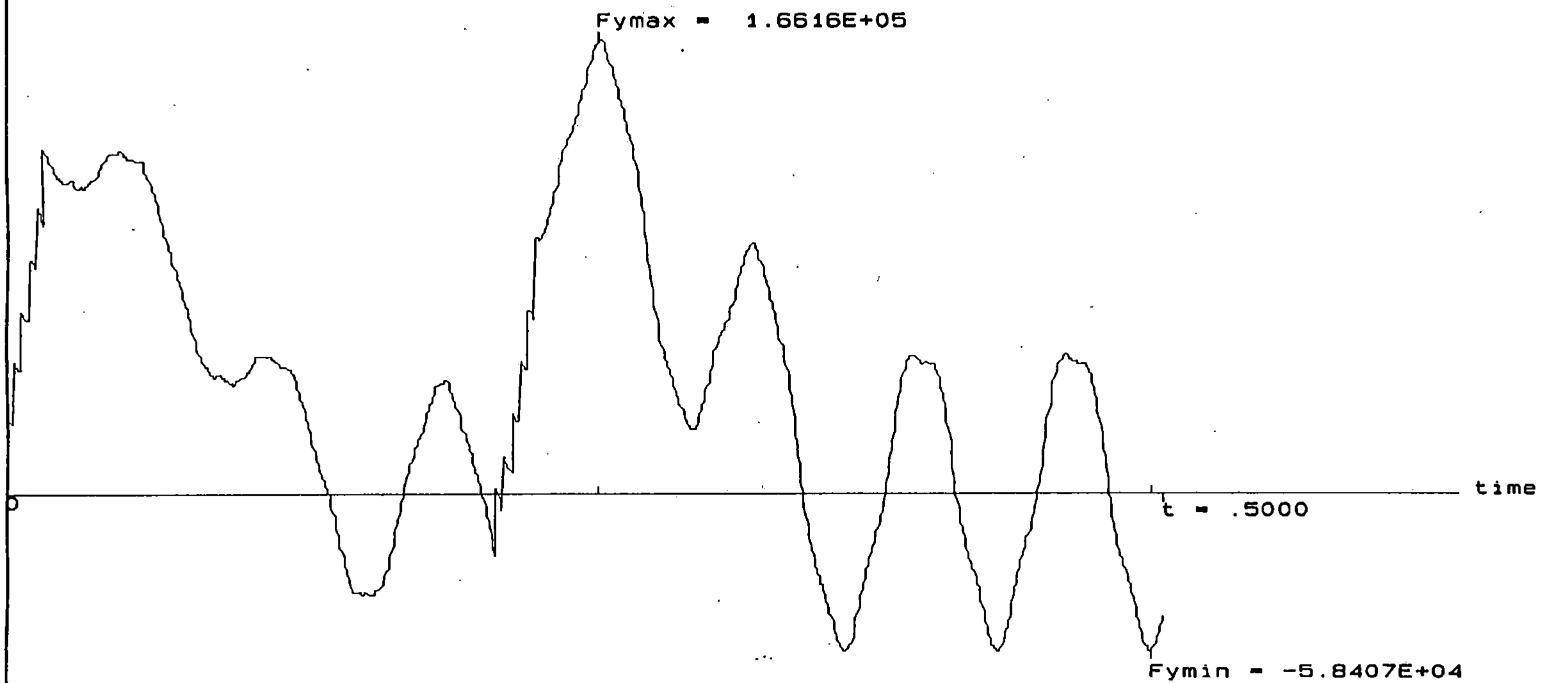
Date: 6/25/1992
Time: 11: 8: 54

78-A-87

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 1.5281E+01 Hz

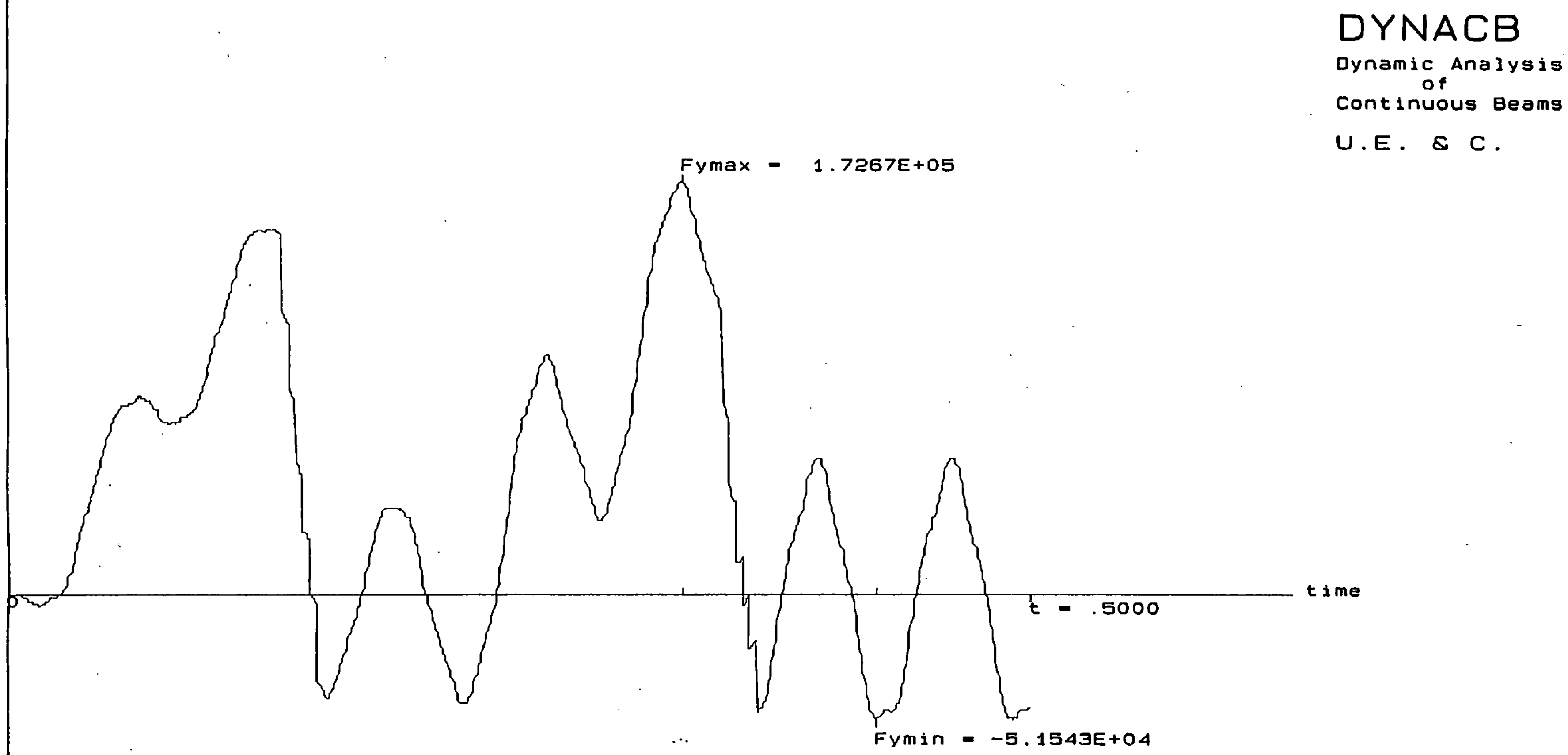
Results at Node = 1

Reaction : Fymin = -5.8407E+04 (t = .4950) Fymax = 1.6616E+05 (t = .2580)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 18.288 m Span, 1.7272 m Depth

Date: 6/25/1992
Time: 11: 8:54

LB-A-88



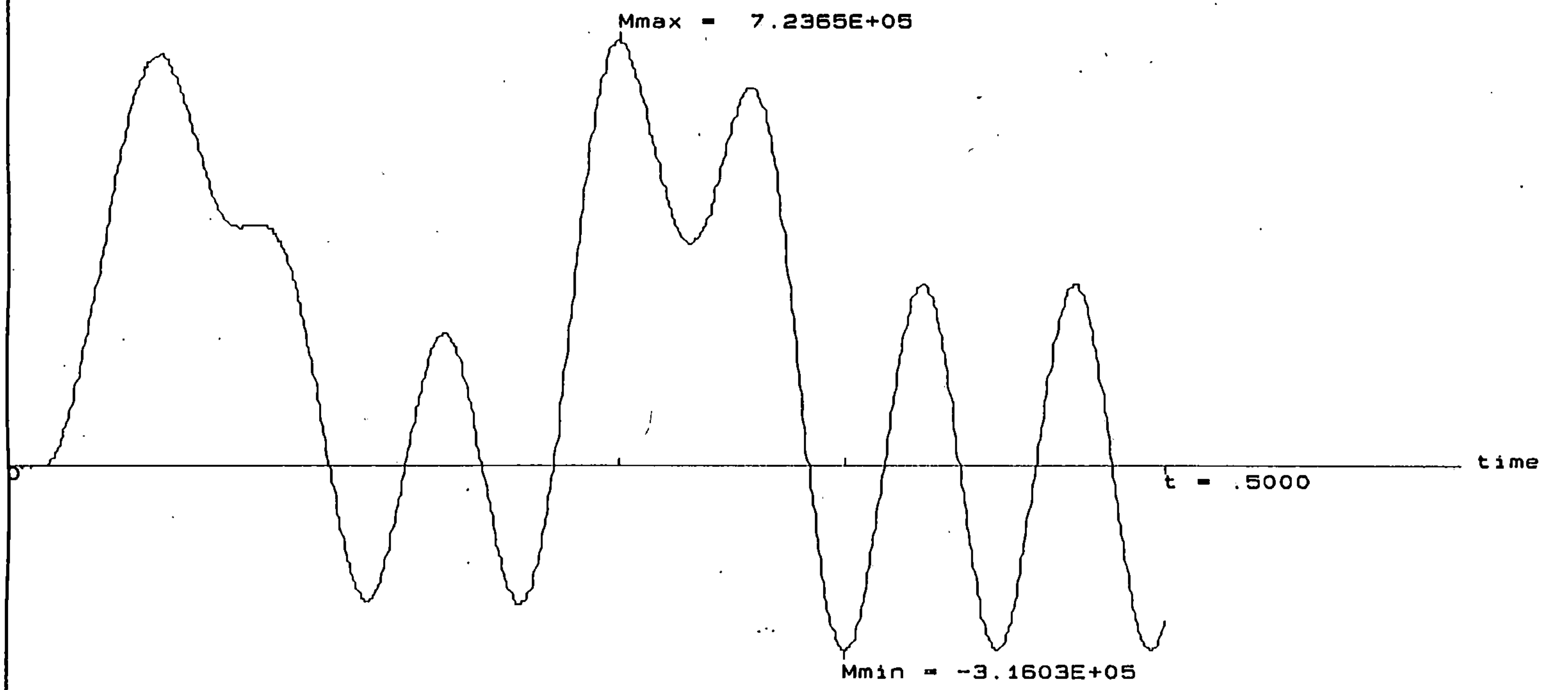
Beam Fundamental Natural Frequency = 1.5281E+01 Hz

Results at Node = 9

Reaction : Fymin = -5.1543E+04 (t = .4250) Fymax = 1.7267E+05 (t = .3305)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 18.288 m Span, 1.7272 m Depth

Date: 6/25/1992
Time: 11: 8:54



DYNACB
Dynamic Analysis
of
Continuous Beams
U.E. & C.

Beam Fundamental Natural Frequency = 1.5281E+01 Hz

Results at Elem = 4 (End Node)

Bending Moment : Mmin = -3.1603E+05 (t = .3630) Mmax = 7.2365E+05 (t = .2655)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 18.288 m Span, 1.7272 m Depth

Date: 6/25/1992
Time: 11: 8:54

LB-A-90

Section Properties For Modified Guideway Sheet Cross-section (D=.8128 m)

Radius To Inside Of Guideway Sheet, R -	2.100000E+00
Half Angle, ALPHA ----------------------	2.092483E+01
Depth Of Section, D --------------------	8.128000E-01
Thickness Of Guideway Sheet, T1 -------	2.000000E-02
Thickness Of Outer Sheet, T2 ----------	6.350000E-03
Thickness Of Web Plates, T3 -----------	6.350000E-03

Section Properties:

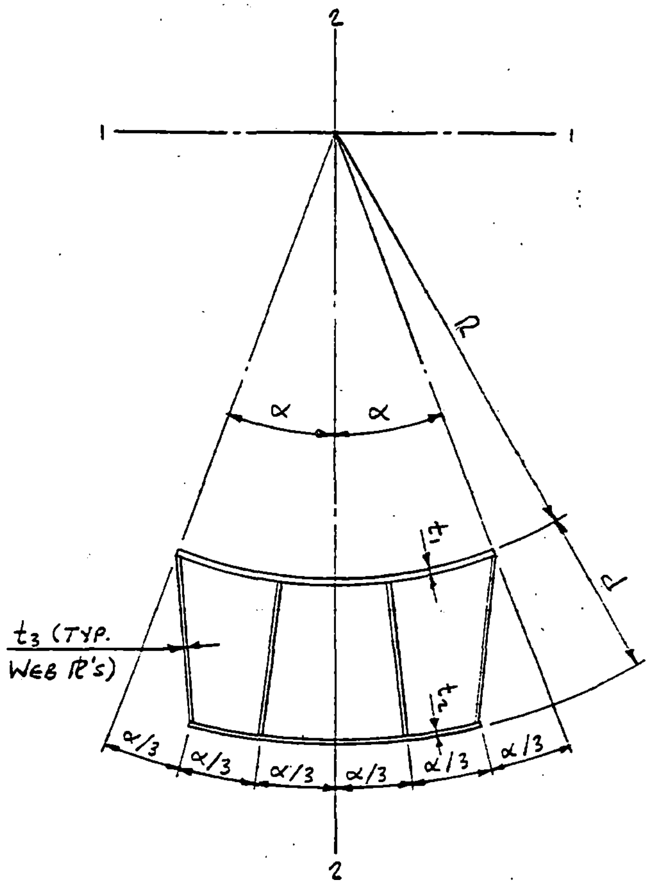
Cross-sectional Area ------------------	6.050720E-02
Centroidal Location In 1-1 Direction --	0.000000E+00
Centroidal Location In 2-2 Direction --	2.315749E+00

Bending About Centroidal Axis Parallel To 1-1 Axis:

Moment Of Inertia ---------------------	6.429507E-03
Section Modulus (Inside) --------------	1.814992E-02
Section Modulus (Outside) -------------	1.076877E-02

Bending About Centroidal Axis Parallel To 2-2 Axis:

Moment Of Inertia ---------------------	1.405282E-02
Section Modulus -----------------------	1.350861E-02



LEVITATION BOX BEAM

LB-A-92

PROGRAM DYNACB

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

STRUCTURAL PARAMETERS

NN	NE	NRN	E	RHO
9	8	2	6.8950E+10	2.7126E+03

NODAL COORDINATES

NODE	X
1	0.0000E+00
2	1.1430E+00
3	2.2860E+00
4	3.4290E+00
5	4.5720E+00
6	5.7150E+00
7	6.8580E+00
8	8.0010E+00
9	9.1440E+00

ELEMENT INFORMATION

ELEM.	J	K	AX	ZI	EL
1	1	2	6.0507E-02	6.4295E-03	1.1430E+00
2	2	3	6.0507E-02	6.4295E-03	1.1430E+00
3	3	4	6.0507E-02	6.4295E-03	1.1430E+00
4	4	5	6.0507E-02	6.4295E-03	1.1430E+00
5	5	6	6.0507E-02	6.4295E-03	1.1430E+00
6	6	7	6.0507E-02	6.4295E-03	1.1430E+00
7	7	8	6.0507E-02	6.4295E-03	1.1430E+00
8	8	9	6.0507E-02	6.4295E-03	1.1430E+00

NODAL RESTRAINTS

NODE	NR1	NR2
1	1	0
9	1	0

NUMBER OF DEGREES OF FREEDOM: NDF = 16
NUMBER OF NODAL RESTRAINTS: NNR = 2

OUTPUT KEY FOR MODAL ANALYSIS: IMO = 0

STIFFNESS MATRIX DECOMPOSED

LG-A-93

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

MODE	FREQUENCY (Hz)
1	3.0875E+01
2	1.2353E+02
3	2.7823E+02
4	4.9595E+02
5	7.7903E+02
6	1.1318E+03
7	1.5600E+03
8	2.1932E+03
9	2.7306E+03
10	3.4861E+03
11	4.4038E+03
12	5.5127E+03
13	6.8235E+03
14	8.2589E+03
15	9.5188E+03
16	1.0050E+04

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

DYNAMIC PARAMETERS

ISOLVE	NTS	DT	DAMPR
1	750	5.0000E-04	0.0000E+00

INITIAL CONDITIONS

NNID	NNIV
0	0

APPLIED ACTIONS

NLN	NEL	IML
0	0	12

MOVING LOADS

P	VOP	AOP	SPACING
-2.9648E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.9648E+04	1.3411E+02	0.0000E+00	2.6401E+01
-2.9648E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.2992E+04	1.3411E+02	0.0000E+00	4.5000E-01
-2.9648E+04	1.3411E+02	0.0000E+00	0.0000E+00

GROUND ACCELERATIONS

IGA
0

DIRECT NUMERICAL INTEGRATION

ALPHA = -0.1000 BETA = 0.3025 GAMMA = 0.6000

OUTPUT SELECTION

IWR	IPL	NNO	NEO	NRO
2	1	1	1	2

NODES (DISPL.): 5

ELEMENTS: 4

NODES (REACT.): 1 9

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

DISPLACEMENT TIME HISTORY FOR NODE 5

	UY	ROTZ
MAXIMUM	1.1165E-03	2.0717E-04
TIME OF MAXIMUM	8.3000E-02	2.4350E-01
MINIMUM	-6.0105E-03	-2.1390E-04
TIME OF MINIMUM	2.5850E-01	2.7250E-01

LB-A-96

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 4

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	8.3546E+04	5.6248E+04	5.6119E+04	3.3426E+05
TIME OF MAXIMUM	2.5600E-01	8.3000E-02	3.4000E-02	2.5800E-01
MINIMUM	-3.7554E+04	-3.1158E+05	-5.9328E+04	-5.9729E+04
TIME OF MINIMUM	2.3900E-01	3.4500E-02	2.6500E-01	8.2500E-02

LB-A-97

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

REACTION FORCE TIME HISTORY FOR NODE 1

	FY	MZ
MAXIMUM	1.4248E+05	7.6778E+01
TIME OF MAXIMUM	2.3050E-01	2.3500E-01
MINIMUM	-2.2472E+04	-1.8160E+02
TIME OF MINIMUM	8.3500E-02	5.0000E-04

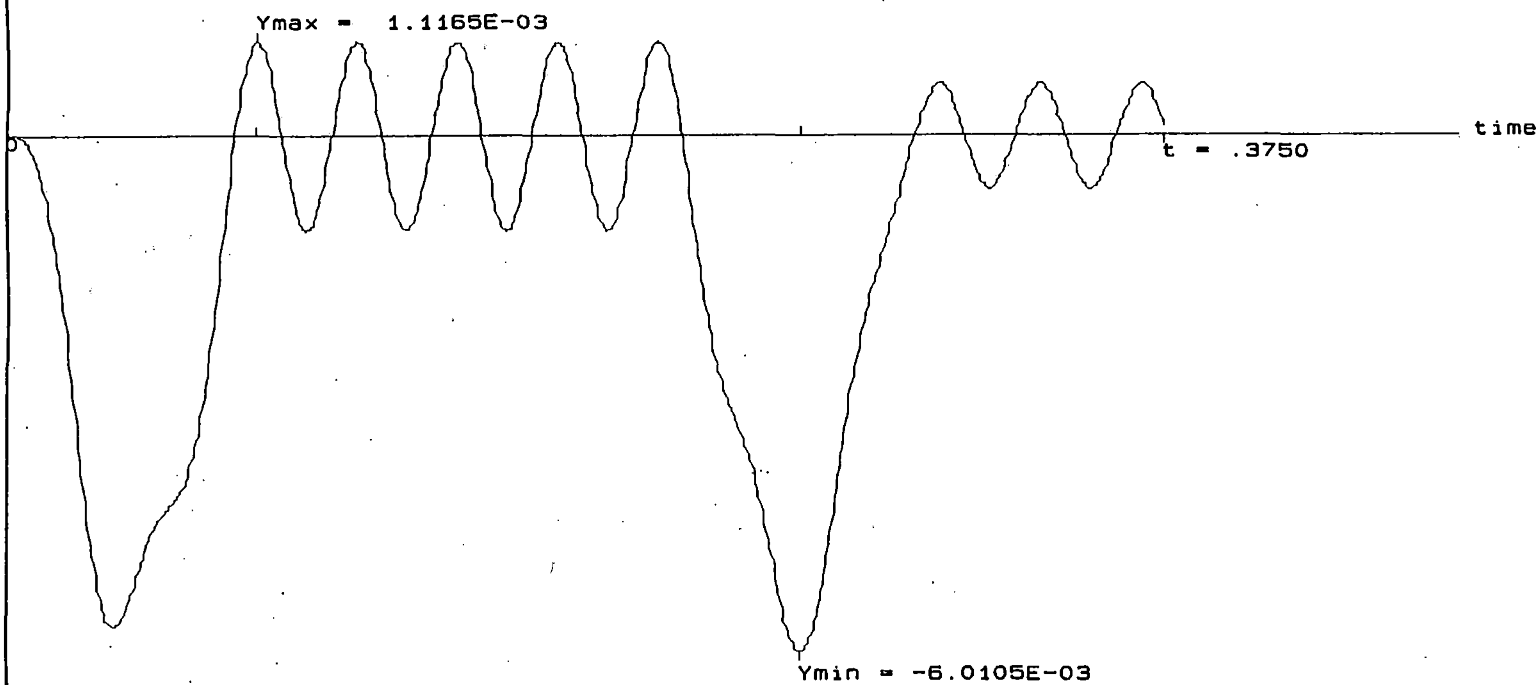
REACTION FORCE TIME HISTORY FOR NODE 9

	FY	MZ
MAXIMUM	1.4503E+05	7.7110E+01
TIME OF MAXIMUM	6.8000E-02	2.7750E-01
MINIMUM	-2.1535E+04	-1.6843E+02
TIME OF MINIMUM	2.1150E-01	2.9850E-01

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0875E+01 Hz

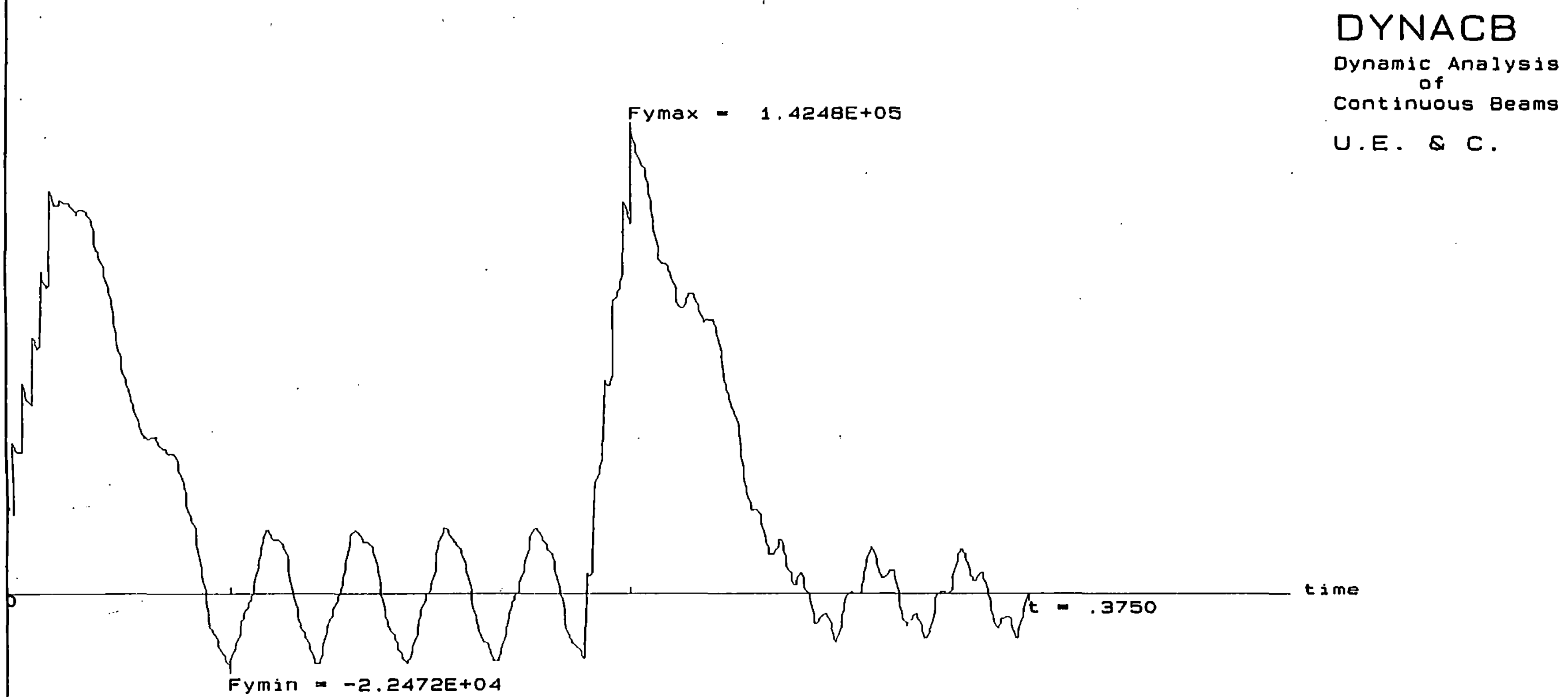
Results at Node = 5

Displacement : Ymin = -6.0105E-03 (t = .2585) Ymax = 1.1165E-03 (t = .0830)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

Date: 9/21/1992
Time: 8: 36: 14

LB-A-98



Beam Fundamental Natural Frequency = 3.0875E+01 Hz

Results at Node = 1

Reaction : Fymin = -2.2472E+04 (t = .0835) Fymax = 1.4248E+05 (t = .2305)

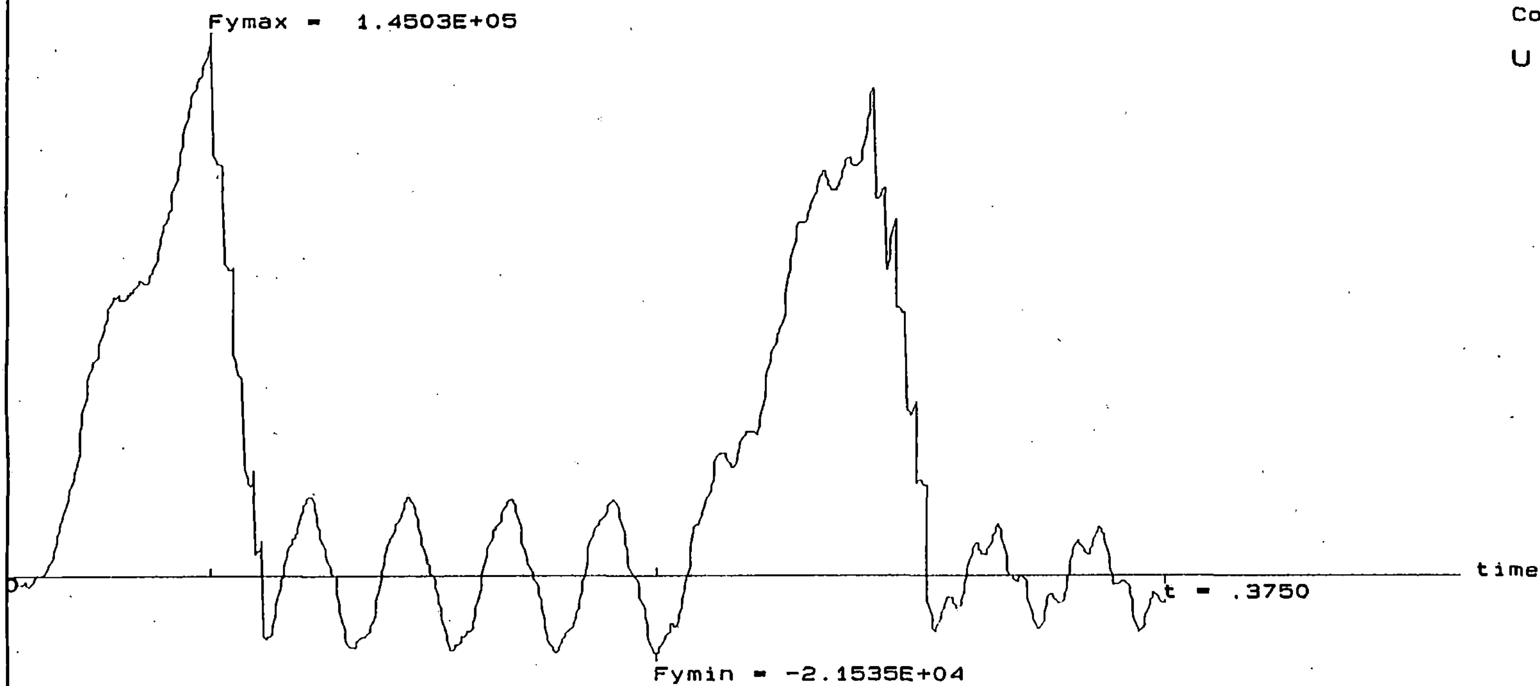
Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

Date: 9/21/1992
Time: 8:36:14

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0875E+01 Hz

Results at Node = 9

Reaction : Fymin = -2.1535E+04 (t = .2115) Fymax = 1.4503E+05 (t = .0680)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

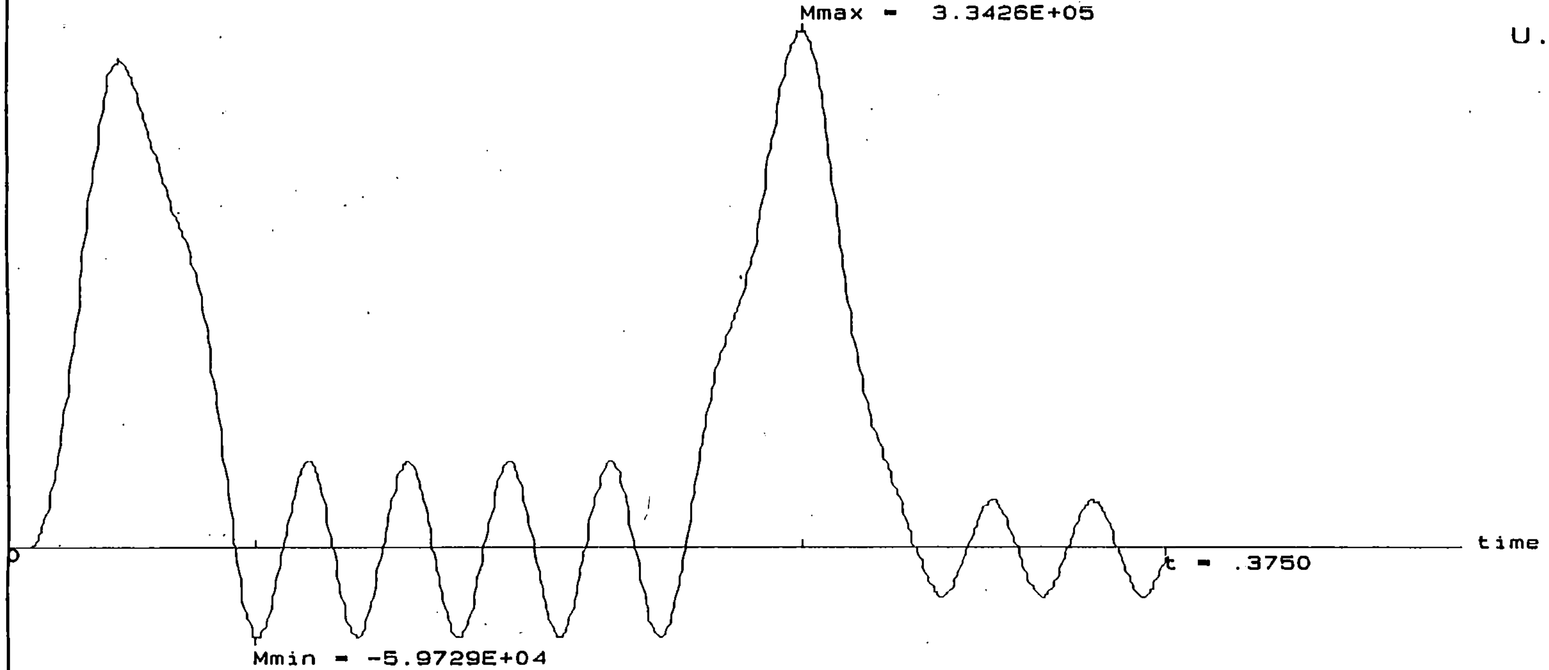
Date: 9/21/1992
Time: 8: 36: 14

LB-A-100

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0875E+01 Hz

Results at Elem = 4 (End Node)

Bending Moment : Mmin = -5.9729E+04 (t = .0825) Mmax = 3.3426E+05 (t = .2580)

Guideway Sheet Sect. - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

Date: 9/21/1992
Time: 8: 36: 14

LB-A-101

United Engineers & Constructors
A Raytheon Company

JOB NO. 6869002 DATE 5/12/92 BY RJC CH'K
CUSTOMER MIT MI PROJECT MAGLEV
SUBJECT GUIDEWAY SHEET

ANALYSIS OF GUIDEWAY SHEET

THE PURPOSE OF THE ANALYSIS WHICH FOLLOWS IS TO DETERMINE THE DYNAMIC DEFLECTIONS AND STRESSES IN THE .02 m THICK CURVED GUIDEWAY SHEET WHICH FORMS THE TOP FLANGE OF THE LEVITATION BOX BEAMS.

THE GUIDEWAY SHEET IS MODELLED AS A CURVED PANEL SUBTENDING AN ARC OF 41.85° WITH A SPAN OF 4.50 m IN THE DIRECTION OF THE GUIDEWAY. THE PANEL IS SUPPORTED RADIALLY BY FOUR EQUALLY SPACED LONGITUDINAL STIFFENERS.

THE CURVED PANEL IS SUBJECTED TO LOADS FROM THE LEVITATION COIL MODULES FOR THE 140 PASSENGER VEHICLE. THE VEHICLE SPEED IS ASSUMED TO BE 300 mph (134 m/s). FOR THE LEVITATION COIL MODULE LOAD FOOTPRINT, SEE THE CALCULATIONS ON THE LEVITATION BOX BEAMS.

A TRANSIENT DYNAMIC ANALYSIS WAS PERFORMED USING ANSYS PC-LINEAR, REVISION 4.4A. A TIME-HISTORY OF THE MOVING LOADS WAS INPUT AND THE SOLUTION WAS OBTAINED USING MODAL SUPERPOSITION. A TOTAL OF 30 MODES WERE CONSIDERED (UP TO 500 cps).

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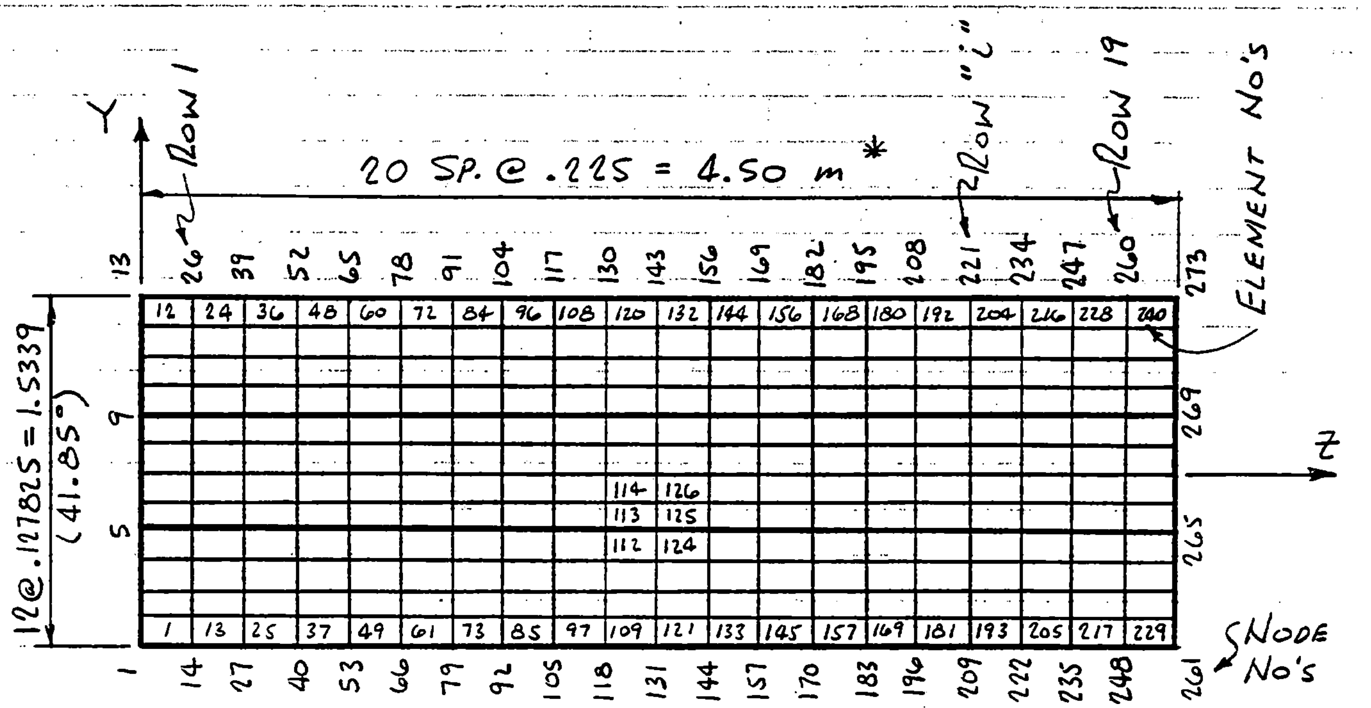
JOB NO. 6869002 DATE 5/7/92 BY RJC CH'K

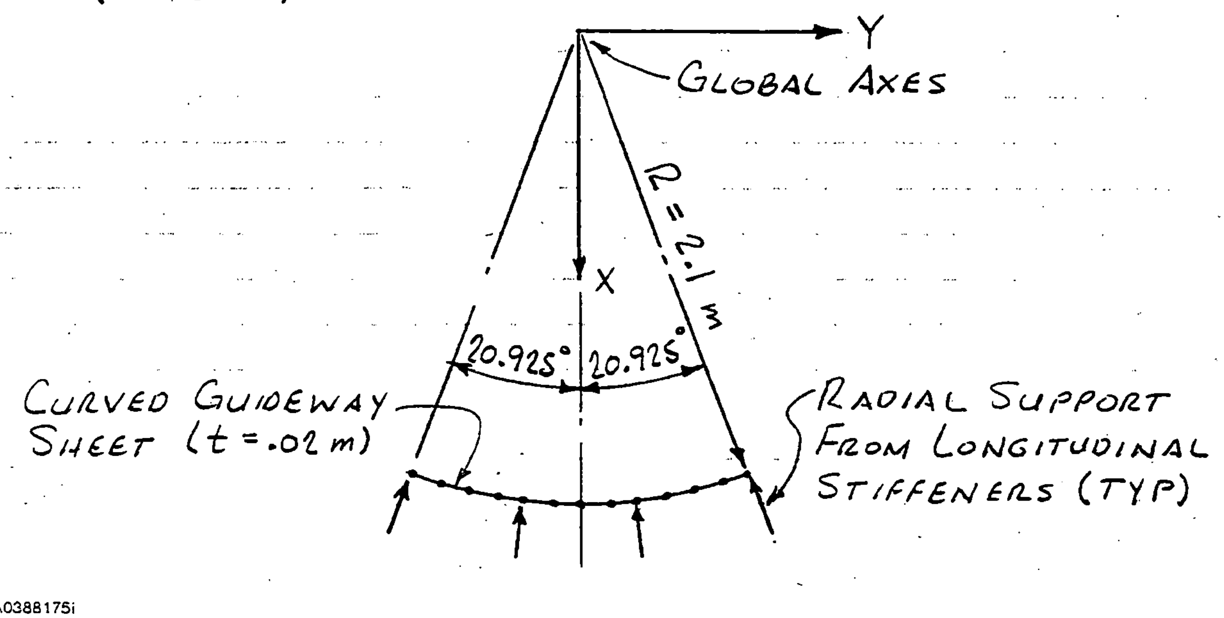
CUSTOMER MIT MI PROJECT MAGLEV

SUBJECT GUIDEWAY SHEET



FINITE ELEMENT MODEL OF GUIDEWAY SHEET

* ACTUAL SPAN LENGTH = 4.572 m. FOR ANALYSIS PURPOSES USE 4.50 m SO THAT THE LENGTH OF THE LEVITATION COIL LOAD FOOTPRINT (2.25 m) IS AN EXACT MULTIPLE OF THE MESH SPACING (.225 m).



FORM 62-114/A0388175i

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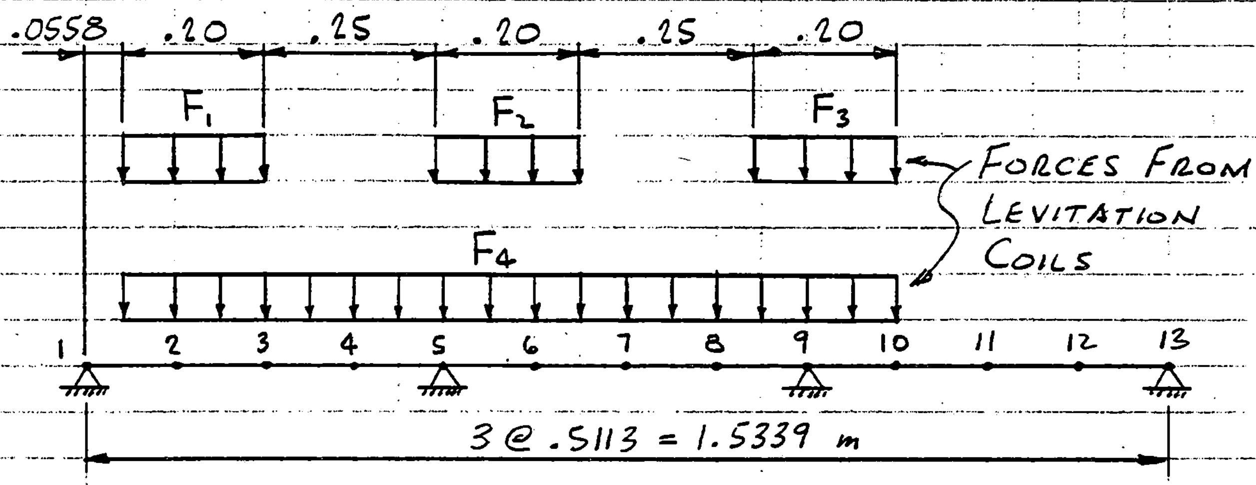
JOB NO. 6869002 DATE 5/7/92 BY RJC CH'K

CUSTOMER MIT MI PROJECT MAGLEV

SUBJECT GUIDEWAY SHEET



GUIDEWAY SHEET ROLL-OUT

FOR 140 PASSENGER VEHICLE

$F_1 = (F_{AF}/2.25) \times .225 = .1 F_{AF} = 1270.6$ N

$F_2 = .1 F_{BE} = 8954.8$ N

$F_3 = .1 F_{CD} = 1270.6$ N

$F_4 = F_{FE} + F_{ED} = 18152$ N

PEAK NODAL FORCES

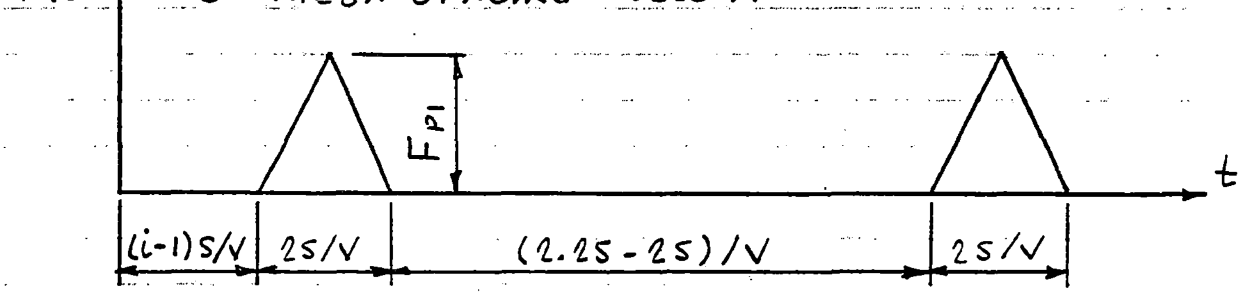
NODE	F_1, F_2, F_3	F_4
1	129.5	336.2
2	735.1	1909.4
3	406.0	2109.3
4	0	"
5	2861.7	"
6	5180.8	"
7	912.3	"
8	129.5	"
9	735.1	2109.3
10	406.0	1141.3
Σ	11496.0	18152.0

FORM 62-114/A0388175i

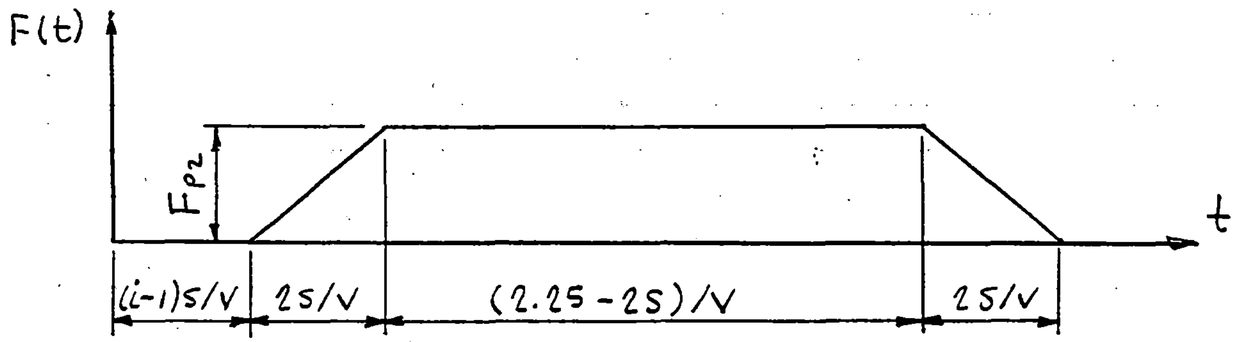
FORCE TIME-HISTORY FOR NODES ALONG ROW "i"

VEHICLE SPEED, V = 300 mph = 134.1123 m/s

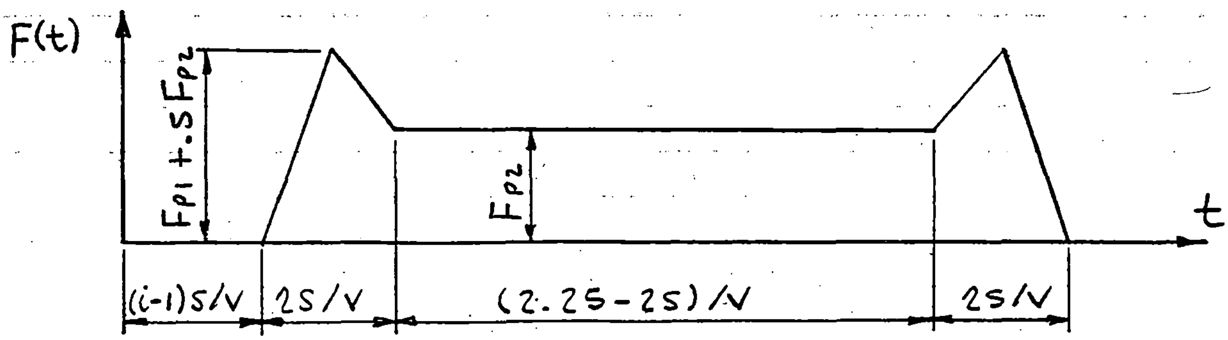
S = MESH SPACING = .225 m



F_{p1} = PEAK NODAL FORCE RESULTING FROM "F_4"



F_{p2} = PEAK NODAL FORCE RESULTING FROM "F_1", "F_2", & "F_3"



TOTAL FORCE

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JOB NO. 6869002 DATE 5/12/92 BY RJC CH'K

CUSTOMER MIT MI PROJECT MAGLEV

SUBJECT GUIDEWAY SHEET

NODAL RADIAL DISPLACEMENTS

SUMMARY OF VARIABLES STORED THIS STEP AND EXTREME VALUES

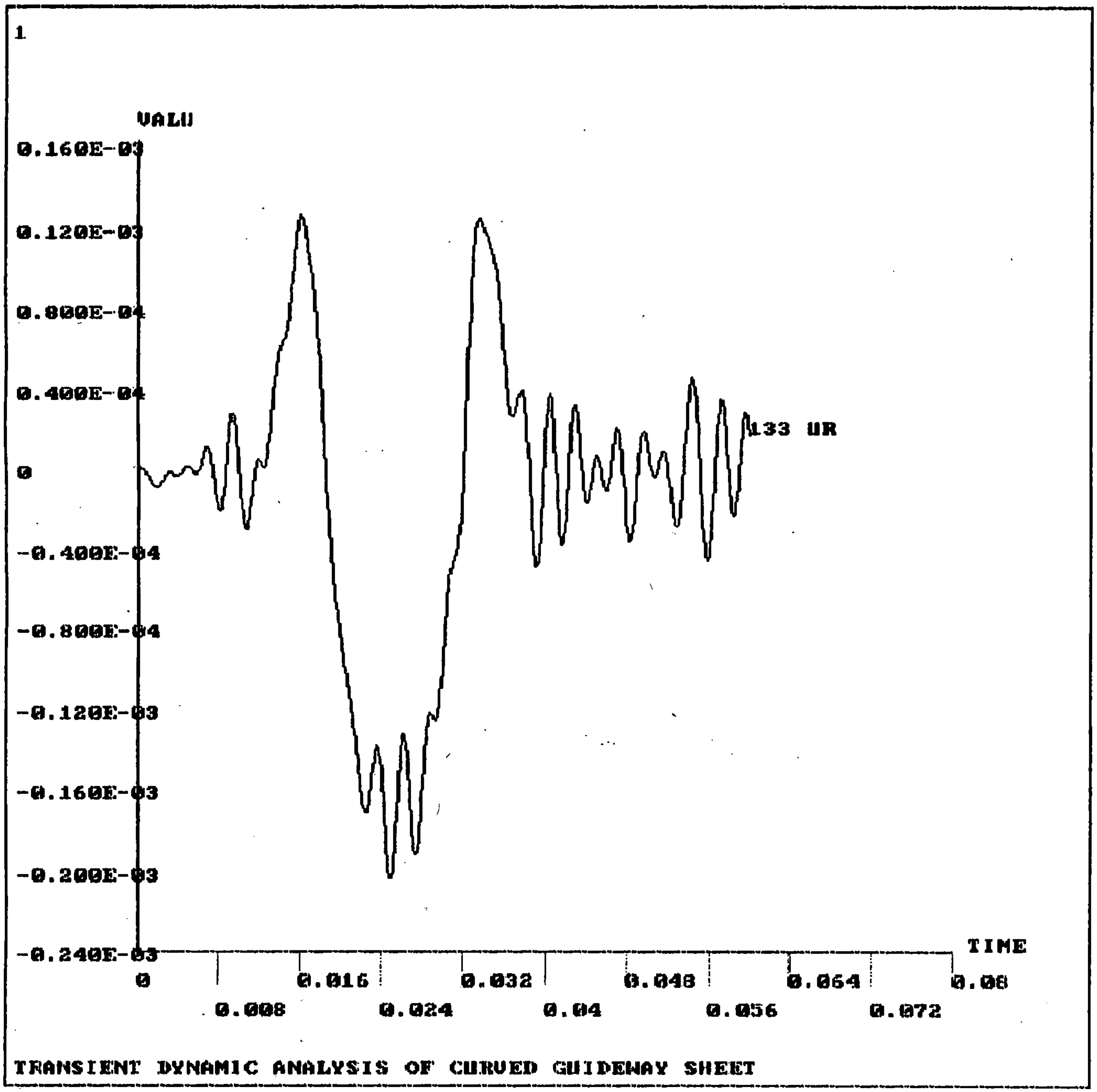
VARI	TYPE	IDENTIFIERS		NAME		MINIMUM	AT TIME	MAXIMUM	AT TIME
2	DISP	133	UX	133	UR	-0.2037E-03	0.2491E-01	0.1251E-03	0.1607E-01
3	DISP	137	UX	137	UR	-0.3578E-04	0.1045E-01	0.5766E-03	0.2893E-01
4	DISP	146	UX	146	UR	-0.2016E-03	0.2813E-01	0.1397E-03	0.3587E-01
5	DISP	150	UX	150	UR	-0.1056E-03	0.4722E-01	0.6158E-03	0.2923E-01

POST26-INP=

Node No.

SEE ALSO TIME-HISTORY PLOTS (PG'S 5-8).

MAX. RADIAL DISPLACEMENT = 6.158×10^{-4} m (NODE 150)



ANSYS-PC 4.4A1
MAY 12 1992
8:53:32
PLOT NO. 1
POST26

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YF =0.5
ZF =0.5

PAGE 5-57

ANSYS-PC 4.4A1
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8:53:37
PLOT NO. 2
POST26

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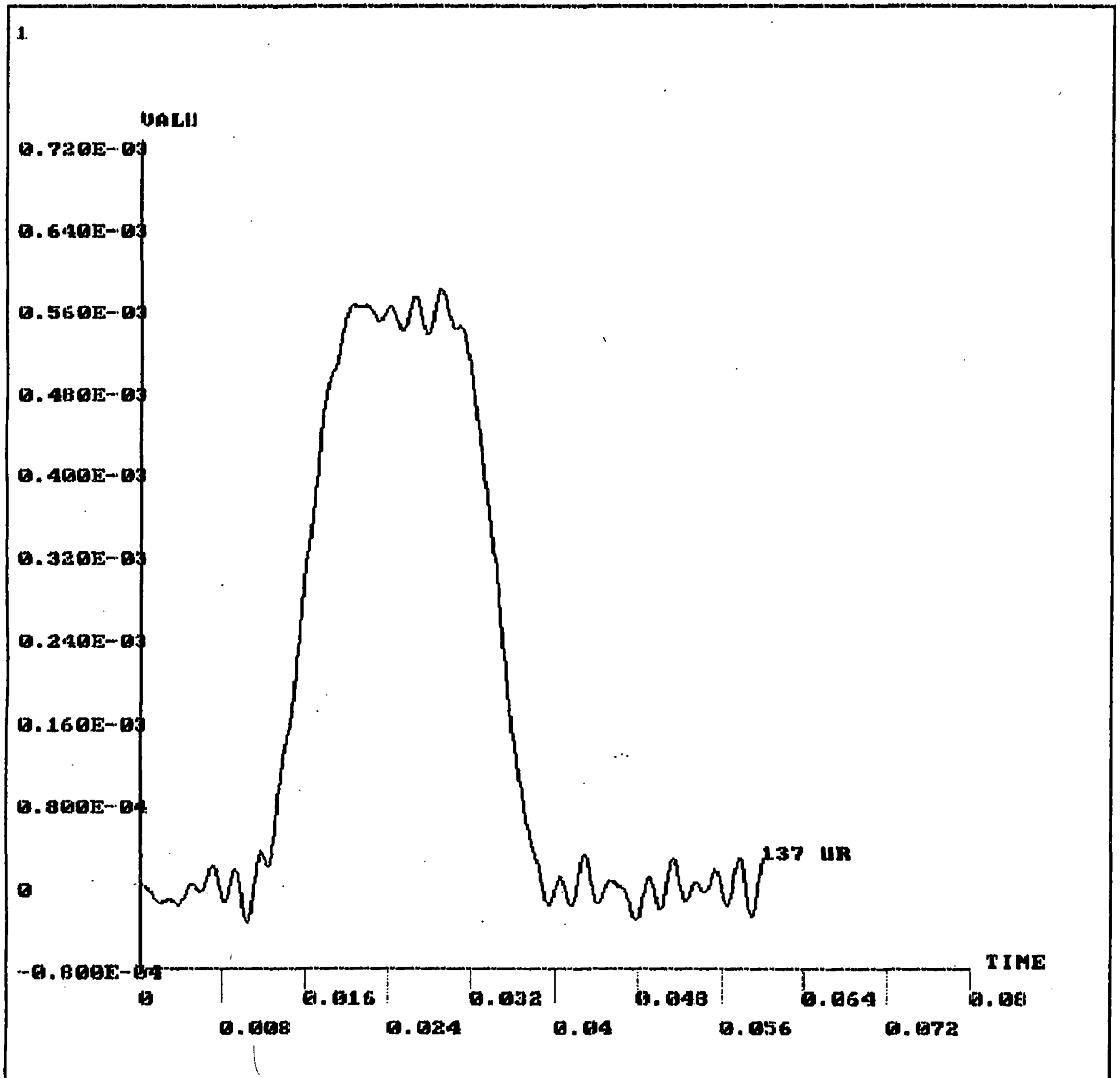
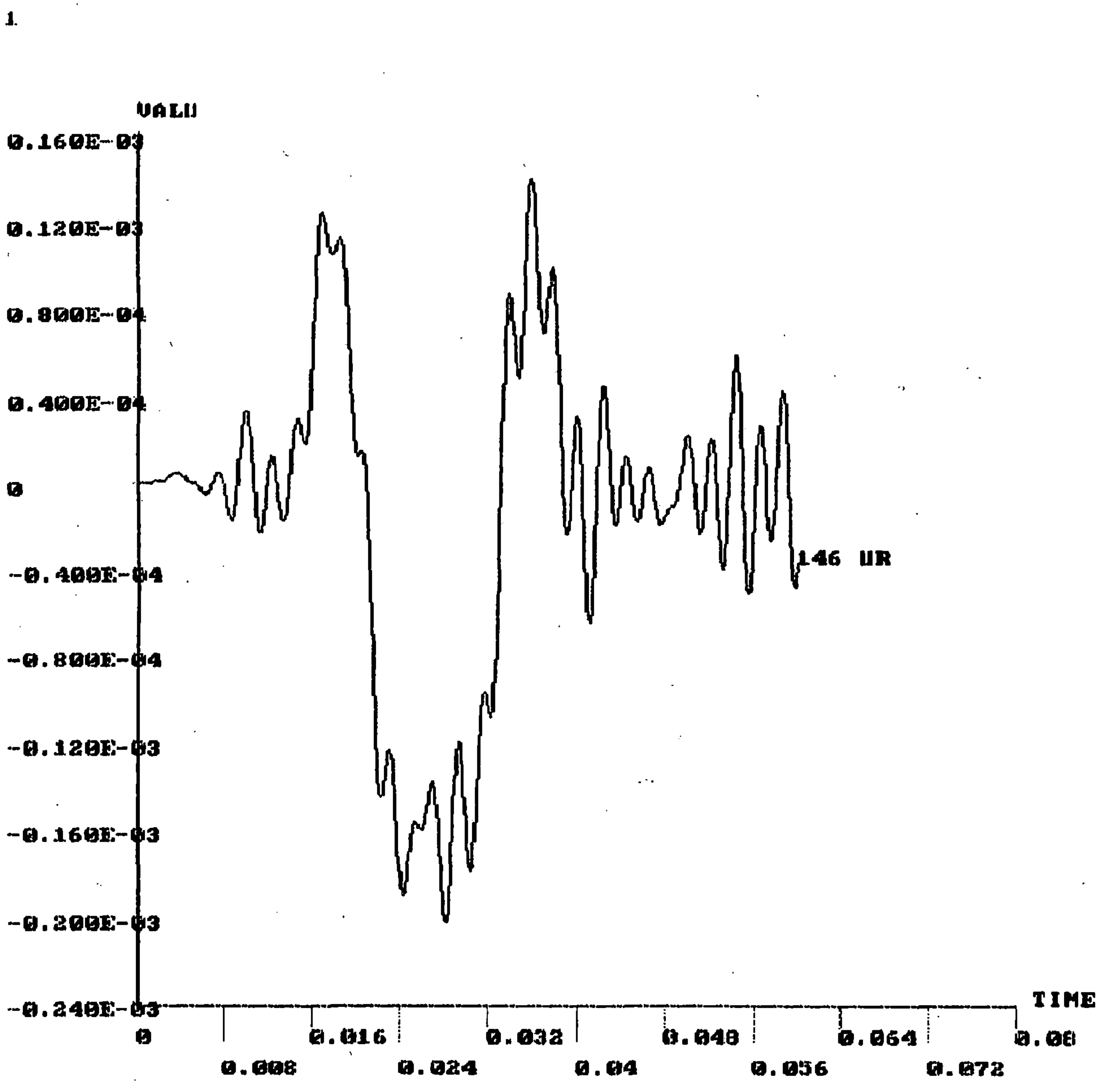
YF =0.5
ZF =0.5



TRANSIENT DYNAMIC ANALYSIS OF CURVED GUIDEWAY SHEET

PAGE 15-6



TRANSIENT DYNAMIC ANALYSIS OF CURVED GUIDEWAY SHEET

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POST26

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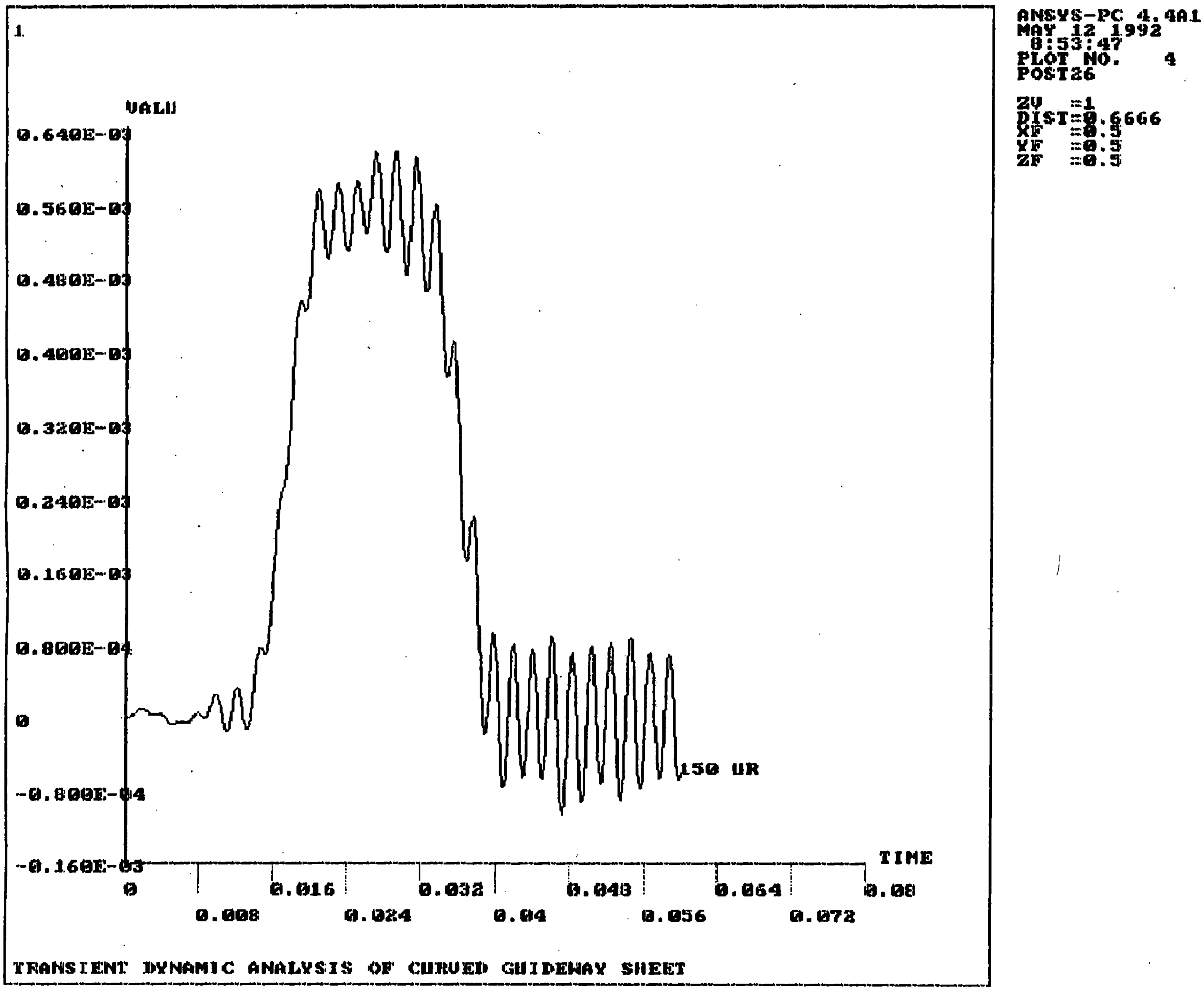
ZF =0.5


ANSYS-PC 4.4A1
MAY 12 1992
8:53:47
PLOT NO. 4
POST26
ZV =1
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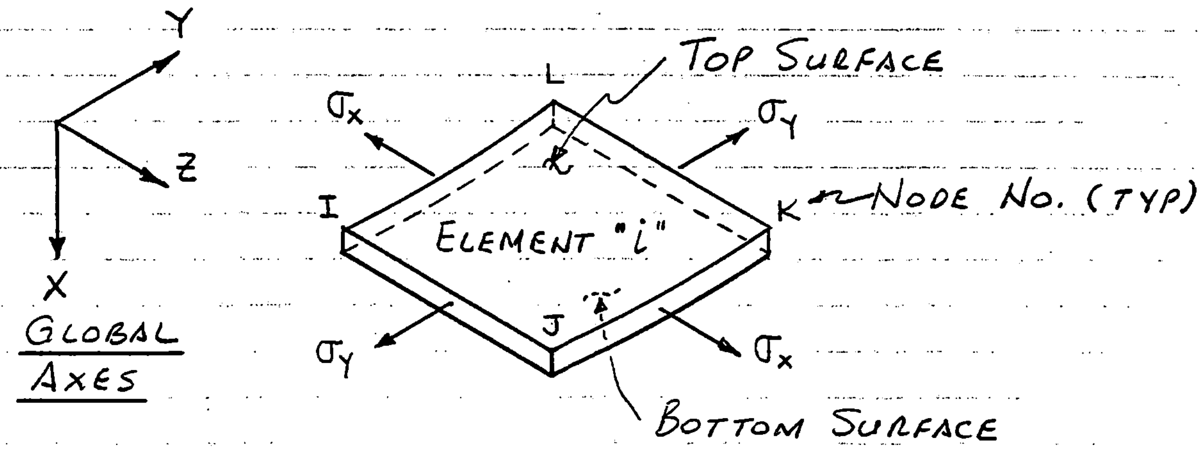
XF =0.5
YF =0.5
ZF =0.5
1
VALU
0.640E-03
0.560E-03
0.480E-03
0.400E-03
0.320E-03
0.240E-03
0.160E-03
0.800E-04
0
-0.800E-04
-0.160E-03
150 UR
TIME
0
0.008
0.016
0.024
0.032
0.04
0.048
0.056
0.064
0.072
0.08
TRANSIENT DYNAMIC ANALYSIS OF CURVED GUIDEWAY SHEET

PAGE 5-8

STRESSES IN .02 m THICK GUIDEWAY SHEET



σ_Y STRESSES (SEE ALSO TIME-HISTORY PLOTS)

SUMMARY OF VARIABLES STORED THIS STEP AND EXTREME VALUES

VARI	TYPE	IDENTIFIERS		NAME		MINIMUM	AT TIME	MAXIMUM	AT TIME
2	ESTR	112	30	112	SYTK	-0.3455E+07	0.3898E-01	0.1736E+08	0.3355E-01
3	ESTR	113	26	113	SYTJ	-0.3543E+07	0.3898E-01	0.1705E+08	0.3355E-01
4	ESTR	114	62	114	SYBK	-0.2631E+07	0.1025E-01	0.2102E+08	0.3124E-01
5	ESTR	124	30	124	SYTK	-0.5724E+07	0.4079E-01	0.2138E+08	0.3355E-01
6	ESTR	125	26	125	SYTJ	-0.6879E+07	0.4079E-01	0.2221E+08	0.3355E-01
7	ESTR	126	62	126	SYBK	-0.6330E+07	0.4079E-01	0.2440E+08	0.3355E-01

POST26-INP=

Element No. — Node No. (IJKL)

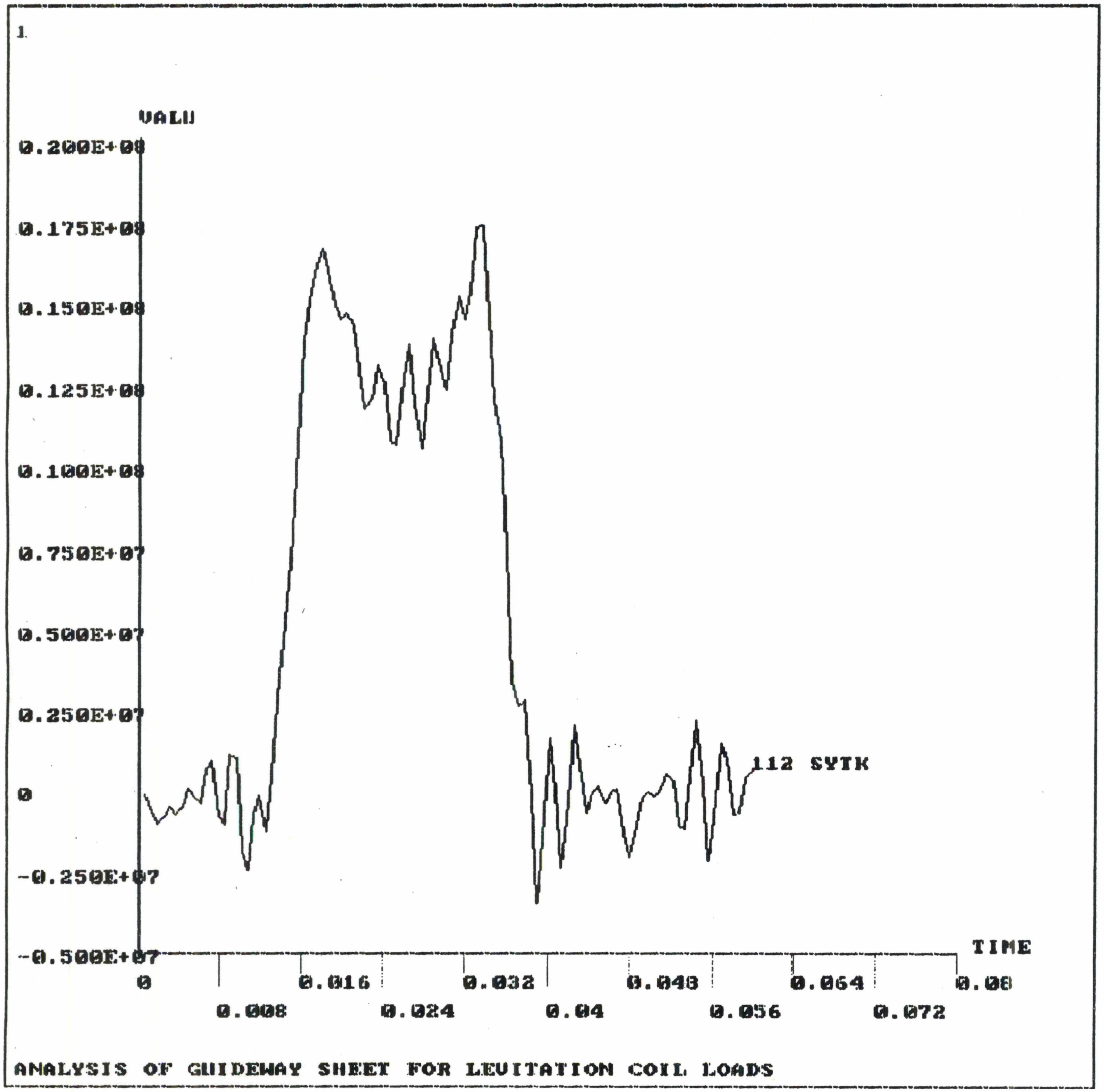
Stress Component — Surface (Top or Bottom)

σ_x STRESSES (SEE ALSO TIME-HISTORY PLOTS)

SUMMARY OF VARIABLES STORED THIS STEP AND EXTREME VALUES

VARI	TYPE	IDENTIFIERS		NAME		MINIMUM	AT TIME	MAXIMUM	AT TIME
2	ESTR	121	61	121	SXBK	-0.3331E+07	0.3064E-01	0.5727E+07	0.3597E-01
3	ESTR	124	29	124	SXTK	-0.2578E+07	0.4079E-01	0.7271E+07	0.3355E-01
4	ESTR	125	25	125	SXTJ	-0.2923E+07	0.4079E-01	0.7234E+07	0.3355E-01
5	ESTR	126	61	126	SXBK	-0.5451E+07	0.4079E-01	0.1191E+08	0.3355E-01

POST26-INP=



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MAY 12 1992
10:41:16
PLOT NO. 1
POST26

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YF =0.5
ZF =0.5

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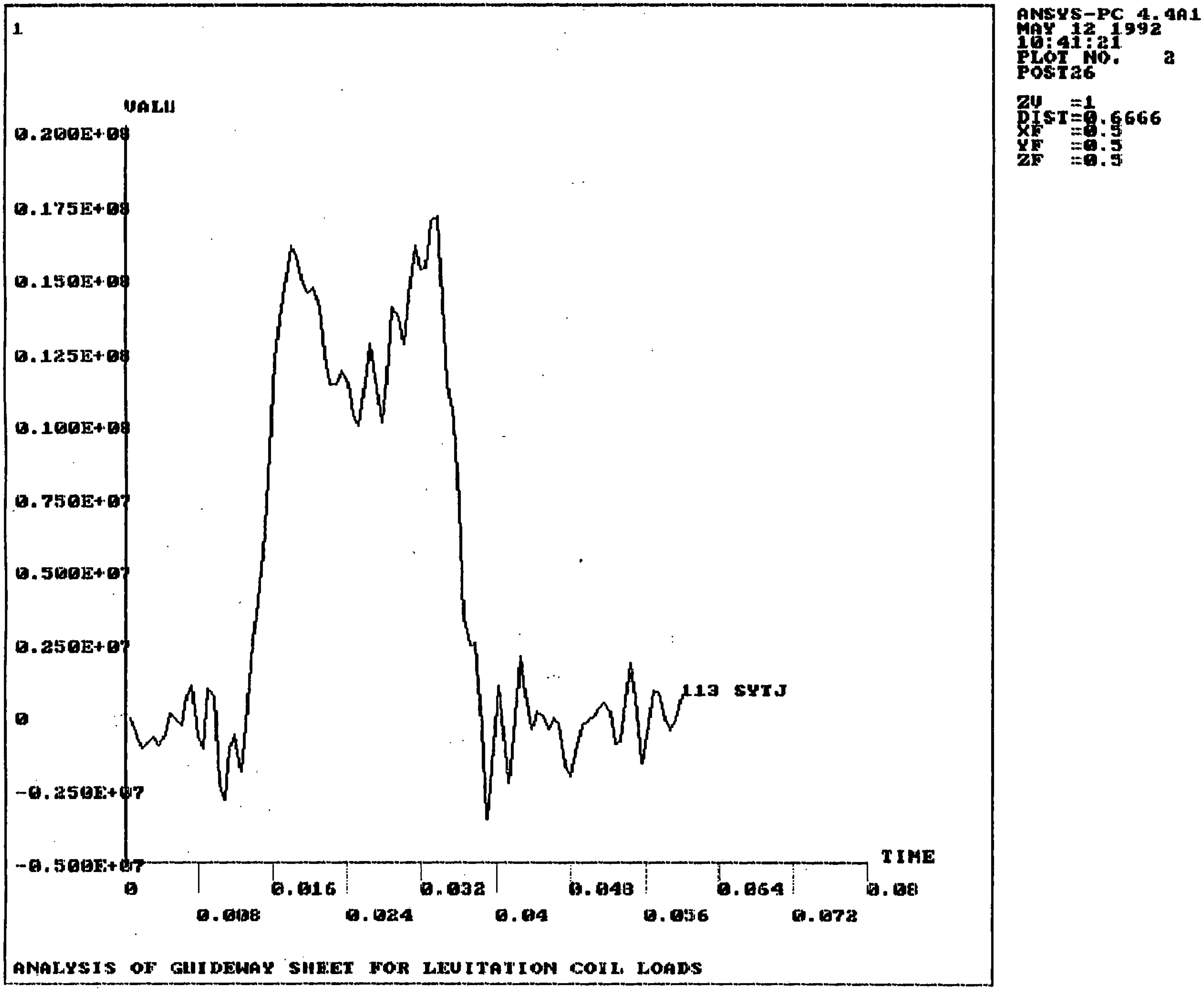

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MAY 12 1992
10:41:21
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POST26
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XF =0.5
YF =0.5
ZF =0.5
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VALU
0.200E+08
0.175E+08
0.150E+08
0.125E+08
0.100E+08
0.750E+07
0.500E+07
0.250E+07
0
-0.250E+07
-0.500E+07
113 SYTJ
TIME
0
0.008
0.016
0.024
0.032
0.04
0.048
0.056
0.064
0.072
0.08
ANALYSIS OF GUIDEWAY SHEET FOR LEVITATION COIL LOADS

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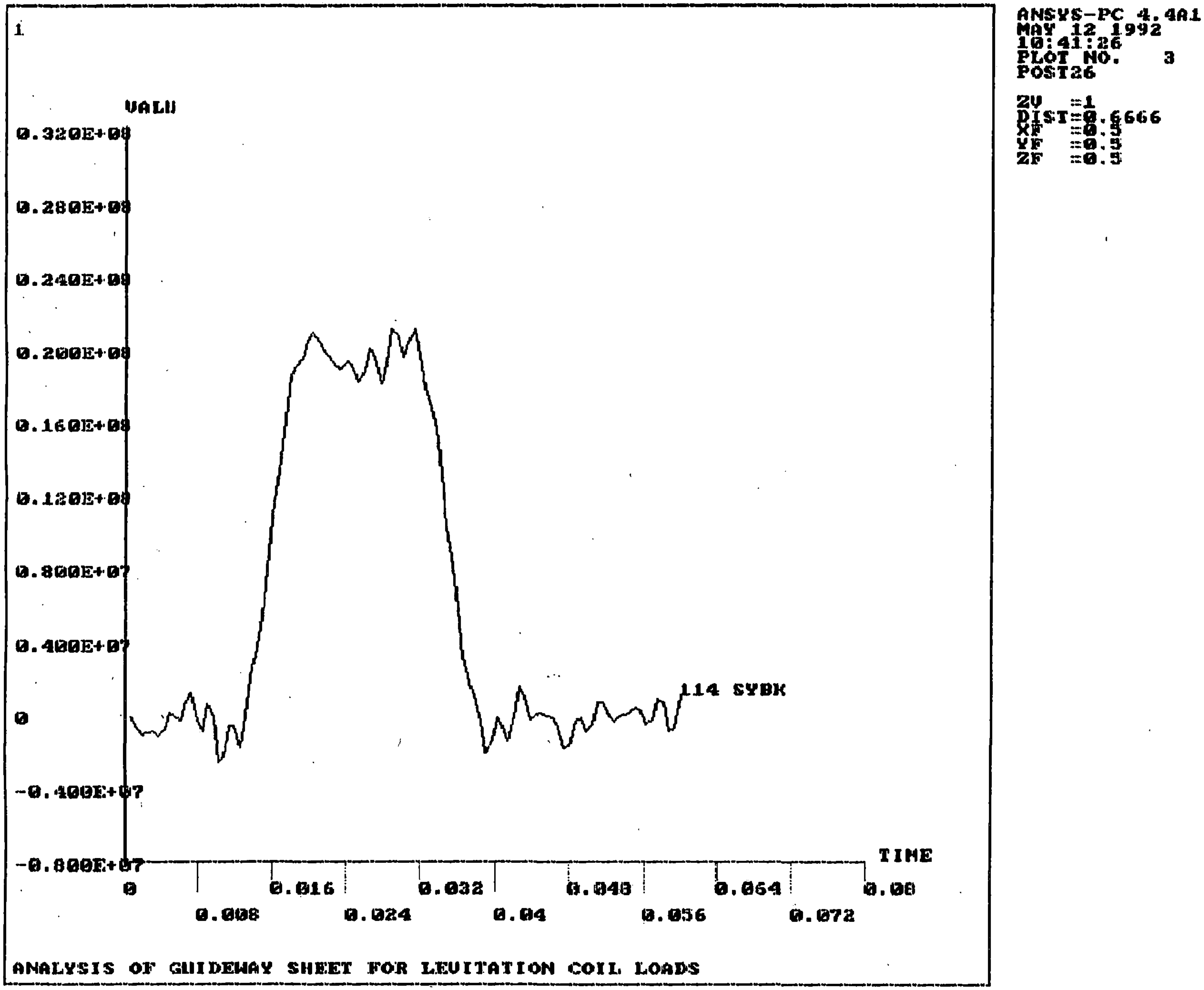
ANSYS-PC 4.4A1
MAY 12 1992
10:41:26
PLOT NO. 3
POST26
ZV =1
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XF =0.5
YF =0.5
ZF =0.5
1
VALU
0.320E+08
0.280E+08
0.240E+08
0.200E+08
0.160E+08
0.120E+08
0.800E+07
0.400E+07
0
-0.400E+07
-0.800E+07
114 SYBK
TIME
0
0.008
0.016
0.024
0.032
0.04
0.048
0.056
0.064
0.072
0.08
ANALYSIS OF GUIDEWAY SHEET FOR LEVITATION COIL LOADS

ANSYS-PC 4.4A1
MAY 12 1992
10:41:32
PLOT NO. 4
POST26

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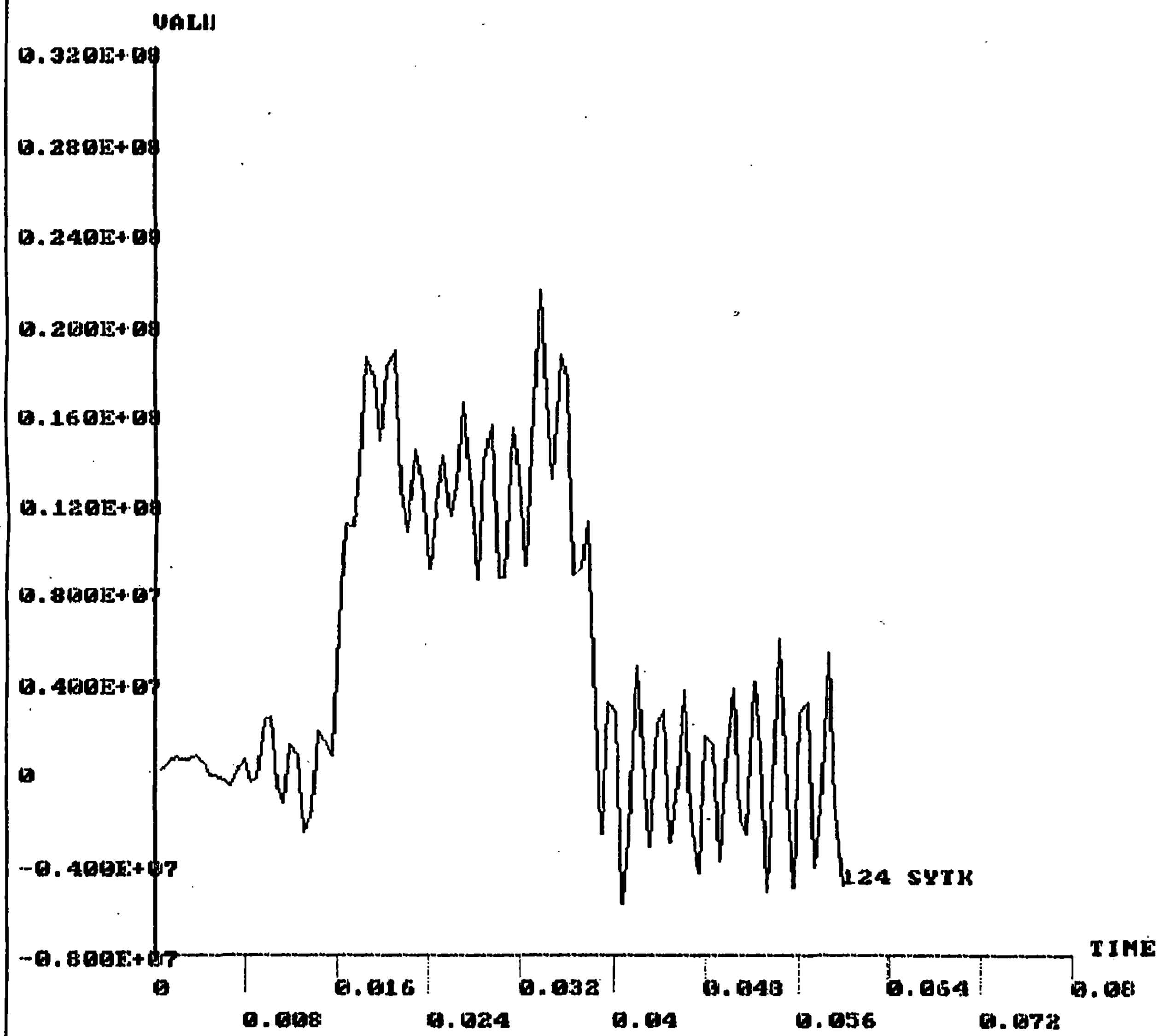
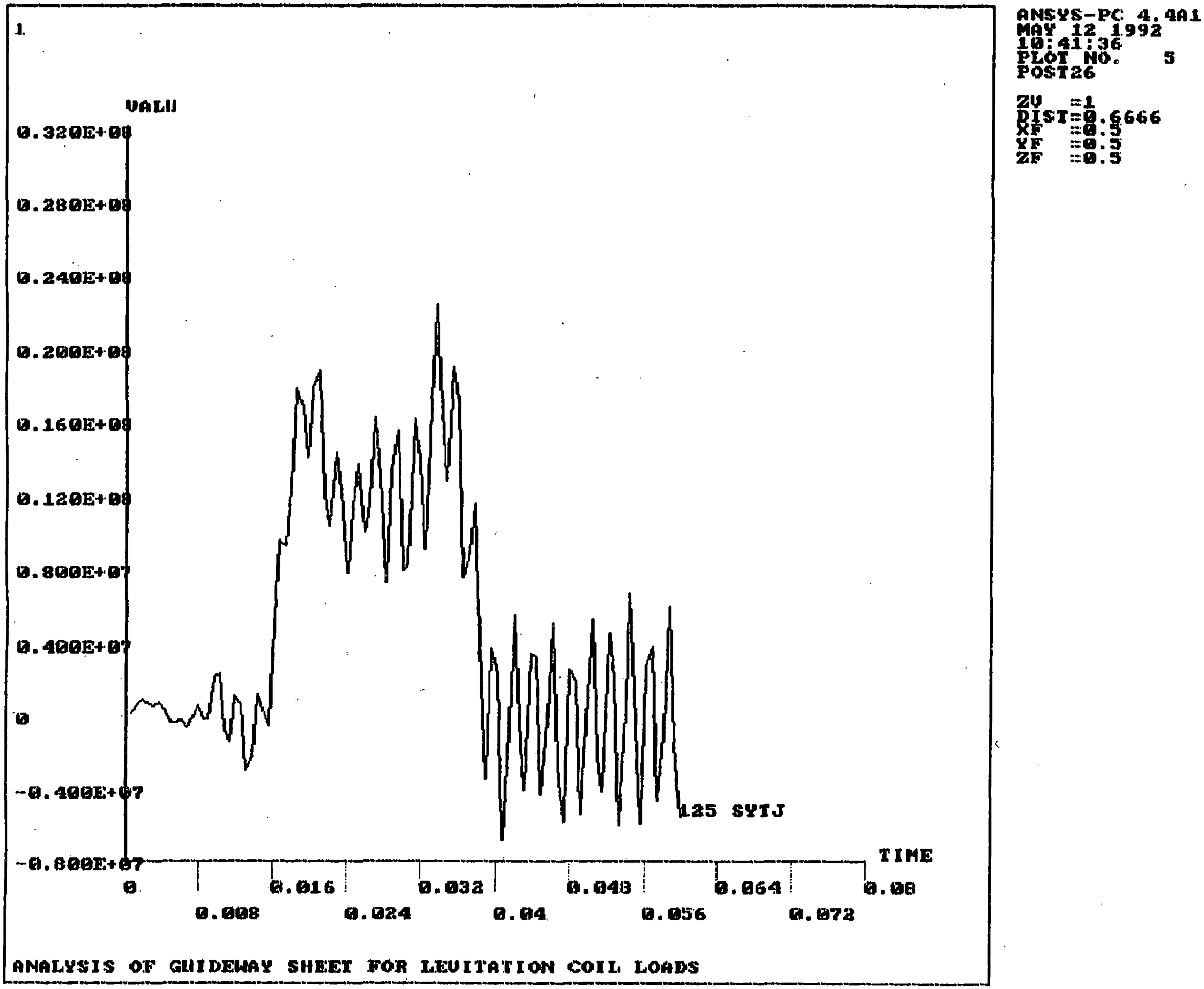
XF =0.5
YF =0.5
ZF =0.5

1



ANALYSIS OF GUIDEWAY SHEET FOR LEVITATION COIL LOADS



1
ANSYS-PC 4.4A1
MAY 12 1992
10:41:36
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POST26
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XF =0.5
YF =0.5
ZF =0.5
VALU
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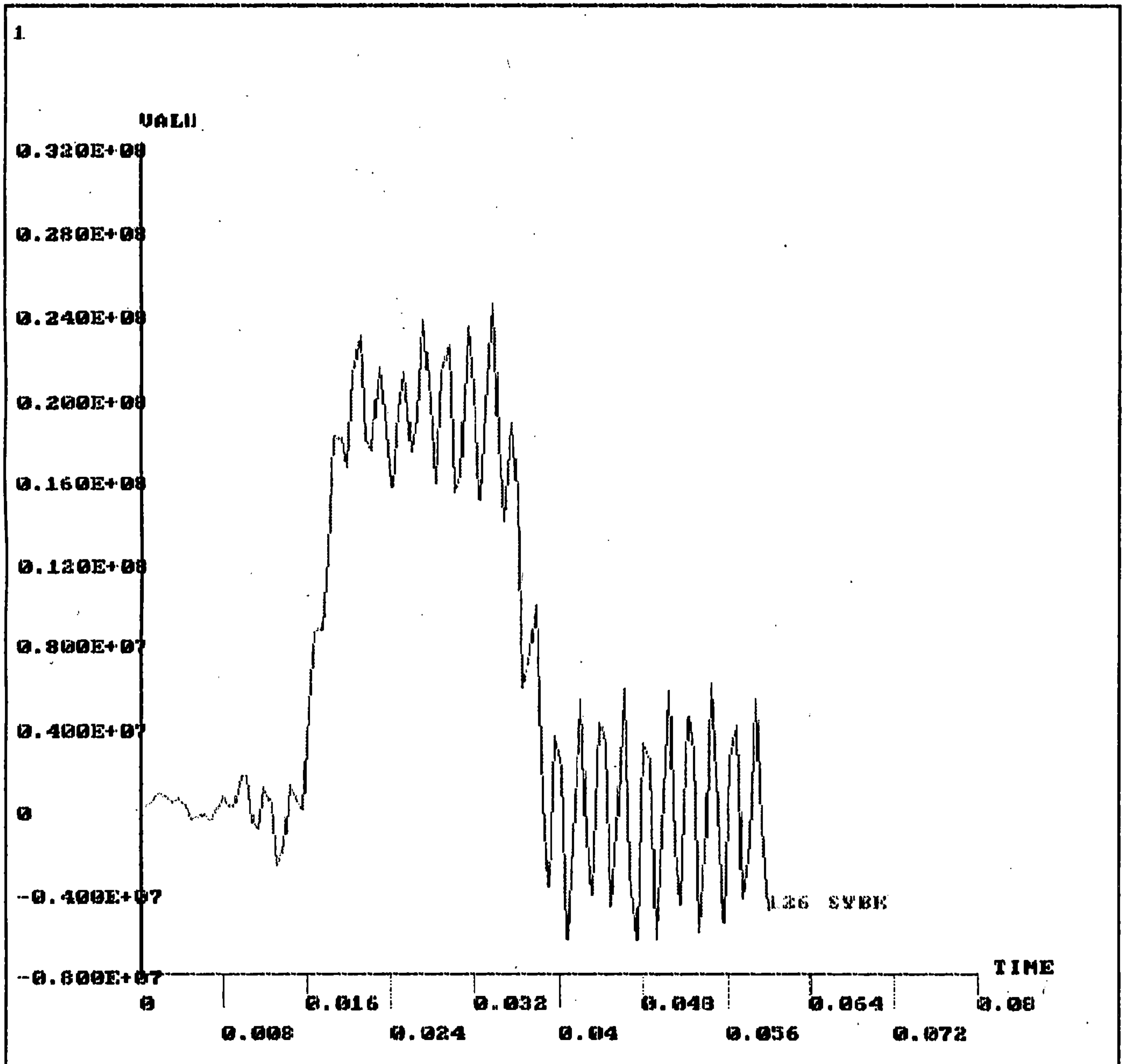
0.280E+08
0.240E+08
0.200E+08
0.160E+08
0.120E+08
0.800E+07
0.400E+07
0
-0.400E+07
-0.800E+07
125 SYTJ
TIME
0
0.008
0.016
0.024
0.032
0.04
0.048
0.056
0.064
0.072
0.08
ANALYSIS OF GUIDEWAY SHEET FOR LEVITATION COIL LOADS

PAGE 5.14

[redacted]



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MAY 12 1992
10:41:39
PLOT NO. 6
POST26

ZV =1
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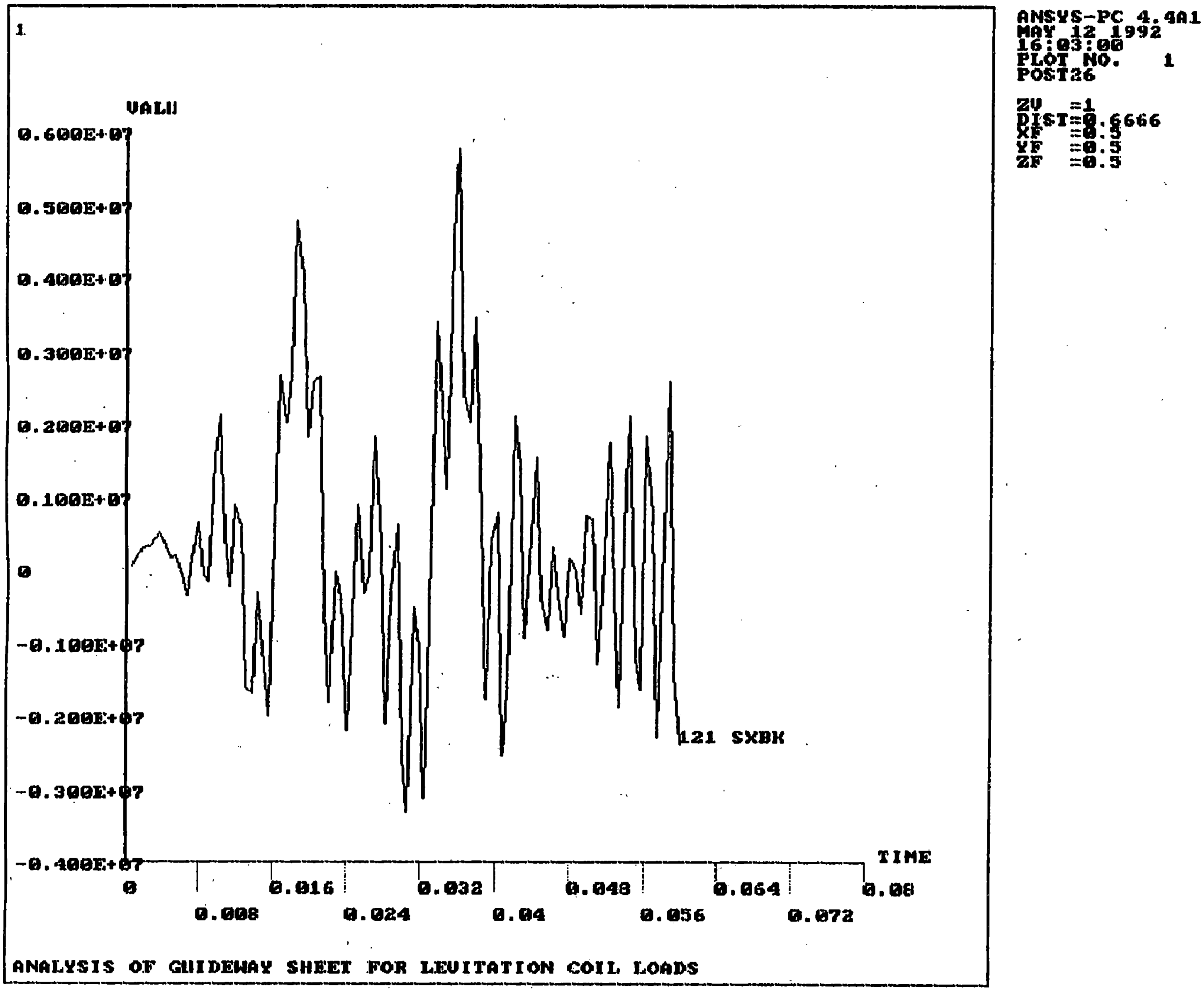
YF =0.5
ZF =0.5

ANALYSIS OF GUIDEWAY SHEET FOR LEVITATION COIL LOADS

45-
PAGE 15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YF =0.5
ZF =0.5
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0.500E+07
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0.300E+07
0.200E+07
0.100E+07
0
-0.100E+07
-0.200E+07
-0.300E+07
-0.400E+07
121 SXBK
TIME
0
0.008
0.016
0.024
0.032
0.04
0.048
0.056
0.064
0.072
0.08
ANALYSIS OF GUIDEWAY SHEET FOR LEVITATION COIL LOADS

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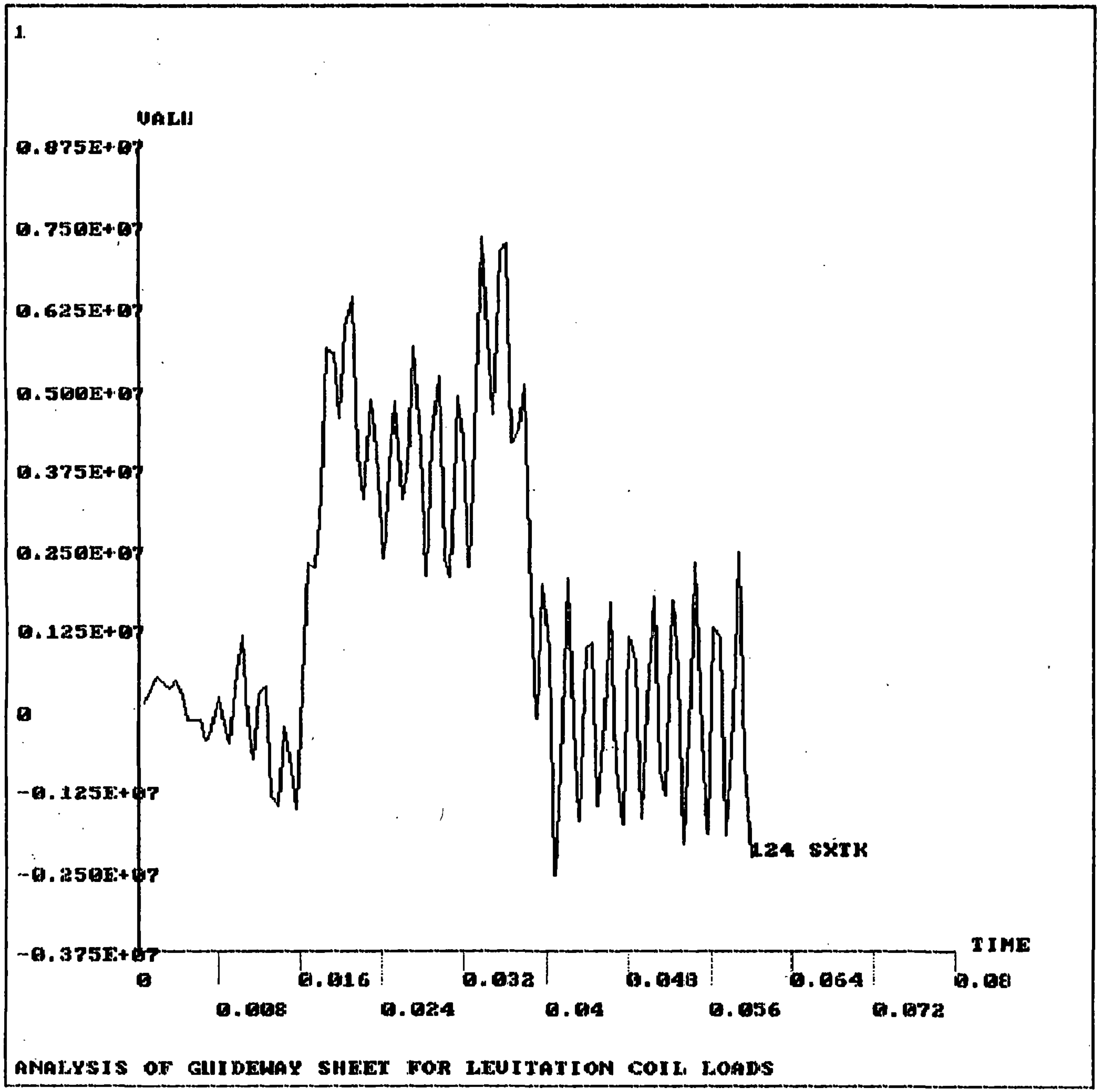
LS



ANSYS-PC 4.4A1
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POST26

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YF =0.5
ZF =0.5

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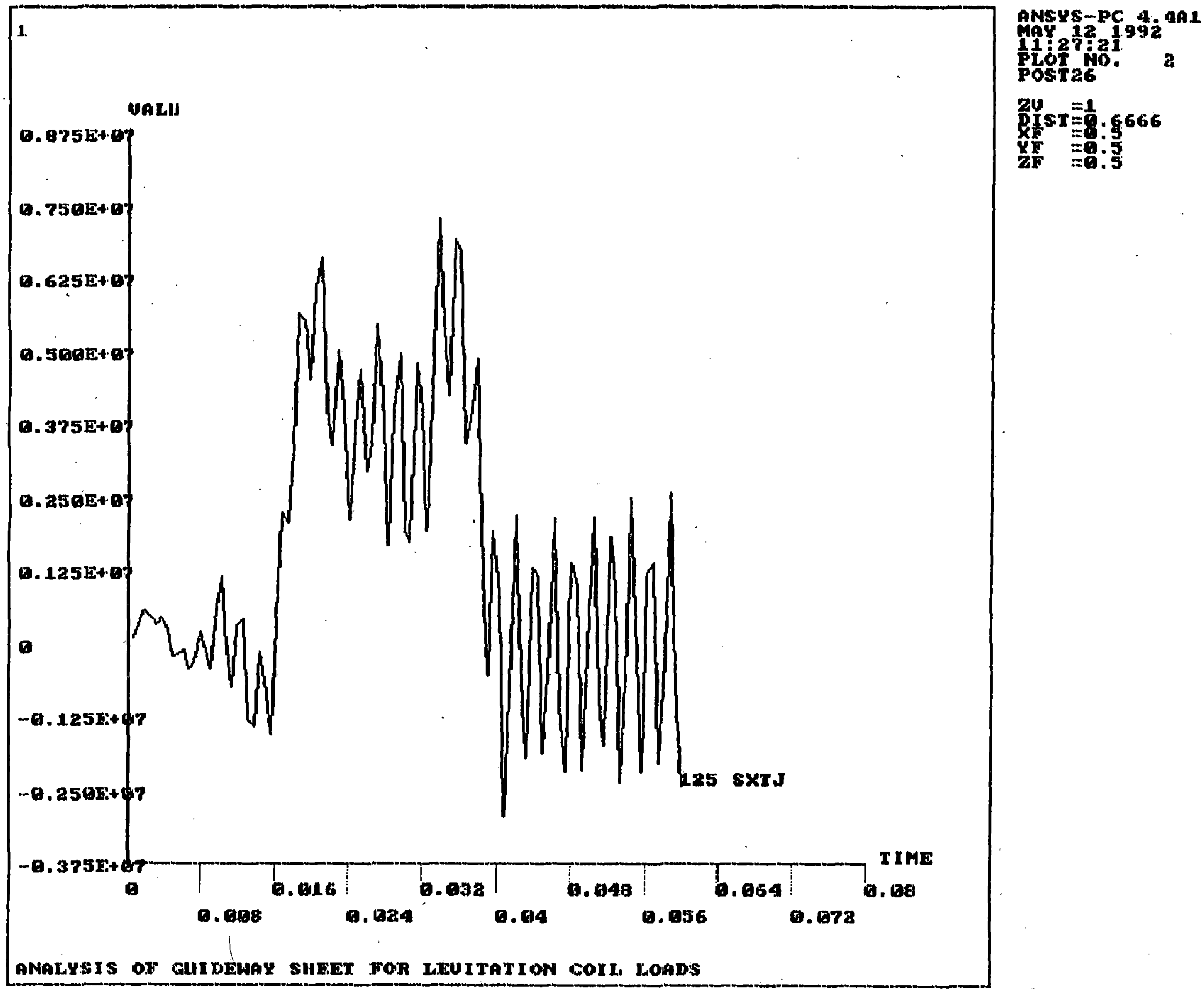
1
VALU
0.875E+07
0.750E+07
0.625E+07
0.500E+07
0.375E+07
0.250E+07
0.125E+07
0
-0.125E+07
-0.250E+07
-0.375E+07
125 SXTJ
TIME
0
0.008
0.016
0.024
0.032
0.04
0.048
0.056
0.064
0.072
0.08
ANALYSIS OF GUIDEWAY SHEET FOR LEVITATION COIL LOADS
ANSYS-PC 4.4A1
MAY 12 1992
11:27:21
PLOT NO. 2
POST26
ZV =1
DIST=0.6666
XF =0.5
YF =0.5
ZF =0.5

ANSYS-PC 4.4A1
MAY 12 1992
11:27:26
PLOT NO. 3
POST26

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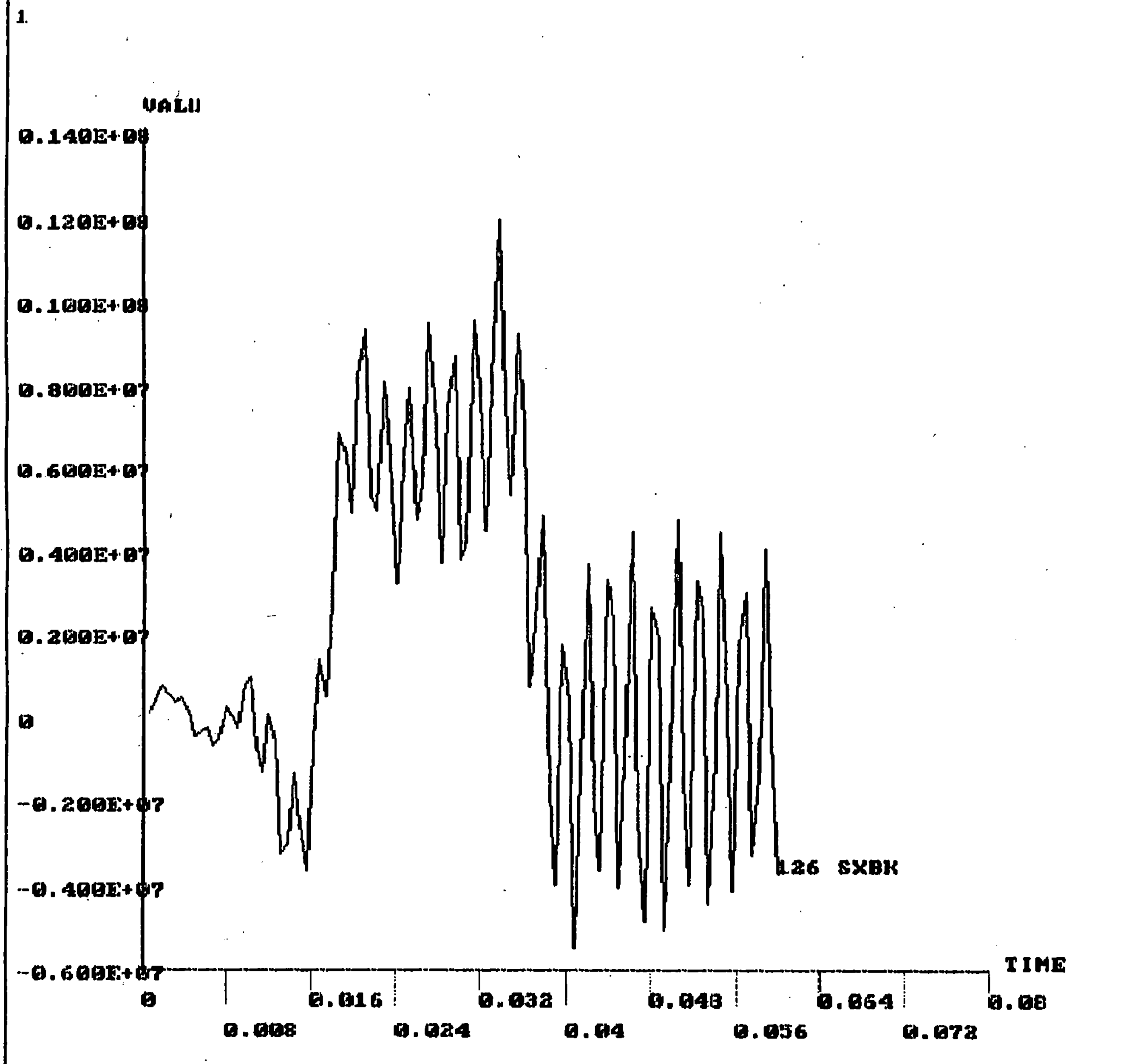
XF =0.5
YF =0.5
ZF =0.5



ANALYSIS OF GUIDEWAY SHEET FOR LEVITATION COIL LOADS

CHECK STRESSES IN GUIDEWAY SHEET

THE MAXIMUM ALLOWABLE STRESS RANGE FOR FATIGUE CONSIDERATIONS IS TAKEN FROM THE FOLLOWING REFERENCE:
"ALUMINUM CONSTRUCTION MANUAL", 5TH ED., SECTION 3, ENGINEERING DATA FOR ALUMINUM STRUCTURES.
THE PERTINENT SECTION 4.8 OF THE ABOVE REFERENCE IS INCLUDED IN THIS REPORT ON PAGES 24-28.

I. STRESSES IN ELEMENT "Y" DIRECTION
(SEE PG. 9)

A) STRESS IN PLATE OVER LONGITUDINAL STIFFENER.

REFERRING TO PG'S 24 TO 28, THIS CONDITION IS SIMILAR TO ILLUSTRATIVE EXAMPLE 19 WITH $a < 2$ in. THEREFORE THE STRESS CATEGORY IS "C".
FROM TABLE 4.8.1 a, THE ALLOWABLE STRESS RANGE IS 4.0 KSI (2.758×10^7 N/m²).

THE MAXIMUM STRESS RANGE OCCURS FOR ELEMENT 125, NODE J. (SEE PG. 9)

$\sigma_R = 2.221 \times 10^7 - (-.688 \times 10^7)$
$= 2.909 \times 10^7 \ N/m^2 > 2.758$

$\% \text{ OVERSTRESS} = \dfrac{(2.909 - 2.758) \times 100}{2.758} = 5.5\%$

THIS IS DEEMED ACCEPTABLE.

B) STRESS IN PLATE BETWEEN STIFFENERS.

THIS CASE FALLS UNDER THE GENERAL CONDITION "PLAIN MATERIAL" AND THEREFORE STRESS CATEGORY "A".
FROM TABLE 4.8.1a, THE ALLOWABLE STRESS RANGE IS 9.5 KSI (6.550×10^7 N/m^2)

THE MAXIMUM STRESS RANGE OCCURS FOR ELEMENT 126, NODE K. (SEE PG. 9)

$$\sigma_R = 2.440 \times 10^7 - (-.633 \times 10^7)$$
$$= 3.073 \times 10^7 \ N/m^2 < 6.550 \times 10^7$$

II. STRESSES IN ELEMENT "X" DIRECTION (SEE PG. 9).

THIS CONDITION IS SIMILAR TO ILLUSTRATIVE EXAMPLE 4 UNDER THE GENERAL CONDITION "BUILT-UP MEMBERS". THEREFORE THE STRESS CATEGORY IS "B".

FROM TABLE 4.8.1a, THE ALLOWABLE STRESS RANGE IS 6.0 KSI (4.137×10^7 N/m^2).

A) STRESS IN PLATE NEAR EDGE OF PANEL.

THE MAXIMUM STRESS RANGE OCCURS FOR ELEMENT 121, NODE K (SEE PG. 9).

THE STRESSES FROM THIS ANALYSIS MUST BE ADDED TO THE LONGITUDINAL BENDING STRESSES IN THE PLATE WHEN IT SERVES AS THE TOP FLANGE OF THE LEVITATION BOX BEAM.

United Engineers & Constructors
A Raytheon Company

JOB NO. 6869002 DATE 5/13/92 BY RJC CH'K
CUSTOMER MIT M.I PROJECT MAGLEV
SUBJECT GUIDEWAY SHEET

1) STRESS RANGE DUE TO LOCAL BENDING

$\sigma_{R1} = .573\times10^7 - (-.333\times10^7)$
$= .906\times10^7 \ N/m^2$

2) STRESS RANGE DUE TO BENDING OF LEVITATION BOX BEAM (REFER TO PG'S 8 & 10 OF CALCULATIONS ON LEVITATION BOX BEAMS).

$\Delta M = 125416 \ N\text{-}m$

$S = \text{SECTION MODULUS} = \dfrac{1.283436\times10^{-3}}{2.163617 - 2.1\cos 17.4375^\circ}$

$= 8.0153\times10^{-3} \ m^3$

$\sigma_{R2} = 125416/8.0153\times10^{-3} = 1.565\times10^7 \ N/m^2$

TOTAL STRESS RANGE:

$\sigma_R = .906\times10^7 + 1.565\times10^7 = 2.471\times10^7 \ N/m^2$
$< 4.137\times10^7$

B) STRESS IN PLATE AT CENTER OF PANEL

THE MAXIMUM STRESS RANGE OCCURS FOR ELEMENT 126, NODE K (SEE PG. 9).

1) STRESS RANGE DUE TO LOCAL BENDING

$\sigma_{R1} = 1.191\times10^7 - (-.545\times10^7)$
$= 1.736\times10^7 \ N/m^2$

2) STRESS RANGE DUE TO BENDING OF LEVITATION BOX BEAM

$S = \dfrac{1.283436\times10^{-3}}{2.163617 - 2.1} = 2.0174\times10^{-2} \ m^2$

$\sigma_{R2} = 125416/2.0174\times10^{-2} = .622\times10^7 \ N/m^2$

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JOB NO. 6869002 DATE 5/13/92 BY RJC CH'K
CUSTOMER MIT MI PROJECT MAGLEV
SUBJECT GUIDEWAY SHEET

TOTAL STRESS RANGE:

$$\sigma_R = 1.736 \times 10^7 + .622 \times 10^7 = 2.358 \times 10^7 \ N/m^2$$

$$< 4.137 \times 10^7$$

FORM 62-114/A0388175i

PAGE 25-24

Aluminum Construction Manual

Section 3
Engineering data for aluminum structures

the Aluminum Association
900 19th St., N.W., Washington, D.C. 20006

Fifth Edition, December, 1986

(Specifications 9, 15, 16, 18, or 19 of Tables 3.3.6 to 3.3.29).

Where deflection at design loads is critical, the effective width concept may be used to determine an effective section to be used in deflection calculations. The effective width, b_e, of a thin element subjected to direct compression stresses is:

If $f_a \leqq n_a F_{ab}$, $b_e = b$

If $f_a > n_a F_{ab}$, $b_e = b\sqrt{n_a F_{ab}/f_a}$

where:

b_e = effective width of flat plate element to be used in deflection calculations, in.

b = clear width of element, in.

n_a = factor of safety on appearance of buckling

F_{ab} = allowable stress for element from Section 4.7.1, ksi

f_a = compressive stress on element due to applied loads, ksi

The same expression may be used to calculate the effective width on the compression side of a web in bending, with the compressive bending stress due to the applied loads, f_b, replacing f_a.

4.7.7 Web Crippling. Allowable interior reactions and concentrated loads for flat webs should be

$$P_c = 0.6\frac{F_{cy}dt^2}{h}\left(6 + 0.04\frac{N}{t}\right)\left[1.1 - 0.1\left(\frac{\theta}{90}\right)\sqrt{\frac{R_i}{t}}\right] \text{ for } \frac{h}{t} < C_y$$

$$\text{and } P_c = 1.5\ Ed\ (N + h)\left(\frac{t}{h}\right)^3 \text{ for } \frac{h}{t} > C_y$$

$$\text{in which } C_y = \frac{2.5\,E\left(\frac{N}{h} + 1\right)}{F_{cy}\left(6 + 0.04\frac{N}{t}\right)\left[1.1 - 0.1\left(\frac{\theta}{90}\right)\sqrt{\frac{R_i}{t}}\right]}$$

Allowable end reactions should be

$$P_c = 0.6\frac{F_{cy}dt^2}{h}\left(3 + 0.04\frac{N}{t}\right)\left[1.1 - 0.1\left(\frac{\theta}{90}\right)\sqrt{\frac{R_i}{t}}\right] \text{ for } \frac{h}{t} < C_y$$

$$\text{and } P_c = 1.5\ Ed\left(N + \frac{h}{2}\right)\left(\frac{t}{h}\right)^3 \text{ for } \frac{h}{t} > C_y$$

$$\text{in which } C_y = \frac{1.25\ E\left(\frac{2N}{h} + 1\right)}{F_{cy}\left(3 + 0.04\frac{N}{t}\right)\left[1.1 - 0.1\left(\frac{\theta}{90}\right)\sqrt{\frac{R_i}{t}}\right]}$$

The terms appearing in the above formulas are defined as follows:

d = depth of web (vertical projection), in.

E = compressive modulus of elasticity, ksi

F_{cy} = minimum compressive yield strength of sheet, ksi

h = slope width of web (shear element spanning between flats) in.

N = length of bearing at reaction or concentrated load, in.

P_c = allowable reaction or concentrated load per web, kips

R_i = bend radius at juncture of flange and web measured to inside surface of bend, in.

t = web thickness, in.

θ = angle between plane of web and plane of bearing surface ($\theta \leq 90$), degrees

4.8 Fatigue. In members and connections subjected to repeated fluctuations of stress, special design considerations must be made. Fatigue results in damage that may cause fracture after a number of applications of load. (See Appendix C for commentary.)

The joint details and, to a lesser extent, fabrication greatly affect fatigue strength. Special considerations should be given to selecting details which minimize the damaging effects of fatigue.

4.8.1 Allowable Stresses. Members, connections and fasteners subjected to repeated tensile stress variation or stress reversal shall be designed so that the maximum stress does not exceed the maximum allowable stress under static loading as defined in Sections 3 and 4 and the range of stress from live load fluctuations does not exceed the allowable stress range as listed in Table 4.8.1a.

TABLE 4.8.1a
ALLOWABLE STRESS RANGE, KSI

	Design Stress Cycles			
Stress Category[1]	Up To 100,000	100,000-500,000	500,000-2,000,000	over 2,000,000
A	17.5	13.6	11.0	9.5
B	16.0	11.4	8.5	6.0
C	12.0	8.2	5.9	4.0
D	9.5	6.4	4.5	3.0
E	7.5	4.7	3.2	2.0
F	6.0	3.8	2.5	1.6

[1]See Table 4.8.1b

The stress category shall be determined from Table 4.8.1b which defines the categories for representative details. The stress range is defined as the algebraic difference between the minimum and maximum calculated stress due to dead load, live load and impact.

4.8.2 Aerodynamic Response. The aeroelastic response of undamped structures or components can result in excessive stress magnitudes and cycles. Appropriate vibration dampers may be necessary to limit wind induced vibrations.

TABLE 4.8.1b
STRESS CATEGORY

General Condition	Situation	Stress Category. (See Table 4.8.1a)[a]	Illustrative Example Nos. (See Fig. 4.8.1)[b]
Plain material	Base metal with rolled or cleaned surfaces.	A	1,2
Built-up members	Base metal and weld metal in members, without attachments, built-up of plates or shapes connected by continuous full- or partial-penetration groove welds or continuous fillet welds parallel to the direction of applied stress.	B	3,4,5
	Calculated flexural stress, f_b, in base metal at toe of welds on girder webs or flanges adjacent to welded transverse stiffeners.	C	6
	Base metal at end of partial-length welded cover plates having square or tapered ends, with or without welds across the ends.	E	5
Mechanically fastened	Base metal at net section of mechanically fastened joints which do *not* induce out-of-plane bending in connected material, where		
	Stress ratio, the ratio of minimum stress to maximum stress, SR is:		
	$SR < 0$	C	7
	$0 \le SR < 0.5$	D	7
	$0.5 \le SR$	E	7
	Base metal at net section of mechanically fastened joints which induce out-of-plane bending in connected material.	E	8
Fillet welded connections	Base metal at intermittent fillet welds.	E	
	Base metal at junction of axially loaded members with fillet welded end connections. Welds shall be disposed about the axis of the members so as to balance weld stresses.	E	15,17
	Weld metal of continuous or intermittent longitudinal or transverse fillet welds.	F	5,15,18
Groove welds	Base metal and weld metal at full-penetration groove welded splices of parts of similar cross section ground flush, with grinding in the direction of applied stress and with weld soundness established by nondestructive inspection.	B	9
	Base metal and weld metal at full-penetration groove welded splices at transitions in width or thickness, with welds ground to provide slopes no steeper than 1 to 2½, with grinding in the direction of applied stress, and with weld soundness established by nondestructive inspection.	B	11,12
	Base metal and weld metal at full-penetration groove welded splices, with or without transitions having slopes no greater than 1 to 2½, when reinforcement is not removed and/or weld soundness is not established by nondestructive inspection.	C	9,10,11,12
Attachments	Base metal detail of any length attached by groove welds subject to transverse and/or longitudinal loading, when the detail embodies a transition radius, the radius of an attachment of the weld detail, R, 2 inches or greater, with the weld termination ground smooth:		

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TABLE 4.8.1b (Continued)
STRESS CATEGORY

General Condition	Situation	Stress Category. (See Table 4.8.1a)[a]	Illustrative Example Nos. (See Fig. 4.8.1)[b]
	R ≥ 24 in.	B	13
	24 in. > R ≥ 6 in.	C	13
	6 in. > R ≥ 2 in.	D	13
	Base metal at detail attached by groove welds or fillet welds subject to longitudinal loading, with transition radius, if any, less than 2 inches:		
	2 in. ≤ a ≤ 12b or 4 in.	D	14
	a > 12b or 4 in.	E	14,19,20
	where a = detail dimension parallel to the direction of stress b = detail dimension normal to the direction of stress and the surface of the base metal		
	Base metal at a detail of any length attached by fillet welds or partial-penetration groove welds in the direction parallel to the stress, when the detail embodies a transition radius, R, 2 inches or greater, with weld termination ground smooth:		
	R ≥ 24 in.	B	16
	24 in. > R ≥ 6 in.	C	16
	6 in. > R ≥ 2 in.	D	16
	Base metal at a detail attached by groove welds or fillet welds, where the detail dimension parallel to the direction of stress, a, is less than 2 in.	C	19

[a]All stresses are T and Rev., where "T" signifies range in tensile stress only; "Rev." signifies a range involving reversal of tensile or compressive stress; except Category F where stress range is in shear including shear stress reversal.

[b]These examples are provided as guidelines and are not indended to exclude other reasonably similar situations.

Fig. 4.8.1 Illustrative examples

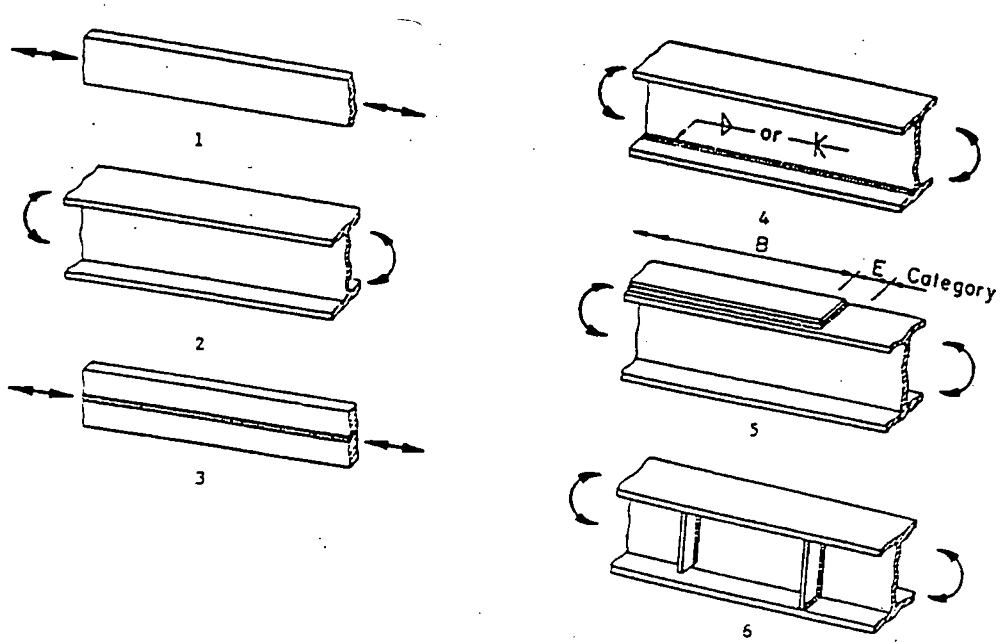
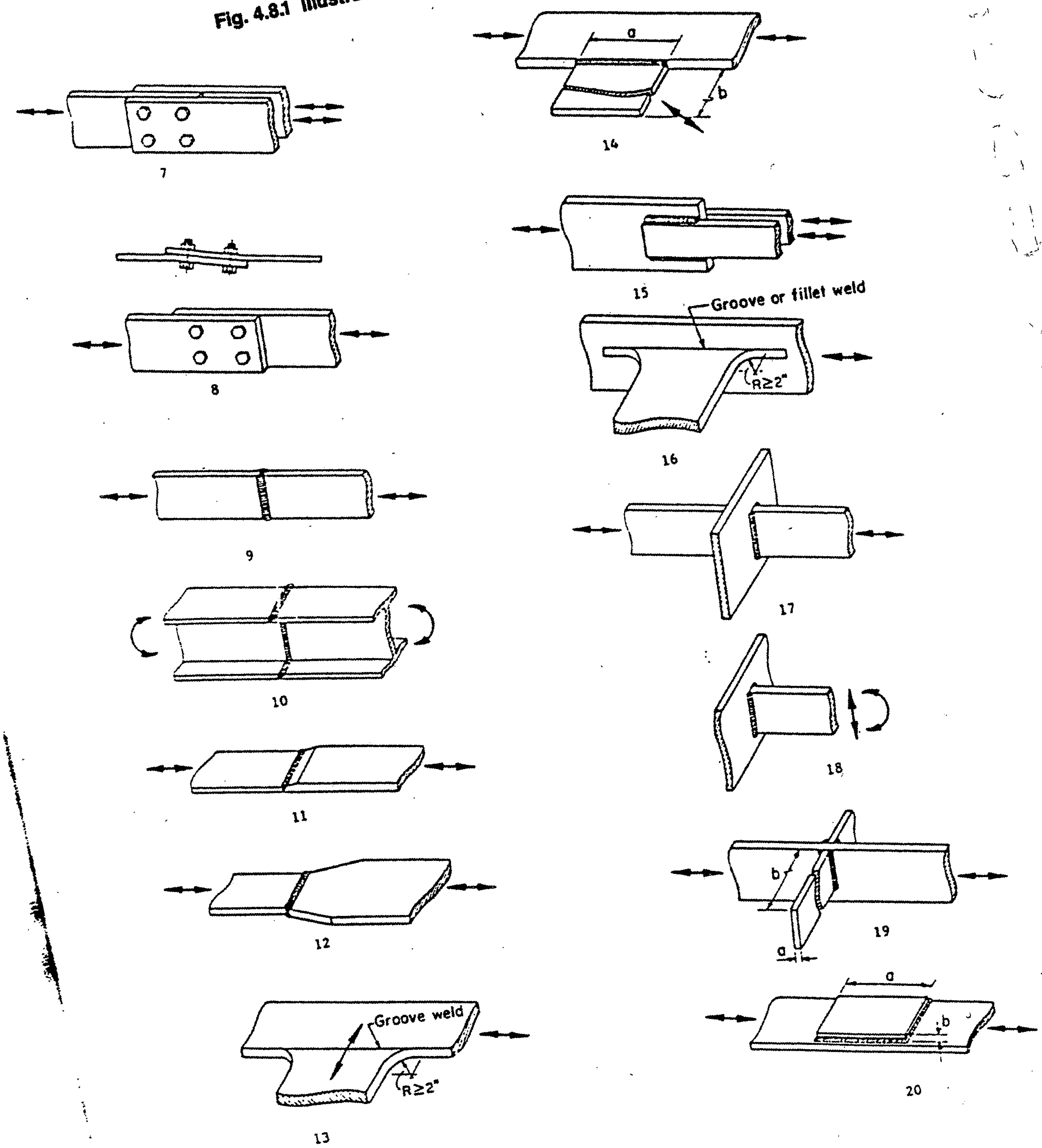


Fig. 4.8.1 Illustrative examples (continued)



MODAL ANALYSIS

A PARTIAL PRINTOUT OF THE RESULTS OF THE MODAL ANALYSIS FOLLOWS.

MODE NO. 1 (182.2 cps), NO. 5 (229.8 cps), & NO. 14 (325.8 cps) REPRESENT THE FIRST THREE PRIMARY BENDING MODES OF THE PANEL ACTING AS A 3-SPAN BEAM CONTINUOUS OVER THE 4 RADIAL SUPPORTS.

ANSYS - ENGINEERING ANALYSIS SYSTEM REVISION 4.4 A 1 40195-PC/L1-4.4A MAY 1,1990

FOR SUPPORT CALL PHONE TWX

MODAL ANALYSIS OF GUIDEWAY SHEET 8.1223 MAY 12,1992 CP= 407.330

***** EIGENVALUE (NATURAL FREQUENCY) SOLUTION *****

MODE	FREQUENCY (CYCLES/TIME)
1	182.225615
2	190.000675
3	203.708225
4	223.418123
5	229.803181
6	236.264903
7	248.059723
8	248.806314
9	265.748490
10	279.206992
11	289.086551
12	313.640964
13	317.136784
14	325.753440
15	334.658806
16	348.771985
17	350.985240
18	353.196859
19	378.030301
20	383.071819
21	390.741421
22	404.454898
23	419.475401
24	429.690619
25	432.090570
26	454.153160
27	457.714002
28	474.684188
29	478.770831
30	497.699374

***** REDUCED MASS DISTRIBUTION *****

ROW	NODE	DIR	VALUE
1	38	UX	1.5687
2	141	UX	1.5925
3	150	UX	1.6196
4	56	UX	1.6055
5	193	UX	1.5939
6	28	UX	1.5687
7	55	UX	1.5916
8	127	UX	1.6073
9	15	UX	1.5659
10	99	UX	1.6174
11	128	UX	1.5925
12	225	UX	1.6069
13	115	UX	1.5927
14	84	UX	1.6175
15	129	UX	1.5720
16	72	UX	1.6195

0-30-57

17	71	UX	1.6165
18	16	UX	1.5750
19	43	UX	1.6006
20	214	UX	1.6201
21	155	UX	1.5720
22	59	UX	1.6159
23	17	UX	1.5807
24	175	UX	1.6186
25	138	UX	1.6163
26	188	UX	1.6200
27	75	UX	1.6076
28	60	UX	1.6131
29	202	UX	1.6243
30	32	UX	1.5958
31	142	UX	1.5720
32	19	UX	1.5842
33	103	UX	1.5721
34	85	UX	1.6206
35	154	UX	1.5926
36	119	UX	1.5720
37	88	UX	1.6082
38	114	UX	1.6076
39	76	UX	1.5928
40	194	UX	1.5724
41	20	UX	1.5856
42	47	UX	1.6062
43	224	UX	1.5923
44	185	UX	1.5939
45	63	UX	1.5916
46	21	UX	1.5842
47	101	UX	1.6080
48	241	UX	1.6059
49	116	UX	1.5720
50	77	UX	1.5720
51	64	UX	1.5716
52	90	UX	1.5721
53	36	UX	1.5918
54	89	UX	1.5931
55	23	UX	1.5807
56	219	UX	1.5941
57	136	UX	1.6163
58	167	UX	1.5929
59	123	UX	1.6164
60	86	UX	1.6175
61	46	UX	1.6087
62	33	UX	1.5978
63	137	UX	1.6192
64	24	UX	1.5750
65	51	UX	1.5706
66	246	UX	1.5700
67	173	UX	1.6087
68	67	UX	1.5720
69	25	UX	1.5659
70	49	UX	1.6006
71	102	UX	1.5929
72	50	UX	1.5887
73	62	UX	1.6055
74	189	UX	1.6233
75	37	UX	1.5829
76	34	UX	1.5958
77	98	UX	1.6204
78	254	UX	1.5861
79	140	UX	1.6072
80	171	UX	1.5722
81	29	UX	1.5829
82	166	UX	1.6079

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83	30	UX	1.5918
84	151	UX	1.6165
85	68	UX	1.5928
86	95	UX	1.6080
87	124	UX	1.6194
88	190	UX	1.6200
89	41	UX	1.5706
90	240	UX	1.6035
91	42	UX	1.5887
92	45	UX	1.6062
93	168	UX	1.5721
94	229	UX	1.6151
95	180	UX	1.5933
96	181	UX	1.5722
97	111	UX	1.6199
98	207	UX	1.5725
99	54	UX	1.5716
100	216	UX	1.6201
101	206	UX	1.5943
102	58	UX	1.6131
103	211	UX	1.5941
104	108	UX	1.6076
105	245	UX	1.5875
106	80	UX	1.5721
107	107	UX	1.5927
108	179	UX	1.6087
109	69	UX	1.6076
110	227	UX	1.6151
111	112	UX	1.6168
112	73	UX	1.6165
113	153	UX	1.6074
114	237	UX	1.5875
115	192	UX	1.6097
116	223	UX	1.5717
117	81	UX	1.5931
118	218	UX	1.6101
119	82	UX	1.6082
120	203	UX	1.6210
121	120	UX	1.5925
122	147	UX	1.6074
123	176	UX	1.6217
124	242	UX	1.6035
125	93	UX	1.5721
126	238	UX	1.5985
127	94	UX	1.5929
128	97	UX	1.6174
129	220	UX	1.5724
130	236	UX	1.5700
131	232	UX	1.5923
132	233	UX	1.5717
133	163	UX	1.6204
134	259	UX	1.5670
135	106	UX	1.5720
136	177	UX	1.6186
137	258	UX	1.5767
138	110	UX	1.6168
139	250	UX	1.5767
140	160	UX	1.6079
141	198	UX	1.5943
142	132	UX	1.5720
143	159	UX	1.5929
144	231	UX	1.6069
145	121	UX	1.6073
146	201	UX	1.6210
147	164	UX	1.6173
148	125	UX	1.6164

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149	205	UX	1.6105
150	251	UX	1.5824
151	244	UX	1.5985
152	253	UX	1.5845
153	133	UX	1.5925
154	257	UX	1.5824
155	134	UX	1.6072
156	255	UX	1.5845
157	172	UX	1.5933
158	199	UX	1.6105
159	228	UX	1.6180
160	212	UX	1.6101
161	145	UX	1.5720
162	249	UX	1.5670
163	146	UX	1.5926
164	149	UX	1.6165
165	162	UX	1.6173
166	184	UX	1.5724
167	197	UX	1.5725
168	210	UX	1.5724
169	215	UX	1.6233
170	186	UX	1.6097
171	158	UX	1.5721

MASS(X,Y,Z) = 273.0 0.0000E+00 0.0000E+00

***** PARTICIPATION FACTOR CALCULATION ***** X DIRECTION

MODE	FREQUENCY	PERIOD	PARTIC.FACTOR	RATIO
1	182.226	0.54877E-02	-4.6392	0.351347
2	190.001	0.52631E-02	0.90188E-01	0.006830
3	203.708	0.49090E-02	1.6908	0.128051
4	223.418	0.44759E-02	-0.53914E-01	0.004083
5	229.803	0.43515E-02	-0.57235E-14	0.000000
6	236.265	0.42325E-02	0.26572E-13	0.000000
7	248.060	0.40313E-02	0.61873E-11	0.000000
8	248.806	0.40192E-02	-1.0374	0.078570
9	265.748	0.37630E-02	-0.39381E-13	0.000000
10	279.207	0.35816E-02	-0.24261E-01	0.001837
11	289.087	0.34592E-02	0.16617E-12	0.000000
12	313.641	0.31884E-02	-0.52610	0.039844
13	317.137	0.31532E-02	0.18077E-11	0.000000
14	325.753	0.30698E-02	13.204	1.000000
15	334.659	0.29881E-02	0.89641	0.067889
16	348.772	0.28672E-02	-0.20520E-12	0.000000
17	350.985	0.28491E-02	1.0368	0.078523
18	353.197	0.28313E-02	-4.7005	0.355985
19	378.030	0.26453E-02	-0.41306	0.031283
20	383.072	0.26105E-02	0.98410E-13	0.000000
21	390.741	0.25592E-02	0.50346	0.038129
22	404.455	0.24725E-02	-2.7158	0.205678
23	419.475	0.23839E-02	0.97276E-13	0.000000
24	429.691	0.23273E-02	0.14884	0.011272
25	432.091	0.23143E-02	0.97974E-01	0.007420
26	454.153	0.22019E-02	1.7530	0.132764
27	457.714	0.21848E-02	-0.44470E-12	0.000000
28	474.684	0.21067E-02	-0.41375	0.031335
29	478.771	0.20887E-02	-0.97801E-01	0.007407
30	497.699	0.20092E-02	-0.55235E-13	0.000000

SUM OF EFFECTIVE MASSES=

EFFECTIVE MASS	CUMULATIVE MASS FRACTION
21.5225	0.915251E-01
0.813381E-02	0.915597E-01
2.85880	0.103717
0.290672E-02	0.103729
0.327583E-28	0.103729
0.706082E-27	0.103729
0.382828E-22	0.103729
1.07630	0.108306
0.155084E-26	0.108306
0.588598E-03	0.108309
0.276139E-25	0.108309
0.276786	0.109486
0.326796E-23	0.109486
174.349	0.850913
0.803556	0.854330
0.421083E-25	0.854330
1.07501	0.858901
22.0945	0.952859
0.170619	0.953585
0.968457E-26	0.953585
0.253477	0.954663
7.37556	0.986028
0.946270E-26	0.986028
0.221540E-01	0.986122
0.959881E-02	0.986163
3.07315	0.999231
0.197756E-24	0.999231
0.171189	0.999959
0.956506E-02	1.00000
0.305095E-26	1.00000
235.154	

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***** PARTICIPATION FACTOR CALCULATION ***** Y DIRECTION

MODE	FREQUENCY	PERIOD	PARTIC.FACTOR	RATIO
1	182.226	0.54877E-02	0.12973E-13	0.000000
2	190.001	0.52631E-02	-0.83653E-14	0.000000
3	203.708	0.49090E-02	-0.12520E-13	0.000000
4	223.418	0.44759E-02	0.33406E-12	0.000000
5	229.803	0.43515E-02	2.8578	1.000000
6	236.265	0.42325E-02	-0.55553E-01	0.019439
7	248.060	0.40313E-02	0.98594	0.344998
8	248.806	0.40192E-02	0.58207E-11	0.000000
9	265.748	0.37630E-02	0.55178E-01	0.019308
10	279.207	0.35816E-02	-0.60959E-12	0.000000
11	289.087	0.34592E-02	0.58746	0.205563
12	313.641	0.31884E-02	0.27001E-13	0.000000
13	317.137	0.31532E-02	0.39027E-01	0.013656
14	325.753	0.30698E-02	-0.43849E-14	0.000000
15	334.659	0.29881E-02	0.30226E-13	0.000000
16	348.772	0.28672E-02	0.39779	0.139194
17	350.985	0.28491E-02	0.65297E-13	0.000000
18	353.197	0.28313E-02	0.37483E-14	0.000000
19	378.030	0.26453E-02	-0.80985E-14	0.000000
20	383.072	0.26105E-02	0.23877E-01	0.008355
21	390.741	0.25592E-02	-0.30173E-15	0.000000
22	404.455	0.24725E-02	0.78922E-14	0.000000
23	419.475	0.23839E-02	0.28239	0.098813
24	429.691	0.23273E-02	0.13245E-14	0.000000
25	432.091	0.23143E-02	0.51383E-15	0.000000
26	454.153	0.22019E-02	-0.40435E-14	0.000000
27	457.714	0.21848E-02	-0.13076E-01	0.004575
28	474.684	0.21067E-02	0.61295E-14	0.000000
29	478.771	0.20887E-02	0.26740E-14	0.000000
30	497.699	0.20092E-02	-0.20290	0.071000

SUM OF EFFECTIVE MASSES=

***** PARTICIPATION FACTOR CALCULATION ***** Z DIRECTION

MODE	FREQUENCY	PERIOD	PARTIC.FACTOR	RATIO
1	182.226	0.54877E-02	0.00000E+00	0.000000
2	190.001	0.52631E-02	0.00000E+00	0.000000
3	203.708	0.49090E-02	0.00000E+00	0.000000
4	223.418	0.44759E-02	0.00000E+00	0.000000
5	229.803	0.43515E-02	0.00000E+00	0.000000
6	236.265	0.42325E-02	0.00000E+00	0.000000
7	248.060	0.40313E-02	0.00000E+00	0.000000
8	248.806	0.40192E-02	0.00000E+00	0.000000
9	265.748	0.37630E-02	0.00000E+00	0.000000
10	279.207	0.35816E-02	0.00000E+00	0.000000
11	289.087	0.34592E-02	0.00000E+00	0.000000
12	313.641	0.31884E-02	0.00000E+00	0.000000
13	317.137	0.31532E-02	0.00000E+00	0.000000
14	325.753	0.30698E-02	0.00000E+00	0.000000
15	334.659	0.29881E-02	0.00000E+00	0.000000
16	348.772	0.28672E-02	0.00000E+00	0.000000
17	350.985	0.28491E-02	0.00000E+00	0.000000
18	353.197	0.28313E-02	0.00000E+00	0.000000
19	378.030	0.26453E-02	0.00000E+00	0.000000
20	383.072	0.26105E-02	0.00000E+00	0.000000
21	390.741	0.25592E-02	0.00000E+00	0.000000
22	404.455	0.24725E-02	0.00000E+00	0.000000
23	419.475	0.23839E-02	0.00000E+00	0.000000
24	429.691	0.23273E-02	0.00000E+00	0.000000

EFFECTIVE MASS	CUMULATIVE MASS FRACTION
0.168304E-27	0.172235E-28
0.699788E-28	0.243848E-28
0.156756E-27	0.404265E-28
0.111598E-24	0.114608E-25
8.16707	0.835780
0.308619E-02	0.836095
0.972072	0.935573
0.338801E-22	0.935573
0.304465E-02	0.935884
0.371600E-24	0.935884
0.345109	0.971201
0.729033E-27	0.971201
0.152308E-02	0.971357
0.192276E-28	0.971357
0.913597E-27	0.971357
0.158237	0.987550
0.426374E-26	0.987550
0.140498E-28	0.987550
0.655852E-28	0.987550
0.570107E-03	0.987609
0.910431E-31	0.987609
0.622864E-28	0.987609
0.797435E-01	0.995769
0.175427E-29	0.995769
0.264020E-30	0.995769
0.163497E-28	0.995769
0.170976E-03	0.995787
0.375711E-28	0.995787
0.715005E-29	0.995787
0.411703E-01	1.00000
9.77180	

EFFECTIVE MASS	CUMULATIVE MASS FRACTION
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00

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25	432.091	0.23143E-02	0.00000E+00	0.000000	0.000000E+00	0.000000E+00
26	454.153	0.22019E-02	0.00000E+00	0.000000	0.000000E+00	0.000000E+00
27	457.714	0.21848E-02	0.00000E+00	0.000000	0.000000E+00	0.000000E+00
28	474.684	0.21067E-02	0.00000E+00	0.000000	0.000000E+00	0.000000E+00
29	478.771	0.20887E-02	0.00000E+00	0.000000	0.000000E+00	0.000000E+00
30	497.699	0.20092E-02	0.00000E+00	0.000000	0.000000E+00	0.000000E+00

SS-57

MODAL ANALYSIS OF GUIDEWAY SHEET 8.1278 MAY 12,1992 CP= 426.880

***** EXPANDED MODE SHAPE FOR MODE 1 LOAD STEP 1 ***** FREQUENCY = 182.226 (CYCLES/TIME)

NOTE - ALL DISPLACEMENTS ARE IN NODAL COORDINATE SYSTEMS. SOME NODAL COORD. SYSTEMS MAY NOT BE PARALLEL TO THE GLOBAL CARTESIAN SYSTEM. SEE NODE LOCATION PRINTOUT FOR ROTATION ANGLES.

NODE	UX	UY	UZ	ROTX	ROTY	ROTZ
1	0.000000E+00	0.000000E+00	0.000000E+00	0.132426E-01	-0.137379E-02	-0.103795E-02
2	0.000000E+00	0.000000E+00	0.000000E+00	0.164226E-01	0.356339E-01	-0.758475E-03
3	0.000000E+00	0.000000E+00	0.000000E+00	-0.215091E-02	0.502992E-01	0.159888E-04
4	0.000000E+00	0.000000E+00	0.000000E+00	-0.215306E-01	0.355941E-01	0.719307E-03
5	0.000000E+00	0.000000E+00	0.000000E+00	-0.290977E-01	-0.136880E-03	0.103250E-02
6	0.000000E+00	0.000000E+00	0.000000E+00	-0.201792E-01	-0.362484E-01	0.741756E-03
7	0.000000E+00	0.000000E+00	0.000000E+00	0.566801E-15	-0.512542E-01	-0.151910E-16
8	0.000000E+00	0.000000E+00	0.000000E+00	0.201792E-01	-0.362484E-01	-0.741756E-03
9	0.000000E+00	0.000000E+00	0.000000E+00	0.290977E-01	-0.136880E-03	-0.103250E-02
10	0.000000E+00	0.000000E+00	0.000000E+00	0.215306E-01	0.355941E-01	-0.719307E-03
11	0.000000E+00	0.000000E+00	0.000000E+00	0.215091E-02	0.502992E-01	-0.159888E-04
12	0.000000E+00	0.000000E+00	0.000000E+00	-0.164226E-01	0.356339E-01	0.758475E-03
13	0.000000E+00	0.000000E+00	0.000000E+00	-0.132426E-01	-0.137379E-02	0.103795E-02
14	0.000000E+00	0.803037E-03	0.398175E-03	0.120930E-01	-0.771543E-03	-0.743539E-01
15	0.883236E-02	0.540691E-03	-0.190533E-03	0.133732E-01	0.386816E-01	-0.525427E-01
16	0.124904E-01	-0.133029E-04	-0.396170E-03	-0.197228E-02	0.544588E-01	-0.115179E-04
17	0.883532E-02	-0.559671E-03	-0.287903E-03	-0.183447E-01	0.384522E-01	0.525124E-01
18	0.000000E+00	-0.784567E-03	0.341355E-04	-0.249484E-01	0.363695E-04	0.746582E-01
19	-0.891011E-02	-0.554030E-03	0.363141E-03	-0.174016E-01	-0.381864E-01	0.530765E-01
20	-0.126063E-01	-0.257861E-16	0.500046E-03	0.913926E-15	-0.539888E-01	-0.691987E-15
21	-0.891011E-02	0.554030E-03	0.363141E-03	0.174016E-01	-0.381864E-01	-0.530765E-01
22	0.000000E+00	0.784567E-03	0.341355E-04	0.249484E-01	0.363695E-04	-0.746582E-01
23	0.883532E-02	0.559671E-03	-0.287903E-03	0.183447E-01	0.384522E-01	-0.525124E-01
24	0.124904E-01	0.133029E-04	-0.396170E-03	0.197228E-02	0.544588E-01	0.115179E-04
25	0.883236E-02	-0.540691E-03	-0.190533E-03	-0.133732E-01	0.386816E-01	0.525427E-01
26	0.000000E+00	-0.803037E-03	0.398175E-03	-0.120930E-01	-0.771543E-03	0.743539E-01
27	0.000000E+00	0.196324E-02	0.395368E-03	0.102378E-01	-0.537710E-03	-0.157888
28	0.187626E-01	0.140619E-02	-0.264507E-03	0.105720E-01	0.428745E-01	-0.111404
29	0.264881E-01	0.450516E-04	-0.582748E-03	-0.187032E-02	0.604383E-01	0.379216E-03
30	0.186914E-01	-0.130588E-02	-0.419513E-03	-0.153300E-01	0.426532E-01	0.111519
31	0.000000E+00	-0.186731E-02	0.659477E-04	-0.207533E-01	0.141773E-03	0.156823
32	-0.185913E-01	-0.132291E-02	0.562568E-03	-0.144487E-01	-0.416822E-01	0.110452
33	-0.262761E-01	-0.597295E-16	0.769263E-03	0.678155E-15	-0.589098E-01	-0.952372E-15
34	-0.185913E-01	0.132291E-02	0.562568E-03	0.144487E-01	-0.416822E-01	-0.110452
35	0.000000E+00	0.186731E-02	0.659477E-04	0.207533E-01	0.141773E-03	-0.156823
36	0.186914E-01	0.130588E-02	-0.419513E-03	0.153300E-01	0.426532E-01	-0.111519
37	0.264881E-01	-0.450516E-04	-0.582748E-03	0.187032E-02	0.604383E-01	-0.379216E-03
38	0.187626E-01	-0.140619E-02	-0.264507E-03	-0.105720E-01	0.428745E-01	0.111404
39	0.000000E+00	-0.196324E-02	0.395368E-03	-0.102378E-01	-0.537710E-03	0.157888
40	0.000000E+00	0.310818E-02	0.324465E-03	0.941954E-02	-0.668948E-03	-0.246073
41	0.292593E-01	0.222539E-02	-0.317648E-03	0.104497E-01	0.433047E-01	-0.173799
42	0.413365E-01	0.778392E-04	-0.619364E-03	-0.173370E-02	0.611656E-01	0.475013E-03
43	0.291699E-01	-0.207364E-02	-0.437773E-03	-0.147444E-01	0.432358E-01	0.174048
44	0.000000E+00	-0.297055E-02	0.944848E-04	-0.197419E-01	0.388522E-04	0.244179
45	-0.289022E-01	-0.210483E-02	0.639218E-03	-0.136003E-01	-0.427800E-01	0.171495
46	-0.408345E-01	-0.888190E-16	0.866175E-03	-0.906529E-16	-0.604637E-01	-0.204771E-14
47	-0.289022E-01	0.210483E-02	0.639218E-03	0.136003E-01	-0.427800E-01	-0.171495
48	0.000000E+00	0.297055E-02	0.944848E-04	0.197419E-01	0.388522E-04	-0.244179
49	0.291699E-01	0.207364E-02	-0.437773E-03	0.147444E-01	0.432358E-01	-0.174048

50	0.413365E-01	-0.778392E-04	-0.619364E-03	0.173370E-02	0.611656E-01	-0.475013E-03
51	0.292593E-01	-0.222539E-02	-0.317648E-03	-0.104497E-01	0.433047E-01	0.173799

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NODE	UX	UY	UZ	ROTX	ROTY	ROTZ

NOTE - ALL DISPLACEMENTS ARE IN NODAL COORDINATE SYSTEMS. SOME NODAL COORD. SYSTEMS MAY NOT BE PARALLEL TO THE GLOBAL CARTESIAN SYSTEM. SEE NODE LOCATION PRINTOUT FOR ROTATION ANGLES.

52	0.000000E+00	-0.310818E-02	0.324465E-03	-0.941954E-02	-0.668948E-03	0.246073
53	0.000000E+00	0.418105E-02	0.256507E-03	0.919571E-02	-0.727840E-03	-0.331770
54	0.394545E-01	0.298349E-02	-0.333847E-03	0.107111E-01	0.407279E-01	-0.234412
55	0.557580E-01	0.768591E-04	-0.603465E-03	-0.148772E-02	0.575049E-01	0.476003E-03
56	0.393638E-01	-0.283216E-02	-0.410887E-03	-0.145485E-01	0.406743E-01	0.234702
57	0.000000E+00	-0.404329E-02	0.112869E-03	-0.197830E-01	-0.877366E-05	0.329660
58	-0.390476E-01	-0.286313E-02	0.647549E-03	-0.137689E-01	-0.406638E-01	0.231709
59	-0.551742E-01	-0.107057E-15	0.870257E-03	-0.175376E-15	-0.575003E-01	-0.143816E-14
60	-0.390476E-01	0.286313E-02	0.647549E-03	0.137689E-01	-0.406638E-01	-0.231709
61	0.000000E+00	0.404329E-02	0.112869E-03	0.197830E-01	-0.877366E-05	-0.329660
62	0.393638E-01	0.283216E-02	-0.410887E-03	0.145485E-01	0.406743E-01	-0.234702
63	0.557580E-01	-0.768591E-04	-0.603465E-03	0.148772E-02	0.575049E-01	-0.476003E-03
64	0.394545E-01	-0.298349E-02	-0.333847E-03	-0.107111E-01	0.407279E-01	0.234412
65	0.000000E+00	-0.418105E-02	0.256507E-03	-0.919571E-02	-0.727840E-03	0.331770
66	0.000000E+00	0.514938E-02	0.202130E-03	0.866197E-02	-0.661850E-03	-0.410451
67	0.488125E-01	0.366290E-02	-0.319747E-03	0.100388E-01	0.365137E-01	-0.290065
68	0.689959E-01	0.623872E-04	-0.551166E-03	-0.129881E-02	0.515570E-01	0.434979E-03
69	0.487285E-01	-0.353993E-02	-0.365929E-03	-0.134043E-01	0.364851E-01	0.290331
70	0.000000E+00	-0.503605E-02	0.118182E-03	-0.184802E-01	-0.248720E-04	0.408483
71	-0.484347E-01	-0.356388E-02	0.609253E-03	-0.130241E-01	-0.366722E-01	0.287538
72	-0.684525E-01	-0.121091E-15	0.813655E-03	-0.483215E-15	-0.518725E-01	0.517648E-15
73	-0.484347E-01	0.356388E-02	0.609253E-03	0.130241E-01	-0.366722E-01	-0.287538
74	0.000000E+00	0.503605E-02	0.118182E-03	0.184802E-01	-0.248720E-04	-0.408483
75	0.487285E-01	0.353993E-02	-0.365929E-03	0.134043E-01	0.364851E-01	-0.290331
76	0.689959E-01	-0.623872E-04	-0.551166E-03	0.129881E-02	0.515570E-01	-0.434979E-03
77	0.488125E-01	-0.366290E-02	-0.319747E-03	-0.100388E-01	0.365137E-01	0.290065
78	0.000000E+00	-0.514938E-02	0.202130E-03	-0.866197E-02	-0.661850E-03	0.410451
79	0.000000E+00	0.598977E-02	0.159068E-03	0.759837E-02	-0.564317E-03	-0.479326
80	0.570040E-01	0.425116E-02	-0.282163E-03	0.871887E-02	0.311284E-01	-0.338793
81	0.805861E-01	0.442527E-04	-0.473709E-03	-0.109223E-02	0.439609E-01	0.365154E-03
82	0.569327E-01	-0.416354E-02	-0.308536E-03	-0.115683E-01	0.311213E-01	0.339010
83	0.000000E+00	-0.590863E-02	0.111559E-03	-0.160727E-01	-0.283009E-04	0.477668
84	-0.566886E-01	-0.417956E-02	0.536312E-03	-0.114090E-01	-0.313641E-01	0.336677
85	-0.801326E-01	-0.135477E-15	0.712883E-03	0.649107E-16	-0.443717E-01	0.189282E-14
86	-0.566886E-01	0.417956E-02	0.536312E-03	0.114090E-01	-0.313641E-01	-0.336677
87	0.000000E+00	0.590863E-02	0.111559E-03	0.160727E-01	-0.283009E-04	-0.477668
88	0.569327E-01	0.416354E-02	-0.308536E-03	0.115683E-01	0.311213E-01	-0.339010
89	0.805861E-01	-0.442527E-04	-0.473709E-03	0.109223E-02	0.439609E-01	-0.365154E-03
90	0.570040E-01	-0.425116E-02	-0.282163E-03	-0.871887E-02	0.311284E-01	0.338793
91	0.000000E+00	-0.598977E-02	0.159068E-03	-0.759837E-02	-0.564317E-03	0.479326
92	0.000000E+00	0.668241E-02	0.122484E-03	0.613955E-02	-0.448538E-03	-0.536281
93	0.637779E-01	0.473584E-02	-0.227787E-03	0.700572E-02	0.248147E-01	-0.379095
94	0.901719E-01	0.280212E-04	-0.377564E-03	-0.859763E-03	0.350484E-01	0.290252E-03
95	0.637207E-01	-0.468020E-02	-0.242268E-03	-0.927030E-02	0.248167E-01	0.379261
96	0.000000E+00	-0.663102E-02	0.963169E-04	-0.129388E-01	-0.243379E-04	0.534958
97	-0.635290E-01	-0.468934E-02	0.437747E-03	-0.922061E-02	-0.250380E-01	0.377422
98	-0.898146E-01	-0.155800E-15	0.579617E-03	0.300053E-16	-0.354252E-01	0.182553E-14
99	-0.635290E-01	0.468934E-02	0.437747E-03	0.922061E-02	-0.250380E-01	-0.377422
100	0.000000E+00	0.663102E-02	0.963169E-04	0.129388E-01	-0.243379E-04	-0.534958
101	0.637207E-01	0.468020E-02	-0.242268E-03	0.927030E-02	0.248167E-01	-0.379261
102	0.901719E-01	-0.280212E-04	-0.377564E-03	0.859763E-03	0.350484E-01	-0.290252E-03
103	0.637779E-01	-0.473584E-02	-0.227787E-03	-0.700572E-02	0.248147E-01	0.379095
104	0.000000E+00	-0.668241E-02	0.122484E-03	-0.613955E-02	-0.448538E-03	0.536281
105	0.000000E+00	0.720918E-02	0.882755E-04	0.442167E-02	-0.320257E-03	-0.579639
106	0.689347E-01	0.510462E-02	-0.161939E-03	0.503199E-02	0.177741E-01	-0.409778
107	0.974700E-01	0.156433E-04	-0.267796E-03	-0.606057E-03	0.251064E-01	0.225789E-03
108	0.688896E-01	-0.507348E-02	-0.169119E-03	-0.664536E-02	0.177797E-01	0.409902

NOTE - ALL DISPLACEMENTS ARE IN NODAL COORDINATE SYSTEMS. SOME NODAL COORD. SYSTEMS MAY NOT BE PARALLEL TO THE GLOBAL CARTESIAN SYSTEM. SEE NODE LOCATION PRINTOUT FOR ROTATION ANGLES.

NODE	UX	UY	UZ	ROTX	ROTY	ROTZ
109	0.000000E+00	-0.718102E-02	0.751267E-04	-0.930832E-02	-0.179155E-04	0.578602
110	-0.687416E-01	-0.507750E-02	0.321004E-03	-0.665289E-02	-0.179496E-01	0.408479
111	-0.971933E-01	-0.181501E-15	0.423111E-03	0.608407E-15	-0.253978E-01	-0.159945E-15
112	-0.687416E-01	0.507750E-02	0.321004E-03	0.665289E-02	-0.179496E-01	-0.408479
113	0.000000E+00	0.718102E-02	0.751267E-04	0.930832E-02	-0.179155E-04	-0.578602
114	0.688896E-01	0.507348E-02	-0.169119E-03	0.664536E-02	0.177797E-01	-0.409902
115	0.974700E-01	-0.156433E-04	-0.267796E-03	0.606057E-03	0.251064E-01	-0.225789E-03
116	0.689347E-01	-0.510462E-02	-0.161939E-03	-0.503199E-02	0.177741E-01	0.409778
117	0.000000E+00	-0.720918E-02	0.882755E-04	-0.442167E-02	-0.320257E-03	0.579639
118	0.000000E+00	0.755479E-02	0.541419E-04	0.254058E-02	-0.182993E-03	-0.608128
119	0.723232E-01	0.534656E-02	-0.888781E-04	0.288966E-02	0.102093E-01	-0.429941
120	0.102266	0.720523E-05	-0.148708E-03	-0.332254E-03	0.144239E-01	0.177119E-03
121	0.722873E-01	-0.533224E-02	-0.910074E-04	-0.379257E-02	0.102181E-01	0.430035
122	0.000000E+00	-0.754279E-02	0.502424E-04	-0.534907E-02	-0.119728E-04	0.607303
123	-0.721712E-01	-0.533284E-02	0.192226E-03	-0.384399E-02	-0.103359E-01	0.428918
124	-0.102049	-0.208454E-15	0.251174E-03	0.137536E-14	-0.146267E-01	-0.181815E-15
125	-0.721712E-01	0.533284E-02	0.192226E-03	0.384399E-02	-0.103359E-01	-0.428918
126	0.000000E+00	0.754279E-02	0.502424E-04	0.534907E-02	-0.119728E-04	-0.607303
127	0.722873E-01	0.533224E-02	-0.910074E-04	0.379257E-02	0.102181E-01	-0.430035
128	0.102266	-0.720523E-05	-0.148708E-03	0.332254E-03	0.144239E-01	-0.177119E-03
129	0.723232E-01	-0.534656E-02	-0.888781E-04	-0.288966E-02	0.102093E-01	0.429941
130	0.000000E+00	-0.755479E-02	0.541419E-04	-0.254058E-02	-0.182993E-03	0.608128
131	0.000000E+00	0.770822E-02	0.192692E-04	0.569471E-03	-0.402479E-04	-0.620899
132	0.738422E-01	0.545358E-02	-0.119968E-04	0.652469E-03	0.233313E-02	-0.438985
133	0.104417	0.198094E-05	-0.242957E-04	-0.421529E-04	0.330264E-02	0.143255E-03
134	0.738128E-01	-0.544972E-02	-0.993758E-05	-0.800631E-03	0.234694E-02	0.439058
135	0.000000E+00	-0.770641E-02	0.233749E-04	-0.120142E-02	-0.745831E-05	0.620219
136	-0.737181E-01	-0.544827E-02	0.567177E-04	-0.904286E-03	-0.242398E-02	0.438149
137	-0.104240	-0.217259E-15	0.705618E-04	0.604928E-15	-0.343452E-02	-0.152010E-14
138	-0.737181E-01	0.544827E-02	0.567177E-04	0.904286E-03	-0.242398E-02	-0.438149
139	0.000000E+00	0.770641E-02	0.233749E-04	0.120142E-02	-0.745831E-05	-0.620219
140	0.738128E-01	0.544972E-02	-0.993758E-05	0.800631E-03	0.234694E-02	-0.439058
141	0.104417	-0.198094E-05	-0.242957E-04	0.421529E-04	0.330264E-02	-0.143255E-03
142	0.738422E-01	-0.545358E-02	-0.119968E-04	-0.652469E-03	0.233313E-02	0.438985
143	0.000000E+00	-0.770822E-02	0.192692E-04	-0.569471E-03	-0.402479E-04	0.620899
144	0.000000E+00	0.766364E-02	-0.161666E-04	-0.142908E-02	0.104258E-03	-0.617539
145	0.734428E-01	0.542123E-02	0.659065E-04	-0.161289E-02	-0.563528E-02	-0.436618
146	0.103854	-0.931115E-06	0.101667E-03	0.257512E-03	-0.794764E-02	0.120559E-03
147	0.734178E-01	-0.542323E-02	0.719621E-04	0.224284E-02	-0.561388E-02	0.436678
148	0.000000E+00	-0.766758E-02	-0.415712E-05	0.300651E-02	-0.448487E-05	0.616957
149	-0.733372E-01	-0.542069E-02	-0.808528E-04	0.207146E-02	0.556378E-02	0.435906
150	-0.103703	-0.218250E-15	-0.112672E-03	0.544649E-15	0.786405E-02	-0.186841E-14
151	-0.733372E-01	0.542069E-02	-0.808528E-04	-0.207146E-02	0.556378E-02	-0.435906
152	0.000000E+00	0.766758E-02	-0.415712E-05	-0.300651E-02	-0.448487E-05	-0.616957
153	0.734178E-01	0.542323E-02	0.719621E-04	-0.224284E-02	-0.561388E-02	-0.436678
154	0.103854	0.931115E-06	0.101667E-03	-0.257512E-03	-0.794764E-02	-0.120559E-03
155	0.734428E-01	-0.542123E-02	0.659065E-04	0.161289E-02	-0.563528E-02	0.436618
156	0.000000E+00	-0.766364E-02	-0.161666E-04	0.142908E-02	0.104258E-03	0.617539
157	0.000000E+00	0.742077E-02	-0.514391E-04	-0.339747E-02	0.246631E-03	-0.598086
158	0.711293E-01	0.524905E-02	0.142428E-03	-0.384284E-02	-0.134767E-01	-0.422869
159	0.100584	-0.232377E-05	0.225583E-03	0.557970E-03	-0.190174E-01	0.104995E-03
160	0.711073E-01	-0.525388E-02	0.152513E-03	0.525021E-02	-0.134455E-01	0.422921
161	0.000000E+00	-0.742748E-02	-0.313181E-04	0.715329E-02	-0.277140E-05	0.597572
162	-0.710363E-01	-0.525089E-02	-0.216280E-03	0.499727E-02	0.134105E-01	0.422241
163	-0.100451	-0.212221E-15	-0.293017E-03	0.161174E-15	0.189622E-01	-0.194974E-14
164	-0.710363E-01	0.525089E-02	-0.216280E-03	-0.499727E-02	0.134105E-01	-0.422241
165	0.000000E+00	0.742748E-02	-0.313181E-04	-0.715329E-02	-0.277140E-05	-0.597572

LS-39

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NODE	UX	UY	UZ	ROTX	ROTY	ROTZ
166	0.711073E-01	0.525388E-02	0.152513E-03	-0.525021E-02	-0.134455E-01	-0.422921
167	0.100584	0.232377E-05	0.225583E-03	-0.557970E-03	-0.190174E-01	-0.104995E-03
168	0.711293E-01	-0.524905E-02	0.142428E-03	0.384284E-02	-0.134767E-01	0.422869
169	0.000000E+00	-0.742077E-02	-0.514391E-04	0.339747E-02	0.246631E-03	0.598086
170	0.000000E+00	0.698497E-02	-0.855765E-04	-0.528140E-02	0.382978E-03	-0.563014
171	0.669584E-01	0.494065E-02	0.215432E-03	-0.597651E-02	-0.209777E-01	-0.398074
172	0.946861E-01	-0.279015E-05	0.344048E-03	0.849679E-03	-0.296058E-01	0.931887E-04
173	0.669387E-01	-0.494643E-02	0.229561E-03	0.813590E-02	-0.209356E-01	0.398120
174	0.000000E+00	-0.699257E-02	-0.572582E-04	0.111234E-01	-0.194509E-05	0.562553
175	-0.668750E-01	-0.494341E-02	-0.345726E-03	0.779313E-02	0.209069E-01	0.397512
176	-0.945671E-01	-0.203819E-15	-0.465402E-03	0.350280E-15	0.295643E-01	-0.296527E-14
177	-0.668750E-01	0.494341E-02	-0.345726E-03	-0.779313E-02	0.209069E-01	-0.397512
178	0.000000E+00	0.699257E-02	-0.572582E-04	-0.111234E-01	-0.194509E-05	-0.562553
179	0.669387E-01	0.494643E-02	0.229561E-03	-0.813590E-02	-0.209356E-01	-0.398120
180	0.946861E-01	0.279015E-05	0.344048E-03	-0.849679E-03	-0.296058E-01	-0.931887E-04
181	0.669584E-01	-0.494065E-02	0.215432E-03	0.597651E-02	-0.209777E-01	0.398074
182	0.000000E+00	-0.698497E-02	-0.855765E-04	0.528140E-02	0.382978E-03	0.563014
183	0.000000E+00	0.636702E-02	-0.117552E-03	-0.703010E-02	0.509635E-03	-0.513223
184	0.610368E-01	0.450352E-02	0.282988E-03	-0.795641E-02	-0.279364E-01	-0.362870
185	0.863126E-01	-0.273025E-05	0.453884E-03	0.112335E-02	-0.394281E-01	0.827386E-04
186	0.610193E-01	-0.450918E-02	0.301045E-03	0.108191E-01	-0.278831E-01	0.362911
187	0.000000E+00	-0.637437E-02	-0.812544E-04	0.148086E-01	-0.168265E-05	0.512811
188	-0.609623E-01	-0.450637E-02	-0.465685E-03	0.103847E-01	0.278552E-01	0.362368
189	-0.862063E-01	-0.184124E-15	-0.625170E-03	-0.147264E-15	0.393909E-01	-0.287904E-14
190	-0.609623E-01	0.450637E-02	-0.465685E-03	-0.103847E-01	0.278552E-01	-0.362368
191	0.000000E+00	0.637437E-02	-0.812544E-04	-0.148086E-01	-0.168265E-05	-0.512811
192	0.610193E-01	0.450918E-02	0.301045E-03	-0.108191E-01	-0.278831E-01	-0.362911
193	0.863126E-01	0.273025E-05	0.453884E-03	-0.112335E-02	-0.394281E-01	-0.827386E-04
194	0.610368E-01	-0.450352E-02	0.282988E-03	0.795641E-02	-0.279364E-01	0.362870
195	0.000000E+00	-0.636702E-02	-0.117552E-03	0.703010E-02	0.509635E-03	0.513223
196	0.000000E+00	0.558271E-02	-0.146389E-03	-0.859721E-02	0.622890E-03	-0.450005
197	0.535184E-01	0.394878E-02	0.343354E-03	-0.973038E-02	-0.341674E-01	-0.318173
198	0.756808E-01	-0.239433E-05	0.552180E-03	0.137030E-02	-0.482227E-01	0.721204E-04
199	0.535031E-01	-0.395375E-02	0.365061E-03	0.132260E-01	-0.341032E-01	0.318209
200	0.000000E+00	-0.558920E-02	-0.102680E-03	0.181103E-01	-0.170418E-05	0.449645
201	-0.534532E-01	-0.395129E-02	-0.572989E-03	0.127042E-01	0.340730E-01	0.317733
202	-0.755877E-01	-0.154738E-15	-0.768098E-03	-0.348097E-15	0.481841E-01	-0.206665E-14
203	-0.534532E-01	0.395129E-02	-0.572989E-03	-0.127042E-01	0.340730E-01	-0.317733
204	0.000000E+00	0.558920E-02	-0.102680E-03	-0.181103E-01	-0.170418E-05	-0.449645
205	0.535031E-01	0.395375E-02	0.365061E-03	-0.132260E-01	-0.341032E-01	-0.318209
206	0.756808E-01	0.239433E-05	0.552180E-03	-0.137030E-02	-0.482227E-01	-0.721204E-04
207	0.535184E-01	-0.394878E-02	0.343354E-03	0.973038E-02	-0.341674E-01	0.318173
208	0.000000E+00	-0.558271E-02	-0.146389E-03	0.859721E-02	0.622890E-03	0.450005
209	0.000000E+00	0.465238E-02	-0.171219E-03	-0.994411E-02	0.720960E-03	-0.375010
210	0.445994E-01	0.329076E-02	0.394987E-03	-0.112496E-01	-0.395048E-01	-0.265148
211	0.630684E-01	-0.192853E-05	0.636351E-03	0.158459E-02	-0.557568E-01	0.606004E-04
212	0.445866E-01	-0.329478E-02	0.419908E-03	0.152925E-01	-0.394316E-01	0.265179
213	0.000000E+00	-0.465767E-02	-0.120991E-03	0.209418E-01	-0.195972E-05	0.374707
214	-0.445445E-01	-0.329275E-02	-0.664838E-03	0.146917E-01	0.393976E-01	0.264778
215	-0.629900E-01	-0.124313E-15	-0.890451E-03	-0.671315E-15	0.557139E-01	-0.449742E-15
216	-0.445445E-01	0.329275E-02	-0.664838E-03	-0.146917E-01	0.393976E-01	-0.264778
217	0.000000E+00	0.465767E-02	-0.120991E-03	-0.209418E-01	-0.195972E-05	-0.374707
218	0.445866E-01	0.329478E-02	0.419908E-03	-0.152925E-01	-0.394316E-01	-0.265179
219	0.630684E-01	0.192853E-05	0.636351E-03	-0.158459E-02	-0.557568E-01	-0.606004E-04
220	0.445994E-01	-0.329076E-02	0.394987E-03	0.112496E-01	-0.395048E-01	0.265148
221	0.000000E+00	-0.465238E-02	-0.171219E-03	0.994411E-02	0.720960E-03	0.375010
222	0.000000E+00	0.360032E-02	-0.191312E-03	-0.110409E-01	0.794026E-03	-0.290201

NODE	UX	UY	UZ	ROTX	ROTY	ROTZ

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NODE	UX	UY	UZ	ROTX	ROTY	ROTZ
223	0.345131E-01	0.254663E-02	0.436571E-03	-0.124883E-01	-0.438107E-01	-0.205184
224	0.488052E-01	-0.141928E-05	0.704212E-03	0.175683E-02	-0.618309E-01	0.475588E-04
225	0.345031E-01	-0.254959E-02	0.464144E-03	0.169700E-01	-0.437269E-01	0.205208
226	0.000000E+00	-0.360426E-02	-0.135731E-03	0.232379E-01	-0.216161E-05	0.289962
227	-0.344699E-01	-0.254804E-02	-0.738859E-03	0.163018E-01	0.436885E-01	0.204892
228	-0.487434E-01	-0.903010E-16	-0.989063E-03	-0.426209E-15	0.617818E-01	-0.741531E-15
229	-0.344699E-01	0.254804E-02	-0.738859E-03	-0.163018E-01	0.436885E-01	-0.204892
230	0.000000E+00	0.360426E-02	-0.135731E-03	-0.232379E-01	-0.216161E-05	-0.289962
231	0.345031E-01	0.254959E-02	0.464144E-03	-0.169700E-01	-0.437269E-01	-0.205208
232	0.488052E-01	0.141928E-05	0.704212E-03	-0.175683E-02	-0.618309E-01	-0.475588E-04
233	0.345131E-01	-0.254663E-02	0.436571E-03	0.124883E-01	-0.438107E-01	0.205184
234	0.000000E+00	-0.360032E-02	-0.191312E-03	0.110409E-01	0.794026E-03	0.290201
235	0.000000E+00	0.245396E-02	-0.206145E-03	-0.118797E-01	0.873855E-03	-0.197805
236	0.235244E-01	0.173579E-02	0.467061E-03	-0.133990E-01	-0.469537E-01	-0.139858
237	0.332658E-01	-0.926055E-06	0.753990E-03	0.190092E-02	-0.662786E-01	0.341939E-04
238	0.235172E-01	-0.173771E-02	0.496597E-03	0.182458E-01	-0.468732E-01	0.139874
239	0.000000E+00	-0.245655E-02	-0.146534E-03	0.249815E-01	-0.280647E-05	0.197640
240	-0.234941E-01	-0.173666E-02	-0.793140E-03	0.175245E-01	0.468290E-01	0.139654
241	-0.332227E-01	-0.609933E-16	-0.106138E-02	-0.148553E-15	0.662228E-01	-0.118140E-15
242	-0.234941E-01	0.173666E-02	-0.793140E-03	-0.175245E-01	0.468290E-01	-0.139654
243	0.000000E+00	0.245655E-02	-0.146534E-03	-0.249815E-01	-0.280647E-05	-0.197640
244	0.235172E-01	0.173771E-02	0.496597E-03	-0.182458E-01	-0.468732E-01	-0.139874
245	0.332658E-01	0.926055E-06	0.753990E-03	-0.190092E-02	-0.662786E-01	-0.341939E-04
246	0.235244E-01	-0.173579E-02	0.467061E-03	0.133990E-01	-0.469537E-01	0.139858
247	0.000000E+00	-0.245396E-02	-0.206145E-03	0.118797E-01	0.873855E-03	0.197805
248	0.000000E+00	0.124320E-02	-0.215198E-03	-0.125649E-01	0.812465E-03	-0.100127
249	0.119168E-01	0.879370E-03	0.485667E-03	-0.139589E-01	-0.489424E-01	-0.707882E-01
250	0.168517E-01	-0.456393E-06	0.784375E-03	0.197505E-02	-0.690562E-01	0.165314E-04
251	0.119133E-01	-0.880327E-03	0.516411E-03	0.189963E-01	-0.488348E-01	0.707988E-01
252	0.000000E+00	-0.124450E-02	-0.153126E-03	0.260048E-01	-0.313112E-05	0.100039
253	-0.119017E-01	-0.879802E-03	-0.826274E-03	0.182425E-01	0.487867E-01	0.706882E-01
254	-0.168300E-01	-0.302620E-16	-0.110552E-02	-0.411739E-15	0.689910E-01	-0.188181E-15
255	-0.119017E-01	0.879802E-03	-0.826274E-03	-0.182425E-01	0.487867E-01	-0.706882E-01
256	0.000000E+00	0.124450E-02	-0.153126E-03	-0.260048E-01	-0.313112E-05	-0.100039
257	0.119133E-01	0.880327E-03	0.516411E-03	-0.189963E-01	-0.488348E-01	-0.707988E-01
258	0.168517E-01	0.456393E-06	0.784375E-03	-0.197505E-02	-0.690562E-01	-0.165314E-04
259	0.119168E-01	-0.879370E-03	0.485667E-03	0.139589E-01	-0.489424E-01	0.707882E-01
260	0.000000E+00	-0.124320E-02	-0.215198E-03	0.125649E-01	0.812465E-03	0.100127
261	0.000000E+00	0.000000E+00	-0.218198E-03	-0.129060E-01	0.110012E-02	-0.130600E-02
262	0.000000E+00	0.000000E+00	0.491913E-03	-0.151179E-01	-0.495644E-01	-0.955437E-03
263	0.000000E+00	0.000000E+00	0.794590E-03	0.204005E-02	-0.699688E-01	0.116715E-04
264	0.000000E+00	0.000000E+00	0.523074E-03	0.204084E-01	-0.494822E-01	0.933513E-03
265	0.000000E+00	0.000000E+00	-0.155341E-03	0.279781E-01	-0.269226E-05	0.131689E-02
266	0.000000E+00	0.000000E+00	-0.837412E-03	0.196314E-01	0.494353E-01	0.928299E-03
267	0.000000E+00	0.000000E+00	-0.112036E-02	-0.466971E-16	0.699081E-01	-0.139816E-17
268	0.000000E+00	0.000000E+00	-0.837412E-03	-0.196314E-01	0.494353E-01	-0.928299E-03
269	0.000000E+00	0.000000E+00	-0.155341E-03	-0.279781E-01	-0.269226E-05	-0.131689E-02
270	0.000000E+00	0.000000E+00	0.523074E-03	-0.204084E-01	-0.494822E-01	-0.933513E-03
271	0.000000E+00	0.000000E+00	0.794590E-03	-0.204005E-02	-0.699688E-01	-0.116715E-04
272	0.000000E+00	0.000000E+00	0.491913E-03	0.151179E-01	-0.495644E-01	0.955437E-03
273	0.000000E+00	0.000000E+00	-0.218198E-03	0.129060E-01	0.110012E-02	0.130600E-02

MAXIMUMS

NODE	133	143	267	5	263	131
VALUE	0.104417	-0.770822E-02	-0.112036E-02	-0.290977E-01	-0.699688E-01	-0.620899

INTEGER STORAGE REQUIREMENTS FOR BACK SUBSTITUTION CP= 429.020 TIME= 8.12836
FIXED DATA = 2180 TEMPORARY DATA = 3290 TOTAL= 5470
FIXED AVAIL= 2251500 TEMPORARY AVAIL= 2251500 TOTAL AVAIL= 2251500

ANSYS - ENGINEERING ANALYSIS SYSTEM REVISION 4.4 A 1 40195-PC/L1-4.4A MAY 1,1990

FOR SUPPORT CALL PHONE TWX

MODAL ANALYSIS OF GUIDEWAY SHEET 8.1412 MAY 12,1992 CP= 475.270

***** EXPANDED MODE SHAPE FOR MODE 5 LOAD STEP 1 ***** FREQUENCY = 229.803 (CYCLES/TIME)

NOTE - ALL DISPLACEMENTS ARE IN NODAL COORDINATE SYSTEMS. SOME NODAL COORD. SYSTEMS MAY NOT
BE PARALLEL TO THE GLOBAL CARTESIAN SYSTEM. SEE NODE LOCATION PRINTOUT FOR ROTATION ANGLES.

NODE	UX	UY	UZ	ROTX	ROTY	ROTZ
1	0.000000E+00	0.000000E+00	0.000000E+00	0.114471E-01	-0.243769E-02	-0.157754E-02
2	0.000000E+00	0.000000E+00	0.000000E+00	0.161109E-01	0.421963E-01	-0.101233E-02
3	0.000000E+00	0.000000E+00	0.000000E+00	-0.162886E-01	0.553802E-01	0.418491E-03
4	0.000000E+00	0.000000E+00	0.000000E+00	-0.408925E-01	0.344747E-01	0.179859E-02
5	0.000000E+00	0.000000E+00	0.000000E+00	-0.225653E-01	0.241755E-02	0.799221E-03
6	0.000000E+00	0.000000E+00	0.000000E+00	0.117672E-01	-0.777447E-02	-0.829139E-03
7	0.000000E+00	0.000000E+00	0.000000E+00	0.218253E-01	0.256144E-13	-0.807232E-03
8	0.000000E+00	0.000000E+00	0.000000E+00	0.117672E-01	0.777447E-02	-0.829139E-03
9	0.000000E+00	0.000000E+00	0.000000E+00	-0.225653E-01	-0.241755E-02	0.799221E-03
10	0.000000E+00	0.000000E+00	0.000000E+00	-0.408925E-01	-0.344747E-01	0.179859E-02
11	0.000000E+00	0.000000E+00	0.000000E+00	-0.162886E-01	-0.553802E-01	0.418491E-03
12	0.000000E+00	0.000000E+00	0.000000E+00	0.161109E-01	-0.421963E-01	-0.101233E-02
13	0.000000E+00	0.000000E+00	0.000000E+00	0.114471E-01	0.243769E-02	-0.157754E-02
14	0.000000E+00	0.137924E-02	0.975369E-03	0.961419E-02	-0.138902E-02	-0.916286E-01
15	0.107280E-01	0.993338E-03	0.950721E-05	0.111760E-01	0.478009E-01	-0.594763E-01
16	0.140443E-01	0.326470E-03	-0.369243E-03	-0.158149E-01	0.626338E-01	0.116538E-01
17	0.841145E-02	-0.242970E-03	-0.354078E-03	-0.363449E-01	0.390943E-01	0.638698E-01
18	0.000000E+00	-0.429214E-03	-0.153435E-03	-0.186461E-01	0.306724E-02	0.460636E-01
19	-0.234888E-02	-0.337065E-03	-0.252135E-04	0.125937E-01	-0.840022E-02	-0.416910E-02
20	0.567156E-14	-0.264165E-03	-0.941953E-16	0.211502E-01	0.191286E-13	-0.234414E-01
21	0.234888E-02	-0.337065E-03	0.252135E-04	0.125937E-01	0.840022E-02	-0.416910E-02
22	0.000000E+00	-0.429214E-03	0.153435E-03	-0.186461E-01	-0.306724E-02	0.460636E-01
23	-0.841145E-02	-0.242970E-03	0.354078E-03	-0.363449E-01	-0.390943E-01	0.638698E-01
24	-0.140443E-01	0.326470E-03	0.369243E-03	-0.158149E-01	-0.626338E-01	0.116538E-01
25	-0.107280E-01	0.993338E-03	-0.950721E-05	0.111760E-01	-0.478009E-01	-0.594763E-01
26	0.000000E+00	0.137924E-02	-0.975369E-03	0.961419E-02	0.138902E-02	-0.916286E-01
27	0.000000E+00	0.338283E-02	0.127741E-02	0.673590E-02	-0.106260E-02	-0.200464
28	0.234951E-01	0.265389E-02	0.123916E-03	0.677308E-02	0.553595E-01	-0.129952
29	0.307182E-01	0.100593E-02	-0.524616E-03	-0.165622E-01	0.728760E-01	0.258010E-01
30	0.183955E-01	-0.450067E-03	-0.558523E-03	-0.349245E-01	0.457819E-01	0.139789
31	0.000000E+00	-0.962063E-03	-0.290777E-03	-0.154666E-01	0.392696E-02	0.100291
32	-0.504258E-02	-0.773779E-03	-0.807682E-04	0.155792E-01	-0.934181E-02	-0.915660E-02
33	0.896876E-14	-0.608376E-03	-0.509628E-16	0.221625E-01	0.893410E-14	-0.503575E-01
34	0.504258E-02	-0.773779E-03	0.807682E-04	0.155792E-01	0.934181E-02	-0.915660E-02
35	0.000000E+00	-0.962063E-03	0.290777E-03	-0.154666E-01	-0.392696E-02	0.100291
36	-0.183955E-01	-0.450067E-03	0.558523E-03	-0.349245E-01	-0.457819E-01	0.139789
37	-0.307182E-01	0.100593E-02	0.524616E-03	-0.165622E-01	-0.728760E-01	0.258010E-01
38	-0.234951E-01	0.265389E-02	-0.123916E-03	0.677308E-02	-0.553595E-01	-0.129952
39	0.000000E+00	0.338283E-02	-0.127741E-02	0.673590E-02	0.106260E-02	-0.200464
40	0.000000E+00	0.554454E-02	0.136768E-02	0.563893E-02	-0.135523E-02	-0.318165
41	0.373357E-01	0.440375E-02	0.158406E-03	0.688976E-02	0.569549E-01	-0.206798
42	0.489255E-01	0.177960E-02	-0.538969E-03	-0.170736E-01	0.751950E-01	0.403344E-01
43	0.293690E-01	-0.595227E-03	-0.623699E-03	-0.361083E-01	0.473358E-01	0.222658
44	0.000000E+00	-0.147025E-02	-0.355439E-03	-0.156737E-01	0.398144E-02	0.159579
45	-0.794215E-02	-0.120999E-02	-0.118814E-03	0.164679E-01	-0.964222E-02	-0.146266E-01
46	0.985963E-14	-0.960997E-03	0.653286E-16	0.229435E-01	-0.304544E-14	-0.791737E-01
47	0.794215E-02	-0.120999E-02	0.118814E-03	0.164679E-01	0.964222E-02	-0.146266E-01
48	0.000000E+00	-0.147025E-02	0.355439E-03	-0.156737E-01	-0.398144E-02	0.159579
49	-0.293690E-01	-0.595227E-03	0.623699E-03	-0.361083E-01	-0.473358E-01	0.222658

50	-0.489255E-01	0.177960E-02	0.538969E-03	-0.170736E-01	-0.751950E-01	0.403344E-01
51	-0.373357E-01	0.440375E-02	-0.158406E-03	0.688976E-02	-0.569549E-01	-0.206798

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NODE	UX	UY	UZ	ROTX	ROTY	ROTZ

NOTE - ALL DISPLACEMENTS ARE IN NODAL COORDINATE SYSTEMS. SOME NODAL COORD. SYSTEMS MAY NOT BE PARALLEL TO THE GLOBAL CARTESIAN SYSTEM. SEE NODE LOCATION PRINTOUT FOR ROTATION ANGLES.

52	0.000000E+00	0.554454E-02	-0.136768E-02	0.563893E-02	0.135523E-02	-0.318165
53	0.000000E+00	0.768079E-02	0.133321E-02	0.566580E-02	-0.139363E-02	-0.434607
54	0.510200E-01	0.613288E-02	0.169645E-03	0.751648E-02	0.544111E-01	-0.282706
55	0.669079E-01	0.253727E-02	-0.517998E-03	-0.164968E-01	0.717125E-01	0.547766E-01
56	0.402029E-01	-0.727198E-03	-0.610330E-03	-0.357520E-01	0.450731E-01	0.304550
57	0.000000E+00	-0.194718E-02	-0.360573E-03	-0.159734E-01	0.374241E-02	0.218181
58	-0.108130E-01	-0.161008E-02	-0.127400E-03	0.157301E-01	-0.925222E-02	-0.200361E-01
59	0.724611E-14	-0.127757E-02	0.177280E-15	0.223421E-01	-0.183255E-13	-0.107698
60	0.108130E-01	-0.161008E-02	0.127400E-03	0.157301E-01	0.925222E-02	-0.200361E-01
61	0.000000E+00	-0.194718E-02	0.360573E-03	-0.159734E-01	-0.374241E-02	0.218181
62	-0.402029E-01	-0.727198E-03	0.610330E-03	-0.357520E-01	-0.450731E-01	0.304550
63	-0.669079E-01	0.253727E-02	0.517998E-03	-0.164968E-01	-0.717125E-01	0.547766E-01
64	-0.510200E-01	0.613288E-02	-0.169645E-03	0.751648E-02	-0.544111E-01	-0.282706
65	0.000000E+00	0.768079E-02	-0.133321E-02	0.566580E-02	0.139363E-02	-0.434607
66	0.000000E+00	0.966753E-02	0.122183E-02	0.555514E-02	-0.129370E-02	-0.542860
67	0.637383E-01	0.773741E-02	0.164331E-03	0.725048E-02	0.492452E-01	-0.353218
68	0.836077E-01	0.324241E-02	-0.465803E-03	-0.151816E-01	0.648682E-01	0.683107E-01
69	0.502511E-01	-0.845769E-03	-0.556777E-03	-0.330200E-01	0.407408E-01	0.380608
70	0.000000E+00	-0.237928E-02	-0.332287E-03	-0.150208E-01	0.337267E-02	0.272611
71	-0.134899E-01	-0.196547E-02	-0.119509E-03	0.141084E-01	-0.840632E-02	-0.250413E-01
72	0.149860E-14	-0.155310E-02	0.233051E-15	0.203836E-01	-0.269559E-13	-0.134302
73	0.134899E-01	-0.196547E-02	0.119509E-03	0.141084E-01	0.840632E-02	-0.250413E-01
74	0.000000E+00	-0.237928E-02	0.332287E-03	-0.150208E-01	-0.337267E-02	0.272611
75	-0.502511E-01	-0.845769E-03	0.556777E-03	-0.330200E-01	-0.407408E-01	0.380608
76	-0.836077E-01	0.324241E-02	0.465803E-03	-0.151816E-01	-0.648682E-01	0.683107E-01
77	-0.637383E-01	0.773741E-02	-0.164331E-03	0.725048E-02	-0.492452E-01	-0.353218
78	0.000000E+00	0.966753E-02	-0.122183E-02	0.555514E-02	0.129370E-02	-0.542860
79	0.000000E+00	0.114202E-01	0.105885E-02	0.500524E-02	-0.112111E-02	-0.638327
80	0.749528E-01	0.915222E-02	0.150053E-03	0.642295E-02	0.422142E-01	-0.415370
81	0.983269E-01	0.386488E-02	-0.394400E-03	-0.131493E-01	0.555904E-01	0.802881E-01
82	0.591040E-01	-0.946268E-03	-0.475750E-03	-0.286391E-01	0.349024E-01	0.447643
83	0.000000E+00	-0.275374E-02	-0.285368E-03	-0.131781E-01	0.288353E-02	0.320605
84	-0.158557E-01	-0.226996E-02	-0.102992E-03	0.119891E-01	-0.722304E-02	-0.294414E-01
85	-0.489187E-14	-0.178623E-02	0.208545E-15	0.175168E-01	-0.235574E-13	-0.157820
86	0.158557E-01	-0.226996E-02	0.102992E-03	0.119891E-01	0.722304E-02	-0.294414E-01
87	0.000000E+00	-0.275374E-02	0.285368E-03	-0.131781E-01	-0.288353E-02	0.320605
88	-0.591040E-01	-0.946268E-03	0.475750E-03	-0.286391E-01	-0.349024E-01	0.447643
89	-0.983269E-01	0.386488E-02	0.394400E-03	-0.131493E-01	-0.555904E-01	0.802881E-01
90	-0.749528E-01	0.915222E-02	-0.150053E-03	0.642295E-02	-0.422142E-01	-0.415370
91	0.000000E+00	0.114202E-01	-0.105885E-02	0.500524E-02	0.112111E-02	-0.638327
92	0.000000E+00	0.128786E-01	0.859528E-03	0.411452E-02	-0.902656E-03	-0.717648
93	0.842701E-01	0.103295E-01	0.129631E-03	0.522631E-02	0.338004E-01	-0.466999
94	0.110554	0.438445E-02	-0.309097E-03	-0.105978E-01	0.445041E-01	0.902590E-01
95	0.664559E-01	-0.102631E-02	-0.376830E-03	-0.230928E-01	0.279368E-01	0.503327
96	0.000000E+00	-0.306003E-02	-0.226238E-03	-0.107044E-01	0.230581E-02	0.360480
97	-0.178236E-01	-0.251730E-02	-0.815159E-04	0.953440E-02	-0.578991E-02	-0.330903E-01
98	-0.931296E-14	-0.197390E-02	0.107807E-15	0.140260E-01	-0.122455E-13	-0.177385
99	0.178236E-01	-0.251730E-02	0.815159E-04	0.953440E-02	0.578991E-02	-0.330903E-01
100	0.000000E+00	-0.306003E-02	0.226238E-03	-0.107044E-01	-0.230581E-02	0.360480
101	-0.664559E-01	-0.102631E-02	0.376830E-03	-0.230928E-01	-0.279368E-01	0.503327
102	-0.110554	0.438445E-02	0.309097E-03	-0.105978E-01	-0.445041E-01	0.902590E-01
103	-0.842701E-01	0.103295E-01	-0.129631E-03	0.522631E-02	-0.338004E-01	-0.466999
104	0.000000E+00	0.128786E-01	-0.859528E-03	0.411452E-02	0.902656E-03	-0.717648
105	0.000000E+00	0.139981E-01	0.633885E-03	0.299514E-02	-0.652340E-03	-0.778342
106	0.913992E-01	0.112337E-01	0.105026E-03	0.378564E-02	0.243724E-01	-0.506498
107	0.119908	0.478558E-02	-0.214032E-03	-0.768153E-02	0.320883E-01	0.978969E-01
108	0.720801E-01	-0.108350E-02	-0.265415E-03	-0.167261E-01	0.201413E-01	0.545930

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NODE	UX	UY	UZ	ROTX	ROTY	ROTZ

NOTE - ALL DISPLACEMENTS ARE IN NODAL COORDINATE SYSTEMS. SOME NODAL COORD. SYSTEMS MAY NOT BE PARALLEL TO THE GLOBAL CARTESIAN SYSTEM. SEE NODE LOCATION PRINTOUT FOR ROTATION ANGLES.

NODE	UX	UY	UZ	ROTX	ROTY	ROTZ
109	0.000000E+00	-0.328990E-02	-0.159135E-03	-0.779060E-02	0.166168E-02	0.390992
110	-0.193302E-01	-0.270170E-02	-0.568250E-04	0.683408E-02	-0.417710E-02	-0.358786E-01
111	-0.105837E-13	-0.211253E-02	-0.425094E-16	0.100963E-01	0.176001E-14	-0.192362
112	0.193302E-01	-0.270170E-02	0.568250E-04	0.683408E-02	0.417710E-02	-0.358786E-01
113	0.000000E+00	-0.328990E-02	0.159135E-03	-0.779060E-02	-0.166168E-02	0.390992
114	-0.720801E-01	-0.108350E-02	0.265415E-03	-0.167261E-01	-0.201413E-01	0.545930
115	-0.119908	0.478558E-02	0.214032E-03	-0.768153E-02	-0.320883E-01	0.978969E-01
116	-0.913992E-01	0.112337E-01	-0.105026E-03	0.378564E-02	-0.243724E-01	-0.506498
117	0.000000E+00	0.139981E-01	-0.633885E-03	0.299514E-02	0.652340E-03	-0.778342
118	0.000000E+00	0.147463E-01	0.390137E-03	0.173316E-02	-0.381513E-03	-0.818627
119	0.961314E-01	0.118390E-01	0.775150E-04	0.219230E-02	0.142448E-01	-0.532714
120	0.126117	0.505701E-02	-0.112399E-03	-0.452145E-02	0.187540E-01	0.102971
121	0.758130E-01	-0.111616E-02	-0.145752E-03	-0.981479E-02	0.117713E-01	0.574210
122	0.000000E+00	-0.343703E-02	-0.868344E-04	-0.459193E-02	0.970990E-03	0.411248
123	-0.203305E-01	-0.281856E-02	-0.301486E-04	0.396202E-02	-0.244185E-02	-0.377263E-01
124	-0.820802E-14	-0.219895E-02	-0.194806E-15	0.587353E-02	0.182606E-13	-0.202304
125	0.203305E-01	-0.281856E-02	0.301486E-04	0.396202E-02	0.244185E-02	-0.377263E-01
126	0.000000E+00	-0.343703E-02	0.868344E-04	-0.459193E-02	-0.970990E-03	0.411248
127	-0.758130E-01	-0.111616E-02	0.145752E-03	-0.981479E-02	-0.117713E-01	0.574210
128	-0.126117	0.505701E-02	0.112399E-03	-0.452145E-02	-0.187540E-01	0.102971
129	-0.961314E-01	0.118390E-01	-0.775150E-04	0.219230E-02	-0.142448E-01	-0.532714
130	0.000000E+00	0.147463E-01	-0.390137E-03	0.173316E-02	0.381513E-03	-0.818627
131	0.000000E+00	0.151022E-01	0.135790E-03	0.393493E-03	-0.991591E-04	-0.837358
132	0.983322E-01	0.121286E-01	0.481814E-04	0.515752E-03	0.371419E-02	-0.544901
133	0.129004	0.519133E-02	-0.715766E-05	-0.122291E-02	0.489048E-02	0.105335
134	0.775491E-01	-0.112323E-02	-0.215042E-04	-0.259549E-02	0.306999E-02	0.587366
135	0.000000E+00	-0.349731E-02	-0.116905E-04	-0.123371E-02	0.253387E-03	0.420673
136	-0.207957E-01	-0.286474E-02	-0.240085E-05	0.991163E-03	-0.636379E-03	-0.385817E-01
137	-0.193921E-14	-0.223097E-02	-0.286205E-15	0.148553E-02	0.321436E-13	-0.206924
138	0.207957E-01	-0.286474E-02	0.240085E-05	0.991163E-03	0.636379E-03	-0.385817E-01
139	0.000000E+00	-0.349731E-02	0.116905E-04	-0.123371E-02	-0.253387E-03	0.420673
140	-0.775491E-01	-0.112323E-02	0.215042E-04	-0.259549E-02	-0.306999E-02	0.587366
141	-0.129004	0.519133E-02	0.715766E-05	-0.122291E-02	-0.489048E-02	0.105335
142	-0.983322E-01	0.121286E-01	-0.481814E-04	0.515752E-03	-0.371419E-02	-0.544901
143	0.000000E+00	0.151022E-01	-0.135790E-03	0.393493E-03	0.991591E-04	-0.837358
144	0.000000E+00	0.150561E-01	-0.121886E-03	-0.972395E-03	0.186467E-03	-0.834000
145	0.979387E-01	0.120945E-01	0.180165E-04	-0.118686E-02	-0.692780E-02	-0.542715
146	0.128488	0.518501E-02	0.988429E-04	0.211648E-02	-0.911926E-02	0.104919
147	0.772390E-01	-0.110429E-02	0.103853E-03	0.471524E-02	-0.572271E-02	0.585024
148	0.000000E+00	-0.346889E-02	0.641489E-04	0.217504E-02	-0.471596E-03	0.418997
149	-0.207124E-01	-0.283887E-02	0.255998E-04	-0.200315E-02	0.118866E-02	-0.384206E-01
150	0.623346E-14	-0.220764E-02	-0.263549E-15	-0.294626E-02	0.319093E-13	-0.206088
151	0.207124E-01	-0.283887E-02	-0.255998E-04	-0.200315E-02	-0.118866E-02	-0.384206E-01
152	0.000000E+00	-0.346889E-02	-0.641489E-04	0.217504E-02	0.471596E-03	0.418997
153	-0.772390E-01	-0.110429E-02	-0.103853E-03	0.471524E-02	0.572271E-02	0.585024
154	-0.128488	0.518501E-02	-0.988429E-04	0.211648E-02	0.911926E-02	0.104919
155	-0.979387E-01	0.120945E-01	-0.180165E-04	-0.118686E-02	0.692780E-02	-0.542715
156	0.000000E+00	0.150561E-01	0.121886E-03	-0.972395E-03	-0.186467E-03	-0.834000
157	0.000000E+00	0.146090E-01	-0.375763E-03	-0.232075E-02	0.467488E-03	-0.808621
158	0.949589E-01	0.117376E-01	-0.120305E-04	-0.286463E-02	-0.173938E-01	-0.526198
159	0.124579	0.503837E-02	0.202812E-03	0.540351E-02	-0.228972E-01	0.101731
160	0.748892E-01	-0.105957E-02	0.226955E-03	0.119119E-01	-0.143698E-01	0.567231
161	0.000000E+00	-0.335224E-02	0.138627E-03	0.553440E-02	-0.118450E-02	0.406255
162	-0.200822E-01	-0.274138E-02	0.530880E-04	-0.494388E-02	0.298373E-02	-0.372465E-01
163	0.121952E-13	-0.212936E-02	-0.127243E-15	-0.730290E-02	0.149147E-13	-0.199812
164	0.200822E-01	-0.274138E-02	-0.530880E-04	-0.494388E-02	-0.298373E-02	-0.372465E-01
165	0.000000E+00	-0.335224E-02	-0.138627E-03	0.553440E-02	0.118450E-02	0.406255

LS-45

NOTE - ALL DISPLACEMENTS ARE IN NODAL COORDINATE SYSTEMS. SOME NODAL COORD. SYSTEMS MAY NOT BE PARALLEL TO THE GLOBAL CARTESIAN SYSTEM. SEE NODE LOCATION PRINTOUT FOR ROTATION ANGLES.

NODE	UX	UY	UZ	ROTX	ROTY	ROTZ
166	-0.748892E-01	-0.105957E-02	-0.226955E-03	0.119119E-01	0.143698E-01	0.567231
167	-0.124579	0.503837E-02	-0.202812E-03	0.540351E-02	0.228972E-01	0.101731
168	-0.949589E-01	0.117376E-01	0.120305E-04	-0.286463E-02	0.173938E-01	-0.526198
169	0.000000E+00	0.146090E-01	0.375763E-03	-0.232075E-02	-0.467488E-03	-0.808621
170	0.000000E+00	0.137729E-01	-0.618926E-03	-0.361245E-02	0.736299E-03	-0.761879
171	0.894704E-01	0.110674E-01	-0.410485E-04	-0.447065E-02	-0.274043E-01	-0.495781
172	0.117379	0.475550E-02	0.302043E-03	0.854887E-02	-0.360753E-01	0.958546E-01
173	0.705607E-01	-0.989979E-03	0.344549E-03	0.187986E-01	-0.226403E-01	0.534450
174	0.000000E+00	-0.315013E-02	0.209770E-03	0.875085E-02	-0.186632E-02	0.382778
175	-0.189215E-01	-0.257457E-02	0.793349E-04	-0.775440E-02	0.470076E-02	-0.350898E-01
176	0.129302E-13	-0.199793E-02	0.591040E-16	-0.114686E-01	-0.896268E-14	-0.188259
177	0.189215E-01	-0.257457E-02	-0.793349E-04	-0.775440E-02	-0.470076E-02	-0.350898E-01
178	0.000000E+00	-0.315013E-02	-0.209770E-03	0.875085E-02	0.186632E-02	0.382778
179	-0.705607E-01	-0.989979E-03	-0.344549E-03	0.187986E-01	0.226403E-01	0.534450
180	-0.117379	0.475550E-02	-0.302043E-03	0.854887E-02	0.360753E-01	0.958546E-01
181	-0.894704E-01	0.110674E-01	0.410485E-04	-0.447065E-02	0.274043E-01	-0.495781
182	0.000000E+00	0.137729E-01	0.618926E-03	-0.361245E-02	-0.736299E-03	-0.761879
183	0.000000E+00	0.125700E-01	-0.844798E-03	-0.481197E-02	0.985844E-03	-0.695004
184	0.816174E-01	0.101021E-01	-0.681758E-04	-0.596121E-02	-0.366930E-01	-0.452262
185	0.107076	0.434416E-02	0.393963E-03	0.114683E-01	-0.483031E-01	0.874437E-01
186	0.643675E-01	-0.897016E-03	0.453553E-03	0.251905E-01	-0.303145E-01	0.487543
187	0.000000E+00	-0.286756E-02	0.275712E-03	0.117372E-01	-0.249904E-02	0.349184
188	-0.172607E-01	-0.234251E-02	0.103654E-03	-0.103610E-01	0.629397E-02	-0.320070E-01
189	0.840532E-14	-0.181648E-02	0.210709E-15	-0.153331E-01	-0.259343E-13	-0.171732
190	0.172607E-01	-0.234251E-02	-0.103654E-03	-0.103610E-01	-0.629397E-02	-0.320070E-01
191	0.000000E+00	-0.286756E-02	-0.275712E-03	0.117372E-01	0.249904E-02	0.349184
192	-0.643675E-01	-0.897016E-03	-0.453553E-03	0.251905E-01	0.303145E-01	0.487543
193	-0.107076	0.434416E-02	-0.393963E-03	0.114683E-01	0.483031E-01	0.874437E-01
194	-0.816174E-01	0.101021E-01	0.681758E-04	-0.596121E-02	0.366930E-01	-0.452262
195	0.000000E+00	0.125700E-01	0.844798E-03	-0.481197E-02	-0.985844E-03	-0.695004
196	0.000000E+00	0.110324E-01	-0.104730E-02	-0.588703E-02	0.120890E-02	-0.609759
197	0.716069E-01	0.886722E-02	-0.926172E-04	-0.729747E-02	-0.450136E-01	-0.396790
198	0.939432E-01	0.381554E-02	0.476192E-03	0.140834E-01	-0.592564E-01	0.767203E-01
199	0.564728E-01	-0.782789E-03	0.551115E-03	0.309171E-01	-0.371884E-01	0.427747
200	0.000000E+00	-0.251164E-02	0.334732E-03	0.144139E-01	-0.306541E-02	0.306358
201	-0.151436E-01	-0.205099E-02	0.125416E-03	-0.126942E-01	0.772130E-02	-0.280794E-01
202	0.140037E-14	-0.158948E-02	0.273844E-15	-0.187930E-01	-0.297997E-13	-0.150666
203	0.151436E-01	-0.205099E-02	-0.125416E-03	-0.126942E-01	-0.772130E-02	-0.280794E-01
204	0.000000E+00	-0.251164E-02	-0.334732E-03	0.144139E-01	0.306541E-02	0.306358
205	-0.564728E-01	-0.782789E-03	-0.551115E-03	0.309171E-01	0.371884E-01	0.427747
206	-0.939432E-01	0.381554E-02	-0.476192E-03	0.140834E-01	0.592564E-01	0.767203E-01
207	-0.716069E-01	0.886722E-02	0.926172E-04	-0.729747E-02	0.450136E-01	-0.396790
208	0.000000E+00	0.110324E-01	0.104730E-02	-0.588703E-02	-0.120890E-02	-0.609759
209	0.000000E+00	0.920114E-02	-0.122098E-02	-0.681204E-02	0.140225E-02	-0.508393
210	0.597032E-01	0.739588E-02	-0.113667E-03	-0.843954E-02	-0.521443E-01	-0.330827
211	0.783264E-01	0.318398E-02	0.546596E-03	0.163286E-01	-0.686450E-01	0.639680E-01
212	0.470849E-01	-0.649944E-03	0.634697E-03	0.358292E-01	-0.430817E-01	0.356641
213	0.000000E+00	-0.209140E-02	0.385302E-03	0.167105E-01	-0.355260E-02	0.255431
214	-0.126262E-01	-0.170735E-02	0.144064E-03	-0.146939E-01	0.894371E-02	-0.234102E-01
215	-0.531883E-14	-0.132256E-02	0.234576E-15	-0.217592E-01	-0.246045E-13	-0.125619
216	0.126262E-01	-0.170735E-02	-0.144064E-03	-0.146939E-01	-0.894371E-02	-0.234102E-01
217	0.000000E+00	-0.209140E-02	-0.385302E-03	0.167105E-01	0.355260E-02	0.255431
218	-0.470849E-01	-0.649944E-03	-0.634697E-03	0.358292E-01	0.430817E-01	0.356641
219	-0.783264E-01	0.318398E-02	-0.546596E-03	0.163286E-01	0.686450E-01	0.639680E-01
220	-0.597032E-01	0.739588E-02	0.113667E-03	-0.843954E-02	0.521443E-01	-0.330827
221	0.000000E+00	0.920114E-02	0.122098E-02	-0.681204E-02	-0.140225E-02	-0.508393
222	0.000000E+00	0.712490E-02	-0.136122E-02	-0.756566E-02	0.154683E-02	-0.393586

NOTE - ALL DISPLACEMENTS ARE IN NODAL COORDINATE SYSTEMS. SOME NODAL COORD. SYSTEMS MAY NOT BE PARALLEL TO THE GLOBAL CARTESIAN SYSTEM. SEE NODE LOCATION PRINTOUT FOR ROTATION ANGLES.

NODE	UX	UY	UZ	ROTX	ROTY	ROTZ
223	0.462207E-01	0.572732E-02	-0.130733E-03	-0.937919E-02	-0.579022E-01	-0.256117
224	0.606384E-01	0.246653E-02	0.603389E-03	0.181317E-01	-0.762185E-01	0.495229E-01
225	0.364520E-01	-0.501635E-03	0.702147E-03	0.397899E-01	-0.478313E-01	0.276104
226	0.000000E+00	-0.161759E-02	0.426110E-03	0.185722E-01	-0.393856E-02	0.197749
227	-0.977487E-02	-0.132026E-02	0.159110E-03	-0.162928E-01	0.993419E-02	-0.181231E-01
228	-0.992661E-14	-0.102236E-02	0.112079E-15	-0.241405E-01	-0.118570E-13	-0.972502E-01
229	0.977487E-02	-0.132026E-02	-0.159110E-03	-0.162928E-01	-0.993419E-02	-0.181231E-01
230	0.000000E+00	-0.161759E-02	-0.426110E-03	0.185722E-01	0.393856E-02	0.197749
231	-0.364520E-01	-0.501635E-03	-0.702147E-03	0.397899E-01	0.478313E-01	0.276104
232	-0.606384E-01	0.246653E-02	-0.603389E-03	0.181317E-01	0.762185E-01	0.495229E-01
233	-0.462207E-01	0.572732E-02	0.130733E-03	-0.937919E-02	0.579022E-01	-0.256117
234	0.000000E+00	0.712490E-02	0.136122E-02	-0.756566E-02	-0.154683E-02	-0.393586
235	0.000000E+00	0.485881E-02	-0.146445E-02	-0.813665E-02	0.170473E-02	-0.268383
236	0.315175E-01	0.390588E-02	-0.143280E-03	-0.100633E-01	-0.620988E-01	-0.174648
237	0.413485E-01	0.168247E-02	0.645133E-03	0.195072E-01	-0.817614E-01	0.337746E-01
238	0.248557E-01	-0.341388E-03	0.751695E-03	0.428102E-01	-0.513256E-01	0.188275
239	0.000000E+00	-0.110227E-02	0.456063E-03	0.199838E-01	-0.425068E-02	0.134844
240	-0.666548E-02	-0.899496E-03	0.170125E-03	-0.175122E-01	0.106443E-01	-0.123575E-01
241	-0.106351E-13	-0.696355E-03	-0.508510E-16	-0.259333E-01	0.661002E-14	-0.663187E-01
242	0.666548E-02	-0.899496E-03	-0.170125E-03	-0.175122E-01	-0.106443E-01	-0.123575E-01
243	0.000000E+00	-0.110227E-02	-0.456063E-03	0.199838E-01	0.425068E-02	0.134844
244	-0.248557E-01	-0.341388E-03	-0.751695E-03	0.428102E-01	0.513256E-01	0.188275
245	-0.413485E-01	0.168247E-02	-0.645133E-03	0.195072E-01	0.817614E-01	0.337746E-01
246	-0.315175E-01	0.390588E-02	0.143280E-03	-0.100633E-01	0.620988E-01	-0.174648
247	0.000000E+00	0.485881E-02	0.146445E-02	-0.813665E-02	-0.170473E-02	-0.268383
248	0.000000E+00	0.246252E-02	-0.152780E-02	-0.867897E-02	0.160566E-02	-0.135886
249	0.159718E-01	0.197962E-02	-0.150958E-03	-0.103718E-01	-0.648217E-01	-0.884256E-01
250	0.209552E-01	0.852850E-03	0.670703E-03	0.203626E-01	-0.853128E-01	0.170608E-01
251	0.125970E-01	-0.172818E-03	0.782002E-03	0.439867E-01	-0.534999E-01	0.952973E-01
252	0.000000E+00	-0.558406E-03	0.474341E-03	0.207191E-01	-0.432769E-02	0.682686E-01
253	-0.337653E-02	-0.455650E-03	0.176840E-03	-0.177570E-01	0.111477E-01	-0.622392E-02
254	-0.683632E-14	-0.352727E-03	-0.189411E-15	-0.271143E-01	0.235976E-13	-0.334965E-01
255	0.337653E-02	-0.455650E-03	-0.176840E-03	-0.177570E-01	-0.111477E-01	-0.622392E-02
256	0.000000E+00	-0.558406E-03	-0.474341E-03	0.207191E-01	0.432769E-02	0.682686E-01
257	-0.125970E-01	-0.172818E-03	-0.782002E-03	0.439867E-01	0.534999E-01	0.952973E-01
258	-0.209552E-01	0.852850E-03	-0.670703E-03	0.203626E-01	0.853128E-01	0.170608E-01
259	-0.159718E-01	0.197962E-02	0.150958E-03	-0.103718E-01	0.648217E-01	-0.884256E-01
260	0.000000E+00	0.246252E-02	0.152780E-02	-0.867897E-02	-0.160566E-02	-0.135886
261	0.000000E+00	0.000000E+00	-0.154914E-02	-0.900206E-02	0.207970E-02	-0.215294E-02
262	0.000000E+00	0.000000E+00	-0.153558E-03	-0.117875E-01	-0.656755E-01	-0.137847E-02
263	0.000000E+00	0.000000E+00	0.679327E-03	0.213953E-01	-0.865000E-01	0.565827E-03
264	0.000000E+00	0.000000E+00	0.792210E-03	0.474805E-01	-0.542325E-01	0.262416E-02
265	0.000000E+00	0.000000E+00	0.480479E-03	0.222896E-01	-0.435498E-02	0.109167E-02
266	0.000000E+00	0.000000E+00	0.179106E-03	-0.193255E-01	0.113098E-01	-0.129200E-02
267	0.000000E+00	0.000000E+00	-0.243673E-15	-0.288665E-01	0.305736E-13	-0.108862E-02
268	0.000000E+00	0.000000E+00	-0.179106E-03	-0.193255E-01	-0.113098E-01	-0.129200E-02
269	0.000000E+00	0.000000E+00	-0.480479E-03	0.222896E-01	0.435498E-02	0.109167E-02
270	0.000000E+00	0.000000E+00	-0.792210E-03	0.474805E-01	0.542325E-01	0.262416E-02
271	0.000000E+00	0.000000E+00	-0.679327E-03	0.213953E-01	0.865000E-01	0.565827E-03
272	0.000000E+00	0.000000E+00	0.153558E-03	-0.117875E-01	0.656755E-01	-0.137847E-02
273	0.000000E+00	0.000000E+00	0.154914E-02	-0.900206E-02	-0.207970E-02	-0.215294E-02

MAXIMUMS

	UX	UY	UZ	ROTX	ROTY	ROTZ
NODE	133	131	261	270	263	131
VALUE	0.129004	0.151022E-01	-0.154914E-02	0.474805E-01	-0.865000E-01	-0.837358

LS-47

ANSYS - ENGINEERING ANALYSIS SYSTEM REVISION 4.4 A 1 40195-PC/L1-4.4A MAY 1,1990

FOR SUPPORT CALL PHONE TWX

MODAL ANALYSIS OF GUIDEWAY SHEET 8.1712 MAY 12,1992 CP= 583.310

***** EXPANDED MODE SHAPE FOR MODE 14 LOAD STEP 1 ***** FREQUENCY = 325.753 (CYCLES/TIME)

NOTE - ALL DISPLACEMENTS ARE IN NODAL COORDINATE SYSTEMS. SOME NODAL COORD. SYSTEMS MAY NOT
BE PARALLEL TO THE GLOBAL CARTESIAN SYSTEM. SEE NODE LOCATION PRINTOUT FOR ROTATION ANGLES.

NODE	UX	UY	UZ	ROTX	ROTY	ROTZ
1	0.000000E+00	0.000000E+00	0.000000E+00	-0.307784E-02	-0.239328E-02	-0.139165E-02
2	0.000000E+00	0.000000E+00	0.000000E+00	0.496341E-03	0.239323E-01	-0.678718E-03
3	0.000000E+00	0.000000E+00	0.000000E+00	-0.287649E-01	0.253593E-01	0.846813E-03
4	0.000000E+00	0.000000E+00	0.000000E+00	-0.385751E-01	0.894605E-02	0.212910E-02
5	0.000000E+00	0.000000E+00	0.000000E+00	0.923047E-02	0.393940E-02	-0.635765E-03
6	0.000000E+00	0.000000E+00	0.000000E+00	0.408720E-01	0.337540E-01	-0.267266E-02
7	0.000000E+00	0.000000E+00	0.000000E+00	0.122641E-13	0.521943E-01	-0.530886E-15
8	0.000000E+00	0.000000E+00	0.000000E+00	-0.408720E-01	0.337540E-01	0.267266E-02
9	0.000000E+00	0.000000E+00	0.000000E+00	-0.923047E-02	0.393940E-02	0.635765E-03
10	0.000000E+00	0.000000E+00	0.000000E+00	0.385751E-01	0.894605E-02	-0.212910E-02
11	0.000000E+00	0.000000E+00	0.000000E+00	0.287649E-01	0.253593E-01	-0.846813E-03
12	0.000000E+00	0.000000E+00	0.000000E+00	-0.496341E-03	0.239323E-01	0.678718E-03
13	0.000000E+00	0.000000E+00	0.000000E+00	0.307784E-02	-0.239328E-02	0.139165E-02
14	0.000000E+00	0.159830E-02	0.154149E-02	-0.446387E-02	-0.137708E-02	-0.562067E-01
15	0.636557E-02	0.123728E-02	0.523424E-03	-0.384416E-02	0.285775E-01	-0.287544E-01
16	0.670532E-02	0.833960E-03	0.755462E-04	-0.286032E-01	0.307927E-01	0.229816E-01
17	0.185036E-02	0.619786E-03	-0.125770E-03	-0.354471E-01	0.118495E-01	0.365376E-01
18	0.000000E+00	0.627286E-03	-0.310964E-03	0.111655E-01	0.465262E-02	-0.273678E-01
19	0.802921E-02	0.488951E-03	-0.606176E-03	0.408724E-01	0.358542E-01	-0.642553E-01
20	0.131416E-01	-0.248986E-15	-0.758752E-03	0.562019E-14	0.554631E-01	-0.182591E-13
21	0.802921E-02	-0.488951E-03	-0.606176E-03	-0.408724E-01	0.358542E-01	0.642553E-01
22	0.000000E+00	-0.627286E-03	-0.310964E-03	-0.111655E-01	0.465262E-02	0.273678E-01
23	0.185036E-02	-0.619786E-03	-0.125770E-03	0.354471E-01	0.118495E-01	-0.365376E-01
24	0.670532E-02	-0.833960E-03	0.755462E-04	0.286032E-01	0.307927E-01	-0.229816E-01
25	0.636557E-02	-0.123728E-02	0.523424E-03	0.384416E-02	0.285775E-01	0.287544E-01
26	0.000000E+00	-0.159830E-02	0.154149E-02	0.446387E-02	-0.137708E-02	0.562067E-01
27	0.000000E+00	0.378075E-02	0.230303E-02	-0.623450E-02	-0.125110E-02	-0.126347
28	0.143535E-01	0.326999E-02	0.105546E-02	-0.693267E-02	0.334548E-01	-0.650670E-01
29	0.152275E-01	0.232436E-02	0.220710E-03	-0.315106E-01	0.363046E-01	0.506799E-01
30	0.445169E-02	0.174768E-02	-0.222160E-03	-0.397871E-01	0.143070E-01	0.824245E-01
31	0.000000E+00	0.168515E-02	-0.611875E-03	0.111945E-01	0.609949E-02	-0.562097E-01
32	0.171314E-01	0.126521E-02	-0.108832E-02	0.444816E-01	0.436913E-01	-0.137717
33	0.281039E-01	-0.277838E-15	-0.132126E-02	-0.304664E-14	0.671287E-01	-0.260410E-13
34	0.171314E-01	-0.126521E-02	-0.108832E-02	-0.444816E-01	0.436913E-01	0.137717
35	0.000000E+00	-0.168515E-02	-0.611875E-03	-0.111945E-01	0.609949E-02	0.562097E-01
36	0.445169E-02	-0.174768E-02	-0.222160E-03	0.397871E-01	0.143070E-01	-0.824245E-01
37	0.152275E-01	-0.232436E-02	0.220710E-03	0.315106E-01	0.363046E-01	-0.506799E-01
38	0.143535E-01	-0.326999E-02	0.105546E-02	0.693267E-02	0.334548E-01	0.650670E-01
39	0.000000E+00	-0.378075E-02	0.230303E-02	0.623450E-02	-0.125110E-02	0.126347
40	0.000000E+00	0.629007E-02	0.274461E-02	-0.631324E-02	-0.185807E-02	-0.200598
41	0.228158E-01	0.555280E-02	0.134141E-02	-0.512396E-02	0.334998E-01	-0.103220
42	0.241906E-01	0.410925E-02	0.357834E-03	-0.344154E-01	0.354809E-01	0.813183E-01
43	0.693785E-02	0.317773E-02	-0.264947E-03	-0.475511E-01	0.126369E-01	0.131823
44	0.000000E+00	0.301476E-02	-0.803819E-03	0.634729E-02	0.694913E-02	-0.951081E-01
45	0.284985E-01	0.221396E-02	-0.140430E-02	0.444639E-01	0.531806E-01	-0.227675
46	0.466054E-01	-0.954695E-16	-0.168629E-02	-0.879528E-14	0.811849E-01	-0.990420E-14
47	0.284985E-01	-0.221396E-02	-0.140430E-02	-0.444639E-01	0.531806E-01	0.227675
48	0.000000E+00	-0.301476E-02	-0.803819E-03	-0.634729E-02	0.694913E-02	0.951081E-01
49	0.693785E-02	-0.317773E-02	-0.264947E-03	0.475511E-01	0.126369E-01	-0.131823

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50	0.241906E-01	-0.410925E-02	0.357834E-03	0.344154E-01	0.354809E-01	-0.813183E-01
51	0.228158E-01	-0.555280E-02	0.134141E-02	0.512396E-02	0.334998E-01	0.103220

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NODE	UX	UY	UZ	ROTX	ROTY	ROTZ

NOTE - ALL DISPLACEMENTS ARE IN NODAL COORDINATE SYSTEMS. SOME NODAL COORD. SYSTEMS MAY NOT BE PARALLEL TO THE GLOBAL CARTESIAN SYSTEM. SEE NODE LOCATION PRINTOUT FOR ROTATION ANGLES.

52	0.000000E+00	-0.629007E-02	0.274461E-02	0.631324E-02	-0.185807E-02	0.200598
53	0.000000E+00	0.893312E-02	0.293915E-02	-0.623068E-02	-0.199483E-02	-0.275433
54	0.313111E-01	0.796515E-02	0.147498E-02	-0.437482E-02	0.342141E-01	-0.140662
55	0.329685E-01	0.600139E-02	0.408762E-03	-0.356135E-01	0.358772E-01	0.114262
56	0.899833E-02	0.473514E-02	-0.283542E-03	-0.507300E-01	0.123218E-01	0.181470
57	0.000000E+00	0.449341E-02	-0.895179E-03	0.508326E-02	0.722215E-02	-0.142580
58	0.414691E-01	0.327516E-02	-0.155605E-02	0.455533E-01	0.564618E-01	-0.329025
59	0.675790E-01	0.191276E-15	-0.186330E-02	-0.900310E-14	0.861177E-01	0.123725E-13
60	0.414691E-01	-0.327516E-02	-0.155605E-02	-0.455533E-01	0.564618E-01	0.329025
61	0.000000E+00	-0.449341E-02	-0.895179E-03	-0.508326E-02	0.722215E-02	0.142580
62	0.899833E-02	-0.473514E-02	-0.283542E-03	0.507300E-01	0.123218E-01	-0.181470
63	0.329685E-01	-0.600139E-02	0.408762E-03	0.356135E-01	0.358772E-01	-0.114262
64	0.313111E-01	-0.796515E-02	0.147498E-02	0.437482E-02	0.342141E-01	0.140662
65	0.000000E+00	-0.893312E-02	0.293915E-02	0.623068E-02	-0.199483E-02	0.275433
66	0.000000E+00	0.116298E-01	0.295160E-02	-0.710365E-02	-0.175195E-02	-0.354017
67	0.402477E-01	0.104126E-01	0.147249E-02	-0.612546E-02	0.367872E-01	-0.180516
68	0.423167E-01	0.790090E-02	0.397931E-03	-0.349809E-01	0.396991E-01	0.147737
69	0.113933E-01	0.627268E-02	-0.301883E-03	-0.477221E-01	0.151984E-01	0.233672
70	0.000000E+00	0.594840E-02	-0.911335E-03	0.815650E-02	0.710194E-02	-0.188105
71	0.542986E-01	0.432281E-02	-0.156485E-02	0.471079E-01	0.524468E-01	-0.429901
72	0.883917E-01	0.386344E-15	-0.186755E-02	-0.135348E-14	0.803442E-01	0.246760E-13
73	0.542986E-01	-0.432281E-02	-0.156485E-02	-0.471079E-01	0.524468E-01	0.429901
74	0.000000E+00	-0.594840E-02	-0.911335E-03	-0.815650E-02	0.710194E-02	0.188105
75	0.113933E-01	-0.627268E-02	-0.301883E-03	0.477221E-01	0.151984E-01	-0.233672
76	0.423167E-01	-0.790090E-02	0.397931E-03	0.349809E-01	0.396991E-01	-0.147737
77	0.402477E-01	-0.104126E-01	0.147249E-02	0.612546E-02	0.367872E-01	0.180516
78	0.000000E+00	-0.116298E-01	0.295160E-02	0.710365E-02	-0.175195E-02	0.354017
79	0.000000E+00	0.142865E-01	0.277347E-02	-0.774864E-02	-0.137133E-02	-0.436712
80	0.496972E-01	0.128074E-01	0.136326E-02	-0.781024E-02	0.375482E-01	-0.223931
81	0.525244E-01	0.970878E-02	0.348378E-03	-0.323292E-01	0.416721E-01	0.179799
82	0.145777E-01	0.767543E-02	-0.305184E-03	-0.416294E-01	0.175255E-01	0.288864
83	0.000000E+00	0.724850E-02	-0.866590E-03	0.111596E-01	0.657750E-02	-0.224090
84	0.656514E-01	0.526097E-02	-0.146521E-02	0.461551E-01	0.450980E-01	-0.520927
85	0.106996	0.372436E-15	-0.174258E-02	0.654904E-14	0.694933E-01	0.158014E-13
86	0.656514E-01	-0.526097E-02	-0.146521E-02	-0.461551E-01	0.450980E-01	0.520927
87	0.000000E+00	-0.724850E-02	-0.866590E-03	-0.111596E-01	0.657750E-02	0.224090
88	0.145777E-01	-0.767543E-02	-0.305184E-03	0.416294E-01	0.175255E-01	-0.288864
89	0.525244E-01	-0.970878E-02	0.348378E-03	0.323292E-01	0.416721E-01	-0.179799
90	0.496972E-01	-0.128074E-01	0.136326E-02	0.781024E-02	0.375482E-01	0.223931
91	0.000000E+00	-0.142865E-01	0.277347E-02	0.774864E-02	-0.137133E-02	0.436712
92	0.000000E+00	0.167080E-01	0.238782E-02	-0.666593E-02	-0.118406E-02	-0.514789
93	0.586406E-01	0.149819E-01	0.117024E-02	-0.674362E-02	0.324572E-01	-0.265631
94	0.623400E-01	0.113245E-01	0.290267E-03	-0.279547E-01	0.360351E-01	0.208551
95	0.179033E-01	0.889607E-02	-0.279794E-03	-0.358861E-01	0.151753E-01	0.341096
96	0.000000E+00	0.836496E-02	-0.770021E-03	0.980375E-02	0.566145E-02	-0.252323
97	0.753346E-01	0.606762E-02	-0.129067E-02	0.400036E-01	0.387737E-01	-0.599575
98	0.122972	0.207833E-15	-0.153138E-02	0.960034E-14	0.597645E-01	-0.526879E-14
99	0.753346E-01	-0.606762E-02	-0.129067E-02	-0.400036E-01	0.387737E-01	0.599575
100	0.000000E+00	-0.836496E-02	-0.770021E-03	-0.980375E-02	0.566145E-02	0.252323
101	0.179033E-01	-0.889607E-02	-0.279794E-03	0.358861E-01	0.151753E-01	-0.341096
102	0.623400E-01	-0.113245E-01	0.290267E-03	0.279547E-01	0.360351E-01	-0.208551
103	0.586406E-01	-0.149819E-01	0.117024E-02	0.674362E-02	0.324572E-01	0.265631
104	0.000000E+00	-0.167080E-01	0.238782E-02	0.666593E-02	-0.118406E-02	0.514789
105	0.000000E+00	0.186635E-01	0.183100E-02	-0.406274E-02	-0.117612E-02	-0.575677
106	0.655946E-01	0.167424E-01	0.910532E-03	-0.322738E-02	0.223087E-01	-0.297518
107	0.698351E-01	0.126526E-01	0.227010E-03	-0.221759E-01	0.237844E-01	0.232302
108	0.202168E-01	0.992754E-02	-0.229750E-03	-0.306663E-01	0.872089E-02	0.381677

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NODE	UX	UY	UZ

NOTE - ALL DISPLACEMENTS ARE IN NODAL COORDINATE SYSTEM
BE PARALLEL TO THE GLOBAL CARTESIAN SYSTEM. SEE NODE

109	0.000000E+00	0.932327E-02	-0.632225E-03
110	0.837552E-01	0.675997E-02	-0.105734E-02
111	0.136764	0.857734E-16	-0.125301E-02
112	0.837552E-01	-0.675997E-02	-0.105734E-02
113	0.000000E+00	-0.932327E-02	-0.632225E-03
114	0.202168E-01	-0.992754E-02	-0.229750E-03
115	0.698351E-01	-0.126526E-01	0.227010E-03
116	0.655946E-01	-0.167424E-01	0.910532E-03
117	0.000000E+00	-0.186635E-01	0.183100E-02
118	0.000000E+00	0.200247E-01	0.118862E-02
119	0.698922E-01	0.179785E-01	0.595639E-03
120	0.741884E-01	0.136264E-01	0.139497E-03
121	0.210906E-01	0.107392E-01	-0.176948E-03
122	0.000000E+00	0.101050E-01	-0.464291E-03
123	0.907978E-01	0.732402E-02	-0.766843E-03
124	0.148116	0.158900E-15	-0.905481E-03
125	0.907978E-01	-0.732402E-02	-0.766843E-03
126	0.000000E+00	-0.101050E-01	-0.464291E-03
127	0.210906E-01	-0.107392E-01	-0.176948E-03
128	0.741884E-01	-0.136264E-01	0.139497E-03
129	0.698922E-01	-0.179785E-01	0.595639E-03
130	0.000000E+00	-0.200247E-01	0.118862E-02
131	0.000000E+00	0.208112E-01	0.529593E-03
132	0.720945E-01	0.186987E-01	0.237969E-03
133	0.762608E-01	0.142152E-01	0.154036E-04
134	0.212214E-01	0.112569E-01	-0.137484E-03
135	0.000000E+00	0.106156E-01	-0.276464E-03
136	0.954633E-01	0.769201E-02	-0.424257E-03
137	0.155558	0.403773E-15	-0.492252E-03
138	0.954633E-01	-0.769201E-02	-0.424257E-03
139	0.000000E+00	-0.106156E-01	-0.276464E-03
140	0.212214E-01	-0.112569E-01	-0.137484E-03
141	0.762608E-01	-0.142152E-01	0.154036E-04
142	0.720945E-01	-0.186987E-01	0.237969E-03
143	0.000000E+00	-0.208112E-01	0.529593E-03
144	0.000000E+00	0.210866E-01	-0.141011E-03
145	0.730383E-01	0.189488E-01	-0.144889E-03
146	0.772691E-01	0.144073E-01	-0.129541E-03
147	0.215153E-01	0.114093E-01	-0.105188E-03
148	0.000000E+00	0.107578E-01	-0.766138E-04
149	0.966918E-01	0.779416E-02	-0.511404E-04
150	0.157562	0.659562E-15	-0.406481E-04
151	0.966918E-01	-0.779416E-02	-0.511404E-04
152	0.000000E+00	-0.107578E-01	-0.766138E-04
153	0.215153E-01	-0.114093E-01	-0.105188E-03
154	0.772691E-01	-0.144073E-01	-0.129541E-03
155	0.730383E-01	-0.189488E-01	-0.144889E-03
156	0.000000E+00	-0.210866E-01	-0.141011E-03
157	0.000000E+00	0.208305E-01	-0.853962E-03
158	0.726519E-01	0.187108E-01	-0.532715E-03
159	0.771384E-01	0.141893E-01	-0.264154E-03
160	0.219526E-01	0.111857E-01	-0.614783E-04
161	0.000000E+00	0.105212E-01	0.128827E-03
162	0.943871E-01	0.762299E-02	0.322098E-03
163	0.153970	0.713988E-15	0.409020E-03
164	0.943871E-01	-0.762299E-02	0.322098E-03
165	0.000000E+00	-0.105212E-01	0.128827E-03

MS. - SOME NODAL COORD. SYSTEMS MAY NOT
LOCATION PRINTOUT FOR ROTATION ANGLES.

ROTX	ROTY	ROTZ
0.457478E-02	0.442349E-02	-0.279222
0.294014E-01	0.335760E-01	-0.667033
0.322265E-14	0.513651E-01	-0.228014E-13
-0.294014E-01	0.335760E-01	0.667033
-0.457478E-02	0.442349E-02	0.279222
0.306663E-01	0.872089E-02	-0.381677
0.221759E-01	0.237844E-01	-0.232302
0.322738E-02	0.223087E-01	0.297518
0.406274E-02	-0.117612E-02	0.575677
-0.167796E-02	-0.102979E-02	-0.613661
-0.264032E-03	0.121997E-01	-0.316132
-0.152736E-01	0.119536E-01	0.249824
-0.232079E-01	0.293685E-02	0.406711
0.117521E-03	0.299676E-02	-0.306017
0.180522E-01	0.258311E-01	-0.721725
-0.645879E-14	0.391827E-01	-0.234102E-13
-0.180522E-01	0.258311E-01	0.721725
-0.117521E-03	0.299676E-02	0.306017
0.232079E-01	0.293685E-02	-0.406711
0.152736E-01	0.119536E-01	-0.249824
0.264032E-03	0.121997E-01	0.316132
0.167796E-02	-0.102979E-02	0.613661
-0.771177E-03	-0.521928E-03	-0.633328
-0.146281E-04	0.585777E-02	-0.325048
-0.753850E-02	0.565920E-02	0.260424
-0.116545E-01	0.126820E-02	0.419523
-0.223449E-03	0.149368E-02	-0.325579
0.872178E-02	0.130451E-01	-0.757222
-0.106109E-13	0.197644E-01	-0.220573E-14
-0.872178E-02	0.130451E-01	0.757222
0.223449E-03	0.149368E-02	0.325579
0.116545E-01	0.126820E-02	-0.419523
0.753850E-02	0.565920E-02	-0.260424
0.146281E-04	0.585777E-02	0.325048
0.771177E-03	-0.521928E-03	0.633328
-0.680783E-03	0.187923E-03	-0.641598
-0.126845E-02	0.158540E-02	-0.329339
0.683246E-03	0.241519E-02	0.263749
0.220005E-02	0.187546E-02	0.425048
0.170782E-02	-0.552218E-04	-0.329673
0.475450E-03	-0.256609E-02	-0.766980
-0.672821E-14	-0.371214E-02	0.211991E-13
-0.475450E-03	-0.256609E-02	0.766980
-0.170782E-02	-0.552218E-04	0.329673
-0.220005E-02	0.187546E-02	-0.425048
-0.683246E-03	0.241519E-02	-0.263749
0.126845E-02	0.158540E-02	0.329339
0.680783E-03	0.187923E-03	0.641598
0.321577E-03	0.728266E-03	-0.637840
-0.942923E-03	-0.532839E-02	-0.328683
0.901933E-02	-0.448634E-02	0.259532
0.145417E-01	-0.138103E-04	0.422874
0.118678E-02	-0.166551E-02	-0.317962
-0.968132E-02	-0.161796E-01	-0.750238
0.246096E-14	-0.244000E-01	0.283436E-13
0.968132E-02	-0.161796E-01	0.750238
-0.118678E-02	-0.166551E-02	0.317962

NODE	UX	UY	UZ	ROTX	ROTY	ROTZ

NOTE - ALL DISPLACEMENTS ARE IN NODAL COORDINATE SYSTEMS. SOME NODAL COORD. SYSTEMS MAY NOT BE PARALLEL TO THE GLOBAL CARTESIAN SYSTEM. SEE NODE LOCATION PRINTOUT FOR ROTATION ANGLES.

166	0.219526E-01	-0.111857E-01	-0.614783E-04	-0.145417E-01	-0.138103E-04	-0.422874
167	0.771384E-01	-0.141893E-01	-0.264154E-03	-0.901933E-02	-0.448634E-02	-0.259532
168	0.726519E-01	-0.187108E-01	-0.532715E-03	0.942923E-03	-0.532839E-02	0.328683
169	0.000000E+00	-0.208305E-01	-0.853962E-03	-0.321577E-03	0.728266E-03	0.637840
170	0.000000E+00	0.199378E-01	-0.160619E-02	0.290173E-02	0.939977E-03	-0.613840
171	0.699518E-01	0.179020E-01	-0.909056E-03	0.217971E-02	-0.166091E-01	-0.317352
172	0.744977E-01	0.135452E-01	-0.373091E-03	0.171441E-01	-0.175644E-01	0.247588
173	0.215858E-01	0.106359E-01	0.452793E-07	0.235955E-01	-0.625556E-02	0.407214
174	0.000000E+00	0.998286E-02	0.332740E-03	-0.364823E-02	-0.330976E-02	-0.298011
175	0.894144E-01	0.723319E-02	0.675150E-03	-0.227192E-01	-0.255948E-01	-0.711993
176	0.145995	0.535503E-15	0.830861E-03	0.872853E-14	-0.391463E-01	0.123264E-13
177	0.894144E-01	-0.723319E-02	0.675150E-03	0.227192E-01	-0.255948E-01	0.711993
178	0.000000E+00	-0.998286E-02	0.332740E-03	0.364823E-02	-0.330976E-02	0.298011
179	0.215858E-01	-0.106359E-01	0.452793E-07	-0.235955E-01	-0.625556E-02	-0.407214
180	0.744977E-01	-0.135452E-01	-0.373091E-03	-0.171441E-01	-0.175644E-01	-0.247588
181	0.699518E-01	-0.179020E-01	-0.909056E-03	-0.217971E-02	-0.166091E-01	0.317352
182	0.000000E+00	-0.199378E-01	-0.160619E-02	-0.290173E-02	0.939977E-03	0.613840
183	0.000000E+00	0.183455E-01	-0.233293E-02	0.580317E-02	0.104825E-02	-0.563634
184	0.642201E-01	0.164757E-01	-0.126397E-02	0.594348E-02	-0.285757E-01	-0.291065
185	0.683214E-01	0.124773E-01	-0.469544E-03	0.248116E-01	-0.317541E-01	0.228042
186	0.196724E-01	0.981171E-02	0.636892E-04	0.312703E-01	-0.134269E-01	0.373842
187	0.000000E+00	0.921590E-02	0.526530E-03	-0.947519E-02	-0.488251E-02	-0.276262
188	0.825722E-01	0.667701E-02	0.100562E-02	-0.359397E-01	-0.333519E-01	-0.657078
189	0.134777	0.254579E-15	0.122463E-02	0.847078E-14	-0.514761E-01	-0.117871E-13
190	0.825722E-01	-0.667701E-02	0.100562E-02	0.359397E-01	-0.333519E-01	0.657078
191	0.000000E+00	-0.921590E-02	0.526530E-03	0.947519E-02	-0.488251E-02	0.276262
192	0.196724E-01	-0.981171E-02	0.636892E-04	-0.312703E-01	-0.134269E-01	-0.373842
193	0.683214E-01	-0.124773E-01	-0.469544E-03	-0.248116E-01	-0.317541E-01	-0.228042
194	0.642201E-01	-0.164757E-01	-0.126397E-02	-0.594348E-02	-0.285757E-01	0.291065
195	0.000000E+00	-0.183455E-01	-0.233293E-02	-0.580317E-02	0.104825E-02	0.563634
196	0.000000E+00	0.161347E-01	-0.295543E-02	0.728600E-02	0.137545E-02	-0.491440
197	0.559539E-01	0.145007E-01	-0.159007E-02	0.733851E-02	-0.361947E-01	-0.252518
198	0.592514E-01	0.110217E-01	-0.574252E-03	0.318126E-01	-0.400865E-01	0.201503
199	0.165903E-01	0.872015E-02	0.108291E-03	0.404315E-01	-0.167730E-01	0.325674
200	0.000000E+00	0.821618E-02	0.701748E-03	-0.116615E-01	-0.626086E-02	-0.250747
201	0.737586E-01	0.595171E-02	0.131657E-02	-0.457347E-01	-0.432185E-01	-0.585335
202	0.120220	0.838771E-16	0.159767E-02	0.142754E-14	-0.666469E-01	-0.236288E-13
203	0.737586E-01	-0.595171E-02	0.131657E-02	0.457347E-01	-0.432185E-01	0.585335
204	0.000000E+00	-0.821618E-02	0.701748E-03	0.116615E-01	-0.626086E-02	0.250747
205	0.165903E-01	-0.872015E-02	0.108291E-03	-0.404315E-01	-0.167730E-01	-0.325674
206	0.592514E-01	-0.110217E-01	-0.574252E-03	-0.318126E-01	-0.400865E-01	-0.201503
207	0.559539E-01	-0.145007E-01	-0.159007E-02	-0.733851E-02	-0.361947E-01	0.252518
208	0.000000E+00	-0.161347E-01	-0.295543E-02	-0.728600E-02	0.137545E-02	0.491440
209	0.000000E+00	0.134844E-01	-0.344788E-02	0.714446E-02	0.194568E-02	-0.408152
210	0.464468E-01	0.121251E-01	-0.187692E-02	0.605435E-02	-0.387708E-01	-0.208959
211	0.490171E-01	0.923997E-02	-0.685969E-03	0.379244E-01	-0.416695E-01	0.168966
212	0.134392E-01	0.734212E-02	0.130584E-03	0.510728E-01	-0.157583E-01	0.270307
213	0.000000E+00	0.693285E-02	0.852342E-03	-0.971217E-02	-0.739696E-02	-0.214203
214	0.623206E-01	0.502144E-02	0.159886E-02	-0.514776E-01	-0.552491E-01	-0.493620
215	0.101477	0.123321E-15	0.193936E-02	-0.587098E-14	-0.846901E-01	-0.129050E-13
216	0.623206E-01	-0.502144E-02	0.159886E-02	0.514776E-01	-0.552491E-01	0.493620
217	0.000000E+00	-0.693285E-02	0.852342E-03	0.971217E-02	-0.739696E-02	0.214203
218	0.134392E-01	-0.734212E-02	0.130584E-03	-0.510728E-01	-0.157583E-01	-0.270307
219	0.490171E-01	-0.923997E-02	-0.685969E-03	-0.379244E-01	-0.416695E-01	-0.168966
220	0.464468E-01	-0.121251E-01	-0.187692E-02	-0.605435E-02	-0.387708E-01	0.208959
221	0.000000E+00	-0.134844E-01	-0.344788E-02	-0.714446E-02	0.194568E-02	0.408152
222	0.000000E+00	0.105293E-01	-0.384419E-02	0.690759E-02	0.241755E-02	-0.320539

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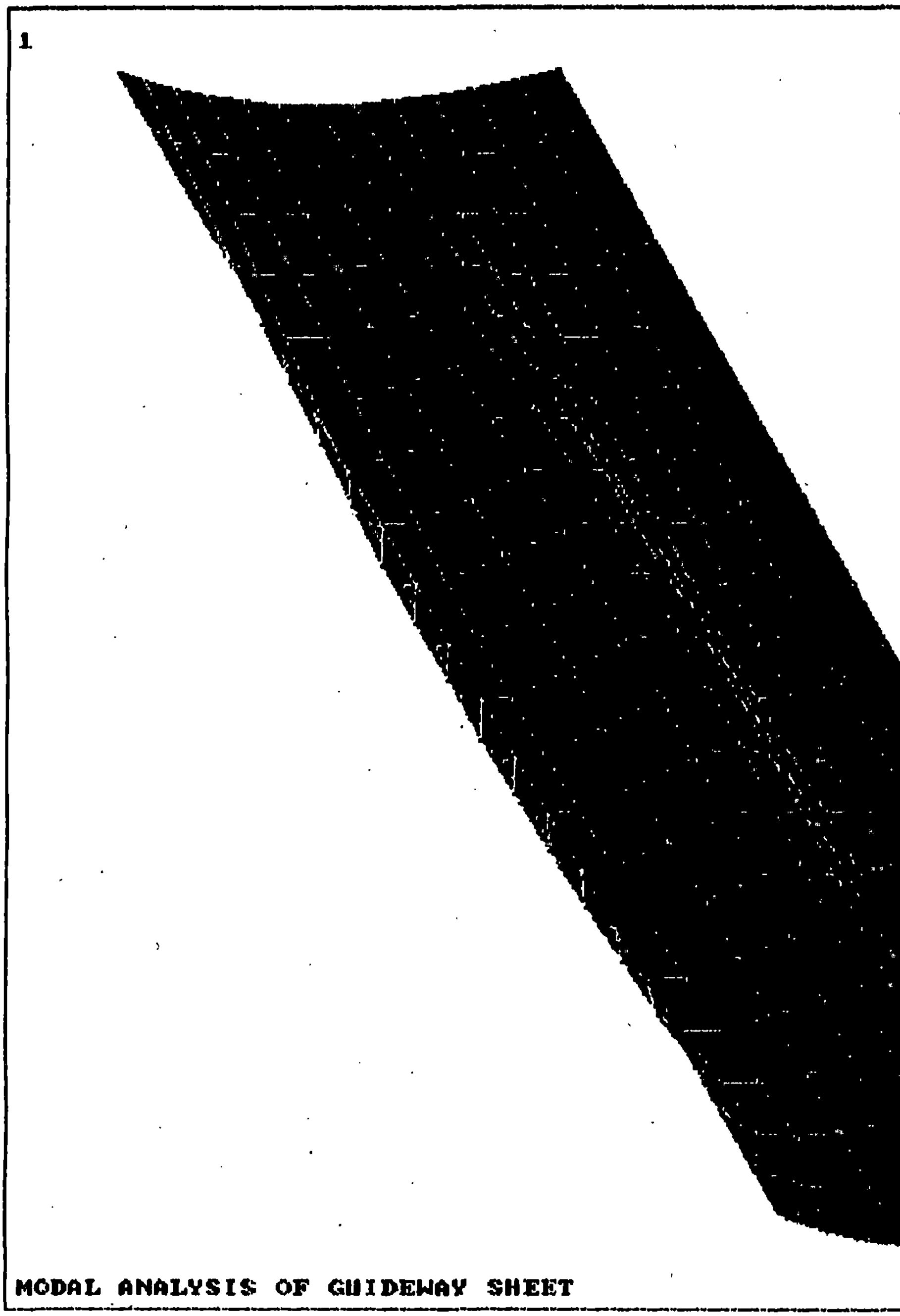
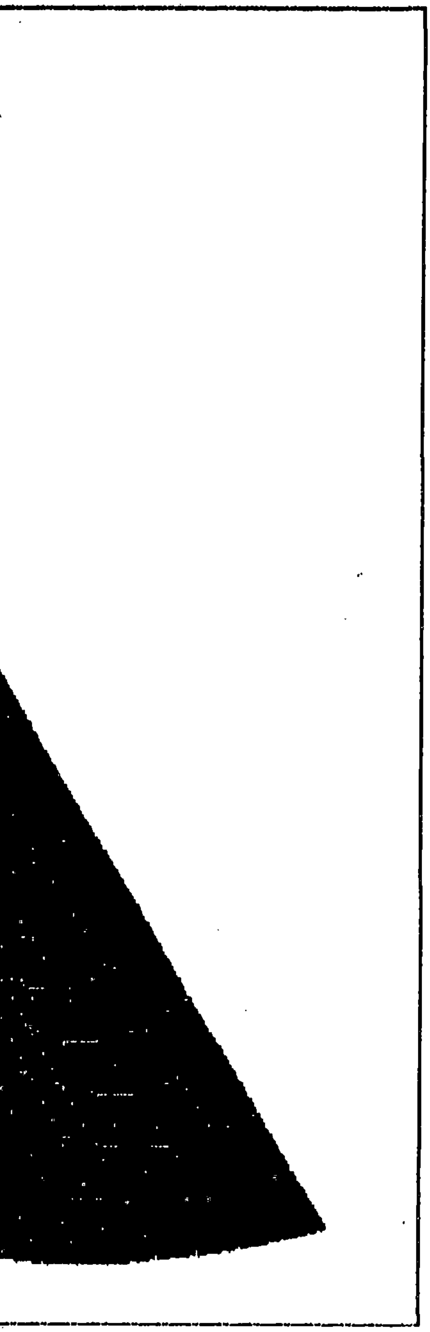
NODE	UX	UY	UZ	ROTX	ROTY	ROTZ
223	0.364943E-01	0.946369E-02	-0.211071E-02	0.477058E-02	-0.405072E-01	-0.164664
224	0.386366E-01	0.719475E-02	-0.778707E-03	0.428746E-01	-0.424454E-01	0.131511
225	0.108039E-01	0.569412E-02	0.147403E-03	0.599269E-01	-0.145741E-01	0.212411
226	0.000000E+00	0.536553E-02	0.974931E-03	-0.779042E-02	-0.829726E-02	-0.163843
227	0.481610E-01	0.388649E-02	0.182974E-02	-0.558697E-01	-0.653035E-01	-0.382152
228	0.784934E-01	0.280161E-15	0.221898E-02	-0.818633E-14	-0.997500E-01	0.862014E-14
229	0.481610E-01	-0.388649E-02	0.182974E-02	0.558697E-01	-0.653035E-01	0.382152
230	0.000000E+00	-0.536553E-02	0.974931E-03	0.779042E-02	-0.829726E-02	0.163843
231	0.108039E-01	-0.569412E-02	0.147403E-03	-0.599269E-01	-0.145741E-01	-0.212411
232	0.386366E-01	-0.719475E-02	-0.778707E-03	-0.428746E-01	-0.424454E-01	-0.131511
233	0.364943E-01	-0.946369E-02	-0.211071E-02	-0.477058E-02	-0.405072E-01	0.164664
234	0.000000E+00	-0.105293E-01	-0.384419E-02	-0.690759E-02	0.241755E-02	0.320539
235	0.000000E+00	0.728942E-02	-0.417745E-02	0.798989E-02	0.260039E-02	-0.225944
236	0.257634E-01	0.654225E-02	-0.227978E-02	0.599689E-02	-0.451878E-01	-0.117281
237	0.275390E-01	0.493626E-02	-0.829173E-03	0.465996E-01	-0.478267E-01	0.901638E-01
238	0.815100E-02	0.385708E-02	0.173955E-03	0.643061E-01	-0.170963E-01	0.149999
239	0.000000E+00	0.361065E-02	0.106672E-02	-0.977220E-02	-0.906877E-02	-0.106094
240	0.322699E-01	0.261623E-02	0.198943E-02	-0.617526E-01	-0.696745E-01	-0.257552
241	0.527532E-01	0.371621E-15	0.240985E-02	-0.228513E-14	-0.106509	0.218495E-13
242	0.322699E-01	-0.261623E-02	0.198943E-02	0.617526E-01	-0.696745E-01	0.257552
243	0.000000E+00	-0.361065E-02	0.106672E-02	0.977220E-02	-0.906877E-02	0.106094
244	0.815100E-02	-0.385708E-02	0.173955E-03	-0.643061E-01	-0.170963E-01	-0.149999
245	0.275390E-01	-0.493626E-02	-0.829173E-03	-0.465996E-01	-0.478267E-01	-0.901638E-01
246	0.257634E-01	-0.654225E-02	-0.227978E-02	-0.599689E-02	-0.451878E-01	0.117281
247	0.000000E+00	-0.728942E-02	-0.417745E-02	-0.798989E-02	0.260039E-02	0.225944
248	0.000000E+00	0.375050E-02	-0.442360E-02	0.981769E-02	0.219570E-02	-0.118410
249	0.135381E-01	0.336075E-02	-0.237979E-02	0.922155E-02	-0.518539E-01	-0.621364E-01
250	0.146194E-01	0.251457E-02	-0.841787E-03	0.487766E-01	-0.563436E-01	0.457571E-01
251	0.457460E-02	0.193662E-02	0.204445E-03	0.628794E-01	-0.220415E-01	0.787127E-01
252	0.000000E+00	0.179933E-02	0.112399E-02	-0.140845E-01	-0.932893E-02	-0.504076E-01
253	0.160071E-01	0.130442E-02	0.207626E-02	-0.657306E-01	-0.694171E-01	-0.128421
254	0.262628E-01	0.266045E-15	0.251109E-02	0.618851E-14	-0.106806	0.180310E-13
255	0.160071E-01	-0.130442E-02	0.207626E-02	0.657306E-01	-0.694171E-01	0.128421
256	0.000000E+00	-0.179933E-02	0.112399E-02	0.140845E-01	-0.932893E-02	0.504076E-01
257	0.457460E-02	-0.193662E-02	0.204445E-03	-0.628794E-01	-0.220415E-01	-0.787127E-01
258	0.146194E-01	-0.251457E-02	-0.841787E-03	-0.487766E-01	-0.563436E-01	-0.457571E-01
259	0.135381E-01	-0.336075E-02	-0.237979E-02	-0.922155E-02	-0.518539E-01	0.621364E-01
260	0.000000E+00	-0.375050E-02	-0.442360E-02	-0.981769E-02	0.219570E-02	0.118410
261	0.000000E+00	0.000000E+00	-0.451737E-02	0.106583E-01	0.260286E-02	-0.260198E-02
262	0.000000E+00	0.000000E+00	-0.241255E-02	0.985474E-02	-0.549712E-01	-0.126376E-02
263	0.000000E+00	0.000000E+00	-0.841309E-03	0.514793E-01	-0.605295E-01	0.158577E-02
264	0.000000E+00	0.000000E+00	0.218352E-03	0.667632E-01	-0.246239E-01	0.435224E-02
265	0.000000E+00	0.000000E+00	0.114347E-02	-0.178764E-01	-0.944531E-02	-0.125964E-02
266	0.000000E+00	0.000000E+00	0.210262E-02	-0.739335E-01	-0.685985E-01	-0.547085E-02
267	0.000000E+00	0.000000E+00	0.254115E-02	0.101479E-13	-0.105891	0.537280E-15
268	0.000000E+00	0.000000E+00	0.210262E-02	0.739335E-01	-0.685985E-01	0.547085E-02
269	0.000000E+00	0.000000E+00	0.114347E-02	0.178764E-01	-0.944531E-02	0.125964E-02
270	0.000000E+00	0.000000E+00	0.218352E-03	-0.667632E-01	-0.246239E-01	-0.435224E-02
271	0.000000E+00	0.000000E+00	-0.841309E-03	-0.514793E-01	-0.605295E-01	-0.158577E-02
272	0.000000E+00	0.000000E+00	-0.241255E-02	-0.985474E-02	-0.549712E-01	0.126376E-02
273	0.000000E+00	0.000000E+00	-0.451737E-02	-0.106583E-01	0.260286E-02	0.260198E-02

MAXIMUMS

	UX	UY	UZ	ROTX	ROTY	ROTZ
NODE	150	156	273	268	254	151
VALUE	0.157562	-0.210866E-01	-0.451737E-02	0.739335E-01	-0.106806	0.766980

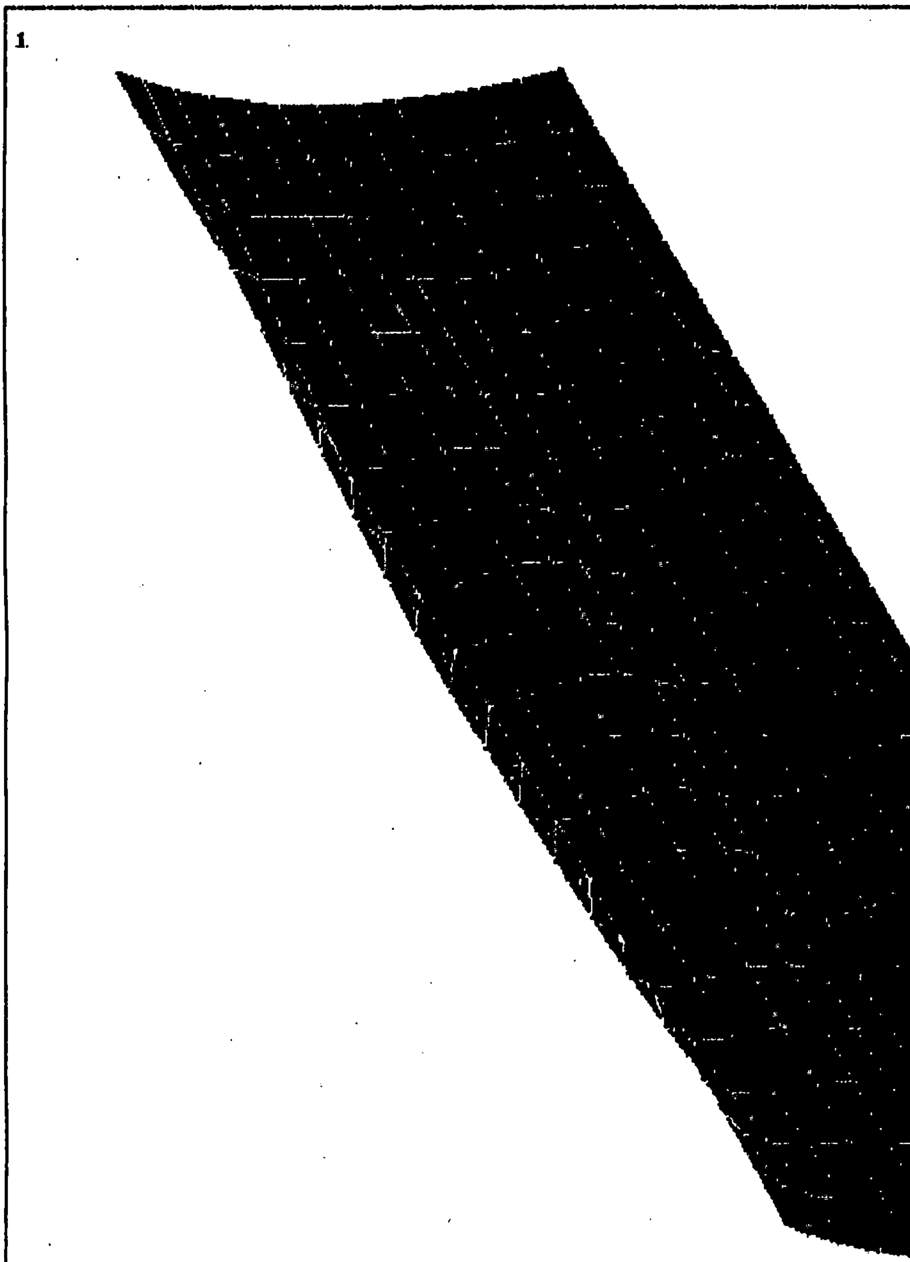
55-57


1
MODAL ANALYSIS OF GUIDEWAY SHEET

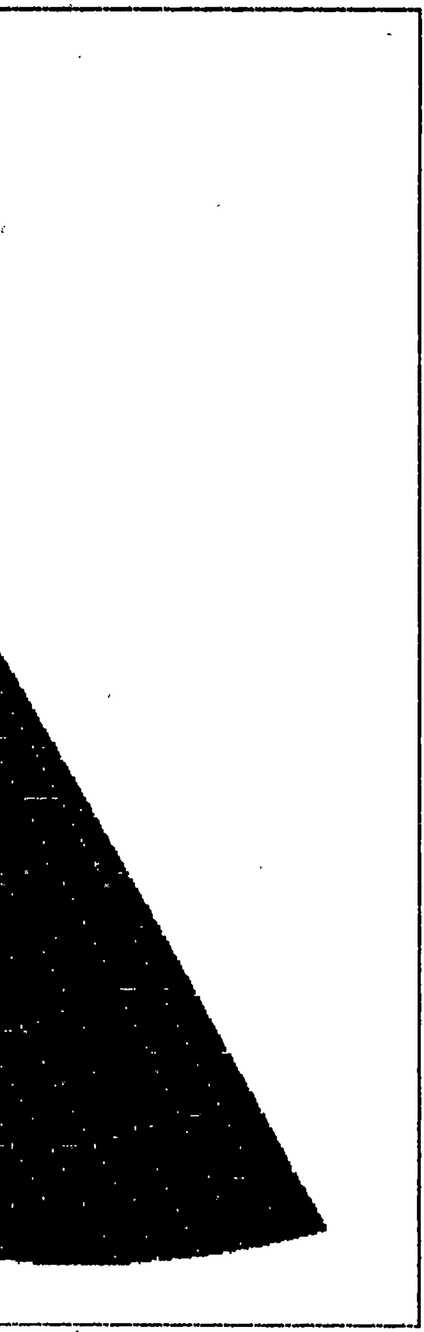


ANSYS-PC 4.4A1
MAY 8 1992
8:38:02
PLOT NO. 1
POST1 DISPL.
STEP=1
ITER=1
FREQ=182.226
DMX =0.104417

DSCA=1.728
XV =-1
YV =-1
ZV =1
DIST=1.804
XF =2.031
ZF =2.25
ANGZ=-90



MODAL ANALYSIS OF GUIDEWAY SHEET

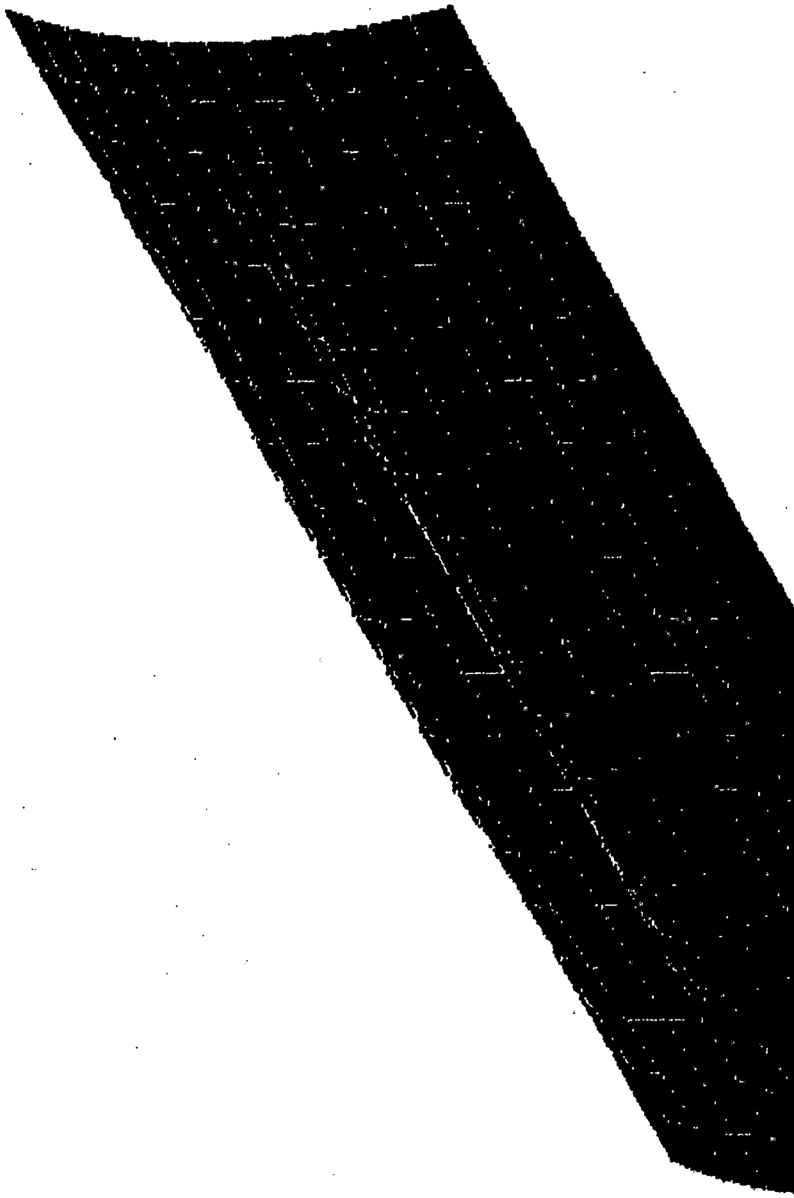


ANSYS-PC 4.4A1
MAY 8 1992
8:38:14
PLOT NO. 2
POST1 DISPL.
STEP=1
ITER=5
FREQ=229.803
DMX =0.129109

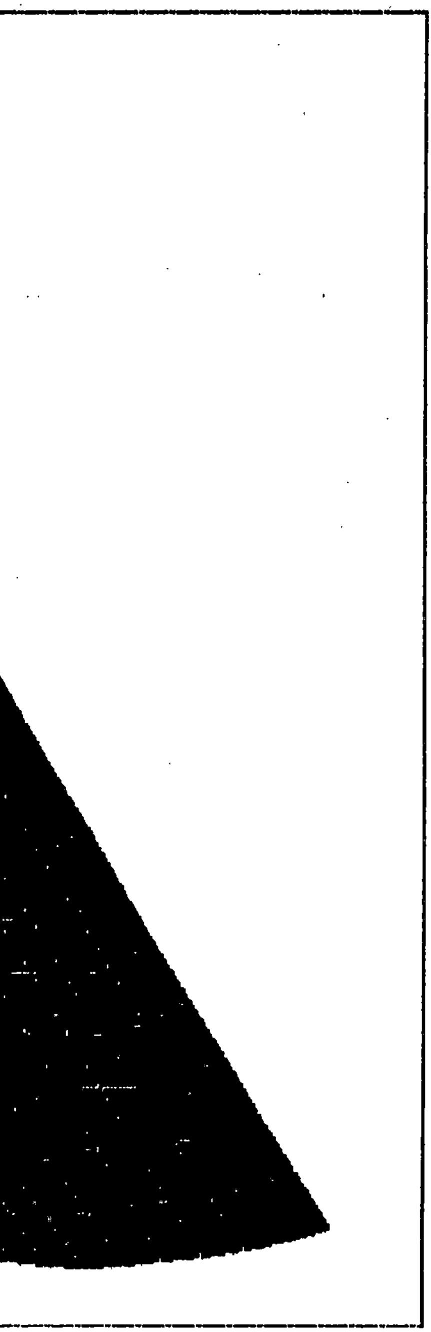
DSCA=1.397
XV =-1
YV =-1
ZV =1
DIST=1.804
XF =2.031
ZF =2.25
ANGZ=-90

55-57

1.



MODAL ANALYSIS OF GUIDEWAY SHEET



ANSYS-PC 4.4A1
MAY 8 1992
8:38:30
PLOT NO. 3
POST1 DISPL.
STEP=1
ITER=14
FREQ=325.753
DMX =0.157562

DSCA=1.145
XV =-1
YV =-1
ZV =1
DIST=1.804
XF =2.031
ZF =2.25
ANGZ=-90

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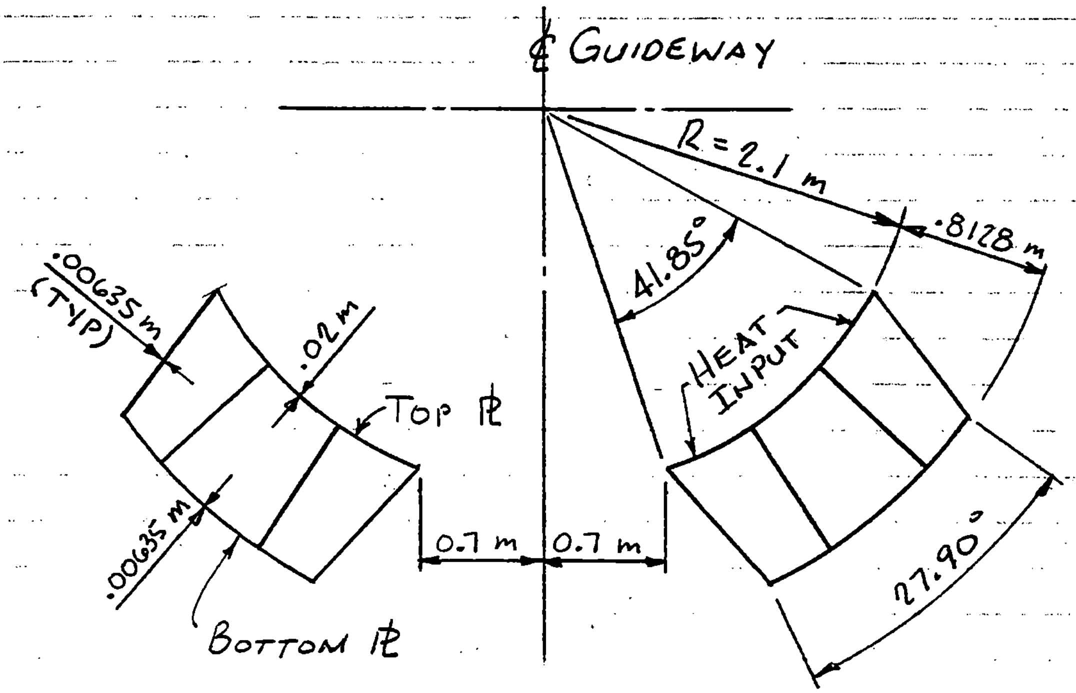
JOB NO. 6869002 DATE 9/15/92 BY RJC CH'K

CUSTOMER MIT MI PROJECT MAGLEV

SUBJECT THERMAL STRESS - LEVITATION BOX BEAMS



SECTION THRU BOX BEAMS

ASSUMPTIONS

1. GUIDEWAY HEAT INPUT LOADS ARE AS SPECIFIED IN FIG. 98, PG. 172, OF "DRAFT CONCEPT DEFINITION REPORT, MAY 1992".
2. AMBIENT TEMPERATURE ASSUMED TO BE 32 °C.
3. BOTTOM PLATE OF BOX BEAM ASSUMED TO RADIATE TO GROUND WITH AN EMISSIVITY OF 0.2 (OXIDIZED ALUMINUM). ALL OTHER EXTERNAL SURFACES ASSUMED TO HAVE NEGLIGIBLE RADIANT HEAT LOSS SINCE THEY RADIATE ESSENTIALLY TO THE SURROUNDING AIR WHICH IS A POOR ABSORBER OF RADIANT ENERGY.
4. NATURAL (FREE) CONVECTION FROM EXTERNAL SURFACES TO SURROUNDING AIR.
5. RADIANT HEAT TRANSFER ON INSIDE SURFACES OF BOX BEAM PLATES. EMISSIVITY ASSUMED EQUAL TO 0.2.

FORM 62-114/A0388175i

ASSUMPTIONS (CONT'D)

6. NATURAL CONVECTION FROM INTERNAL SURFACES TO ENCLOSED AIR.
7. CONDUCTION THRU ENCLOSED AIR.
8. CONDUCTION THRU ALUMINUM PLATES.

METHOD OF ANALYSIS

THE TEMPERATURE DISTRIBUTION IN THE LEVITATION BOX BEAM DUE TO THE HEATING EFFECT OF THE PASSAGE OF MANY VEHICLES WAS SOLVED USING THE ANSYS - PC/THERMAL PROGRAM, REV. 4.4A.

ASSUMING A SYMMETRIC TEMPERATURE DISTRIBUTION ABOUT THE ℄ OF EACH BOX BEAM, A FINITE ELEMENT MODEL CONSISTING OF 1/2 OF THE BOX BEAM WAS CREATED. THE LENGTH OF BOX BEAM WAS ARBITRARILY CHOSEN TO BE .07 m. (ANY LENGTH COULD HAVE BEEN CHOSEN SINCE THE TEMPERATURES ARE ASSUMED CONSTANT IN A DIRECTION PARALLEL TO THE GUIDEWAY).

THE ALUMINUM PLATES WERE MODELLED USING 3-D QUADRILATERAL THERMAL SHELL ELEMENTS. THE ENCLOSED AIR WAS MODELLED USING 3-D ISOPARAMETRIC THERMAL SOLID ELEMENTS. CONVECTIVE AND RADIANT HEAT TRANSFER WAS MODELLED WITH APPROPRIATE CONVECTION AND RADIATION LINKS. SEE PG'S 3-13 FOR FINITE ELEMENT MODEL.

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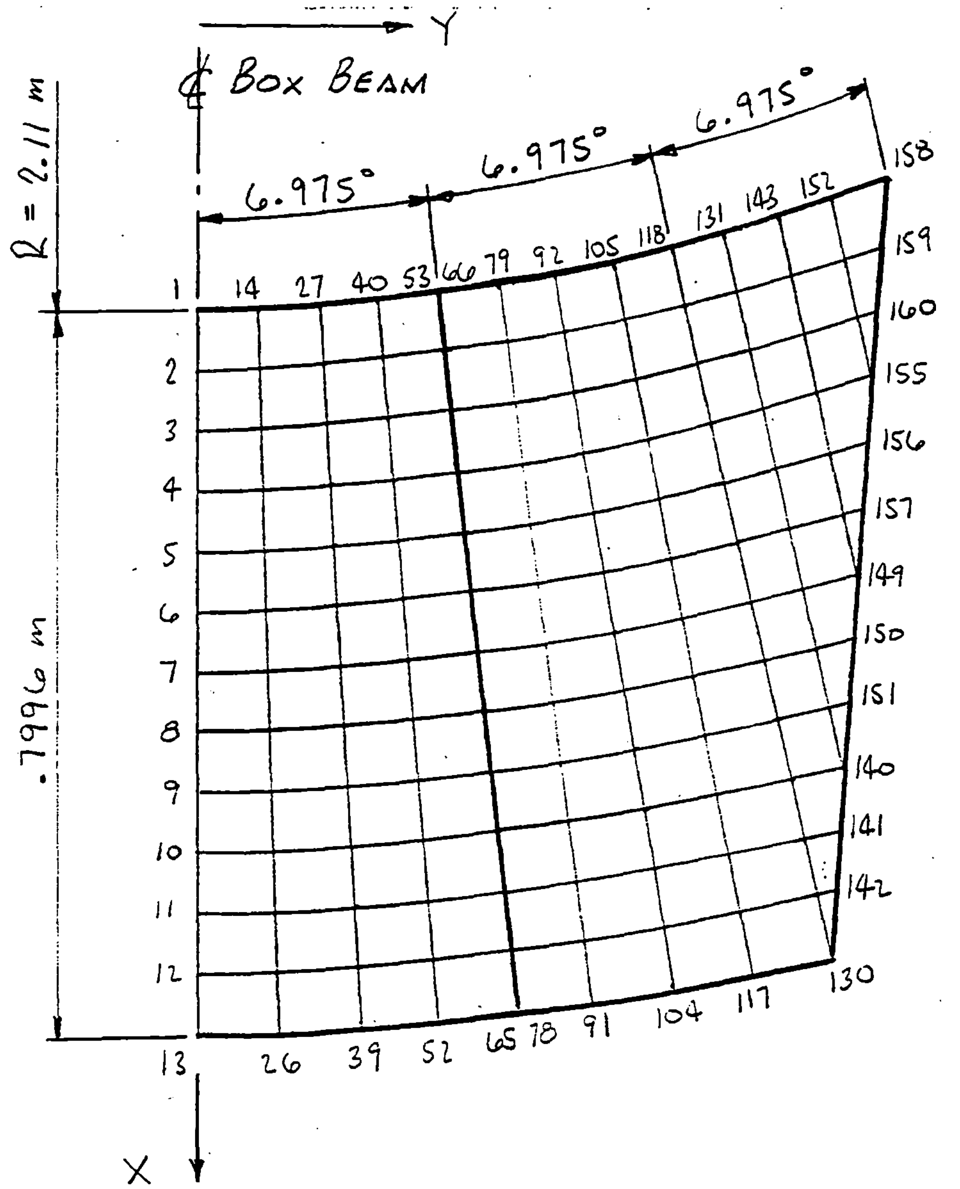
CUSTOMER MIT MI PROJECT MAGLEV

SUBJECT THERMAL STRESS - LEVITATION BOX BEAMS



SECTION THRU BOX BEAM

NODES FOR ENCLOSED AIR

Z = 0

FORM 62-114 A0388175

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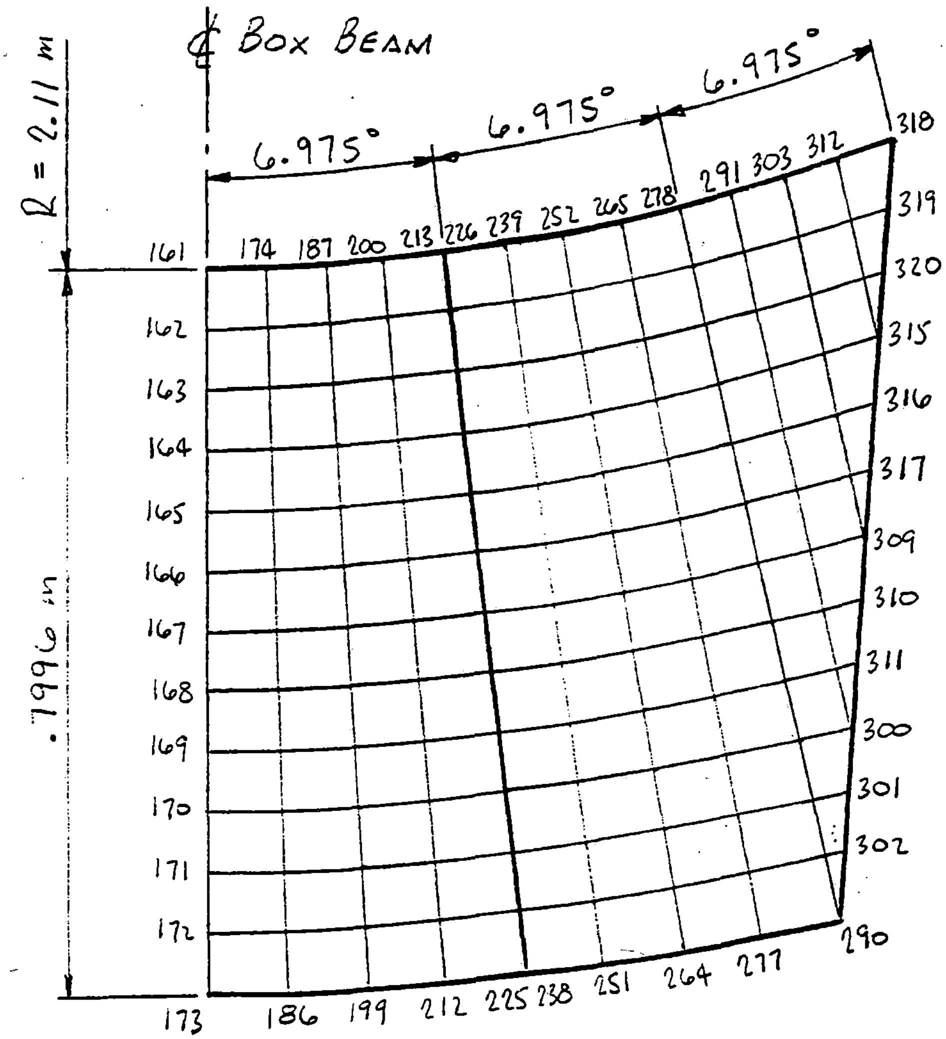
CUSTOMER MIT MI PROJECT MAGLEV

SUBJECT THERMAL STRESS - LEVITATION BOX BEAMS



SECTION THRU BOX BEAM

NODES FOR ENCLOSED AIR

Z = .07 m

FORM 62-114 (A0388175)

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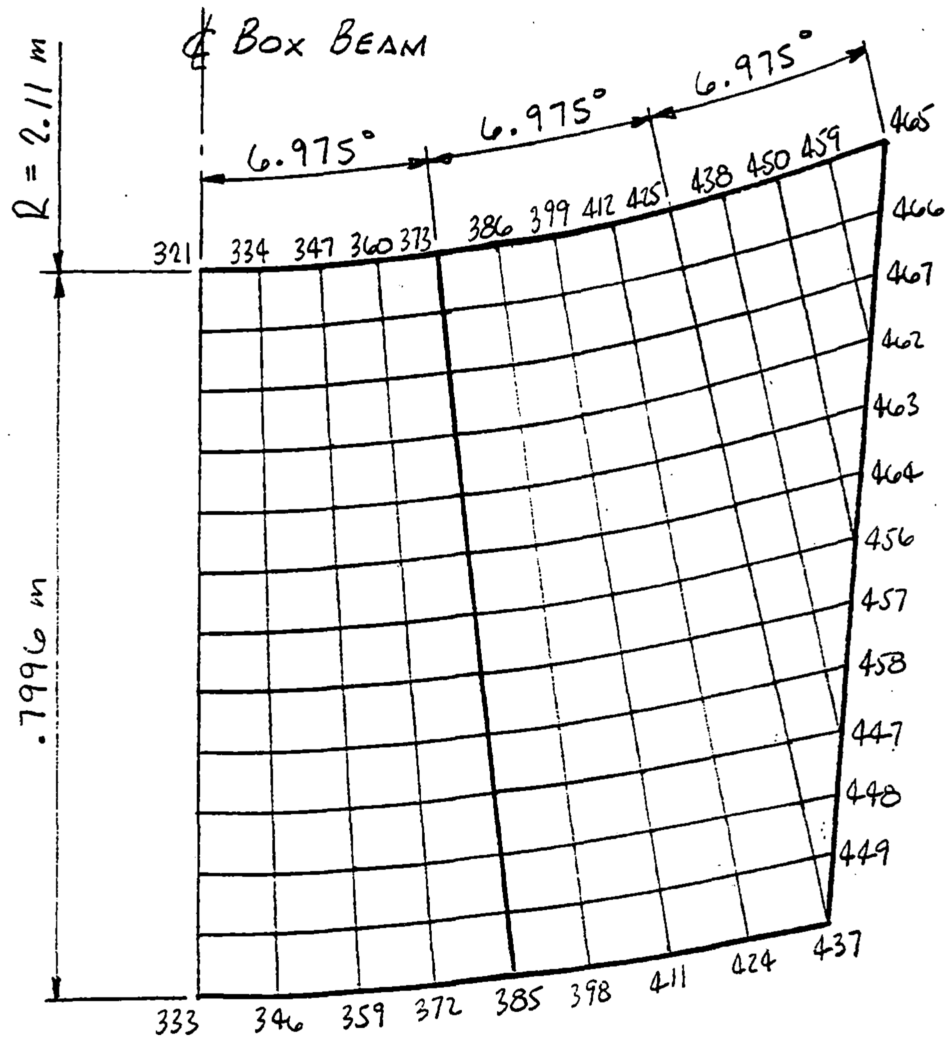
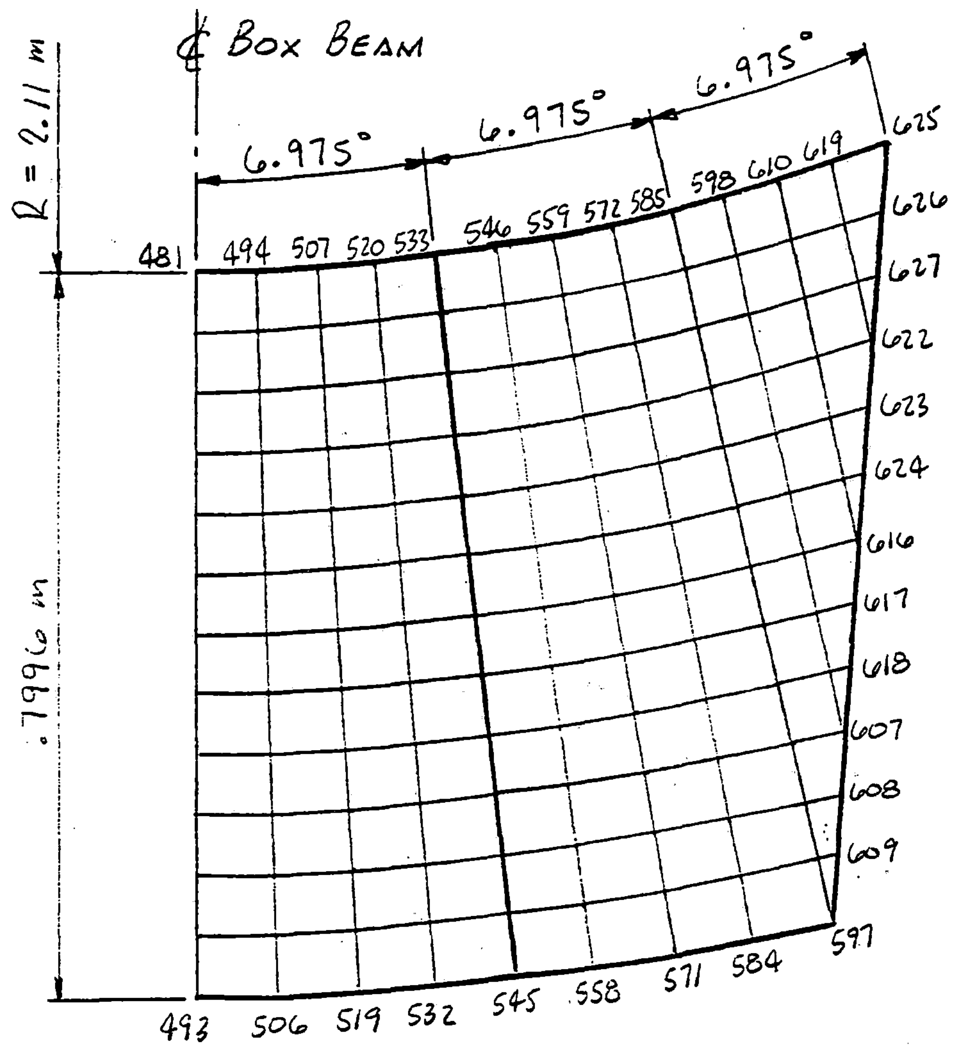
CUSTOMER MIT MI PROJECT MAGLEV
SUBJECT THERMAL STRESS - LEVITATION BOX BEAMS



SECTION THRU BOX BEAM

NODES FOR ALUMINUM PLATE

Z = 0



SECTION THRU BOX BEAM

NODES FOR ALUMINUM PLATE

$z = .07$ m

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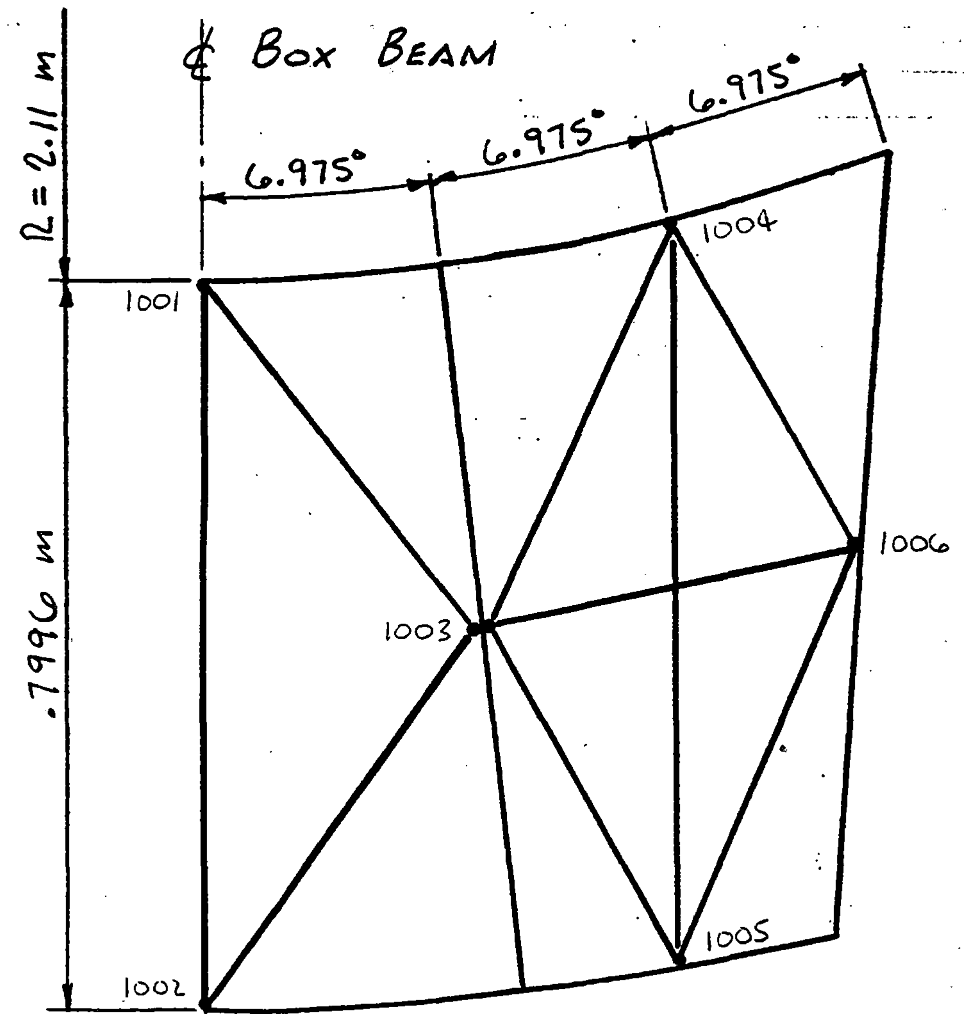
SUBJECT THERMAL STRESS - LEVITATION BOX BEAMS



SECTION THRU BOX BEAM

NODES FOR INTERNAL RADIATION LINKS

$Z = 0$

(TEMP. OF MID-SIDE NODE ASSUMED EQUAL TO AVERAGE OF PLATE TEMPS ALONG SIDE)

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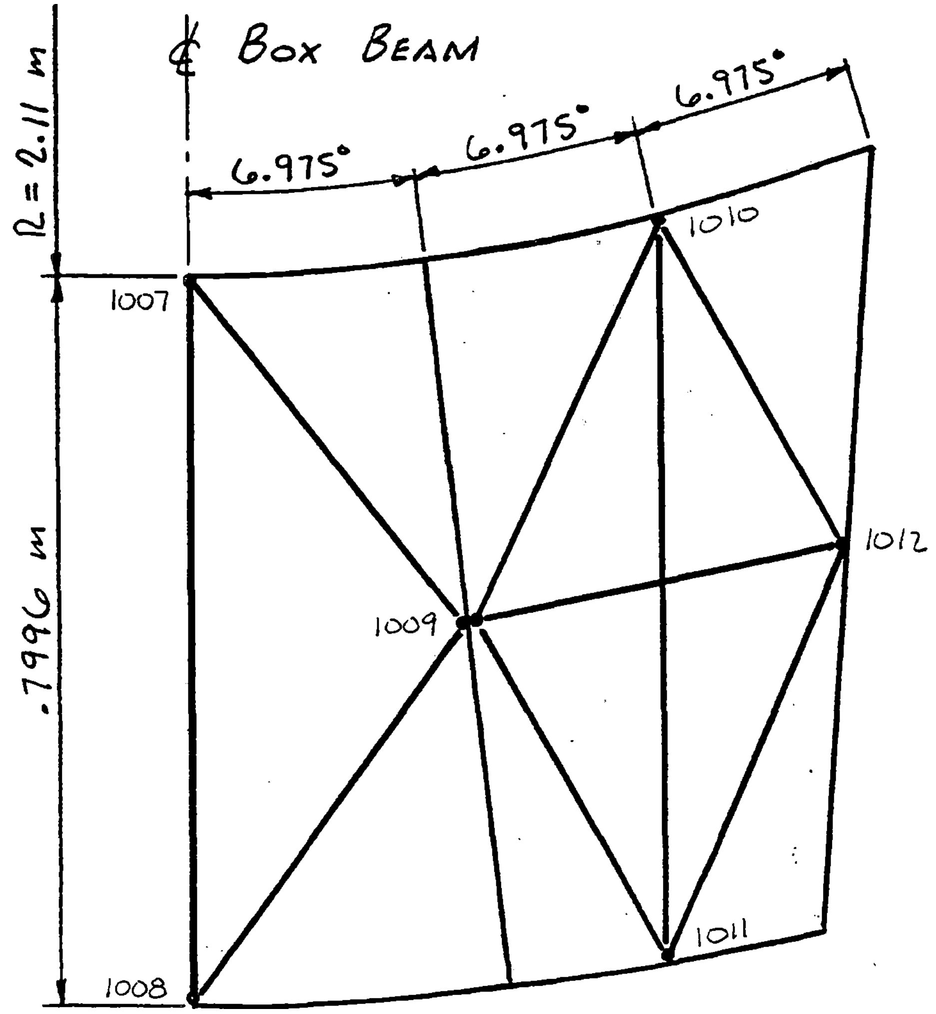
CUSTOMER MIT MI PROJECT MAGLEV

SUBJECT THERMAL STRESS - LEVITATION BOX BEAMS

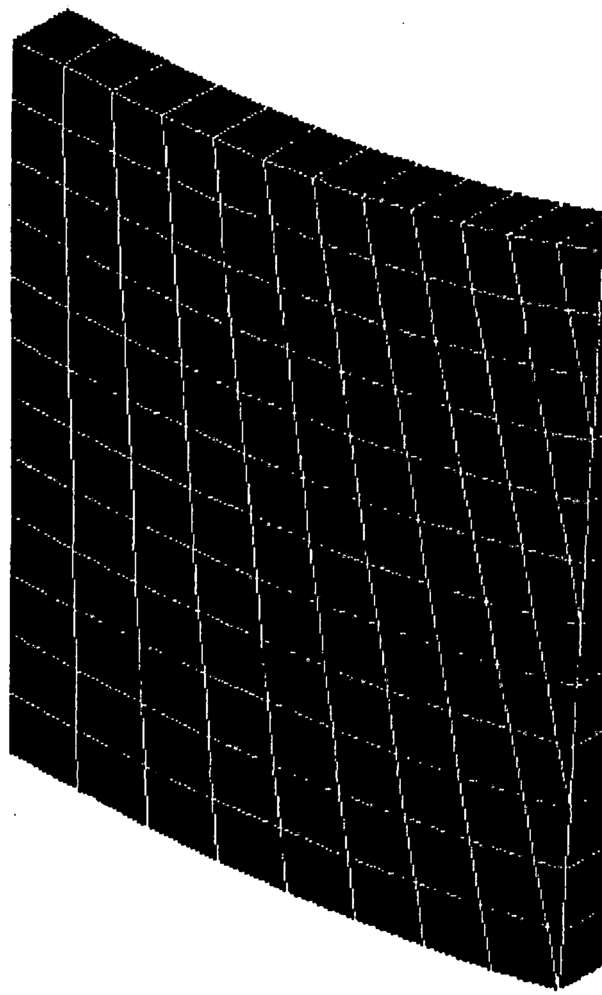


SECTION THRU BOX BEAM

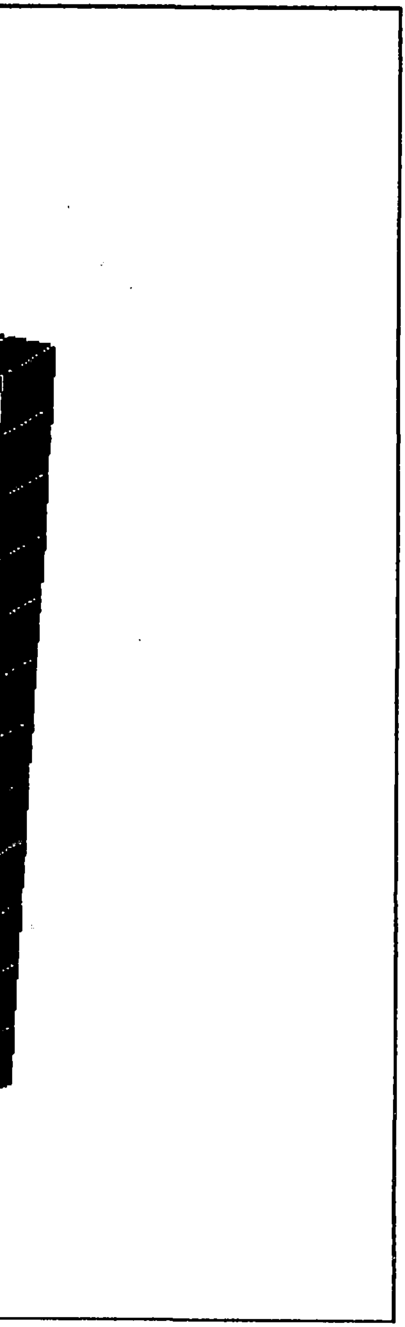
NODES FOR INTERNAL RADIATION LINKS

Z = .07

1



Heat Transfer Analysis Of Levitation Box Beam



ANSYS-PC 4.4A1
SEP 4 1992
13:42:48
PLOT NO. 1
PREP7 ELEMENTS
TYPE NUM

XV =-1
YV =1
ZV =1
*DIST=0.6
*XF =2.5
*YF =0.375
*ZF =0.035
ANG2=-120
CENTROID HIDDEN

ENCLOSED AIR

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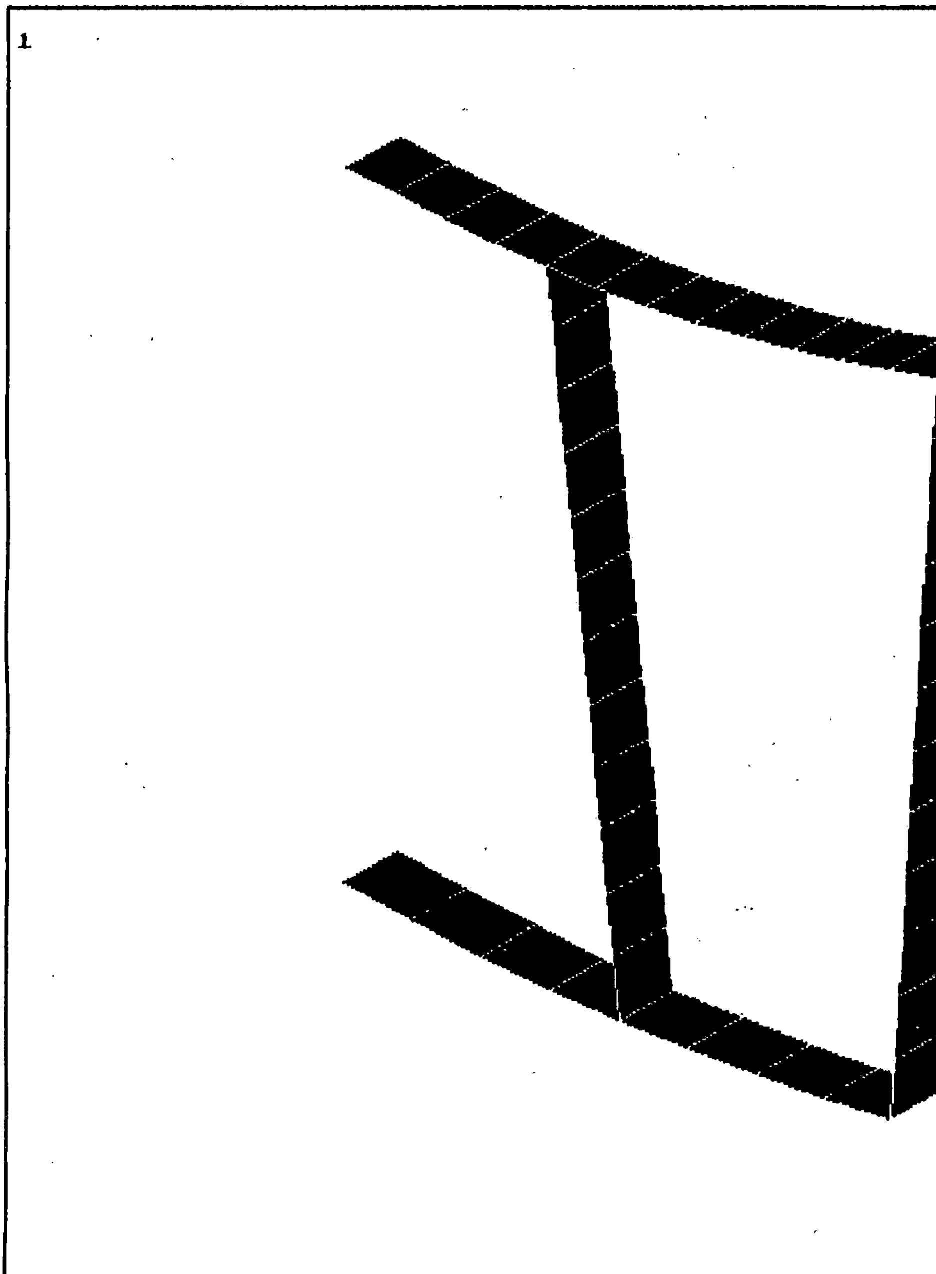
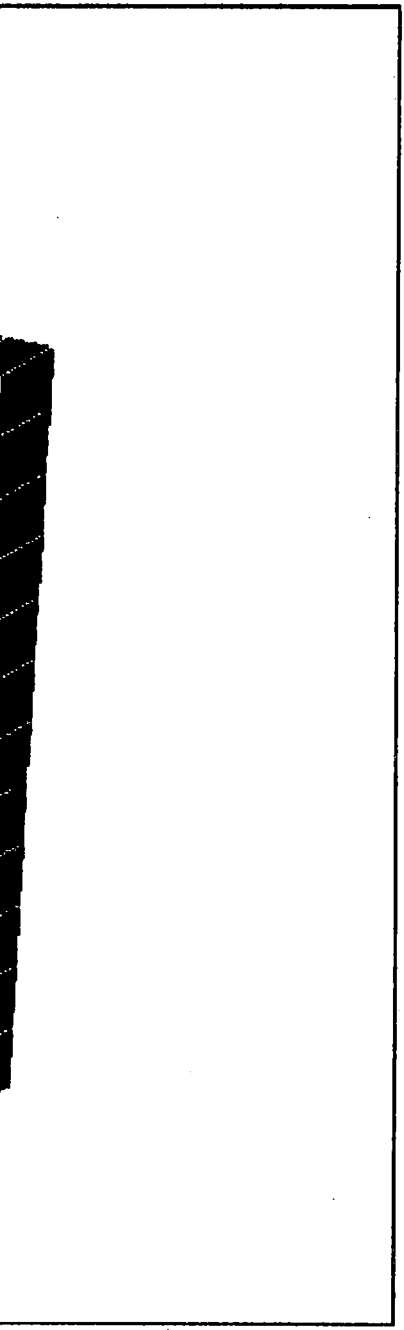


Heat Transfer Analysis Of Levitation Box Beam



ANSYS-PC 4.4A1
SEP 4 1992
13:43:17
PLOT NO. 2
PREP7 ELEMENTS
TYPE NUM

XV =-1
YV =1
ZV =1
*DIST=0.6
*XF =2.5
*YF =0.375
*ZF =0.035
ANGZ=-120
CENTROID HIDDEN

ALUMINUM PLATE

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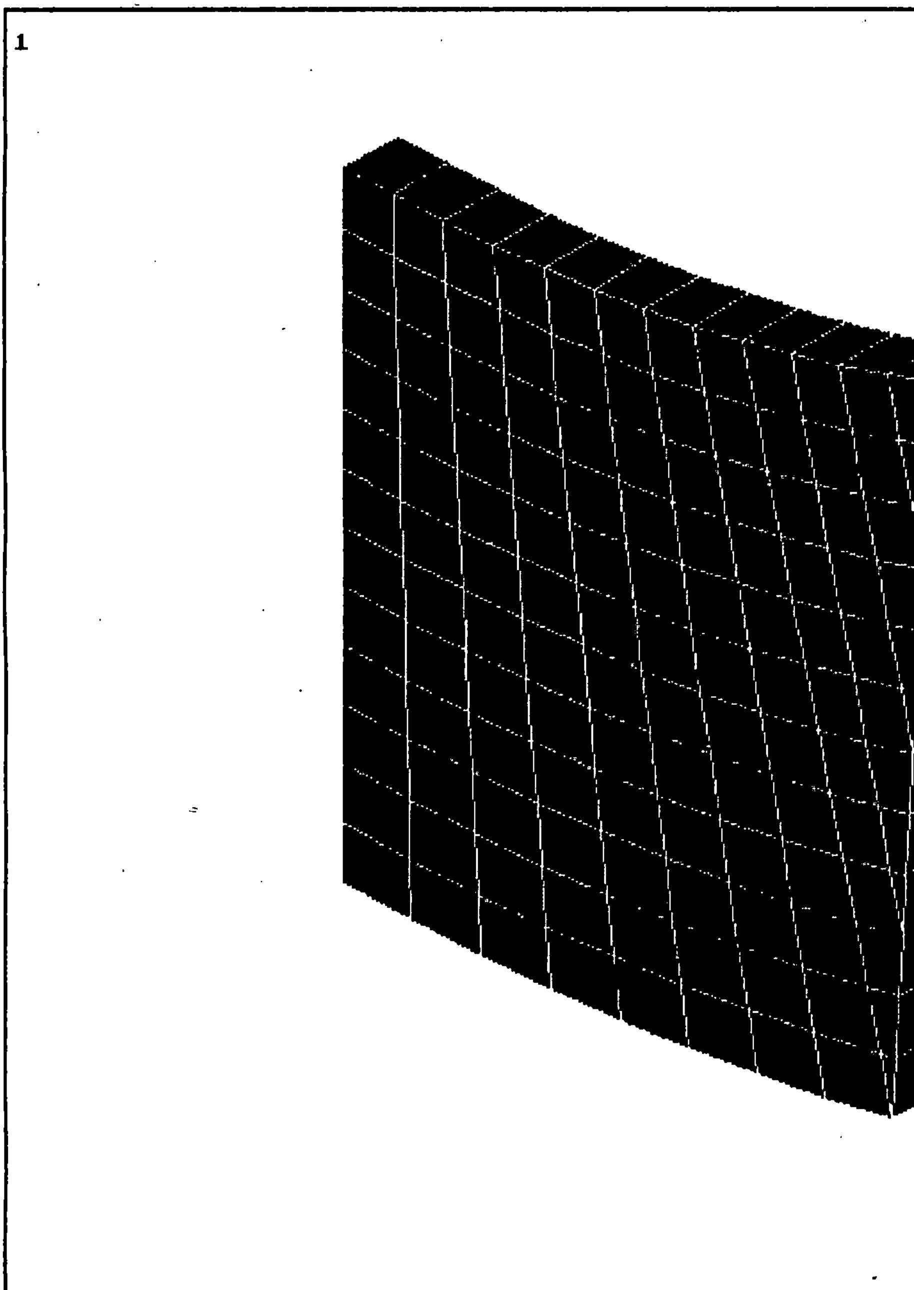
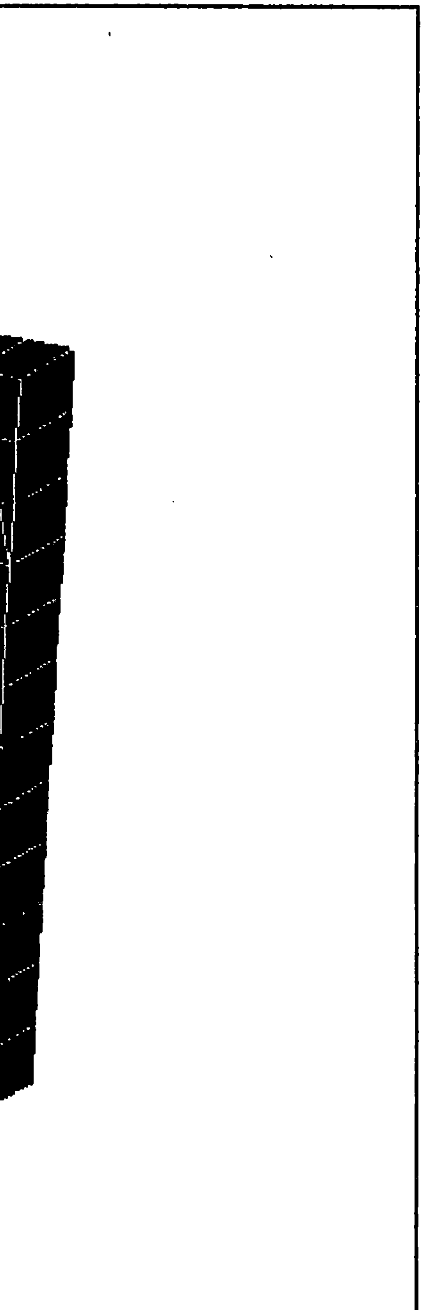


Heat Transfer Analysis Of Levitation Box Beam



ANSYS-PC 4.4A1
SEP 4 1992
13:43:44
PLOT NO. 3
PREP7 ELEMENTS
TYPE NUM

XV =-1
YV =1
ZV =1
*DIST=0.6
*XF =2.5
*YF =0.375
*ZF =0.035
ANGZ=-120
CENTROID HIDDEN

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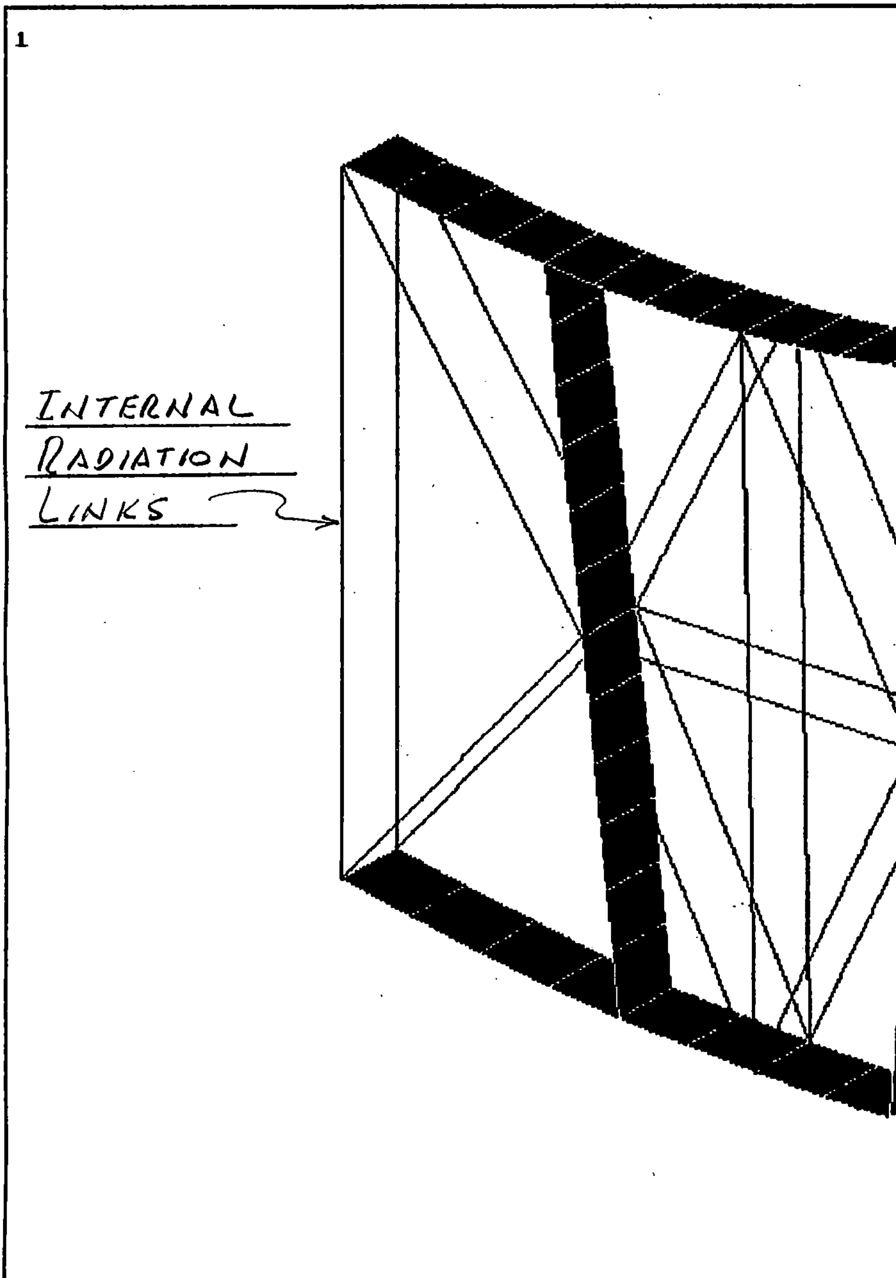
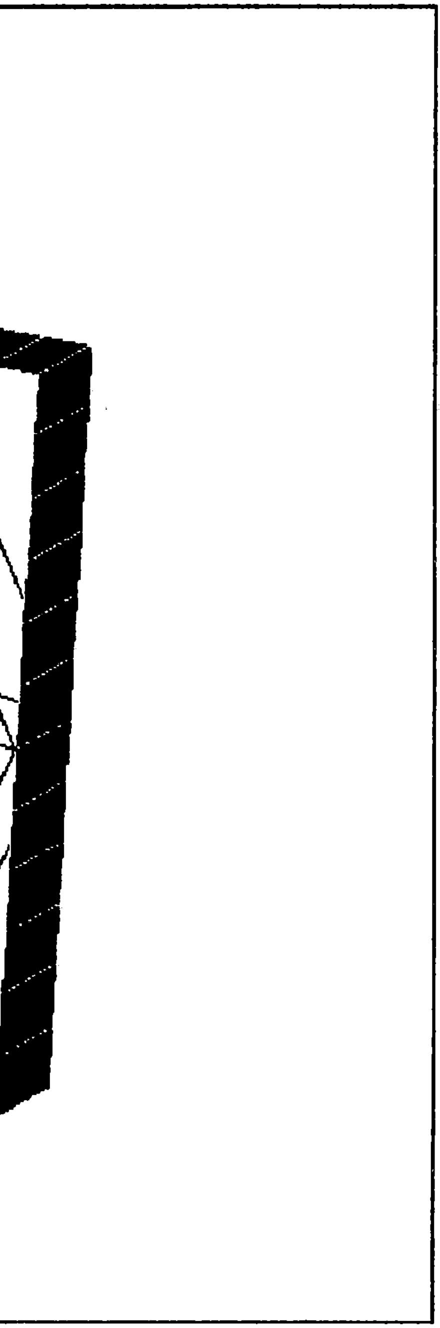


Heat Transfer Analysis Of Levitation Box Beam



ANSYS-PC 4.4A1
SEP 4 1992
13:46:47
PLOT NO. 4
PREP7 ELEMENTS
TYPE NUM

XV =-1
YV =1
ZV =1
*DIST=0.6
*XF =2.5
*YF =0.375
*ZF =0.035
ANGZ=-120
CENTROID HIDDEN

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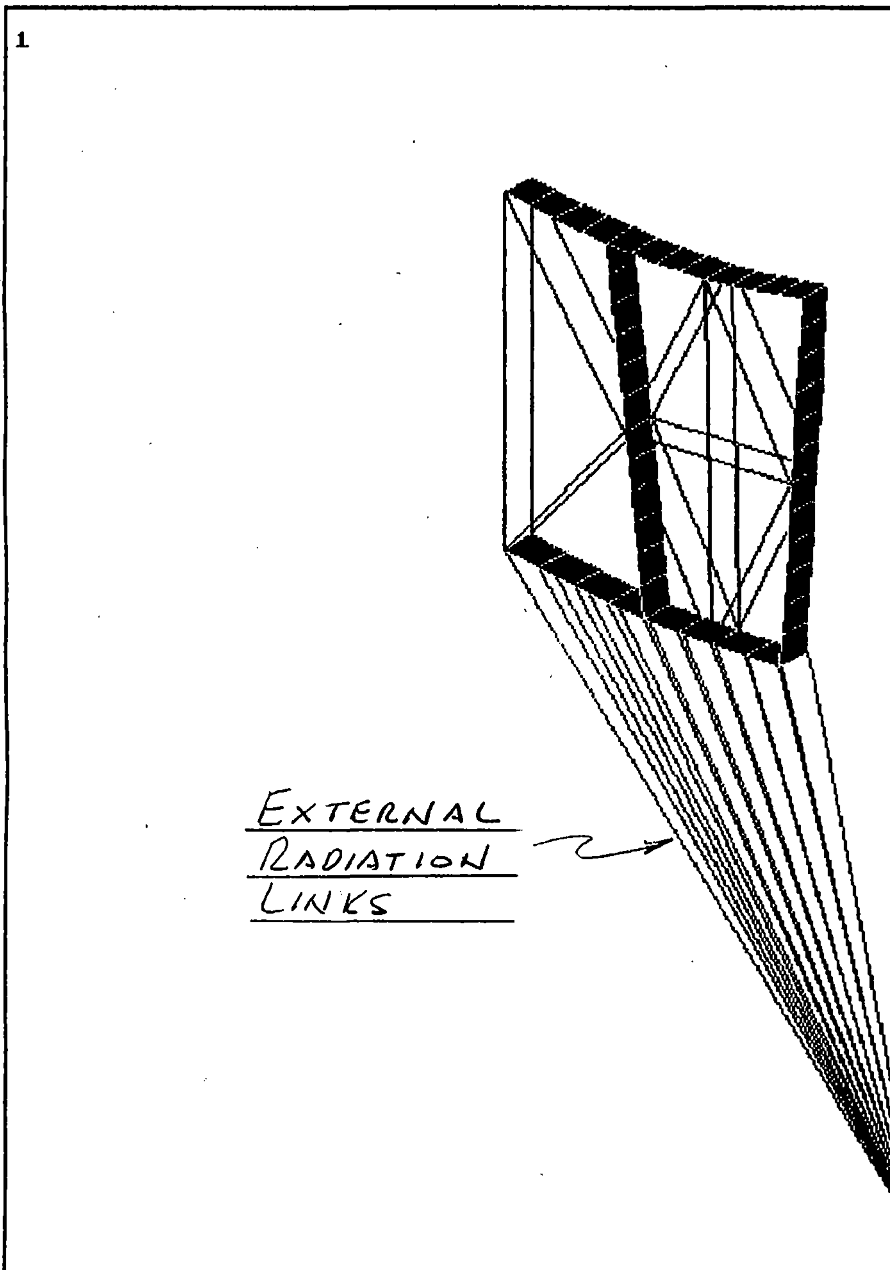

Heat Transfer Analysis Of Levitation Box Beam

2002 (32°C)

ANSYS-PC 4.4A1
SEP 4 1992
13:49:19
PLOT NO. 6
PREP7 ELEMENTS
TYPE NUM

XV =-1
YV =1
ZV =1
*DIST=1.2
*XF =3
*YF =0.375
*ZF =0.035
ANGZ=-120
CENTROID HIDDEN

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FILM COEFFICIENTS (FREE CONVECTION)

REF: "HEAT TRANSFER", J. P. HOLMAN, 4TH ED., PG'S 244-245.

T_s = SURFACE TEMP. OF PLATE
T_∞ = TEMP. OF SURROUNDING FLUID (AIR) FAR REMOVED FROM HEAT SOURCE
$\Delta T = T_s - T_\infty$
T_f = FILM TEMP. $= (T_s + T_\infty)/2 = T_s - \Delta T/2$
g = ACCELERATION OF GRAVITY

THE FOLLOWING ARE PROPERTIES OF THE SURROUNDING FLUID (AIR):
ρ = MASS DENSITY
C_p = SPECIFIC HEAT
μ = ABSOLUTE VISCOSITY
K = THERMAL CONDUCTIVITY
β = TEMP. COEFF. OF VOLUME EXPANSION

L = PLATE CHARACTERISTIC LENGTH

Gr_f = GRASHOF NO. EVALUATED AT T_f
$$= \left(\frac{\rho^2 g \beta}{\mu^2}\right)_f (T_s - T_\infty) L^3$$

Pr_f = PRANDTL NO. EVALUATED AT T_f
$$= \left(\frac{C_p \mu}{K}\right)_f$$

NOTE: FILM COEFFICIENTS WILL BE CALCULATED USING ENGLISH UNITS AND THEN CONVERTED TO METRIC UNITS.

UPPER SURFACE OF HEATED PLATES OR
LOWER SURFACE OF COOLED PLATES

THIS CASE APPLIES TO:

1) OUTER SURFACE OF TOP FLANGE
2) OUTER SURFACE OF EXTERNAL WEB
3) INNER SURFACE OF EXTERNAL WEB
4) UPPER SURFACE OF INTERNAL WEB

Nu_f = NUSSELT NO. EVALUATED AT T_f

$$= .15\,(Gr_f\,Pr_f)^{1/3}, \quad 8\times10^{6} < Gr_f\,Pr_f < 10^{11}$$

FILM COEFFICIENT:

$$h_c = Nu_f\left(\frac{K_f}{L}\right)$$

$$= .15\,K_f\left[\left(\frac{\rho^2 g \beta}{\mu^2}\right)_f \left(\frac{C_p \mu}{K}\right)_f \Delta T\right]^{1/3}$$

FOR TOP FLANGE, $L \approx 1.5$ m $= 4.921'$
FOR WEB, $L \approx .8$ m $= 2.625'$

THE AVERAGE FILM TEMPERATURE, T_f, IS ESTIMATED TO RANGE BETWEEN 100°F (37.8°C) AND 250°F (121.1°C).

FOR $T_f = 100$°F,

$$h_c = .15\times.0154\,[1.76\times10^{6}\times.72]^{1/3}\,\Delta T^{1/3}$$

$$= .250\,\Delta T^{1/3}$$

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SUBJECT THERMAL STRESS - LEVITATION BOX BEAMS

FOR $T_f = 250°F$,

$$h_c = .15 \times .0184 [6.47 \times 10^5 \times .715]^{1/3} \Delta T^{1/3}$$

$$= .213 \Delta T^{1/3}$$

USE AVERAGE VALUE

$$h_c = .231 \Delta T^{1/3} \quad BTU/hr/ft^2/°F$$

A CHECK SHOWS THAT $8 \times 10^6 < Gr_f Pr_f < 10^{11}$

ΔT °F	ΔT °C	h_c $BTU/hr/ft^2/°C$	h_c $W/m^2/°C$
0	0	0	0
5	2.778	.395	2.242
10	5.555	.498	2.825
20	11.11	.627	3.560
30	16.67	.718	4.075
40	22.22	.790	4.485
50	27.78	.851	4.831
100	55.56	1.072	6.087
150	83.33	1.227	6.968
200	111.1	1.351	7.669
250	138.9	1.455	8.261
300	166.7	1.546	8.778

LOWER SURFACE OF HEATED PLATES OR
UPPER SURFACE OF COOLED PLATES

THIS CASE APPLIES TO:
1) INNER SURFACE OF TOP FLANGE
2) INNER SURFACE OF BOTTOM FLANGE
3) OUTER SURFACE OF BOTTOM FLANGE
4) LOWER SURFACE OF INTERNAL WEB

$$Nu_f = .58\,(Gr_f\, Pr_f)^{1/5}, \qquad 10^5 < Gr_f\, Pr_f < 10^{11}$$

FILM COEFFICIENT:

$$h_c = Nu_f \left(\frac{K_f}{L}\right)$$

$$= .58\, K_f \left[\left(\frac{\rho^2 g \beta}{\mu^2}\right)_f \left(\frac{C_p \mu}{K}\right)_f \frac{\Delta T}{L^2}\right]^{1/5}$$

FOR $T_f = 100°F$

$$h_c = .58 \times .0154\,[1.76\times 10^6 \times .72]^{1/5} \left(\frac{\Delta T}{L^2}\right)^{1/5}$$

$$= .148 \left(\frac{\Delta T}{L^2}\right)^{1/5}$$

FOR $T_f = 250°F$

$$h_c = .58\times .0184\,[6.47\times 10^5 \times .715]^{1/5} \left(\frac{\Delta T}{L^2}\right)^{1/5}$$

$$= .145 \left(\frac{\Delta T}{L^2}\right)^{1/5}$$

USE AVERAGE VALUE

$$h_c = .147 \left(\frac{\Delta T}{L^2}\right)^{1/5}$$

FOR $L = 1.5\,m = 4.921'$

$$h_c = .0777\ \Delta T^{1/5}\ BTU/hr/ft^2/°F$$

ΔT °F	ΔT °C	h_c $BTU/hr/ft^2/°F$	h_c $W/m^2/°C$
0	0	0	0
5	2.778	.107	.609
10	5.555	.123	.699
20	11.11	.141	.803
30	16.67	.153	.871
40	22.22	.162	.922
50	27.78	.170	.965
100	55.56	.195	1.108
150	83.33	.212	1.202
200	111.1	.224	1.273
250	138.9	.234	1.331
300	166.7	.243	1.380

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CUSTOMER MIT MI PROJECT MAGLEV

SUBJECT THERMAL STRESS - LEVITATION BOX BEAMS

For $l = .8\,m = 2.625'$

$$h_c = .0999\ \Delta T^{1/5}\ \text{BTU/hr/ft}^2/°\text{F}$$

ΔT °F	ΔT °C	h_c BTU/hr/ft²/°F	h_c W/m²/°C
0	0	0	0
5	2.778	.138	.782
10	5.555	.158	.899
20	11.11	.182	1.032
30	16.67	.197	1.120
40	22.22	.209	1.186
50	27.78	.218	1.240
100	55.56	.251	1.425
150	83.33	.272	1.545
200	111.1	.288	1.636
250	138.9	.301	1.711
300	166.7	.313	1.775

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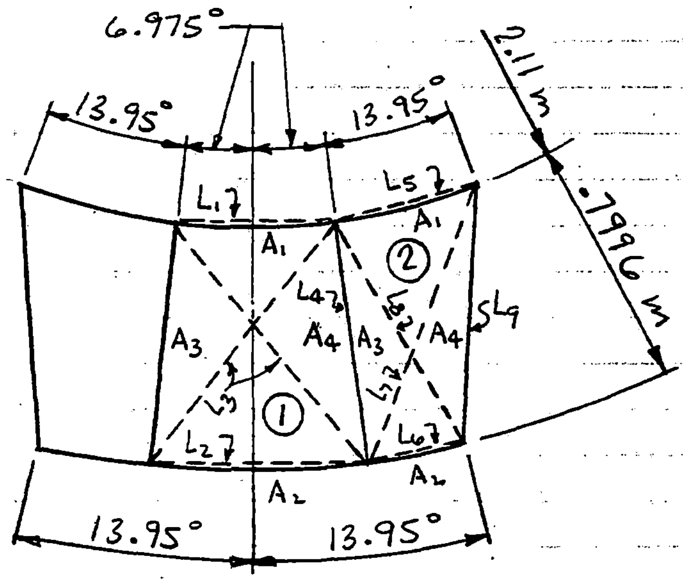
SUBJECT THERMAL STRESS - LEVITATION BOX BEAMS

VIEW FACTORS FOR INTERNAL RADIATION
(BLACK-BODY RADIATION)



REF: "HEAT TRANSMISSION", W.H. MC ADAMS, 3RD ED., pp. 63-69.

LENGTHS, L_1 THRU L_9:

$L_1 = 2 \times 2.11 \sin 6.975° = .5125$ m
$L_2 = 2 \times 2.9096 \sin 6.975° = .7067$ m

$L_3 = \sqrt{(5.0196 \sin 6.975°)^2 + (.7996 \cos 6.975°)^2}$
$= 1.0007$ m
$L_4 = .7996$ m
$L_5 = L_1 = .5125$ m

$L_6 = 2.9096 \sqrt{(\sin 13.95° - \sin 6.975°)^2 + (\cos 6.975° - \cos 13.95°)^2}$
$= .3540$ m

FORM 62-114/A0388175I

$$L_7 = \sqrt{(2.11\sin 20.925° - 2.9096\sin 6.975°)^2 + (2.9096\cos 6.975° - 2.11\cos 20.925°)^2}$$

$$= 1.0007 \text{ m}$$

$$L_8 = \sqrt{(2.9096\sin 13.95° - 2.11\sin 6.975°)^2 + (2.9096\cos 13.95° - 2.11\cos 6.975°)^2}$$

$$= .8545 \text{ m}$$

$$L_9 = \sqrt{(2.11\sin 20.925° - 2.9096\sin 13.95°)^2 + (2.9096\cos 13.95° - 2.11\cos 20.925°)^2}$$

$$= .8545 \text{ m}$$

CELL No. 1

$A_1F_{12} = (2L_3 - 2L_4)/2 = .2011$

$A_1F_{13} = A_1F_{14} = (L_1 + L_4 - L_3)/2 = .1557$

$A_1F_{12} + A_1F_{13} + A_1F_{14} = .5125 = A_1$ (CHECKS)

$A_2F_{23} = A_2F_{24} = (L_2 + L_4 - L_3)/2 = .2528$

$A_2F_{21} + A_2F_{23} + A_2F_{24} = .7067 = A_2$ (CHECKS)

$A_3F_{34} = (2L_3 - L_1 - L_2)/2 = .3911$

$A_3F_{31} + A_3F_{32} + A_3F_{34} = .7996 = A_3$ (CHECKS)

CELL No. 2

$$A_1 F_{12} = (L_7 + L_8 - L_4 - L_9)/2 = .1006$$

$$A_1 F_{13} = (L_4 + L_5 - L_7)/2 = .1557$$

$$A_1 F_{14} = (L_5 + L_9 - L_8)/2 = .2562$$

$$A_1 F_{12} + A_1 F_{13} + A_1 F_{14} = .5125 = A_1 \quad \text{(CHECKS)}$$

$$A_2 F_{23} = (L_4 + L_6 - L_8)/2 = .1495$$

$$A_2 F_{24} = (L_6 + L_9 - L_7)/2 = .1039$$

$$A_2 F_{21} + A_2 F_{23} + A_2 F_{24} = .3540 = A_2 \quad \text{(CHECKS)}$$

$$A_3 F_{34} = (L_7 + L_8 - L_5 - L_6)/2 = .4944$$

$$A_3 F_{31} + A_3 F_{32} + A_3 F_{34} = .7996 = A_3 \quad \text{(CHECKS)}$$

TOTAL SHAPE FACTOR

THE GEOMETRIC VIEW FACTORS MUST BE FURTHER MODIFIED BY THE DEPARTURE OF THE SURFACES FROM BLACK-BODY CONDITIONS.

REF: "PRINCIPLES OF HEAT TRANSFER", F. KREITH, 2ND ED.

REFERRING TO EQ. 5-29, PG. 227

$$A_i F'_{ij} = \frac{1}{\rho_i/(A_i F_{ij} \epsilon_i) + \rho_j/(A_j F_{ji} \epsilon_j) + 1/(A_i F_{ij})}$$

$$F'_{ij} = \text{TOTAL SHAPE FACTOR}$$

$$\rho_i = 1 - \epsilon_i$$

$$\rho_j = 1 - \epsilon_j$$

$$A_j F_{ji} = A_i F_{ij}$$

$\therefore$

$$F'_{ij} = F_{ij} \left(\frac{1}{1/\epsilon_i + 1/\epsilon_j - 1} \right)$$

LET $\epsilon_i = \epsilon_j = \epsilon$

$$F'_{ij} = F_{ij} \left(\frac{\epsilon}{2 - \epsilon} \right)$$

$$q_{i \to j} = A_i F'_{ij} \sigma (T_i^4 - T_j^4)$$

$$= \sigma \epsilon \left(\frac{F_{ij}}{2 - \epsilon} \right) A_i (T_i^4 - T_j^4)$$

BASELINE = 120 sec HEADWAY

Magnetic Drag Guideway Heatloads for 20 Second Headway (others by inverse proportion)

Velocity m/s	150	100	50	30
Magnetic Drag Newtons (lbs)	15052 (3384)	21368 (4804)	40868 (9188)	68107 (15312)
Guideway ΔT Per Vehicle °C (°F)	0.09 (0.17)	0.13 (0.24)	0.25 (0.45)	0.42 (0.76)
	250	356	681	1134 ← W/m² *
Energy Input to 3.05 m (10 ft) of Guideway kw (BTU/hr)	2.29 (~~2820~~) 7816	3.26 (11,132)	6.23 (21,275)	10.38 (35,447)
Q/A Convective kw/m² (BTU/hr ft²)	0.25 (79.5)	0.36 (113.1)	0.68 (216)	1.13 (360)
ΔT (Convection Only) °C (°F)	52 (93)	61 (110)	89 (160)	136 (244)
ΔT est Convection + Radiation at ∈=.4 for Anodized Aluminum °C (°F)	42 (75)	50 (90)	61 (110)	72 (130)

* $W/m^2 = \frac{1000 \times kW}{3 \times 3.05}$

Figure 98 Guideway heating

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TABLE 1
COEFFICIENTS OF THERMAL CONDUCTIVITY AND THERMAL DIFFUSIVITY

Temp. (F)	Carbon Steel[1]		Austenitic SS[2]		Low-Chrome Steel[6]		High-Chrome Steel[3]		Aluminum		Nickel-Chrome-Iron	
	TC[4]	TD[5]	TC	TD	TC[4]	TD[5]	TC	TD	TC	TD	TC	TD
70	31.50	0.5692	8.35	0.1498	18.95	0.3424	13.10	0.2414	120.75	3.3753	8.40	0.1406
100	31.00	0.5509	8.40	0.1495	18.90	0.3387	13.30	0.2410	121.25	3.3469	8.50	0.1441
150	30.50	0.5241	8.67	0.1525	18.85	0.3350	13.55	0.2394	122.00	3.3084	8.80	0.1444
200	30.00	0.5246	8.90	0.1548	18.80	0.3287	13.80	0.2379	123.00	3.2807	9.00	0.1460
250	29.50	0.5075	9.12	0.1568	18.75	0.3226	14.05	0.2366	123.75	3.2523	9.30	0.1491
300	29.10	0.4928	9.35	0.1589	18.70	0.3167	14.30	0.2362	124.50	3.2252	9.50	0.1505
350	28.60	0.4770	9.56	0.1601	18.65	0.3110	14.55	0.2350	125.50	3.2075	9.75	0.1521
400	28.10	0.4616	9.80	0.1630	18.60	0.3055	14.80	0.2338	126.25	3.1956	10.00	0.1549
450	27.60	0.4467	10.00	0.1639	18.55	0.3003	15.05	0.2327	127.00	3.1709	10.25	0.1565
500	27.20	0.4338	10.23	0.1659	18.50	0.2951	15.30	0.2316	128.00	3.1616	10.50	0.1586
550	26.70	0.4198	10.45	0.1684	18.45	0.2901	15.60	0.2306	128.75	3.1512	10.75	0.1613
600	26.20	0.4061	10.70	0.1707	18.40	0.2852	15.85	0.2305	129.50	3.1364	11.00	0.1634
650	25.80	0.3915	10.90	0.1721	18.35	0.2784	16.10	0.2296	130.50	3.1390	11.25	0.1653
700	25.30	0.3763	11.10	0.1736	18.30	0.2722	16.35	0.2288	131.25	3.1296	11.50	0.1673
750	24.80	0.3616	11.35	0.1757	18.25	0.2661	16.60	0.2280	132.25	3.1266	11.75	0.1692
800	24.30	0.3450	11.55	0.1778	18.20	0.2584	16.85	0.2273	133.00	3.1191	12.00	0.1718
850	23.90	0.3305	11.80	0.1799	18.15	0.2510	17.10	0.2266	133.75	3.1107	12.30	0.1744
900	23.40	0.3033	11.95	0.1806	18.10	0.2446	17.35	0.2260	134.52	3.1039	12.55	0.1762
950	22.90	0.2979	12.20	0.1833	18.05	0.2358	17.60	0.2254	135.25	3.1019	12.85	0.1794
1000	22.40	0.2830	12.42	0.1849	18.00	0.2274	17.90	0.2268	136.25	3.1056	13.15	0.1819
1050	22.00	0.2703	12.70	0.1880	17.95	0.2205	18.15	0.2276	...	...	13.40	0.1844
1100	21.50	0.2570	12.90	0.1890	17.90	0.2139	18.40	0.2297	...	...	13.70	0.1874
1150	21.00	0.2402	13.10	0.1918	17.85	0.1999	18.65	0.2325	...	...	14.00	0.1905
1200	20.50	0.2299	13.30	0.1931	17.80	0.1996	18.90	0.2353	...	...	14.30	0.1928
1250	20.00	0.2173	13.55	0.1957	17.75	0.1929	19.15	0.2403	...	...	14.55	0.1951
1300	19.60	0.2055	13.80	0.1985	17.70	0.1854	19.40	0.2446	...	...	14.65	0.1981
1350	18.70	0.1926	14.00	0.2001	17.65	0.1780	19.65	0.2496	...	...	15.20	0.2017
1400	18.70	0.1859	14.20	0.2019	17.60	0.1747	19.90	0.2547	...	...	15.45	0.2040
1450	18.30	0.1704	14.40	0.2038	17.55	0.1633	20.15	0.2592	...	...	15.70	0.2062
1500	17.70	0.1577	14.65	0.2070	17.50	0.1559	20.45	0.2651	...	...	16.00	0.2098

NOTES:
(1) This group includes carbon and carbon-molybdenum steels.
(2) Austenitic stainless steels include those having 18 Cr-8 Ni through and including those having 25 Cr-20 Ni.
(3) This group includes those chrome steels containing 12 Cr and 17 Cr.
(4) TC equals thermal conductivity, Btu/hr, ft, F.
(5) TD equals thermal diffusivity, ft^2/hr. Thermal diffusivity equals:

$$\frac{\text{Thermal Conductivity (Btu/hr, ft, F)}}{\text{Density (lb/ft}^3\text{)} \times \text{Specific Heat (Btu/lb, F)}}$$

(6) 3% Max. Cr.

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TABLE A-3

PHYSICAL PROPERTIES OF GASES, LIQUIDS, AND LIQUID METALS
(All Gas Properties Are for Atmospheric Pressure)

GASES

Air

T (F)	ρ (lbm/cu ft)	c_p (Btu/lbm F)	$\mu \times 10^3$ (lbm/ft sec)	$\nu \times 10^3$ (sq ft/sec)	k (Btu/hr ft F)	Pr	α (sq ft/hr)	$\beta \times 10^3$ (1/F)	$\frac{g\beta\rho^2}{\mu^2}$ (1/F cu ft)
0	0.086	0.239	1.110	0.130	0.0133	0.73	0.646	2.18	4.2×10^6
32	0.081	0.240	1.165	0.145	0.0140	0.72	0.720	2.03	3.16
100	0.071	0.240	1.285	0.180	0.0154	0.72	0.905	1.79	1.76
200	0.060	0.241	1.440	0.239	0.0174	0.72	1.20	1.52	0.850
300	0.052	0.243	1.610	0.306	0.0193	0.71	1.53	1.32	0.444
400	0.046	0.245	1.750	0.378	0.0212	0.689	1.88	1.16	0.258
500	0.0412	0.247	1.890	0.455	0.0231	0.683	2.27	1.04	0.159
600	0.0373	0.250	2.000	0.540	0.0250	0.685	2.68	0.943	0.106
700	0.0341	0.253	2.14	0.625	0.0268	0.690	3.10	0.862	70.4×10^3
800	0.0314	0.256	2.25	0.717	0.0286	0.697	3.56	0.794	49.8
900	0.0291	0.259	2.36	0.815	0.0303	0.705	4.02	0.735	36.0
1000	0.0271	0.262	2.47	0.917	0.0319	0.713	4.50	0.685	26.5
1500	0.0202	0.276	3.00	1.47	0.0400	0.739	7.19	0.510	7.45
2000	0.0161	0.286	3.45	2.14	0.0471	0.753	10.2	0.406	2.84
2500	0.0133	0.292	3.69	2.80	0.051	0.763	13.1	0.338	1.41
3000	0.0114	0.297	3.86	3.39	0.054	0.765	16.0	0.289	0.815

Steam

T (F)	ρ (lbm/cu ft)	c_p (Btu/lbm F)	$\mu \times 10^3$ (lbm/ft sec)	$\nu \times 10^3$ (sq ft/sec)	k (Btu/hr ft F)	Pr	α (sq ft/hr)	$\beta \times 10^3$ (1/F)	$\frac{g\beta\rho^2}{\mu^2}$ (1/F cu ft)
212	0.0372	0.451	0.870	0.234	0.0145	0.96	0.864	1.49	0.877×10^6
300	0.0328	0.456	1.000	0.303	0.0171	0.95	1.14	1.32	0.459
400	0.0288	0.462	1.130	0.395	0.0200	0.94	1.50	1.16	0.243
500	0.0258	0.470	1.265	0.490	0.0228	0.94	1.88	1.04	0.139
600	0.0233	0.477	1.420	0.610	0.0257	0.94	2.31	0.943	82×10^3
700	0.0213	0.485	1.555	0.725	0.0288	0.93	2.79	0.862	52.1
800	0.0196	0.494	1.700	0.855	0.0321	0.92	3.32	0.794	34.0
900	0.0181	0.50	1.810	0.987	0.0355	0.91	3.93	0.735	23.6
1000	0.0169	0.51	1.920	1.13	0.0388	0.91	4.50	0.685	17.1
1200	0.0149	0.53	2.14	1.44	0.0457	0.88	5.80	0.603	9.4
1400	0.0133	0.55	2.36	1.78	0.053	0.87	7.25	0.537	5.49
1600	0.0120	0.56	2.58	2.14	0.061	0.87	9.07	0.485	3.38
1800	0.0109	0.58	2.81	2.58	0.068	0.87	10.8	0.442	2.14
2000	0.0100	0.60	3.03	3.03	0.076	0.86	12.7	0.406	1.43
2500	0.0083	0.64	3.58	4.30	0.096	0.86	18.1	0.338	0.603
3000	0.0071	0.67	4.00	5.75	0.114	0.86	24.0	0.289	0.293

Oxygen

T (F)	ρ (lbm/cu ft)	c_p (Btu/lbm F)	$\mu \times 10^3$ (lbm/ft sec)	$\nu \times 10^3$ (sq ft/sec)	k (Btu/hr ft F)	Pr	α (sq ft/hr)	$\beta \times 10^3$ (1/F)	$\frac{g\beta\rho^2}{\mu^2}$ (1/F cu ft)
0	0.0955	0.2185	1.215	0.127	0.0131	0.73	0.627	2.18	4.33×10^6
100	0.0785	0.2200	1.420	0.181	0.0159	0.71	0.880	1.79	1.76
200	0.0666	0.2228	1.610	0.242	0.0179	0.722	1.20	1.52	0.84
400	0.0511	0.2305	1.955	0.382	0.0228	0.710	1.94	1.16	0.256
600	0.0415	0.2390	2.26	0.545	0.0277	0.704	2.79	0.943	0.103
800	0.0349	0.2465	2.53	0.725	0.0324	0.695	3.76	0.794	48.5×10^3
1000	0.0301	0.2528	2.78	0.924	0.0366	0.690	4.80	0.685	25.8
1500	0.0224	0.2635	3.32	1.480	0.0465	0.677	7.88	0.510	7.50

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TABLE 5-1
EMISSIVITIES OF VARIOUS SURFACES

Material	Wavelength and Average Temperature				
	9.3μ 100 F	5.4μ 500 F	3.6μ 1000 F	1.8μ 2500 F	0.6μ Solar
Metals					
Aluminum					
Polished	0.04	0.05	0.08	0.19	~0.3
Oxidized	0.11	0.12	0.18		
24-ST weathered	0.4	0.32	0.27		
Surface roofing	0.22				
Anodized (at 1000 F)	0.94	0.42	0.60	0.34	
Brass					
Polished	0.10	0.10			
Oxidized	0.61				
Chromium					
Polished	0.08	0.17	0.26	0.40	0.49
Copper					
Polished	0.04	0.05	0.18	0.17	
Oxidized	0.87	0.83	0.77		
Iron					
Polished	0.06	0.08	0.13	0.25	0.45
Cast, oxidized	0.63	0.66	0.76		
Galvanized, new	0.23	....	....	0.42	0.66
Galvanized, dirty	0.28	....	....	0.90	0.89
Steel plate, rough	0.94	0.97	0.98		
Oxide	0.96	....	0.85	....	0.74
Molten	....	....	....	0.3–0.4	
Magnesium	0.07	0.13	0.18	0.24	0.30
Molybdenum filament	....	....	~0.09	~0.15	~0.2*
Silver					
Polished	0.01	0.02	0.03	....	0.11
Stainless steel					
18–8, polished	0.15	0.18	0.22		
18–8, weathered	0.85	0.85	0.85		
Steel tube					
Oxidized	....	0.80			
Tungsten filament	0.03	....	....	~0.18	0.35†
Zinc					
Polished	0.02	0.03	0.04	0.06	0.46
Galvanized sheet	~0.25				
Building and Insulating Materials					
Asbestos paper	0.93	0.93			
Asphalt	0.93	....	0.9	...	0.93
Brick					
Red	0.93	....	....	....	0.7
Fire clay	0.9	....	~0.7	~0.75	
Silica	0.9	....	~0.75	0.84	
Magnesite refractory	0.9	....	....	~0.4	
Enamel, white	0.9				
Marble, white	0.95	....	0.93	....	0.47
Paper, white	0.95	....	0.82	0.25	0.28
Plaster	0.91				

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TABLE A-23. NORMAL TOTAL EMISSIVITY OF VARIOUS SURFACES
(Compiled by H. C. Hottel)

Surface	t, deg F[a]	Emissivity	Reference number
A. Metals and Their Oxides			
Aluminum:			
Highly polished plate, 98.3 %, pure	440–1070	0.039–0.057	26
Polished	212	0.095	1
Rough polish	212	0.18	1
Rough plate	100	0.055–0.07	25
Commercial sheet	212	0.09	1
Oxidized at 1110°F	390–1110	0.11–0.19	23
Heavily oxidized	200–940	0.20–0.31	2
Aluminum oxide	530–930	0.63–0.42	21
Aluminum oxide	930–1520	0.42–0.26	21
Al-surfaced roofing	100	0.216	15
Aluminum alloys[b]			
Alloy 75 ST: A, B_1, C	75	0.11, 0.10, 0.08	36
Alloy 75 ST: A^c	450–900	0.22–0.16	36
Alloy 75 ST: B_1^c	450–800	0.20–0.18	36
Alloy 75 ST: C^c	450–930	0.22–0.15	36
Alloy 24 ST: A, B_1, C	75	0.09	36
Alloy 24 ST: A^c	450–910	0.17–0.15	36
Alloy 24 ST: B_1^c	450–940	0.20–0.16	36
Alloy 24 ST: C^c	450–860	0.16–0.13	36
Calorized surfaces, heated at 1110°F			
Copper	390–1110	0.18–0.19	23
Steel	390–1110	0.52–0.57	23
Brass:			
Highly polished			
73.2 Cu, 26.7 Zn	476–674	0.028–0.031	26
62.4 Cu, 36.8 Zn, 0.4 Pb, 0.3 Al	494–710	0.033–0.037	26
82.9 Cu, 17.0 Zn	530	0.030	26
Hard-rolled, polished, but direction of polishing visible	70	0.038	25
Hard-rolled, polished, but somewhat attacked	73	0.043	25
Hard-rolled, polished, but traces of stearin from polish left on	75	0.053	25
Polished	212	0.06	1
Polished	100–600	0.10	15
Rolled plate, natural surface	72	0.06	25
Rolled plate, rubbed with coarse emery	72	0.20	25
Dull plate	120–660	0.22	32
Oxidized by heating at 1110°F	390–1110	0.61–0.59	23
Chromium (see nickel alloys for Ni-Cr steels):			
Polished	100–2000	0.08–0.36	7–17
Polished	212	0.075	1

United Engineers & Constructors
A Raytheon Company

JOB NO. 6869002 DATE 9/17/92 BY RJC CH'K
CUSTOMER MIT MI PROJECT MAGLEV
SUBJECT THERMAL STRESSES - LEVITATION BOX BEAMS

RESULTS OF HEAT TRANSFER ANALYSIS

1) ON PG'S 30-34 ARE PRINTED AND PLOTTED RESULTS OF HEAT TRANSFER ANALYSIS FOR CASE OF VEHICLE SPEED = 30 m/s WITH A 20 s HEADWAY.

2) ON PG'S 35-39 THERE ARE SIMILAR RESULTS FOR THE CASE OF VEHICLE SPEED = 30 m/s WITH A 120 s HEADWAY.

Heat Transfer Analysis Of Levitation Box Beam (30 m/s; 20 s Headway)

***** TEMPERATURE SOLUTION ***** TIME = 0.00000E+00 LOAD STEP

NODE	TEMP	NODE	TEMP	NODE	TEMP
1	128.37	2	123.87	3	119.55
6	107.08	7	103.01	8	98.970
11	86.987	12	82.951	13	78.834
16	119.56	17	115.36	18	111.22
21	98.996	22	94.997	23	91.027
26	78.994	27	127.96	28	123.75
31	111.30	32	107.18	33	103.10
36	91.147	37	87.268	38	83.425
41	123.78	42	119.74	43	115.59
46	103.22	47	99.179	48	95.193
51	83.851	52	80.431	53	127.66
56	115.84	57	111.65	58	107.49
61	95.309	62	91.371	63	87.535
66	127.84	67	123.92	68	119.57
71	106.78	72	102.65	73	98.600
76	86.903	77	83.228	78	80.344
81	116.91	82	112.32	83	107.82
86	95.253	87	91.439	88	87.840
91	78.840	92	124.55	93	119.36
96	104.57	97	100.01	98	95.712
101	84.680	102	81.694	103	79.020
106	117.27	107	111.66	108	106.27
111	91.846	112	87.782	113	84.165
116	76.217	117	74.280	118	121.52
121	103.01	122	97.438	123	92.248
126	79.653	127	76.648	128	74.306
131	119.61	132	112.77	133	106.18
136	88.374	137	83.453	138	79.131
141	71.880	142	71.751	143	117.50
146	96.448	147	89.939	148	84.049
151	73.986	152	115.45	153	108.57
156	87.042	157	82.472	158	115.98
161	128.37	162	123.87	163	119.55
166	107.08	167	103.01	168	98.970
171	86.987	172	82.951	173	78.834
176	119.56	177	115.36	178	111.22
181	98.996	182	94.997	183	91.027
186	78.994	187	127.96	188	123.75
191	111.30	192	107.18	193	103.10
196	91.147	197	87.268	198	83.425
201	123.78	202	119.74	203	115.59
206	103.22	207	99.179	208	95.193
211	83.851	212	80.431	213	127.66
216	115.84	217	111.65	218	107.49
221	95.309	222	91.371	223	87.535
226	127.84	227	123.92	228	119.57
231	106.78	232	102.65	233	98.600
236	86.903	237	83.228	238	80.344
241	116.91	242	112.32	243	107.82
246	95.253	247	91.439	248	87.840
251	78.840	252	124.55	253	119.36
256	104.57	257	100.01	258	95.712
261	84.680	262	81.694	263	79.020
266	117.27	267	111.66	268	106.27
271	91.846	272	87.782	273	84.165
276	76.217	277	74.280		

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12.9933 SEP 17,1992 CP=   172.910

P=   1   ITERATION=   50   CUM. ITER.=   8

NODE	TEMP	NODE	TEMP
4	115.34	5	111.19
9	94.965	10	90.979
14	128.27	15	123.83
19	107.10	20	103.03
24	87.066	25	83.076
29	119.60	30	115.44
34	99.070	35	95.083
39	79.552	40	127.54
44	111.44	45	107.31
49	91.280	50	87.469
54	124.19	55	120.04
59	103.38	60	99.315
64	83.867	65	81.007
69	115.25	70	110.98
74	94.620	75	90.718
79	125.81	80	121.50
84	103.46	85	99.265
89	84.484	90	81.463
94	114.30	95	109.35
99	91.707	100	88.022
104	76.525	105	123.16
109	101.14	110	96.314
114	81.026	115	78.385
119	115.06	120	108.90
124	87.513	125	83.295
129	72.720	130	72.201
134	99.843	135	93.870
139	75.494	140	72.616
144	110.45	145	103.37
149	78.844	150	76.038
154	100.57	155	92.690
159	107.70	160	99.534
164	115.34	165	111.19
169	94.965	170	90.979
174	128.27	175	123.83
179	107.10	180	103.03
184	87.066	185	83.076
189	119.60	190	115.44
194	99.070	195	95.083
199	79.552	200	127.54
204	111.44	205	107.31
209	91.280	210	87.469
214	124.19	215	120.04
219	103.38	220	99.315
224	83.867	225	81.007
229	115.25	230	110.98
234	94.620	235	90.718
239	125.81	240	121.50
244	103.46	245	99.265
249	84.484	250	81.463
254	114.30	255	109.35
259	91.707	260	88.022
264	76.525	265	123.16
269	101.14	270	96.314
274	81.026	275	78.385

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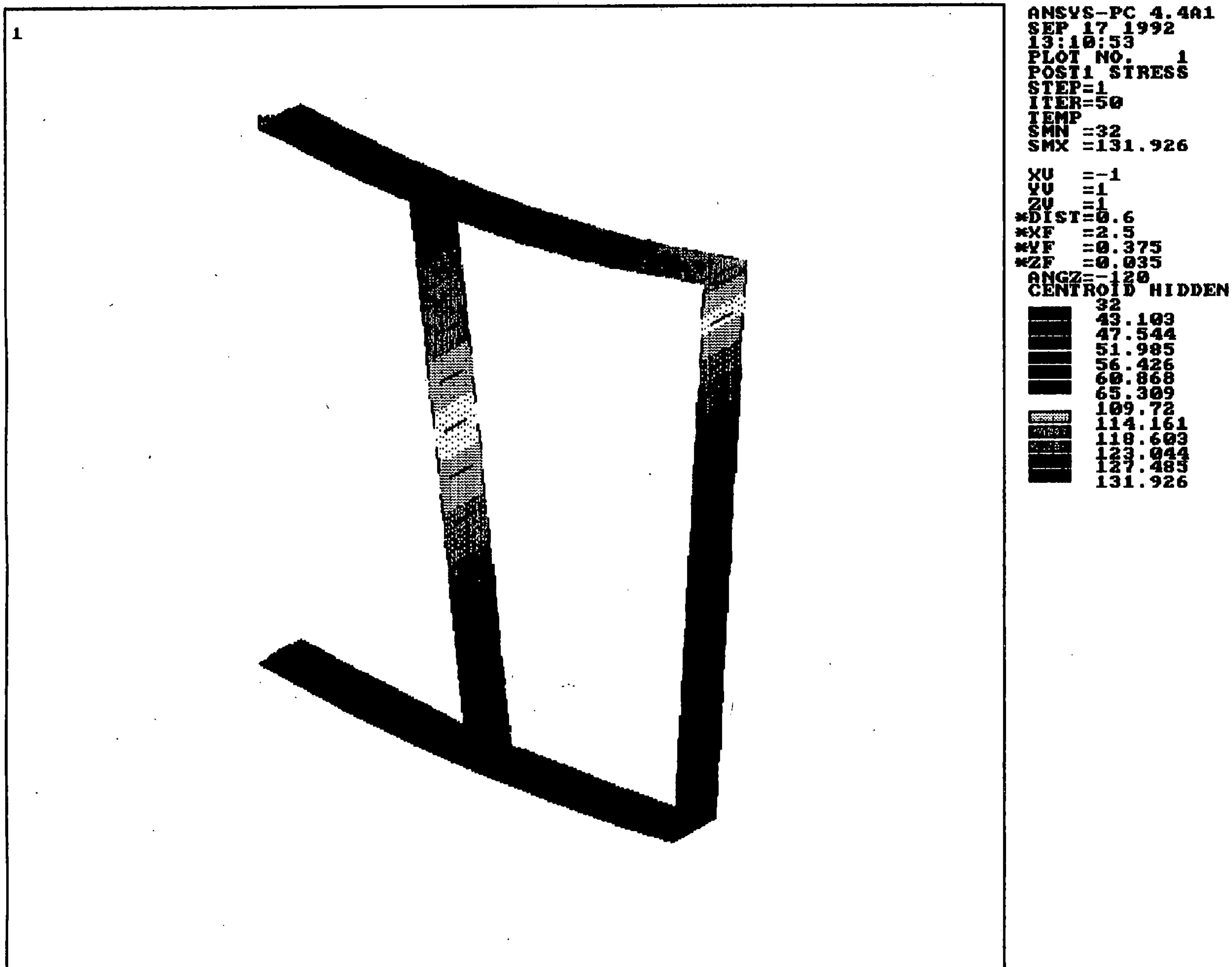
				278	121.52
281	103.01	282	97.438	283	92.248
286	79.653	287	76.648	288	74.306
291	119.61	292	112.77	293	106.18
296	88.374	297	83.453	298	79.131
301	71.880	302	71.751	303	117.50
306	96.448	307	89.939	308	84.049
311	73.986	312	115.45	313	108.57
316	87.042	317	82.472	318	115.98
321	131.93				
				333	75.881
346	76.064	347	131.26		
		372	77.997	373	129.18
376	116.12	377	111.87	378	107.68
381	95.413	382	91.431	383	87.499
386	128.98				
				398	76.970
411	74.675	412	127.50		
		437	71.491	438	124.51
		447	71.329	448	70.737
456	77.281	457	74.552	458	72.588
		462	91.055	463	85.400
466	106.53	467	98.017		
481	131.93				
				493	75.881
506	76.064	507	131.26		
		532	77.997	533	129.18
536	116.12	537	111.87	538	107.68
541	95.413	542	91.431	543	87.499
546	128.98				
				558	76.970
571	74.675	572	127.50		
		597	71.491	598	124.51
		607	71.329	608	70.737
616	77.281	617	74.552	618	72.588
		622	91.055	623	85.400
626	106.53	627	98.017		
1001	130.91	1002	77.298	1003	103.90
1006	83.657	1007	130.91	1008	77.298
1011	75.156	1012	83.657		
		2002	32.000		

MAXIMUM TEMPERATURE= 131.93 AT NODE 481
MINIMUM TEMPERATURE= 32.000 AT NODE 2002

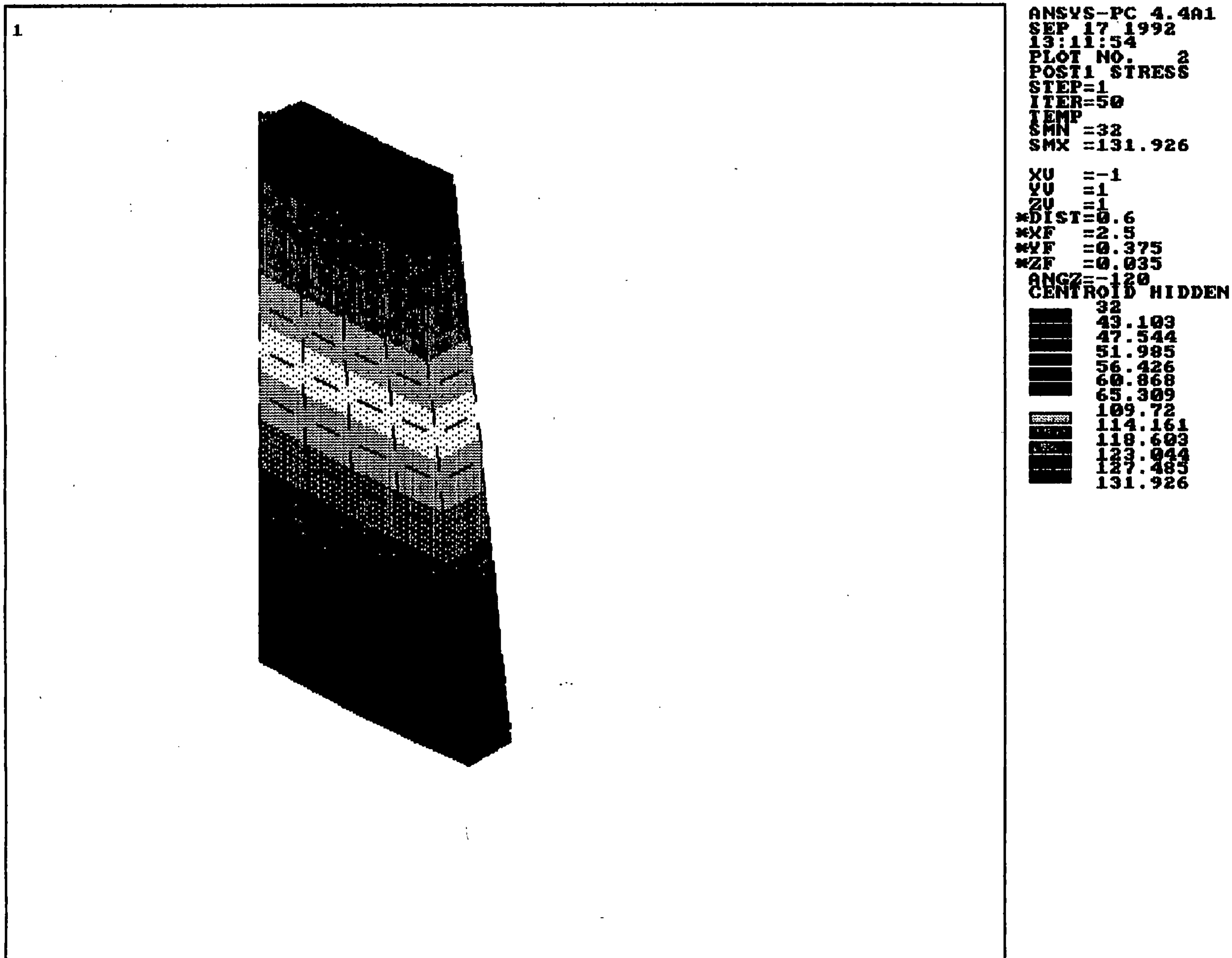
279	115.06	280	108.90
284	87.513	285	83.295
289	72.720	290	72.201
294	99.843	295	93.870
299	75.494	300	72.616
304	110.45	305	103.37
309	78.844	310	76.038
314	100.57	315	92.690
319	107.70	320	99.534
334	131.77		
359	76.764	360	130.40
374	124.77	375	120.42
379	103.54	380	99.449
384	83.617	385	79.785
399	128.43		
424	72.859	425	126.20
449	70.792	450	122.41
459	119.88		
464	80.858	465	116.91
494	131.77		
519	76.764	520	130.40
534	124.77	535	120.42
539	103.54	540	99.449
544	83.617	545	79.785
559	128.43		
584	72.859	585	126.20
609	70.792	610	122.41
619	119.88		
624	80.858	625	116.91
1004	124.89	1005	75.156
1009	103.90	1010	124.89

LT-31



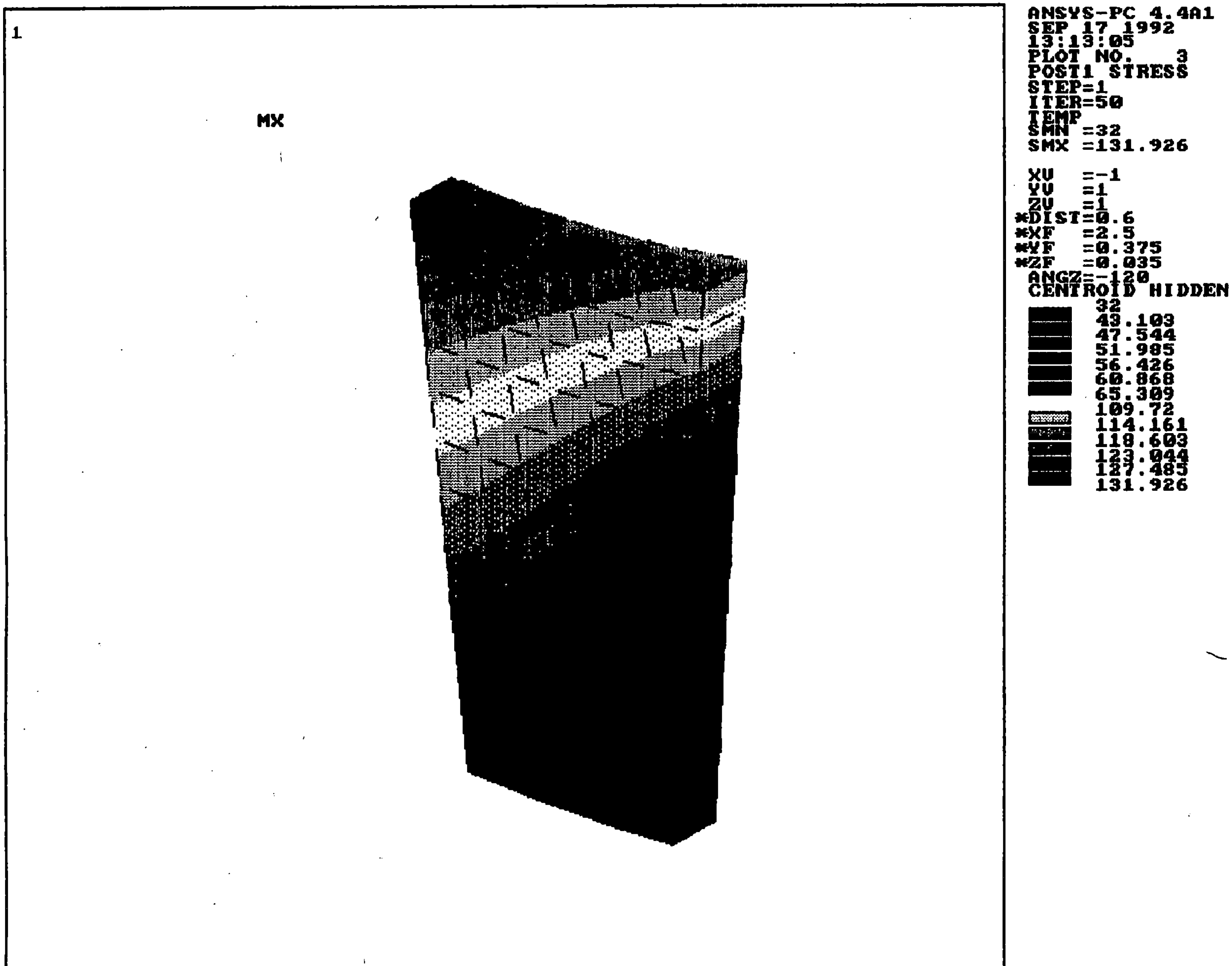
Heat Transfer Analysis Of Levitation Box Beam (30 m/s; 20 s Headway)

LT-32



Heat Transfer Analysis Of Levitation Box Beam (30 m/s; 20 s Headway)

LT-33



Heat Transfer Analysis Of Levitation Box Beam (30 m/s; 20 s Headway)

LT-34

ANSYS - ENGINEERING ANALYSIS SYSTEM REVISION 4.4 A

FOR SUPPORT CALL PHONE TWX

Heat Transfer Analysis Of Levitation Box Beam (30 m/s; 120 s Headway)

***** TEMPERATURE SOLUTION ***** TIME = 0.00000E+00 LOAD STEP

NODE	TEMP	NODE	TEMP	NODE	TEMP
1	55.402	2	54.431	3	53.498
6	50.784	7	49.894	8	49.011
11	46.391	12	45.510	13	44.611
16	53.504	17	52.594	18	51.691
21	49.021	22	48.145	23	47.277
26	44.654	27	55.327	28	54.423
31	51.722	32	50.824	33	49.932
36	47.312	37	46.466	38	45.630
41	54.452	42	53.581	43	52.681
46	49.978	47	49.090	48	48.215
51	45.736	52	45.002	53	55.318
56	52.767	57	51.853	58	50.943
61	48.264	62	47.394	63	46.547
66	55.317	67	54.488	68	53.553
71	50.767	72	49.862	73	48.970
76	46.394	77	45.595	78	44.991
81	53.004	82	52.022	83	51.055
86	48.325	87	47.490	88	46.699
91	44.734	92	54.625	93	53.542
96	50.423	97	49.448	98	48.522
101	46.113	102	45.452	103	44.857
106	53.131	107	51.970	108	50.850
111	47.797	112	46.919	113	46.129
116	44.339	117	43.889	118	54.020
121	50.246	122	49.090	123	48.002
126	45.294	127	44.622	128	44.080
131	53.652	132	52.290	133	50.966
136	47.303	137	46.260	138	45.329
141	43.629	142	43.505	143	53.259
146	49.095	147	47.765	148	46.539
151	44.253	152	52.902	153	51.600
156	47.271	157	46.263	158	53.047
161	55.402	162	54.431	163	53.498
166	50.784	167	49.894	168	49.011
171	46.391	172	45.510	173	44.611
176	53.504	177	52.594	178	51.691
181	49.021	182	48.145	183	47.277
186	44.654	187	55.327	188	54.423
191	51.722	192	50.824	193	49.932
196	47.312	197	46.466	198	45.630
201	54.452	202	53.581	203	52.681
206	49.978	207	49.090	208	48.215
211	45.736	212	45.002	213	55.318
216	52.767	217	51.853	218	50.943
221	48.264	222	47.394	223	46.547
226	55.317	227	54.488	228	53.553
231	50.767	232	49.862	233	48.970
236	46.394	237	45.595	238	44.991
241	53.004	242	52.022	243	51.055
246	48.325	247	47.490	248	46.699
251	44.734	252	54.625	253	53.542
256	50.423	257	49.448	258	48.522
261	46.113	262	45.452	263	44.857
266	53.131	267	51.970	268	50.850
271	47.797	272	46.919	273	46.129
276	44.339	277	43.889	278	54.020

1 40195-PC/LT-4.4A MAY 1,1990

12.8426 SEP 17,1992 CP= 135.610

P= 1 ITERATION= 50 CUM. ITER.= 6

NODE	TEMP	NODE	TEMP
4	52.585	5	51.681
9	48.135	10	47.263
14	55.383	15	54.427
19	50.794	20	49.903
24	46.412	25	45.542
29	53.526	30	52.624
34	49.048	35	48.174
39	44.791	40	55.259
44	51.776	45	50.873
49	47.355	50	46.522
54	54.575	55	53.679
59	50.041	60	49.147
64	45.746	65	45.133
69	52.615	70	51.685
74	48.094	75	47.234
79	54.890	80	53.978
84	50.113	85	49.201
89	45.962	90	45.303
94	52.481	95	51.437
99	47.653	100	46.848
104	44.302	105	54.343
109	49.773	110	48.752
114	45.434	115	44.839
119	52.709	120	51.455
124	46.997	125	46.090
129	43.687	130	43.505
134	49.679	135	48.450
139	44.530	140	43.876
144	51.887	145	50.486
149	45.435	150	44.768
154	50.048	155	48.478
159	51.515	160	49.892
164	52.585	165	51.681
169	48.135	170	47.263
174	55.383	175	54.427
179	50.794	180	49.903
184	46.412	185	45.542
189	53.526	190	52.624
194	49.048	195	48.174
199	44.791	200	55.259
204	51.776	205	50.873
209	47.355	210	46.522
214	54.575	215	53.679
219	50.041	220	49.147
224	45.746	225	45.133
229	52.615	230	51.685
234	48.094	235	47.234
239	54.890	240	53.978
244	50.113	245	49.201
249	45.962	250	45.303
254	52.481	255	51.437
259	47.653	260	46.848
264	44.302	265	54.343
269	49.773	270	48.752
274	45.434	275	44.839
279	52.709	280	51.455

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281	50.246	282	49.090	283	48.002
286	45.294	287	44.622	288	44.080
291	53.652	292	52.290	293	50.966
296	47.303	297	46.260	298	45.329
301	43.629	302	43.505	303	53.259
306	49.095	307	47.765	308	46.539
311	44.253	312	52.902	313	51.600
316	47.271	317	46.263	318	53.047
321	56.275				
				333	43.825
346	43.877	347	56.136		
		372	44.370	373	55.702
376	52.869	377	51.942	378	51.022
381	48.314	382	47.428	383	46.550
386	55.671				
				398	44.243
411	43.801	412	55.385		
		437	43.284	438	54.794
		447	43.505	448	43.298
456	44.996	457	44.346	458	43.852
		462	48.047	463	46.827
466	51.244	467	49.508		
481	56.275				
				493	43.825
506	43.877	507	56.136		
		532	44.370	533	55.702
536	52.869	537	51.942	538	51.022
541	48.314	542	47.428	543	46.550
546	55.671				
				558	44.243
571	43.801	572	55.385		
		597	43.284	598	54.794
		607	43.505	608	43.298
616	44.996	617	44.346	618	43.852
		622	48.047	623	46.827
626	51.244	627	49.508		
1001	56.062	1002	44.189	1003	50.169
1006	46.250	1007	56.062	1008	44.189
1011	43.925	1012	46.250		
		2002	32.000		

MAXIMUM TEMPERATURE= 56.275 AT NODE 481
MINIMUM TEMPERATURE= 32.000 AT NODE 2002

284	46.997	285	46.090
289	43.687	290	43.505
294	49.679	295	48.450
299	44.530	300	43.876
304	51.887	305	50.486
309	45.435	310	44.768
314	50.048	315	48.478
319	51.515	320	49.892
334	56.242		
359	44.058	360	55.956
374	54.749	375	53.805
379	50.112	380	49.209
384	45.679	385	44.816
399	55.566		
424	43.482	425	55.128
449	43.225	450	54.379
459	53.883		
464	45.817	465	53.301
494	56.242		
519	44.058	520	55.956
534	54.749	535	53.805
539	50.112	540	49.209
544	45.679	545	44.816
559	55.566		
584	43.482	585	55.128
609	43.225	610	54.379
619	53.883		
624	45.817	625	53.301
1004	54.868	1005	43.925
1009	50.169	1010	54.868

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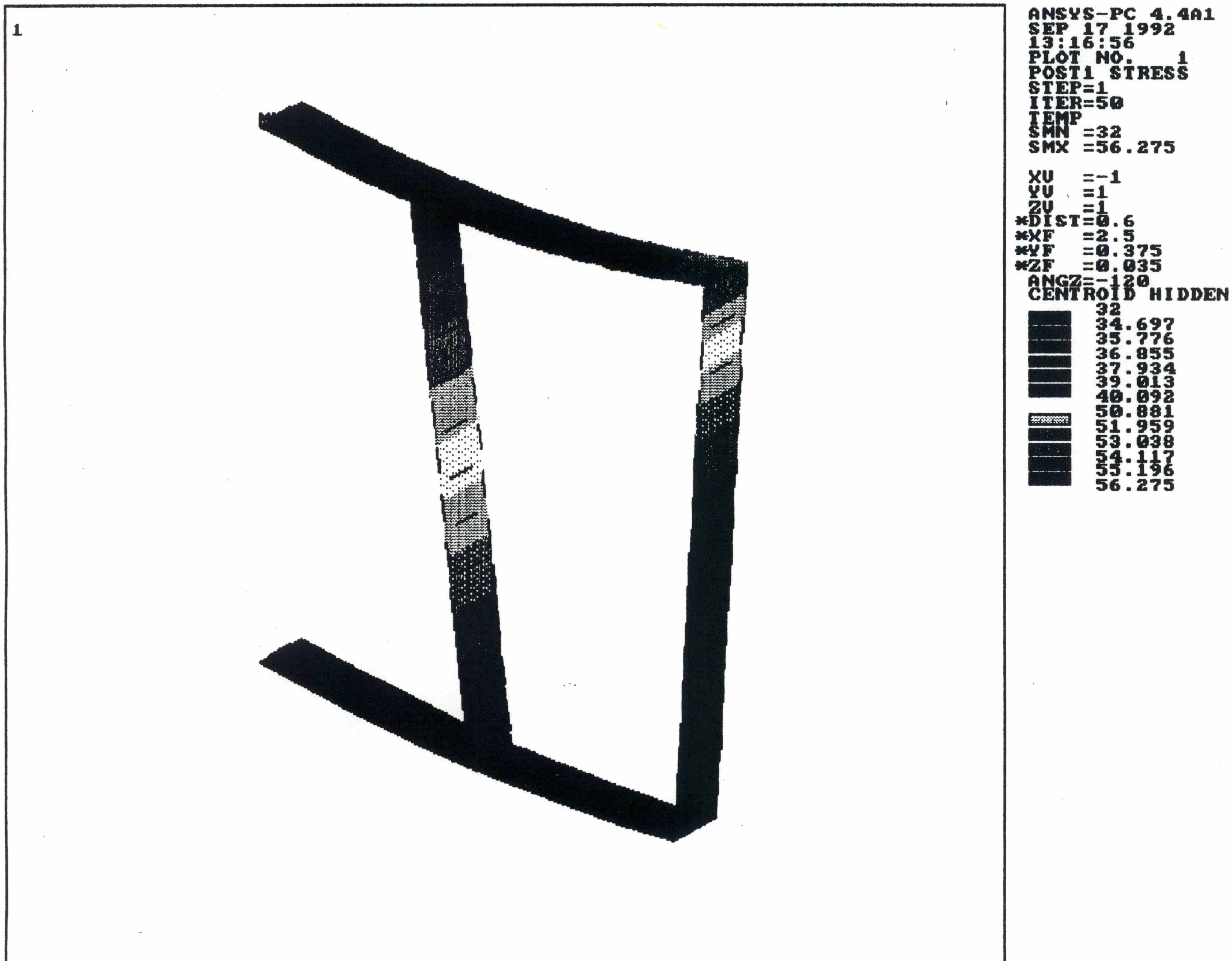
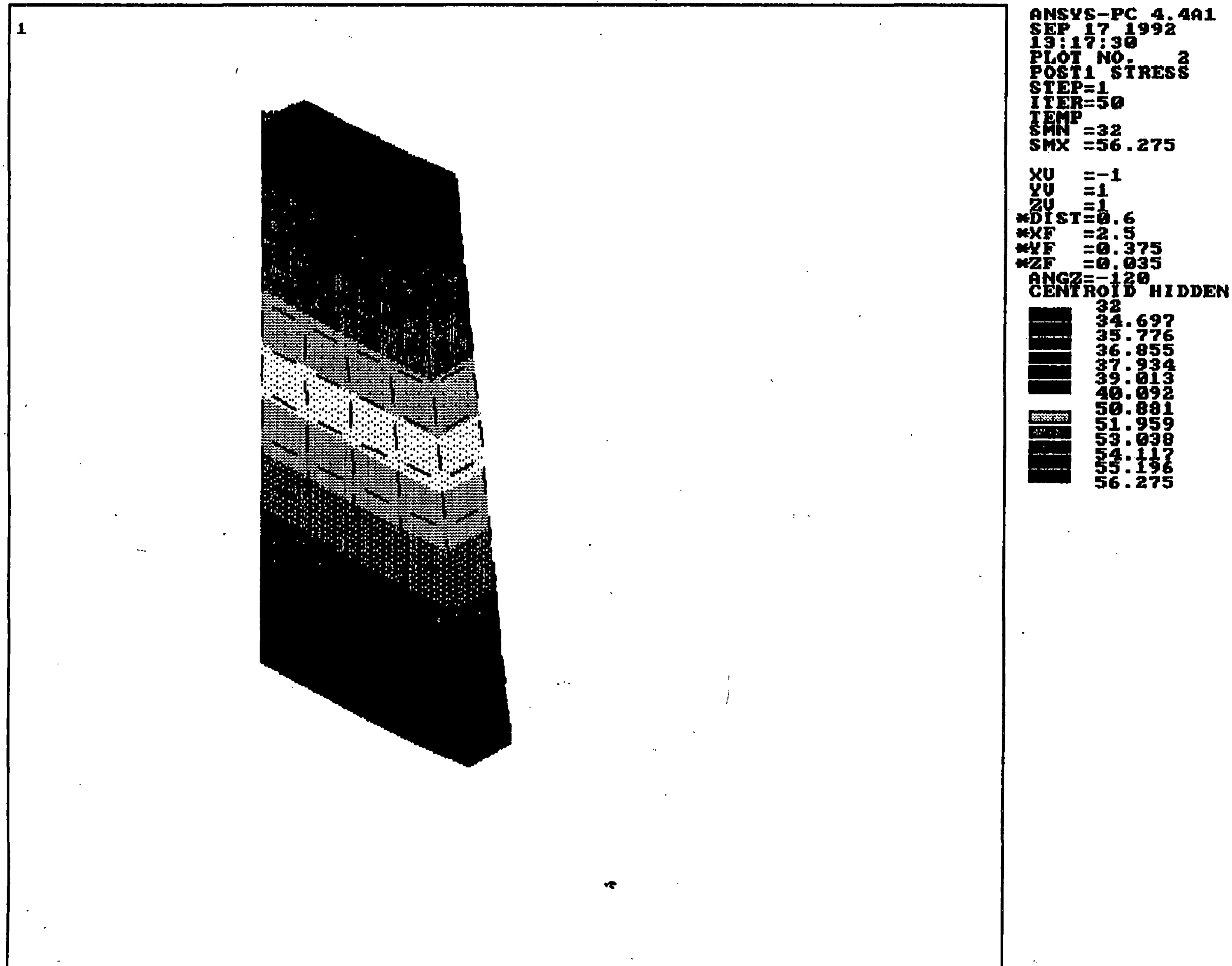
[redacted]

[redacted]



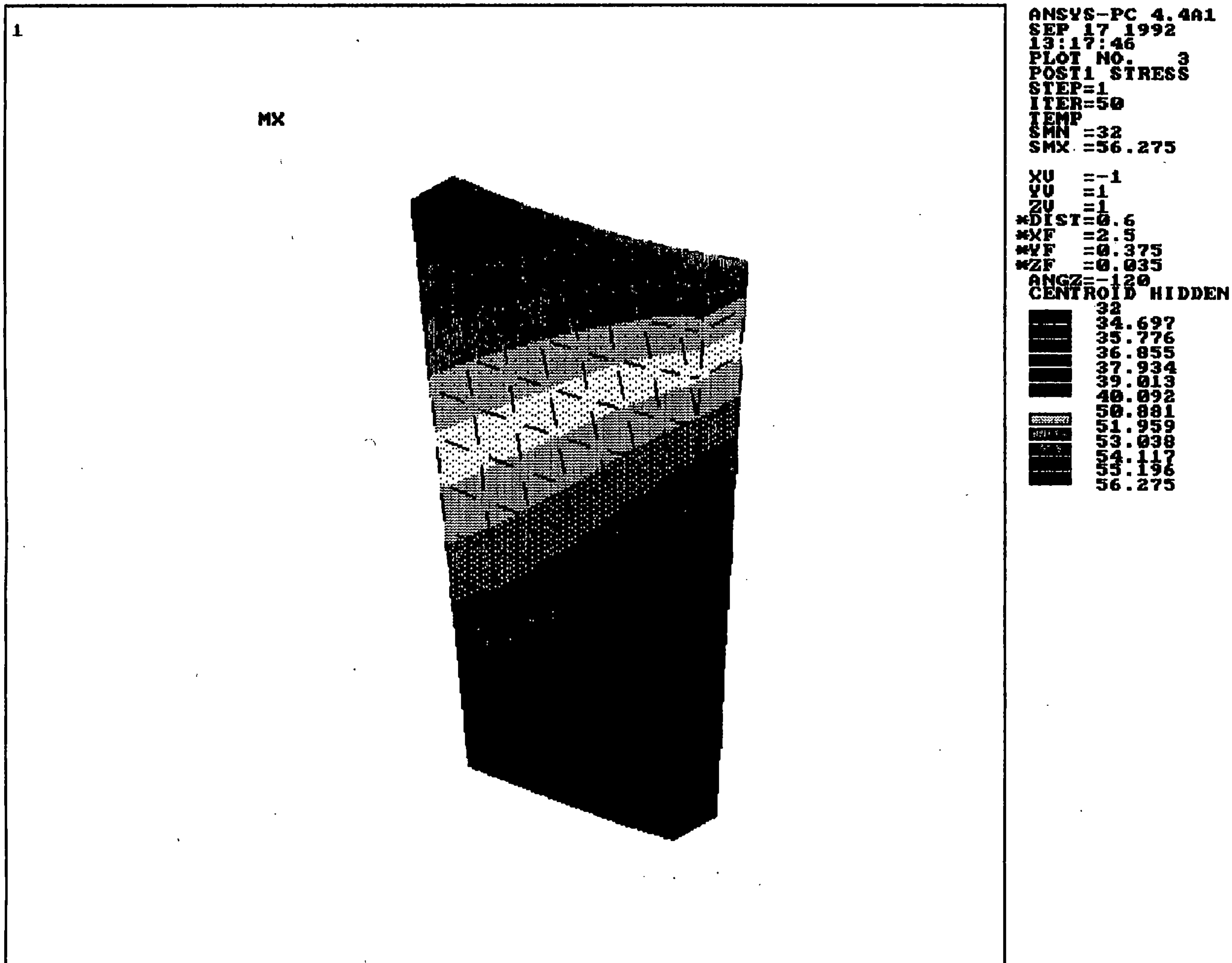
Heat Transfer Analysis Of Levitation Box Beam (30 m/s; 120 s Headway)

LT-37



Heat Transfer Analysis Of Levitation Box Beam (30 m/s; 120 s Headway)

LT-38



Heat Transfer Analysis Of Levitation Box Beam (30 m/s; 120 s Headway)

LT-39

LT-40

ANSYS INPUT DATA

```
/PREP7
/TITLE,Heat Transfer Analysis Of Levitation Box Beam (30 m/s; 20 s Headway)
C***  FILE : HTRLEV    Sept. 17, 1992
C***  UNITS: watts,meters,deg C
KAN, -1
TOFFST, 273.
C***  stif 70: Isoparametric Thermal Solid
C***  stif 57: Quadrilateral Thermal Shell
C***  stif 34: Convection Link
C***  stif 31: Radiation Link
ET,1,70,,3
  ,2,70,,3
  ,3,57,,3
  ,4,34,,3
  ,5,31
  ,6,31
C***
TREF,20.
C*** ////////////////////////////////////////////////////////////////////////
C***      32.   100.    200.     300.     400.   Deg. F
MPTEMP, 1, 0., 37.778, 93.333, 148.889, 204.444
C***
C***  Material 1: Enclosed Air
MPDATA, KXX, 1, 1, .0242, .0266, .0301, .0334, .0367
C*** ////////////////////////////////////////////////////////////////////////
MPTEMP
C***          70.    100.    150.    200.     250.     300.   Deg. F
MPTEMP, 1, 21.111, 37.778, 65.556, 93.333, 121.111, 148.889
C***          350.     400.   Deg. F
MPTEMP, 7, 176.667, 204.444
C***
C***  Material 2: Aluminum Plate
MPDATA, KXX, 2, 1, 208.93, 209.80, 211.10, 212.83, 214.12, 215.42
MPDATA, KXX, 2, 7, 217.15, 218.45
C*** ////////////////////////////////////////////////////////////////////////
MPTEMP
C***           0.       5.      10.      20.      30.      40.   Deg. F
MPTEMP, 1,  0.000,  2.778,  5.556,  11.111,  16.667,  22.222
C***          50.    100.    150.     200.     250.     300.   Deg. F
MPTEMP, 7, 27.778, 55.556, 83.333, 111.111, 138.889, 166.667
C***
C***  Material 3: Natural Convection Coefficients - Upper Surface Of
C***              Heated Plates Or Lower Surface Of Cooled Plates.
C***              Coefficients Are A Function Of Temperature Difference.
C***              Applicable To:
C***              1) Outer Surface Of Top Flange;
C***              2) Outer Surface Of External Web.
MPDATA,  HF, 3, 1, 0.000, 2.242, 2.825, 3.560, 4.075, 4.485
MPDATA,  HF, 3, 7, 4.831, 6.087, 6.968, 7.669, 8.261, 8.778
C*** ////////////////////////////////////////////////////////////////////////
C***  Material 4: Natural Convection Coefficients - Lower Surface Of
C***              Heated Plates Or Upper Surface Of Cooled Plates.
C***              Coefficients Are A Function Of Temperature Difference.
C***              Applicable To:
C***              1) Outer Surface Of Bottom Flange.
MPDATA,  HF, 4, 1, 0.000,  .609,  .699,  .803,  .871,  .922
MPDATA,  HF, 4, 7,  .965, 1.108, 1.202, 1.273, 1.331, 1.380
C*** ////////////////////////////////////////////////////////////////////////
MPTEMP
C***
C***  Material 5: Natural Convection Coefficients - Upper Surface Of
C***              Heated Plates Or Lower Surface Of Cooled Plates.
C***              Coefficients Are A Function Of Temperature Difference.
C***              They Are Of The Form:
C***              Hc = 1.59517*(Delta T)**.333333     W/m**2/Deg. C
C***              Applicable To:
```

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```
C***                 1) Inner Surface Of External Web;
C***                 2) Upper Surface Of Internal Web.
     HF, 5, 1.59517
C*** ////////////////////////////////////////////////////////////////////////
C***  Material 6: Natural Convection Coefficients - Lower Surface Of
C***              Heated Plates Or Upper Surface Of Cooled Plates.
C***              Coefficients Are A Function Of Temperature Difference.
C***              They Are Of The Form:
C***              Hc = .496112*(Delta T)**.2          W/m**2/Deg. C
C***              Applicable To:
C***              1) Inner Surface Of Top Flange;
C***              2) Inner Surface Of Bottom Flange;
     HF, 6, .496112
C*** ////////////////////////////////////////////////////////////////////////
C***  Material 7: Natural Convection Coefficients - Lower Surface Of
C***              Heated Plates Or Upper Surface Of Cooled Plates.
C***              Coefficients Are A Function Of Temperature Difference.
C***              They Are Of The Form:
C***              Hc = .637859*(Delta T)**.2          W/m**2/Deg. C
C***              Applicable To:
C***              1) Lower Surface Of Internal Web.
     HF, 7, .637859
C*** ////////////////////////////////////////////////////////////////////////
C***  Box Beam Top Flange Thickness (.02 m)
R,1,.02
C***  Box Beam Bottom Flange Thickness (.00635 m)
R,2,.00635
C***  Box Beam Web Thickness (.00635 m)
R,3,.00635
C*** ////////////////////////////////////////////////////////////////////////
C***  Area Of Convection Links
C***  Top Flange To Enclosed Air
R,4,.00112378,.2,0.
 ,5,.00224756,.2,0.
C***  Bottom Flange To Enclosed Air
R,6,.00154965,.2,0.
 ,7,.00309930,.2,0.
C***  Web Plates To Enclosed Air
R, 8,.00116608,.333333,0.
 , 9,.00233217,.333333,0.
 ,10,.00124620,.333333,0.
 ,11,.00249240,.333333,0.
 ,12,.00116608,.2,0.
 ,13,.00233217,.2,0.
C*** ////////////////////////////////////////////////////////////////////////
C***  Properties Of External Radiation Links
C***  Use Emissivity = 0.2 For Oxidized Aluminum
C***  Top Flange (Not Used)
R,14,.00112378, 1., .2, 5.6699E-8
 ,15,.00224756, 1., .2, 5.6699E-8
C***  Bottom Flange
R,16,.00154965, 1., .2, 5.6699E-8
 ,17,.00309930, 1., .2, 5.6699E-8
C***  Outer Web Plate (Not Used)
R,18,.00124620, 1., .2, 5.6699E-8
 ,19,.00249240, 1., .2, 5.6699E-8
C*** ////////////////////////////////////////////////////////////////////////
C***  Properties Of Internal Radiation Links
C***  Use Emissivity = 0.2 For Oxidized Aluminum
C***  Cell No. 1
R,20,.00896875,.217995, .2, 5.6699E-8
 ,21,.00896875,.168780, .2, 5.6699E-8
 ,22,.01236725,.198733, .2, 5.6699E-8
C***  Cell No. 2
R,23,.01793750,.109051, .2, 5.6699E-8
 ,24,.01793750,.168780, .2, 5.6699E-8
```

```
 ,25,.01793750,.277724, .2, 5.6699E-8
 ,26,.01239000,.234620, .2, 5.6699E-8
 ,27,.01239000,.163057, .2, 5.6699E-8
 ,28,.02798600,.343505, .2, 5.6699E-8
C*** ////////////////////////////////////////////////////////////////////////
C***  Nodal Coordinates
CSYS,1
N,1,2.11
 ,13,2.9096
FILL
NGEN,5,13,1,13,,,1.74375
    ,2,13,53,65
    ,5,13,66,78,,,1.74375
N,131,2.11,15.69375
 ,143,2.11,17.43750
 ,152,2.11,19.18125
 ,158,2.11,20.92500
 ,159,2.17663,20.13100
 ,160,2.24327,19.38843
 ,155,2.30990,18.69250
 ,156,2.37653,18.03875
 ,157,2.44317,17.42327
 ,149,2.50980,16.84288
 ,150,2.57643,16.29451
 ,151,2.64307,15.77546
 ,140,2.70970,15.28353
 ,141,2.77633,14.81655
 ,142,2.84297,14.37256
CSYS,0
FILL,131,140
    ,143,149
    ,152,155
CSYS,1
NGEN,2,160,1,160,,,,.07
    ,2,320,1,65
    ,2,307,79,160
    ,2,320,161,225
    ,2,307,239,320
C***  Nodes For Internal Radiation Links.
NGEN,2,1000,1
    ,2,989,13
    ,2,944,59
    ,2,886,118
    ,2,901,104
    ,2,857,149
    ,2,6,1001,1006,,,,.07
C***  Nodes For External Radiation Links.
CSYS,0
N,2001,1.,.2
 ,2002,4.,1.
 ,2003,2.5,1.5

NLIST
C*** ////////////////////////////////////////////////////////////////////////
C***  Elements Representing Enclosed Air
TYPE,1
MAT,1
E,2,15,14,1,162,175,174,161
EGEN,12,1,-1
    ,4,13,-12
TYPE,2
E,67,80,79,66,227,240,239,226
EGEN,12,1,-1
    ,4,13,-12
E,119,132,131,118,279,292,291,278
EGEN,11,1,-1
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E,142,129,130,130,302,289,290,290
 ,132,144,143,131,292,304,303,291
EGEN,8,1,-1
E,151,139,140,140,311,299,300,300
 ,144,153,152,143,304,313,312,303
EGEN,5,1,-1
E,157,148,149,149,317,308,309,309
 ,153,159,158,152,313,319,318,312
EGEN,2,1,-1
E,160,154,155,155,320,314,315,315
C*** ///////////////////////////////////////////////////////////////////////
C***  Box Beam Plate Elements
C***  Top Flange
TYPE,3
MAT,2
REAL,1
E,321,334,494,481
EGEN,9,13,-1
E,438,450,610,598
 ,450,459,619,610
 ,459,465,625,619
C***  Bottom Flange
REAL,2
E,333,346,506,493
EGEN,8,13,-1
C***  Internal Web
REAL,3
E,373,374,534,533
EGEN,12,1,-1
C***  External Web
E,465,466,626,625
 ,466,467,627,626
 ,467,462,622,627
 ,462,463,623,622
 ,463,464,624,623
 ,464,456,616,624
 ,456,457,617,616
 ,457,458,618,617
 ,458,447,607,618
 ,447,448,608,607
 ,448,449,609,608
 ,449,437,597,609
C*** ///////////////////////////////////////////////////////////////////////
C***  Convection Links From Box Beam To Enclosed Air
C***  Top Flange To Enclosed Air
TYPE,4
MAT,6
REAL,4
E,321,1
REAL,5
E,334,14
EGEN,3,13,-1
REAL,4
E,373,53
 ,373,66
REAL,5
E,386,79
EGEN,5,13,-1
E,450,143
 ,459,152
REAL,4
E,465,158
C***  Bottom Flange To Enclosed Air
MAT,6
REAL,6
E,333,13
```

```
REAL,7
E,346,26
EGEN,3,13,-1
REAL,6
E,385,65
 ,385,78
REAL,7
E,398,91
EGEN,3,13,-1
REAL,6
E,437,130
C***  Web Plates To Enclosed Air
C***  Lower Surface Of Internal Web
MAT,7
REAL,12
E,373,53
REAL,13
E,374,54
EGEN,11,1,-1
REAL,12
E,385,65
C***  Upper Surface Of Internal Web
MAT,5
REAL,8
E,373,66
REAL,9
E,374,67
EGEN,11,1,-1
REAL,8
E,385,78
C***  Inner Surface Of External Web
MAT,5
REAL,10
E,465,158
REAL,11
E,466,159
 ,467,160
 ,462,155
 ,463,156
 ,464,157
 ,456,149
 ,457,150
 ,458,151
 ,447,140
 ,448,141
 ,449,142
REAL,10
E,437,130
EGEN,2,160,-63
C*** ///////////////////////////////////////////////////////////////////////
C***  External Radiation Links From Box Beam
C***  Bottom Flange To Ground
TYPE,5
REAL,16
E,333,2002
REAL,17
E,346,2002
RP7,13,0
REAL,16
E,437,2002
 ,493,2002
REAL,17
E,506,2002
RP7,13,0
REAL,16
E,597,2002
```

```
C*** ///////////////////////////////////////////////////////////////////
C***  Internal Radiation Links
TYPE,6
REAL,20
E,1001,1002
REAL,21
E,1001,1003
REAL,22
E,1002,1003
REAL,23
E,1004,1005
REAL,24
E,1003,1004
REAL,25
E,1004,1006
REAL,26
E,1003,1005
REAL,27
E,1005,1006
REAL,28
E,1003,1006
EGEN,2,6,-9
ELIST
C*** ///////////////////////////////////////////////////////////////////
C***  Constraint Equations
CESIZE,14
CE, 1,0.,1001,TEMP, -5.,321,TEMP,1.,334,TEMP,1.
  , 1,0., 347,TEMP,  1.,360,TEMP,1.,373,TEMP,1.
  , 2,0.,1002,TEMP, -5.,333,TEMP,1.,346,TEMP,1.
  , 2,0., 359,TEMP,  1.,372,TEMP,1.,385,TEMP,1.
  , 3,0.,1003,TEMP,-13.,373,TEMP,1.,374,TEMP,1.
  , 3,0., 375,TEMP,  1.,376,TEMP,1.,377,TEMP,1.
  , 3,0., 378,TEMP,  1.,379,TEMP,1.,380,TEMP,1.
  , 3,0., 381,TEMP,  1.,382,TEMP,1.,383,TEMP,1.
  , 3,0., 384,TEMP,  1.,385,TEMP,1.
  , 4,0.,1004,TEMP, -9.,373,TEMP,1.,386,TEMP,1.
  , 4,0., 399,TEMP,  1.,412,TEMP,1.,425,TEMP,1.
  , 4,0., 438,TEMP,  1.,450,TEMP,1.,459,TEMP,1.
  , 4,0., 465,TEMP,  1.
  , 5,0.,1005,TEMP, -5.,385,TEMP,1.,398,TEMP,1.
  , 5,0., 411,TEMP,  1.,424,TEMP,1.,437,TEMP,1.
  , 6,0.,1006,TEMP,-13.,465,TEMP,1.,466,TEMP,1.
  , 6,0., 467,TEMP,  1.,462,TEMP,1.,463,TEMP,1.
  , 6,0., 464,TEMP,  1.,456,TEMP,1.,457,TEMP,1.
  , 6,0., 458,TEMP,  1.,447,TEMP,1.,448,TEMP,1.
  , 6,0., 449,TEMP,  1.,437,TEMP,1.
  , 7,0.,1007,TEMP, -5.,481,TEMP,1.,494,TEMP,1.
  , 7,0., 507,TEMP,  1.,520,TEMP,1.,533,TEMP,1.
  , 8,0.,1008,TEMP, -5.,493,TEMP,1.,506,TEMP,1.
  , 8,0., 519,TEMP,  1.,532,TEMP,1.,545,TEMP,1.
  , 9,0.,1009,TEMP,-13.,533,TEMP,1.,534,TEMP,1.
  , 9,0., 535,TEMP,  1.,536,TEMP,1.,537,TEMP,1.
  , 9,0., 538,TEMP,  1.,539,TEMP,1.,540,TEMP,1.
  , 9,0., 541,TEMP,  1.,542,TEMP,1.,543,TEMP,1.
  , 9,0., 544,TEMP,  1.,545,TEMP,1.
  ,10,0.,1010,TEMP, -9.,533,TEMP,1.,546,TEMP,1.
  ,10,0., 559,TEMP,  1.,572,TEMP,1.,585,TEMP,1.
  ,10,0., 598,TEMP,  1.,610,TEMP,1.,619,TEMP,1.
  ,10,0., 625,TEMP,  1.
  ,11,0.,1011,TEMP, -5.,545,TEMP,1.,558,TEMP,1.
  ,11,0., 571,TEMP,  1.,584,TEMP,1.,597,TEMP,1.
  ,12,0.,1012,TEMP,-13.,625,TEMP,1.,626,TEMP,1.
  ,12,0., 627,TEMP,  1.,622,TEMP,1.,623,TEMP,1.
  ,12,0., 624,TEMP,  1.,616,TEMP,1.,617,TEMP,1.
  ,12,0., 618,TEMP,  1.,607,TEMP,1.,608,TEMP,1.
  ,12,0., 609,TEMP,  1.,597,TEMP,1.
```

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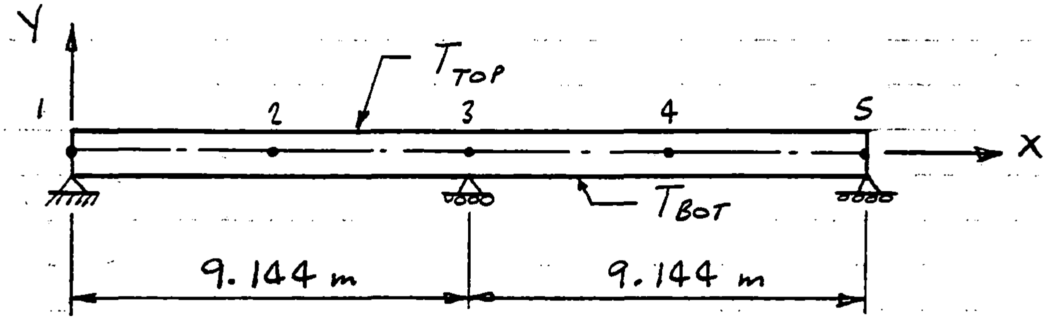
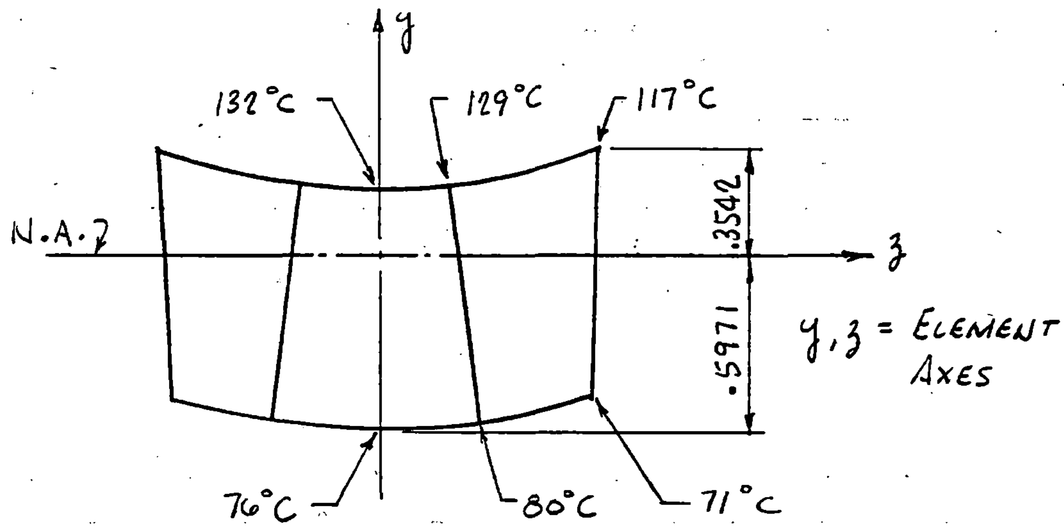
```
C*** ///////////////////////////////////////////////////////////////////////
C***
CSYS,1
WSORT,Y
C*** ///////////////////////////////////////////////////////////////////////
ITER,  -50, 50
C***   Convergence Tolerance Of .5 Degree C
CNVR, .5
C***   Step Boundary Condition
KBC,  1
C***  Initial Iteration Temperature = 32 Deg C
TUNIF, 32.
C***  Steady State
TIME, 0
C*** ///////////////////////////////////////////////////////////////////////
C***  Boundary Conditions
NT,2002, TEMP, 32.
C***  Heat Flow Rates Based On Vehicle Velocity = 30 m/s & 20 s Headway
HFLOW,321,HEAT,1.2744,,465,144
     ,334,HEAT,2.5487,,438,13
     ,450,HEAT,2.5487,,459,9
     ,481,HEAT,1.2744,,625,144
     ,494,HEAT,2.5487,,598,13
     ,610,HEAT,2.5487,,619,9
C***
C***  Define Convection Faces (To Ambient Air)
C***  Top Flange
EC, 127, 2, -3, 32., 138
C***  Bottom Flange
EC, 139, 1, -4, 32., 146
C***  External Web
EC, 159, 2, -3, 32., 170
C*** ///////////////////////////////////////////////////////////////////////
LWRITE
AFWRIT,27,1
FINISH
```

THERMAL BENDING STRESSES



FOR VEHICLE SPEED = 30 m/s AND 20 s HEADWAY



REFERRING TO TABULATED RESULTS ON PG'S 30 & 31,

$(T_{TOP})_{AVG} = 127°C$

$(T_{BOT})_{AVG} = 76°C$

CROSS-SECTION PROPERTIES:

$A = 6.05072 \times 10^{-2}\ m^2$

$I_z = 6.42951 \times 10^{-3}\ m^4$

SEE PG'S 48, 49 FOR TEMPERATURE DEPENDENT COEFF. OF EXPANSION AND MODULUS OF ELASTICITY.

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TABLE AMG-1.1
COEFFICIENTS OF THERMAL EXPANSION FOR ALUMINUM ALLOYS[1]

Materials	Coefficient	Temperature, Deg. F 70	100	150	200	250	300	350	400	450	500	550	600
3003	A	12.41	12.61	12.95	13.30	13.59	13.89	14.18	14.48	14.78	15.02	15.32	15.61
	B	12.41	12.51	12.68	12.84	13.00	13.16	13.32	13.46	13.61	13.76	13.91	14.06
3004	C	0	0.0045	0.0122	0.0200	0.0281	0.0363	0.0448	0.0533	0.0621	0.0710	0.0801	0.0894
5052	A	12.73	12.93	13.28	13.64	13.94	14.24	14.54	14.85	15.15	15.40	15.71	16.01
5083	B	12.73	12.83	13.00	13.17	13.33	13.49	13.66	13.81	13.96	14.11	14.26	14.41
5086	C	0	0.0046	0.0125	0.0205	0.0288	0.0372	0.0459	0.0547	0.0637	0.0728	0.0821	0.0916
5454	A	12.66	12.86	13.22	13.57	13.87	14.17	14.47	14.77	15.08	15.33	15.63	15.93
	B	12.66	12.76	12.93	13.11	13.27	13.43	13.59	13.74	13.89	14.04	14.19	14.34
	C	0	0.0046	0.0124	0.0205	0.0287	0.0371	0.0457	0.0544	0.0633	0.0724	0.0817	0.0912
6061	A	12.47	12.67	13.02	13.36	13.66	13.96	14.26	14.55	14.85	15.10	15.39	15.69
	B	12.47	12.57	12.74	12.91	13.07	13.23	13.38	13.53	13.68	13.83	13.98	14.13
	C	0	0.0045	0.0122	0.0201	0.0282	0.0365	0.0450	0.0536	0.0624	0.0714	0.0805	0.0899
6063	A	12.54	12.74	13.08	13.43	13.73	14.03	14.33	14.63	14.92	15.17	15.47	15.77
	B	12.54	12.64	12.81	12.97	13.13	13.29	13.45	13.60	13.75	13.90	14.05	14.20
	C	0	0.0046	0.0123	0.0202	0.0284	0.0367	0.0453	0.0539	0.0627	0.0717	0.0809	0.0903

NOTE:
(1) A — Instantaneous Coefficient of Thermal Expansion × 10^6 (in./in./deg. F)
B — Mean Coefficient of Thermal Expansion × 10^6 (in./in./deg. F) } In going from 70 F to Indicated Temperature
C — Linear Thermal Expansion (in./ft) }

TABLE AMG-1.2
COEFFICIENTS OF THERMAL EXPANSION FOR COPPER AND COPPER ALLOYS[1]

Materials	Coef-ficient	Temperature, Deg. F 550	Materials	Coef-ficient	Temperature, Deg. F 550
Copper	A	...	10% Cupro Nickel	A	...
	B	9.8		B	9.5
	C	0.0564		C	0.0547
Admiralty Brass	A	...	Copper Silicon (A,C)	A	...
	B	11.2		B	10.0
	C	0.0645		C	0.0576
Aluminum Brass	A	...	Aluminum Bronze	A	...
	B	10.3		B	9.0
	C	0.0593		C	0.0518
Naval Brass	A	...	Aluminum Bronze (D)	A	...
	B	11.8		B	...
	C	0.0680		C	...
30% Cupro Nickel	A	...			
	B	9.1			
	C	0.0524			

NOTE:
(1) A — Instantaneous Coefficient of Thermal Expansion × 10^6 (in./in./deg. F)
B — Mean Coefficient of Thermal Expansion × 10^6 (in./in./deg. F) } In going from 70 F to Indicated Temperature
C — Linear Thermal Expansion (in./ft) }

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TABLE AMG-1.4
COEFFICIENTS OF THERMAL EXPANSION FOR TITANIUM AND TITANIUM ALLOYS[1]

Material	Coef-ficient	Temperature, Deg. F 70	100	200	300	400	500	600
C. P. Titanium	A	. . .	. . .	4.5	. . .	4.8	. . .	4.9
	B	. . .	. . .	4.8	. . .	. . .	. . .	5.1
0.2% Pd. Titanium Alloy	A	. . .	. . .	4.5	. . .	4.8	. . .	4.9
	B	. . .	. . .	4.8	. . .	. . .	. . .	5.1

NOTE:
(1) A = Mean coefficient of thermal expansion $\times 10^6$ (in./in./F) in going from 32 F to temperature indicated
B = Instantaneous coefficient of thermal expansion $\times 10^6$ (in./in./F)

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TABLE AMG-2
MODULI OF ELASTICITY FOR FERROUS MATERIALS

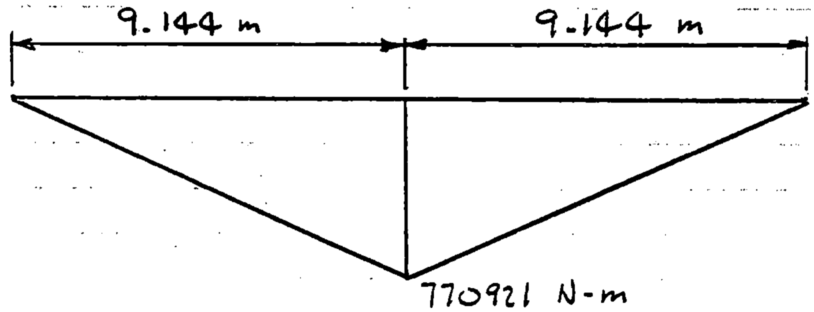
Materials	Temperature, Deg. F 70	200	300	400	500	600	700	800	900
Carbon steels with carbon content 0.30% or less	27.9	27.7	27.4	27.0	26.4	25.7	24.8	23.4	18.5
Carbon steels with carbon content above 0.30%	29.9	29.5	29.0	23.3	27.4	26.7	25.4	23.8	21.5
Carbon-moly steels, low chrome-moly steels through 3%	29.9	29.5	29.0	28.6	28.0	27.4	26.6	25.7	24.5
Intermediate chrome-moly steels (5–9% Cr), austenitic stainless steels	27.4	27.1	26.8	26.4	26.0	25.4	24.9	24.2	23.5
Austenitic steels (TP304, 310, 316, 321, 347)	28.3	27.7	27.1	26.6	26.1	25.4	24.8	24.1	23.4
Straight chromium stainless steels (12 Cr, 17 Cr, 27 Cr)	29.2	28.7	28.3	27.7	27.0	26.0	24.8	23.1	21.1

TABLE AMG-2.1
MODULI OF ELASTICITY FOR ALUMINUM ALLOYS

Aluminum Alloy Designation	Room Temp.	Temperature, Deg. F 150	200	250	300	350	400
3003 3004	10.0	9.8	9.6	9.4	9.1	8.7	8.3
5052 5454	10.2	10.0	9.8	9.4	9.0	8.5	8.0
5083 5086	10.3	10.1	10.0	9.8	9.5	9.1	8.7
6061	10.0	9.8	9.6	9.4	9.2	9.0	8.7
6063	10.0	9.8	9.6	9.4	9.1	8.7	8.3

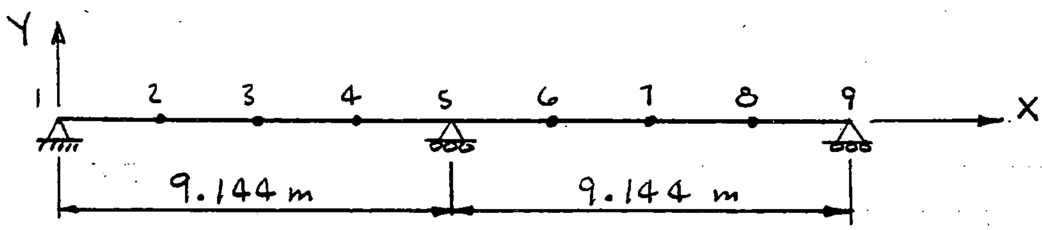
BOX BEAM THERMAL STRESSES

BENDING MOMENT DIAGRAM (SEE PRINT-OUT OF "ANSYS" RESULTS, PG'S 52-59)



$$(f_b)_{max} = \frac{770921}{1.0769\times10^{-2}} = 7.159\times10^{7}\ N/m^2$$
(TENSION IN BOTTOM OF BEAM)

COMBINED THERMAL AND DYNAMIC STRESSES DUE TO MOVING VEHICLE :



MODEL FOR MOVING LOAD ANALYSIS

FOR RESULTS, SEE PG'S 60-75.

COMBINED STRESSES @ X = 4.572 m :

M (THERMAL) = 385460 N-m
M (DYNAMIC) = 232090 N-m
617550 N-m

$$f_b = \frac{617550}{1.0769 \times 10^{-2}} = 5.735 \times 10^{7}\ N/m^2$$

COMBINED STRESS @ X = 6.858 m :

M(THERMAL)	= 578191	N-m
M(DYNAMIC)	= 98992	N-m
	677183	N-m

$$f_b = \frac{677183}{1.0769 \times 10^{-2}} = 6.288 \times 10^{7}\ N/m^2$$

COMBINED STRESS @ X = 9.144 m :

M(THERMAL)	= 770921	N-m
M(DYNAMIC)	= 519	N-m
	771440	N-m

$$f_b = \frac{771440}{1.0769 \times 10^{-2}} = 7.164 \times 10^{7}\ N/m^2$$

∴ MAXIMUM COMBINED STRESS OCCURS AT CENTER SUPPORT

$$f_b = 7.164 \times 10^{7}\ N/m^2 = 10.4\ KSI$$

ALLOWABLE STRESS:
REF: "ALUMINUM CONSTRUCTION MANUAL", 5TH ED., SECTION 3, ENGINEERING DATA FOR ALUMINUM STRUCTURES.

FROM TABLE 3.3-27
F_b = 19 KSI AT LOCATIONS > 1" FROM WELD
= 11 KSI " " < 1" " "

∴ $(F_b)_{min}$ = 11 KSI > 10.4 STRESSES OK

Thermal Stress Analysis Of Levitation Box Beam (30 m/s; 20 s Headway) 9.0196 SEP 18,1992 CP= 8.020

***** ANALYSIS OPTIONS *****

	VALUE
ANALYSIS TYPE	0
ELEMENT CONSTANT TABLE . . .	16
REACTION FORCE KEY	1
MASTER DOF READ KEY	1
MATERIAL TABLE ENTRIES. . . .	5
REFERENCE TEMPERATURE	20.00
UNIFORM TEMPERATURE	20.00

***** ELEMENT TYPES *****

TYPE	STIF	DESCRIPTION	KEY OPTIONS 1	2	3	4	5	6	7	8	9	NJ	INOTPR
1	54	TAPERED UNSYM. BEAM, 2-D	0	0	0	0	0	1	0	0	0	0	0

NUMBER OF ELEMENT TYPES= 1

***** TABLE OF ELEMENT REAL CONSTANTS *****

```
NO.

  1  0.60507E-01 0.64295E-02 0.35425     0.59705     0.60507E-01 0.64295E-02 0.35425     0.59705
     0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00  2.9250
```

NUMBER OF REAL CONSTANT SETS= 1

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```
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Thermal Stress Analysis Of Levitation Box Beam (30 m/s; 20 s Headway)          9.0199  SEP 18,1992 CP=      9.120


         ***** ELEMENT DEFINITIONS *****

ELEMENT    NODES                                      MAT  TYPE                  ELEMENT REAL CONSTANTS


SWITCHED TO FIXED FORMAT INPUT
                                                                          2-D       BEAM      CONS
    1    1    2                                        1    1

                                                               0.605E-01 0.643E-02 0.354     0.597     0.605E-01 0.643E-02
                                                                0.354    0.597     0.000E+00 0.000E+00 0.000E+00 0.000E+00
                                                                 2.92    0.000E+00 0.000E+00 0.000E+00
    2    2    3                                        1    1

                                                               0.605E-01 0.643E-02 0.354     0.597     0.605E-01 0.643E-02
                                                                0.354    0.597     0.000E+00 0.000E+00 0.000E+00 0.000E+00
                                                                 2.92    0.000E+00 0.000E+00 0.000E+00
    3    3    4                                        1    1

                                                               0.605E-01 0.643E-02 0.354     0.597     0.605E-01 0.643E-02
                                                                0.354    0.597     0.000E+00 0.000E+00 0.000E+00 0.000E+00
                                                                 2.92    0.000E+00 0.000E+00 0.000E+00
    4    4    5                                        1    1

                                                               0.605E-01 0.643E-02 0.354     0.597     0.605E-01 0.643E-02
                                                                0.354    0.597     0.000E+00 0.000E+00 0.000E+00 0.000E+00
                                                                 2.92    0.000E+00 0.000E+00 0.000E+00
 INTEGER STORAGE REQUIREMENTS FOR ELEMENT INPUT                     CP=      9.890  TIME=  9.02012
FIXED DATA =     1034  TEMPORARY DATA =       10    TOTAL=     1044
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500    TOTAL AVAIL= 2251500
 MAXIMUM NODE NUMBER FOR AVAILABLE AUXILIARY MEMORY SIZE=     1125232

 NUMBER OF ELEMENTS =       4     MAXIMUM NODE NUMBER USED =       5


         ***** NODE DEFINITIONS *****

                LOCATION            ROTATION (DEGREES)

  NODE          X             Y            THXY
              (OR R)      (OR THETA)     (OR RT)


SWITCHED TO FIXED FORMAT INPUT
     1      0.00000E+00    0.00000E+00    0.00000E+00
     2        4.5720       0.00000E+00    0.00000E+00
     3        9.1440       0.00000E+00    0.00000E+00
     4        13.716       0.00000E+00    0.00000E+00
     5        18.288       0.00000E+00    0.00000E+00

 XMIN= 0.0000E+00  XMAX=   18.29      YMIN= 0.0000E+00  YMAX= 0.0000E+00  ZMIN= 0.0000E+00  ZMAX= 0.0000E+00

 INTEGER STORAGE REQUIREMENTS FOR NODE INPUT                        CP=     10.770  TIME=  9.02036
FIXED DATA =     1034  TEMPORARY DATA =       30    TOTAL=     1064
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500    TOTAL AVAIL= 2251500
```

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ANSYS - ENGINEERING ANALYSIS SYSTEM REVISION 4.4 A 1 40195-PC/L1-4.4A MAY 1,1990

Thermal Stress Analysis Of Levitation Box Beam (30 m/s; 20 s Headway) 9.0206 SEP 18,1992 CP= 11.760

***** MATERIAL PROPERTIES *****

MATERIAL 1

NUXY PROPERTY TABLE (LINEAR INTERPOLATION)

TEMP	NUXY	TEMP	NUXY	TEMP	NUXY	TEMP	NUXY	TEMP	NUXY
-9999.0	0.30000	9999.0	0.30000						

EX PROPERTY TABLE (LINEAR INTERPOLATION)

TEMP	EX	TEMP	EX	TEMP	EX	TEMP	EX	TEMP	EX
21.1	0.68950E+11	65.6	0.67570E+11	93.3	0.66190E+11	121.1	0.64810E+11	148.9	0.63430E+11

ALPX PROPERTY TABLE (LINEAR INTERPOLATION)

TEMP	ALPX	TEMP	ALPX	TEMP	ALPX	TEMP	ALPX	TEMP	ALPX
21.1	0.22446E-04	65.6	0.22932E-04	93.3	0.23238E-04	121.1	0.23526E-04	148.9	0.23814E-04

MAXIMUM MATERIAL NUMBER= 1

***** MASTER DEGREES OF FREEDOM *****

NODE DEGREES OF FREEDOM LIST

NUMBER OF SPECIFIED MASTER D.O.F.= 0
TOTAL NUMBER OF MASTER D.O.F. = 0

INTEGER STORAGE REQUIREMENTS FOR MATERIALS, ETC. INPUT CP= 12.360 TIME= 9.02081
FIXED DATA = 62 TEMPORARY DATA = 0 TOTAL= 62
FIXED AVAIL= 2251500 TEMPORARY AVAIL= 2251500 TOTAL AVAIL= 2251500

*** LOAD STEP 1 OPTIONS SPECIFICATIONS

NITTER= 1 NPRINT= 1 NPOST= 1

ALL PRINT CONTROLS RESET TO 1

ALL POST DATA FILE CONTROLS RESET TO 1

NEW TITLE= Thermal Stress Analysis Of Levitation Box Beam (30 m/s; 20 s Headway)

NO CONVERGENCE CHECKING OR TIME STEP OPTIMIZATION

TIME= 0.00000E+00

ACEL= 0.00000E+00 0.00000E+00 0.00000E+00

OMEGA= 0.00000E+00 0.00000E+00 0.00000E+00

DOMEGA= 0.00000E+00 0.00000E+00 0.00000E+00

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```
CGLOC=  0.00000E+00 0.00000E+00 0.00000E+00

CGOMGA= 0.00000E+00 0.00000E+00 0.00000E+00

DCGOME= 0.00000E+00 0.00000E+00 0.00000E+00

EXTRACTED MODE RANGE - FROM 0.000000E+00 TO  0.000000E+00

INERTIA RELIEF KEY=  0

KTEMP=    -1     0

READ IN TEMPERATURES IN ELEMENT FORMAT

KUSE=   0

PLASTICITY CONVERGENCE CRITERION=      0.0100
CREEP OPTIMIZATION CRITERIA=      0.1000
LARGE DEFL. CONVERGENCE CRITERIA=    0.001000
DISPLACEMENT LIMIT= 0.10000E+11
KEY TO TERMINATE RUN IF NO CONVERGENCE=    0.
CUMULATIVE ITERATION LIMIT=     0

HARMONIC LOAD PARAMETERS  MODE=    0   ISYM=    1

NUMBER OF STRESS PASS CALCULATIONS=     0

LOADS RAMPED TO FINAL VALUES DURING ITERATIONS (KBC= 0)

STRAIN ENERGY KEY= 0

REACTION FORCE KEY= 1

UNIFORM TEMPERATURE=   20.000  (TREF=   20.000)

SEISMIC COMBINATION TYPE (MCOMB)=   0

DAMPING RATIO =       0.0000

BOUNDARY CONDITION PRINT KEY=  0
```

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Thermal Stress Analysis Of Levitation Box Beam (30 m/s; 20 s Headway)            9.0209  SEP 18,1992 CP=     12.580


LOAD STEP NUMBER=     1

         *** LOAD OPTIONS SUMMARY ***

TIME   = 0.00000E+00 (TIME AT END OF LOAD STEP)
NITTER=        1       (NUMBER OF ITERATIONS)
TUNIF =  20.0000       (UNIFORM TEMPERATURE)   (TREF=  20.0000)
KTEMP =  -1            (USE SPECIFIED NODAL OR ELEMENT TEMPERATURES)
KRF   =   1            (PRINT NODAL FORCES AND CONSTRAINED NODE REACTIONS)

NPRINT=      1         (OVERALL PRINT FREQUENCY)
NPOST =      1         (OVERALL POST FREQUENCY)

 DISPLACEMENT PRINT FREQUENCIES
  FREQ    NSTRT  NSTOP    NINC
     1        1 999999       1

 ELEMENT PRINT AND POST FREQUENCIES
  TYPE  STIFF  STRESS  FORCE       STRESS  STRESS  FORCE
          NO.   PRINT  PRINT        POST    LEVEL   POST
     1     54      1      1            1       3      1


          ***** SPECIFIED DISPLACEMENTS *****

   NODE       UX               UY                ROTZ

     1    0.000000E+00    0.000000E+00
     3                    0.000000E+00
     5                    0.000000E+00


          ***** ELEMENT TEMPERATURE DATA *****
   ELEM. (IN ELEMENT SOLUTION ORDER)

      1    127.00      76.000
      2    127.00      76.000
      3    127.00      76.000
      4    127.00      76.000


***** LOAD SUMMARY -      4 DISPLACEMENTS      0 FORCES      0 PRESSURES     *****


 INTEGER STORAGE REQUIREMENTS FOR LOAD DATA INPUT               CP=    13.190  TIME=  9.02104
FIXED DATA =      106  TEMPORARY DATA =        0   TOTAL=      106
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500   TOTAL AVAIL= 2251500

 RANGE OF ELEMENT MAXIMUM STIFFNESS IN GLOBAL COORDINATES


MAXIMUM= 0.870608E+09  AT ELEMENT      4.
MINIMUM= 0.870608E+09  AT ELEMENT      3.
```

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```
 INTEGER STORAGE REQUIREMENTS FOR ELEMENT FORMULATION          CP=     15.490  TIME=  9.02168
FIXED DATA =      106  TEMPORARY DATA =        0   TOTAL=     106
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500   TOTAL AVAIL= 2251500

  *** ELEMENT STIFFNESS FORMULATION TIMES
 TYPE  NUMBER  STIF  TOTAL CP   AVE CP

   1       4    54     0.330    0.082


TIME AT END OF ELEMENT STIFFNESS FORMULATION  CP=      15.550


MAXIMUM IN-CORE WAVE FRONT ALLOWED FOR REQUESTED MEMORY SIZE= 1498.

 INTEGER STORAGE REQUIREMENTS FOR WAVE FRONT MATRIX SOLUTION      CP=     16.320  TIME=  9.02191
FIXED DATA =      106  TEMPORARY DATA =       81   TOTAL=     187
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500   TOTAL AVAIL= 2251500


MAXIMUM IN-CORE WAVE FRONT=       7.


     MATRIX SOLUTION TIMES
 READ IN ELEMENT STIFFNESSES   CP=           0.000


 NODAL COORD. TRANSFORMATION   CP=           0.000
 MATRIX TRIANGULARIZATION      CP=           0.060


TIME AT END OF MATRIX TRIANGULARIZATION  CP=         16.370
EQUATION SOLVER MAXIMUM PIVOT= 0.17412E+10 AT NODE     2. UX
EQUATION SOLVER MINIMUM PIVOT= 0.48175E+08 AT NODE     2. UY

 TIME AT START OF BACK SUBSTITUTION   CP=    16.430      LOAD STEP=   1  ITERATION=      1  CUM. ITER.=    1


 ***** DISPLACEMENT SOLUTION *****  TIME =  0.00000E+00  LOAD STEP=   1  ITERATION=      1  CUM. ITER.=    1
   NODE       UX                UY                ROTZ


     1    0.000000E+00    0.000000E+00    0.309992E-02
     2    0.869045E-02    0.354321E-02   -0.533360E-03
     3    0.173809E-01    0.000000E+00    0.216840E-18
     4    0.260713E-01    0.354321E-02    0.533360E-03
     5    0.347618E-01    0.000000E+00   -0.309992E-02

MAXIMUMS
NODE          5               4                5
VALUE    0.347618E-01    0.354321E-02    -0.309992E-02

 INTEGER STORAGE REQUIREMENTS FOR BACK SUBSTITUTION            CP=     16.700  TIME=  9.02201
FIXED DATA =      106  TEMPORARY DATA =       38   TOTAL=     144
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500   TOTAL AVAIL= 2251500

  ***** ELEMENT STRESSES *****  TIME =  0.000000E+00   LOAD STEP=    1   ITERATION=      1   CUM. ITER.=    1

EL=      1  NODES=      1      2  MAT=  1  TTOP,TBOT=  127.0    76.0                                  2-D TAP BEAM  54
END         SDIR          SSH          SBYB         SBYT          SYB          SYT
  I     0.46176E-07  0.00000E+00  0.00000E+00  0.00000E+00  0.46176E-07  0.46176E-07
  J     0.46176E-07  0.00000E+00  0.35794E+08 -0.21238E+08  0.35794E+08 -0.21238E+08
FORCES ON MEMBER AT NODE        1 -0.279397E-08   84308.9       0.000000E+00
                                2  0.279397E-08  -84308.9        385460.
 STATIC FORCES ON NODE      1  0.269074E-08  -84308.9      -0.550315E-11
 STATIC FORCES ON NODE      2 -0.269074E-08   84308.9       -385460.
```

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```
EL=      2  NODES=      2      3  MAT=  1  TTOP,TBOT=  127.0    76.0                                                           2-D TAP BEAM  54
END        SDIR          SSH           SBYB          SBYT          SYB           SYT
  I      0.76960E-07  0.00000E+00  0.35794E+08 -0.21238E+08  0.35794E+08 -0.21238E+08
  J      0.76960E-07  0.00000E+00  0.71589E+08 -0.42475E+08  0.71589E+08 -0.42475E+08
FORCES ON MEMBER AT NODE      2 -0.465661E-08   84308.9        -385460.
                              3  0.465661E-08  -84308.9         770921.
 STATIC FORCES ON NODE       2  0.476302E-08  -84308.9         385460.
 STATIC FORCES ON NODE       3 -0.476302E-08   84308.9        -770921.

EL=      3  NODES=      3      4  MAT=  1  TTOP,TBOT=  127.0    76.0                                                           2-D TAP BEAM  54
END        SDIR          SSH           SBYB          SBYT          SYB           SYT
  I      0.61568E-07  0.00000E+00  0.71589E+08 -0.42475E+08  0.71589E+08 -0.42475E+08
  J      0.61568E-07  0.00000E+00  0.35794E+08 -0.21238E+08  0.35794E+08 -0.21238E+08
FORCES ON MEMBER AT NODE      3 -0.372529E-08  -84308.9        -770921.
                              4  0.372529E-08   84308.9         385460.
 STATIC FORCES ON NODE       3  0.363980E-08   84308.9         770921.
 STATIC FORCES ON NODE       4 -0.363980E-08  -84308.9        -385460.

EL=      4  NODES=      4      5  MAT=  1  TTOP,TBOT=  127.0    76.0                                                           2-D TAP BEAM  54
END        SDIR          SSH           SBYB          SBYT          SYB           SYT
  I      0.61568E-07  0.00000E+00  0.35794E+08 -0.21238E+08  0.35794E+08 -0.21238E+08
  J      0.61568E-07  0.00000E+00  0.00000E+00  0.00000E+00  0.61568E-07  0.61568E-07
FORCES ON MEMBER AT NODE      4 -0.372529E-08  -84308.9        -385460.
                              5  0.372529E-08   84308.9        0.000000E+00
 STATIC FORCES ON NODE       4  0.381442E-08   84308.9         385460.
 STATIC FORCES ON NODE       5 -0.381442E-08  -84308.9        0.130740E-10

  ***** REACTION FORCES *****    TIME =  0.00000E+00   LOAD STEP=     1  ITERATION=     1  CUM. ITER.=     1

 NOTE - REACTION FORCES ARE IN THE NODAL COORDINATE SYSTEM.


   NODE       FX                FY                MZ

      1    -0.269074E-08      84308.9
      3                      -168618.
      5                       84308.9

TOTAL    -0.269074E-08    -0.145519E-10    0.000000E+00

  *** ELEM. STRESS CALC. TIMES
 TYPE  NUMBER   STIF   TOTAL CP    AVE CP

  1       4     54      0.220    0.055

  *** NODAL FORCE CALC. TIMES
 TYPE  NUMBER   STIF   TOTAL CP    AVE CP

  1       4     54      0.000    0.000

*** LOAD STEP     1   ITER      1  COMPLETED.  TIME=  0.000000E+00  TIME INC=  0.000000E+00 NEW TRIANG MATRIX  CUM. ITER.=     1

 INTEGER STORAGE REQUIREMENTS FOR STRESS AND FORCE CALCULATIONS   CP=     17.690  TIME=  9.02229
FIXED DATA =      106  TEMPORARY DATA =       90   TOTAL=      196
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500   TOTAL AVAIL= 2251500


 *** STORAGE REQUIREMENT SUMMARY
MAXIMUM FIXED MEMORY USED    =       1034
MAXIMUM TEMPORARY MEMORY USED=         90
MAXIMUM TOTAL MEMORY USED    =       1064
MAXIMUM TEMPORARY AVAILABLE  =    2251392
```

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```
  *** PROBLEM STATISTICS
 NO. OF ACTIVE DEGREES OF FREEDOM =       11
 R.M.S. WAVEFRONT SIZE =      4.5


 *** ANSYS BINARY FILE STATISTICS
BUFFER SIZE USED= 2048
POST DATA WRITTEN ON FILE12
RESTART DATA WRITTEN ON FILE03    (          13388 BYTES)
TRIANGULARIZED MATRIX WRITTEN ON FILE11    (            768 BYTES)

***** END OF INPUT ENCOUNTERED ON FILE27.  FILE27 REWOUND

***** INPUT FILE SWITCHED FROM FILE27 TO FILE18


***** ROUTINE COMPLETED *****  CP =        18.020

***** END OF INPUT ENCOUNTERED ON FILE18


PREP7 AFWRITE OR SFWRITE WARNING MESSAGES =    0
NUMBER OF SOLUTION PHASE WARNING MESSAGES =    0


***** RUN COMPLETED *****  CP=       18.3500   TIME=    9.0225
```

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PROGRAM DYNACB

Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

STRUCTURAL PARAMETERS

NN	NE	NRN	E	RHO
9	8	3	6.8950E+10	2.7126E+03

NODAL COORDINATES

NODE	X
1	0.0000E+00
2	2.2860E+00
3	4.5720E+00
4	6.8580E+00
5	9.1440E+00
6	1.1430E+01
7	1.3716E+01
8	1.6002E+01
9	1.8288E+01

ELEMENT INFORMATION

ELEM.	J	K	AX	ZI	EL
1	1	2	6.0507E-02	6.4295E-03	2.2860E+00
2	2	3	6.0507E-02	6.4295E-03	2.2860E+00
3	3	4	6.0507E-02	6.4295E-03	2.2860E+00
4	4	5	6.0507E-02	6.4295E-03	2.2860E+00
5	5	6	6.0507E-02	6.4295E-03	2.2860E+00
6	6	7	6.0507E-02	6.4295E-03	2.2860E+00
7	7	8	6.0507E-02	6.4295E-03	2.2860E+00
8	8	9	6.0507E-02	6.4295E-03	2.2860E+00

NODAL RESTRAINTS

NODE	NR1	NR2
1	1	0
5	1	0
9	1	0

NUMBER OF DEGREES OF FREEDOM: NDF = 15
NUMBER OF NODAL RESTRAINTS: NNR = 3

OUTPUT KEY FOR MODAL ANALYSIS: IMO = 0

STIFFNESS MATRIX DECOMPOSED

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Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

MODE	FREQUENCY (Hz)
1	3.0883E+01
2	4.8263E+01
3	1.2399E+02
4	1.5728E+02
5	2.8295E+02
6	3.3346E+02
7	5.4830E+02
8	6.2620E+02
9	8.7151E+02
10	1.0209E+03
11	1.3782E+03
12	1.6301E+03
13	2.0647E+03
14	2.3600E+03
15	2.5126E+03

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Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

DYNAMIC PARAMETERS

ISOLVE	NTS	DT	DAMPR
1	1000	2.0000E-03	0.0000E+00

INITIAL CONDITIONS

NNID	NNIV
0	0

APPLIED ACTIONS

NLN	NEL	IML
0	0	12

MOVING LOADS

P	VOP	AOP	SPACING
-2.9648E+04	3.0000E+01	0.0000E+00	4.5000E-01
-2.2992E+04	3.0000E+01	0.0000E+00	4.5000E-01
-2.2992E+04	3.0000E+01	0.0000E+00	4.5000E-01
-2.2992E+04	3.0000E+01	0.0000E+00	4.5000E-01
-2.2992E+04	3.0000E+01	0.0000E+00	4.5000E-01
-2.9648E+04	3.0000E+01	0.0000E+00	2.6401E+01
-2.9648E+04	3.0000E+01	0.0000E+00	4.5000E-01
-2.2992E+04	3.0000E+01	0.0000E+00	4.5000E-01
-2.2992E+04	3.0000E+01	0.0000E+00	4.5000E-01
-2.2992E+04	3.0000E+01	0.0000E+00	4.5000E-01
-2.2992E+04	3.0000E+01	0.0000E+00	4.5000E-01
-2.9648E+04	3.0000E+01	0.0000E+00	0.0000E+00

GROUND ACCELERATIONS

IGA
0

DIRECT NUMERICAL INTEGRATION

ALPHA = -0.1000 BETA = 0.3025 GAMMA = 0.6000

OUTPUT SELECTION

IWR	IPL	NNO	NEO	NRO
2	1	2	3	3

NODES (DISPL.): 3 7

ELEMENTS: 2 4 6

NODES (REACT.): 1 5 9

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Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

DISPLACEMENT TIME HISTORY FOR NODE 3

	UY	ROTZ
MAXIMUM	1.5887E-03	2.7426E-04
TIME OF MAXIMUM	1.4280E+00	1.0860E+00
MINIMUM	-3.7797E-03	-1.0257E-04
TIME OF MINIMUM	1.1460E+00	2.6600E-01

DISPLACEMENT TIME HISTORY FOR NODE 7

	UY	ROTZ
MAXIMUM	1.5681E-03	1.0268E-04
TIME OF MAXIMUM	1.1480E+00	4.1400E-01
MINIMUM	-3.8028E-03	-2.7411E-04
TIME OF MINIMUM	1.4600E+00	5.5400E-01

Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 2

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	8.2799E+04	3.4938E+04	6.8493E+04	2.3209E+05
TIME OF MAXIMUM	1.5200E-01	1.4280E+00	1.5200E-01	1.1480E+00
MINIMUM	-2.3892E+04	-1.9701E+05	-4.2727E+04	-6.8160E+04
TIME OF MINIMUM	7.6000E-02	1.0860E+00	2.2800E-01	1.4280E+00

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 4

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	1.2577E+04	9.8992E+04	1.3865E+05	5.1897E+02
TIME OF MAXIMUM	1.2600E+00	1.4280E+00	3.0400E-01	6.9200E-01
MINIMUM	-1.0908E+05	-1.3158E+05	-1.5972E+03	-1.2886E+05
TIME OF MINIMUM	1.1820E+00	1.2120E+00	1.6900E+00	1.1580E+00

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 6

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	1.0871E+05	9.8168E+04	4.2777E+04	2.3339E+05
TIME OF MAXIMUM	4.5600E-01	1.1800E+00	1.4120E+00	1.4580E+00
MINIMUM	-1.2136E+04	-1.3190E+05	-6.8370E+04	-6.7334E+04
TIME OF MINIMUM	1.3360E+00	1.3960E+00	1.4880E+00	1.1480E+00

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Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

REACTION FORCE TIME HISTORY FOR NODE 1

	FY	MZ
MAXIMUM	1.2760E+05	1.1354E+02
TIME OF MAXIMUM	7.6000E-02	1.1000E-01
MINIMUM	-1.5427E+04	-1.8574E+02
TIME OF MINIMUM	1.4280E+00	9.7200E-01

REACTION FORCE TIME HISTORY FOR NODE 5

	FY	MZ
MAXIMUM	1.4976E+05	1.1893E+02
TIME OF MAXIMUM	1.3060E+00	1.3720E+00
MINIMUM	-5.3714E+02	-1.3748E+02
TIME OF MINIMUM	6.9200E-01	1.2900E+00

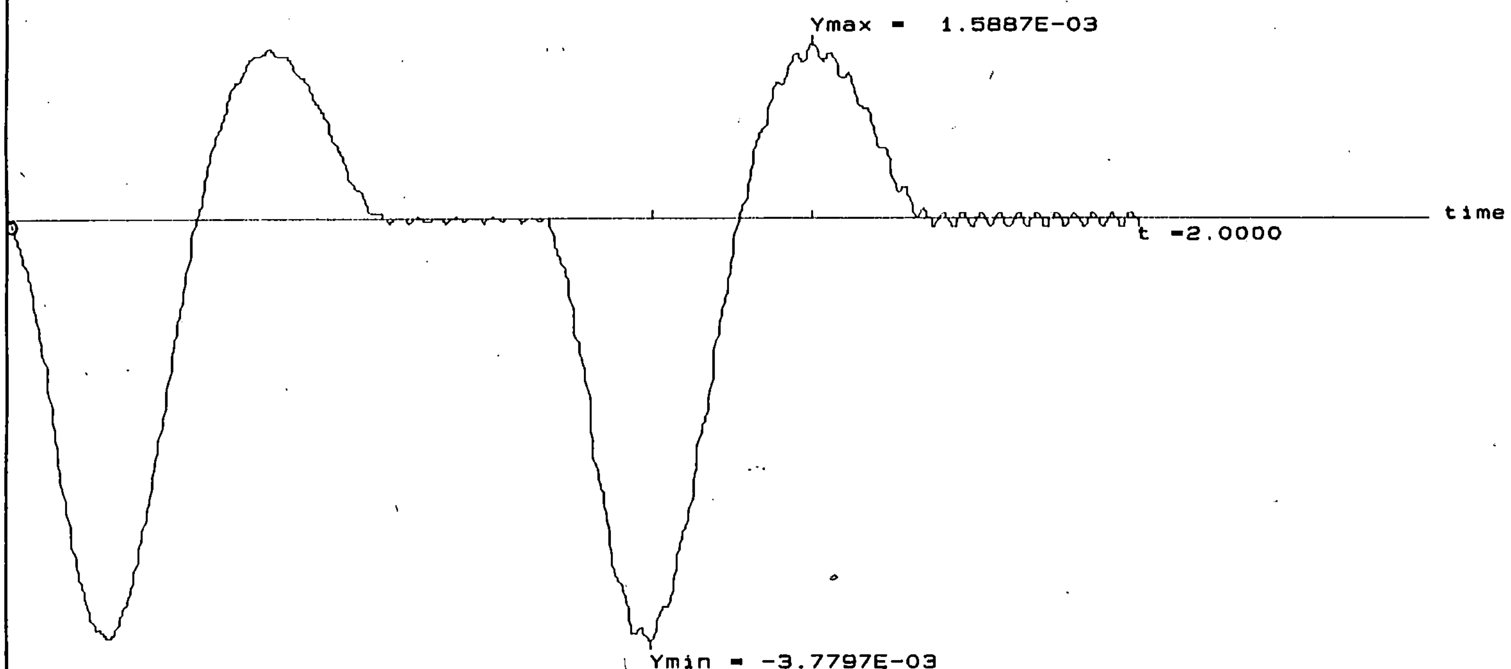
REACTION FORCE TIME HISTORY FOR NODE 9

	FY	MZ
MAXIMUM	1.2854E+05	1.1426E+02
TIME OF MAXIMUM	1.5640E+00	5.7200E-01
MINIMUM	-1.5273E+04	-1.7569E+02
TIME OF MINIMUM	1.1480E+00	1.6240E+00

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0883E+01 Hz

Results at Node = 3

Displacement : Ymin = -3.7797E-03 (t =1.1460) Ymax = 1.5887E-03 (t =1.4280)

Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 9/18/1992
Time: 10: 10: 6

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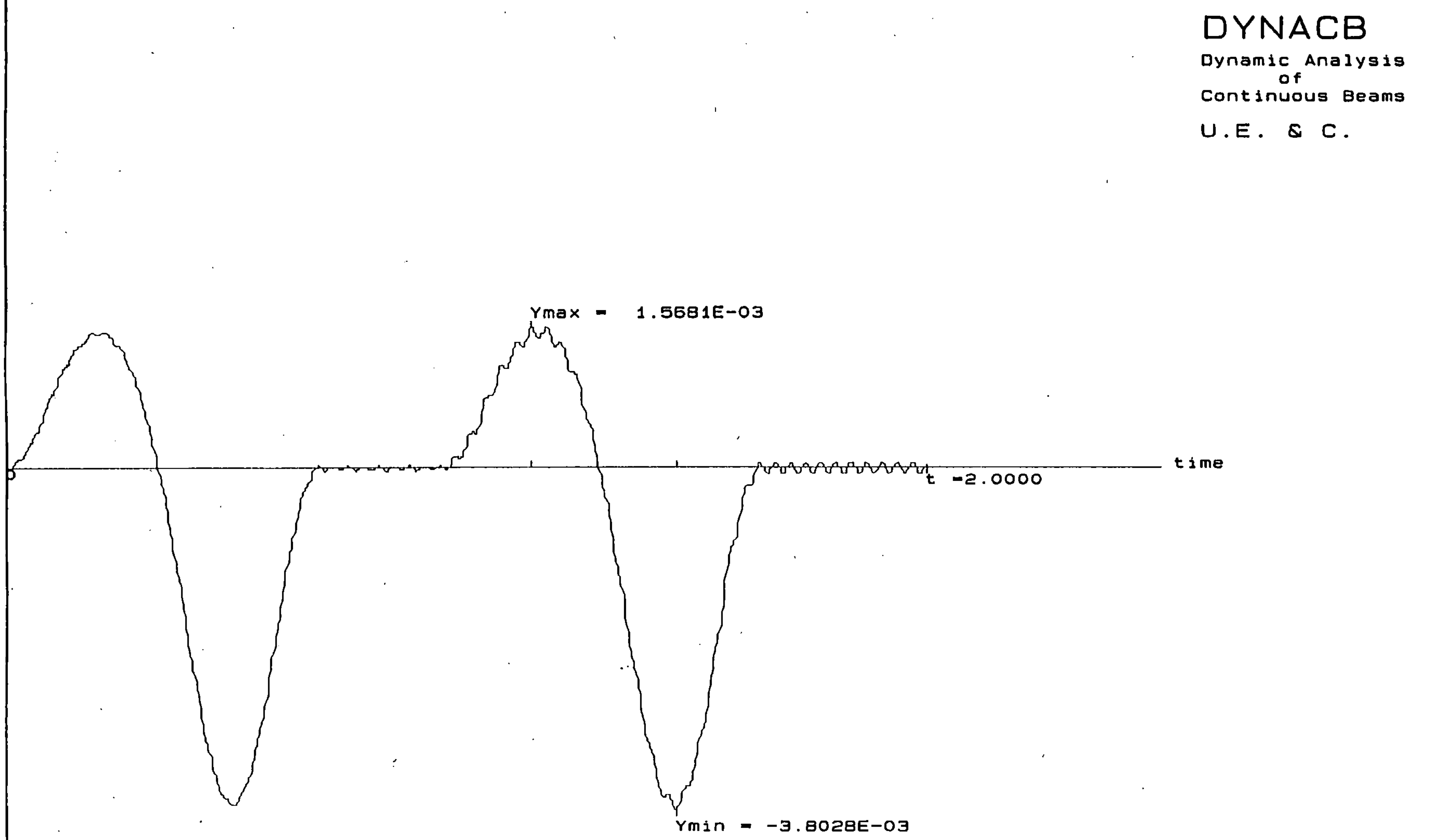

Beam Fundamental Natural Frequency = 3.0883E+01 Hz

Results at Node = 7

Displacement : Ymin = -3.8028E-03 (t =1.4600) Ymax = 1.5681E-03 (t =1.1480)

Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 9/18/1992
Time: 10: 10: 6

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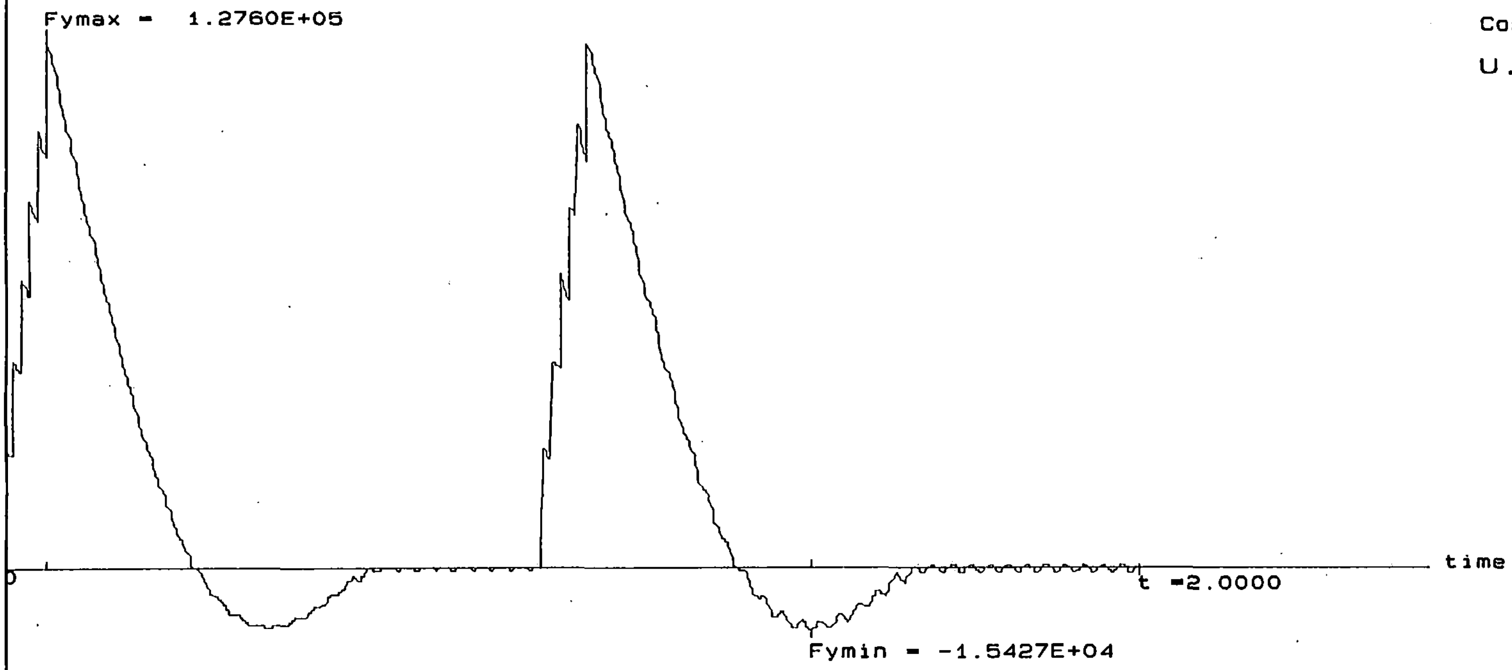
DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0883E+01 Hz

Results at Node = 1

Reaction : Fymin = -1.5427E+04 (t =1.4280) Fymax = 1.2760E+05 (t = .0760)

Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 9/18/1992
Time: 10: 10: 6

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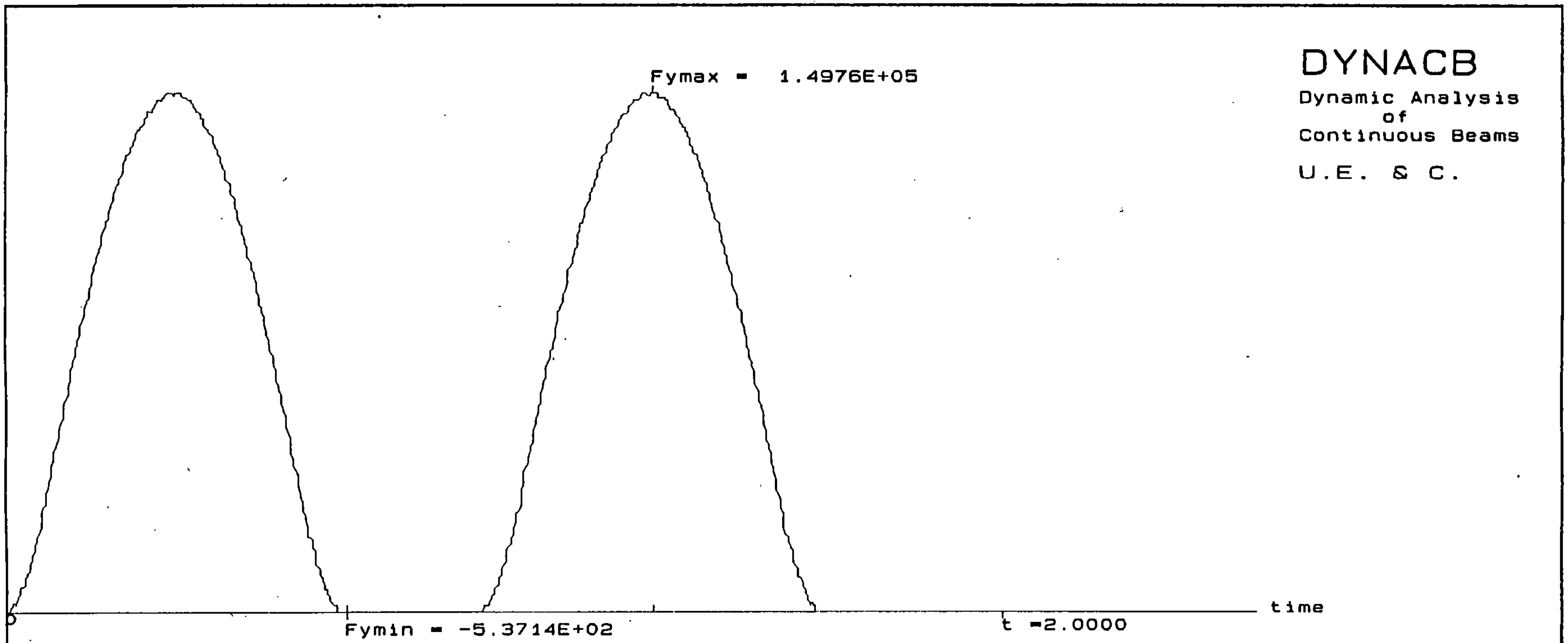


Beam Fundamental Natural Frequency = 3.0883E+01 Hz

Results at Node = 5

Reaction : Fymin = -5.3714E+02 (t = .6920) Fymax = 1.4976E+05 (t =1.3060)

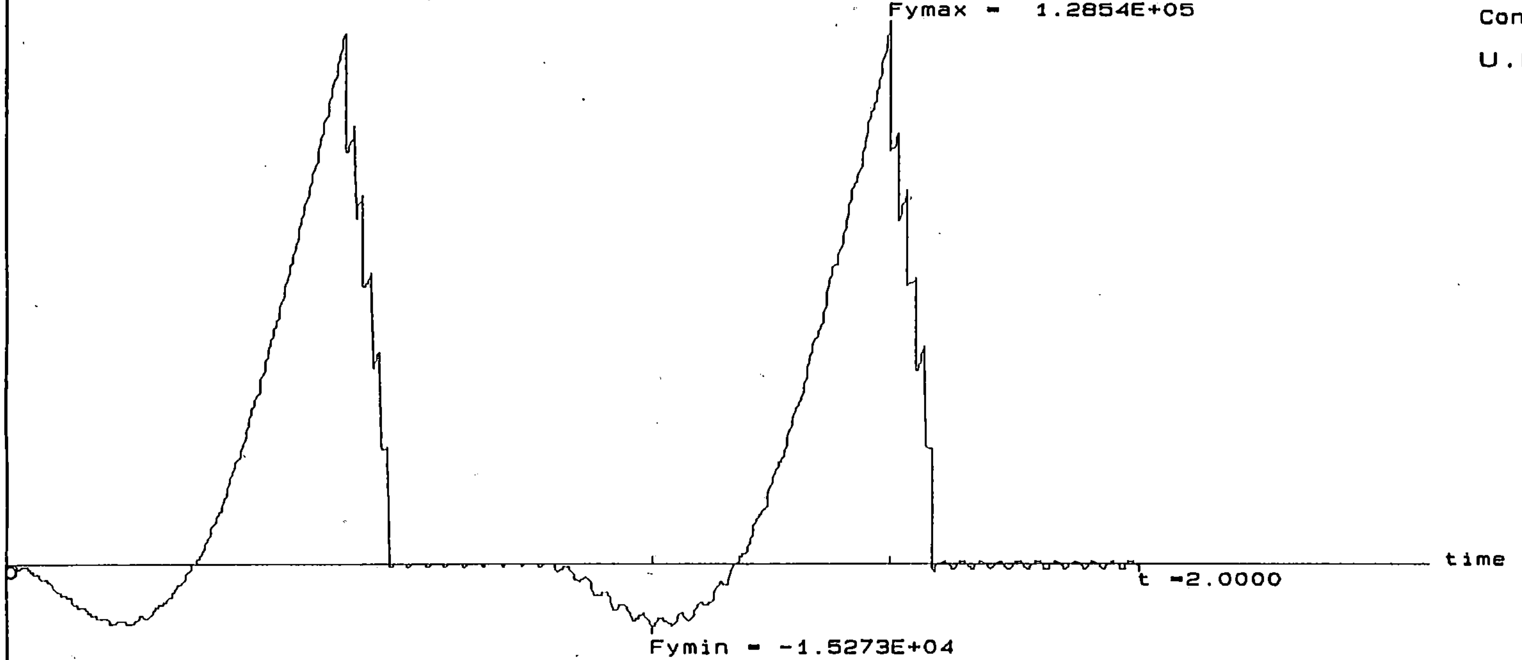
Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 9/18/1992
Time: 10: 10: 6

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0883E+01 Hz

Results at Node = 9

Reaction : Fymin = -1.5273E+04 (t =1.1480) Fymax = 1.2854E+05 (t =1.5640)

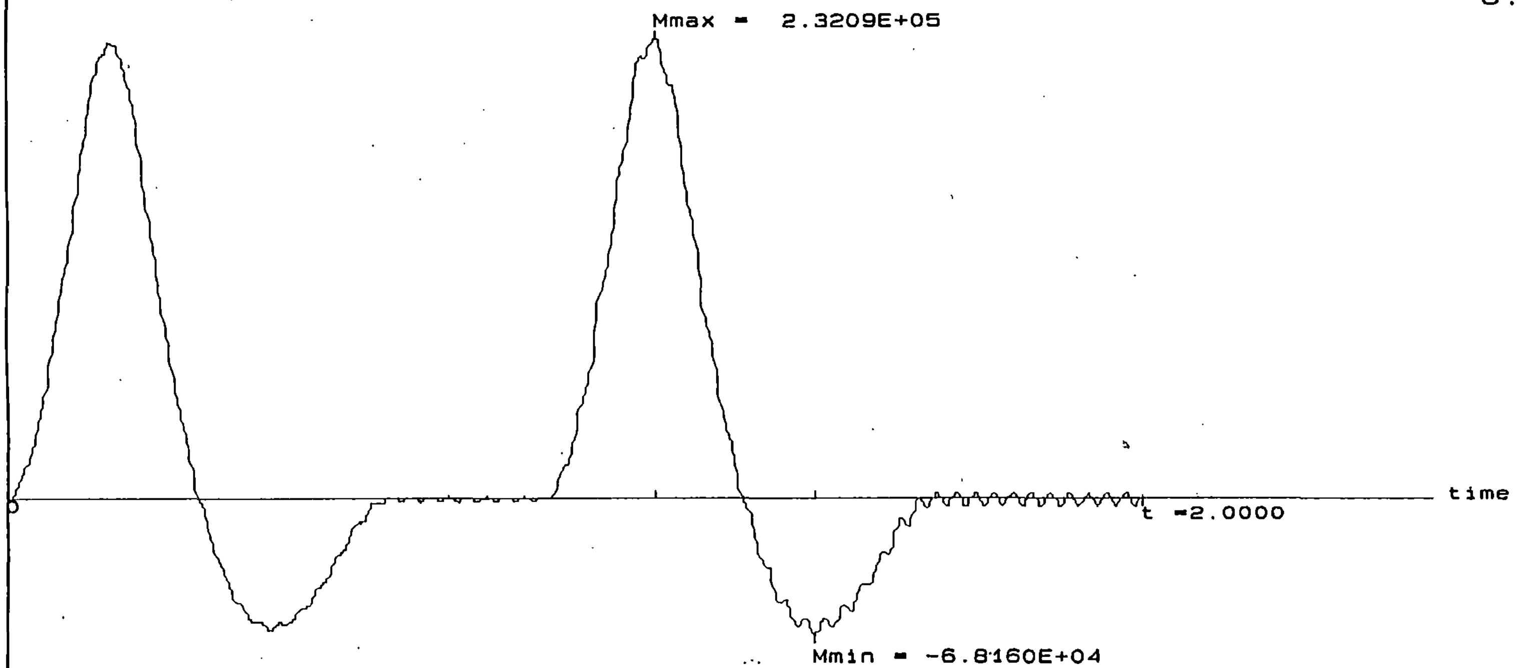
Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 9/18/1992
Time: 10: 10: 6

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0883E+01 Hz

Results at Elem = 2 (End Node)

Bending Moment : Mmin = -6.8160E+04 (t = 1.4280) Mmax = 2.3209E+05 (t = 1.1480)

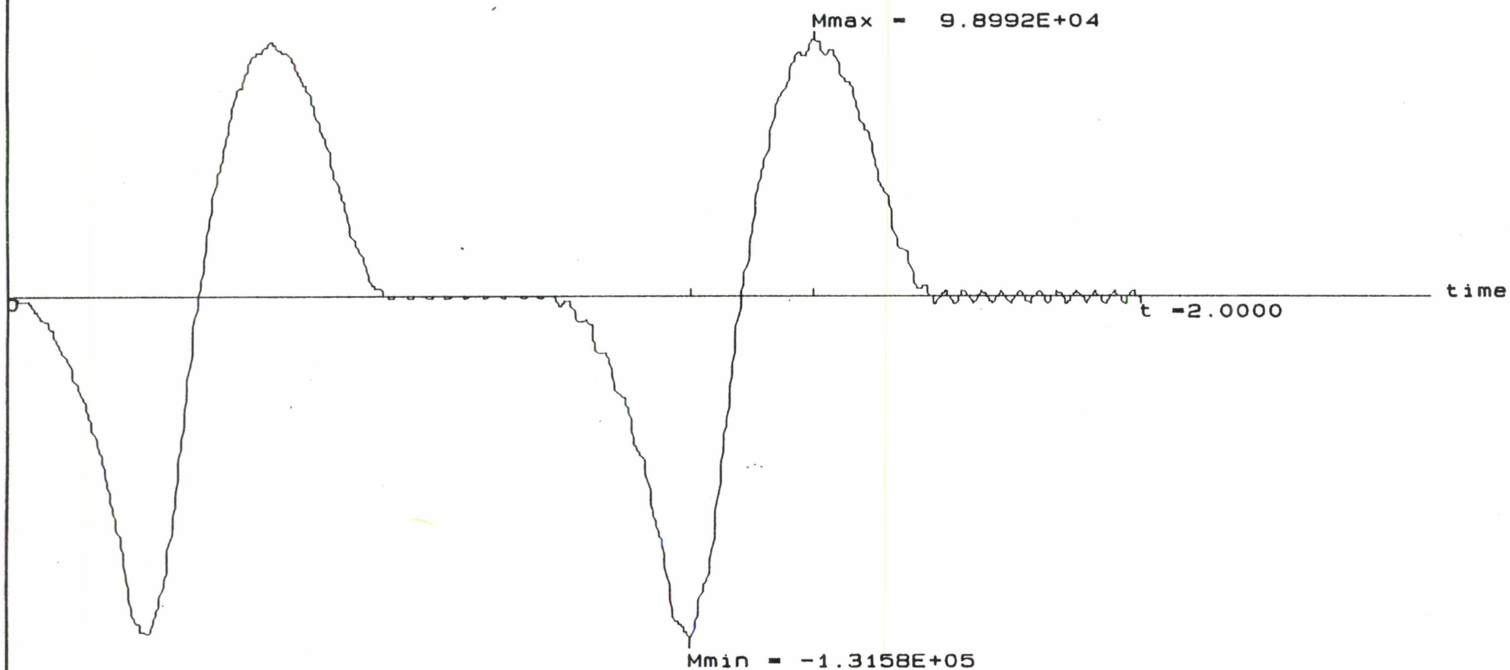
Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 9/18/1992
Time: 10:10: 6

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0883E+01 Hz

Results at Elem = 4 (Start Node)

Bending Moment : Mmin = -1.3158E+05 (t =1.2120) Mmax = 9.8992E+04 (t =1.4280)

Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 9/18/1992
Time: 10: 43: 44

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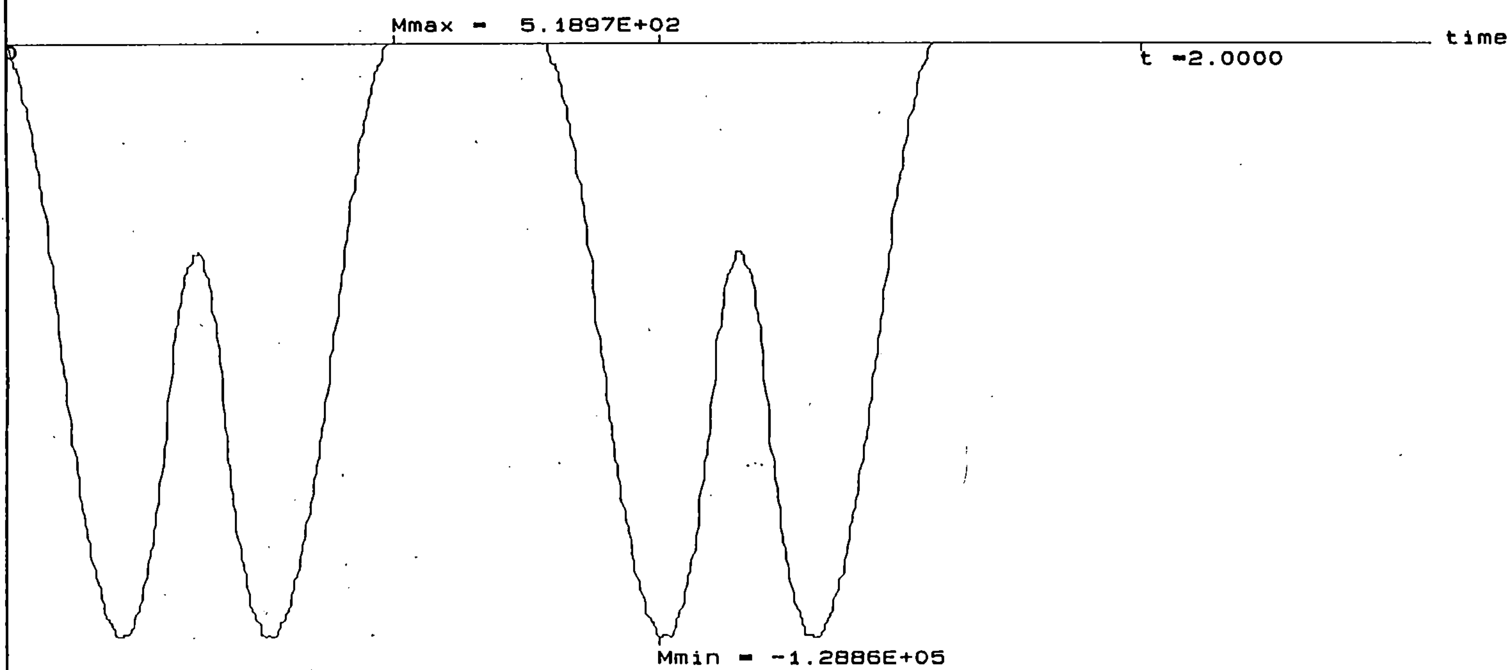
DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0883E+01 Hz

Results at Elem = 4 (End Node)

Bending Moment : Mmin = -1.2886E+05 (t =1.1580) Mmax = 5.1897E+02 (t = .6920)

Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 9/18/1992
Time: 10: 10: 6

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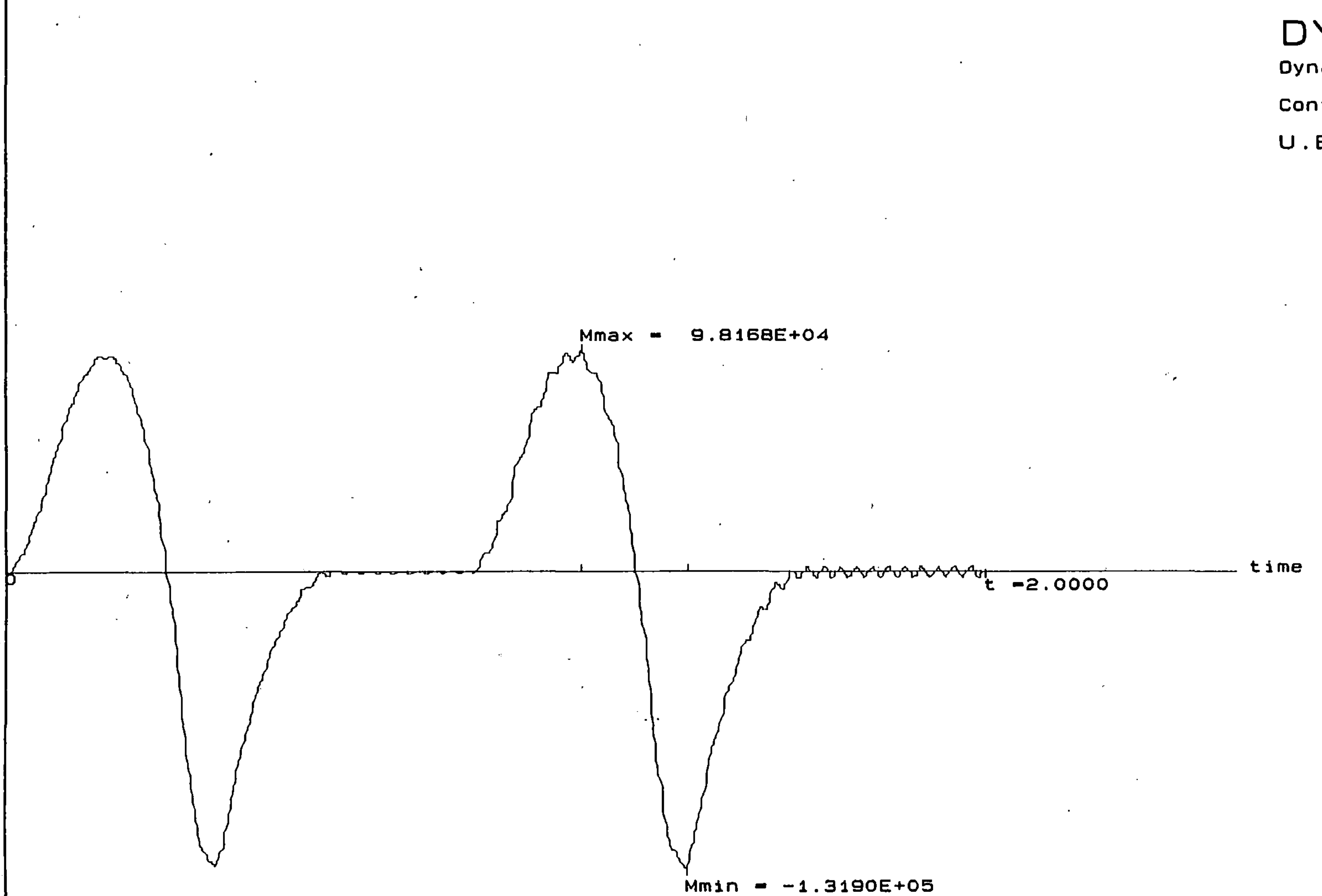

Beam Fundamental Natural Frequency = 3.0883E+01 Hz

Results at Elem = 6 (Start Node)

Bending Moment : Mmin = -1.3190E+05 (t =1.3960) Mmax = 9.8168E+04 (t =1.1800)

Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 9/18/1992
Time: 10: 43: 44

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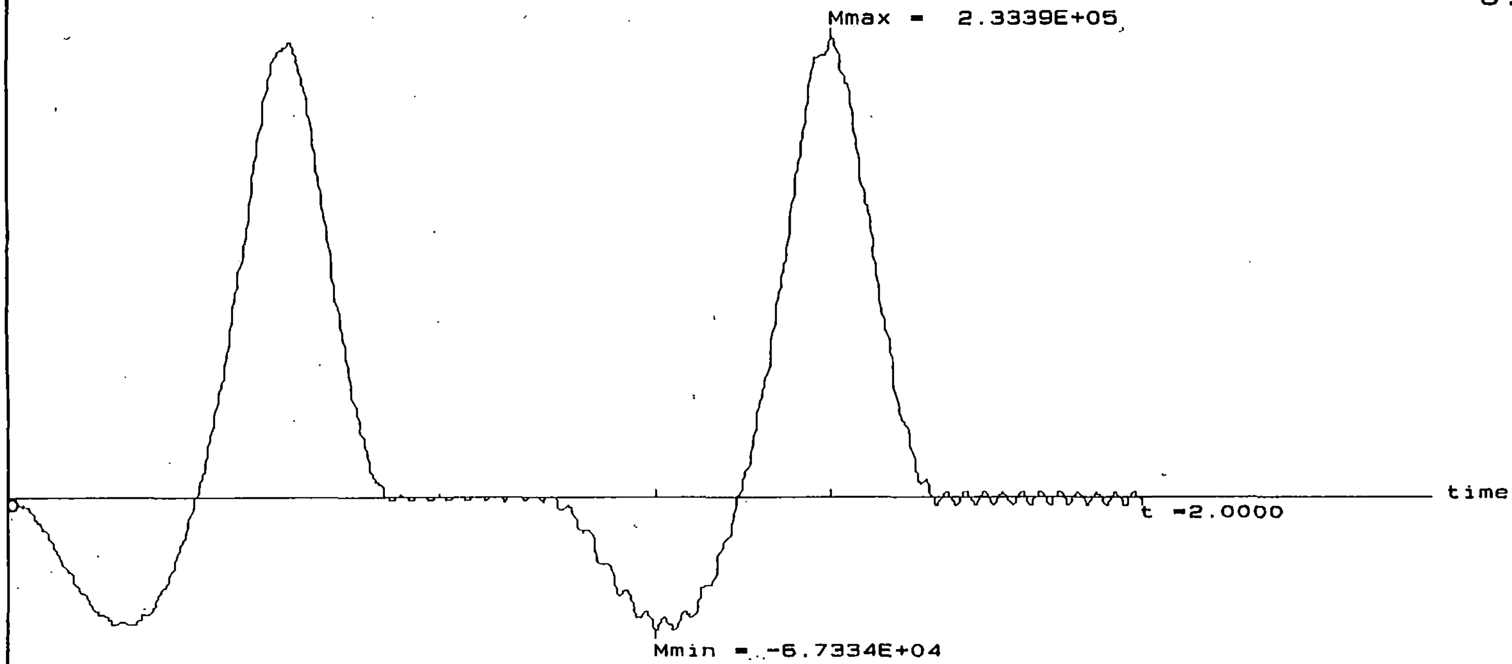
DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



Beam Fundamental Natural Frequency = 3.0883E+01 Hz

Results at Elem = 6 (End Node)

Bending Moment : Mmin = -6.7334E+04 (t =1.1480) Mmax = 2.3339E+05 (t =1.4580)

Guideway Sheet Sect. - 30 m/s, 140 Passenger, 2 x 9.144 m Spans, .8128 m Depth

Date: 9/18/1992
Time: 10: 10: 6

LT-75

Thermal Stress Analysis Of Levitation Box Beam (30 m/s; 20 s Headway) 16.3224 SEP 18,1992 CP= 7.850

DEFLECTION ANALYSIS

9.144 m SIMPLE SPAN

***** ANALYSIS OPTIONS *****

	VALUE
ANALYSIS TYPE	0
ELEMENT CONSTANT TABLE . . .	16
REACTION FORCE KEY	1
MASTER DOF READ KEY	1
MATERIAL TABLE ENTRIES. . . .	5
REFERENCE TEMPERATURE	20.00
UNIFORM TEMPERATURE	20.00

***** ELEMENT TYPES *****

TYPE	STIF	DESCRIPTION	KEY OPTIONS 1	2	3	4	5	6	7	8	9	NJ	INOTPR
1	54	TAPERED UNSYM. BEAM, 2-D	0	0	0	0	0	1	0	0	0	0	0

NUMBER OF ELEMENT TYPES= 1

***** TABLE OF ELEMENT REAL CONSTANTS *****

NO.								
1	0.60507E-01	0.64295E-02	0.35425	0.59705	0.60507E-01	0.64295E-02	0.35425	0.59705
	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	2.9250			

NUMBER OF REAL CONSTANT SETS= 1

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Thermal Stress Analysis Of Levitation Box Beam (30 m/s; 20 s Headway)          16.3227  SEP 18,1992 CP=      8.890


          ***** ELEMENT DEFINITIONS *****

ELEMENT    NODES                                         MAT  TYPE                     ELEMENT REAL CONSTANTS

SWITCHED TO FIXED FORMAT INPUT
                                                                                 2-D       BEAM      CONS
    1    1    2                                           1    1

                                                                  0.605E-01 0.643E-02 0.354     0.597     0.605E-01 0.643E-02
                                                                   0.354     0.597     0.000E+00 0.000E+00 0.000E+00 0.000E+00
                                                                    2.92     0.000E+00 0.000E+00 0.000E+00
    2    2    3                                           1    1

                                                                  0.605E-01 0.643E-02 0.354     0.597     0.605E-01 0.643E-02
                                                                   0.354     0.597     0.000E+00 0.000E+00 0.000E+00 0.000E+00
                                                                    2.92     0.000E+00 0.000E+00 0.000E+00
    3    3    4                                           1    1

                                                                  0.605E-01 0.643E-02 0.354     0.597     0.605E-01 0.643E-02
                                                                   0.354     0.597     0.000E+00 0.000E+00 0.000E+00 0.000E+00
                                                                    2.92     0.000E+00 0.000E+00 0.000E+00
    4    4    5                                           1    1

                                                                  0.605E-01 0.643E-02 0.354     0.597     0.605E-01 0.643E-02
                                                                   0.354     0.597     0.000E+00 0.000E+00 0.000E+00 0.000E+00
                                                                    2.92     0.000E+00 0.000E+00 0.000E+00
 INTEGER STORAGE REQUIREMENTS FOR ELEMENT INPUT                       CP=      9.610  TIME= 16.32286
FIXED DATA =      1034  TEMPORARY DATA =       10    TOTAL=     1044
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500    TOTAL AVAIL= 2251500
 MAXIMUM NODE NUMBER FOR AVAILABLE AUXILIARY MEMORY SIZE=     1125232

 NUMBER OF ELEMENTS =       4     MAXIMUM NODE NUMBER USED =       5


          ***** NODE DEFINITIONS *****

                 LOCATION            ROTATION (DEGREES)

  NODE          X              Y              THXY
             (OR R)       (OR THETA)      (OR RT)


SWITCHED TO FIXED FORMAT INPUT
     1     0.00000E+00   0.00000E+00   0.00000E+00
     2       2.2860      0.00000E+00   0.00000E+00
     3       4.5720      0.00000E+00   0.00000E+00
     4       6.8580      0.00000E+00   0.00000E+00
     5       9.1440      0.00000E+00   0.00000E+00

 XMIN= 0.0000E+00  XMAX=  9.144      YMIN= 0.0000E+00  YMAX= 0.0000E+00  ZMIN= 0.0000E+00  ZMAX= 0.0000E+00

 INTEGER STORAGE REQUIREMENTS FOR NODE INPUT                          CP=     10.380  TIME= 16.32307
FIXED DATA =      1034  TEMPORARY DATA =       30    TOTAL=     1064
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500    TOTAL AVAIL= 2251500
```

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Thermal Stress Analysis Of Levitation Box Beam (30 m/s; 20 s Headway)            16.3233  SEP 18,1992 CP=     11.260


      ***** MATERIAL PROPERTIES *****

 MATERIAL    1


  NUXY PROPERTY TABLE (LINEAR INTERPOLATION)
 TEMP        NUXY        TEMP        NUXY        TEMP        NUXY        TEMP        NUXY        TEMP        NUXY

 -9999.0  0.30000        9999.0  0.30000

  EX   PROPERTY TABLE (LINEAR INTERPOLATION)
 TEMP        EX          TEMP        EX          TEMP        EX          TEMP        EX          TEMP        EX

    21.1  0.68950E+11      65.6  0.67570E+11      93.3  0.66190E+11     121.1  0.64810E+11     148.9  0.63430E+11

  ALPX PROPERTY TABLE (LINEAR INTERPOLATION)
 TEMP        ALPX        TEMP        ALPX        TEMP        ALPX        TEMP        ALPX        TEMP        ALPX

    21.1  0.22446E-04      65.6  0.22932E-04      93.3  0.23238E-04     121.1  0.23526E-04     148.9  0.23814E-04

MAXIMUM MATERIAL NUMBER=    1


      ***** MASTER DEGREES OF FREEDOM  *****

  NODE       DEGREES OF FREEDOM LIST


NUMBER OF SPECIFIED MASTER D.O.F.=      0
TOTAL NUMBER OF MASTER D.O.F.    =      0

 INTEGER STORAGE REQUIREMENTS FOR MATERIALS, ETC. INPUT         CP=     11.750  TIME= 16.32345
FIXED DATA =       62  TEMPORARY DATA =       0   TOTAL=       62
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500   TOTAL AVAIL= 2251500

*** LOAD STEP    1  OPTIONS SPECIFICATIONS

NITTER=      1  NPRINT=      1  NPOST=      1

ALL PRINT CONTROLS RESET TO      1

ALL POST DATA FILE CONTROLS RESET TO      1

NEW TITLE= Thermal Stress Analysis Of Levitation Box Beam (30 m/s; 20 s Headway)

NO CONVERGENCE CHECKING OR TIME STEP OPTIMIZATION

TIME= 0.00000E+00

ACEL=   0.00000E+00 0.00000E+00 0.00000E+00

OMEGA=  0.00000E+00 0.00000E+00 0.00000E+00

DOMEGA= 0.00000E+00 0.00000E+00 0.00000E+00
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CGLOC=  0.00000E+00 0.00000E+00 0.00000E+00

CGOMGA= 0.00000E+00 0.00000E+00 0.00000E+00

DCGOME= 0.00000E+00 0.00000E+00 0.00000E+00

EXTRACTED MODE RANGE - FROM 0.000000E+00 TO  0.000000E+00

INERTIA RELIEF KEY=  0

KTEMP=     -1      0

READ IN TEMPERATURES IN ELEMENT FORMAT

KUSE=   0

PLASTICITY CONVERGENCE CRITERION=      0.0100
CREEP OPTIMIZATION CRITERIA=      0.1000
LARGE DEFL. CONVERGENCE CRITERIA=    0.001000
DISPLACEMENT LIMIT= 0.10000E+11
KEY TO TERMINATE RUN IF NO CONVERGENCE=    0.
CUMULATIVE ITERATION LIMIT=     0

HARMONIC LOAD PARAMETERS  MODE=    0   ISYM=    1

NUMBER OF STRESS PASS CALCULATIONS=     0

LOADS RAMPED TO FINAL VALUES DURING ITERATIONS (KBC= 0)

STRAIN ENERGY KEY= 0

REACTION FORCE KEY= 1

UNIFORM TEMPERATURE=   20.000  (TREF=   20.000)

SEISMIC COMBINATION TYPE (MCOMB)=   0

DAMPING RATIO =        0.0000

BOUNDARY CONDITION PRINT KEY=  0
```

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    FOR SUPPORT CALL                    PHONE                    TWX

Thermal Stress Analysis Of Levitation Box Beam (30 m/s; 20 s Headway)          16.3235   SEP 18,1992 CP=     12.030


LOAD STEP NUMBER=     1

         *** LOAD OPTIONS SUMMARY ***

TIME   = 0.00000E+00 (TIME AT END OF LOAD STEP)
NITTER=       1      (NUMBER OF ITERATIONS)
TUNIF =  20.0000     (UNIFORM TEMPERATURE)   (TREF=  20.0000)
KTEMP =  -1          (USE SPECIFIED NODAL OR ELEMENT TEMPERATURES)
KRF   =   1          (PRINT NODAL FORCES AND CONSTRAINED NODE REACTIONS)

NPRINT=      1       (OVERALL PRINT FREQUENCY)
NPOST =      1       (OVERALL POST FREQUENCY)

 DISPLACEMENT PRINT FREQUENCIES
  FREQ   NSTRT  NSTOP   NINC
     1       1 999999      1

 ELEMENT PRINT AND POST FREQUENCIES
  TYPE  STIFF  STRESS  FORCE        STRESS  STRESS  FORCE
         NO.    PRINT  PRINT         POST    LEVEL   POST
     1    54      1      1             1       3      1


           ***** SPECIFIED DISPLACEMENTS *****

   NODE       UX                UY                ROTZ

     1    0.000000E+00     0.000000E+00
     5                     0.000000E+00


           ***** ELEMENT TEMPERATURE DATA *****
   ELEM. (IN ELEMENT SOLUTION ORDER)

      1    127.00       76.000
      2    127.00       76.000
      3    127.00       76.000
      4    127.00       76.000


***** LOAD SUMMARY -      3 DISPLACEMENTS       0 FORCES       0 PRESSURES      *****


 INTEGER STORAGE REQUIREMENTS FOR LOAD DATA INPUT              CP=     12.520  TIME= 16.32367
FIXED DATA =       96  TEMPORARY DATA =       0   TOTAL=       96
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500   TOTAL AVAIL= 2251500

 RANGE OF ELEMENT MAXIMUM STIFFNESS IN GLOBAL COORDINATES


MAXIMUM= 0.174122E+10  AT ELEMENT      4.
MINIMUM= 0.174122E+10  AT ELEMENT      2.

 INTEGER STORAGE REQUIREMENTS FOR ELEMENT FORMULATION          CP=     14.660  TIME= 16.32426
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FIXED DATA =       96  TEMPORARY DATA =        0   TOTAL=       96
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500   TOTAL AVAIL= 2251500

  *** ELEMENT STIFFNESS FORMULATION TIMES
 TYPE  NUMBER  STIF  TOTAL CP   AVE CP

   1      4     54     0.280    0.070


TIME AT END OF ELEMENT STIFFNESS FORMULATION  CP=      14.660


MAXIMUM IN-CORE WAVE FRONT ALLOWED FOR REQUESTED MEMORY SIZE= 1498.

 INTEGER STORAGE REQUIREMENTS FOR WAVE FRONT MATRIX SOLUTION       CP=    15.430  TIME= 16.32448
FIXED DATA =       96  TEMPORARY DATA =      100   TOTAL=      196
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500   TOTAL AVAIL= 2251500


MAXIMUM IN-CORE WAVE FRONT=      8.


     MATRIX SOLUTION TIMES
 READ IN ELEMENT STIFFNESSES   CP=          0.000


 NODAL COORD. TRANSFORMATION   CP=          0.000
 MATRIX TRIANGULARIZATION      CP=          0.050


TIME AT END OF MATRIX TRIANGULARIZATION  CP=         15.490
EQUATION SOLVER MAXIMUM PIVOT= 0.34824E+10 AT NODE     2. UX
EQUATION SOLVER MINIMUM PIVOT= 0.13486E+09 AT NODE     5. ROTZ

 TIME AT START OF BACK SUBSTITUTION   CP=    15.540      LOAD STEP=   1  ITERATION=     1  CUM. ITER.=    1


 ***** DISPLACEMENT SOLUTION *****  TIME =  0.00000E+00  LOAD STEP=   1  ITERATION=     1  CUM. ITER.=    1
   NODE       UX               UY               ROTZ


     1    0.000000E+00    0.000000E+00    0.571660E-02
     2    0.434522E-02    0.980112E-02    0.285830E-02
     3    0.869045E-02    0.130682E-01   -0.140946E-17
     4    0.130357E-01    0.980112E-02   -0.285830E-02
     5    0.173809E-01    0.000000E+00   -0.571660E-02

MAXIMUMS
NODE          5               3                1
VALUE    0.173809E-01    0.130682E-01    0.571660E-02

 INTEGER STORAGE REQUIREMENTS FOR BACK SUBSTITUTION                CP=    15.760  TIME= 16.32457
FIXED DATA =       96  TEMPORARY DATA =       38   TOTAL=      134
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500   TOTAL AVAIL= 2251500

  ***** ELEMENT STRESSES *****  TIME =  0.000000E+00   LOAD STEP=    1   ITERATION=     1   CUM. ITER.=    1

EL=      1  NODES=      1      2  MAT=  1  TTOP,TBOT=  127.0    76.0                                   2-D TAP BEAM  54
END        SDIR            SSH           SBYB          SBYT           SYB           SYT
  I     0.46176E-07  0.00000E+00 -0.21621E-07  0.12828E-07  0.24555E-07  0.59004E-07
  J     0.46176E-07  0.00000E+00 -0.43242E-07  0.25657E-07  0.29340E-08  0.71832E-07
FORCES ON MEMBER AT NODE      1 -0.279397E-08  0.145661E-09  0.232831E-09
                              2  0.279397E-08 -0.145661E-09 -0.465661E-09
 STATIC FORCES ON NODE       1  0.269074E-08 -0.145661E-09 -0.289949E-09
 STATIC FORCES ON NODE       2 -0.269074E-08  0.145661E-09  0.415639E-09
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EL=      2  NODES=      2      3  MAT=  1  TTOP,TBOT=  127.0   76.0                                                  2-D TAP BEAM  54
END         SDIR          SSH           SBYB          SBYT          SYB           SYT
  I     0.46176E-07  0.00000E+00 -0.54052E-07  0.32071E-07 -0.78765E-08  0.78247E-07
  J     0.46176E-07  0.00000E+00 -0.54052E-07  0.32071E-07 -0.78765E-08  0.78247E-07
FORCES ON MEMBER AT NODE      2 -0.279397E-08  0.669258E-10  0.582077E-09
                              3  0.279397E-08 -0.669258E-10 -0.582077E-09
 STATIC FORCES ON NODE       2  0.269119E-08 -0.669258E-10 -0.613688E-09
 STATIC FORCES ON NODE       3 -0.269119E-08  0.669258E-10  0.613643E-09

EL=      3  NODES=      3      4  MAT=  1  TTOP,TBOT=  127.0   76.0                                                  2-D TAP BEAM  54
END         SDIR          SSH           SBYB          SBYT          SYB           SYT
  I     0.10774E-06  0.00000E+00 -0.64863E-07  0.38485E-07  0.42881E-07  0.14623E-06
  J     0.10774E-06  0.00000E+00 -0.10810E-07  0.64141E-08  0.96933E-07  0.11416E-06
FORCES ON MEMBER AT NODE      3 -0.651926E-08  0.287343E-09  0.698492E-09
                              4  0.651926E-08 -0.287343E-09 -0.116415E-09
 STATIC FORCES ON NODE       3  0.674663E-08 -0.287343E-09 -0.640776E-09
 STATIC FORCES ON NODE       4 -0.674663E-08  0.287343E-09  0.157002E-09

EL=      4  NODES=      4      5  MAT=  1  TTOP,TBOT=  127.0   76.0                                                  2-D TAP BEAM  54
END         SDIR          SSH           SBYB          SBYT          SYB           SYT
  I     0.61568E-07  0.00000E+00 -0.43242E-07  0.25657E-07  0.18326E-07  0.87224E-07
  J     0.61568E-07  0.00000E+00  0.32431E-07 -0.19242E-07  0.93999E-07  0.42325E-07
FORCES ON MEMBER AT NODE      4 -0.372529E-08  0.360956E-09  0.465661E-09
                              5  0.372529E-08 -0.360956E-09  0.349246E-09
 STATIC FORCES ON NODE       4  0.381442E-08 -0.360956E-09 -0.506869E-09
 STATIC FORCES ON NODE       5 -0.381442E-08  0.360956E-09 -0.371756E-09

  ***** REACTION FORCES *****    TIME =  0.00000E+00  LOAD STEP=    1  ITERATION=    1  CUM. ITER.=    1

 NOTE - REACTION FORCES ARE IN THE NODAL COORDINATE SYSTEM.


   NODE       FX                FY                MZ

     1   -0.269074E-08     0.145661E-09
     5                    -0.360956E-09

TOTAL   -0.269074E-08    -0.215294E-09    0.000000E+00

  *** ELEM. STRESS CALC. TIMES
 TYPE  NUMBER  STIF  TOTAL CP   AVE CP

  1       4    54     0.220   0.055

  *** NODAL FORCE CALC. TIMES
 TYPE  NUMBER  STIF  TOTAL CP   AVE CP

  1       4    54     0.000   0.000

*** LOAD STEP    1   ITER     1  COMPLETED.  TIME=  0.000000E+00  TIME INC=  0.000000E+00 NEW TRIANG MATRIX  CUM. ITER.=    1

 INTEGER STORAGE REQUIREMENTS FOR STRESS AND FORCE CALCULATIONS   CP=    16.750  TIME= 16.32484
FIXED DATA =      96  TEMPORARY DATA =      90   TOTAL=      186
FIXED AVAIL= 2251500  TEMPORARY AVAIL= 2251500   TOTAL AVAIL= 2251500


 *** STORAGE REQUIREMENT SUMMARY
MAXIMUM FIXED MEMORY USED     =        1034
MAXIMUM TEMPORARY MEMORY USED=          100
MAXIMUM TOTAL MEMORY USED     =        1064
MAXIMUM TEMPORARY AVAILABLE   =     2251404


 *** PROBLEM STATISTICS
 NO. OF ACTIVE DEGREES OF FREEDOM =     12
```

LT-82

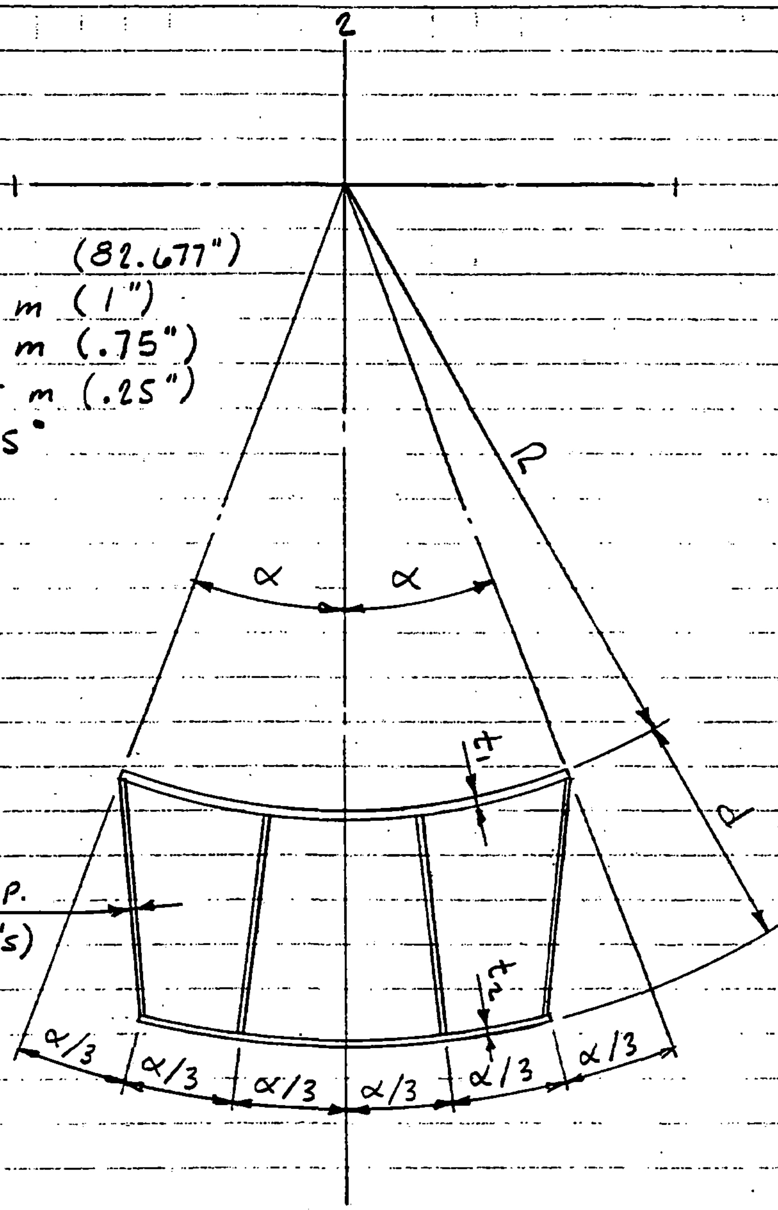
```
 R.M.S. WAVEFRONT SIZE =      5.2

 *** ANSYS BINARY FILE STATISTICS
BUFFER SIZE USED= 2048
POST DATA WRITTEN ON FILE12
RESTART DATA WRITTEN ON FILE03    (          13340 BYTES)
TRIANGULARIZED MATRIX WRITTEN ON FILE11    (              892 BYTES)

***** END OF INPUT ENCOUNTERED ON FILE27.  FILE27 REWOUND

***** INPUT FILE SWITCHED FROM FILE27 TO FILE18


***** ROUTINE COMPLETED *****  CP =        17.020

***** END OF INPUT ENCOUNTERED ON FILE18

PREP7 AFWRITE OR SFWRITE WARNING MESSAGES =   0
NUMBER OF SOLUTION PHASE WARNING MESSAGES =   0

***** RUN COMPLETED *****  CP=       17.3000   TIME=   16.3250
```

LT-83

United Engineers & Constructors
A Raytheon Company

PAGE LC-1
JOB NO. 6869002 DATE 7/20/92 BY RJC CH'K
CUSTOMER MIT MI PROJECT MAGLEV
SUBJECT GUIDEWAY SHEET SECTION IN CURVE

$R = 2.1$ m (82.677")
$t_1 = .0254$ m (1")
$t_2 = .01905$ m (.75")
$t_3 = .00635$ m (.25")
$\alpha = 20.925°$



LEVITATION BOX BEAM

FORM 62-114/A0388175i

LC-2

Section Properties For Guideway Sheet Cross-section (D=.8128 m)

Radius To Inside Of Guideway Sheet, R -	2.100000E+00
Half Angle, ALPHA ---------------------	2.092483E+01
Depth Of Section, D -------------------	8.128000E-01
Thickness Of Guideway Sheet, T1 -------	2.540000E-02
Thickness Of Outer Sheet, T2 ----------	1.905000E-02
Thickness Of Web Plates, T3 -----------	6.350000E-03

Section Properties:

Cross-sectional Area ------------------	8.636893E-02
Centroidal Location In 1-1 Direction --	0.000000E+00
Centroidal Location In 2-2 Direction --	2.406355E+00

Bending About Centroidal Axis Parallel To 1-1 Axis:

Moment Of Inertia ---------------------	1.166726E-02
Section Modulus (Inside) --------------	2.622738E-02
Section Modulus (Outside) -------------	2.303755E-02

Bending About Centroidal Axis Parallel To 2-2 Axis:

Moment Of Inertia ---------------------	1.848380E-02
Section Modulus -----------------------	1.776800E-02

LC-3

PROGRAM DYNACB

Curved Guideway Sheet - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

STRUCTURAL PARAMETERS

NN	NE	NRN	E	RHO
9	8	2	6.8950E+10	2.7126E+03

NODAL COORDINATES

NODE	X
1	0.0000E+00
2	1.1430E+00
3	2.2860E+00
4	3.4290E+00
5	4.5720E+00
6	5.7150E+00
7	6.8580E+00
8	8.0010E+00
9	9.1440E+00

ELEMENT INFORMATION

ELEM.	J	K	AX	ZI	EL
1	1	2	8.6369E-02	1.1667E-02	1.1430E+00
2	2	3	8.6369E-02	1.1667E-02	1.1430E+00
3	3	4	8.6369E-02	1.1667E-02	1.1430E+00
4	4	5	8.6369E-02	1.1667E-02	1.1430E+00
5	5	6	8.6369E-02	1.1667E-02	1.1430E+00
6	6	7	8.6369E-02	1.1667E-02	1.1430E+00
7	7	8	8.6369E-02	1.1667E-02	1.1430E+00
8	8	9	8.6369E-02	1.1667E-02	1.1430E+00

NODAL RESTRAINTS

NODE	NR1	NR2
1	1	0
9	1	0

NUMBER OF DEGREES OF FREEDOM: NDF = 16
NUMBER OF NODAL RESTRAINTS: NNR = 2

OUTPUT KEY FOR MODAL ANALYSIS: IMO = 0

STIFFNESS MATRIX DECOMPOSED

LC-4

Curved Guideway Sheet - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

MODE	FREQUENCY (Hz)
1	3.4812E+01
2	1.3928E+02
3	3.1371E+02
4	5.5918E+02
5	8.7836E+02
6	1.2761E+03
7	1.7589E+03
8	2.4728E+03
9	3.0787E+03
10	3.9306E+03
11	4.9653E+03
12	6.2157E+03
13	7.6936E+03
14	9.3120E+03
15	1.0733E+04
16	1.1332E+04

LC-5

Curved Guideway Sheet - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

DYNAMIC PARAMETERS

ISOLVE	NTS	DT	DAMPR
1	750	5.0000E-04	0.0000E+00

INITIAL CONDITIONS

NNID	NNIV
0	0

APPLIED ACTIONS

NLN	NEL	IML
0	0	12

MOVING LOADS

P	VOP	AOP	SPACING
-4.5954E+04	1.3411E+02	0.0000E+00	4.5000E-01
-3.5638E+04	1.3411E+02	0.0000E+00	4.5000E-01
-3.5638E+04	1.3411E+02	0.0000E+00	4.5000E-01
-3.5638E+04	1.3411E+02	0.0000E+00	4.5000E-01
-3.5638E+04	1.3411E+02	0.0000E+00	4.5000E-01
-4.5954E+04	1.3411E+02	0.0000E+00	2.6401E+01
-4.5954E+04	1.3411E+02	0.0000E+00	4.5000E-01
-3.5638E+04	1.3411E+02	0.0000E+00	4.5000E-01
-3.5638E+04	1.3411E+02	0.0000E+00	4.5000E-01
-3.5638E+04	1.3411E+02	0.0000E+00	4.5000E-01
-3.5638E+04	1.3411E+02	0.0000E+00	4.5000E-01
-4.5954E+04	1.3411E+02	0.0000E+00	0.0000E+00

GROUND ACCELERATIONS

IGA
0

DIRECT NUMERICAL INTEGRATION

ALPHA = -0.1000 BETA = 0.3025 GAMMA = 0.6000

OUTPUT SELECTION

IWR	IPL	NNO	NEO	NRO
2	1	1	1	2

NODES (DISPL.): 5

ELEMENTS: 4

NODES (REACT.): 1 9

LC-6

Curved Guideway Sheet - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

DISPLACEMENT TIME HISTORY FOR NODE 5

	UY	ROTZ
MAXIMUM	2.5570E-04	1.7592E-04
TIME OF MAXIMUM	1.6450E-01	2.4050E-01
MINIMUM	-4.5088E-03	-1.7326E-04
TIME OF MINIMUM	3.5500E-02	2.7300E-01

LC-7

Curved Guideway Sheet - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

*** LOADING NUMBER 1 OF 1 ***

MEMBER END-FORCES TIME HISTORY FOR ELEMENT 4

	FY(J)	MZ(J)	FY(K)	MZ(K)
MAXIMUM	1.1746E+05	2.4939E+04	8.9577E+04	4.5336E+05
TIME OF MAXIMUM	4.2500E-02	7.8500E-02	2.4750E-01	3.8500E-02
MINIMUM	-5.3831E+04	-4.5469E+05	-8.7839E+04	-2.4909E+04
TIME OF MINIMUM	2.5500E-02	3.5000E-02	2.6500E-01	1.3650E-01

LC-8

Curved Guideway Sheet - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

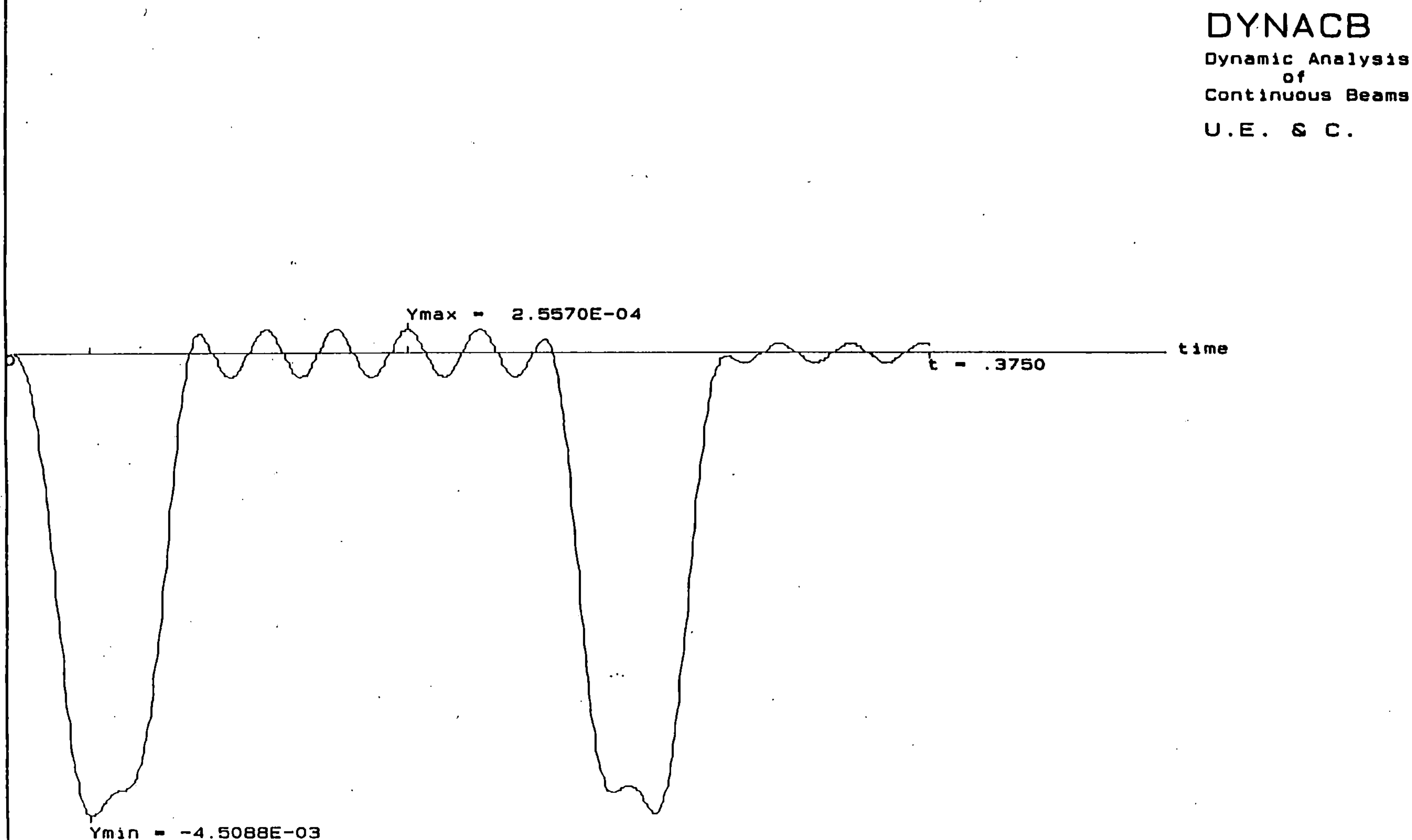
*** LOADING NUMBER 1 OF 1 ***

REACTION FORCE TIME HISTORY FOR NODE 1

	FY	MZ
MAXIMUM	2.0491E+05	1.2801E+02
TIME OF MAXIMUM	2.3350E-01	2.3450E-01
MINIMUM	-1.1435E+04	-2.8436E+02
TIME OF MINIMUM	7.6500E-02	5.0000E-04

REACTION FORCE TIME HISTORY FOR NODE 9

	FY	MZ
MAXIMUM	2.0538E+05	1.2427E+02
TIME OF MAXIMUM	6.8000E-02	6.4000E-02
MINIMUM	-1.1348E+04	-2.6253E+02
TIME OF MINIMUM	2.1850E-01	2.9850E-01



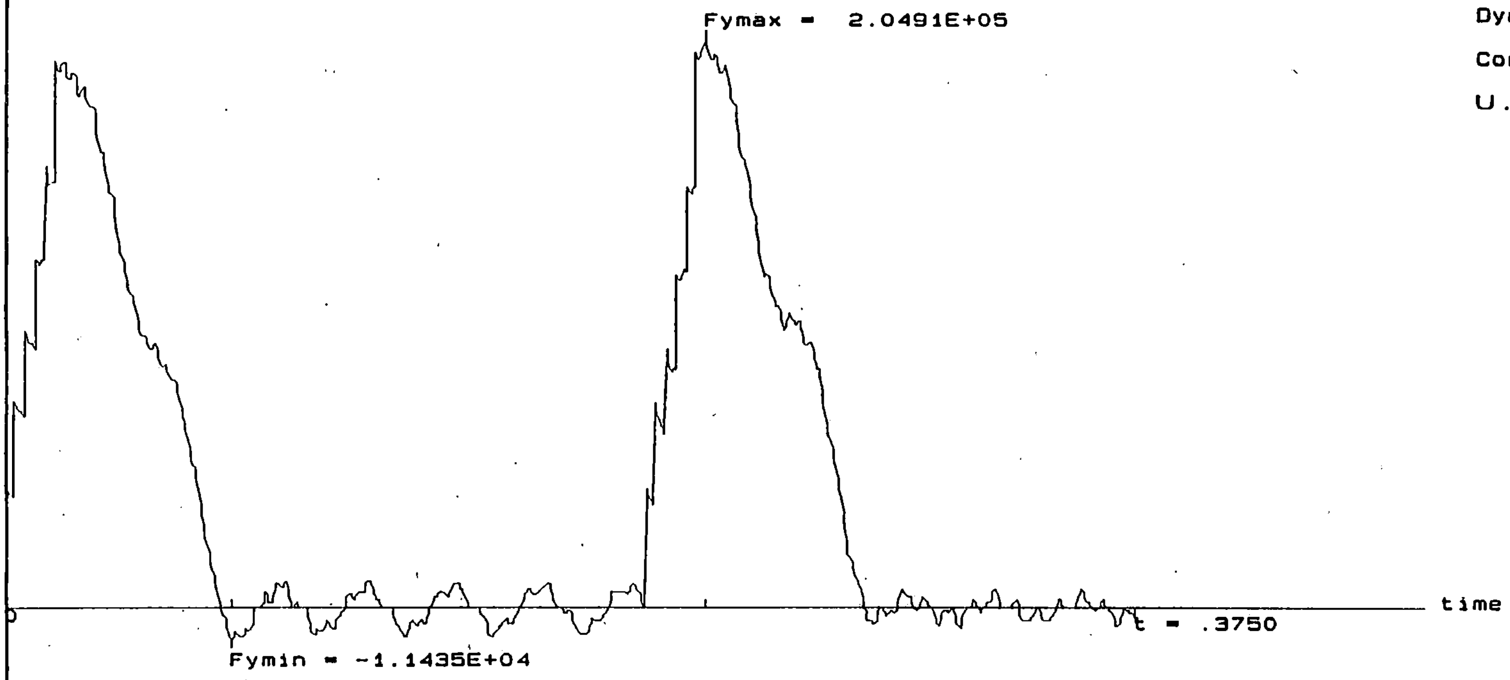
Beam Fundamental Natural Frequency = 3.4812E+01 Hz

Results at Node = 5

Displacement : Ymin = -4.5088E-03 (t = .0355) Ymax = 2.5570E-04 (t = .1645)

Curved Guideway Sheet - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

Date: 7/20/1992
Time: 18:26:52



DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.

Beam Fundamental Natural Frequency = 3.4812E+01 Hz

Results at Node = 1

Reaction : Fymin = -1.1435E+04 (t = .0765) Fymax = 2.0491E+05 (t = .2335)

Curved Guideway Sheet - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

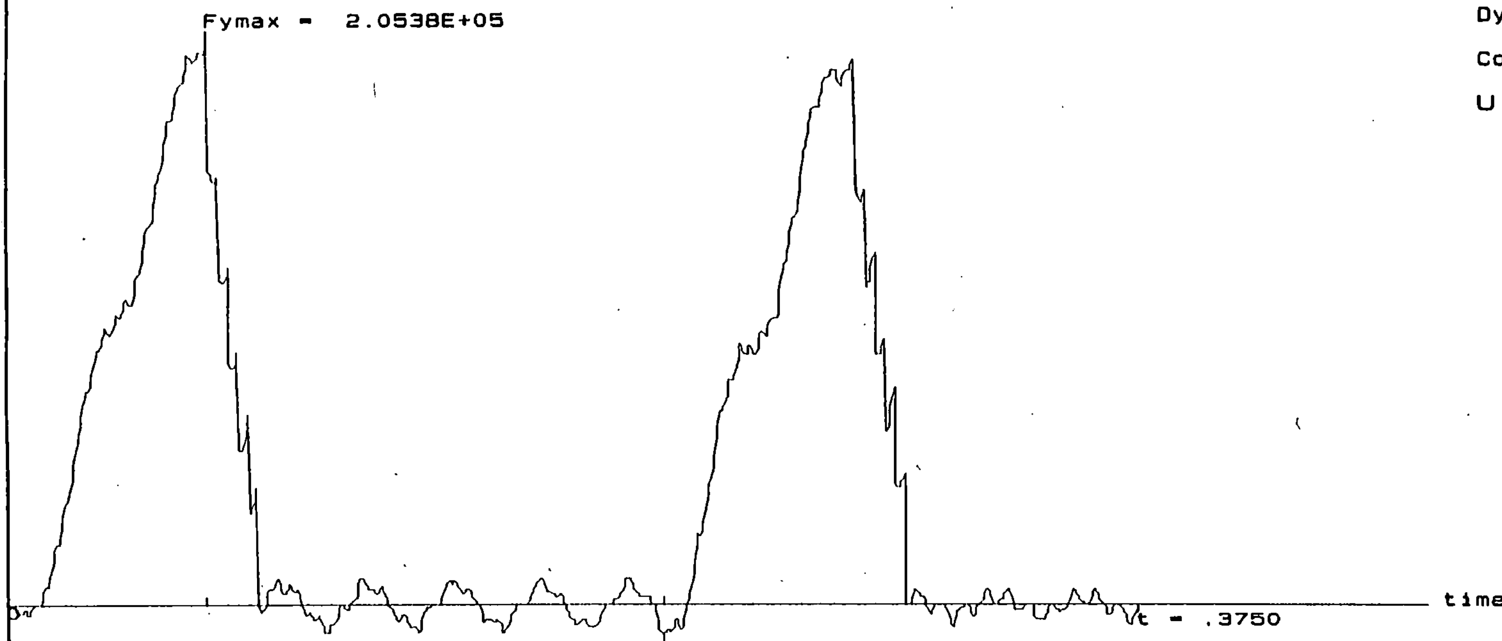
Date: 7/20/1992
Time: 18:38:37

[redacted]

DYNACB

Dynamic Analysis
of
Continuous Beams

U.E. & C.



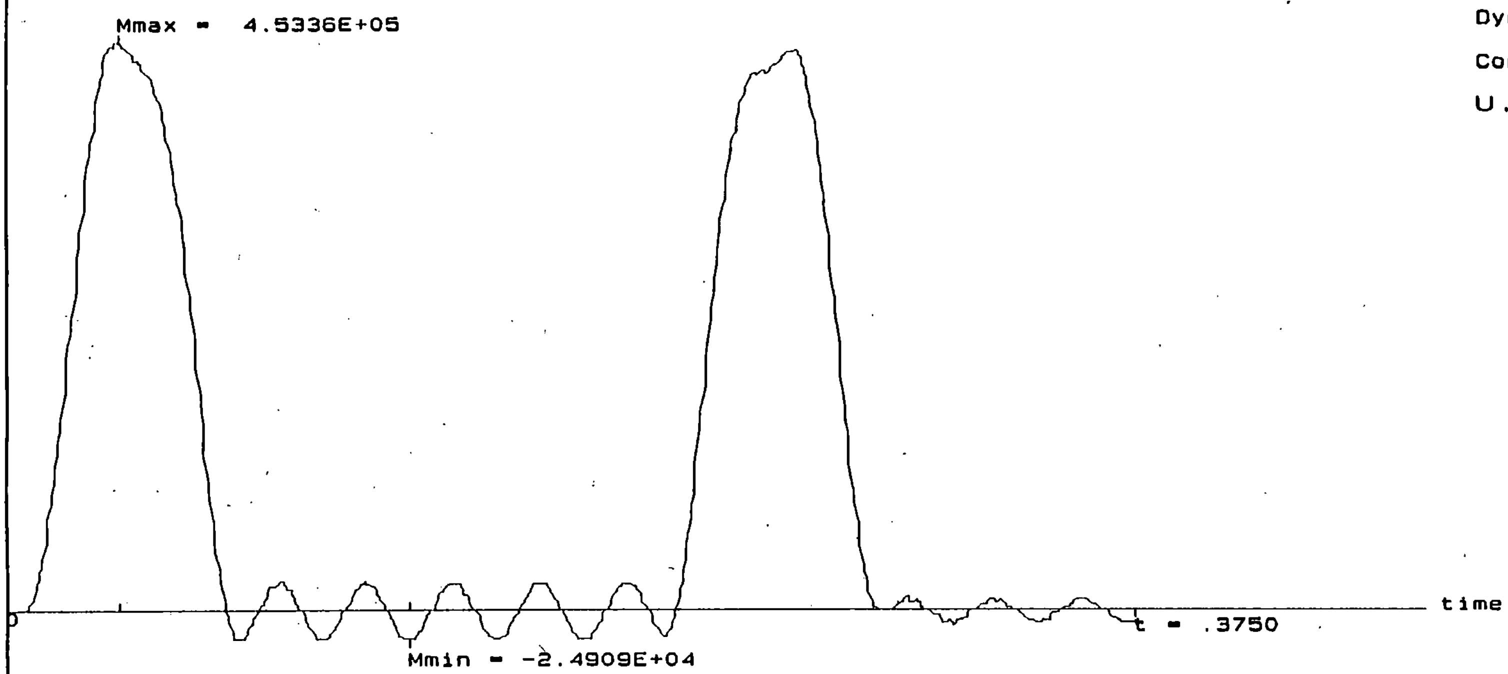
Beam Fundamental Natural Frequency = 3.4812E+01 Hz

Results at Node = 9

Reaction : Fymin = -1.1348E+04 (t = .2185) Fymax = 2.0538E+05 (t = .0680)

Curved Guideway Sheet - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

Date: 7/20/1992
Time: 18:26:52



DYNACB
Dynamic Analysis
of
Continuous Beams
U.E. & C.

Beam Fundamental Natural Frequency = 3.4812E+01 Hz

Results at Elem = 4 (End Node)

Bending Moment : Mmin = -2.4909E+04 (t = .1365) Mmax = 4.5336E+05 (t = .0385)

Curved Guideway Sheet - 300 Mph, 140 Passenger, 1 x 9.144 m Span, .8128 m Depth

Date: 7/20/1992
Time: 18:26:52

LC-12

[redacted]

FORM 5007 REV. 7/79 GENERAL COMPUTATION SHEET

(DISCIPLINE) United Engineers & Constructors
A Raytheon Company

NAME OF COMPANY MI/MIT UNIT/S

SUBJECT MAGNEPLANE

CALC. SET NO.		REV	COMP. BY	CHK'D. BY
PRELIM.		0	PARKER	
FINAL			DATE 9-30-92	DATE
VOID				
SHEET	OF		DATE	DATE
J.O 6869002				

MAGNEPLANE INTERNATIONAL - SYSTEM CONCEPT DEFINITION REPORT

SUPPLEMENT C
BACKUP MATERIALS-MAGWAY STRUCTURE

CONCRETE BOX BEAMS (Report reference section 3.2.2.a & 5.3.2.23)

The following pages provide preliminary calculations for the Concrete BOX beams. The primary design tool is STAAD III by Research Engineers. This program calculates natural frequency and is capable of dynamic analysis which is required due to the speed of the vehicle. Please refer to the report for further discussion; ie, section 3.2.2.a.2 outlines the structural design criteria. Of particular importance for this design is the natural frequency and the LL deflection requirement which generally controlled the beam designs even when dynamic increase factors are included on the stresses. Sections 5.3.2.23 in the Trade Study Section include a summary of material quantities and costs for various spans and heights. IT SHOULD BE NOTED THAT THE BEAM DESIGN IS PRELIMINARY AND THAT THE DESIGN SHOWN HEREIN IS GENERALLY CONSERVATIVE ESPECIALLY FOR THE LONGER SPANS. THE USE OF PRESTRESSING TENDONS SHOULD BE INVESTIGATED IN FUTURE STUDIES.

The STAAD printout is included for the 30′ span. This is representative of the data that has been produced for all spans which is on file but not included in this document.

CONTENTS:

United Engineers & Constructors
A Raytheon Company
Stearns-Roger Division

PAGE C-1

JOB NO. 6869002 DATE 4-10-92 BY ANC CH'K

CUSTOMER MI PROJECT Maglev

SUBJECT Concrete Box Girder

Single Guideway

Span = 9.15 m. (30.0 ft.)

Cross-sectional Area = 2.29 $m.^2$ (24.65 $ft.^2$)

Moment of Inertia : 0.757 $m.^4$ (87.62 $ft.^4$)

Natural Frequency = 23.33 hz.

United Engineers & Constructors
Raytheon
Stearns-Roger Division

JOB NO. 6869002 DATE 4-7-92 BY ANC
CUSTOMER MI PROJECT Maglev
SUBJECT Column Loads

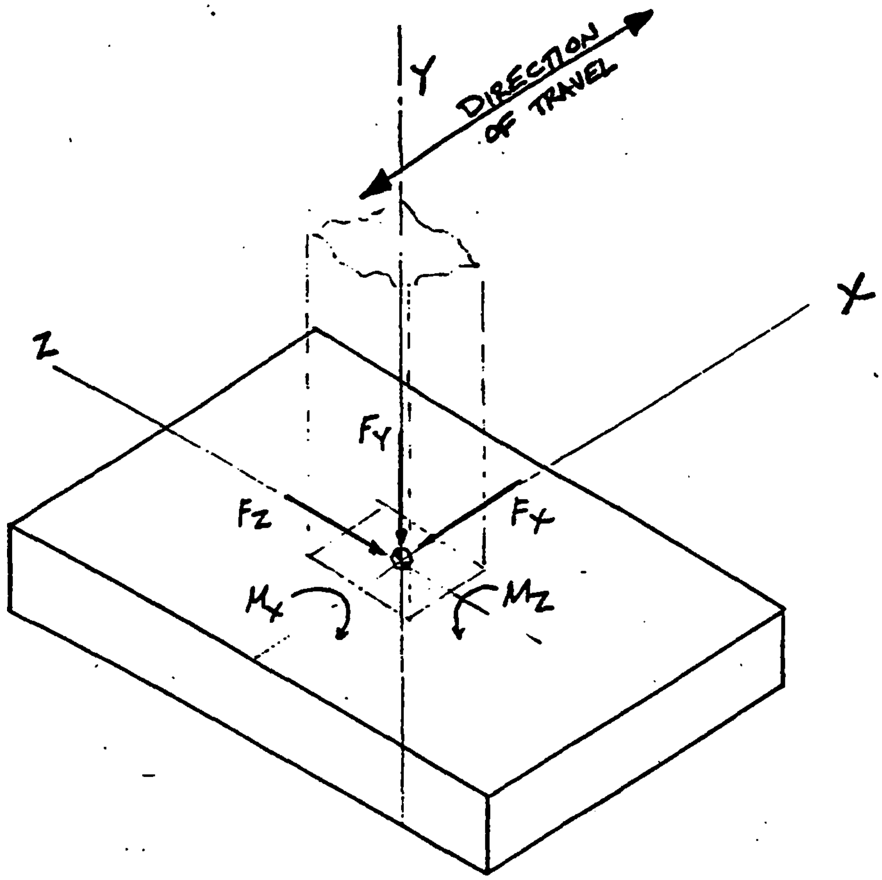
CONCRETE BOX GIRDER - SINGLE GUIDEWAY

SUMMARY OF LOADS   SPAN = 9.15 m. (30.0 ft.)

LOADS \ COLUMN HT.	h_1 = 5.18 m. (17.0 ft.)	h_2 = 7.62 m. (25.0 ft.)	h_3 = 9.14 m. (30.0 ft.)	h_4 = 20.0 m (65.6 ft.)
Dead Load				
F_Y	181.22 k	190.82 k	196.82 k	475.68 k
Snow Load				
F_Y	15.18 k	15.18 k	15.18 k	15.18 k
Vehicle Live Load				
F_Y	55.0 k	55.0 k	55.0 k	55.0 k
Seismic Load Lateral				
F_Z	13.79 k	14.80 k	15.43 k	44.71 k
M_X	258.47 'k	372.81 'k	448.36 'k	1890.66 'k
Seismic Load Longitudinal				
F_X	13.79 k	14.80 k	15.43 k	44.71 k
M_Z	258.47 'k	372.81 '	448.36 'k	1890.66 '
Wind Load Lateral				
F_Z	10.30 k	11.20 k	11.76 k	23.09 k
M_X	189.48 'k	275.49 'k	332.89 'k	1063.51 'k
Braking Load Longitudinal				
F_X	35.75 k	35.75 k	35.75 k	35.75 k
M_Z	694.88 'k	943.89 'k	1094.87 'k	2345.2 'k
Wind on Oper. Vehicle				
F_Y	-2.50 k	-2.50 k	-2.50 k	-2.50 k
F_Z	6.76 k	6.76 k	6.76 k	6.76 k
M_X	214.43 'k	268.51 'k	302.31 'k	542.96 'k

United Engineers & Constructors
A Raytheon Company
Stearns-Roger Division

PAGE 1 C-3
JOB NO. 6869002 DATE 4-2-92 BY ANC CH'K
CUSTOMER MI PROJECT Maglev
SUBJECT Column Loads to Foundation



LOAD COMBINATIONS TO BE CONSIDERED

D

$D+S$

$D+L$

$D \pm W$

$D \pm E_t$

$D \pm E_L$

$D+L \pm \left[\left(\frac{30}{85}\right)^2 W + W_v\right]$

$(D + L \pm E_t) * .75$

$(D + L \pm E_L) * .75$

$(D + L \pm B) * .75$

United Engineers & Constructors
A Raytheon ...

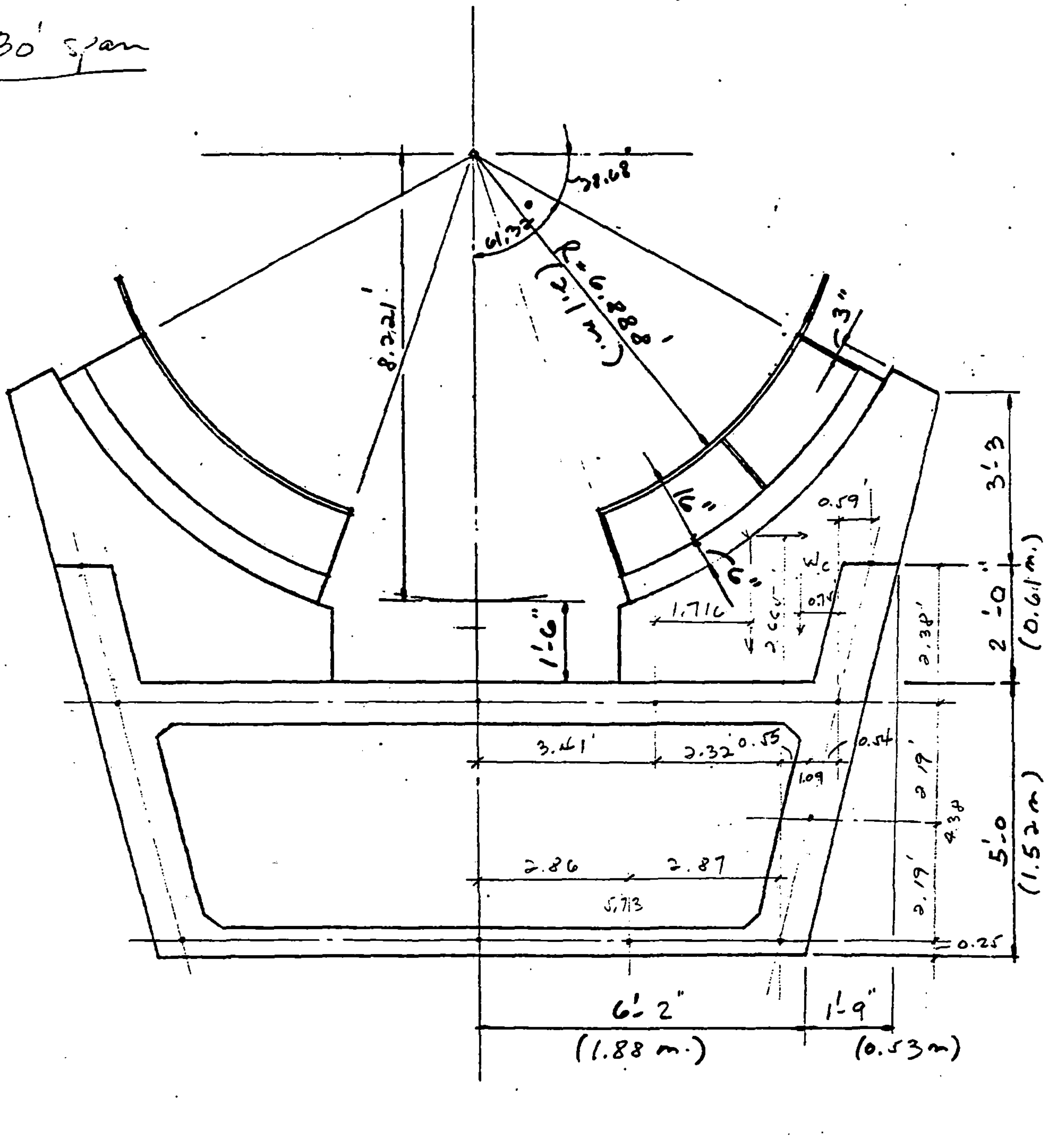
PAGE C-4

JOB NO. 6869002 DATE 3.30.92 BY AWC CH'K

CUSTOMER MI PROJECT Maglev

SUBJECT Single Guideway

30' span



TYPICAL SECTION

FORM 62-114/A03-3175

		A		Y		AY
Side wall	$-\ 2\times1\times7$ —	14.0	×	3.5	=	49.–
Top slab	$-\ 1\times0.75\times12.64$ =	9.48	×	4.625	=	43.84
bot slab	$-\ 1\times0.5\times10.33$ =	5.17	×	0.25	=	1.29
		28.65				94.13

$$\bar{Y} = 3.286'$$

$$I_{x\text{-}x} = \frac{2(7)^3}{12} + \frac{12.64(0.75)^3}{12} + \frac{10.33(0.5)^3}{12} + 14(0.214)^2 + 9.48(1.339)^2 + 5.17(3.036)^2$$

$$= 57.17 + 0.44 + 0.11 + 0.64 + 17.0 + 47.65$$

$$= 123.01\ \text{ft.}^4$$

		A		Y		AY
Side wall	$-\ 2\times1\times5$ —	10.0	×	2.50	=	25.0
Top slab	$-\ 1\times0.75\times12.64$ =	9.48	×	4.625	=	43.84
bot slab	$-\ 1\times0.50\times10.33$ =	5.17	×	0.25	=	1.29
		24.65				70.13

$$\bar{Y} = 2.845'$$

$$I_{x\text{-}x} = \frac{2(5)^3}{12} + 0.44 + 0.11 + 10(0.345)^2 + 9.48(1.78)^2 + 5.17(2.595)^2$$

$$= 20.83 + 0.55 + 1.19 + 30.04 + 34.81$$

$$= 87.42\ \text{ft.}^4$$

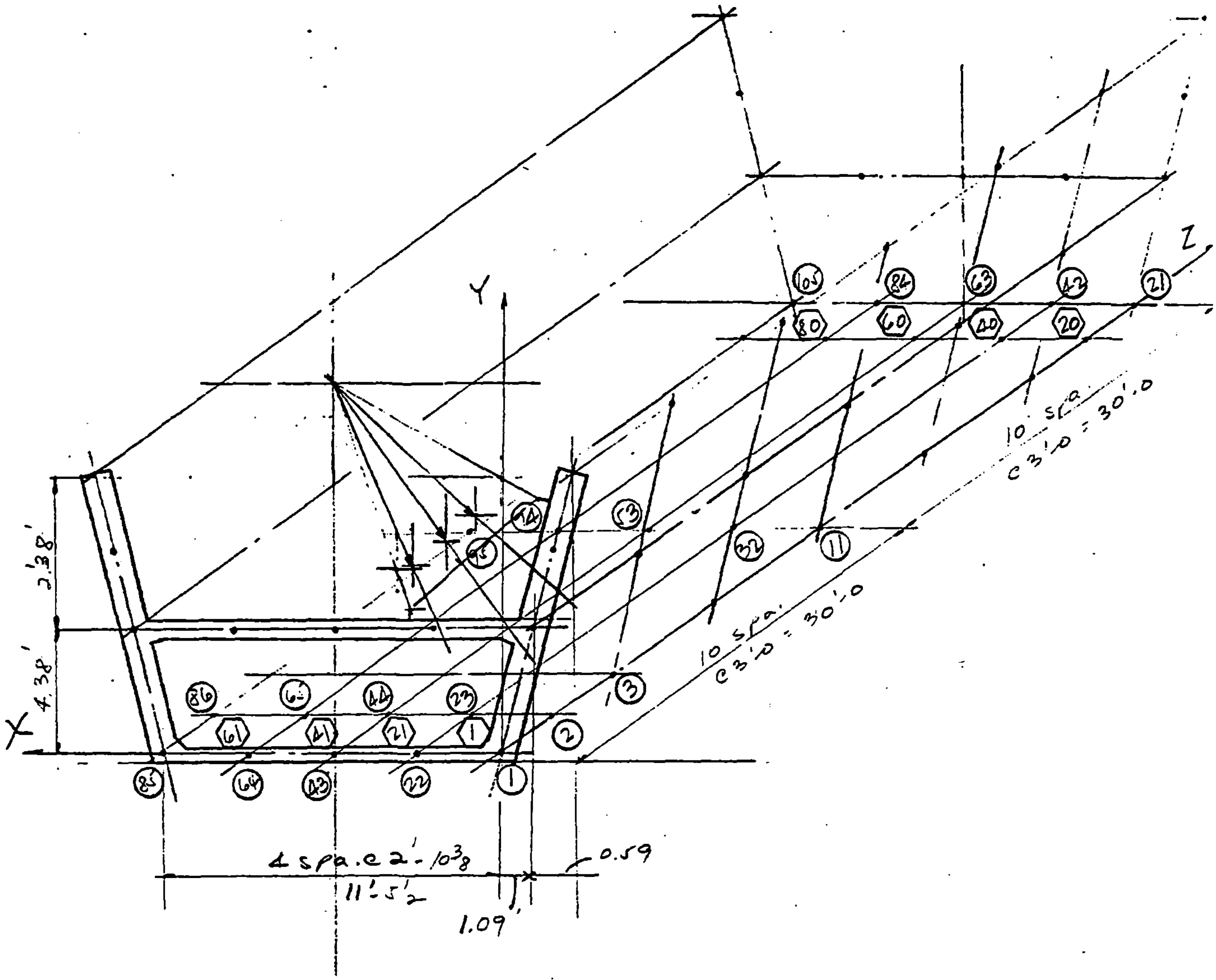
$$I_{Y\text{-}Y} = \frac{0.5(10.33)^3}{12} + \frac{0.75(12.64)^3}{12} + \frac{2(5)1^3}{12} + 10(6.24)^2$$

$$= 45.93 + 126.22 + 0.83 + 389.38 = 562.36\ \text{ft.}^4$$

United Engineers & Constructors
Raytheon
Stearns-Roger Division

PAGE C-6
JOB NO. ______ DATE ______ BY ______ CH'K ______
CUSTOMER ______ PROJECT ______
SUBJECT ______

30 ft. span

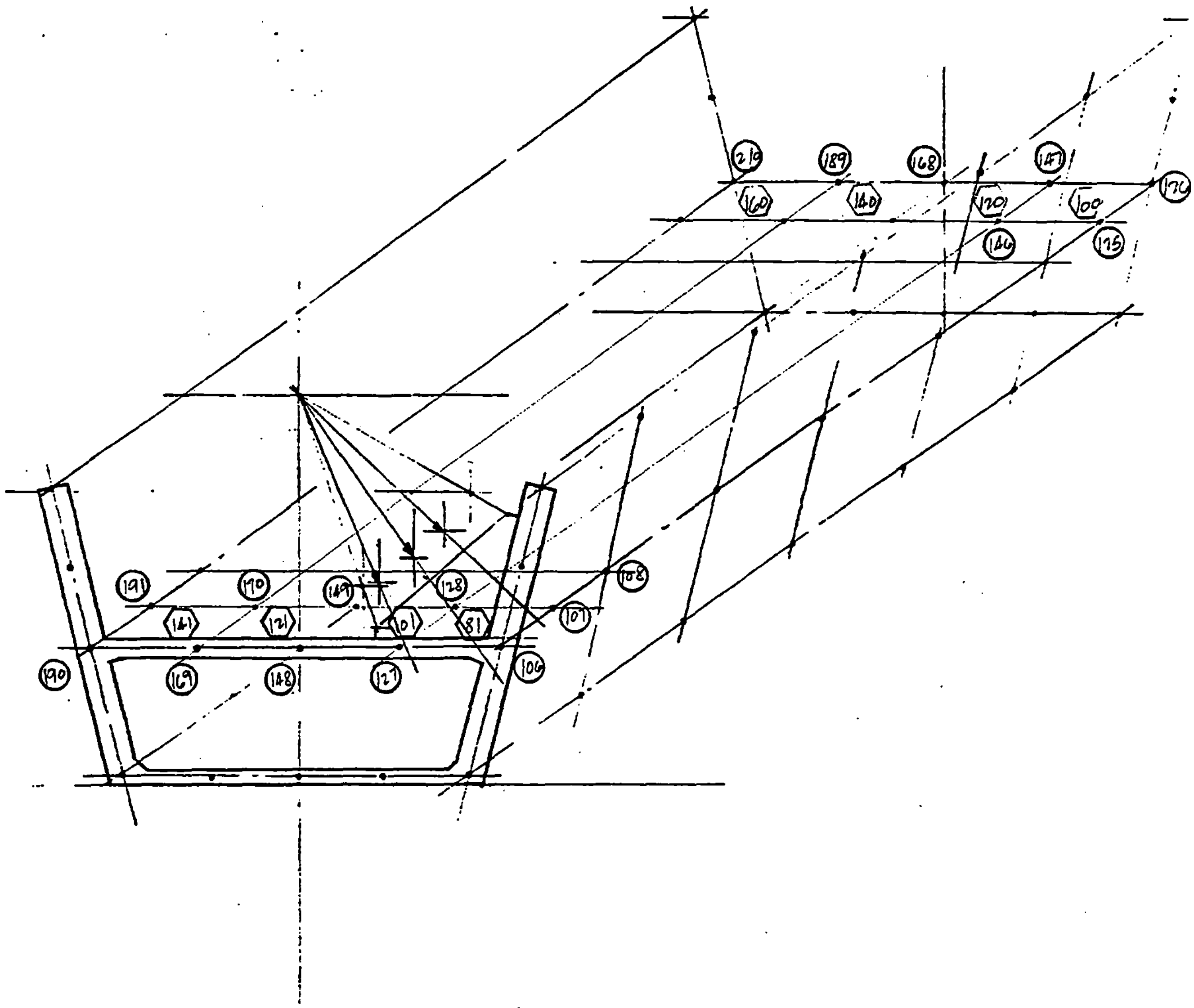


FORM 62-114 A(0086175)

United Engineers & Constructors
Raytheon
Stearns-Roger Division

PAGE C-7
JOB NO. ______ DATE ______ BY ______ CHK'D ______
CUSTOMER ______ PROJECT ______
SUBJECT ______

30 ft. span



FORM 62-114(A) (3517S)

United Engineers
& Constructors
Raytheon
Stearns-Roger Division

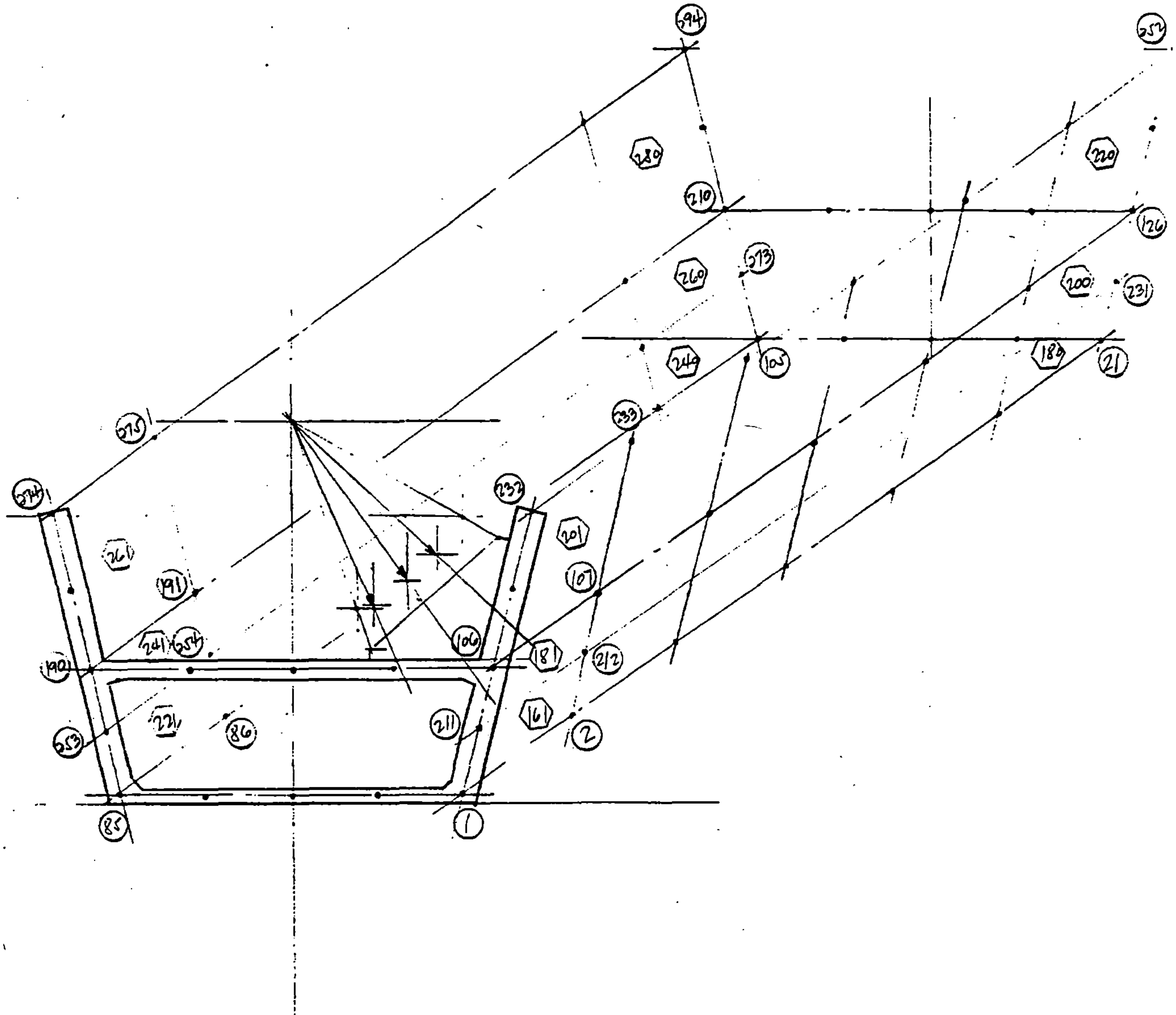
PAGE C-8

JOB NO. ________ DATE ________ BY ________ CH'K ________

CUSTOMER ________ PROJECT ________

SUBJECT ________

30 ft. span



```
**************************************************
*                                                *
*           S T A A D - III                      *
*           REVISION 14.0 (VERSION 14 LEVEL 0)   *
*           PROPRIETARY PROGRAM OF               *
*           RESEARCH ENGINEERS,INC.              *
*           DATE=    APR  9, 1992                *
*           TIME=    13:34:16                    *
*                                                *
**************************************************

  1. STAAD SPACE MAGLEV E-2 FRAME - 30'-0" SPAN
  2. *** PRECAST CONCRETE BOX GIRDER ***
  3. *** NATURAL FREQUENCY ***
  4. UNIT FEET KIP
  5. **********************************
  6. JOINT COORDINATES
  7. **********************************
  8.   1  0.0   0.0    0.0   21  0.0   0.0   30.0
  9.  22  2.87  0.0    0.0   42  2.87  0.0   30.0
 10.  43  5.73  0.0    0.0   63  5.73  0.0   30.0
 11.  64  8.59  0.0    0.0   84  8.59  0.0   30.0
 12.  85 11.46  0.0    0.0  105 11.46  0.0   30.0
 13. 106 -1.09  4.38   0.0  126 -1.09  4.38  30.0
 14. 127  2.32  4.38   0.0  147  2.32  4.38  30.0
 15. 148  5.73  4.38   0.0  168  5.73  4.38  30.0
 16. 169  9.14  4.38   0.0  189  9.14  4.38  30.0
 17. 190 12.55  4.38   0.0  210 12.55  4.38  30.0
 18. 211 -0.55  2.19   0.0  231 -0.55  2.19  30.0
 19. 232 -1.68  6.76   0.0  252 -1.68  6.76  30.0
 20. 253 12.01  2.19   0.0  273 12.01  2.19  30.0
 21. 274 13.14  6.76   0.0  294 13.14  6.76  30.0
 22. ***********************
 23. ELEMENT INCIDENCES
 24. ***********************
 25. *** BOTTOM SLAB ***
 26. 1 1 2 23 22 TO 20 ; 21 22 23 44 43 TO 40
 27. 41 43 44 65 64 TO 60 ; 61 64 65 86 85 TO 80
 28. *** TOP SLAB ***
 29. 81 106 107 128 127 TO 100 ; 101 127 128 149 148 TO 120
 30. 121 148 149 170 169 TO 140 ; 141 169 170 191 190 TO 160
 31. *** SIDEWALLS ***
 32. 161 1 2 212 211 TO 180 ; 181 211 212 107 106 TO 200
 33. 201 106 107 233 232 TO 220 ; 221 85 86 254 253 TO 240
 34. 241 253 254 191 190 TO 260 ; 261 190 191 275 274 TO 280
 35. **********************************
 36. UNIT INCH KIP
 37. *******************************
 38. ELEMENT PROPERTIES
 39. *******************************
 40. *** BOTTOM SLAB ***
 41. 1 TO 80 TH 6.0
 42. *** TOP SLAB ***
 43. 81 TO 160 TH 9.0
 44. *** SIDEWALLS ***
 45. 161 TO 280 TH 12.0
```

```
*****************************************
CONSTANTS
*****************************************
```

```
*** PRECAST CONCRETE BOX GIRDER ***
E 4030.0 ALL
POI 0.25 ALL
**************************************
UNIT FEET KIP
**************************************
CONSTANTS
**************************************
DENSITY 0.150 ALL
**************************************
SUPPORT
***************************************
1 21 85 105 FIXED BUT MZ MY MX FZ
***************************************
LOADING 1 DEAD LOAD 1
***************************************
SELFWEIGHT Y -1.0
***************************************
ELEMENT LOAD
*** UTILITY - ELECTRICAL, PIPE, ETC. - 200 PLF ***
101 TO 140 PRESSURE -0.0288
*** PROPULSION WINDING - 50 PLF ***
101 TO 140 PRESSURE -0.00722
JOINT LOAD
*** GUIDEWAY ALUM. BOX BEAM CONCRETE SUPPORT BLOCK ***
127 137 147 FY -0.80
169 179 189 FY -0.80
106 116 126 FY -2.80
190 200 210 FY -2.80
*** GUIDEWAY ALUMINUM BOX BEAM ***
127 137 147 FY -0.85
169 179 189 FY -0.85
106 116 126 FY -0.85
190 200 210 FY -0.85
**************************************
CALCULATE NATURAL FREQUENCY
************************************
LOADING 2 LIVE LOAD 1 - SNOW LOAD - 40 PSF
************************************
ELEMENT LOAD
*** SNOW LOAD ***
81 TO 160 PRESSURE -0.040
************************************
LOADING 3 LIVE LOAD 2 - VEHICLE BOGIE CENTERED ON SUPPORT
************************************
JOINT LOAD
*** VEHICLE + PASSENGER - 50,000 KG ( 110 KIPS ) ***
127 169 FY -13.75
106 190 FY -13.75
232 FX -9.99
274 FX  9.99
*************************************
LOADING 4 LIVE LOAD 3 - VEHICLE CENTERED ON SPAN
*************************************
JOINT LOAD
*** VEHICLE + PASSENGER - 50,000 KG ( 110 KIPS ) ***
137 179 FY -13.75
116 200 FY -13.75
242 FX -9.99
```

:

107. 284 FX 9.99
108. **

C-12

```
LOADING 5 WIND LOAD - P = 22.38 PSF
***************************************
ELEMENT LOAD
*** WINDWARD - 36.4 PSF ***
221 TO 280 PRESSURE  0.0364
*** LEEWARD - 19.6 PSF ***
161 TO 220 PRESSURE  0.0196
******************************************
LOADING 6 LATERAL LOAD 1 - USE W/ LIVE LOAD 2 - 20% VERTICAL LOAD
******************************************
JOINT LOAD
232 FX -11.0
******************************************
LOADING 7 LATERAL LOAD 2 - USE W/ LIVE LOAD 3 - 20% VERTICAL LOAD
*******************************************
JOINT LOAD
242 FX -11.0
***********************************************
LOADING 8 LONGITUDINAL LOAD 1 - USE W/ LIVE LOAD 2 - 10% VERTICAL LOAD
************************************************
JOINT LOAD
127 169 FZ 2.75
127 169 MX 7.33
************************************************
LOADING 9 LONGITUDINAL LOAD 2 - USE W/ LIVE LOAD 3 - 10% VERTICAL LOAD
************************************************
JOINT LOAD
137 179 FZ 2.75
137 179 MX 7.33
*************************************************
LOADING 10 SEISMIC LOAD
*************************************************
*** CANTILEVER WALL - ( 0.54 K x 0.3 ) - CP = 0.8 ***
*************************************************
JOINT LOAD
232 TO 252 FX -0.160
274 TO 294 FX -0.160
*************************************************
*** SIDE WALL - ( 0.99 K x 0.11 ) - CP = 0.3 ***
*************************************************
253 TO 273 FX -0.109
211 TO 231 FX -0.109
***********************************************
*** TOP SLAB - ( 2.14 K x 0.11 ) - CP = 0.3 ***
***********************************************
190 TO 210 FX -0.235
***************************************************
*** BOTTOM SLAB - ( 1.18 K x 0.11 ) - CP = 0.3 ***
***************************************************
85 TO 105 FX -0.130
*************************************************
*** LOAD COMBINATION ***
*****************************
LOAD COMB 11 DEAD + LIVE LOAD 1 + LIVE LOAD 2 + LAT. + LONG.
1 1.0 2 1.0 3 1.0 6 1.0 8 1.0
******************************
LOAD COMB 12 DEAD + LIVE LOAD 1 + LIVE LOAD 3 + LAT. + LONG.
1 1.0 2 1.0 4 1.0 7 1.0 9 1.0
```

167. ********************************

168. LOAD COMB 13 DEAD + LIVE LOAD 1 + LIVE LOAD 2 + WL + LAT. + LONG.

```
169. 1 0.75 2 0.75 3 0.75 5 0.75 6 0.75 8 0.75
170. ********************************
171. LOAD COMB 14 DEAD + LIVE LOAD 1 + LIVE LOAD 3 + WL + LAT. + LONG.
172. 1 0.75 2 0.75 4 0.75 5 0.75 7 0.75 9 0.75
173. *********************************
174. LOAD COMB 15 DEAD + SEISMIC LOAD
175. 1 0.90 10 1.1
176. *********************************
177. LOAD COMB 16 DEAD + LIVE LOAD 1 + LIVE LOAD 2 + LAT. + LONG. + SEIS.
178. 1 0.75 2 0.75 3 0.75 6 0.75 8 0.75 10 0.75
179. **********************************
180. LOAD COMB 17 DEAD + LIVE LOAD 1 + LIVE LOAD 3 + LAT. + LONG. + SEIS.
181. 1 0.75 2 0.75 4 0.75 7 0.75 9 0.75 10 0.75
182. **********************************
183. *** ULTIMATE STRENGTH DESIGN ***
184. *********************************
185. LOAD COMB 18 DEAD + LIVE LOAD 1 + LIVE LOAD 2 + LAT. + LONG.
186. 1 1.4 2 1.7 3 1.7 6 1.7 8 1.7
187. ********************************
188. LOAD COMB 19 DEAD + LIVE LOAD 1 + LIVE LOAD 3 + LAT. + LONG.
189. 1 1.4 2 1.7 4 1.7 7 1.7 9 1.7
190. ********************************
191. LOAD COMB 20 DEAD + LIVE LOAD 1 + LIVE LOAD 2 + WL + LAT. + LONG.
192. 1 1.05 2 1.28 3 1.28 5 1.28 6 1.28 8 1.28
193. ********************************
194. LOAD COMB 21 DEAD + LIVE LOAD 1 + LIVE LOAD 3 + WL + LAT. + LONG.
195. 1 1.05 2 1.28 4 1.28 5 1.28 7 1.28 9 1.28
196. *********************************
197. LOAD COMB 22 DEAD + SEISMIC LOAD
198. 1 0.90 10 1.40
199. *********************************
200. LOAD COMB 23 DEAD + LIVE LOAD 1 + LIVE LOAD 2 + LAT. + LONG. + SEIS.
201. 1 1.05 2 1.28 3 1.28 6 1.28 8 1.28 10 1.40
202. *********************************
203. LOAD COMB 24 DEAD + LIVE LOAD 1 + LIVE LOAD 3 + LAT. + LONG. + SEIS.
204. 1 1.05 2 1.28 4 1.28 7 1.28 9 1.28 10 1.40
205. *********************************
206. PERFORM ANALYSIS


        P R O B L E M   S T A T I S T I C S
        -----------------------------------

  NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =   294/  280/    4
  ORIGINAL/FINAL BAND-WIDTH =  211/    25
  TOTAL PRIMARY LOAD CASES  =    10, TOTAL DEGREES OF FREEDOM =  1764
  SIZE OF STIFFNESS MATRIX =  275184 DOUBLE PREC. WORDS
  TOTAL REQUIRED DISK SPACE =     6.42 MEGA-BYTES


++ PROCESSING ELEMENT STIFFNESS MATRIX.                 13:35:18
++ PROCESSING GLOBAL STIFFNESS MATRIX.                  13:35:32
++ PROCESSING TRIANGULAR FACTORIZATION.                 13:46:22

 ***WARNING - IMPROPER LOAD WILL CAUSE INSTABILITY AT JOINT  274
  DIRECTION = FZ  PROBABLE CAUSE MODELING PROBLEM   -0.103E-05
++ CALCULATING JOINT DISPLACEMENTS.                     13:55:22
```

```
**********************************************************
*                                                        *
* NATURAL FREQUENCY FOR LOADING   1 =   25.11676 CPS     *
* MAX DEFLECTION =  0.02492 INCH GLO Y, AT JOINT  158    *
*                                                        *
**********************************************************

++ CALCULATING ELEMENT FORCES.                    14: 2:26

207. LOAD LIST 1 TO 6 10 TO 17
208. PRINT JOINT DISPLACEMENT LIST 10 11 12 52 53 54 94 95 96
```

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
10	1	0.00004	-0.01586	-0.00447	0.00002	0.00000	0.00001
	2	0.00000	-0.00159	-0.00046	0.00000	0.00000	0.00001
	3	0.00002	-0.00141	0.00061	-0.00001	0.00000	0.00000
	4	0.00006	-0.00818	-0.00251	0.00002	0.00000	0.00002
	5	-0.00164	-0.00205	0.00036	0.00000	0.00000	0.00009
	6	-0.00197	-0.00289	0.00140	0.00000	0.00000	0.00014
	10	-0.00251	-0.00314	0.00049	0.00000	0.00000	0.00015
	11	-0.00198	-0.02203	5.49809	0.00002	0.00000	0.00016
	12	-0.00164	-0.02809	5.49409	0.00004	0.00000	0.00016
	13	-0.00271	-0.01806	4.12384	0.00001	0.00000	0.00019
	14	-0.00245	-0.02261	4.12083	0.00003	0.00000	0.00019
	15	-0.00273	-0.01773	-0.00349	0.00002	0.00000	0.00018
	16	-0.00337	-0.01888	4.12393	0.00002	0.00000	0.00024
	17	-0.00311	-0.02342	4.12093	0.00003	0.00000	0.00024
11	1	0.00004	-0.01601	-0.00398	0.00000	0.00000	0.00001
	2	0.00000	-0.00160	-0.00041	0.00000	0.00000	0.00001
	3	0.00001	-0.00128	0.00061	-0.00001	0.00000	0.00000
	4	0.00005	-0.00830	-0.00217	0.00000	0.00000	0.00002
	5	-0.00165	-0.00207	0.00044	0.00000	0.00000	0.00009
	6	-0.00196	-0.00291	0.00150	0.00000	0.00000	0.00014
	10	-0.00253	-0.00317	0.00061	0.00000	0.00000	0.00015
	11	-0.00197	-0.02208	5.49873	-0.00001	0.00000	0.00016
	12	-0.00165	-0.02843	5.49506	0.00000	0.00000	0.00016
	13	-0.00272	-0.01812	4.12438	0.00000	0.00000	0.00019
	14	-0.00248	-0.02287	4.12162	0.00000	0.00000	0.00019
	15	-0.00275	-0.01790	-0.00291	0.00000	0.00000	0.00018
	16	-0.00338	-0.01894	4.12451	0.00000	0.00000	0.00024
	17	-0.00314	-0.02370	4.12175	0.00000	0.00000	0.00024
12	1	0.00004	-0.01586	-0.00349	-0.00002	0.00000	0.00001
	2	0.00000	-0.00159	-0.00037	0.00000	0.00000	0.00001
	3	0.00001	-0.00115	0.00060	-0.00001	0.00000	0.00000
	4	0.00006	-0.00818	-0.00183	-0.00002	0.00000	0.00002
	5	-0.00164	-0.00205	0.00052	0.00000	0.00000	0.00009
	6	-0.00192	-0.00288	0.00160	0.00000	0.00000	0.00014
	10	-0.00251	-0.00314	0.00073	0.00000	0.00000	0.00015
	11	-0.00193	-0.02174	5.49938	-0.00003	0.00000	0.00016
	12	-0.00164	-0.02813	5.49604	-0.00004	0.00000	0.00016
	13	-0.00268	-0.01785	4.12492	-0.00002	0.00000	0.00018
	14	-0.00245	-0.02264	4.12242	-0.00003	0.00000	0.00019
	15	-0.00273	-0.01773	-0.00233	-0.00002	0.00000	0.00018
	16	-0.00333	-0.01866	4.12508	-0.00003	0.00000	0.00023
	17	-0.00311	-0.02345	4.12258	-0.00003	0.00000	0.00024
52	1	0.00000	-0.02100	-0.00432	0.00002	0.00000	0.00000
	2	0.00000	-0.00134	-0.00045	0.00000	0.00000	0.00000
	3	0.00000	-0.00138	0.00057	-0.00001	0.00000	0.00000
	4	0.00000	-0.00761	-0.00235	0.00001	0.00000	0.00000
	5	-0.00166	0.00008	0.00044	0.00000	0.00000	0.00000
	6	-0.00199	-0.00012	0.00113	0.00000	0.00000	-0.00002

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	10	-0.00255	0.00000	0.00061	0.00000	0.00000	-0.00002
	11	-0.00206	-0.02383	5.49788	0.00001	0.00000	-0.00001
	12	-0.00183	-0.03003	5.49446	0.00003	0.00000	-0.00002
	13	-0.00279	-0.01782	4.12374	0.00001	0.00000	-0.00001
	14	-0.00261	-0.02246	4.12117	0.00002	0.00000	-0.00001
	15	-0.00280	-0.01890	-0.00322	0.00001	0.00000	-0.00002
	16	-0.00345	-0.01787	4.12387	0.00001	0.00000	-0.00002
	17	-0.00328	-0.02252	4.12130	0.00002	0.00000	-0.00002
53	1	0.00000	-0.02114	-0.00398	0.00000	0.00000	0.00000
	2	0.00000	-0.00135	-0.00041	0.00000	0.00000	0.00000
	3	0.00000	-0.00127	0.00058	-0.00001	0.00000	0.00000
	4	0.00000	-0.00770	-0.00217	0.00000	0.00000	0.00000
	5	-0.00167	0.00008	0.00044	0.00000	0.00000	0.00000
	6	-0.00198	-0.00010	0.00113	0.00000	0.00000	-0.00002
	10	-0.00257	0.00000	0.00061	0.00000	0.00000	-0.00001
	11	-0.00205	-0.02386	5.49826	-0.00001	0.00000	-0.00001
	12	-0.00184	-0.03029	5.49501	0.00000	0.00000	-0.00002
	13	-0.00279	-0.01783	4.12403	-0.00001	0.00000	-0.00001
	14	-0.00263	-0.02266	4.12159	0.00000	0.00000	-0.00001
	15	-0.00282	-0.01903	-0.00291	0.00000	0.00000	-0.00002
	16	-0.00346	-0.01789	4.12416	-0.00001	0.00000	-0.00002
	17	-0.00330	-0.02271	4.12172	0.00000	0.00000	-0.00002
54	1	0.00000	-0.02100	-0.00364	-0.00002	0.00000	0.00000
	2	0.00000	-0.00134	-0.00038	0.00000	0.00000	0.00000
	3	0.00000	-0.00115	0.00059	-0.00001	0.00000	0.00000
	4	0.00000	-0.00761	-0.00199	-0.00001	0.00000	0.00000
	5	-0.00166	0.00008	0.00044	0.00000	0.00000	0.00000
	6	-0.00194	-0.00008	0.00113	0.00000	0.00000	-0.00001
	10	-0.00255	0.00000	0.00061	0.00000	0.00000	-0.00002
	11	-0.00200	-0.02357	5.49864	-0.00002	0.00000	-0.00001
	12	-0.00182	-0.03004	5.49557	-0.00003	0.00000	-0.00002
	13	-0.00274	-0.01762	4.12431	-0.00002	0.00000	-0.00001
	14	-0.00260	-0.02247	4.12201	-0.00002	0.00000	-0.00001
	15	-0.00280	-0.01890	-0.00260	-0.00001	0.00000	-0.00002
	16	-0.00341	-0.01767	4.12444	-0.00002	0.00000	-0.00002
	17	-0.00327	-0.02253	4.12214	-0.00002	0.00000	-0.00002
94	1	-0.00004	-0.01586	-0.00447	0.00002	0.00000	-0.00001
	2	0.00000	-0.00159	-0.00046	0.00000	0.00000	-0.00001
	3	-0.00002	-0.00141	0.00061	-0.00001	0.00000	0.00000
	4	-0.00006	-0.00818	-0.00251	0.00002	0.00000	-0.00002
	5	-0.00164	0.00222	0.00052	0.00000	0.00000	0.00009
	6	-0.00197	0.00276	0.00085	0.00000	0.00000	0.00015
	10	-0.00253	0.00315	0.00073	0.00000	0.00000	0.00015
	11	-0.00210	-0.01584	5.49740	0.00001	0.00000	0.00013
	12	-0.00195	-0.02271	5.49413	0.00003	0.00000	0.00012
	13	-0.00280	-0.01021	4.12345	0.00000	0.00000	0.00016
	14	-0.00269	-0.01537	4.12099	0.00002	0.00000	0.00015
	15	-0.00283	-0.01081	-0.00322	0.00001	0.00000	0.00016

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

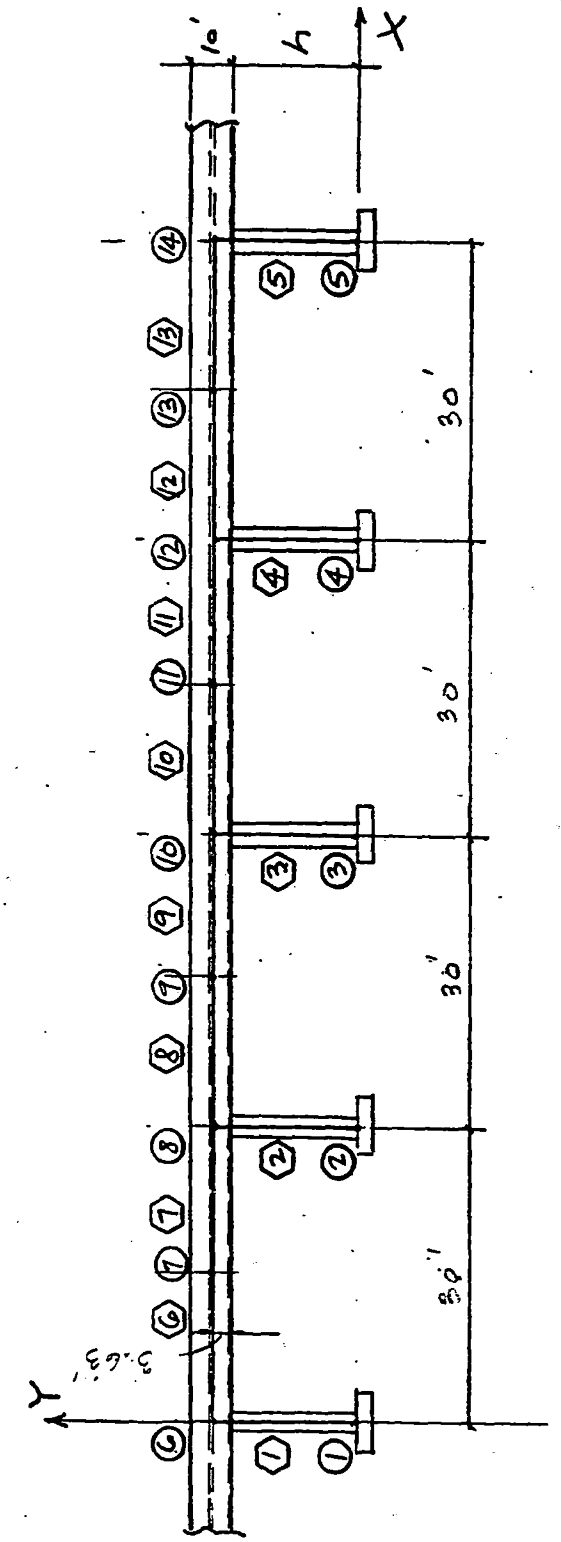
JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	16	-0.00347	-0.00951	4.12360	0.00000	0.00000	0.00021
	17	-0.00336	-0.01467	4.12115	0.00002	0.00000	0.00020
95	1	-0.00004	-0.01601	-0.00398	0.00000	0.00000	-0.00001
	2	0.00000	-0.00160	-0.00041	0.00000	0.00000	-0.00001
	3	-0.00001	-0.00128	0.00061	-0.00001	0.00000	0.00000
	4	-0.00005	-0.00830	-0.00217	0.00000	0.00000	-0.00002
	5	-0.00165	0.00225	0.00044	0.00000	0.00000	0.00009
	6	-0.00196	0.00279	0.00075	0.00000	0.00000	0.00014
	10	-0.00256	0.00318	0.00061	0.00000	0.00000	0.00015
	11	-0.00208	-0.01585	5.49784	-0.00001	0.00000	0.00013
	12	-0.00194	-0.02301	5.49490	0.00000	0.00000	0.00011
	13	-0.00280	-0.01021	4.12371	-0.00001	0.00000	0.00016
	14	-0.00270	-0.01558	4.12151	0.00000	0.00000	0.00015
	15	-0.00285	-0.01091	-0.00291	0.00000	0.00000	0.00016
	16	-0.00348	-0.00950	4.12383	-0.00001	0.00000	0.00021
	17	-0.00337	-0.01488	4.12163	0.00000	0.00000	0.00020
96	1	-0.00004	-0.01586	-0.00349	-0.00002	0.00000	-0.00001
	2	0.00000	-0.00159	-0.00037	0.00000	0.00000	-0.00001
	3	-0.00001	-0.00115	0.00060	-0.00001	0.00000	0.00000
	4	-0.00006	-0.00818	-0.00183	-0.00002	0.00000	-0.00002
	5	-0.00164	0.00222	0.00036	0.00000	0.00000	0.00009
	6	-0.00192	0.00276	0.00065	0.00000	0.00000	0.00014
	10	-0.00253	0.00315	0.00049	0.00000	0.00000	0.00015
	11	-0.00203	-0.01559	5.49827	-0.00002	0.00000	0.00013
	12	-0.00192	-0.02279	5.49568	-0.00003	0.00000	0.00011
	13	-0.00275	-0.01003	4.12397	-0.00002	0.00000	0.00016
	14	-0.00267	-0.01542	4.12203	-0.00002	0.00000	0.00015
	15	-0.00283	-0.01081	-0.00260	-0.00001	0.00000	0.00016
	16	-0.00342	-0.00933	4.12407	-0.00001	0.00000	0.00021
	17	-0.00334	-0.01473	4.12213	-0.00002	0.00000	0.00020

************** END OF LATEST ANALYSIS RESULT **************

209. LOAD LIST 1 TO 17
210. PRINT SUPPORT REACTION

United Engineers & Constructors
Raytheon
Stearns-Roger Division

JOB NO. 6869002 DATE 3.19.92 BY AWC CHK.
CUSTOMER MI PROJECT Maglev
SUBJECT



ELEVATION

Height, h

$h_1 = 5.18m = (17.0')$

$h_2 = 7.62m = (25.0')$

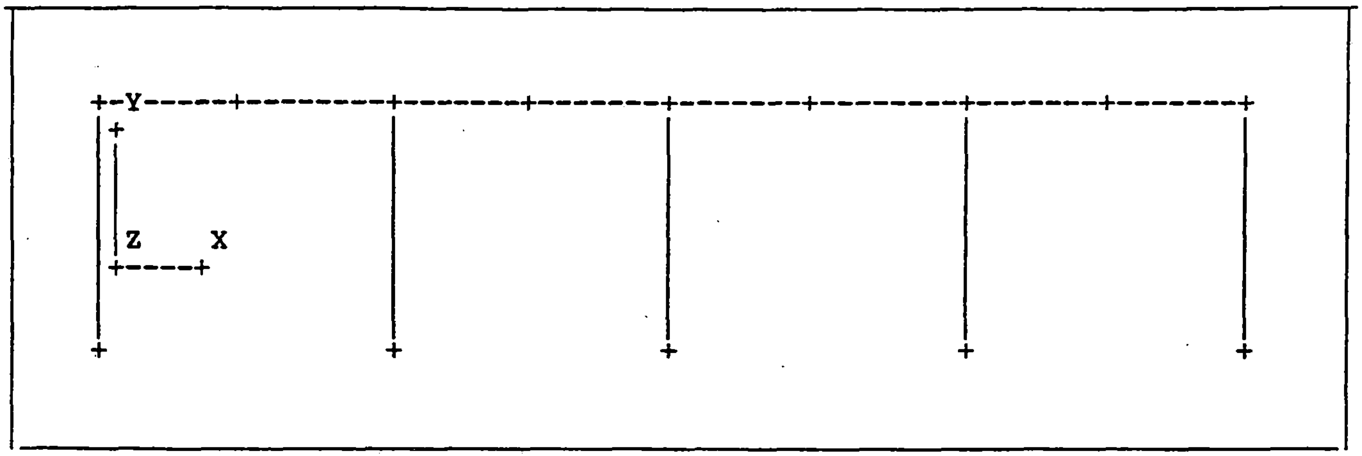
$h_3 = 9.14m = (30.0')$

$h_4 = 20.0m = (65.6')$

```
**************************************************
*                                                *
*             S T A A D - III                    *
*             REVISION 14.0 (VERSION 14 LEVEL 0) *
*             PROPRIETARY PROGRAM OF             *
*             RESEARCH ENGINEERS,INC.            *
*             DATE=    APR 22, 1992              *
*             TIME=    14: 9:32                  *
*                                                *
**************************************************
```

```
 1. STAAD SPACE FRAME - MAGLEV - E2
 2. *** SIMPLE BEAM SPAN *** ( MGLVSF8A )
 3. *** HEIGHT = 7.62 METERS ( 25.0 FEET ) ***
 4. UNIT FEET KIP
 5. **********************************
 6. JOINT COORDINATES
 7. **********************************
 8.   1   0.0   0.0  0.0 ;  2  30.0   0.0  0.0  ;   3  60.0  0.0  0.0
 9.   4  90.0   0.0  0.0 ;  5 120.0   0.0  0.0  ;   6   0.0 28.63 0.0
10.   7  15.0 28.63 0.0 ;  8  30.0 28.63 0.0  ;   9  45.0 28.63 0.0
11.  10  60.0 28.63 0.0 ; 11  75.0 28.63 0.0  ;  12  90.0 28.63 0.0
12.  13 105.0 28.63 0.0 ; 14 120.0 28.63 0.0
13. ***********************
14. MEMBER INCIDENCES
15. ***********************
16. 1 1 6 ; 2 2 8 ; 3 3 10 ; 4 4 12 ; 5 5 14 ; 6 6 7 13
17. ********************************
18. MEMBER PROPERTIES
19. ********************************
20. 1 TO 5 PRIS ZD 4.0 YD 2.0
21. 6 TO 13 PRIS AX 24.65 IZ 87.42 IY 562.36
22. **************************************
23. MEMBER RELEASE
24. **************************************
25. 6 8 10 12 START MZ MY
26. 7 9 11 13 END MZ MY FX
27. **************************************
28. MEMBER OFFSET
29. ***************************************
30. 1 TO 5 END 0.0 -3.63 0.0
31. ****************************************
32. UNIT INCH KIPS
33. ***************************************
34. CONSTANTS
35. ***************************************
36. E 4030.5 ALL
37. DENSITY 0.0000868 ALL
38. ALPHA 0.0000065 ALL
39. ***************************************
40. UNIT FEET KIP
41. ***************************************
42. PLOT PLANE XY
```

*** SIMPLE BEAM SPAN *** (MGLVSF8A)



*** SIMPLE BEAM SPAN *** (MGLVSF8A)

```
****************************************
SUPPORT
****************************************
1 TO 5 FIXED
****************************************
LOADING 1 DEAD LOAD
****************************************
SELFWEIGHT Y -1.0
*************************************************
*** UTILITY + PROPULSION + GUIDEWAY ***
*************************************************
MEMBER LOAD
*************************
6 TO 13 UNI GY -0.200
6 TO 13 UNI GY -0.050
6 TO 13 CON GY -10.6 15.0
***************************
JOINT LOAD
***************************
6 TO 14 FY -10.6
*******************************
CALCULATE NATURAL FREQUENCY
*******************************
LOADING 2 SNOW LOAD
*******************************
MEMBER LOAD
******************************
6 TO 13 UNI GY -0.506
******************************
LOADING 3 LIVE LOAD 1 - VEHICHLE BOGIE CENTERED ON SPAN
*******************************
MEMBER LOAD
*******************************
13 CON GY -55.0 4.0
*******************************
JOINT LOAD
********************************
7 FY -55.0
*******************************
LOADING 4 LIVE LOAD 2 - VEHICHLE BOGIE CENTERED ON SUPPORT
*******************************
MEMBER LOAD
*******************************
12 CON GY -55.0 4.0
*******************************
JOINT LOAD
*******************************
6 FY -55.0
*******************************
LOADING 5 SEISMIC LOAD 1 - TRANSVERSE DIRECTION
********************************
SELFWEIGHT Z 0.105
********************************
LOADING 6 SEISMIC LOAD 2 - LONGITUDINAL DIRECTION
********************************
SELFWEIGHT X 0.105
********************************
LOADING 7 WIND LOAD
********************************
MEMBER LOAD
```

```
********************************
6 TO 13 UNI GZ 0.280
1 TO 5 UNI GZ 0.112
**********************************
LOADING 8 TEMPERATURE LOAD
**********************************
TEMPERATURE LOAD
**********************************
1 TO 13 TEMP 90.0
*******************************
LOAD COMB 9 DEAD LOAD + SNOW LOAD + LIVE LOAD 1
1 1.0 2 1.0 3 1.0
*******************************
LOAD COMB 10 DEAD LOAD + SNOW LOAD + LIVE LOAD 2
1 1.0 2 1.0 4 1.0
*******************************
LOAD COMB 11 DEAD LOAD + SNOW LOAD + LIVE LOAD 1 + TEMPERATURE
1 0.75 2 0.75 3 0.75 8 0.75
************************************
LOAD COMB 12 DEAD LOAD + SNOW LOAD + LIVE LOAD 2 + TEMPERATURE
1 0.75 2 0.75 4 0.75 8 0.75
************************************
LOAD COMB 13 DEAD + SNOW + LIVE LOAD 1 + SEISMIC LOAD 1 + TEMP.
1 0.66 2 0.66 3 0.66 5 0.73 8 0.66
*******************************
LOAD COMB 14 DEAD + SNOW + LIVE LOAD 2 + SEISMIC LOAD 1 + TEMP.
1 0.66 2 0.66 4 0.66 5 0.73 8 0.66
*******************************
LOAD COMB 15 DEAD + SNOW + LIVE LOAD 1 + SEISMIC LOAD 2 + TEMP.
1 0.66 2 0.66 3 0.66 6 0.73 8 0.66
*******************************
LOAD COMB 16 DEAD + SNOW + LIVE LOAD 2 + SEISMIC LOAD 2 + TEMP.
1 0.66 2 0.66 4 0.66 6 0.73 8 0.66
*******************************
LOAD COMB 17 DEAD LOAD + SEISMIC LOAD 1
1 0.90 5 1.10
*******************************
LOAD COMB 18 DEAD LOAD + SEISMIC LOAD 2
1 0.90 6 1.10
********************************
LOAD COMB 19 DEAD LOAD + SEISMIC LOAD 1 + TEMPERATURE
1 0.75 5 0.83 8 0.75
********************************
LOAD COMB 20 DEAD LOAD + SEISMIC LOAD 2 + TEMPERATURE
1 0.75 6 0.83 8 0.75
********************************
LOAD COMB 21 DEAD + SNOW + LIVE LOAD 1 + WIND LOAD + TEMPERATURE
1 0.66 2 0.66 3 0.66 7 0.66 8 0.66
********************************
LOAD COMB 22 DEAD + SNOW + LIVE LOAD 2 + WIND LOAD + TEMPERATURE
1 0.66 2 0.66 4 0.66 7 0.66 8 0.66
********************************
LOAD COMB 23 DEAD LOAD + WIND LOAD + TEMPERATURE
1 0.75 7 0.75 8 0.75
********************************
LOAD COMB 24 DEAD LOAD + WIND LOAD
1 0.90 7 1.0
********************************
*** ULTIMATE STRENGTH DESIGN ***
********************************
```

```
 *** SIMPLE BEAM SPAN *** ( MGLVSF8A )
LOAD COMB 25 DEAD LOAD + SNOW LOAD + LIVE LOAD 1
1 1.40 2 1.70 3 1.70
********************************
LOAD COMB 26 DEAD LOAD + SNOW LOAD + LIVE LOAD 2
1 1.40 2 1.70 4 1.70
********************************
LOAD COMB 27 DEAD LOAD + SNOW LOAD + LIVE LOAD 1 + TEMPERATURE
1 1.05 2 1.28 3 1.28 8 1.28
********************************
LOAD COMB 28 DEAD LOAD + SNOW LOAD + LIVE LOAD 2 + TEMPERATURE
1 1.05 2 1.28 4 1.28 8 1.28
********************************
LOAD COMB 29 DEAD + SNOW + LIVE LOAD 1 + SEISMIC LOAD 1 + TEMP.
1 0.92 2 1.12 3 1.12 5 1.23 8 1.12
************************************
LOAD COMB 30 DEAD + SNOW + LIVE LOAD 2 + SEISMIC LOAD 1 + TEMP.
1 0.92 2 1.12 4 1.12 5 1.23 8 1.12
*******************************
LOAD COMB 31 DEAD + SNOW + LIVE LOAD 1 + SEISMIC LOAD 2 + TEMP.
1 0.92 2 1.12 3 1.12 6 1.23 8 1.12
*******************************
LOAD COMB 32 DEAD + SNOW + LIVE LOAD 2 + SEISMIC LOAD 2 + TEMP.
1 0.92 2 1.12 4 1.12 6 1.23 8 1.12
*******************************
LOAD COMB 33 DEAD LOAD + SEISMIC LOAD 1
1 0.90 5 1.40
*******************************
LOAD COMB 34 DEAD LOAD + SEISMIC LOAD 2
1 0.90 6 1.40
********************************
LOAD COMB 35 DEAD LOAD + SEISMIC LOAD 1 + TEMPERATURE
1 0.90 5 1.40 8 1.28
********************************
LOAD COMB 36 DEAD LOAD + SEISMIC LOAD 2 + TEMPERATURE
1 0.90 6 1.40 8 1.28
********************************
LOAD COMB 37 DEAD + SNOW + LIVE LOAD 1 + WIND LOAD + TEMPERATURE
1 0.92 2 1.12 3 1.12 7 1.12 8 1.12
********************************
LOAD COMB 38 DEAD + SNOW + LIVE LOAD 2 + WIND LOAD + TEMPERATURE
1 0.92 2 1.12 4 1.12 7 1.12 8 1.12
********************************
LOAD COMB 39 DEAD LOAD + WIND LOAD + TEMPERATURE
1 0.90 7 1.28 8 1.28
********************************
LOAD COMB 40 DEAD LOAD + WIND LOAD
1 0.90 7 1.28
********************************
PERFORM ANALYSIS


      P R O B L E M   S T A T I S T I C S
      -----------------------------------

NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =     14/    13/     5
ORIGINAL/FINAL BAND-WIDTH =     9/     2
TOTAL PRIMARY LOAD CASES  =     8, TOTAL DEGREES OF FREEDOM =     54
SIZE OF STIFFNESS MATRIX =      648 DOUBLE PREC. WORDS
TOTAL REQUIRED DISK SPACE =     0.04 MEGA-BYTES
```

C-26


```
++ PROCESSING ELEMENT STIFFNESS MATRIX.          14: 9:40
++ PROCESSING GLOBAL STIFFNESS MATRIX.           14: 9:41
++ PROCESSING TRIANGULAR FACTORIZATION.          14: 9:42
++ CALCULATING JOINT DISPLACEMENTS.              14: 9:43

 **********************************************************
 *                                                        *
 * NATURAL FREQUENCY FOR LOADING   1 =   22.49907 CPS     *
 * MAX DEFLECTION =  0.02403 INCH GLO Y, AT JOINT   11    *
 *                                                        *
 **********************************************************

++ CALCULATING ELEMENT FORCES.                   14: 9:46

 212. LOAD LIST 1 TO 24
 213. PRINT JOINT DISPLACEMENT LIST 6 TO 14
```

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
6	1	0.00000	-0.00616	0.00000	0.00000	0.00000	0.00000
	2	0.00000	-0.00049	0.00000	0.00000	0.00000	0.00000
	3	0.00000	-0.00178	0.00000	0.00000	0.00000	0.00000
	4	0.00000	-0.00355	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.10330	0.00043	0.00000	0.00000
	6	0.76356	0.00000	0.00000	0.00000	0.00000	-0.00325
	7	0.00000	0.00000	0.07693	0.00032	0.00000	0.00000
	8	0.00000	0.17550	0.00000	0.00000	0.00000	0.00000
	9	0.00000	-0.00843	0.00000	0.00000	0.00000	0.00000
	10	0.00000	-0.01021	0.00000	0.00000	0.00000	0.00000
	11	0.00000	0.12530	0.00000	0.00000	0.00000	0.00000
	12	0.00000	0.12397	0.00000	0.00000	0.00000	0.00000
	13	0.00000	0.11027	0.07541	0.00032	0.00000	0.00000
	14	0.00000	0.10909	0.07541	0.00032	0.00000	0.00000
	15	0.55740	0.11027	0.00000	0.00000	0.00000	-0.00237
	16	0.55740	0.10909	0.00000	0.00000	0.00000	-0.00237
	17	0.00000	-0.00555	0.11363	0.00048	0.00000	0.00000
	18	0.83992	-0.00555	0.00000	0.00000	0.00000	-0.00357
	19	0.00000	0.12700	0.08574	0.00036	0.00000	0.00000
	20	0.63375	0.12700	0.00000	0.00000	0.00000	-0.00269
	21	0.00000	0.11027	0.05077	0.00021	0.00000	0.00000
	22	0.00000	0.10909	0.05077	0.00021	0.00000	0.00000
	23	0.00000	0.12700	0.05770	0.00024	0.00000	0.00000
	24	0.00000	-0.00555	0.07693	0.00032	0.00000	0.00000
7	1	0.00000	-0.02143	0.00000	0.00000	0.00000	-0.00001
	2	0.00000	-0.00200	0.00000	0.00000	0.00000	0.00000
	3	0.00000	-0.00909	0.00000	0.00000	0.00000	0.00000
	4	0.00000	-0.00178	0.00000	0.00000	0.00000	0.00001
	5	0.00000	0.00000	0.14789	0.00000	-0.00025	0.00000
	6	0.76367	0.00000	0.00000	0.00000	0.00000	0.00000
	7	0.00000	0.00000	0.10909	0.00000	-0.00018	0.00000
	8	0.10530	0.17550	0.00000	0.00000	0.00000	0.00000
	9	0.00000	-0.03252	0.00000	0.00000	0.00000	-0.00002
	10	0.00000	-0.02520	0.00000	0.00000	0.00000	-0.00001
	11	0.07898	0.10723	0.00000	0.00000	0.00000	-0.00001
	12	0.07898	0.11272	0.00000	0.00000	0.00000	0.00000
	13	0.06950	0.09437	0.10796	0.00000	-0.00018	-0.00001
	14	0.06950	0.09920	0.10796	0.00000	-0.00018	0.00000
	15	0.62698	0.09437	0.00000	0.00000	0.00000	-0.00001
	16	0.62698	0.09920	0.00000	0.00000	0.00000	0.00000
	17	0.00000	-0.01929	0.16268	0.00000	-0.00027	-0.00001
	18	0.84004	-0.01929	0.00000	0.00000	0.00000	-0.00001
	19	0.07898	0.11555	0.12275	0.00000	-0.00020	-0.00001
	20	0.71282	0.11555	0.00000	0.00000	0.00000	-0.00001
	21	0.06950	0.09437	0.07200	0.00000	-0.00012	-0.00001
	22	0.06950	0.09920	0.07200	0.00000	-0.00012	0.00000
	23	0.07898	0.11555	0.08181	0.00000	-0.00013	-0.00001
	24	0.00000	-0.01929	0.10909	0.00000	-0.00018	-0.00001

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JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
8	1	0.00000	-0.01136	0.00000	0.00000	0.00000	0.00000
	2	0.00000	-0.00098	0.00000	0.00000	0.00000	0.00000
	3	0.00000	-0.00178	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.19217	0.00081	0.00000	0.00000
	6	0.76356	0.00000	0.00000	0.00000	0.00000	-0.00325
	7	0.00000	0.00000	0.14103	0.00059	0.00000	0.00000
	8	0.00000	0.17550	0.00000	0.00000	0.00000	0.00000
	9	0.00000	-0.01412	0.00000	0.00000	0.00000	0.00000
	10	0.00000	-0.01234	0.00000	0.00000	0.00000	0.00000
	11	0.00000	0.12104	0.00000	0.00000	0.00000	0.00000
	12	0.00000	0.12237	0.00000	0.00000	0.00000	0.00000
	13	0.00000	0.10651	0.14028	0.00059	0.00000	0.00000
	14	0.00000	0.10769	0.14028	0.00059	0.00000	0.00000
	15	0.55740	0.10651	0.00000	0.00000	0.00000	-0.00237
	16	0.55740	0.10769	0.00000	0.00000	0.00000	-0.00237
	17	0.00000	-0.01022	0.21139	0.00089	0.00000	0.00000
	18	0.83992	-0.01022	0.00000	0.00000	0.00000	-0.00357
	19	0.00000	0.12311	0.15950	0.00067	0.00000	0.00000
	20	0.63375	0.12311	0.00000	0.00000	0.00000	-0.00269
	21	0.00000	0.10651	0.09308	0.00039	0.00000	0.00000
	22	0.00000	0.10769	0.09308	0.00039	0.00000	0.00000
	23	0.00000	0.12311	0.10577	0.00045	0.00000	0.00000
	24	0.00000	-0.01022	0.14103	0.00059	0.00000	0.00000
9	1	0.00000	-0.02403	0.00000	0.00000	0.00000	0.00000
	2	0.00000	-0.00224	0.00000	0.00000	0.00000	0.00000
	3	0.00000	-0.00089	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.19232	0.00000	0.00000	0.00000
	6	0.76367	0.00000	0.00000	0.00000	0.00000	0.00000
	7	0.00000	0.00000	0.14113	0.00000	0.00000	0.00000
	8	0.10530	0.17550	0.00000	0.00000	0.00000	0.00000
	9	0.00000	-0.02716	0.00000	0.00000	0.00000	0.00000
	10	0.00000	-0.02627	0.00000	0.00000	0.00000	0.00000
	11	0.07898	0.11126	0.00000	0.00000	0.00000	0.00000
	12	0.07898	0.11192	0.00000	0.00000	0.00000	0.00000
	13	0.06950	0.09791	0.14039	0.00000	0.00000	0.00000
	14	0.06950	0.09849	0.14039	0.00000	0.00000	0.00000
	15	0.62698	0.09791	0.00000	0.00000	0.00000	0.00000
	16	0.62698	0.09849	0.00000	0.00000	0.00000	0.00000
	17	0.00000	-0.02162	0.21155	0.00000	0.00000	0.00000
	18	0.84004	-0.02162	0.00000	0.00000	0.00000	0.00000
	19	0.07898	0.11361	0.15963	0.00000	0.00000	0.00000
	20	0.71282	0.11361	0.00000	0.00000	0.00000	0.00000
	21	0.06950	0.09791	0.09315	0.00000	0.00000	0.00000
	22	0.06950	0.09849	0.09315	0.00000	0.00000	0.00000
	23	0.07898	0.11361	0.10585	0.00000	0.00000	0.00000
	24	0.00000	-0.02162	0.14113	0.00000	0.00000	0.00000

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
10	1	0.00000	-0.01136	0.00000	0.00000	0.00000	0.00000
	2	0.00000	-0.00098	0.00000	0.00000	0.00000	0.00000
	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.19217	0.00081	0.00000	0.00000
	6	0.76356	0.00000	0.00000	0.00000	0.00000	-0.00325
	7	0.00000	0.00000	0.14103	0.00059	0.00000	0.00000
	8	0.00000	0.17550	0.00000	0.00000	0.00000	0.00000
	9	0.00000	-0.01234	0.00000	0.00000	0.00000	0.00000
	10	0.00000	-0.01234	0.00000	0.00000	0.00000	0.00000
	11	0.00000	0.12237	0.00000	0.00000	0.00000	0.00000
	12	0.00000	0.12237	0.00000	0.00000	0.00000	0.00000
	13	0.00000	0.10769	0.14028	0.00059	0.00000	0.00000
	14	0.00000	0.10769	0.14028	0.00059	0.00000	0.00000
	15	0.55740	0.10769	0.00000	0.00000	0.00000	-0.00237
	16	0.55740	0.10769	0.00000	0.00000	0.00000	-0.00237
	17	0.00000	-0.01022	0.21139	0.00089	0.00000	0.00000
	18	0.83992	-0.01022	0.00000	0.00000	0.00000	-0.00357
	19	0.00000	0.12311	0.15950	0.00067	0.00000	0.00000
	20	0.63375	0.12311	0.00000	0.00000	0.00000	-0.00269
	21	0.00000	0.10769	0.09308	0.00039	0.00000	0.00000
	22	0.00000	0.10769	0.09308	0.00039	0.00000	0.00000
	23	0.00000	0.12311	0.10577	0.00045	0.00000	0.00000
	24	0.00000	-0.01022	0.14103	0.00059	0.00000	0.00000
11	1	0.00000	-0.02403	0.00000	0.00000	0.00000	0.00000
	2	0.00000	-0.00224	0.00000	0.00000	0.00000	0.00000
	3	0.00000	-0.00065	0.00000	0.00000	0.00000	0.00000
	4	0.00000	-0.00154	0.00000	0.00000	0.00000	-0.00001
	5	0.00000	0.00000	0.19232	0.00000	0.00000	0.00000
	6	0.76367	0.00000	0.00000	0.00000	0.00000	0.00000
	7	0.00000	0.00000	0.14113	0.00000	0.00000	0.00000
	8	0.10530	0.17550	0.00000	0.00000	0.00000	0.00000
	9	0.00000	-0.02692	0.00000	0.00000	0.00000	0.00000
	10	0.00000	-0.02781	0.00000	0.00000	0.00000	-0.00001
	11	0.07898	0.11143	0.00000	0.00000	0.00000	0.00000
	12	0.07898	0.11077	0.00000	0.00000	0.00000	-0.00001
	13	0.06950	0.09806	0.14039	0.00000	0.00000	0.00000
	14	0.06950	0.09748	0.14039	0.00000	0.00000	-0.00001
	15	0.62698	0.09806	0.00000	0.00000	0.00000	0.00000
	16	0.62698	0.09748	0.00000	0.00000	0.00000	-0.00001
	17	0.00000	-0.02162	0.21155	0.00000	0.00000	0.00000
	18	0.84004	-0.02162	0.00000	0.00000	0.00000	0.00000
	19	0.07898	0.11361	0.15963	0.00000	0.00000	0.00000
	20	0.71282	0.11361	0.00000	0.00000	0.00000	0.00000
	21	0.06950	0.09806	0.09315	0.00000	0.00000	0.00000
	22	0.06950	0.09748	0.09315	0.00000	0.00000	-0.00001
	23	0.07898	0.11361	0.10585	0.00000	0.00000	0.00000
	24	0.00000	-0.02162	0.14113	0.00000	0.00000	0.00000

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
12	1	0.00000	-0.01136	0.00000	0.00000	0.00000	0.00000
	2	0.00000	-0.00098	0.00000	0.00000	0.00000	0.00000
	3	0.00000	-0.00130	0.00000	0.00000	0.00000	0.00000
	4	0.00000	-0.00308	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.19217	0.00081	0.00000	0.00000
	6	0.76356	0.00000	0.00000	0.00000	0.00000	-0.00325
	7	0.00000	0.00000	0.14103	0.00059	0.00000	0.00000
	8	0.00000	0.17550	0.00000	0.00000	0.00000	0.00000
	9	0.00000	-0.01364	0.00000	0.00000	0.00000	0.00000
	10	0.00000	-0.01542	0.00000	0.00000	0.00000	0.00000
	11	0.00000	0.12139	0.00000	0.00000	0.00000	0.00000
	12	0.00000	0.12006	0.00000	0.00000	0.00000	0.00000
	13	0.00000	0.10683	0.14028	0.00059	0.00000	0.00000
	14	0.00000	0.10565	0.14028	0.00059	0.00000	0.00000
	15	0.55740	0.10683	0.00000	0.00000	0.00000	-0.00237
	16	0.55740	0.10565	0.00000	0.00000	0.00000	-0.00237
	17	0.00000	-0.01022	0.21139	0.00089	0.00000	0.00000
	18	0.83992	-0.01022	0.00000	0.00000	0.00000	-0.00357
	19	0.00000	0.12311	0.15950	0.00067	0.00000	0.00000
	20	0.63375	0.12311	0.00000	0.00000	0.00000	-0.00269
	21	0.00000	0.10683	0.09308	0.00039	0.00000	0.00000
	22	0.00000	0.10565	0.09308	0.00039	0.00000	0.00000
	23	0.00000	0.12311	0.10577	0.00045	0.00000	0.00000
	24	0.00000	-0.01022	0.14103	0.00059	0.00000	0.00000
13	1	0.00000	-0.02177	0.00000	0.00000	0.00000	0.00001
	2	0.00000	-0.00200	0.00000	0.00000	0.00000	0.00000
	3	0.00000	-0.00838	0.00000	0.00000	0.00000	-0.00001
	4	0.00000	-0.00463	0.00000	0.00000	0.00000	0.00001
	5	0.00000	0.00000	0.14789	0.00000	0.00025	0.00000
	6	0.76367	0.00000	0.00000	0.00000	0.00000	0.00000
	7	0.00000	0.00000	0.10909	0.00000	0.00018	0.00000
	8	0.10530	0.17550	0.00000	0.00000	0.00000	0.00000
	9	0.00000	-0.03215	0.00000	0.00000	0.00000	0.00000
	10	0.00000	-0.02840	0.00000	0.00000	0.00000	0.00003
	11	0.07898	0.10751	0.00000	0.00000	0.00000	0.00000
	12	0.07898	0.11032	0.00000	0.00000	0.00000	0.00002
	13	0.06950	0.09461	0.10796	0.00000	0.00018	0.00000
	14	0.06950	0.09708	0.10796	0.00000	0.00018	0.00002
	15	0.62698	0.09461	0.00000	0.00000	0.00000	0.00000
	16	0.62698	0.09708	0.00000	0.00000	0.00000	0.00002
	17	0.00000	-0.01959	0.16268	0.00000	0.00027	0.00001
	18	0.84004	-0.01959	0.00000	0.00000	0.00000	0.00001
	19	0.07898	0.11530	0.12275	0.00000	0.00020	0.00001
	20	0.71282	0.11530	0.00000	0.00000	0.00000	0.00001
	21	0.06950	0.09461	0.07200	0.00000	0.00012	0.00000
	22	0.06950	0.09708	0.07200	0.00000	0.00012	0.00002
	23	0.07898	0.11530	0.08181	0.00000	0.00013	0.00001
	24	0.00000	-0.01959	0.10909	0.00000	0.00018	0.00001

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
14	1	0.00000	-0.00685	0.00000	0.00000	0.00000	0.00000
	2	0.00000	-0.00049	0.00000	0.00000	0.00000	0.00000
	3	0.00000	-0.00225	0.00000	0.00000	0.00000	0.00000
	4	0.00000	-0.00047	0.00000	0.00000	0.00000	0.00000
	5	0.00000	0.00000	0.10330	0.00043	0.00000	0.00000
	6	0.05714	0.00000	0.00000	0.00000	0.00000	-0.00021
	7	0.00000	0.00000	0.07693	0.00032	0.00000	0.00000
	8	0.00000	0.17550	0.00000	0.00000	0.00000	0.00000
	9	0.00000	-0.00959	0.00000	0.00000	0.00000	0.00000
	10	0.00000	-0.00781	0.00000	0.00000	0.00000	0.00000
	11	0.00000	0.12443	0.00000	0.00000	0.00000	0.00000
	12	0.00000	0.12576	0.00000	0.00000	0.00000	0.00000
	13	0.00000	0.10950	0.07541	0.00032	0.00000	0.00000
	14	0.00000	0.11067	0.07541	0.00032	0.00000	0.00000
	15	0.04171	0.10950	0.00000	0.00000	0.00000	-0.00015
	16	0.04171	0.11067	0.00000	0.00000	0.00000	-0.00015
	17	0.00000	-0.00616	0.11363	0.00048	0.00000	0.00000
	18	0.06285	-0.00616	0.00000	0.00000	0.00000	-0.00023
	19	0.00000	0.12649	0.08574	0.00036	0.00000	0.00000
	20	0.04742	0.12649	0.00000	0.00000	0.00000	-0.00018
	21	0.00000	0.10950	0.05077	0.00021	0.00000	0.00000
	22	0.00000	0.11067	0.05077	0.00021	0.00000	0.00000
	23	0.00000	0.12649	0.05770	0.00024	0.00000	0.00000
	24	0.00000	-0.00616	0.07693	0.00032	0.00000	0.00000

************** END OF LATEST ANALYSIS RESULT **************

214. PRINT SUPPORT REACTION

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	0.00	110.41	0.00	0.00	0.00	0.00
	2	0.00	7.59	0.00	0.00	0.00	0.00
	3	0.00	27.50	0.00	0.00	0.00	0.00
	4	0.00	55.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	-8.97	-206.09	0.00	0.00
	6	-14.80	0.00	0.00	0.00	0.00	372.81
	7	0.00	0.00	-7.00	-155.25	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	145.50	0.00	0.00	0.00	0.00
	10	0.00	173.00	0.00	0.00	0.00	0.00
	11	0.00	109.12	0.00	0.00	0.00	0.00
	12	0.00	129.75	0.00	0.00	0.00	0.00
	13	0.00	96.03	-6.55	-150.45	0.00	0.00
	14	0.00	114.18	-6.55	-150.45	0.00	0.00
	15	-10.80	96.03	0.00	0.00	0.00	272.15
	16	-10.80	114.18	0.00	0.00	0.00	272.15
	17	0.00	99.37	-9.87	-226.70	0.00	0.00
	18	-16.28	99.37	0.00	0.00	0.00	410.09
	19	0.00	82.81	-7.45	-171.06	0.00	0.00
	20	-12.28	82.81	0.00	0.00	0.00	309.43
	21	0.00	96.03	-4.62	-102.46	0.00	0.00
	22	0.00	114.18	-4.62	-102.46	0.00	0.00
	23	0.00	82.81	-5.25	-116.43	0.00	0.00
	24	0.00	99.37	-7.00	-155.25	0.00	0.00
2	1	0.00	190.82	0.00	0.00	0.00	0.00
	2	0.00	15.18	0.00	0.00	0.00	0.00
	3	0.00	27.50	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	-14.80	-372.81	0.00	0.00
	6	-14.80	0.00	0.00	0.00	0.00	372.81
	7	0.00	0.00	-11.20	-275.49	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	233.50	0.00	0.00	0.00	0.00
	10	0.00	206.00	0.00	0.00	0.00	0.00
	11	0.00	175.12	0.00	0.00	0.00	0.00
	12	0.00	154.50	0.00	0.00	0.00	0.00
	13	0.00	154.11	-10.80	-272.15	0.00	0.00
	14	0.00	135.96	-10.80	-272.15	0.00	0.00
	15	-10.80	154.11	0.00	0.00	0.00	272.15
	16	-10.80	135.96	0.00	0.00	0.00	272.15
	17	0.00	171.73	-16.28	-410.09	0.00	0.00
	18	-16.28	171.73	0.00	0.00	0.00	410.09
	19	0.00	143.11	-12.28	-309.43	0.00	0.00
	20	-12.28	143.11	0.00	0.00	0.00	309.43
	21	0.00	154.11	-7.39	-181.82	0.00	0.00
	22	0.00	135.96	-7.39	-181.82	0.00	0.00
	23	0.00	143.11	-8.40	-206.62	0.00	0.00
	24	0.00	171.73	-11.20	-275.49	0.00	0.00
3	1	0.00	190.82	0.00	0.00	0.00	0.00
	2	0.00	15.18	0.00	0.00	0.00	0.00

C-33

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	-14.80	-372.81	0.00	0.00
	6	-14.80	0.00	0.00	0.00	0.00	372.81
	7	0.00	0.00	-11.20	-275.49	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	206.00	0.00	0.00	0.00	0.00
	10	0.00	206.00	0.00	0.00	0.00	0.00
	11	0.00	154.50	0.00	0.00	0.00	0.00
	12	0.00	154.50	0.00	0.00	0.00	0.00
	13	0.00	135.96	-10.80	-272.15	0.00	0.00
	14	0.00	135.96	-10.80	-272.15	0.00	0.00
	15	-10.80	135.96	0.00	0.00	0.00	272.15
	16	-10.80	135.96	0.00	0.00	0.00	272.15
	17	0.00	171.73	-16.28	-410.09	0.00	0.00
	18	-16.28	171.73	0.00	0.00	0.00	410.09
	19	0.00	143.11	-12.28	-309.43	0.00	0.00
	20	-12.28	143.11	0.00	0.00	0.00	309.43
	21	0.00	135.96	-7.39	-181.82	0.00	0.00
	22	0.00	135.96	-7.39	-181.82	0.00	0.00
	23	0.00	143.11	-8.40	-206.62	0.00	0.00
	24	0.00	171.73	-11.20	-275.49	0.00	0.00
4	1	0.00	190.82	0.00	0.00	0.00	0.00
	2	0.00	15.18	0.00	0.00	0.00	0.00
	3	0.00	20.17	0.00	0.00	0.00	0.00
	4	0.00	47.67	0.00	0.00	0.00	0.00
	5	0.00	0.00	-14.80	-372.81	0.00	0.00
	6	-14.80	0.00	0.00	0.00	0.00	372.81
	7	0.00	0.00	-11.20	-275.49	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	226.16	0.00	0.00	0.00	0.00
	10	0.00	253.66	0.00	0.00	0.00	0.00
	11	0.00	169.62	0.00	0.00	0.00	0.00
	12	0.00	190.25	0.00	0.00	0.00	0.00
	13	0.00	149.27	-10.80	-272.15	0.00	0.00
	14	0.00	167.42	-10.80	-272.15	0.00	0.00
	15	-10.80	149.27	0.00	0.00	0.00	272.15
	16	-10.80	167.42	0.00	0.00	0.00	272.15
	17	0.00	171.73	-16.28	-410.09	0.00	0.00
	18	-16.28	171.73	0.00	0.00	0.00	410.09
	19	0.00	143.11	-12.28	-309.43	0.00	0.00
	20	-12.28	143.11	0.00	0.00	0.00	309.43
	21	0.00	149.27	-7.39	-181.82	0.00	0.00
	22	0.00	167.42	-7.39	-181.82	0.00	0.00
	23	0.00	143.11	-8.40	-206.62	0.00	0.00
	24	0.00	171.73	-11.20	-275.49	0.00	0.00
5	1	0.00	121.01	0.00	0.00	0.00	0.00
	2	0.00	7.59	0.00	0.00	0.00	0.00
	3	0.00	34.83	0.00	0.00	0.00	0.00
	4	0.00	7.33	0.00	0.00	0.00	0.00

C-34

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
	5	0.00	0.00	-8.97	-206.09	0.00	0.00
	6	-3.15	0.00	0.00	0.00	0.00	39.37
	7	0.00	0.00	-7.00	-155.25	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	163.43	0.00	0.00	0.00	0.00
	10	0.00	135.93	0.00	0.00	0.00	0.00
	11	0.00	122.57	0.00	0.00	0.00	0.00
	12	0.00	101.95	0.00	0.00	0.00	0.00
	13	0.00	107.86	-6.55	-150.45	0.00	0.00
	14	0.00	89.71	-6.55	-150.45	0.00	0.00
	15	-2.30	107.86	0.00	0.00	0.00	28.74
	16	-2.30	89.71	0.00	0.00	0.00	28.74
	17	0.00	108.91	-9.87	-226.70	0.00	0.00
	18	-3.46	108.91	0.00	0.00	0.00	43.31
	19	0.00	90.76	-7.45	-171.06	0.00	0.00
	20	-2.61	90.76	0.00	0.00	0.00	32.68
	21	0.00	107.86	-4.62	-102.46	0.00	0.00
	22	0.00	89.71	-4.62	-102.46	0.00	0.00
	23	0.00	90.76	-5.25	-116.43	0.00	0.00
	24	0.00	108.91	-7.00	-155.25	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

215. LOAD LIST ALL
216. PRINT MEMBER FORCES

United Engineers & Constructors
A Raytheon Company
Stearns-Roger Division

PAGE ______
JOB NO. 6869002 DATE 4-2-92 BY ANC CH'K ______
CUSTOMER MI PROJECT Maglev
SUBJECT Concrete box girder

Elevated Singe Guideway

Span = 22.87 m. (75 ft.)

Cross-Sectional Area = 3.04 m^2 (32.71 ft^2)

Moment of Inertia = 1.53 m^4 (176.88 ft^4)

Natural frequency = 8.62 cps

United Engineers & Constructors
Raytheon
Stearns-Roger Division

PAGE 1
JOB NO. 6869002 DATE 4-2-92 BY ANC
CUSTOMER MI PROJECT Maglev
SUBJECT Column Loads

SUMMARY OF LOADS SPAN = 22.87 m (75'-0)

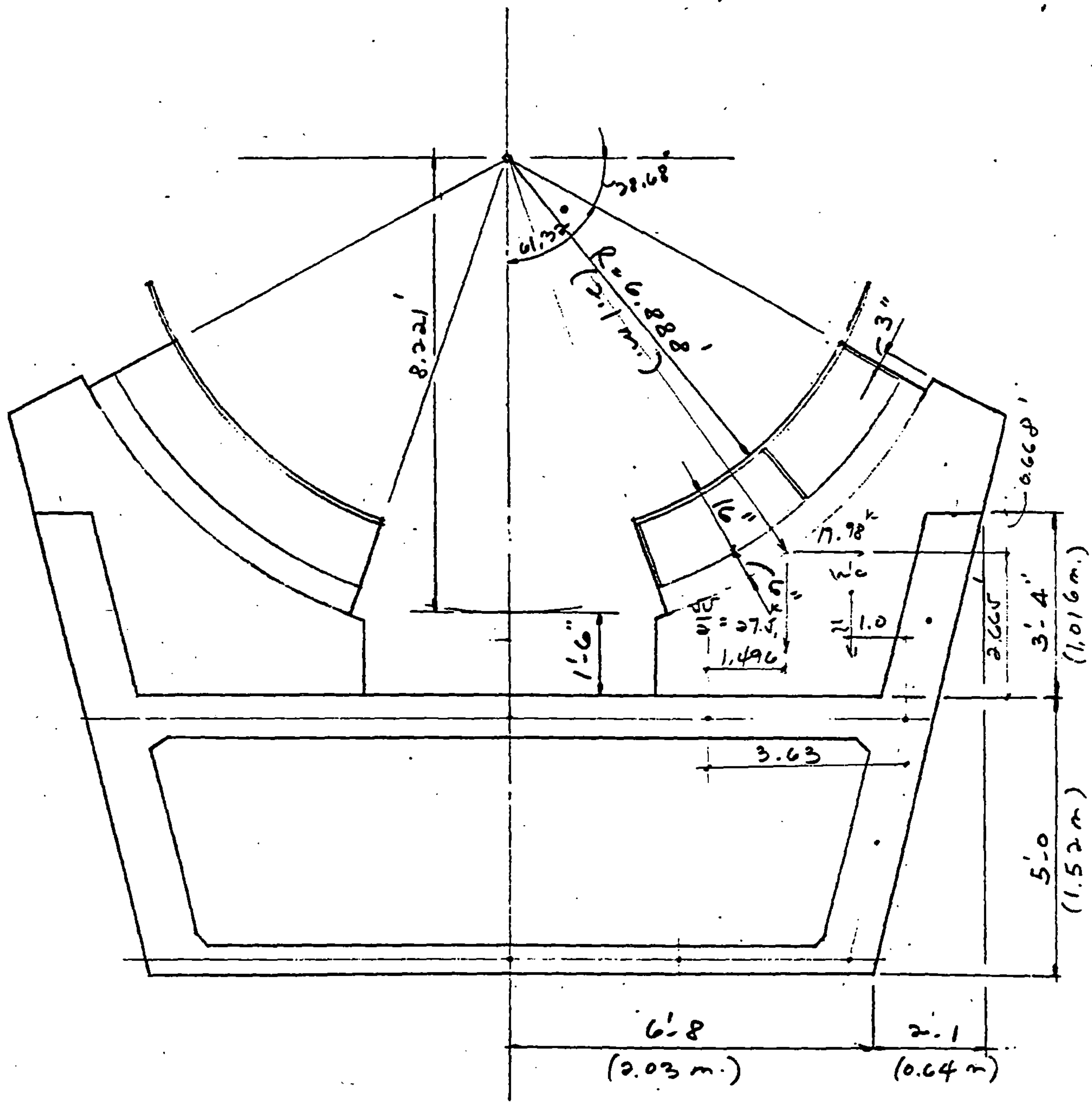
UNFACTORED

LOADS \ COLUMN HT.	h_1 = 5.18 m. (17.0 ft.)	h_2 : 7.62 m. (25.0 ft.)	h_3 : 9.14 m. (30.0 ft.)	h_4 = 20.0 m (65.6 ft.)
Dead Load F_Y	462.51 k	481.71 k	493.71 k	736.57 k
Snow Load F_Y	41.47 k	41.47 k	41.47 k	41.47 k
Vehicle Live Load F_Y	55.0 k	55.0 k	55.0 k	55.0 k
Seismic Load Lateral F_Z	42.92 k	44.94 k	46.20 k	71.70 k
M_X	833.48 'k	1184.90 'k	1412.73 'k	3759.16 'k
Seismic Load Longitudinal F_X	42.92 k	44.94 k	46.20 k	71.70 k
M_Z	833.48 'k	1184.90 'k	1412.73 'k	3759.16 'k
Wind Load Lateral F_Z	38.76 k	40.55 k	41.67 k	49.64 k
M_X	753.39 'k	1070.62 'k	1276.17 'k	2901.56
Braking Load Longitudinal F_X	35.75 k	35.75 k	35.75 k	35.75 k
M_Z	694.88 'k	943.89 'k	1094.87 'k	2345.2

6869002 DATE 3.30.92 BY ANC

MI PROJECT Maglev

SUBJECT Single Guideway



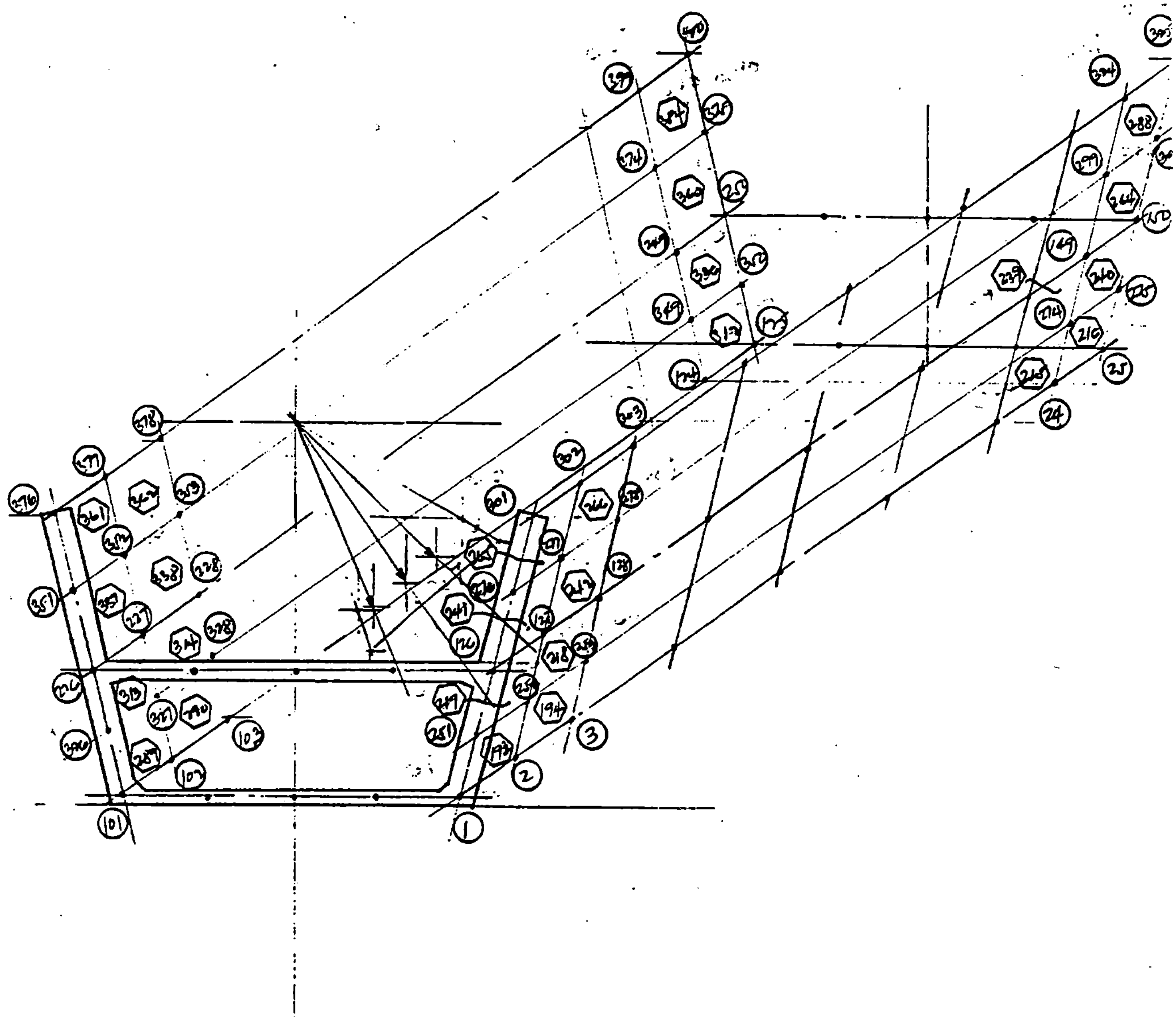
TYPICAL SECTION

PAGE ______

JOB NO. ______ DATE ______ BY ______ CH'K ______

CUSTOMER ______ PROJECT ______

SUBJECT ______



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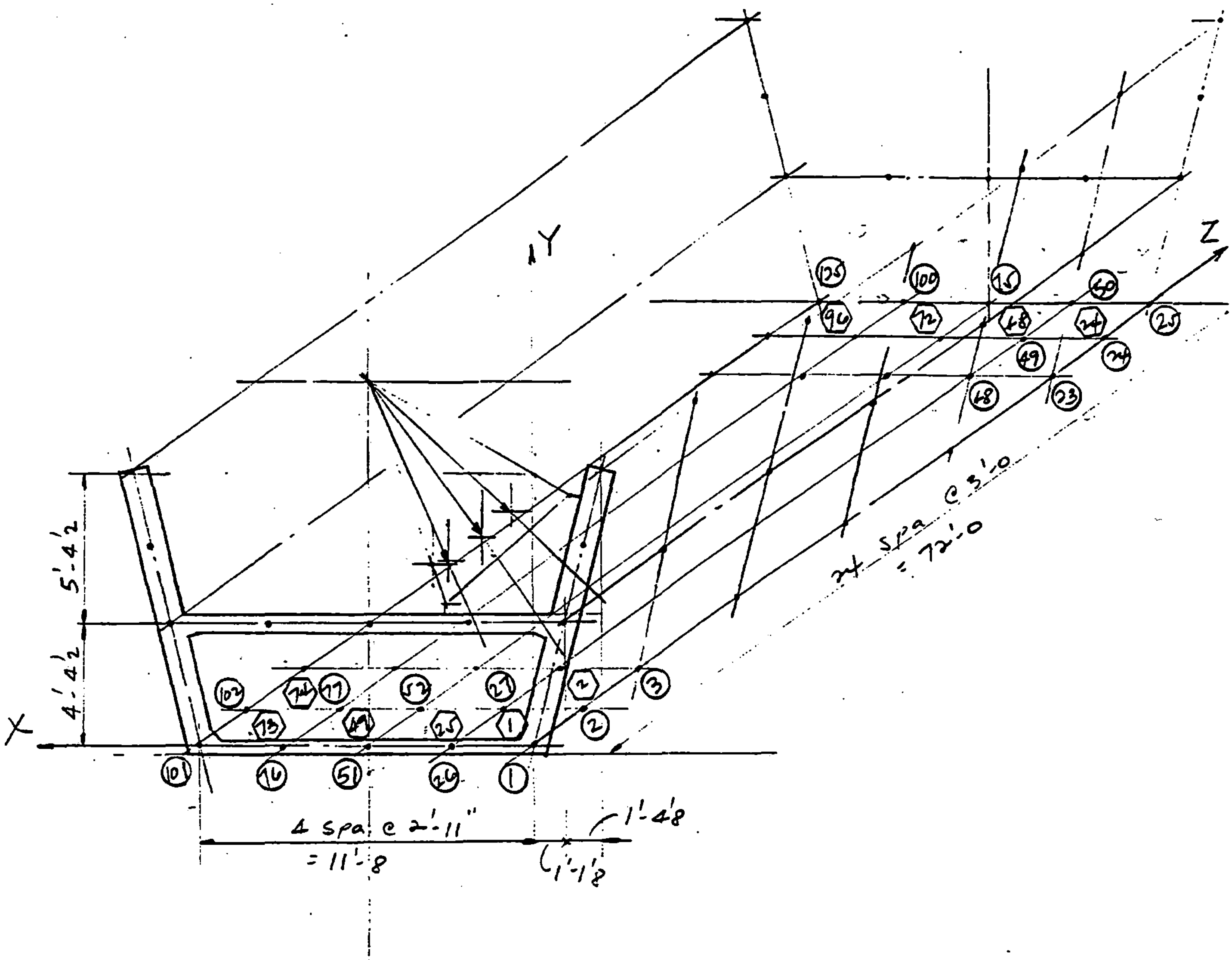
United Engineers & Constructors
Raytheon
Stearns-Roger Division

JOB NO. 6869002 DATE 3.11.92 BY ANC CHK'D

CUSTOMER MIT MT PROJECT Maglev

SUBJECT Precast Concrete Box Girder



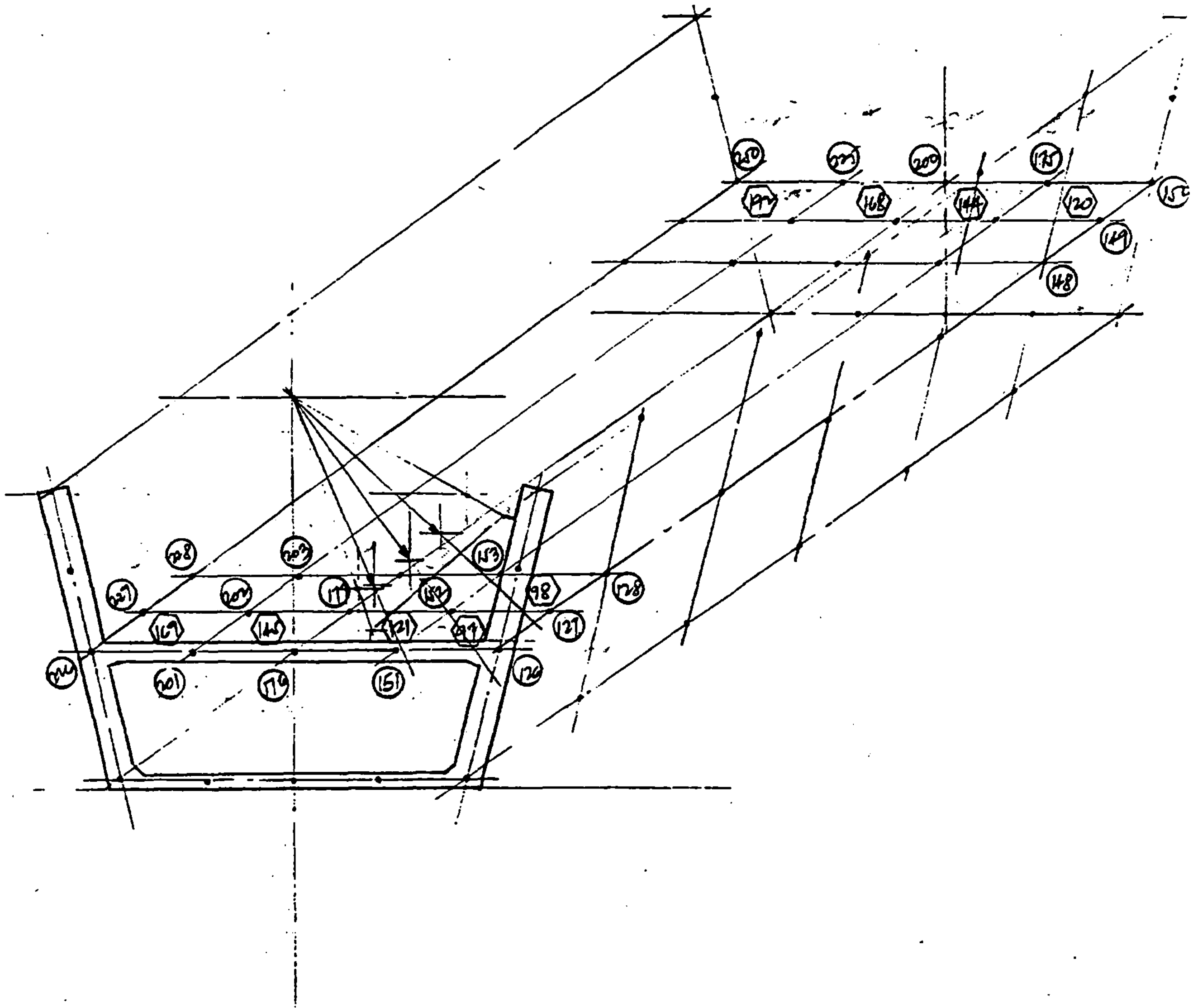
…Engineers
…Contractors
…Division

PAGE C-40

JOB NO. ______ DATE ______ BY ______ CHK ______

CUSTOMER ______ PROJECT ______

SUBJECT ______



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****************************************************
*                                                  *
*            S T A A D - III                       *
*            REVISION 14.0 (VERSION 14 LEVEL 0)    *
*            PROPRIETARY PROGRAM OF                *
*            RESEARCH ENGINEERS,INC.               *
*            DATE=    APR  1, 1992                 *
*            TIME=      9:31: 3                    *
*                                                  *
****************************************************

STAAD SPACE MAGLEV E-2 FRAME - 75'-0" SPAN
*** PRECAST CONCRETE BOX GIRDER ***
*** NATURAL FREQUENCY ***
UNIT FEET KIP
**********************************
JOINT COORDINATES
**********************************
  1  0.0   0.0    0.0   26  0.0   0.0   75.0
 27  3.08  0.0    0.0   52  3.08  0.0   75.0
 53  6.17  0.0    0.0   78  6.17  0.0   75.0
 79  9.25  0.0    0.0  104  9.25  0.0   75.0
105 12.33  0.0    0.0  130 12.33  0.0   75.0
131 -1.09  4.38   0.0  156 -1.09  4.38  75.0
157  2.54  4.38   0.0  182  2.54  4.38  75.0
183  6.17  4.38   0.0  208  6.17  4.38  75.0
209  9.80  4.38   0.0  234  9.80  4.38  75.0
235 13.43  4.38   0.0  260 13.43  4.38  75.0
261 -0.55  2.19   0.0  286 -0.55  2.19  75.0
287 -1.56  6.23   0.0  312 -1.56  6.23  75.0
313 -2.02  8.08   0.0  338 -2.02  8.08  75.0
339 12.88  2.19   0.0  364 12.88  2.19  75.0
365 13.89  6.23   0.0  390 13.89  6.23  75.0
391 14.35  8.08   0.0  416 14.35  8.08  75.0
***********************
ELEMENT INCIDENCES
***********************
*** BOTTOM SLAB ***
1 1 2 28 27 TO 25 ; 26 27 28 54 53 TO 50
51 53 54 80 79 TO 75 ; 76 79 80 106 105 TO 100
*** TOP SLAB ***
101 131 132 158 157 TO 125 ; 126 157 158 184 183 TO 150
151 183 184 210 209 TO 175 ; 176 209 210 236 235 TO 200
*** SIDEWALLS ***
201 1 2 262 261 TO 225 ; 226 261 262 132 131 TO 250
251 131 132 288 287 TO 275 ; 276 287 288 314 313 TO 300
301 105 106 340 339 TO 325 ; 326 339 340 236 235 TO 350
351 235 236 366 365 TO 375 ; 376 365 366 392 391 TO 400
*******************************
UNIT INCH KIP
*******************************
ELEMENT PROPERTIES
*******************************
*** BOTTOM SLAB ***
1 TO 100 TH 6.0
*** TOP SLAB ***
101 TO 200 TH 9.0
*** SIDEWALLS ***
201 TO 400 TH 12.0
```

United Engineers
& Constructors
A Raytheon Company
Stearns-Roger Division

JOB NO. 6869002 DATE 4-8-92 BY ANC CH'K
CUSTOMER MI PROJECT Maglev
SUBJECT Concrete box girder

Elevated Single Guideway

Span = 36.59 m. (120.0 ft.)

Cross-sectional Area = 6.85 m.^{2} (73.65 ft.^{2})

Moment of Inertia = 14.96 m.^{4} (1731.52 ft.^{4})

Natural Frequency = 5.35 cps

CONCRETE BOX GIRDER - SINGLE GUIDEWAY

SUMMARY OF LOADS — SPAN : 36.59 m. (120.0 ft.)

LOADS \ COLUMN HT.	h_1 = 5.18 m. (17.0 ft.)	h_2 = 7.62 m. (25.0 ft.)	h_3 = 9.14 m. (30.0 ft.)	h_4 = 20.0 m. (65.6 ft.)
Dead Load Fy	1497.21 k	1516.41 k	1564.41 k	2046.78 k
Snow Load Fy	66.36 k	66.36 k	66.36 k	66.36 k
Vehicle Live Load Fy	66.92 k	66.92 k	66.92 k	66.92 k
Seismic Load Lateral Fz	143.47 k	145.49 k	150.53 k	201.18 k
Mx	2907.89 'k	4063.74 'k	4851.04 'k	11,669.30 'k
Seismic Load Longitudinal Fx	143.47 k	145.49 k	150.53 k	201.18 k
Mz	2907.89 'k	4063.74 'k	4851.04 'k	11,669.30 'k
Wind Load Lateral Fz	121.41 k	123.20 k	124.32 k	132.29 k
Mx	2458.46 'k	3436.89 'k	4055.69 'k	8623.43 'k
Braking Load Longitudinal Fx	43.50 k	43.50 k	43.50 k	43.50 k
Mz	844.74 'k	1215.02 'k	1401.85 'k	2523.19 'k
Wind on Operating Vehicle Fy	-3.0 k	-3.0 k	-3.0 k	-3.0 k
Fz	8.23 k	8.23 k	8.23 k	8.23 k
Mx	261.06 'k	326.90 'k	368.05 'k	661.03 'k

			A		Y		
End Wall	$- 2 \times 1.25 \times 17.5$	=	43.75	×	8.75	=	382.81
Ctr. Wall	$- 1 \times 1.25 \times 9.75$	=	12.19	×	5.375	=	65.52
Top slab	$- 16.39 \times 0.75$	=	12.29	×	10.625	=	130.57
bot. slab	$- 10.833 \times 0.50$	=	5.42	×	0.25	=	1.36
			73.65				580.27

$$\bar{Y} = \frac{580.27}{73.65} = 7.879'$$

$$I_{x-x} = \frac{2(1.25)17.5^3}{12} + \frac{1.25(9.75)^3}{12} + \frac{16.39(0.75)^3}{12} + \frac{10.833(0.50)^3}{12}$$

$$+ 43.75(0.871)^2 + 12.19(2.504)^2 + 12.29(2.746)^2 + 5.42(7.629)^2$$

$$= 1116.54 + 96.55 + 0.58 + 0.11 + 33.19 + 76.43 + 92.67$$

$$+ 315.45$$

$$= 1731.52 \text{ ft.}^4$$

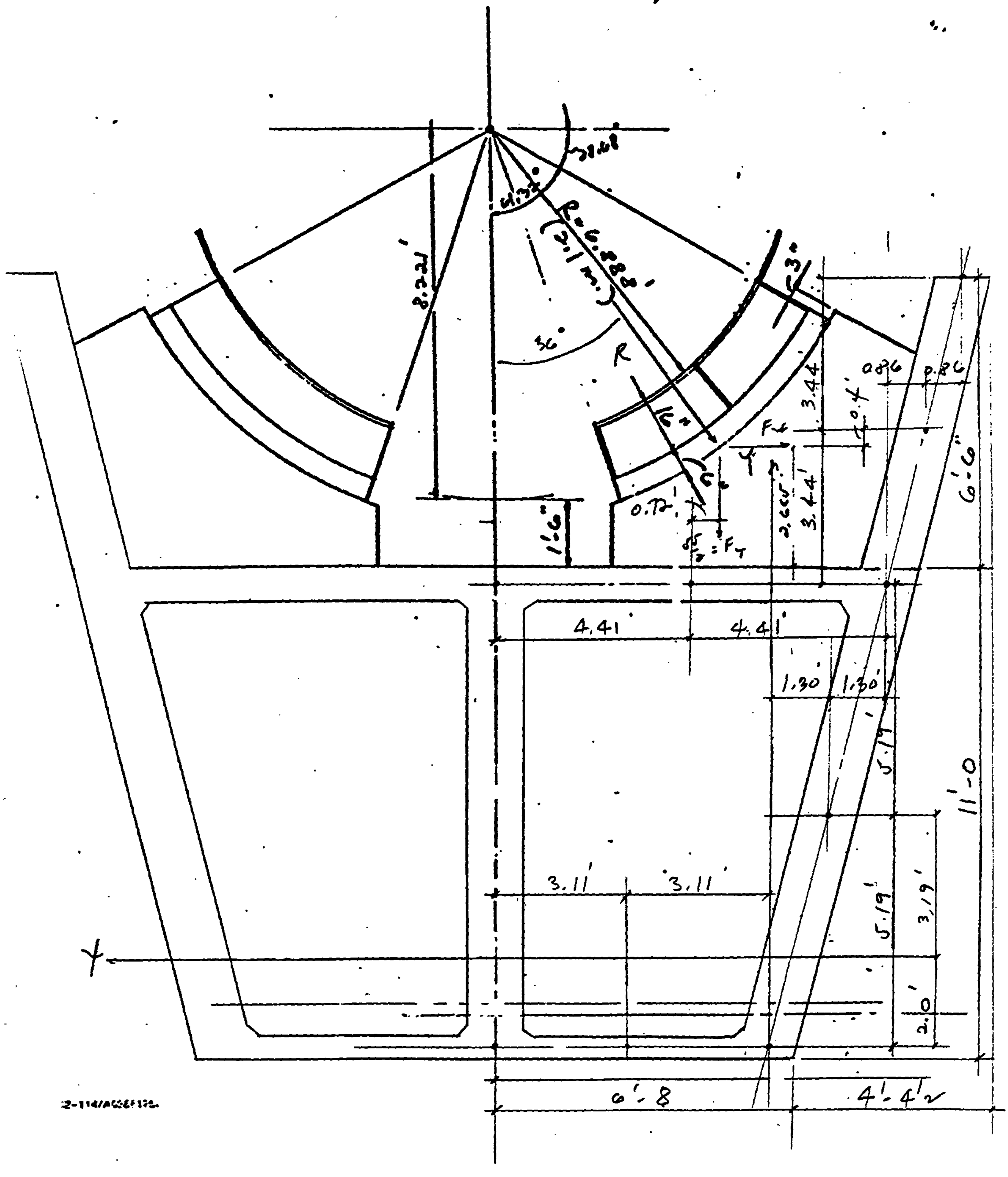
& Constructors

PAGE C-45

JOB NO. 6869002 DATE 3.30.92 BY ANC CHK'K

CUSTOMER MI PROJECT Maglev

SUBJECT Single Guideway

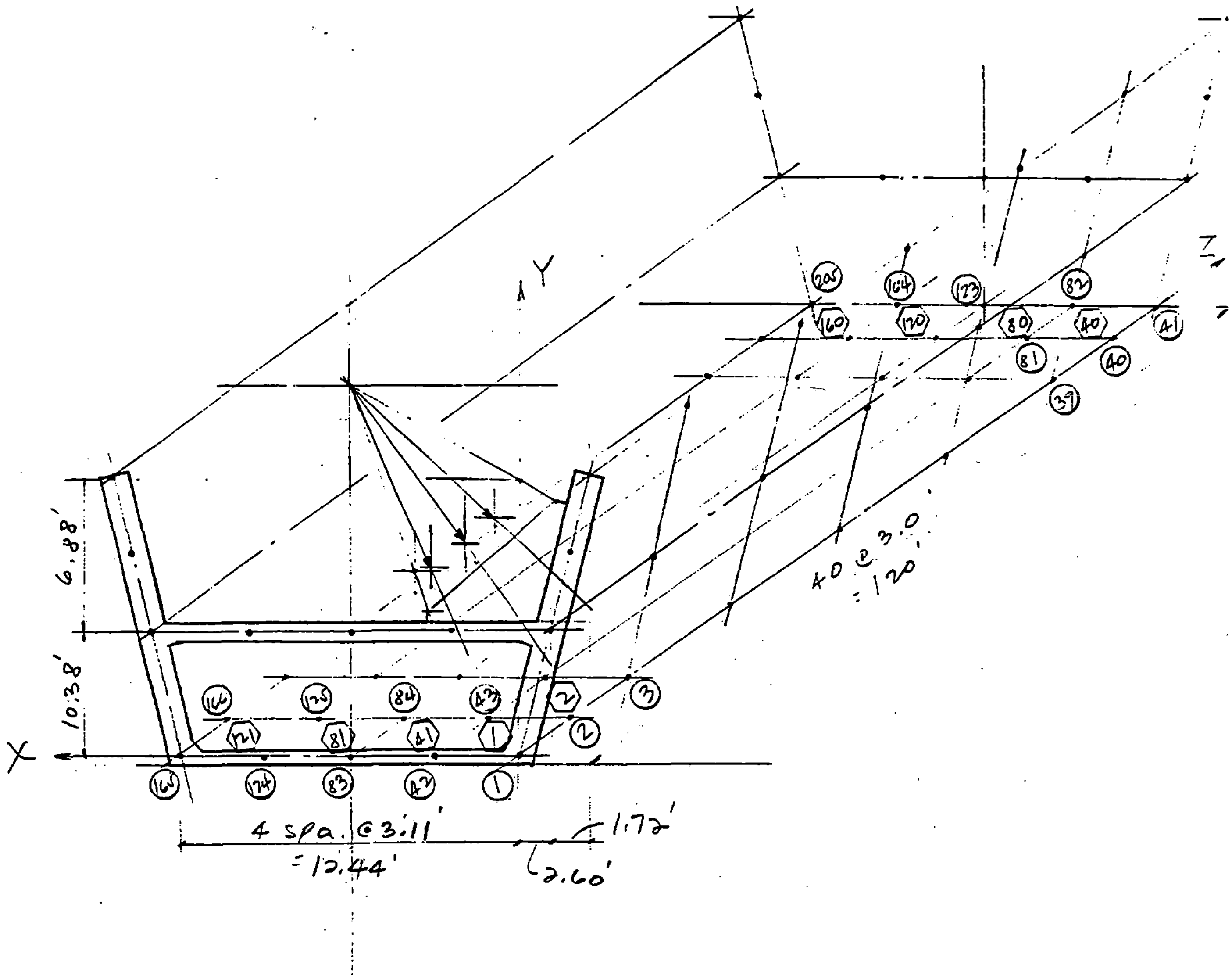


2-114/ACGEF175

United Engineers & Constructors
Raytheon
Stearns-Roger Division

PAGE C-46
JOB NO. 6869002 DATE 3.30.92 BY ANC CH'K
CUSTOMER MIT - MI PROJECT Maglev
SUBJECT Precast Conc. Box Girder

120'-0 Span

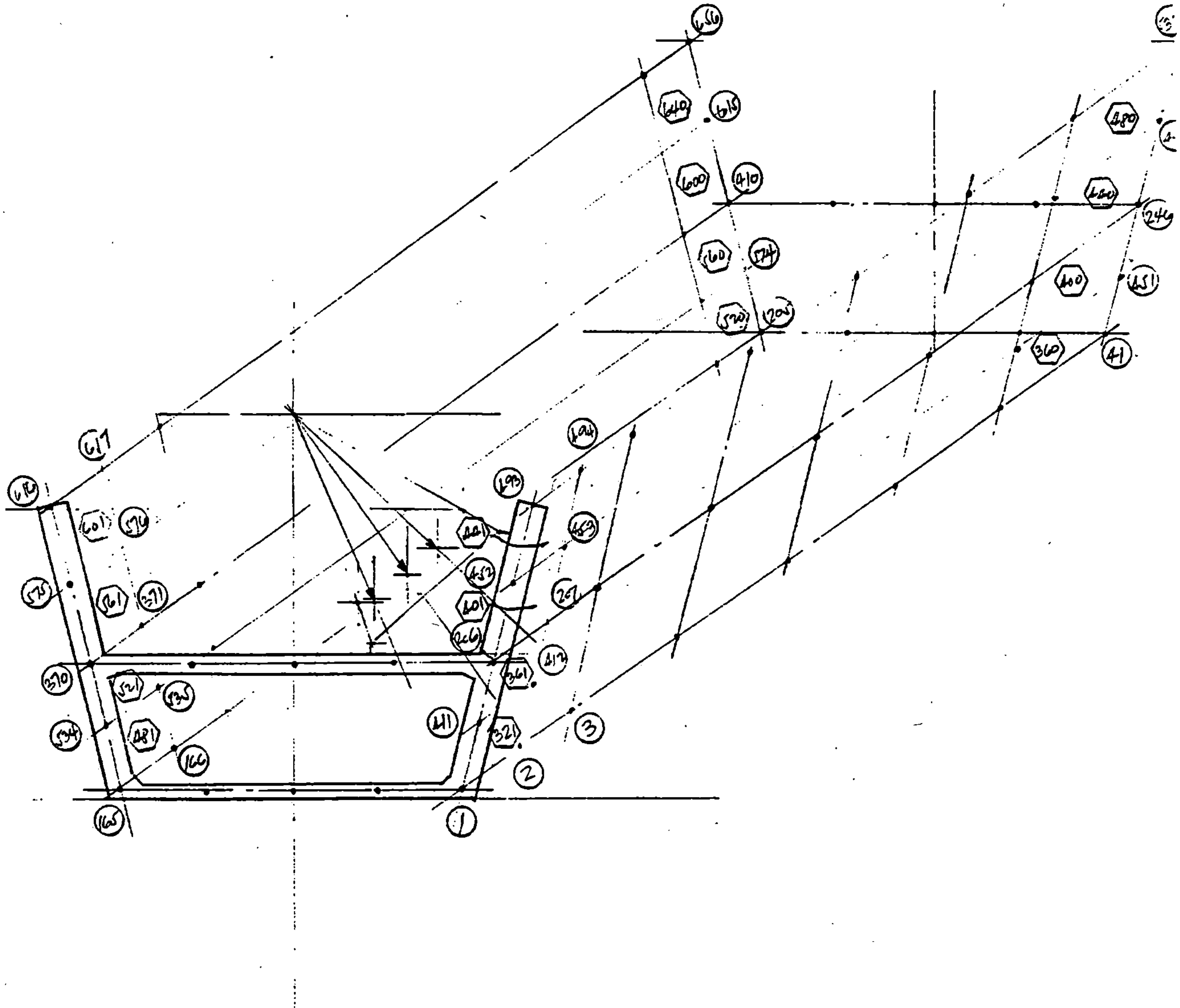


BOTTOM SLAB

United Engineers & Constructors
Raytheon
Stearns-Roger Division

PAGE C-47
JOB NO. 6869002 DATE 3-31-92 BY AWC CH'K
CUSTOMER MI PROJECT Maglev
SUBJECT Single Guideway

120' span

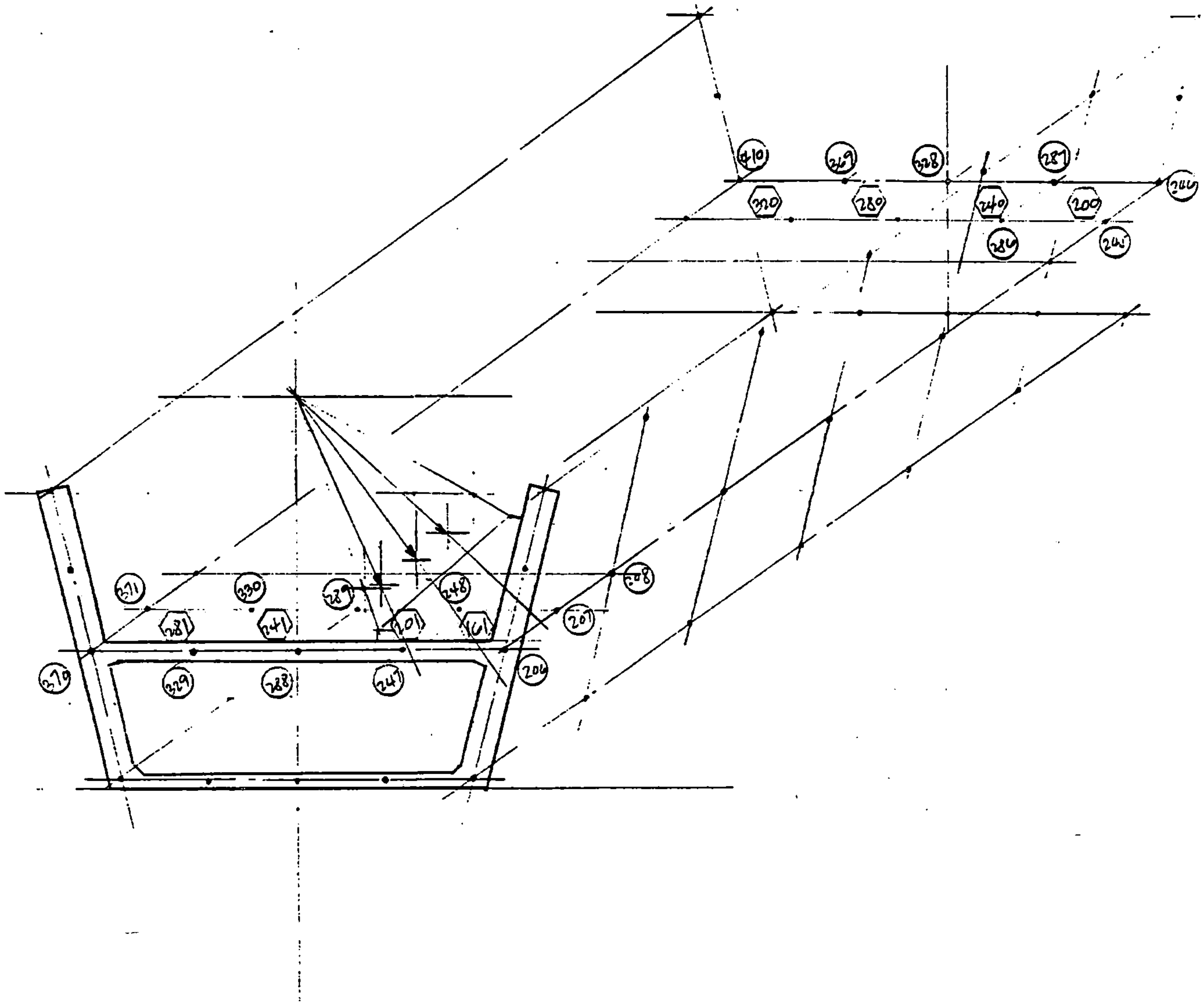


SIDEWALL

United Engineers & Constructors
Raytheon
Stearns-Roger Division

PAGE C-48
JOB NO. 6869002 DATE 3-30-92 BY ANC CHK'D
CUSTOMER MI PROJECT Maglev
SUBJECT Single Guideway

120' span



TOP SLAB

FORM 2624 4-78

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     ****************************************************
     *                                                  *
     *          S T A A D - III                         *
     *          REVISION 14.0 (VERSION 14 LEVEL 0)      *
     *          PROPRIETARY PROGRAM OF                  *
     *          RESEARCH ENGINEERS,INC.                 *
     *          DATE=    APR  8, 1992                   *
     *          TIME=     7:44:23                       *
     *                                                  *
     ****************************************************

  1. STAAD SPACE MAGLEV E-2 FRAME - 120'-0" SPAN
  2. *** PRECAST CONCRETE BOX GIRDER ***
  3. *** NATURAL FREQUENCY ***
  4. UNIT FEET KIP
  5. ************************************
  6. JOINT COORDINATES
  7. ************************************
  8.   1  0.0  -2.0    0.0  41  0.0  -2.0    120.0
  9.  42  3.11 -2.0    0.0  82  3.11 -2.0    120.0
 10.  83  6.22 -2.0    0.0 123  6.22 -2.0    120.0
 11. 124  9.33 -2.0    0.0 164  9.33 -2.0    120.0
 12. 165 12.44 -2.0    0.0 205 12.44 -2.0    120.0
 13. 206 -2.60  8.38   0.0 246 -2.60  8.38   120.0
 14. 247  1.81  8.38   0.0 287  1.81  8.38   120.0
 15. 288  6.22  8.38   0.0 328  6.22  8.38   120.0
 16. 329 10.63  8.38   0.0 369 10.63  8.38   120.0
 17. 370 15.04  8.38   0.0 410 15.04  8.38   120.0
 18. 411 -1.30  3.19   0.0 451 -1.30  3.19   120.0
 19. 452 -3.46 11.82   0.0 492 -3.46 11.82   120.0
 20. 493 -4.32 15.26   0.0 533 -4.32 15.26   120.0
 21. 534 13.74  3.19   0.0 574 13.74  3.19   120.0
 22. 575 15.90 11.82   0.0 615 15.90 11.82   120.0
 23. 616 16.76 15.26   0.0 656 16.75 15.26   120.0
 24. 657  6.22  3.19   0.0 697  6.22  3.19   120.0
 25. ***********************
 26. ELEMENT INCIDENCES
 27. ***********************
 28. *** BOTTOM SLAB ***
 29. 1 1 2 43 42 TO 40 ; 41 42 43 84 83 TO 80
 30. 81 83 84 125 124 TO 120 ; 121 124 125 166 165 TO 160
 31. *** TOP SLAB ***
 32. 161 206 207 248 247 TO 200 ; 201 247 248 289 288 TO 240
 33. 241 288 289 330 329 TO 280 ; 281 329 330 371 370 TO 320
 34. *** SIDEWALLS ***
 35. 321 1 2 412 411 TO 360 ; 361 411 412 207 206 TO 400
 36. 401 206 207 453 452 TO 440 ; 441 452 453 494 493 TO 480
 37. 481 165 166 535 534 TO 520 ; 521 534 535 371 370 TO 560
 38. 561 370 371 576 575 TO 600 ; 601 575 576 617 616 TO 640
 39. *** CENTER WALLS ***
 40. 641 83 84 658 657 TO 680 ; 681 657 658 289 288 TO 720
 41. ********************************
 42. UNIT INCH KIP
  3. ********************************
 44. ELEMENT PROPERTIES
 45. ********************************
 46. *** BOTTOM SLAB ***
 47. 1 TO 160 TH 6.0
 48. *** TOP SLAB ***
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C-50

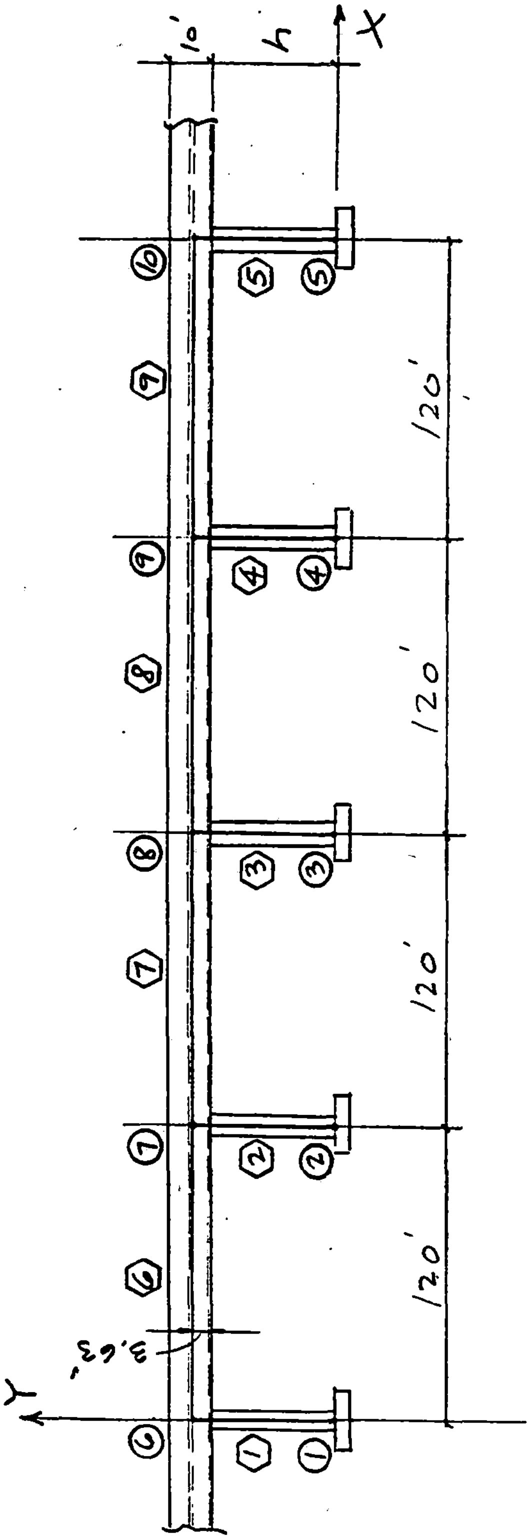
...ited Engineers
...onstructors
...theon ...
...arns-Roger Division

PAGE

JOB NO. 6869002 DATE 3.19.92 BY AWC CH'K

CUSTOMER MI PROJECT Maglev

SUBJECT



ELEVATION

Height, h

$h_1 = 5.18m = (17.0')$

$h_2 = 7.62m = (25.0')$

$h_3 = 9.14m = (30.0')$

$h_4 = 20.0m = (65.6')$

United Engineers & Constructors
A Raytheon Company
Stearns-Roger Division

JOB NO. 6869002 DATE 4-20-92 BY ANC CH'K

CUSTOMER MI PROJECT Maglev

SUBJECT Concrete box girder

Elevated Double Guideway

span = 9.15 m. (30.0 ft.)

Cross-sectional Area = 5.56 m.^{2} (59.85 ft.^{2})

Moment of Inertia = 1.84 m.^{2} (213.48 ft.^{4})

Natural Frequency = 27.69 cps

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A Raytheon Company
Stearns-Roger Division

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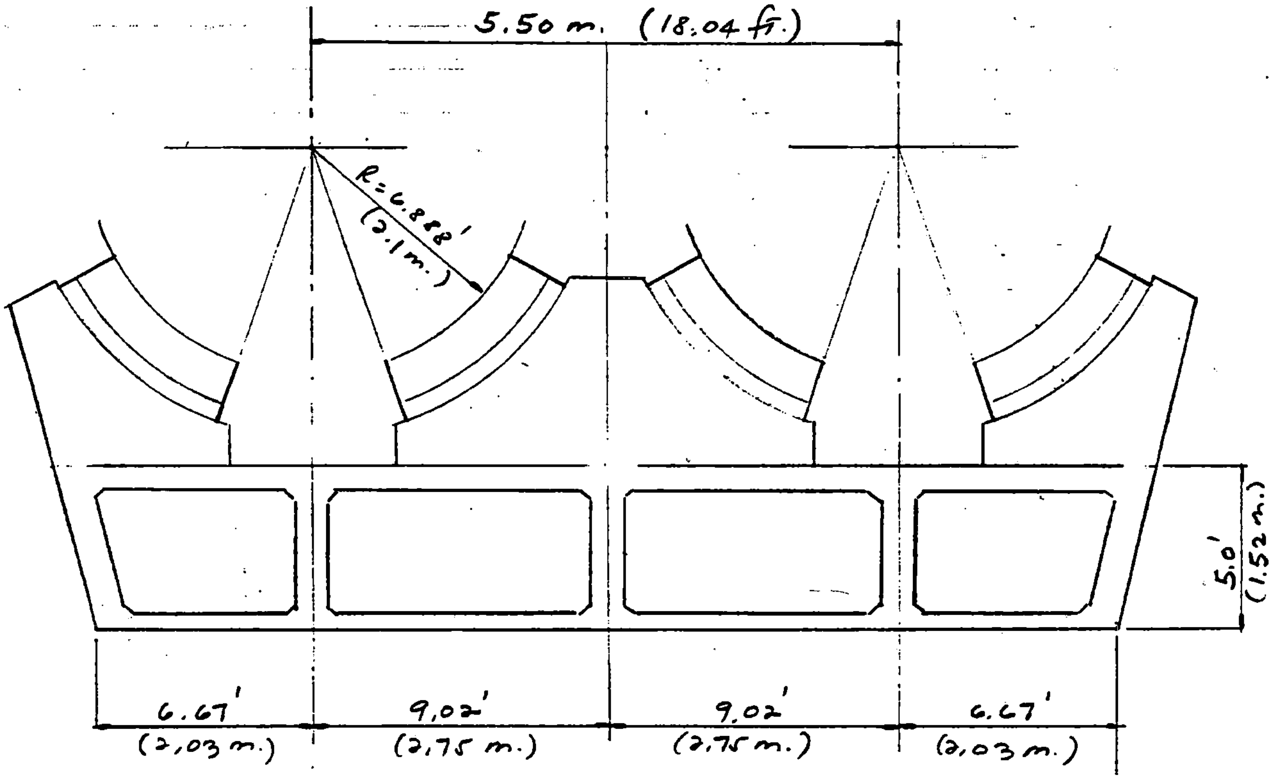
JOB NO. 6869002 DATE 4-10-92 BY ANC CH'K
CUSTOMER MI PROJECT Maglev
SUBJECT Concrete Box Girder



TYPICAL SECTION
Double Guideway

FORM 62-114(A1328175)

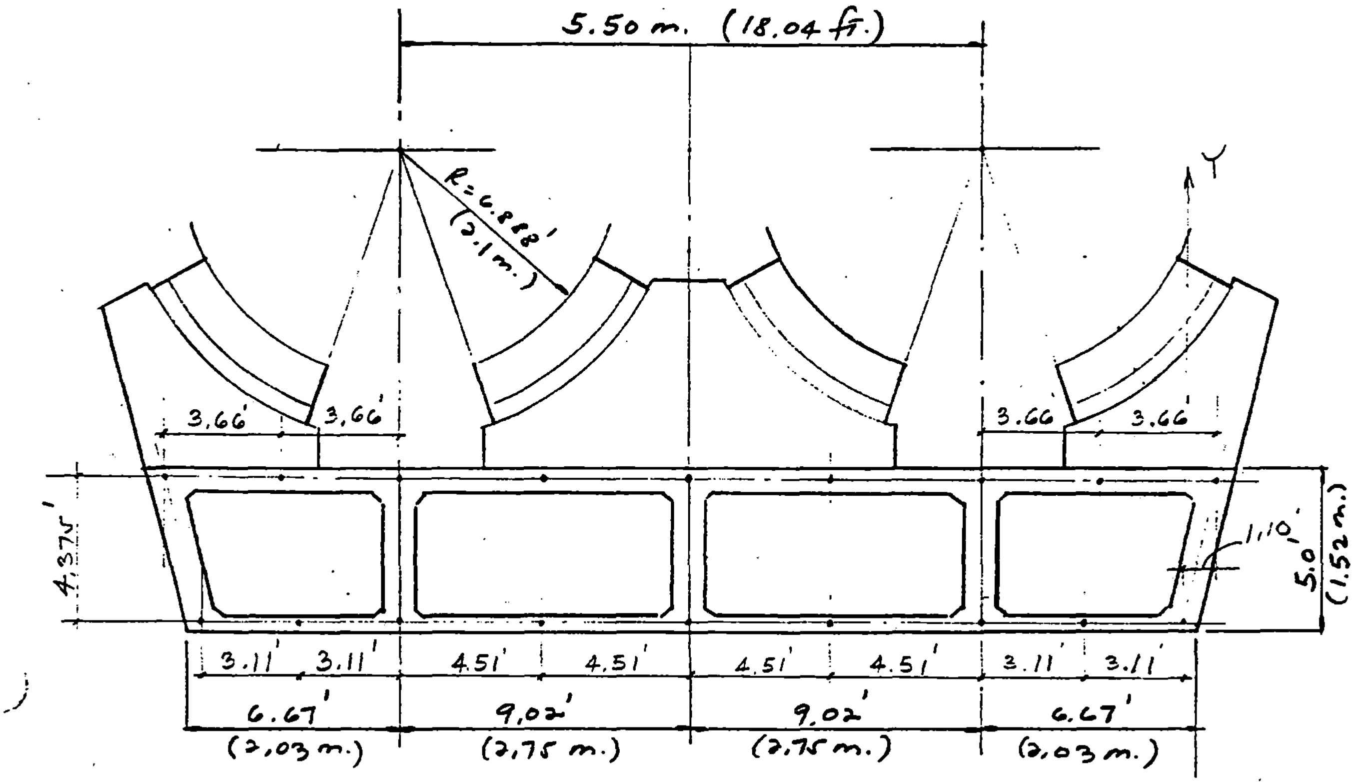
Allied Engineers & Constructors
Raytheon
Harris-Roger Division

PAGE C-53

JOB NO. 6869002 DATE 4-10-92 BY ANC CHK

CUSTOMER MI PROJECT Maglev

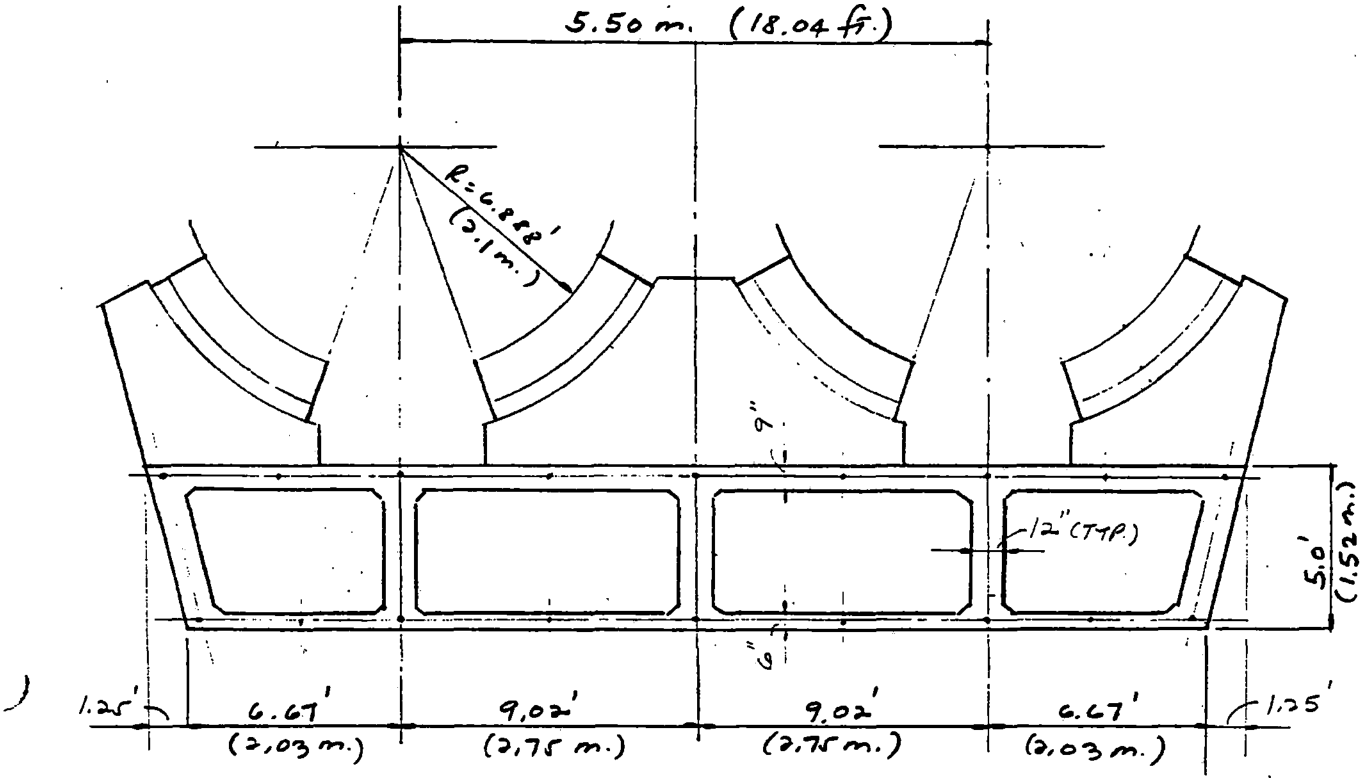
SUBJECT Concrete Box Girder



TYPICAL SECTION
Double Guideway

United Engineers & Constructors
Raytheon
Stearns-Roger Division

PAGE C-54
JOB NO. 6869002 DATE 4-10-92 BY ANC CHK
CUSTOMER MI PROJECT Maglev
SUBJECT Concrete Box Girder



TYPICAL SECTION
Double Guideway

		A		Y		AY
Ext. Side wall	: 2(1)5 — =	10.0	×	2.5	=	25.0
Int. Vert. wall	: 3(1)5 — =	15.0	×	2.5	=	37.5
Top slab —	: 0.75(28.88) =	21.66	×	4.625	=	100.18
Bot. slab —	: 0.50(26.38) =	13.19	×	0.25	=	3.30
		59.85				165.98

$$\bar{Y} = \frac{165.98}{59.85} = 2.773'$$

$$I_x = \frac{5(5)^3}{12} + \frac{28.88(0.75)^3}{12} + \frac{26.38(0.5)^3}{12} + 25.0(0.273)^2 + 21.66(1.852)^2$$

$$+ 13.19(2.523)^2 = 52.08 + 1.02 + 0.27 + 1.86 + 74.29 + 83.96$$

$I_x = 213.48$ ft.^{4} $I_y = 3309.0$ ft.^{4}

United Engineers & Constructors
Raytheon
Stearns-Roger Division

PAGE C-55
JOB NO. 6869002 DATE 4-7-92 BY AJC CHK
CUSTOMER MI PROJECT Maglev
SUBJECT Column Loads

CONCRETE BOX GIRDER. DOUBLE GUIDEWAY

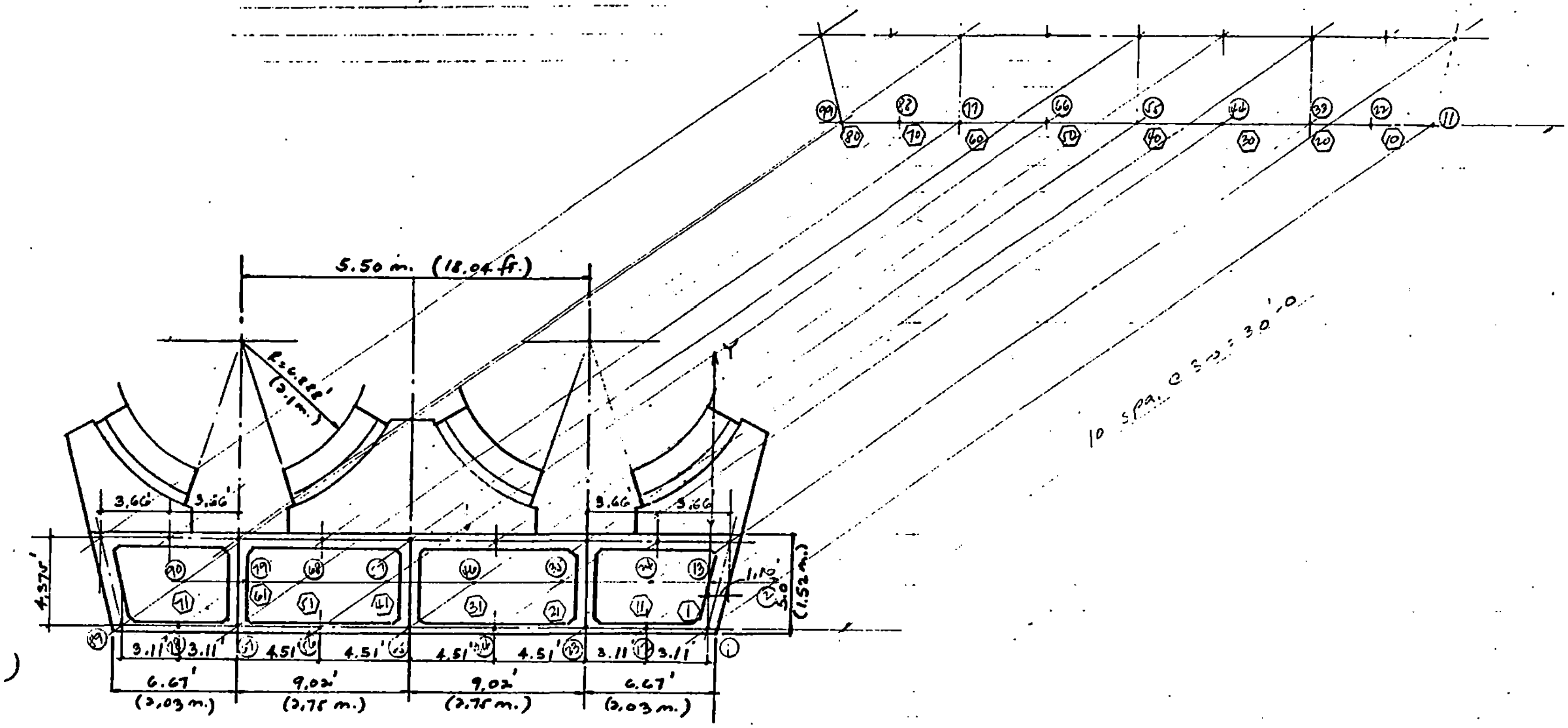
SUMMARY OF LOADS SPAN = 9.15 m. (30.0 ft.)

LOADS \ COLUMN HT.	h_1 = 5.18 m. (17.0 ft.)	h_2 = 7.62 m. (25.0 ft.)	h_3 = 9.14 m. (30.0 ft.)	h_4 = 20.0 m (65.6 ft.)
Dead Load				
F_Y	393.70 k	454.90 k	478.90 k	933.67 k
Snow Load				
F_Y	40.41 k	40.41 k	40.41 k	40.41 k
Vehicle Live Load				
F_Y	110.0 k	110.0 k	110.0 k	110.0 k
Seismic Load Lateral				
F_Z	35.46 k	41.88 k	44.40 k	92.16 k
M_X	684.10 'k	1025.79 'k	1241.52 'k	4149.23 'k
Seismic Load Longitudinal				
F_X	35.46 k	41.88 k	44.40 k	92.16 k
M_Z	684.10 'k	1025.79 'k	1241.52 'k	4149.23 'k
Wind Load Lateral				
F_Z	11.59 k	14.45 k	15.57 k	31.11 k
M_X	213.28 'k	331.80 'k	406.84 'k	1358.91 'k
Braking Load Longitudinal				
F_X	71.5 k	71.5 k	71.5 k	71.5 k
M_Z	1389.76 'k	1887.78 'k	2189.74 'k	4690.4 'k
Wind on oper. Vehicle				
F_Y	-5.0 k	-5.0 k	-5.0 k	-5.0 k
F_Z	13.52 k	13.52 k	13.52 k	13.52 k
M_X	428.86 'k	537.02	604.62 'k	1085.92 'k

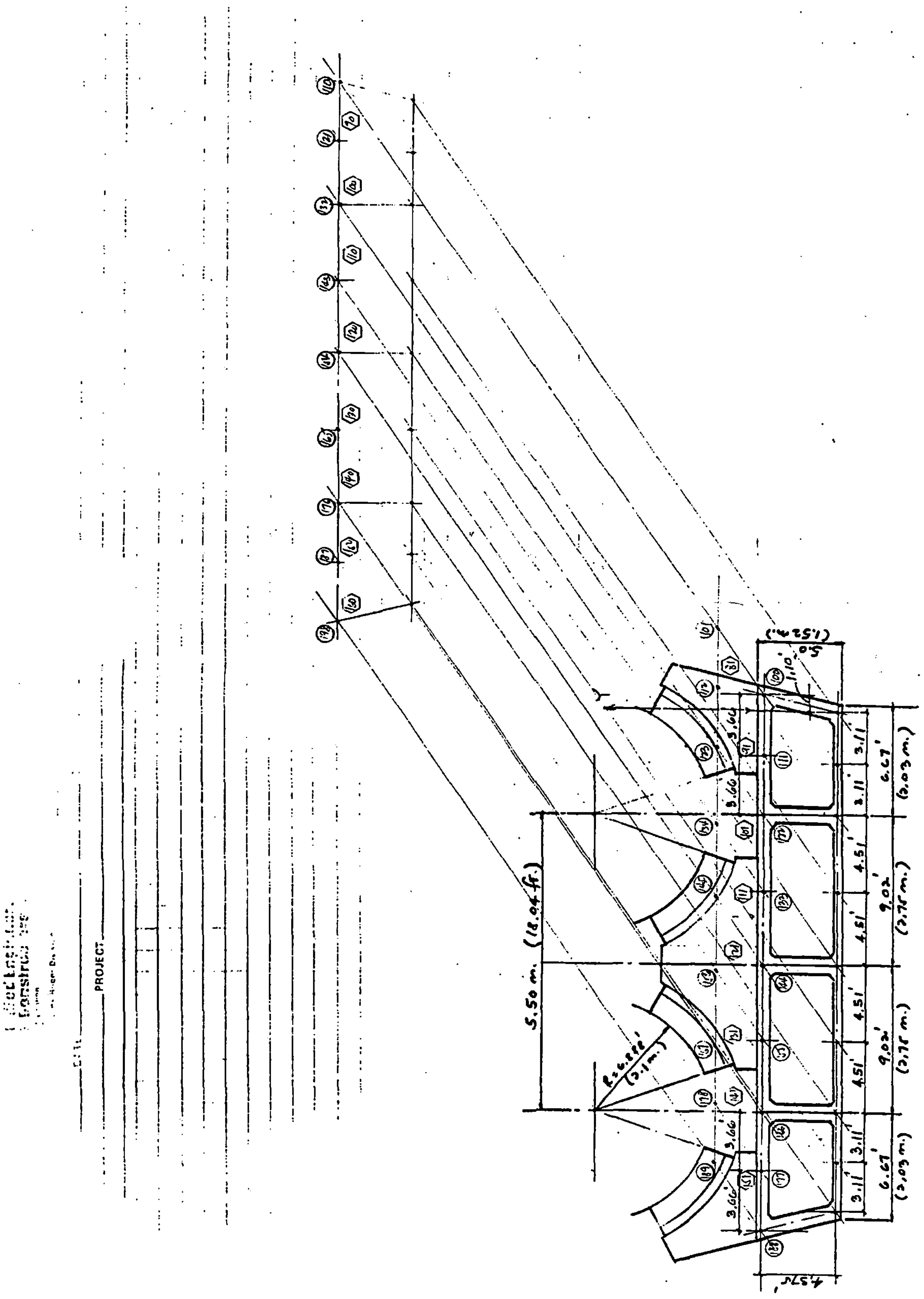
FORM 62-114.AG33175

PROJECT

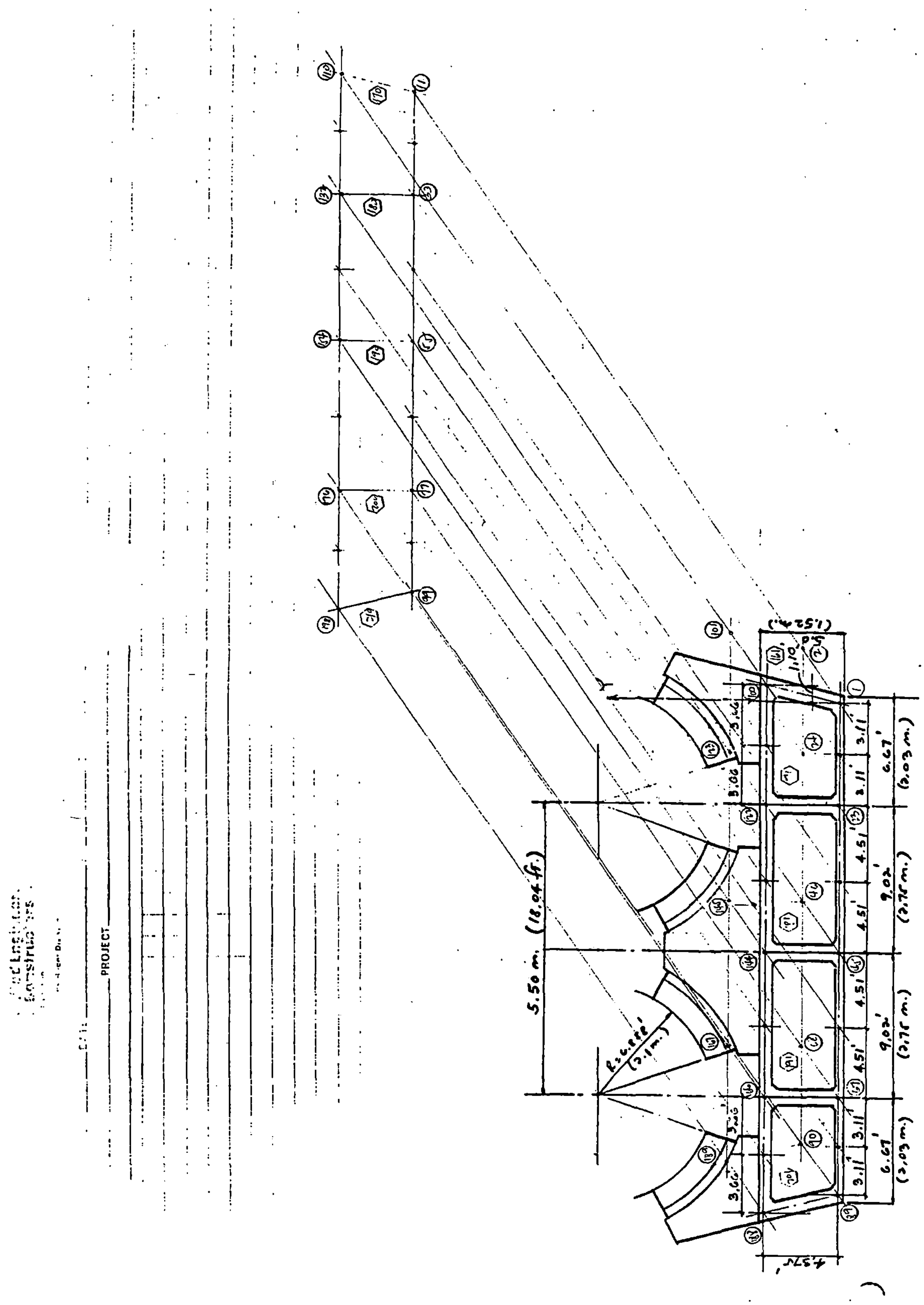
30' double
Span
Double Guideway



C-57



C-58



United Engineers & Constructors
A Raytheon Company

JOB NO. 6869002 DATE 4-14-92 BY ANC CH'K

CUSTOMER MI PROJECT Maglev

SUBJECT Concrete Box Girder

Elevated Double Guideway

Span = 22.87 m. (75.0 ft.)

Cross-sectional Area = 6.49 m.^{2} (69.85 ft.^{2})

Moment of Inertia = 3.05 m.^{4} (352.66 ft.^{4})

Natural frequency = 6.24 cps

Top slab = 9" thick

Bottom slab = 6" thick

Walls = 12" thick

United Engineers & Constructors
Raytheon
Stearns-Roger Division

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JOB NO. 6869002 DATE 4-7-92 BY ANC CHK'D
CUSTOMER MI PROJECT Maglev
SUBJECT Column Loads

CONCRETE BOX GIRDER - DOUBLE GUIDEWAY

SUMMARY OF LOADS SPAN = 22.87m. (75.0 ft.)

* Includes Column Cap

LOADS \ COLUMN HT.	h_1 = 5.18 m. (17.0 ft.)	h_2 = 7.62 m. (25.0 ft.)	h_3 = 9.14 m. (30.0 ft.)	h_4 = 20.0 m (65.6 ft.)
Dead Load F_Y	*1079.40 k	*1152.89 k	*1182.89 k	*1593.26 k
Snow Load F_Y	92.03 k	92.03 k	92.03 k	92.03 k
Vehicle Live Load F_Y	110.0 k	110.0 k	110.0 k	110.0 k
Seismic Load Lateral F_Z	90.54 k	98.25 k	101.40 k	144.49 k
M_X	1745.60 'k	2534.23 'k	3033.38 'k	7720.28 'k
Seismic Load Longitudinal F_X	90.54 k	98.25 k	101.40 k	144.49 k
M_Z	1745.60 'k	2534.23 'k	3033.38 'k	7720.28 'k
Wind Load Lateral F_Z	37.88 k	40.63 k	41.74 k	49.72 k
M_X	736.33 'k	1062.26 'k	1268.18 'k	2896.25 'k
Braking Load Longitudinal F_X	71.5 k	71.5 k	71.5 k	71.5 k
M_Z	1329.76	1887.78 'k	2189.74 'k	4690.4
Wind on Oper. Vehicle F_Y	-5.0 k	-5.0 k	-5.0 k	-5.0 k
F_Z	13.52 k	13.52 k	13.52 k	13.52 k
M_X	428.86 'k	537.02 'k	604.62 'k	1085.92 'k

FORM 62-114, AUG 1975

United Engineers & Constructors
Raytheon
Stearns-Roger Division

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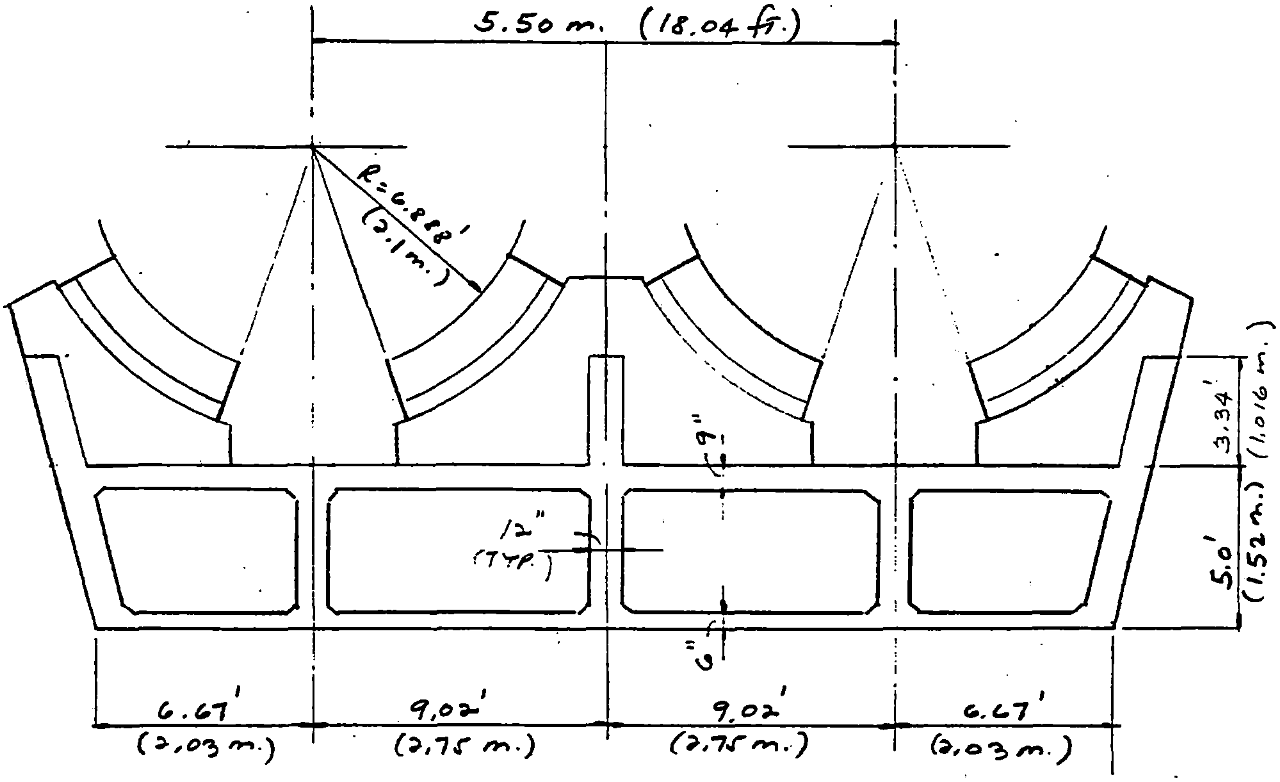
JOB NO. 6869002 DATE 4-10-92 BY ANC CHK'D
CUSTOMER MI PROJECT Maglev
SUBJECT Concrete Box Girder



TYPICAL SECTION
Double Guideway

		A		Y		AY
Deep Wall	- 3(1)8.34 =	25.0	×	4.167	=	104.18
Int. Wall	- 2(1)5.0 =	10.0	×	2.50	=	25.0
Top slab	- 0.75(28.88) =	21.66	×	4.625	=	100.18
bot. slab	- 0.50(26.38) =	13.19	×	0.25	=	3.30
		69.85				232.66

$$\bar{Y} = \frac{232.66}{69.85} = 3.331'$$

$$I_x = \frac{3(8.34)^3}{12} + \frac{2(5)^3}{12} + \frac{28.88(0.75)^3}{12} + \frac{26.38(0.5)^3}{12} + 25(0.836)^2 + 10(0.831)^2$$

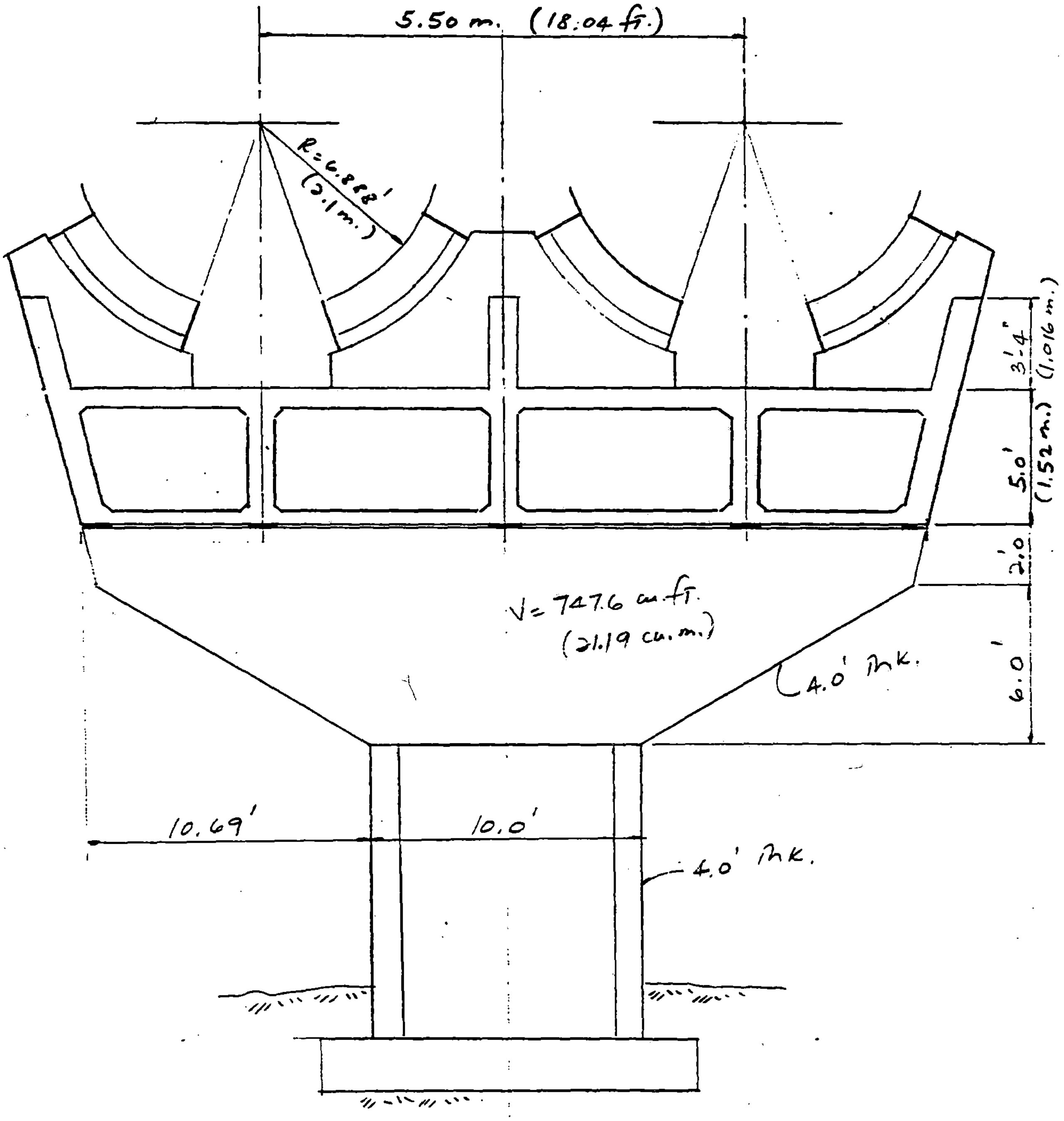
$$+ 21.66(1.294)^2 + 13.19(3.081)^2 = 144.68 + 20.83 + 1.02 + 0.27$$

$$17.47 + 6.91 + 36.27 + 125.21$$

$$I_x = 352.66 \text{ ft.}^4$$

United Engineers & Constructors
Raytheon
Stearns-Roger Division

PAGE	C-62
JOB NO.	6869002
DATE	4-10-92
BY	ANC
CHK'D	
CUSTOMER	MI
PROJECT	Maglev
SUBJECT	Concrete Box Girder



TYP. ELEV. @ SUPPORT
Elevated Double Guideway

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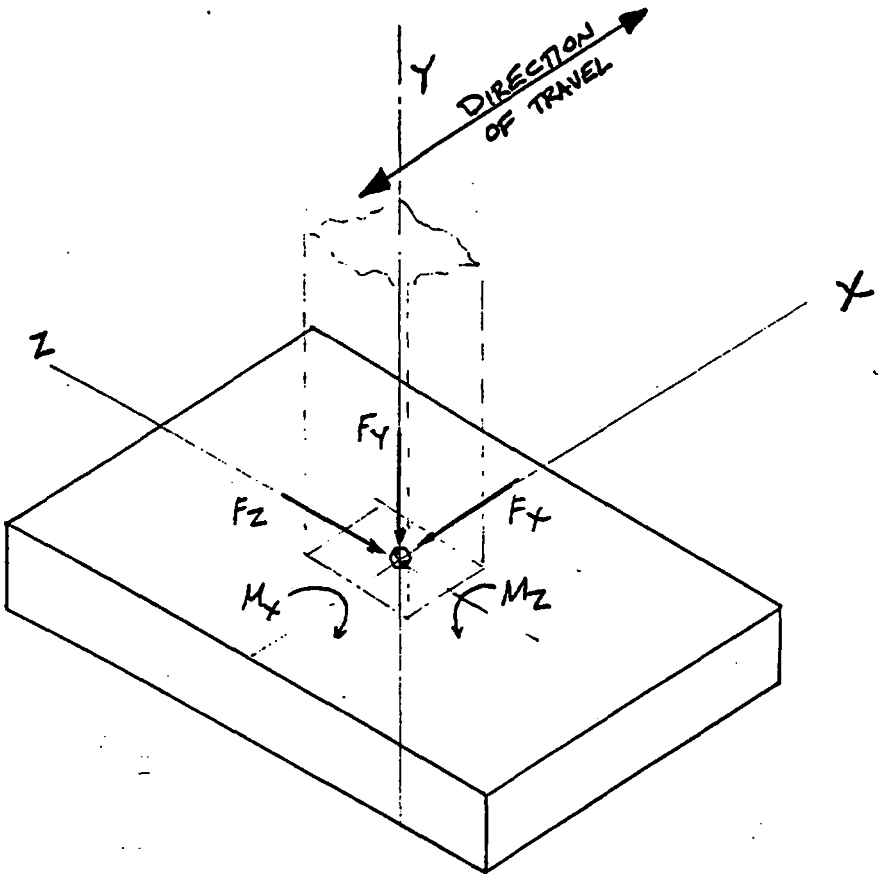
A Raytheon Company
·arns-Roger Division

PAGE 1

JOB NO. 6869002 DATE 4-2-92 BY ANC CH'K

CUSTOMER MI PROJECT Maglev

SUBJECT Column Loads to Foundation



LOAD COMBINATIONS TO BE CONSIDERED

D

D + S

D + L

D ± W

D ± E_t

D ± E_L

$D + L \pm \left[\left(\frac{30}{85}\right)^2 W + W_v\right]$

$(D + L \pm E_t) * .75$

$(D + L \pm E_L) * .75$

$(D + L \pm B) * .75$

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****************************************************
*                                                  *
*            S T A A D - III                       *
*            REVISION 14.0 (VERSION 14 LEVEL 0)    *
*            PROPRIETARY PROGRAM OF                *
*            RESEARCH ENGINEERS,INC.               *
*            DATE=    APR 14, 1992                 *
*            TIME=     9:37:26                     *
*                                                  *
****************************************************
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STAAD SPACE MAGLEV E-2 FRAME - 75'-0" SPAN
*** ELEVATED DOUBLE GUIDEWAY ***
*** PRECAST CONCRETE BOX GIRDER ***
*** NATURAL FREQUENCY ***
UNIT FEET KIP
************************************
JOINT COORDINATES
************************************
  1  0.0   0.0   0.0   21   0.0  0.0  75.0
 22  3.11  0.0   0.0   42   3.11 0.0  75.0
 43  6.22  0.0   0.0   63   6.22 0.0  75.0
 64 10.73  0.0   0.0   84  10.73 0.0  75.0
 85 15.24  0.0   0.0  105  15.24 0.0  75.0
106 19.75  0.0   0.0  126  19.75 0.0  75.0
127 24.26  0.0   0.0  147  24.26 0.0  75.0
148 27.37  0.0   0.0  168  27.37 0.0  75.0
169 30.48  0.0   0.0  189  30.48 0.0  75.0
190 -1.10  4.38  0.0  210  -1.10 4.38 75.0
211  2.56  4.38  0.0  231   2.56 4.38 75.0
232  6.22  4.38  0.0  252   6.22 4.38 75.0
253 10.73  4.38  0.0  273  10.73 4.38 75.0
274 15.24  4.38  0.0  294  15.24 4.38 75.0
295 19.75  4.38  0.0  315  19.75 4.38 75.0
316 24.26  4.38  0.0  336  24.26 4.38 75.0
337 27.92  4.38  0.0  357  27.92 4.38 75.0
358 31.58  4.38  0.0  378  31.58 4.38 75.0
379 -2.02  8.08  0.0  399  -2.02 8.08 75.0
400 15.24  8.08  0.0  420  15.24 8.08 75.0
421 32.50  8.08  0.0  441  32.50 8.08 75.0
***********************
ELEMENT INCIDENCES
***********************
*** BOTTOM SLAB ***
1 1 2 23 22 TO 20 ; 21 22 23 44 43 TO 40
41 43 44 65 64 TO 60 ; 61 64 65 86 85 TO 80
81 85 86 107 106 TO 100 ; 101 106 107 128 127 TO 120
121 127 128 149 148 TO 140 ; 141 148 149 170 169 TO 160
*** TOP SLAB ***
161 190 191 212 211 TO 180 ; 181 211 212 233 232 TO 200
201 232 233 254 253 TO 220 ; 221 253 254 275 274 TO 240
241 274 275 296 295 TO 260 ; 261 295 296 317 316 TO 280
281 316 317 338 337 TO 300 ; 301 337 338 359 358 TO 320
*** SIDEWALLS & WALLS ***
321 1 2 191 190 TO 340 ; 341 43 44 233 232 TO 360
361 85 86 275 274 TO 380 ; 381 127 128 317 316 TO 400
401 169 170 359 358 TO 420 ; 421 190 191 380 379 TO 440
441 274 275 401 400 TO 460 ; 461 358 359 422 421 TO 480
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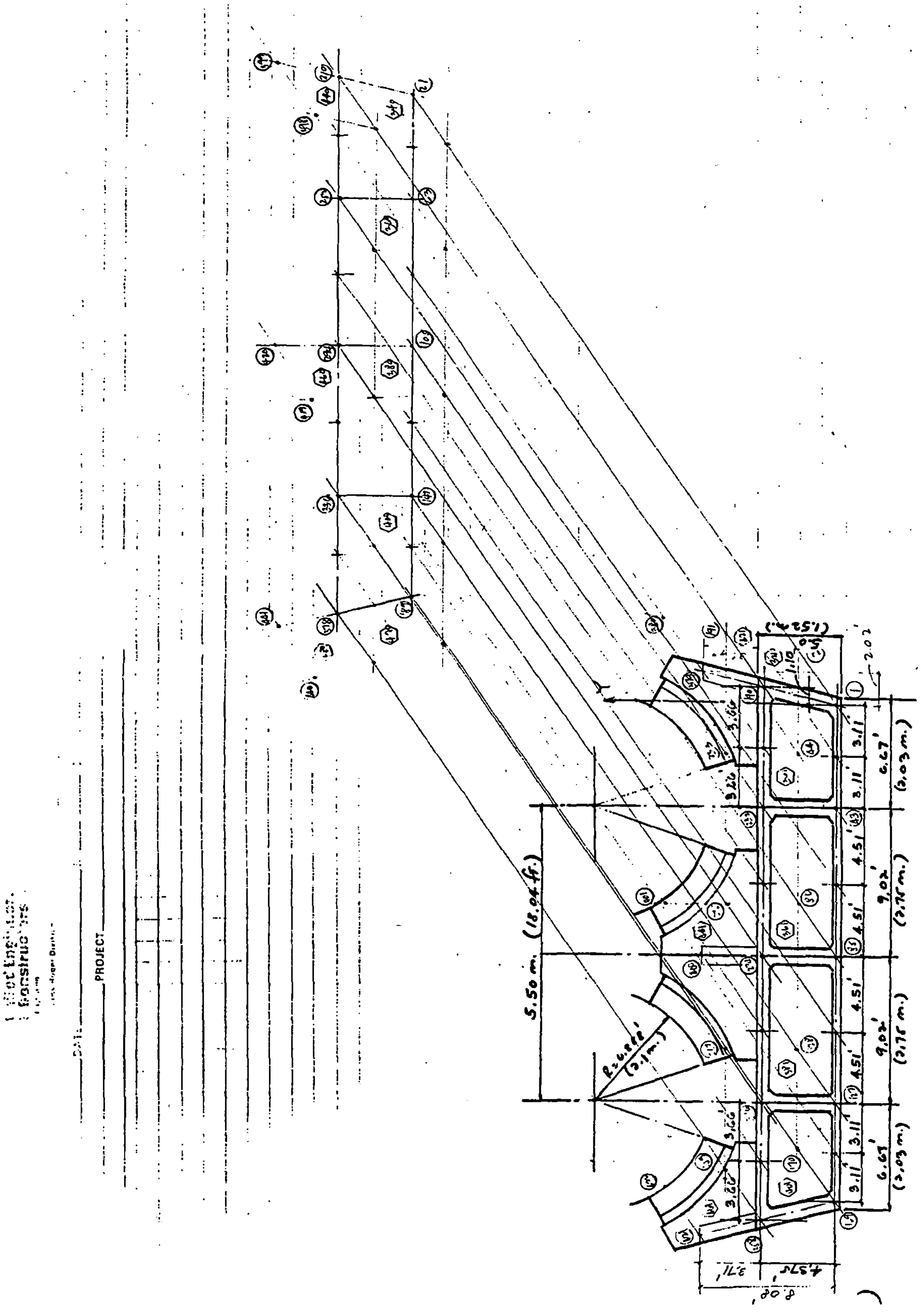
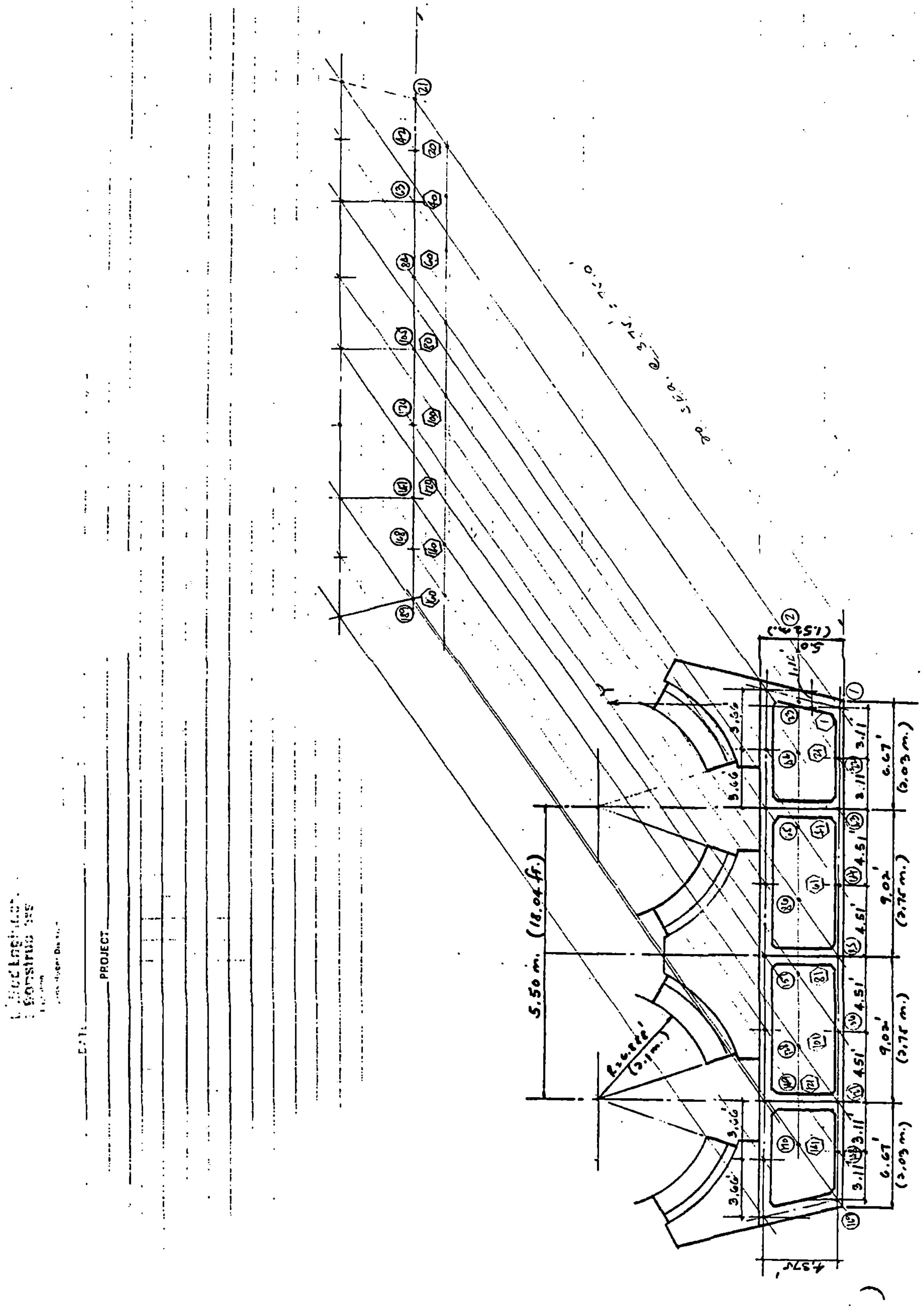
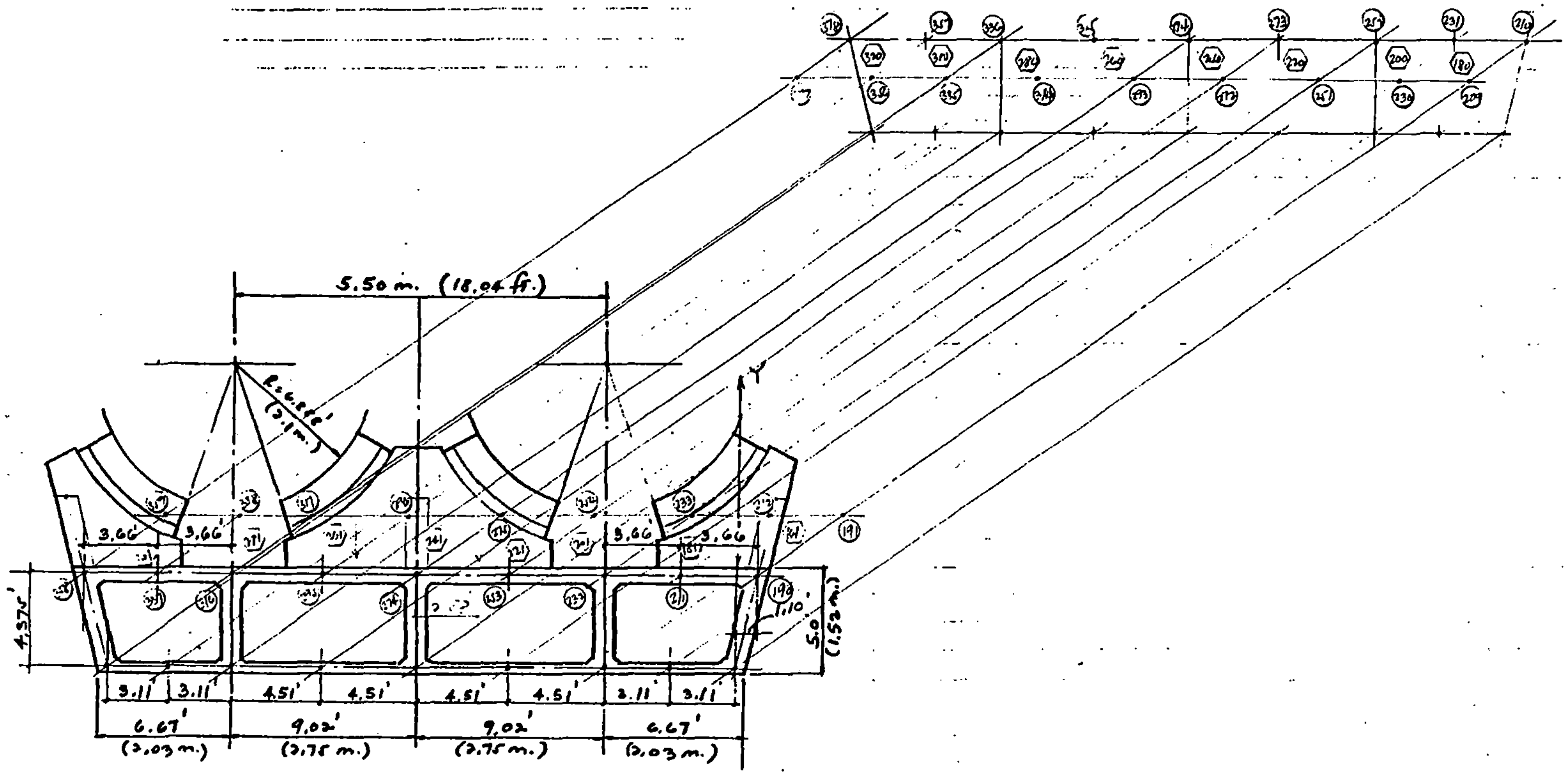
C-65




PROJECT
5.50 m. (18.04 ft.)
6.67'
(2.03 m.)
9.02'
(2.75 m.)
4.51'
3.11'
3.66'
4.57'

PROJECT

75' span



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United Engineers & Constructors
A Raytheon Company

PAGE C-68

JOB NO. 6869002 DATE 4-17-92 BY ANC CH'K

CUSTOMER MI PROJECT Maglev

SUBJECT Concrete box Girder

Elevated Double Guideway

Span = 36.59 m. (120.0 ft.)

Cross-Sectional Area = 13.81 m.^{2} (148.62 ft.^{2})

Moment of Inertia = 31.92 m.^{4} (3695.04 ft.^{4})

Natural Frequency = 5.48 cps

Top and bottom slab = 12" thick

Wall Ext. and Interior = 15" thick

Info. contained here were sent to BCI for foundation design

FORM 62-114/A0328175I

United Engineers & Constructors
Raytheon
Stearns-Roger Division

PAGE C-69
JOB NO. 6869002 DATE 4-7-92 BY ANC CHK'D
CUSTOMER MI PROJECT Maglev
SUBJECT Column Loads

CONCRETE BOX GIRDER - DOUBLE GUIDEWAY

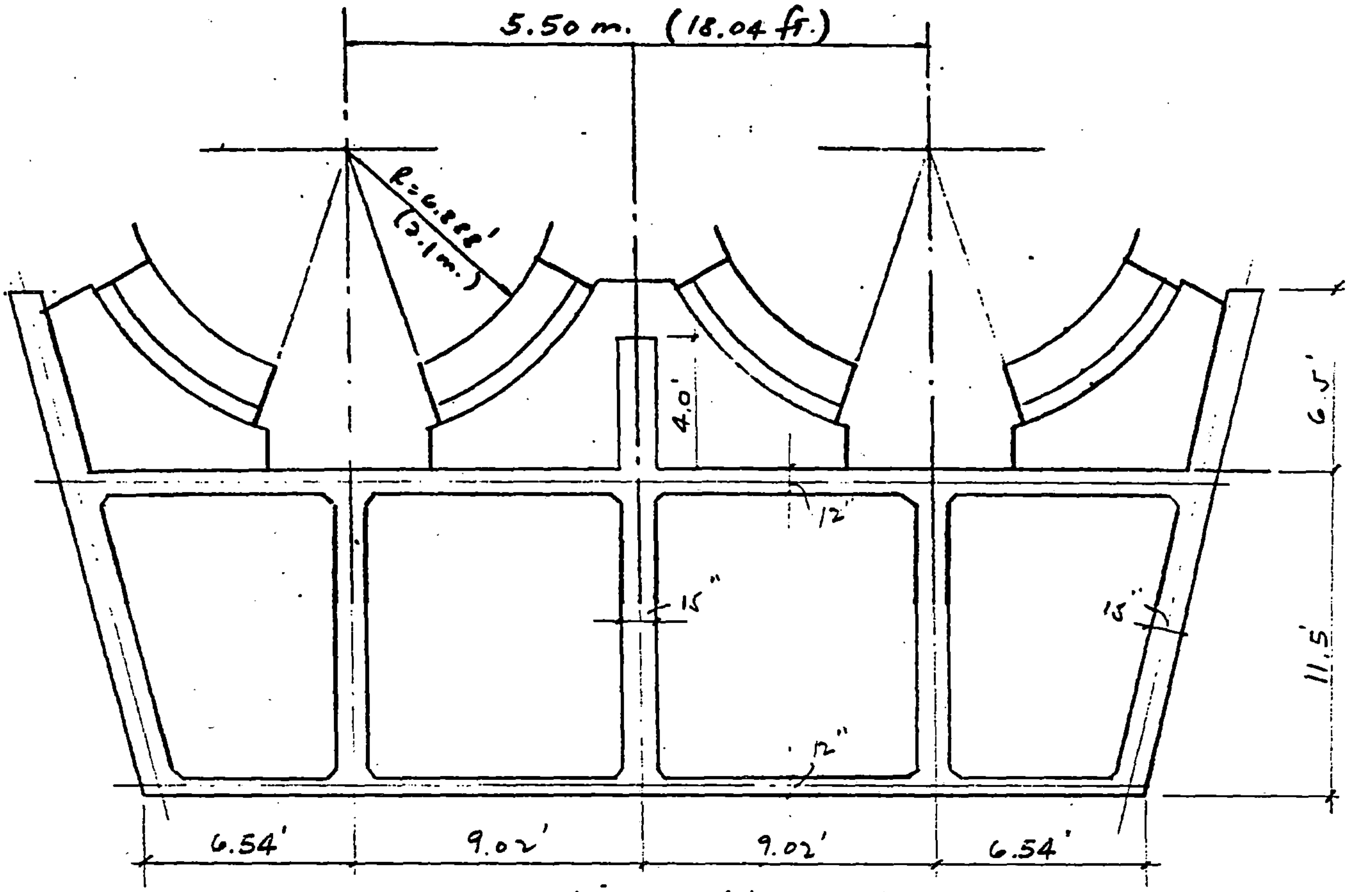
SUMMARY OF LOADS   SPAN = 36.59m. (120.0 ft.)

LOADS \ COLUMN HT.	h_1 = 5.18 m. (17.0 ft.)	h_2 = 7.62 m. (25.0 ft.)	h_3 = 9.14 m. (30.0 ft.)	h_4 = 20.0 m (65.6 ft.)
Dead Load				
F_Y	3032.98 k	3080.98 k	3110.98 k	3757.50 k
Snow Load				
F_Y	161.64 k	161.64 k	161.64 k	161.64 k
Vehicle Live Load				
F_Y	133.83 k	133.83 k	133.83 k	133.83 k
Seismic Load Lateral				
F_Z	291.58 k	296.62 k	299.77 k	367.66 k
M_X	5801.19 'k	8154.02 'k	9654.01 'k	22,207.12 'k
Seismic Load Longitudinal				
F_X	291.58	296.62 k	299.77 k	367.66 k
M_Z	5801.19	8154.02 'k	9654.01 'k	22207.12 'k
Wind Load Lateral				
F_Z	107.97 k	109.76 k	110.88 k	118.85 k
M_X	2149.94 'k	3020.85 'k	3572.45 'k	7661.72 'k
Braking Load Longitudinal				
F_X	87.0 k	87.0 k	87.0 k	87.0 k
M_Z	1691.04 'k	2297.02 'k	2664.44 'k	5707.2 'k
Wind on oper. Vehicle				
F_Y	-5.0 k	-5.0 k	-5.0 k	-5.0 k
F_Z	13.52 k	13.52 k	13.52 k	13.52 k
M_X	428.86 'k	537.02 'k	604.62 'k	1085.92 'k

FORM 62-114

United Engineers & Constructors
Stearns-Roger Division

PAGE C-70
JOB NO. 6869002 DATE 4-10-92 BY ANC CHK'D
CUSTOMER MI PROJECT Maglev
SUBJECT Concrete Box Girder



	A		Y		AY
Ext. wall - 2(18)1.25 =	45.0	×	9.0	=	405
Int. wall - 1(15.5)1.25 =	19.38	×	7.75	=	150.195
2(11.5)1.25 =	28.75	×	5.75	=	165.313
Top slab - 1(30.62) =	30.62	×	11.0	=	336.82
bot slab - 1(24.87) =	24.87	×	0.5	=	12.435
	148.62				1069.76

$$\bar{y} = 7.20'$$

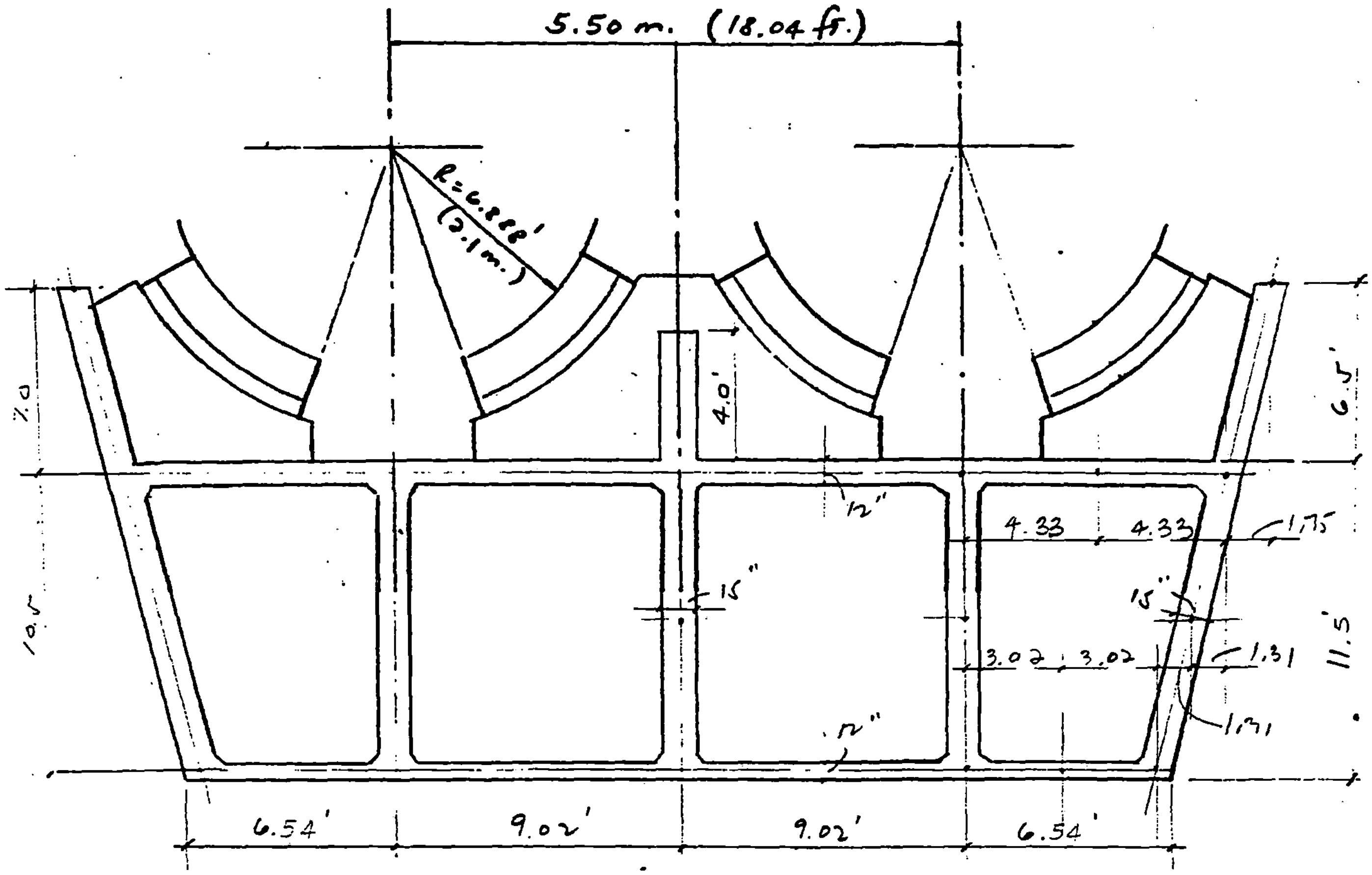
$$I_x = \frac{2(1.25)18^3}{12} + \frac{(1.25)15.5^3}{12} + \frac{2(1.25)11.5^3}{12} + \frac{30.62}{12} + \frac{24.87}{12} + 45(1.8)^2 + 19.38(0.55)^2$$
$$+ 28.75(1.45)^2 + 30.62(3.8)^2 + 24.87(6.7)^2$$

$$= 1215 + 387.90 + 316.85 + 2.55 + 2.07 + 145.8 + 5.86 + 60.45 + 442.15 + 1116.41$$

$I_x = 3695.04$ $\qquad I_y = 16,220\ ft.^4$

United Engineers & Constructors
Stearns-Roger Division

PAGE C-71
JOB NO. 6869002 DATE 4-10-92 BY ANC CHK'K
CUSTOMER MI PROJECT Maglev
SUBJECT Concrete Box Girder



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**************************************************
*                                                *
*           S T A A D - III                      *
*           REVISION 14.0 (VERSION 14 LEVEL 0)   *
*           PROPRIETARY PROGRAM OF               *
*           RESEARCH ENGINEERS,INC.              *
*           DATE=    APR 20, 1992                *
*           TIME=      8: 0:12                   *
*                                                *
**************************************************

STAAD SPACE MAGLEV E-2 FRAME - 120'-0" SPAN
*** ELEVATED DOUBLE GUIDEWAY ***
*** PRECAST CONCRETE BOX GIRDER ***
*** NATURAL FREQUENCY ***
UNIT FEET KIP
**********************************
JOINT COORDINATES
**********************************
  1  0.0    0.0     0.0   31  0.0    0.0    120.0
 32  3.02   0.0     0.0   62  3.02   0.0    120.0
 63  6.04   0.0     0.0   93  6.04   0.0    120.0
 94 10.55   0.0     0.0  124 10.55   0.0    120.0
125 15.06   0.0     0.0  155 15.06   0.0    120.0
156 19.57   0.0     0.0  186 19.57   0.0    120.0
187 24.08   0.0     0.0  217 24.08   0.0    120.0
218 27.10   0.0     0.0  248 27.10   0.0    120.0
249 30.12   0.0     0.0  279 30.12   0.0    120.0
280 -2.62 10.50     0.0  310 -2.62 10.50    120.0
311  1.71 10.50     0.0  341  1.71 10.50    120.0
342  6.04 10.50     0.0  372  6.04 10.50    120.0
373 10.55 10.50     0.0  403 10.55 10.50    120.0
404 15.06 10.50     0.0  434 15.06 10.50    120.0
435 19.57 10.50     0.0  465 19.57 10.50    120.0
466 24.08 10.50     0.0  496 24.08 10.50    120.0
497 28.41 10.50     0.0  527 28.41 10.50    120.0
528 32.74 10.50     0.0  558 32.74 10.50    120.0
559 -1.31  5.75     0.0  589 -1.31  5.75    120.0
590 -4.37 17.50     0.0  620 -4.37 17.50    120.0
621 31.43  5.75     0.0  651 31.43  5.75    120.0
652 34.49 17.50     0.0  682 34.49 17.50    120.0
683  6.04  5.75     0.0  713  6.04  5.75    120.0
714 15.06  5.75     0.0  744 15.06  5.75    120.0
745 24.08  5.75     0.0  775 24.08  5.75    120.0
776 15.06 15.00     0.0  806 15.00 15.00    120.0
**********************
ELEMENT INCIDENCES
**********************
*** BOTTOM SLAB ***
1 1 2 33 32 TO 30 ; 31 32 33 64 63 TO 60
61 63 64 95 94 TO 90 ; 91 94 95 126 125 TO 120
121 125 126 157 156 TO 150 ; 151 156 157 188 187 TO 180
181 187 188 219 218 TO 210 ; 211 218 219 250 249 TO 240
*** TOP SLAB ***
241 280 281 312 311 TO 270 ; 271 311 312 343 342 TO 300
301 342 343 374 373 TO 330 ; 331 373 374 405 404 TO 360
361 404 405 436 435 TO 390 ; 391 435 436 467 466 TO 420
421 466 467 498 497 TO 450 ; 451 497 498 529 528 TO 480
*** SIDEWALLS & WALLS ***
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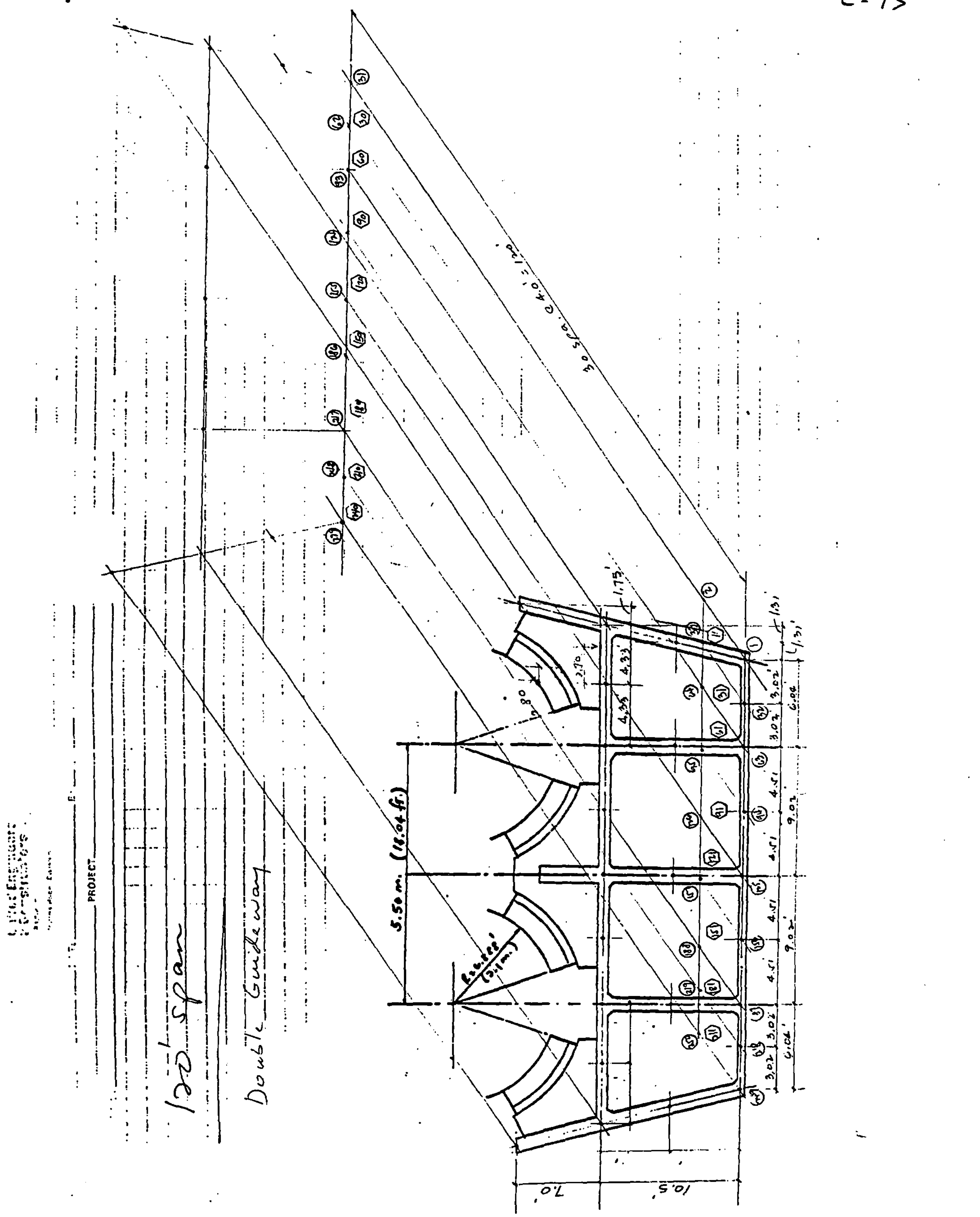
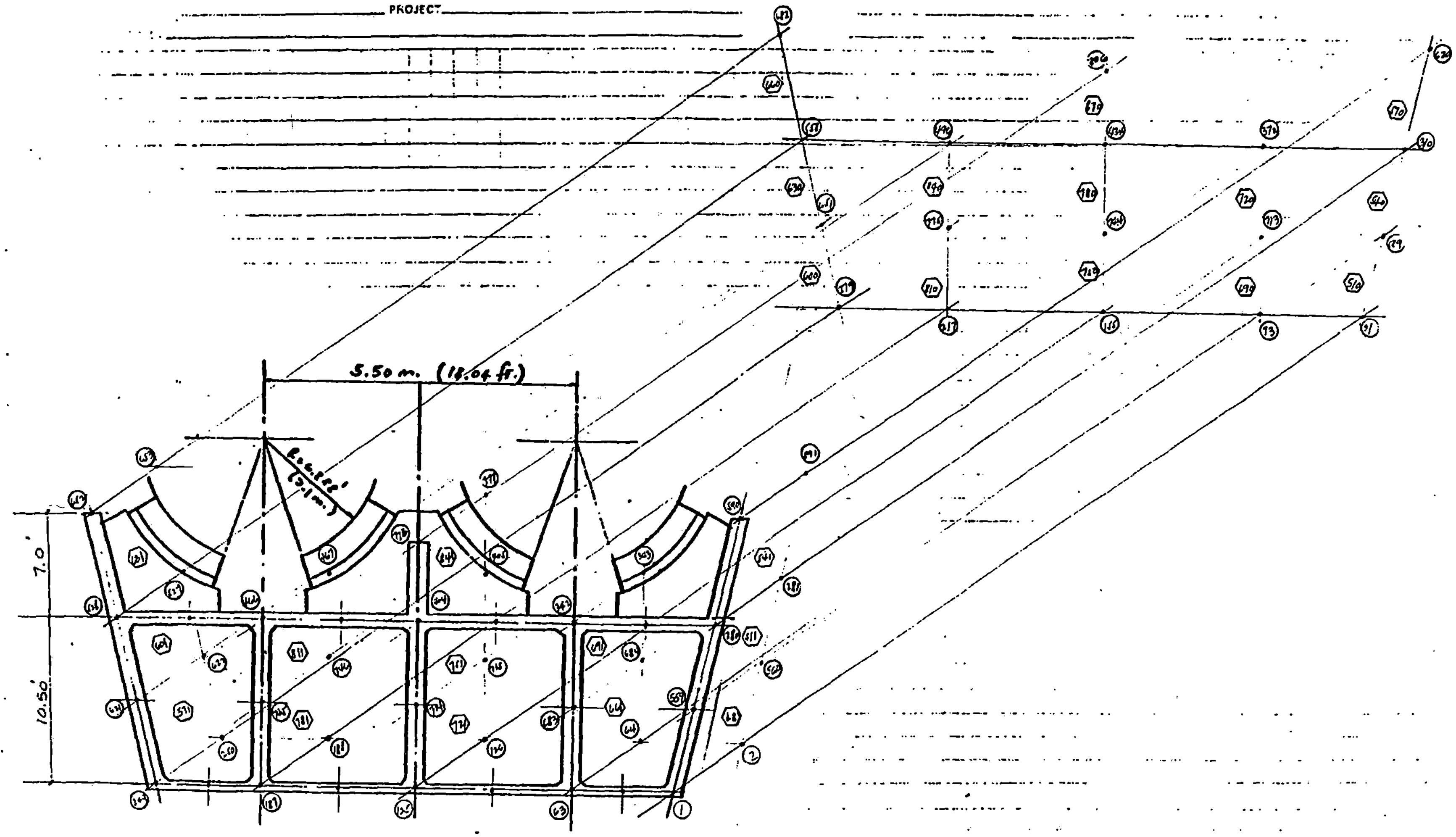
C-73

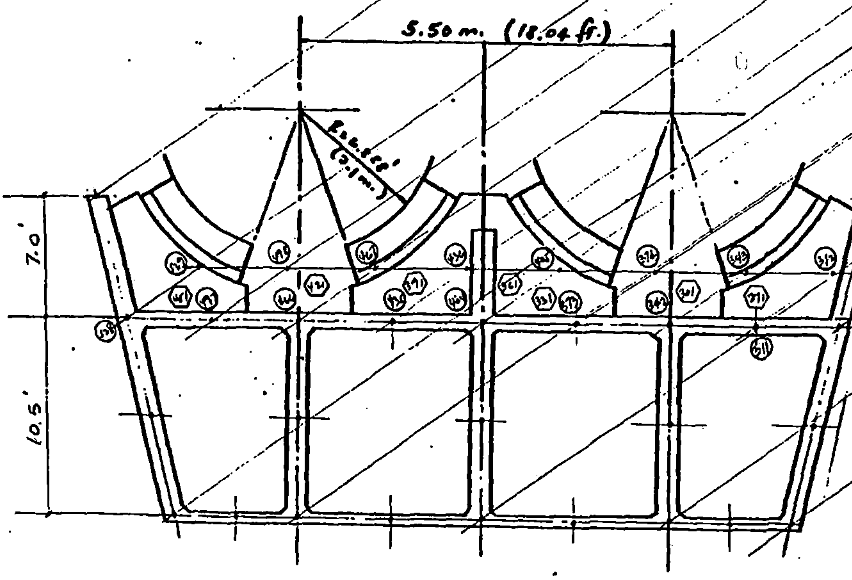

120' Span
Double Guideway
PROJECT
5.50 m. (18.04 ft.)
R=10.00' (3.1 m.)
30 spa. @ 4.0' = 120'
1.75'
10.5'
7.0'

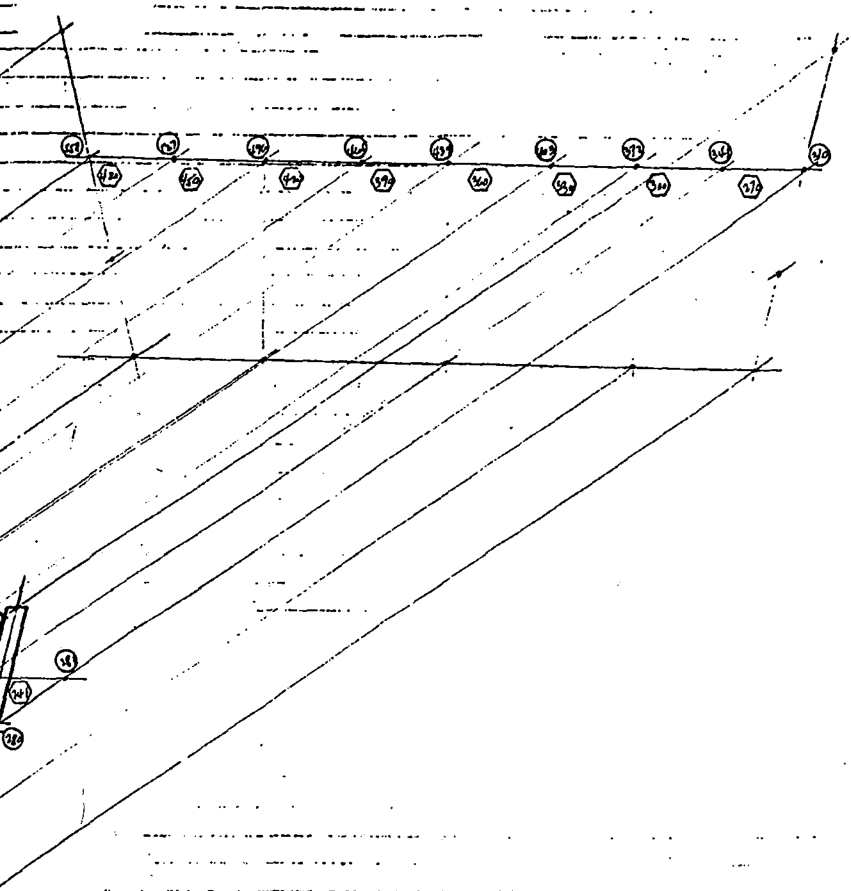
United Engineers
& Constructors

PROJECT



PROJECT





SL-7

United Engineers & Constructors
A Raytheon Company
Stearns-Roger Division

PAGE C-76
JOB NO. 6869002 DATE 4-10-92 BY AJC CH'K
CUSTOMER MI PROJECT Maglev
SUBJECT Concrete Box Girder

Elevated Double Guideway

Trial Section

Span = 36.59 m. (120.0 ft.)

Cross-Sectional-Area : 123.03 $ft.^2$

Moment of Inertia : 2728.89 $ft.^4$

Natural Frequency : 4.68 cps

Top slab = 9" thick

Bottom slab = 6" thick

Wall Ext. and Interior = 12" thick

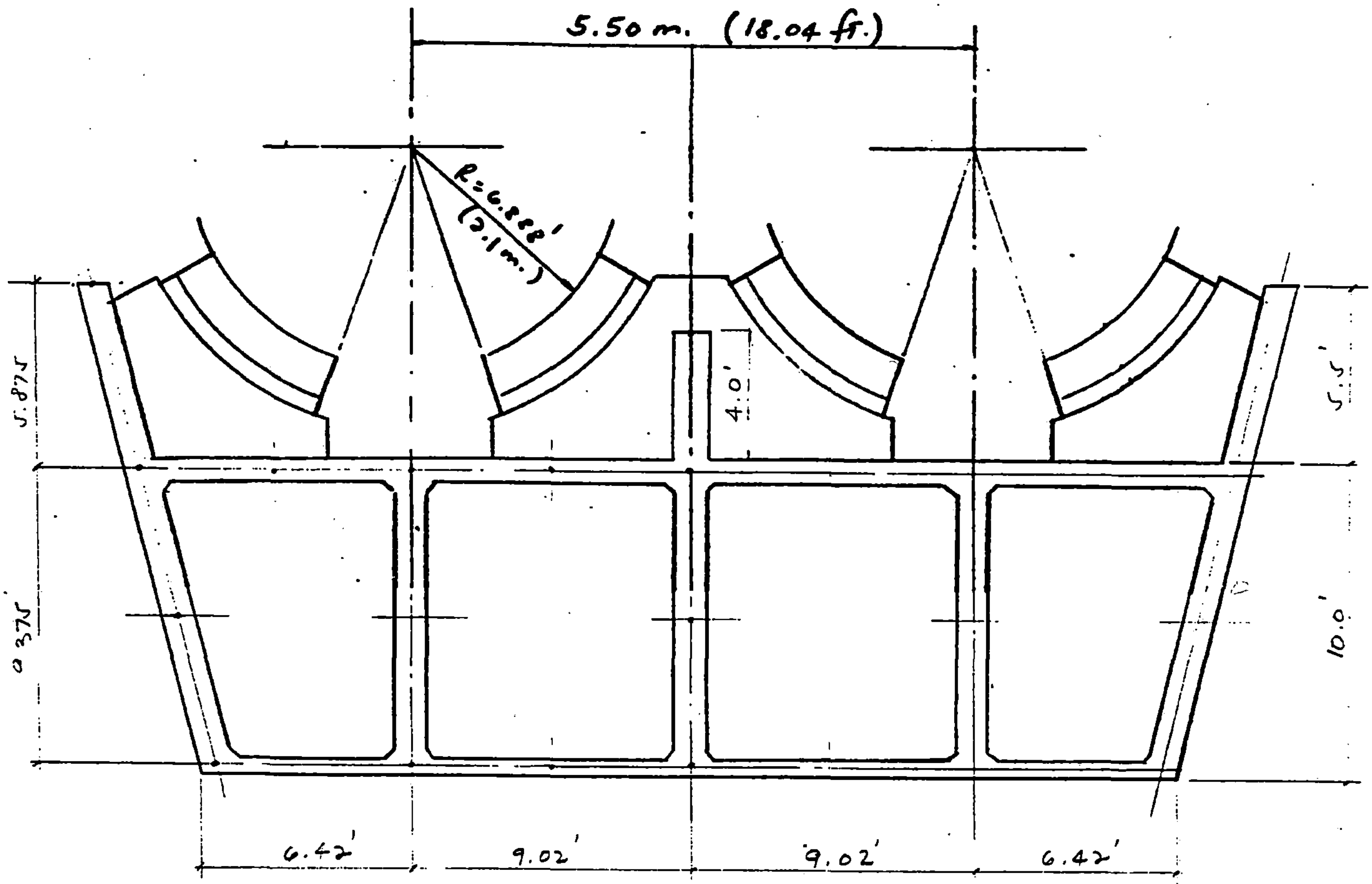
This info. not send to BCI

This Trial section was not pursue because it didn't meet the nat. frequency reqm't.

FORM 62-114/A0388175

United Engineers & Constructors
Raytheon
...-Rogers Division

PAGE C-77
JOB NO. 6869002 DATE 4-10-92 BY ANC CHK'K
CUSTOMER MI PROJECT Maglev
SUBJECT Concrete Box Girder



		A		Y		AY
Ext. wall	- 2(15.5) =	31.0	×	7.75	=	240.25
Int. wall	- 1(14.0) =	14.0	×	7.0	=	98.0
	2(10.0) =	20.0	×	5.0	=	100.0
Top slab	- 0.75(30.68) =	23.0	×	9.625	=	221.38
bot slab	- 0.50(26.0) =	13.0	×	0.25	=	3.25
		101.0				662.88

$\bar{Y} = 6.563'$

$$I_x = \frac{2(15.5)^3}{12} + \frac{1(14)^3}{12} + \frac{2(10)^3}{12} + \frac{30.68(0.75)^3}{12} + \frac{26(0.5)^3}{12} + 31(1.187)^2$$

$$+ 14(0.437)^2 + 20(1.563)^2 + 23(3.062)^2 + 13(6.313)^2$$

$$= 620.65 + 228.67 + 166.67 + 1.08 + 0.27 + 43.68$$

$$+ 2.67 + 48.86 + 215.64 + 518.10$$

$I_x = 1846.29\ ft.^4$ $I_y = 10,520$

```
**************************************************
*                                                *
*            S T A A D - III                     *
*            REVISION 14.0 (VERSION 14 LEVEL 0)  *
*            PROPRIETARY PROGRAM OF              *
*            RESEARCH ENGINEERS,INC.             *
*            DATE=    APR 16, 1992               *
*            TIME=    13:13:41                   *
*                                                *
**************************************************
```

```
STAAD SPACE MAGLEV E-2 FRAME - 120'-0" SPAN
*** ELEVATED DOUBLE GUIDEWAY ***
*** PRECAST CONCRETE BOX GIRDER ***
*** NATURAL FREQUENCY ***
UNIT FEET KIP
**********************************
JOINT COORDINATES
**********************************
  1  0.0   0.0    0.0   31  0.0   0.0   120.0
 32  2.99  0.0    0.0   62  2.99  0.0   120.0
 63  5.98  0.0    0.0   93  5.98  0.0   120.0
 94 10.49  0.0    0.0  124 10.49  0.0   120.0
125 15.00  0.0    0.0  155 15.00  0.0   120.0
156 19.51  0.0    0.0  186 19.51  0.0   120.0
187 24.02  0.0    0.0  217 24.02  0.0   120.0
218 27.01  0.0    0.0  248 27.01  0.0   120.0
249 30.00  0.0    0.0  279 30.00  0.0   120.0
280 -2.34  9.38   0.0  310 -2.34  9.38  120.0
311  1.82  9.38   0.0  341  1.82  9.38  120.0
342  5.98  9.38   0.0  372  5.98  9.38  120.0
373 10.49  9.38   0.0  403 10.49  9.38  120.0
404 15.00  9.38   0.0  434 15.00  9.38  120.0
435 19.51  9.38   0.0  465 19.51  9.38  120.0
466 24.02  9.38   0.0  496 24.02  9.38  120.0
497 28.18  9.38   0.0  527 28.18  9.38  120.0
528 32.34  9.38   0.0  558 32.34  9.38  120.0
559 -1.17  4.69   0.0  589 -1.17  4.69  120.0
590 -3.81 15.25   0.0  620 -3.81 15.25  120.0
621 31.17  4.69   0.0  651 31.17  4.69  120.0
652 33.81 15.25   0.0  682 33.81 15.25  120.0
683  5.98  4.69   0.0  713  5.98  4.69  120.0
714 15.00  4.69   0.0  744 15.00  4.69  120.0
745 24.02  4.69   0.0  775 24.02  4.69  120.0
776 15.00 13.76   0.0  806 15.00 13.76  120.0
*********************
ELEMENT INCIDENCES
*********************
*** BOTTOM SLAB ***
1 1 2 33 32 TO 30 ; 31 32 33 64 63 TO 60
61 63 64 95 94 TO 90 ; 91 94 95 126 125 TO 120
121 125 126 157 156 TO 150 ; 151 156 157 188 187 TO 180
181 187 188 219 218 TO 210 ; 211 218 219 250 249 TO 240
*** TOP SLAB ***
241 280 281 312 311 TO 270 ; 271 311 312 343 342 TO 300
301 342 343 374 373 TO 330 ; 331 373 374 405 404 TO 360
361 404 405 436 435 TO 390 ; 391 435 436 467 466 TO 420
421 466 467 498 497 TO 450 ; 451 497 498 529 528 TO 480
*** SIDEWALLS & WALLS ***
```

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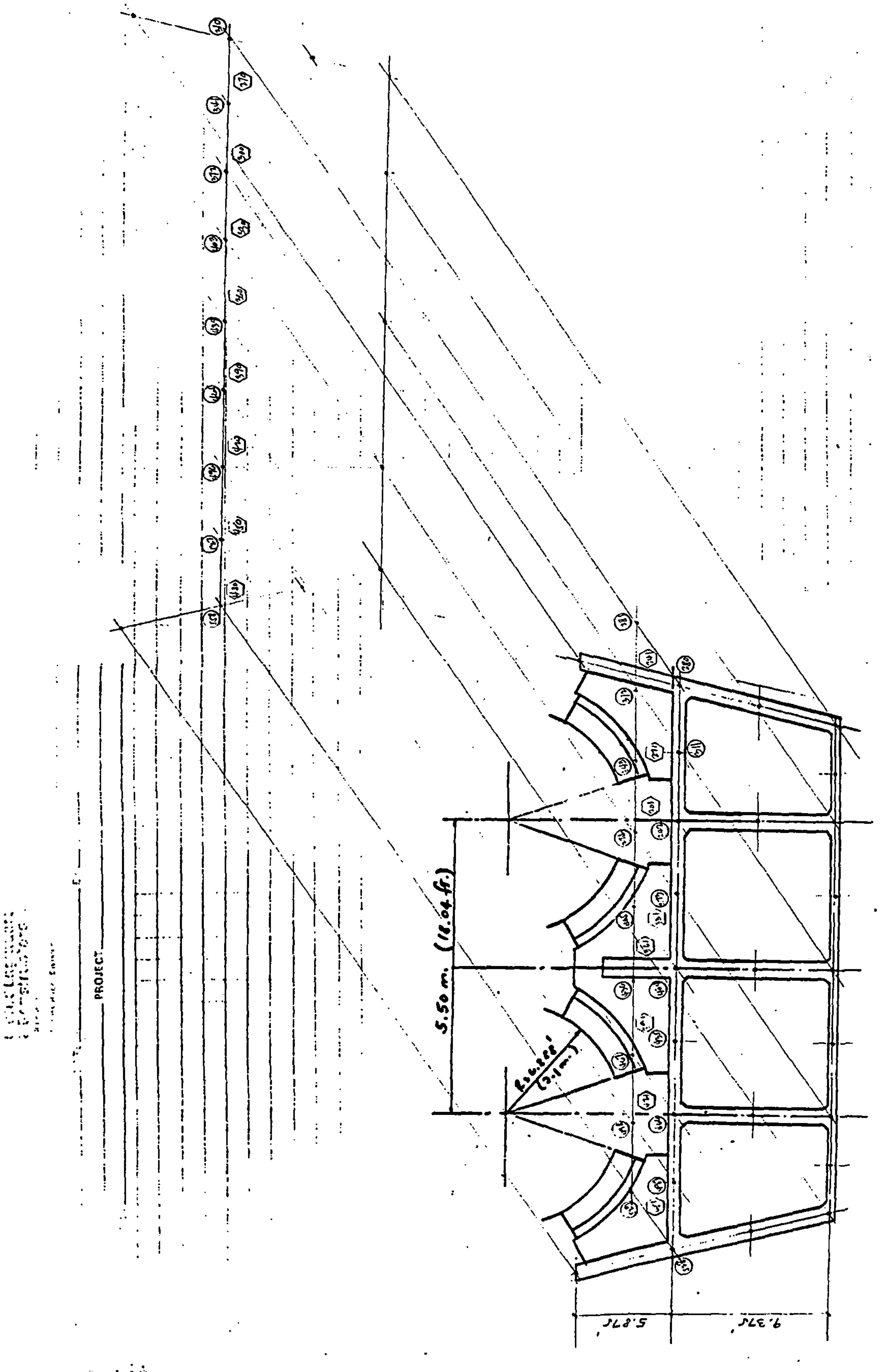
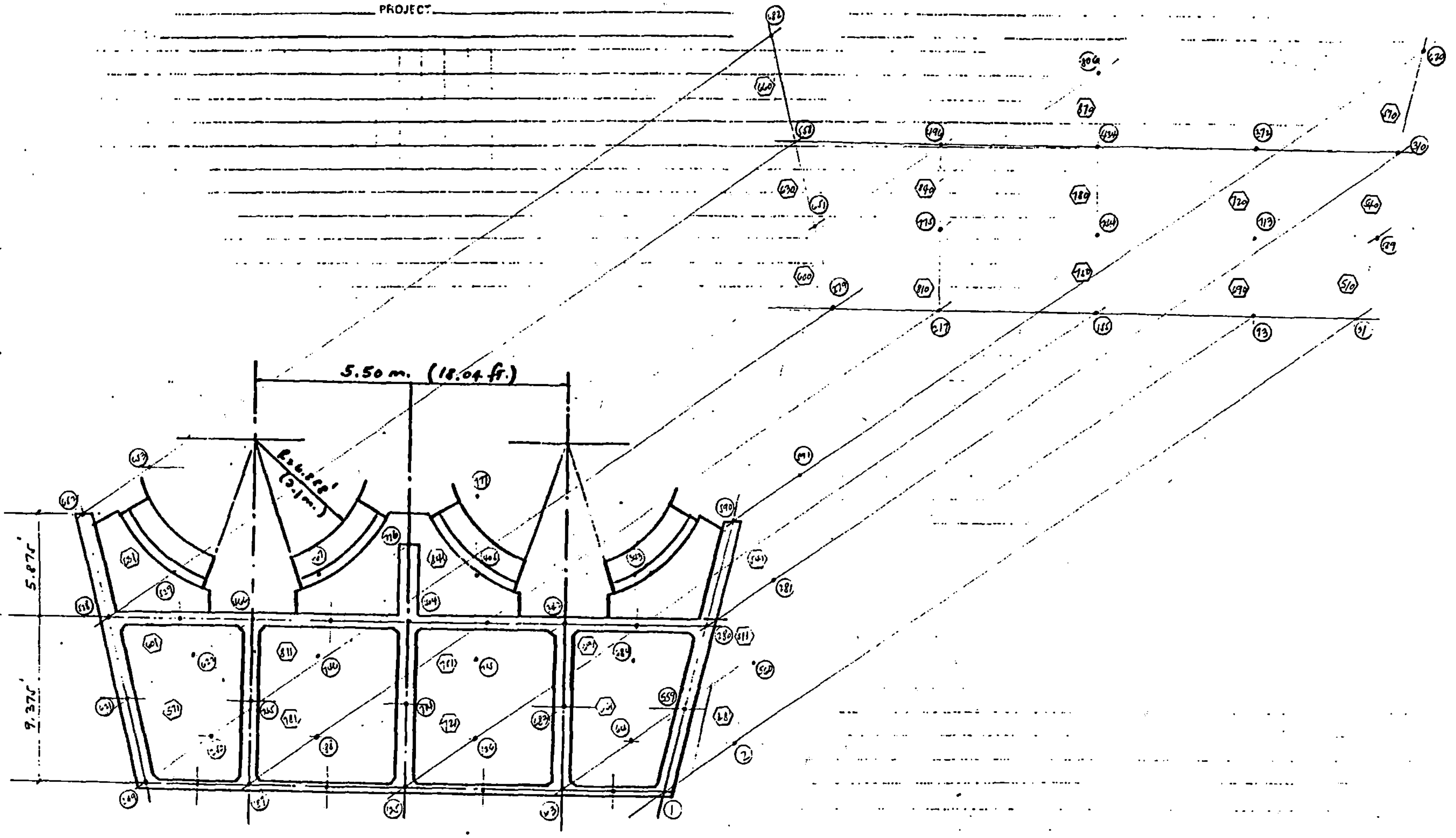


PROJECT

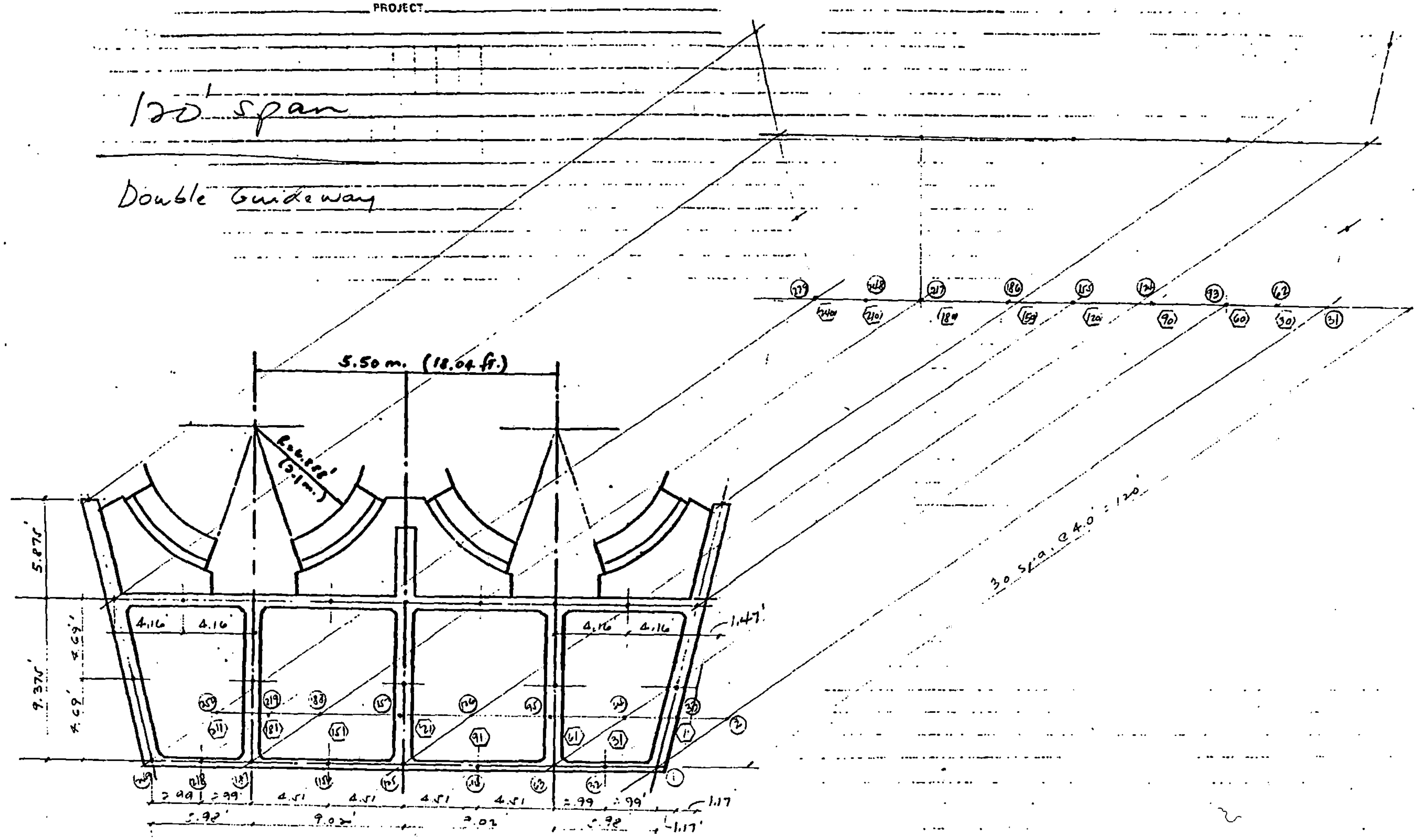


C-80

PROJECT

120' Span

Double Guideway



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United Engineers & Constructors
Raytheon
Stearns-Roger Division

PAGE C-82
JOB NO. 6869002 DATE 4-7-92 BY ANC CHK
CUSTOMER MI PROJECT Maglev
SUBJECT Column Loads

CONCRETE BOX GIRDER - SINGLE GUIDEWAY

SUMMARY OF LOADS

	SPAN = 9.15 m. (30.0 ft.)		SPAN = 22.87 m. (75.0 ft.)	
LOADS / COLUMN HT.	h_1 = 0.61 m. (2.0 ft.)	h_2 = 0.91 m. (3.0 ft.)	h_1 = 0.61 m. (2.0 ft.)	h_2 = 0.91 m. (3.0 ft.)
Dead Load				
F_Y	163.22 k	164.22 k	426.51 k	428.91 k
Snow Load				
F_Y	15.18 k	15.18 k	41.47 k	41.47 k
Vehicle Live Load				
F_Y	55.0 k	55.0 k	55.0 k	55.0 k
Seismic Load Lateral				
F_Z	11.9 k	12.03 k	39.14 k	39.39 k
M_X	55.10 'k	67.73 'k	181.22 'k	221.77 'k
Seismic Load Longitudinal				
F_X	11.9 k	12.03 k	39.14 k	39.39 k
M_Z	55.10 'k	67.73 'k	181.22 'k	221.77 'k
Wind Load Lateral				
F_Z	8.62 k	8.73 k	35.40 k	35.62 k
M_X	39.91 'k	49.15 'k	163.90 'k	200.54 'k
Braking Load Longitudinal				
F_X	35.75 k	35.75 k	35.75 k	35.75 k
M_Z	165.52 'k	201.27 'k	165.52 'k	201.27 'k
Wind on oper. Vehicle				
F_Y	-2.50 k	-2.50 k	-2.50 k	-2.50 k
F_Z	6.76 k	6.76 k	6.76 k	6.76 k
M_X	130.81 'k	137.57 'k	130.81 'k	137.57 'k

FORM 62-114

United Engineers & Constructors
Raytheon
Stearns-Roger Division

JOB NO. 6869002 DATE 4-7-92 BY ANC CHK'D
CUSTOMER MI PROJECT Maglev
SUBJECT Column Loads

CONCRETE BOX GIRDER - SINGLE GUIDEWAY.

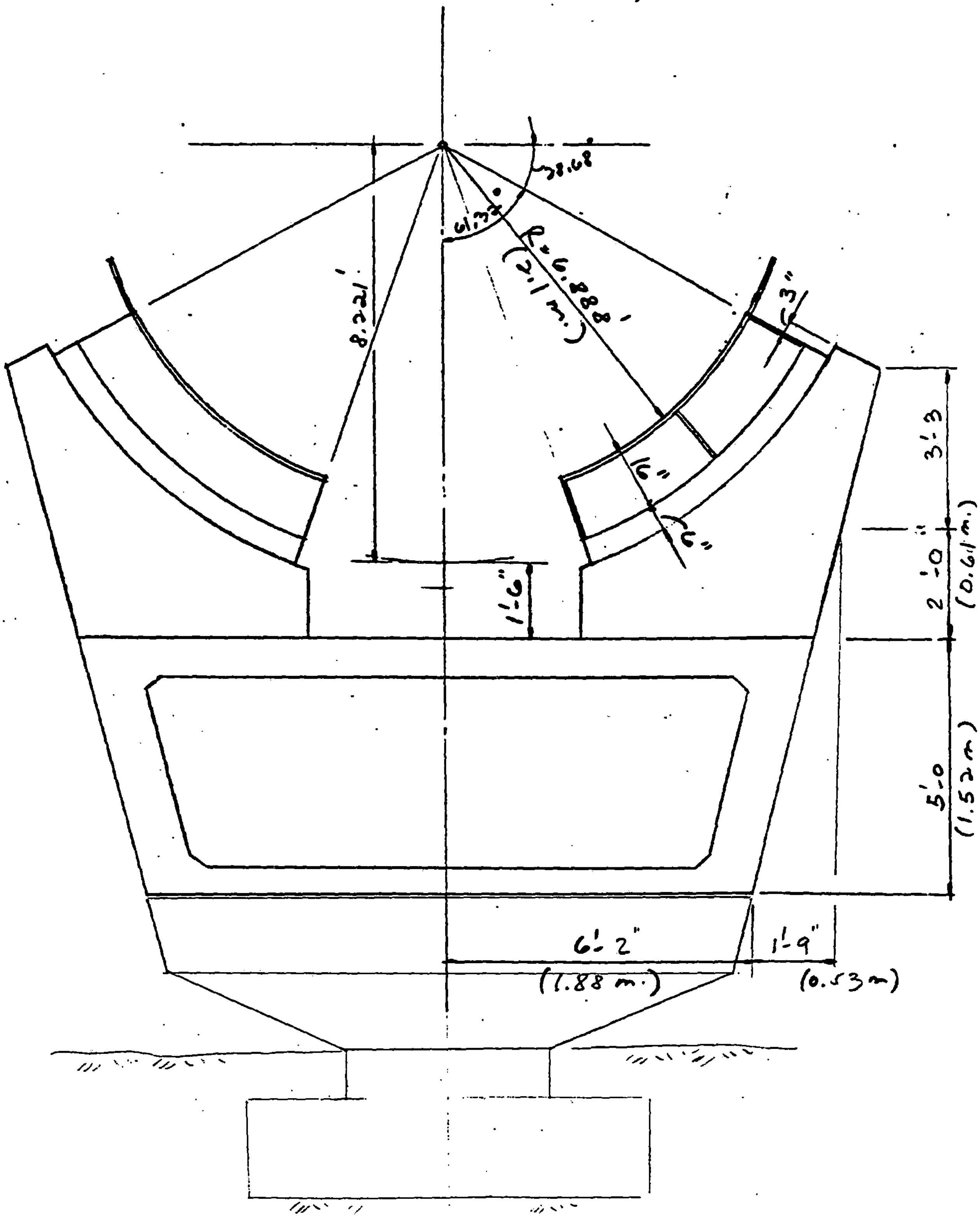
SUMMARY OF LOADS

SPAN = 36.59m. (120.0 ft.) SPAN = m. (ft.)

LOADS \ COLUMN HT.	h_1 = 0.61 m. (2.0 ft.)	h_2 = 0.91 m. (3.0 ft.)	h = m. (ft.)	h = m (ft.)
Dead Load				
F_Y	1463.61^k	1466.01^k		
Snow Load				
F_Y	66.36^k	66.36^k		
Vehicle Live Load				
F_Y	66.92^k	66.92^k		
Seismic Load Lateral				
F_Z	139.95^k	140.20^k		
M_X	1515.52^'k	1655.59^'k		
Seismic Load Longitudinal				
F_X	139.95^k	140.20^k		
M_Z	1515.52^'k	1655.59^'k		
Wind Load Lateral				
F_Z	118.27^k	118.50^k		
M_X	1280.50^'k	1398.88^'k		
Braking Load Longitudinal				
F_X	43.50^k	43.50^k		
M_Z	471.06^'k	513.68^'k		
Wind on Oper. Vehicle				
F_Y	-3.0^k	-3.0^k		
F_Z	8.23^k	8.23^k		
M_X	89.12^'k	97.19^'k		

United Engineers & Constructors
A Raytheon Company

PAGE C-84
JOB NO. 6869002 DATE 3.30.92 BY Awc CH'K
CUSTOMER MI PROJECT Maglev
SUBJECT Single Guideway



FORM 62-114/A03-2175

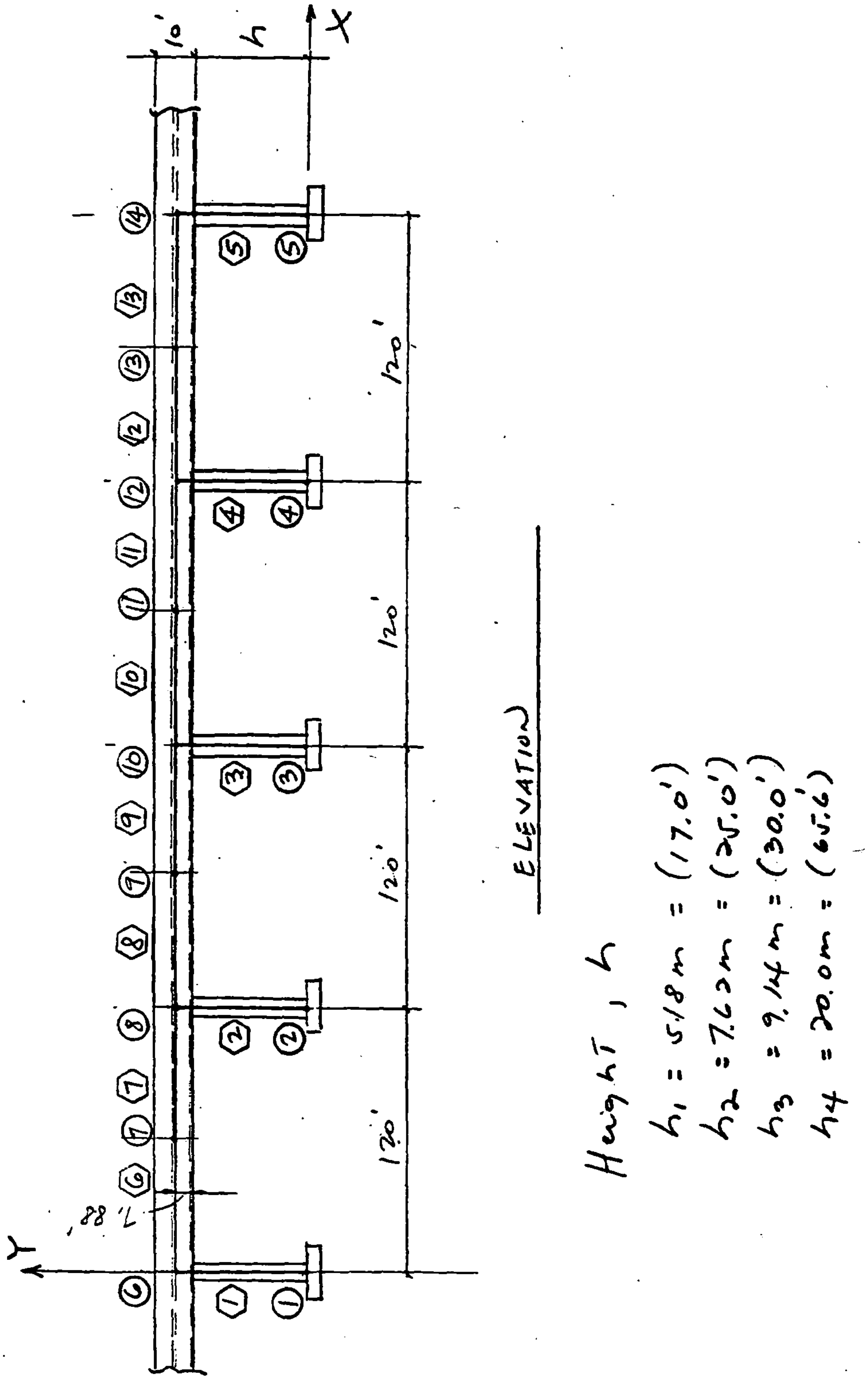
United Engineers & Constructors
Raytheon Company
Stearns-Roger Division

PAGE C-85

JOB NO. 6869002 DATE 3.19.92 BY AWC CHK

CUSTOMER MI PROJECT Maglev

SUBJECT



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**************************************************
*                                                *
*           S T A A D - III                      *
*           REVISION 14.0 (VERSION 14 LEVEL 0)   *
*           PROPRIETARY PROGRAM OF               *
*           RESEARCH ENGINEERS,INC.              *
*           DATE=    APR 21, 1992                *
*           TIME=    14:45:54                    *
*                                                *
**************************************************
```
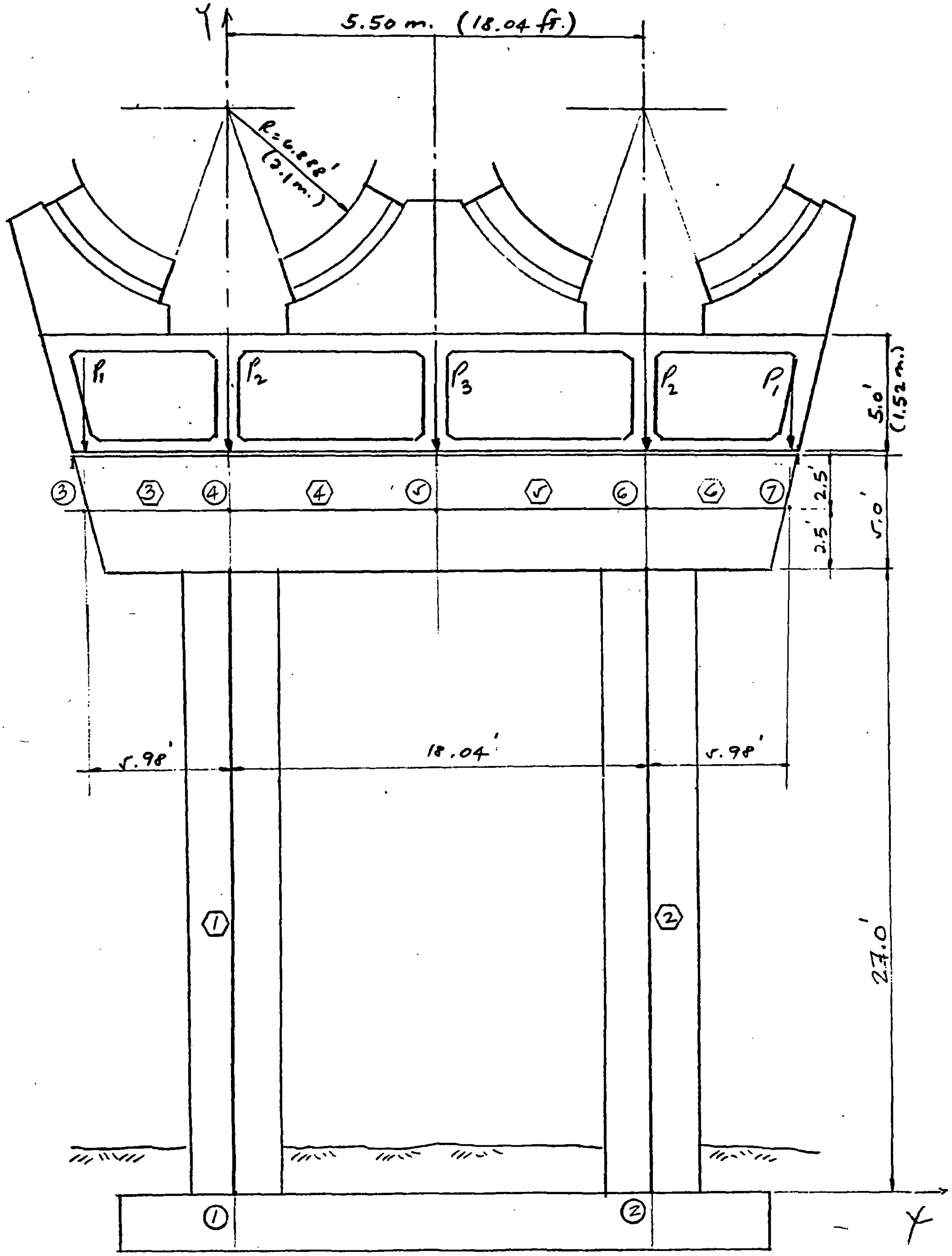

```
STAAD SPACE FRAME - MAGLEV - E2
*** SIMPLE BEAM SPAN *** ( MGLVSF5D )
*** HEIGHT = 0.91 METERS ( 3.0 FEET ) ***
UNIT FEET KIP
*********************************
JOINT COORDINATES
*********************************
  1   0.0  0.0  0.0 ;   2 120.0  0.0  0.0  ;   3 240.0  0.0  0.0
  4 360.0  0.0  0.0 ;   5 480.0  0.0  0.0  ;   6   0.0 11.88 0.0
  7 120.0 11.88 0.0 ;   8 240.0 11.88 0.0  ;   9 360.0 11.88 0.0
 10 480.0 11.88 0.0
**********************
MEMBER INCIDENCES
**********************
1 1 6 5 ; 6 6 7 9
******************************
MEMBER PROPERTIES
******************************
1 TO 5 PRIS ZD 4.0 YD 4.0
6 TO 9 PRIS AX 73.65 IZ 1731.52 IY 1000.0
************************************
MEMBER RELEASE
************************************
6 TO 9 START MZ MY FX
6 TO 9 END MZ MY FX
************************************
MEMBER OFFSET
*************************************
1 TO 5 END 0.0 -7.88 0.0
**************************************
UNIT INCH KIPS
*************************************
CONSTANTS
*************************************
E 4030.5 ALL
DENSITY 0.0000868 ALL
ALPHA 0.0000065 ALL
*************************************
UNIT FEET KIP
*************************************
PLOT PLANE XY
```

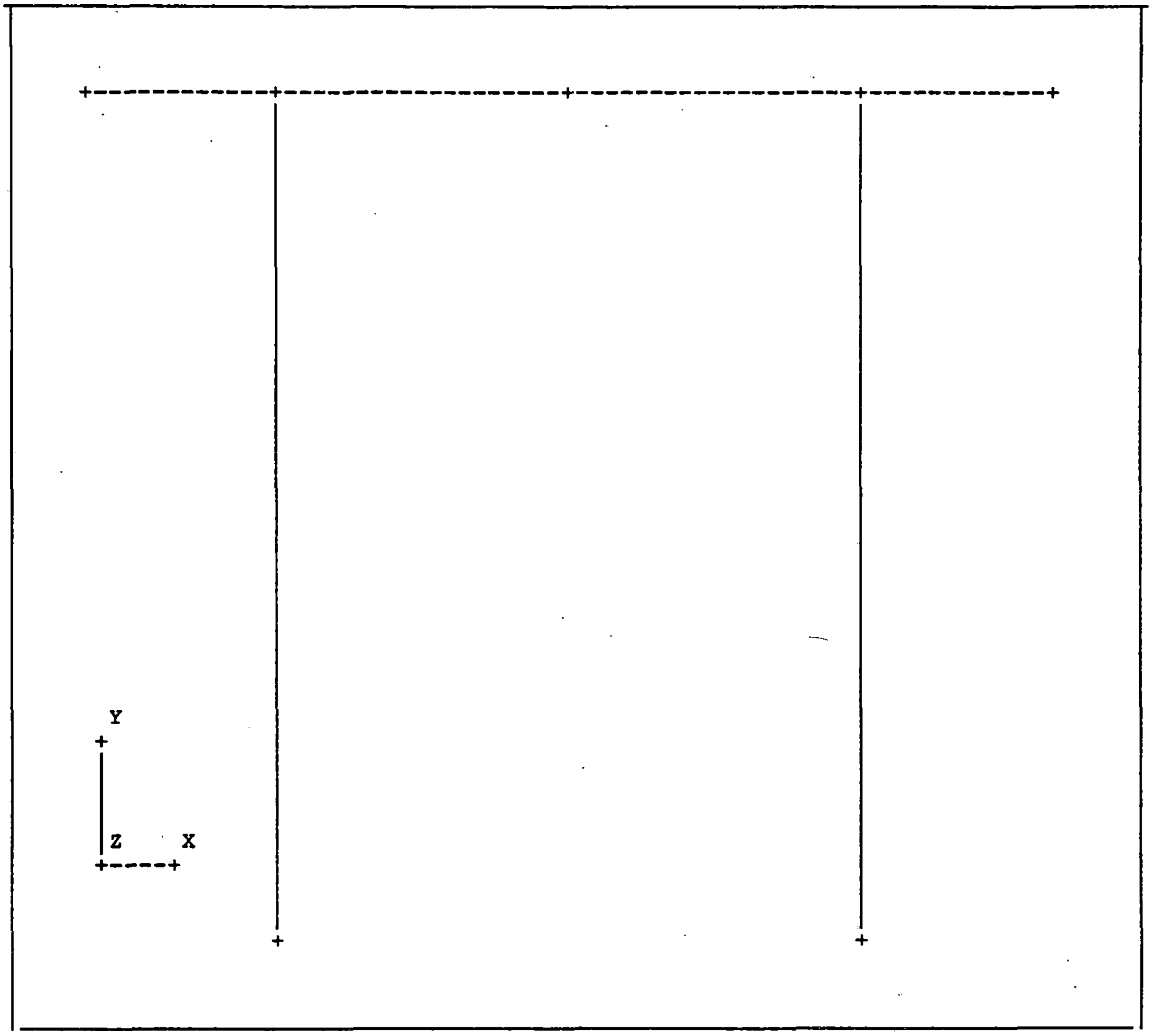
*** SIMPLE BEAM SPAN *** (MGLVSF5D)

```
   Z     X
  +-----+

+----------------+---------------+----------------+----------------+
+                +               +                +                +
```


Y
5.50 m. (18.04 ft.)
R=6.888' (2.1 m.)
P_1
P_2
P_3
P_2
P_1
5.0' (1.52 m.)
3
4
5
6
7
2.5'
5.0'
2.5'
5.98'
18.04'
5.98'
1
2
27.0'
X

```
****************************************************
*                                                  *
*            S T A A D - III                       *
*            REVISION 14.0 (VERSION 14 LEVEL 0)    *
*            PROPRIETARY PROGRAM OF                *
*            RESEARCH ENGINEERS,INC.               *
*            DATE=    APR 24, 1992                 *
*            TIME=    11:25:13                     *
*                                                  *
****************************************************

 1. STAAD SPACE FRAME - MAGLEV - E2
 2. *** ELEVATED DOUBLE GUIDEWAY - ( MGLVDC ) ***
 3. *** SIMPLE BEAM 120 FEET SPAN ***
 4. *** HEIGHT = 9.62 METERS ( 30.0 FEET ) ***
 5. UNIT FEET KIP
 6. **********************************
 7. JOINT COORDINATES
 8. **********************************
 9.   1   0.0   0.0  0.0 ;   2  18.04  0.0  0.0  ;   3  -5.98 27.0 0.0
10.   4   0.0  27.0  0.0 ;   5   9.02 27.0  0.0  ;   6  18.04 27.0 0.0
11.   7  24.02 27.0  0.0
12. ***********************
13. MEMBER INCIDENCES
14. ***********************
15. 1 1 4 ; 2 2 6 ; 3 3 4 6
16. *******************************
17. MEMBER PROPERTIES
18. *******************************
19. 1 2 PRIS ZD 4.0 YD 4.0
20. 3 TO 6 PRIS ZD 4.0 YD 10.0
21. *************************************
22. MEMBER OFFSET
23. **************************************
24. 1 2 END 0.0 -5.0 0.0
25. ***************************************
26. UNIT INCH KIPS
27. **************************************
28. CONSTANTS
29. **************************************
30. E 4030.5 ALL
31. DENSITY 0.0000868 ALL
32. ALPHA 0.0000065 ALL
33. **************************************
34. UNIT FEET KIP
35. **************************************
36. PLOT PLANE XY
```

*** ELEVATED DOUBLE GUIDEWAY - (MGLVDC) ***



```
****************************************
SUPPORT
****************************************
1 2 FIXED
****************************************
LOADING 1 DEAD LOAD 1
****************************************
SELFWEIGHT Y -1.0
*************************************************
LOADING 2 DEAD LOAD 2
*************************************************
*** BOX GIRDER + UTILITY + PROPULSION + GUIDEWAY ***
***************************
JOINT LOAD
***************************
3 7 FY -683.90
4 6 FY -533.88
5 FY -645.42
*******************************
LOADING 3 SNOW LOAD
*******************************
JOINT LOAD
******************************
3 7 FY -34.02
4 6 FY -31.94
5 FY -37.8
******************************
LOADING 4 LIVE LOAD - VEHICHLE LOAD ( 140 PASSENGER )
*******************************
JOINT LOAD
********************************
3 7 FY -22.50
4 6 FY -17.62
5 FY -29.75
*******************************
LOADING 5 SEISMIC LOAD 1 - TRANSVERSE DIRECTION
********************************
SELFWEIGHT X 0.105
********************************
JOINT LOAD
********************************
3 FY -51.43  FX  58.64 MZ -293.2
4 FY -10.78  FX  99.76 MZ -498.8
5 FX  122.14 MZ -610.7
6 FY  10.78  FX  99.76 MZ -498.8
7 FY  51.43  FX  58.64 MZ -293.2
********************************
LOADING 6 SEISMIC LOAD 2 - LONGITUDINAL DIRECTION
********************************
SELFWEIGHT Z 0.105
********************************
JOINT LOAD
********************************
3 FZ  58.64 MX 293.2
4 FZ  99.76 MX 498.8
5 FZ 122.14 MX 610.7
6 FZ  99.76 MX 498.8
7 FZ  58.64 MX 293.2
*********************************
LOADING 7 WIND LOAD
```

```
*******************************
JOINT LOAD
********************************
3 FY -41.62 FX -22.68 MZ 113.4
4 FY  -9.30 FX -36.64 MZ 183.2
5 FY   1.82 FX -43.48 MZ 217.4
6 FY  14.18 FX -35.12 MZ 175.6
7 FY  64.28 FX -17.18 MZ  85.9
*******************************
LOAD COMB 8 DEAD LOAD + SNOW LOAD + LIVE LOAD
1 1.0 2 1.0 3 1.0 4 1.0
*******************************
LOAD COMB 9 DEAD + SNOW + LIVE LOAD + SEISMIC LOAD 1
1 0.66 2 0.66 3 0.66 4 0.66 5 0.73
*******************************
LOAD COMB 10 DEAD + SNOW + LIVE LOAD + SEISMIC LOAD 2
1 0.66 2 0.66 3 0.66 4 0.66 6 0.73
*******************************
LOAD COMB 11 DEAD LOAD + SEISMIC LOAD 1
1 0.90 2 0.90 5 1.10
*******************************
LOAD COMB 12 DEAD LOAD + SEISMIC LOAD 2
1 0.90 2 0.90 6 1.10
********************************
LOAD COMB 13 DEAD + SNOW + LIVE LOAD + WIND LOAD
1 0.66 2 0.66 3 0.66 4 0.66 7 0.66
********************************
LOAD COMB 14 DEAD LOAD + WIND LOAD
1 0.90 2 0.90 7 1.0
********************************
*** ULTIMATE STRENGTH DESIGN ***
********************************
LOAD COMB 15 DEAD LOAD + SNOW LOAD + LIVE LOAD
1 1.40 2 1.40 3 1.70 4 1.70
********************************
LOAD COMB 16 DEAD + SNOW + LIVE LOAD + SEISMIC LOAD 1
1 0.92 2 0.92 3 1.12 4 1.12 5 1.23
************************************
LOAD COMB 17 DEAD + SNOW + LIVE LOAD + SEISMIC LOAD 2
1 0.92 2 0.92 3 1.12 4 1.12 6 1.23
************************************
LOAD COMB 18 DEAD LOAD + SEISMIC LOAD 1
1 0.90 2 0.90 5 1.40
*******************************
LOAD COMB 19 DEAD LOAD + SEISMIC LOAD 2
1 0.90 2 0.90 6 1.40
********************************
LOAD COMB 20 DEAD + SNOW + LIVE LOAD + WIND LOAD
1 0.92 2 0.92 3 1.12 4 1.12 7 1.12
********************************
LOAD COMB 21 DEAD LOAD + WIND LOAD
1 0.90 2 0.90 7 1.28
********************************
PERFORM ANALYSIS
```

```
      P R O B L E M   S T A T I S T I C S
      -----------------------------------

   NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =      7/     6/     2
   ORIGINAL/FINAL BAND-WIDTH =     4/     2
   TOTAL PRIMARY LOAD CASES  =     7, TOTAL DEGREES OF FREEDOM =     30
   SIZE OF STIFFNESS MATRIX =     540 DOUBLE PREC. WORDS
   TOTAL REQUIRED DISK SPACE =     0.02 MEGA-BYTES

++ PROCESSING ELEMENT STIFFNESS MATRIX.               11:25:19
++ PROCESSING GLOBAL STIFFNESS MATRIX.                11:25:19
++ PROCESSING TRIANGULAR FACTORIZATION.               11:25:20
++ CALCULATING JOINT DISPLACEMENTS.                   11:25:21
++ CALCULATING ELEMENT FORCES.                        11:25:22

 151. LOAD LIST 1 TO 14
 152. PRINT JOINT DISPLACEMENT LIST 3 TO 7
```

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*** ELEVATED DOUBLE GUIDEWAY - (MGLVDC) ***

JOINT DISPLACEMENT (INCH RADIANS)   STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
3	1	0.00000	-0.00332	0.00000	0.00000	0.00000	0.00000
	2	-0.00010	-0.05851	0.00000	0.00000	0.00000	0.00017
	3	0.00000	-0.00311	0.00000	0.00000	0.00000	0.00001
	4	0.00000	-0.00199	0.00000	0.00000	0.00000	0.00000
	5	0.25342	0.02698	0.00000	0.00000	0.00000	-0.00022
	6	0.00000	0.00000	1.84657	0.00853	0.00005	0.00000
	7	-0.09353	-0.01613	0.00000	0.00000	0.00000	0.00012
	8	-0.00011	-0.06693	0.00000	0.00000	0.00000	0.00018
	9	0.18492	-0.02448	0.00000	0.00000	0.00000	-0.00004
	10	-0.00007	-0.04417	1.34800	0.00623	0.00004	0.00012
	11	0.27867	-0.02596	0.00000	0.00000	0.00000	-0.00009
	12	-0.00009	-0.05564	2.03123	0.00938	0.00006	0.00015
	13	-0.06180	-0.05482	0.00000	0.00000	0.00000	0.00020
	14	-0.09361	-0.07178	0.00000	0.00000	0.00000	0.00027
4	1	0.00000	-0.00331	0.00000	0.00000	0.00000	0.00000
	2	-0.00010	-0.04379	0.00000	0.00000	0.00000	0.00010
	3	0.00000	-0.00241	0.00000	0.00000	0.00000	0.00000
	4	0.00000	-0.00156	0.00000	0.00000	0.00000	0.00000
	5	0.25323	0.01195	0.00000	0.00000	0.00000	-0.00021
	6	0.00000	0.00000	1.84325	0.00849	0.00002	0.00000
	7	-0.09346	-0.00735	0.00000	0.00000	0.00000	0.00011
	8	-0.00011	-0.05108	0.00000	0.00000	0.00000	0.00011
	9	0.18479	-0.02499	0.00000	0.00000	0.00000	-0.00008
	10	-0.00007	-0.03371	1.34557	0.00620	0.00001	0.00007
	11	0.27846	-0.02925	0.00000	0.00000	0.00000	-0.00014
	12	-0.00009	-0.04239	2.02757	0.00934	0.00002	0.00009
	13	-0.06175	-0.03856	0.00000	0.00000	0.00000	0.00015
	14	-0.09354	-0.04974	0.00000	0.00000	0.00000	0.00021
5	1	0.00000	-0.00378	0.00000	0.00000	0.00000	0.00000
	2	0.00000	-0.04240	0.00000	0.00000	0.00000	0.00000
	3	0.00000	-0.00241	0.00000	0.00000	0.00000	0.00000
	4	0.00000	-0.00161	0.00000	0.00000	0.00000	0.00000
	5	0.25353	0.00000	0.00000	0.00000	0.00000	-0.00013
	6	0.00000	0.00000	1.84438	0.00855	0.00000	0.00000
	7	-0.09354	0.00033	0.00000	0.00000	0.00000	0.00008
	8	0.00000	-0.05021	0.00000	0.00000	0.00000	0.00000
	9	0.18507	-0.03314	0.00000	0.00000	0.00000	-0.00009
	10	0.00000	-0.03314	1.34640	0.00624	0.00000	0.00000
	11	0.27888	-0.04157	0.00000	0.00000	0.00000	-0.00014
	12	0.00000	-0.04157	2.02882	0.00941	0.00000	0.00000
	13	-0.06174	-0.03292	0.00000	0.00000	0.00000	0.00005
	14	-0.09354	-0.04124	0.00000	0.00000	0.00000	0.00008
6	1	0.00000	-0.00331	0.00000	0.00000	0.00000	0.00000
	2	0.00010	-0.04379	0.00000	0.00000	0.00000	-0.00010
	3	0.00000	-0.00241	0.00000	0.00000	0.00000	0.00000
	4	0.00000	-0.00156	0.00000	0.00000	0.00000	0.00000
	5	0.25323	-0.01195	0.00000	0.00000	0.00000	-0.00021
	6	0.00000	0.00000	1.84325	0.00849	-0.00002	0.00000

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = SPACE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
	7	-0.09343	0.00818	0.00000	0.00000	0.00000	0.00012
	8	0.00011	-0.05108	0.00000	0.00000	0.00000	-0.00011
	9	0.18493	-0.04244	0.00000	0.00000	0.00000	-0.00023
	10	0.00007	-0.03371	1.34557	0.00620	-0.00001	-0.00007
	11	0.27864	-0.05554	0.00000	0.00000	0.00000	-0.00033
	12	0.00009	-0.04239	2.02757	0.00934	-0.00002	-0.00009
	13	-0.06159	-0.02831	0.00000	0.00000	0.00000	0.00001
	14	-0.09334	-0.03421	0.00000	0.00000	0.00000	0.00003
7	1	0.00000	-0.00332	0.00000	0.00000	0.00000	0.00000
	2	0.00010	-0.05851	0.00000	0.00000	0.00000	-0.00017
	3	0.00000	-0.00311	0.00000	0.00000	0.00000	-0.00001
	4	0.00000	-0.00199	0.00000	0.00000	0.00000	0.00000
	5	0.25342	-0.02698	0.00000	0.00000	0.00000	-0.00022
	6	0.00000	0.00000	1.84657	0.00853	-0.00005	0.00000
	7	-0.09348	0.01744	0.00000	0.00000	0.00000	0.00013
	8	0.00011	-0.06693	0.00000	0.00000	0.00000	-0.00018
	9	0.18506	-0.06387	0.00000	0.00000	0.00000	-0.00028
	10	0.00007	-0.04417	1.34800	0.00623	-0.00004	-0.00012
	11	0.27885	-0.08533	0.00000	0.00000	0.00000	-0.00039
	12	0.00009	-0.05564	2.03123	0.00938	-0.00006	-0.00015
	13	-0.06163	-0.03266	0.00000	0.00000	0.00000	-0.00003
	14	-0.09339	-0.03821	0.00000	0.00000	0.00000	-0.00002

************** END OF LATEST ANALYSIS RESULT **************

153. PRINT SUPPORT REACTION

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	0.46	142.79	0.00	0.00	0.00	-3.78
	2	-21.66	1540.49	0.00	0.00	0.00	179.72
	3	-0.97	84.86	0.00	0.00	0.00	8.06
	4	-0.55	55.00	0.00	0.00	0.00	4.60
	5	-234.46	-420.41	0.00	0.00	0.00	2678.38
	6	0.00	0.00	-234.46	-7339.16	-7.51	0.00
	7	77.94	258.40	0.00	0.00	0.00	-921.86
	8	-22.73	1823.14	0.00	0.00	0.00	188.61
	9	-186.16	896.37	0.00	0.00	0.00	2079.70
	10	-15.00	1203.27	-171.16	-5357.58	-5.48	124.48
	11	-276.99	1052.50	0.00	0.00	0.00	3104.56
	12	-19.08	1514.95	-257.91	-8073.07	-8.26	158.35
	13	36.44	1373.82	0.00	0.00	0.00	-483.95
	14	58.86	1773.36	0.00	0.00	0.00	-763.51
2	1	-0.46	142.79	0.00	0.00	0.00	3.78
	2	21.66	1540.49	0.00	0.00	0.00	-179.72
	3	0.97	84.86	0.00	0.00	0.00	-8.06
	4	0.55	54.99	0.00	0.00	0.00	-4.60
	5	-234.46	420.41	0.00	0.00	0.00	2678.38
	6	0.00	0.00	-234.46	-7339.16	7.51	0.00
	7	77.16	-287.76	0.00	0.00	0.00	-915.21
	8	22.73	1823.14	0.00	0.00	0.00	-188.61
	9	-156.16	1510.17	0.00	0.00	0.00	1830.74
	10	15.00	1203.27	-171.16	-5357.58	5.48	-124.48
	11	-238.83	1977.40	0.00	0.00	0.00	2787.87
	12	19.08	1514.95	-257.91	-8073.07	8.26	-158.35
	13	65.92	1013.35	0.00	0.00	0.00	-728.52
	14	96.24	1227.19	0.00	0.00	0.00	-1073.56

************** END OF LATEST ANALYSIS RESULT **************

154. LOAD LIST ALL
155. PRINT MEMBER FORCES

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*** ELEVATED DOUBLE GUIDEWAY - (MGLVDC) ***

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	142.79	-0.46	0.00	0.00	0.00	-3.78
		4	-89.99	0.46	0.00	0.00	0.00	-6.24
	2	1	1540.49	21.66	0.00	0.00	0.00	179.72
		4	-1540.49	-21.66	0.00	0.00	0.00	296.71
	3	1	84.86	0.97	0.00	0.00	0.00	8.06
		4	-84.86	-0.97	0.00	0.00	0.00	13.31
	4	1	55.00	0.55	0.00	0.00	0.00	4.60
		4	-55.00	-0.55	0.00	0.00	0.00	7.60
	5	1	-420.41	234.46	0.00	0.00	0.00	2678.38
		4	420.41	-228.92	0.00	0.00	0.00	2418.83
	6	1	0.00	0.00	-234.46	-7.51	7339.16	0.00
		4	0.00	0.00	228.92	7.51	-2241.95	0.00
	7	1	258.40	-77.94	0.00	0.00	0.00	-921.86
		4	-258.40	77.94	0.00	0.00	0.00	-792.92
	8	1	1823.14	22.73	0.00	0.00	0.00	188.61
		4	-1770.34	-22.73	0.00	0.00	0.00	311.38
	9	1	896.37	186.16	0.00	0.00	0.00	2079.70
		4	-861.53	-182.11	0.00	0.00	0.00	1971.26
	10	1	1203.27	15.00	-171.16	-5.48	5357.58	124.48
		4	-1168.42	-15.00	167.11	5.48	-1636.62	205.51
	11	1	1052.50	276.99	0.00	0.00	0.00	3104.56
		4	-1004.99	-270.89	0.00	0.00	0.00	2922.13
	12	1	1514.95	19.08	-257.91	-8.26	8073.07	158.35
		4	-1467.44	-19.08	251.81	8.26	-2466.14	261.42
	13	1	1373.82	-36.44	0.00	0.00	0.00	-483.95
		4	-1338.97	36.44	0.00	0.00	0.00	-317.81
	14	1	1773.36	-58.86	0.00	0.00	0.00	-763.51
		4	-1725.84	58.86	0.00	0.00	0.00	-531.50
	15	1	2594.35	32.28	0.00	0.00	0.00	267.85
		4	-2520.43	-32.28	0.00	0.00	0.00	442.21
	16	1	1188.15	309.60	0.00	0.00	0.00	3470.46
		4	-1139.58	-302.78	0.00	0.00	0.00	3265.81
	17	1	1705.26	21.21	-288.39	-9.24	9027.16	176.05
		4	-1656.68	-21.21	281.57	9.24	-2757.59	290.65
	18	1	926.38	347.33	0.00	0.00	0.00	3908.08
		4	-878.86	-339.57	0.00	0.00	0.00	3647.78
	19	1	1514.95	19.08	-328.25	-10.52	10274.82	158.35
		4	-1467.44	-19.08	320.49	10.52	-3138.73	261.42
	20	1	1994.67	-66.08	0.00	0.00	0.00	-856.43
		4	-1946.09	66.08	0.00	0.00	0.00	-597.42
	21	1	1845.71	-80.69	0.00	0.00	0.00	-1021.63
		4	-1798.19	80.69	0.00	0.00	0.00	-753.51
2	1	2	142.79	0.46	0.00	0.00	0.00	3.78
		6	-89.99	-0.46	0.00	0.00	0.00	6.24
	2	2	1540.49	-21.66	0.00	0.00	0.00	-179.72
		6	-1540.49	21.66	0.00	0.00	0.00	-296.71

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	3	2	84.86	-0.97	0.00	0.00	0.00	-8.06
		6	-84.86	0.97	0.00	0.00	0.00	-13.31
	4	2	54.99	-0.55	0.00	0.00	0.00	-4.60
		6	-54.99	0.55	0.00	0.00	0.00	-7.60
	5	2	420.41	234.46	0.00	0.00	0.00	2678.38
		6	-420.41	-228.92	0.00	0.00	0.00	2418.83
	6	2	0.00	0.00	-234.46	7.51	7339.16	0.00
		6	0.00	0.00	228.92	-7.51	-2241.95	0.00
	7	2	-287.76	-77.16	0.00	0.00	0.00	-915.21
		6	287.76	77.16	0.00	0.00	0.00	-782.21
	8	2	1823.14	-22.73	0.00	0.00	0.00	-188.61
		6	-1770.34	22.73	0.00	0.00	0.00	-311.38
	9	2	1510.17	156.16	0.00	0.00	0.00	1830.74
		6	-1475.32	-152.11	0.00	0.00	0.00	1560.23
	10	2	1203.27	-15.00	-171.16	5.48	5357.58	-124.48
		6	-1168.42	15.00	167.11	-5.48	-1636.62	-205.51
	11	2	1977.40	238.83	0.00	0.00	0.00	2787.87
		6	-1929.89	-232.73	0.00	0.00	0.00	2399.28
	12	2	1514.95	-19.08	-257.91	8.26	8073.07	-158.35
		6	-1467.44	19.08	251.81	-8.26	-2466.14	-261.42
	13	2	1013.35	-65.92	0.00	0.00	0.00	-728.52
		6	-978.50	65.92	0.00	0.00	0.00	-721.77
	14	2	1227.19	-96.24	0.00	0.00	0.00	-1073.56
		6	-1179.67	96.24	0.00	0.00	0.00	-1043.63
	15	2	2594.35	-32.28	0.00	0.00	0.00	-267.85
		6	-2520.43	32.28	0.00	0.00	0.00	-442.21
	16	2	2222.36	267.18	0.00	0.00	0.00	3118.36
		6	-2173.79	-260.36	0.00	0.00	0.00	2684.50
	17	2	1705.26	-21.21	-288.39	9.24	9027.16	-176.05
		6	-1656.68	21.21	281.57	-9.24	-2757.59	-290.65
	18	2	2103.53	309.17	0.00	0.00	0.00	3591.39
		6	-2056.01	-301.41	0.00	0.00	0.00	3124.93
	19	2	1514.95	-19.08	-328.25	10.52	10274.82	-158.35
		6	-1467.44	19.08	320.49	-10.52	-3138.72	-261.42
	20	2	1382.96	-107.63	0.00	0.00	0.00	-1201.09
		6	-1334.39	107.63	0.00	0.00	0.00	-1166.73
	21	2	1146.62	-117.84	0.00	0.00	0.00	-1329.82
		6	-1099.10	117.84	0.00	0.00	0.00	-1262.65
3	1	3	0.00	0.00	0.00	0.00	0.00	0.00
		4	0.00	35.88	0.00	0.00	0.00	-107.27
	2	3	0.00	-683.90	0.00	0.00	0.00	0.00
		4	0.00	683.90	0.00	0.00	0.00	-4089.72
	3	3	0.00	-34.02	0.00	0.00	0.00	0.00
		4	0.00	34.02	0.00	0.00	0.00	-203.44
	4	3	0.00	-22.50	0.00	0.00	0.00	0.00
		4	0.00	22.50	0.00	0.00	0.00	-134.55
	5	3	58.65	-51.43	0.00	0.00	0.00	-293.20
		4	-62.41	51.43	0.00	0.00	0.00	-14.35
	6	3	0.00	0.00	58.63	293.20	-0.01	0.00
		4	0.00	0.00	-62.39	-293.20	-361.92	0.00

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MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	7	3	-22.68	-41.62	0.00	0.00	0.00	113.40
		4	22.68	41.62	0.00	0.00	0.00	-362.29
	8	3	0.00	-740.42	0.00	0.00	0.00	0.00
		4	0.00	776.30	0.00	0.00	0.00	-4534.99
	9	3	42.81	-526.22	0.00	0.00	0.00	-214.04
		4	-45.56	549.90	0.00	0.00	0.00	-3003.57
	10	3	0.00	-488.68	42.80	214.04	0.00	0.00
		4	0.00	512.36	-45.55	-214.04	-264.20	-2993.09
	11	3	64.51	-672.08	0.00	0.00	0.00	-322.52
		4	-68.65	704.37	0.00	0.00	0.00	-3793.09
	12	3	0.00	-615.51	64.49	322.52	-0.01	0.00
		4	0.00	647.80	-68.63	-322.52	-398.11	-3777.30
	13	3	-14.97	-516.15	0.00	0.00	0.00	74.84
		4	14.97	539.83	0.00	0.00	0.00	-3232.20
	14	3	-22.68	-657.13	0.00	0.00	0.00	113.40
		4	22.68	689.42	0.00	0.00	0.00	-4139.59
	15	3	0.00	-1053.54	0.00	0.00	0.00	0.00
		4	0.00	1103.77	0.00	0.00	0.00	-6450.38
	16	3	72.13	-755.75	0.00	0.00	0.00	-360.64
		4	-76.77	788.76	0.00	0.00	0.00	-4257.44
	17	3	0.00	-692.49	72.11	360.64	-0.01	0.00
		4	0.00	725.50	-76.74	-360.64	-445.16	-4239.79
	18	3	82.10	-687.51	0.00	0.00	0.00	-410.48
		4	-87.38	719.80	0.00	0.00	0.00	-3797.39
	19	3	0.00	-615.51	82.08	410.48	-0.01	0.00
		4	0.00	647.80	-87.35	-410.48	-506.68	-3777.30
	20	3	-25.40	-739.11	0.00	0.00	0.00	127.00
		4	25.40	772.11	0.00	0.00	0.00	-4645.55
	21	3	-29.03	-668.78	0.00	0.00	0.00	145.15
		4	29.03	701.07	0.00	0.00	0.00	-4241.03
4	1	4	0.46	54.12	0.00	0.00	0.00	115.80
		5	-0.46	0.00	0.00	0.00	0.00	128.27
	2	4	-21.66	322.71	0.00	0.00	0.00	3684.73
		5	21.66	-322.71	0.00	0.00	0.00	-773.88
	3	4	-0.97	18.90	0.00	0.00	0.00	185.27
		5	0.97	-18.90	0.00	0.00	0.00	-14.79
	4	4	-0.55	14.87	0.00	0.00	0.00	124.18
		5	0.55	-14.87	0.00	0.00	0.00	9.99
	5	4	-66.75	-482.62	0.00	0.00	0.00	-4047.87
		5	61.07	482.62	0.00	0.00	0.00	-305.35
	6	4	0.00	0.00	-66.75	-305.35	354.40	0.00
		5	0.00	0.00	61.07	305.35	222.05	0.00
	7	4	18.62	207.48	0.00	0.00	0.00	1728.13
		5	-18.62	-207.48	0.00	0.00	0.00	143.37
	8	4	-22.73	410.60	0.00	0.00	0.00	4109.97
		5	22.73	-356.49	0.00	0.00	0.00	-650.41
	9	4	-63.73	-81.31	0.00	0.00	0.00	-242.37
		5	59.58	117.03	0.00	0.00	0.00	-652.17
	10	4	-15.00	271.00	-48.73	-222.90	258.71	2712.58
		5	15.00	-235.28	44.58	222.90	162.09	-429.27

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	11	4	-92.51	-191.74	0.00	0.00	0.00	-1032.19
		5	86.26	240.44	0.00	0.00	0.00	-916.93
	12	4	-19.08	339.14	-73.42	-335.88	389.84	3420.47
		5	19.08	-290.44	67.17	335.88	244.25	-581.05
	13	4	-2.71	407.94	0.00	0.00	0.00	3853.15
		5	2.71	-372.22	0.00	0.00	0.00	-334.65
	14	4	-0.46	546.63	0.00	0.00	0.00	5148.60
		5	0.46	-497.92	0.00	0.00	0.00	-437.68
	15	4	-32.28	584.97	0.00	0.00	0.00	5846.79
		5	32.28	-509.21	0.00	0.00	0.00	-912.01
	16	4	-103.32	-209.11	0.00	0.00	0.00	-1135.82
		5	96.33	258.90	0.00	0.00	0.00	-974.91
	17	4	-21.21	384.51	-82.10	-375.58	435.91	3843.06
		5	21.21	-334.72	75.11	375.58	273.12	-599.33
	18	4	-112.54	-336.52	0.00	0.00	0.00	-2246.55
		5	104.58	385.23	0.00	0.00	0.00	-1008.54
	19	4	-19.08	339.14	-93.45	-427.49	496.16	3420.47
		5	19.08	-290.44	85.49	427.49	310.87	-581.05
	20	4	-0.35	616.89	0.00	0.00	0.00	5778.57
		5	0.35	-567.10	0.00	0.00	0.00	-438.76
	21	4	4.76	604.72	0.00	0.00	0.00	5632.48
		5	-4.76	-556.02	0.00	0.00	0.00	-397.54
5	1	5	0.46	0.00	0.00	0.00	0.00	-128.27
		6	-0.46	54.12	0.00	0.00	0.00	-115.80
	2	5	-21.66	-322.71	0.00	0.00	0.00	773.88
		6	21.66	322.71	0.00	0.00	0.00	-3684.73
	3	5	-0.97	-18.90	0.00	0.00	0.00	14.79
		6	0.97	18.90	0.00	0.00	0.00	-185.27
	4	5	-0.55	-14.87	0.00	0.00	0.00	-9.99
		6	0.55	14.87	0.00	0.00	0.00	-124.18
	5	5	61.07	-482.62	0.00	0.00	0.00	-305.35
		6	-66.75	482.62	0.00	0.00	0.00	-4047.87
	6	5	0.00	0.00	61.07	305.35	-222.06	0.00
		6	0.00	0.00	-66.75	-305.35	-354.41	0.00
	7	5	-24.86	209.30	0.00	0.00	0.00	74.03
		6	24.86	-209.30	0.00	0.00	0.00	1813.88
	8	5	-22.73	-356.48	0.00	0.00	0.00	650.41
		6	22.73	410.60	0.00	0.00	0.00	-4109.97
	9	5	29.58	-587.59	0.00	0.00	0.00	206.36
		6	-33.73	623.31	0.00	0.00	0.00	-5667.52
	10	5	-15.00	-235.28	44.58	222.91	-162.10	429.27
		6	15.00	271.00	-48.73	-222.91	-258.72	-2712.58
	11	5	48.09	-821.32	0.00	0.00	0.00	245.17
		6	-54.35	870.02	0.00	0.00	0.00	-7873.13
	12	5	-19.08	-290.44	67.18	335.89	-244.26	581.05
		6	19.08	339.14	-73.43	-335.89	-389.85	-3420.47
	13	5	-31.41	-97.14	0.00	0.00	0.00	478.13
		6	31.41	132.86	0.00	0.00	0.00	-1515.42
	14	5	-43.94	-81.14	0.00	0.00	0.00	655.09
		6	43.94	129.84	0.00	0.00	0.00	-1606.59

MEMBER END FORCES STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	15	5	-32.28	-509.21	0.00	0.00	0.00	912.01
		6	32.28	584.97	0.00	0.00	0.00	-5846.79
	16	5	53.90	-928.34	0.00	0.00	0.00	223.75
		6	-60.89	978.13	0.00	0.00	0.00	-8821.94
	17	5	-21.21	-334.72	75.12	375.58	-273.13	599.34
		6	21.21	384.51	-82.10	-375.58	-435.93	-3843.06
	18	5	66.42	-966.10	0.00	0.00	0.00	153.56
		6	-74.37	1014.81	0.00	0.00	0.00	-9087.49
	19	5	-19.08	-290.44	85.50	427.49	-310.88	581.05
		6	19.08	339.14	-93.45	-427.49	-496.18	-3420.47
	20	5	-49.05	-100.30	0.00	0.00	0.00	682.25
		6	49.05	150.09	0.00	0.00	0.00	-1811.51
	21	5	-50.90	-22.53	0.00	0.00	0.00	675.81
		6	50.90	71.24	0.00	0.00	0.00	-1098.70
6	1	6	0.00	35.88	0.00	0.00	0.00	107.27
		7	0.00	0.00	0.00	0.00	0.00	0.00
	2	6	0.00	683.90	0.00	0.00	0.00	4089.72
		7	0.00	-683.90	0.00	0.00	0.00	0.00
	3	6	0.00	34.02	0.00	0.00	0.00	203.44
		7	0.00	-34.02	0.00	0.00	0.00	0.00
	4	6	0.00	22.50	0.00	0.00	0.00	134.55
		7	0.00	-22.50	0.00	0.00	0.00	0.00
	5	6	-62.40	-51.43	0.00	0.00	0.00	-14.35
		7	58.64	51.43	0.00	0.00	0.00	-293.20
	6	6	0.00	0.00	-62.41	-293.20	361.94	0.00
		7	0.00	0.00	58.64	293.20	0.00	0.00
	7	6	17.18	-64.28	0.00	0.00	0.00	-470.29
		7	-17.18	64.28	0.00	0.00	0.00	85.90
	8	6	0.00	776.30	0.00	0.00	0.00	4534.99
		7	0.00	-740.42	0.00	0.00	0.00	0.00
	9	6	-45.55	474.81	0.00	0.00	0.00	2982.61
		7	42.80	-451.13	0.00	0.00	0.00	-214.04
	10	6	0.00	512.36	-45.56	-214.04	264.22	2993.09
		7	0.00	-488.68	42.81	214.04	0.00	0.00
	11	6	-68.64	591.23	0.00	0.00	0.00	3761.51
		7	64.50	-558.94	0.00	0.00	0.00	-322.52
	12	6	0.00	647.80	-68.65	-322.52	398.13	3777.30
		7	0.00	-615.51	64.51	322.52	0.00	0.00
	13	6	11.34	469.93	0.00	0.00	0.00	2682.70
		7	-11.34	-446.25	0.00	0.00	0.00	56.69
	14	6	17.18	583.52	0.00	0.00	0.00	3307.00
		7	-17.18	-551.23	0.00	0.00	0.00	85.90
	15	6	0.00	1103.77	0.00	0.00	0.00	6450.38
		7	0.00	-1053.54	0.00	0.00	0.00	0.00
	16	6	-76.76	662.24	0.00	0.00	0.00	4222.13
		7	72.12	-629.23	0.00	0.00	0.00	-360.64
	17	6	0.00	725.50	-76.76	-360.64	445.19	4239.78
		7	0.00	-692.49	72.13	360.64	0.00	0.00
	18	6	-87.36	575.80	0.00	0.00	0.00	3757.20
		7	82.09	-543.51	0.00	0.00	0.00	-410.48

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MEMBER END FORCES   STRUCTURE TYPE = SPACE

ALL UNITS ARE -- KIP FEET

MEMB	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	19	6	0.00	647.80	-87.37	-410.48	506.72	3777.30
		7	0.00	-615.51	82.10	410.48	0.00	0.00
	20	6	19.24	653.50	0.00	0.00	0.00	3713.05
		7	-19.24	-620.50	0.00	0.00	0.00	96.21
	21	6	21.99	565.52	0.00	0.00	0.00	3175.32
		7	-21.99	-533.23	0.00	0.00	0.00	109.95

************** END OF LATEST ANALYSIS RESULT **************

156. LOAD LIST 15 TO 21
157. PRINT FORCE ENVELOPE

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MEMBER FORCE ENVELOPE

ALL UNITS ARE KIP FEET

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
1	0.00	MAX.	347.33	18	3908.08	18	0.00	21	10274.82	19
		MIN.	-80.69	21	-1021.63	21	-328.25	19	0.00	21
	2.20	MAX.	346.55	18	3144.81	18	0.00	21	9553.52	19
		MIN.	-80.69	21	-844.12	21	-327.47	19	0.00	21
	4.40	MAX.	345.78	18	2383.25	18	0.00	21	8833.94	19
		MIN.	-80.69	21	-666.60	21	-326.70	19	0.00	21
	6.60	MAX.	345.00	18	1623.39	18	0.00	21	8116.06	19
		MIN.	-80.69	21	-489.09	21	-325.92	19	0.00	21
	8.80	MAX.	344.22	18	865.25	18	0.00	21	7399.89	19
		MIN.	-80.69	21	-311.57	21	-325.14	19	0.00	21
	11.00	MAX.	343.45	18	108.81	18	0.00	21	6685.43	19
		MIN.	-80.69	21	-134.06	21	-324.37	19	0.00	21
	13.20	MAX.	342.67	18	43.46	21	0.00	21	5972.67	19
		MIN.	-80.69	21	-645.93	18	-323.59	19	0.00	21
	15.40	MAX.	341.90	18	220.97	21	0.00	21	5261.63	19
		MIN.	-80.69	21	-1398.95	18	-322.82	19	0.00	21
	17.60	MAX.	341.12	18	398.48	21	0.00	21	4552.29	19
		MIN.	-80.69	21	-2150.27	18	-322.04	19	0.00	21
	19.80	MAX.	340.34	18	576.00	21	0.00	21	3844.65	19
		MIN.	-80.69	21	-2899.88	18	-321.26	19	0.00	21
	22.00	MAX.	339.57	18	753.51	21	0.00	21	3138.73	19
		MIN.	-80.69	21	-3647.78	18	-320.49	19	0.00	21

MAX/MIN FORCE VALUES FOR MEMB 1,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST DIST	LD LD	MZ/ MY	DIST DIST	LD LD	FX	DIST	LD
MAX.	347.33	0.00	18	3908.08	0.00	18			
	0.00	0.00	15	10274.82	0.00	19	2594.35 C	0.00	15
MIN.	-80.69	22.00	21	-3647.78	22.00	18			
	-328.25	0.00	19	0.00	22.00	21	878.86 C	22.00	18

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
2	0.00	MAX.	309.17	18	3591.39	18	0.00	21	10274.82	19
		MIN.	-117.84	21	-1329.82	21	-328.25	19	0.00	21
	2.20	MAX.	308.39	18	2912.07	18	0.00	21	9553.52	19
		MIN.	-117.84	21	-1070.57	21	-327.47	19	0.00	21
	4.40	MAX.	307.62	18	2234.46	18	0.00	21	8833.94	19
		MIN.	-117.84	21	-811.33	21	-326.70	19	0.00	21
	6.60	MAX.	306.84	18	1558.56	18	0.00	21	8116.06	19
		MIN.	-117.84	21	-552.08	21	-325.92	19	0.00	21
	8.80	MAX.	306.06	18	884.37	18	0.00	21	7399.89	19
		MIN.	-117.84	21	-292.83	21	-325.14	19	0.00	21
	11.00	MAX.	305.29	18	211.88	18	0.00	21	6685.43	19

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             MIN.  -117.84  21      -33.58  21   -324.37  19      0.00  21
    13.20    MAX.   304.51  18      225.66  21      0.00  21   5972.67  19
             MIN.  -117.84  21     -458.89  18   -323.59  19      0.00  21
    15.40    MAX.   303.74  18      484.91  21      0.00  21   5261.63  19
             MIN.  -117.84  21    -1127.96  18   -322.82  19      0.00  21
    17.60    MAX.   302.96  18      744.16  21      0.00  21   4552.28  19
             MIN.  -117.84  21    -1795.33  18   -322.04  19      0.00  21
    19.80    MAX.   302.18  18     1003.40  21      0.00  21   3844.65  19
             MIN.  -117.84  21    -2460.98  18   -321.26  19      0.00  21
    22.00    MAX.   301.41  18     1262.65  21      0.00  21   3138.72  19
             MIN.  -117.84  21    -3124.93  18   -320.49  19      0.00  21
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MAX/MIN FORCE VALUES FOR MEMB   2,AMONGST ALL SECT LOCATIONS
           FY/     DIST  LD       MZ/     DIST  LD
           FZ      DIST  LD       MY      DIST  LD        FX        DIST  LD

MAX.     309.17    0.00  18     3591.39   0.00  18
           0.00    0.00  15    10274.82   0.00  19    2594.35 C    0.00  15
MIN.    -117.84   22.00  21    -3124.93  22.00  18
        -328.25    0.00  19        0.00  22.00  21    1099.10 C   22.00  21
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3     0.00   MAX.   -615.51  19     145.15  15      82.08  19      0.00  21
             MIN.  -1053.54  15    -410.48  18       0.00  21     -0.01  19
      0.60   MAX.   -618.74  19     631.52  15      82.61  19     49.23  19
             MIN.  -1058.57  15       1.62  18       0.00  21      0.00  21
      1.20   MAX.   -621.97  19    1266.04  15      83.13  19     98.79  19
             MIN.  -1063.59  15     415.64  18       0.00  21      0.00  21
      1.79   MAX.   -625.20  19    1903.57  15      83.66  19    148.66  19
             MIN.  -1068.61  15     831.60  18       0.00  21      0.00  21
      2.39   MAX.   -628.43  19    2544.10  15      84.19  19    198.85  19
             MIN.  -1073.64  15    1249.50  18       0.00  21      0.00  21
      2.99   MAX.   -631.66  19    3187.64  15      84.71  19    249.35  19
             MIN.  -1078.66  15    1669.32  18       0.00  21      0.00  21
      3.59   MAX.   -634.88  19    3834.18  15      85.24  19    300.16  19
             MIN.  -1083.68  15    2091.07  18       0.00  21      0.00  21
      4.19   MAX.   -638.11  19    4483.72  15      85.77  19    351.30  19
             MIN.  -1088.70  15    2514.75  18       0.00  21      0.00  21
      4.78   MAX.   -641.34  19    5136.27  15      86.30  19    402.74  19
             MIN.  -1093.73  15    2940.37  18       0.00  21      0.00  21
      5.38   MAX.   -644.57  19    5791.82  15      86.82  19    454.51  19
             MIN.  -1098.75  15    3367.91  18       0.00  21      0.00  21
      5.98   MAX.   -647.80  19    6450.38  15      87.35  19    506.68  19
             MIN.  -1103.77  15    3777.30  19       0.00  21      0.00  21
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MAX/MIN FORCE VALUES FOR MEMB   3,AMONGST ALL SECT LOCATIONS
           FY/     DIST  LD       MZ/     DIST  LD
           FZ      DIST  LD       MY      DIST  LD        FX        DIST  LD

MAX.    -615.51    0.00  19     6450.38   5.98  15
          87.35    5.98  19      506.68   5.98  19      87.38 C    5.98  18
MIN.   -1103.77    5.98  15     -410.48   0.00  18
           0.00    5.98  21       -0.01   0.00  19      29.03 T    5.98  21
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4	0.00	MAX.	616.89	20	5846.79	15	0.00	21	496.16	19
		MIN.	-336.52	18	-2246.55	18	-93.45	19	0.00	21
	0.90	MAX.	611.91	20	5322.56	15	0.00	21	412.23	19
		MIN.	-341.39	18	-1940.81	18	-92.65	19	0.00	21
	1.80	MAX.	606.93	20	4805.17	15	0.00	21	329.02	19
		MIN.	-346.26	18	-1630.68	18	-91.86	19	0.00	21
	2.71	MAX.	601.95	20	4294.60	15	0.00	21	246.52	19
		MIN.	-351.13	18	-1316.15	18	-91.06	19	0.00	21
	3.61	MAX.	596.97	20	3790.87	15	0.00	21	164.74	19
		MIN.	-356.00	18	-997.23	18	-90.27	19	0.00	21
	4.51	MAX.	592.00	20	3293.98	15	0.00	21	83.68	19
		MIN.	-360.87	18	-673.92	18	-89.47	19	0.00	21
	5.41	MAX.	587.02	20	2803.92	15	0.00	21	3.34	19
		MIN.	-365.75	18	-346.21	18	-88.67	19	0.00	21
	6.31	MAX.	582.04	20	2320.69	15	0.00	21	0.00	21
		MIN.	-370.62	18	-14.11	18	-87.88	19	-76.29	19
	7.22	MAX.	577.06	20	1844.30	15	0.00	21	0.00	21
		MIN.	-375.49	18	322.38	18	-87.08	19	-155.19	19
	8.12	MAX.	572.08	20	1374.74	15	0.00	21	0.00	21
		MIN.	-380.36	18	663.26	18	-86.29	19	-233.38	19
	9.02	MAX.	567.10	20	1008.54	18	0.00	21	0.00	21
		MIN.	-385.23	18	397.54	21	-85.49	19	-310.87	19

MAX/MIN FORCE VALUES FOR MEMB 4,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST DIST	LD LD	MZ/ MY	DIST DIST	LD LD	FX	DIST	LD
MAX.	616.89	0.00	20	5846.79	0.00	15			
	0.00	0.00	15	496.16	0.00	19	4.76 C	0.00	21
MIN.	-385.23	9.02	18	-2246.55	0.00	18			
	-93.45	0.00	19	-310.87	9.02	19	112.54 T	0.00	18

5	0.00	MAX.	-22.53	21	912.01	15	85.50	19	0.00	21
		MIN.	-966.10	18	153.56	18	0.00	21	-310.88	19
	0.90	MAX.	-27.40	21	1374.74	15	86.29	19	0.00	21
		MIN.	-970.98	18	698.33	21	0.00	21	-233.40	19
	1.80	MAX.	-32.27	21	1907.47	16	87.09	19	0.00	21
		MIN.	-975.85	18	725.25	21	0.00	21	-155.21	19
	2.71	MAX.	-37.14	21	2787.61	18	87.88	19	0.00	21
		MIN.	-980.72	18	756.55	21	0.00	21	-76.30	19
	3.61	MAX.	-42.01	21	3674.42	18	88.68	19	3.33	19
		MIN.	-985.59	18	792.25	21	0.00	21	0.00	21
	4.51	MAX.	-46.88	21	4565.61	18	89.47	19	83.68	19
		MIN.	-990.46	18	832.34	21	0.00	21	0.00	21
	5.41	MAX.	-51.75	21	5461.20	18	90.27	19	164.75	19
		MIN.	-995.33	18	876.83	21	0.00	21	0.00	21
	6.31	MAX.	-56.62	21	6361.18	18	91.07	19	246.53	19
		MIN.	-1000.20	18	925.71	21	0.00	21	0.00	21
	7.22	MAX.	-61.49	21	7265.56	18	91.86	19	329.03	19
		MIN.	-1005.07	18	978.98	21	0.00	21	0.00	21
	8.12	MAX.	-66.37	21	8174.33	18	92.66	19	412.25	19
		MIN.	-1009.94	18	1036.64	21	0.00	21	0.00	21
	9.02	MAX.	-71.24	21	9087.49	18	93.45	19	496.18	19

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		MIN.	-1014.81	18	1098.70	21	0.00	21	0.00	21

MAX/MIN FORCE VALUES FOR MEMB 5,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST DIST	LD LD	MZ/ MY	DIST DIST	LD LD	FX	DIST	LD
MAX.	-22.53	0.00	21	9087.49	9.02	18			
	93.45	9.02	19	496.18	9.02	19	74.37 C	9.02	18
MIN.	-1014.81	9.02	18	153.56	0.00	18			
	0.00	9.02	21	-310.88	0.00	19	50.90 T	9.02	21

6	0.00	MAX.	1103.77	15	6450.38	15	0.00	21	506.72	19
		MIN.	565.52	21	3175.32	21	-87.37	19	0.00	21
	0.60	MAX.	1098.75	15	5791.82	15	0.00	21	454.62	19
		MIN.	562.29	21	2838.10	21	-86.85	19	0.00	21
	1.20	MAX.	1093.73	15	5136.27	15	0.00	21	402.85	19
		MIN.	559.06	21	2502.82	21	-86.32	19	0.00	21
	1.79	MAX.	1088.70	15	4483.72	15	0.00	21	351.39	19
		MIN.	555.83	21	2169.46	21	-85.79	19	0.00	21
	2.39	MAX.	1083.68	15	3834.18	15	0.00	21	300.24	19
		MIN.	552.61	21	1838.04	21	-85.26	19	0.00	21
	2.99	MAX.	1078.66	15	3187.64	15	0.00	21	249.41	19
		MIN.	549.38	21	1508.55	21	-84.74	19	0.00	21
	3.59	MAX.	1073.64	15	2544.10	15	0.00	21	198.90	19
		MIN.	546.15	21	1180.98	21	-84.21	19	0.00	21
	4.19	MAX.	1068.61	15	1903.57	15	0.00	21	148.70	19
		MIN.	542.92	21	855.35	21	-83.68	19	0.00	21
	4.78	MAX.	1063.59	15	1266.04	15	0.00	21	98.81	19
		MIN.	539.69	21	531.65	21	-83.15	19	0.00	21
	5.38	MAX.	1058.57	15	737.90	16	0.00	21	49.25	19
		MIN.	536.46	21	209.88	21	-82.63	19	0.00	21
	5.98	MAX.	1053.54	15	410.48	18	0.00	21	0.00	21
		MIN.	533.23	21	-109.95	21	-82.10	19	0.00	19

MAX/MIN FORCE VALUES FOR MEMB 6,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST DIST	LD LD	MZ/ MY	DIST DIST	LD LD	FX	DIST	LD
MAX.	1103.77	0.00	15	6450.38	0.00	15			
	0.00	0.00	15	506.72	0.00	19	21.99 C	0.00	21
MIN.	533.23	5.98	21	-109.95	5.98	21			
	-87.37	0.00	19	0.00	5.98	19	87.36 T	0.00	18

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

158. UNIT INCH KIP
159. START CONCRETE DESIGN

1

160. CODE ACI
161. FC 5.0 ALL
162. FY 60.0 ALL
163. DESIGN COLUMN 1 2

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C O L U M N   N O.   1   D E S I G N   R E S U L T S

FY - 60000 FC - 5000 PSI, SQRE SIZE - 48.00 X 48.00 INCHES, TIED

AREA OF STEEL REQUIRED = 110.859 SQ. IN.

BAR CONFIGURATION	REINF PCT.	LOAD	LOCATION	PHI
28 - NUMBER 18	4.861	19	STA	0.700

(PROVIDE EQUAL NUMBER OF BARS AT EACH FACE)

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C O L U M N   N O.   2   D E S I G N   R E S U L T S

FY - 60000 FC - 5000 PSI, SQRE SIZE - 48.00 X 48.00 INCHES, TIED

AREA OF STEEL REQUIRED = 110.859 SQ. IN.

BAR CONFIGURATION	REINF PCT.	LOAD	LOCATION	PHI
28 - NUMBER 18	4.861	19	STA	0.700

(PROVIDE EQUAL NUMBER OF BARS AT EACH FACE)

********************END OF COLUMN DESIGN RESULTS********************

164. DESIGN BEAM 3 TO 7

C-110

==

B E A M   N O.   6   D E S I G N   R E S U L T S - FLEXURE

LEN - 5.98FT. FY - 60000. FC - 5000. SIZE - 48.00 X120.00 INCHES

LEVEL	HEIGHT FT.	HEIGHT IN.	BAR INFO	FROM FT.	FROM IN.	TO FT.	TO IN.	ANCHOR STA	ANCHOR END
1	0 +	3-0/0	19-NUM.9	2 +	10-1/2	6 +	0-0/0	NO	YES
2	9 +	9-1/2	19-NUM.9	0 +	0-0/0	6 +	0-0/0	YES	YES

B E A M   N O.   6   D E S I G N   R E S U L T S - SHEAR

AT START SUPPORT - STIRRUPS ARE NOT REQUIRED.
AT END   SUPPORT - STIRRUPS ARE NOT REQUIRED.

```
  6J------------------  72.X  48.X 120.------------------  7J
19#9 H117.   0.TO   72.
                        19#9 H  3.  34.TO  72.

00000  00000  00000  00000  00000  00000  00000  00000    00000
19#9   19#9   19#9   19#9   19#9   19#9   19#9   19#9     19#9
                            19#9   19#9   19#9   19#9     19#9
                            00000  00000  00000  00000    00000
```

***STAAD-III ERROR . MEMB OR ELEM NO 7 DOES NOT EXIST.

********************END OF BEAM DESIGN**************************

165. END CONCRETE DESIGN
166. FINISH

*************** END OF STAAD-III ***************

****** DATE= APR 24,1992   TIME= 11:26:39 ******

```
*****************************************************************
*          FOR QUESTIONS ON STAAD-III/ISDS, CONTACT:            *
*          RESEARCH ENGINEERS, INC AT (609) 983-5050            *
*          TELEX:  4994385       FAX:  (609) 983-3825           *
*****************************************************************
```

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