AN INVESTIGATION OF REINFORCED CONCRETE HYPERBOLIC PARABOLOID SHELLS

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VOLUME 2 - APPENDICES

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8. COMPUTER PROGRAMME AND THEORETICAL RESULTS

8.1 Computer programme

The computer programme for uniformly distributed radial load is given in the form of the type out from a teleprinter.

Sections 8.1.1 and 8.1.2 give the Chapter 4's (shell and edge beam particular integrals) for vertical load and radial load asymmetrically distributed over the transverse span.

```
TITLE
DOUBLY CURVED SHELL RADIAL LOAD(2)  U474  J C SCRIVENER

CHAPTER1
B→15
E→54
C→4
F→10
A→7
D→20
G→5
1)K=0(1)5
Cnv32K+1281+Yn
Dnv32K+Yn
J=0(1)3
Env4J+Cn
Fnv8J+Dn
I=0(1)1
Gnv161+En
Hnv41+Fn
Hn=X15(Gn,4)
REPEAT
REPEAT
REPEAT
PSA
Anv Yn+208
Bnv Yn+240
Cnv Yn+272.
Bn=X15(An,32)
Cn=X17(An,8)
E9=E8E8
E10=XSQPT(E2E2+E6E9)
E11=XSQRT(0.5E10-0.5E2)
E12=XSQRT(0.5E10+0.5E2)
E13=2E4/E8
E14=1/E7
E15=E14E14
E16=XDIVIDE(12E3,12C+CCCE3E9)
E17=XSIN(0.5NE)
E18=CCCE8/12
E19=E0CE15/6
E20=CC
E21=2E0/E20
I=0(1)15
B1=0
REPEAT
B0=-1
B5=-E19
B10=1
```

```
B15=B5
x7(Un)Bo,16
Bo=-E15/C
B5=-E21
B10=E9Bo
B15=B5
AnvUn+16
x7(An)Bo,16
JUMP5,S=1
Bo=-E15
B5=E19E8
B10=E19E7
B15=B10
BnvAn+16
x7(Bn)Bo,16
JUMP5,S=2
Bo=1
B5=E19E7
B10=-E19
B15=-E21E14
CnvBn+16
x7(Cn)Bo,16
5)VnvUn+64
Wnv32R+Vn+160
D10=XMOD(B)
D11=E+F
D12=2£
JUMP2,D12>D11
D11=D11-D12
2)D13=D11D10
J=o(1)1
K=1-2J
I=o(1)15
BI=o
REPEAT
Fo=KE11+E8
F1=KE12-E1
F2=XSQRT(FoFo+F1F1)
F1=XSQRT(o.5F2-o.5Fo)
Fo=XSQRT(o.5F2+o.5Fo)
Anv16JR+16J+Vn
PSA
L=o(1)R
JUMP6,G2>1
JUMP6,L=R
JUMP7,L>T
6)Co=LD13/R
C1=XCOS(CoF1)
C2=XSIN(CoF1)
```

```
C3=XEXP(-CoFo)
C4=XEXP(CoFo)
Bo=C3C1
B1=C3C2
B4=-B1
B5=Bo
B10=C4C1
B11=C4C2
B14=-B11
B15=B10
Bnv16L+An
x7(Bn)Bo,16
7)REPEAT
ACROSS1/2
8)REPEAT
ACROSS1/3
PSA
XSQRT
XCOS
PSA
XEXP
PSA
CLOSE
**********

CHAPTER2
VARIABLES1
1)JUMP2,N≠O
JUMP2,J=1
NEWLINE
NEWLINE
PRINT(E)o,5
PRINT(F)o,5
NEWLINE
PRINT(G)o,5
PRINT(H)o,5
PRINT(U)o,5
PRINT(V)o,5
NEWLIN*E
PRINT(A)o,5
PRINT(B)o,5
PRINT(C)o,5
PRINT(D)o,5
NEWLINE
PRINT(W)o,5
PRINT(X)o,5
PRINT(Y)o,5
NEWLINE
PRINT(Ao)o,5
```

```
PRINT(A1)0,5
PRINT(A2)0,5
PRINT(A3)0,5
NEWLINE
PRINT(A4)0,5
PRINT(A5)0,5
PRINT(A6)0,5
PRINT(A7)0,5
NEWLINE
PRINT(G0)0,5
PRINT(G1)0,5
2)F2=F0F0
F3=F1F1
F4=F2-F3
F5=XDIVIDE(1,F2+F3)
F6=2F0F1
F7=E8F0
F8=E8F1
F9=F2F0-1.5F6F1-F7
F10=F3F1-1.5F6F0+F8
B0=-F0
B1=F1
B2=-B0
B3=B1
B4=KF10+KF8
B5=-KF9+KF7
B6=-B4
B7=B5
B8=1
B9=0
B10=1
B11=0
B12=KF6
B13=KF4
B14=B12
B15=-B13
Cnv32R+16J+32+Vn
X7(Cn)B0,16
PSA
B0=F4
B1=-2KE1-F6
B2=B0
B3=-B1
B4=0
B5=K
B6=0
B7=-K
B8=KE13F5F1-F5F0
B9=-KE13F5F0-F5F1
B10=-B8
```

```
B11=B9
B12=-KF1
B13=-KF0
B14=-B12
B15=B13
Dnv Cn+32
X7(Dn)B0,16
JUMP5,S=1
B0=F4
B1=-F6
B2=B0
B3=-B1
B4=0
B5=K
B6=0
B7=-K
B8=2KF6
B9=2KF4-KE8
B10=B8
B11=-B9
B12=-KF1
B13=-KF0
B14=-B12
B15=B13
Env Dn+32
X7(En)B0,16
JUMP5,S=2
B0=1
B1=0
B2=1
B3=0
B4=KF6
B5=KF4-KE8
B6=B4
B7=-B5
B8=KF10
B9=-KF9
B10=-B8
B11=B9
B12=0
B13=K
B14=0
B15=-K
Fnv En+32
X7(Fn)B0,16
5)Gnv64JR+64J+Wn
I=0(1)S
Hnv16I+Un
Dnv32I+Cn
```

```
Fnv16IR+16I+Gn
Dn=X26(Hn,Dn,4,4,4)
L=o(1)R
JUMP6,G2>1
JUMP6,L=F
JUMP7,L>T
6)Env16L+An
Bnv16L+Fn
Bn=X26(Dn,En,4,4,4)
7)REPEAT
REPEAT
ACROSS8/1
PSA
CLOSE
**********

CHAPTER3
VARIABLES1
1)I=o(1)15
BI=o
REPEAT
K=o(4)4
Bo=-AKE8
B1=-AK/A
B5=-A(K+1)E8
B10=-A(K+2)E8
B15=A(K+3)
Anv12K+Un
X7(An)Bo,16
REPEAT
BnvUn+16
CnvYn+208
Bn=X15(Cn,32)
J=o(1)1
Dnv64J+Un+64
Fnv16JR+16J+Wn
K=o(1)1
Env16KR+Fn
Cnv32K+Dn
I=o(1)1
Bnv64IR+64I+En
Anv16I+Cn
An=X15(Bn,16)
REPEAT
REPEAT
REPEAT
XnvWn+128R+128
K=o(1)5
Cnv32K+Un
```

```
Dnv32K+Xn
J=o(1)3
Env4J+Cn
Fnv8J+Dn
I=o(1)1
Gnv16I+En
Hnv4I+Fn
Hn=X15(Gn,4)
REPEAT
REPEAT
REPEAT


AnvYn+272
Un=X15(An,64)
DnvXn+128
Un=X28(Dn,8,8)
BnvYn+128
AnvYn+464
An=X26(Un,Bn,8,8,8)
CnvXn+64
Cn=X26(Yn,Cn,8,8,8)
Cn=X26(Cn,An,8,8,8)
FnvYn+64
GnvYn+528
Gn=X26(Cn,Fn,8,8,8)
G4=XMOD(G2)


AnvXn+128
Fov16P+16
I=o(1)15
BI=o
REPEAT
D5=1/Go
D6=1/G1
J=o(1)P
JUMP6,J≠o
D1=1
D2=o
JUMP7
6)JUMP8,J≠P
D1=o
D2=1
JUMP7
8)Do=o.5JDE7/P
D1=XCOS(Do)
D2=XSIN(Do)
7)D3=D2E14
```

```
D4=D1E15
Bo=D3
B5=D1
B10=D1
B15=D1
Bnv16J+An
X7(Bn)Bo,16
Bo=D3D5
B5=-D4D5
B10=B5
B15=B5
CnvBn+Fo
X7(Cn)Bo,16
JUMP5,S=1
Bo=D1
B5=D1
B10=D2
B15=D2
DnvCn+Fo
X7(Dn)Bo,16
JUMP5,S=2
Bo=D1
B5=D2
B10=D1
B15=D2D5
EnvDn+Fo
X7(En)Bo,16
5)JUMP2,G4>3
Bo=-D4
B5=Bo
B10=Bo
B15=E14D2
FnvCn+3Fo
X7(Fn)Bo,16
Bo=D3D6
B5=-D4D6
B10=B5
B15=B5
GnvFn+Fo
X7(Gn)Bo,16
2)REPEAT
ACROSS1/4
PSA
XCOS
PSA
CLOSE
**********
```

```
CHAPTER4
VARIABLES1
1)G3v0
JUMP2,N≠0
NEWLINE
CAPTION
RADIAL LOAD OVER WHOLE SURFACE (2)
NEWLINE
2)C0=XDIVIDE(4E17,NE)
C1=C0E16W
J=0(1)15
BJ=0
REPEAT
B2=-CC1/B
B4=C1/A
B5=-C1E8
JUMP5,S=1
B9=C1E18
B10=-E7B9
JUMP5,S=2
B12=B2
B13=B10
B15=-C1E7
5)AnvUn+64
X7(An)B0,16
J=0(1)15
BJ=0
REPEAT
C1=AAE8
C1=XDIVIDE(C0C1,C1-1)
B1=XC1
B0=-B1/A
B5=YC1
B4=-B5/A

Anv16R+Un+112
X7(An)B0,16
Envl6R+Un+96
K=0(1)1
Cnv8K+En
Bnv4K+Vn
J=0(1)1
Anv4J+Cn
An=X15(Bn,4)
REPEAT
REPEAT
ACROSS1/5
PSA
CLOSE
**********
```

```
CHAPTER5
VARIABLES1
1)Anv32R+Un+96
BnvUn+16R+96
DnvBn+8
CnvYn+528
An=X26(Cn,Dn,8,1,8)
EnvAn+8
En=X26(Yn,Bn,8,1,8)
En=X12(An,En,8)
CnvBn+16
An=X11(Cn,En,8)
En=X26(Un,Dn,8,1,8)

AnvYn+208
BnvYn+336
DnvYn+400
JUMP8,N≠0
Bn=X19(An,Go,8)
Dn=X19(An,G1,8)

8)AnvXn+64
An=X26(An,Bn,8,8,8)
FnvUn+32R+112
Fn=X26(Xn,Dn,8,8,8)
Fn=X11(An,Fn,64)
CnvYn+272
An=X15(Cn,64)
An=X28(Fn,8,8)
EnvUn+32R+96
An=X26(An,En,8,1,8)
CnvXn+72
Cn=X26(Bn,An,8,1,8)
BnvYn+464
Cn=X26(Bn,Cn,8,1,8)
EnvEn+8
Cn=X12(Cn,En,8)


ZnvXn+96P+224
NEWLINE
NEWLINE
CAPTION
FOURIER  SERIES  TERM  NO.
PRINT(N)2,0
JUMP3,G4>3
BnvXn+96
Bn=X26(Dn,An,8,1,8)
CnvXn+80
```

```
Cn=X26(Xn,Bn,8,1,8)
Dnv16R+Un+1128
Anv Xn+88
An=X11(Cn,Dn,8)
Gnv Dn+8
Fnv Xn+1024
Fn=X11(Bn,Gn,8)
Anv Xn+1128
Dnv4Fo+Xn+1288
I=o(1)1
NEWLINE
JUMP12,N≠Q
JUMP11,I=1
CAPTION
          N1          M1          M2          M3
JUMP12
11)CAPTION
           U          W           V           O
12)Env IFo+Dn
Fnv 8PI+8I+Zn
M=o(1)1
NEWLINE
JUMP4,M=o
JUMP5,1>G2
JUMP10,N≠Q
CAPTION
R.H.EDGE BEAM
NEWLINE
JUMP10
4)JUMP10,N≠Q
CAPTION
L.H.EDGE BEAM
NEWLINE
10)Cnv Xn+88+4M+16I
Hnv4MP+4M+Fn
J=o(1)P
Bnv16J+En
An=X26(Bn,Cn,4,1,4)
JUMP6,O≠Q
Gnv An
JUMP7
6)Gnv4J+Hn
JUMP9,N≠O
Bnv Yn+2088
Gn=X15(Bn,4)
9)Gn=X11(Gn,An,4)
JUMP2,N≠Q
7)NEWLINE
PRINT(J)2,o
X6(Gn)Bo,4
```

```
SPACE
SPACE
SPACE
L=o(1)3
PRINT(BL)o,2
REPEAT
2)REPEAT
5)REPEAT
REPEAT
3)ACROSS1/6
PSA
CLOSE
**********

CHAPTER6
VARIABLES1
1)Hnv16P+Zn+16
I=o(1)S
NEWLINE
NEWLINE
PRINT(I)1,o
NEWLINE
JUMP9,N≠Q
JUMP13,I=1
JUMP11,I=2
JUMP12,I=3
CAPTION
          N12        R2         N2         M2
JUMP9
13)CAPTION
          U          W          V          O2
JUMP9
11)CAPTION
          N1         M1         R1         M12
JUMP9
12)CAPTION
          N2         Q1         Q2         O1
9)NEWLINE
Cnv16IR+16I+Wn
Dnv4PRI+4PI+4RI+4I+Hn
L=o(1)R
JUMP6,G2>1
JUMP6,L=R
JUMP7,L>T
6)NEWLINE
NEWLINE
PRINT(L)2,o
NEWLINE
Fnvxn+112
Anv16L+Cn
Envxn+72
Fn=x26(An,En,4,1,4)
```

```
Env En+4
Bnv64R+An+64
Anv Fn+4
An=X26(Bn,En,4,1,4)
Fn=X11(Fn,An,4)
Bnv4RIG3+4LG3+4I+Vn
An=X11(Fn,Bn,4)
JUMP8,0=Q
X6(An)Bo,4
NEWLINE
CAPTION
 *
M=o(1)3
PRINT(BM)o,2
REPEAT
8)Bnv IFo+Xn+128
J=o(1)P
Env16J+En
Fnv Xn+120
Fn=X26(En,An,4,1,4)
JUMP4,0≠Q
Gnv Fn
JUMP5
4)Gnv4PL+4L+4J+Dn
JUMP10,N≠0
Env Yn+208
Gn=X15(En,4)
10)Gn=X11(Gn,Fn,4)
JUMP3,N≠Q
5)NEWLINE
PRINT(J)2,o
X6(Gn)Bo,4
SPACE
SPACE
SPACE
M=o(1)3
PRINT(BM)o,2
REPEAT
3)REPEAT
7)REPEAT
REPEAT
HOOT

NEWLINE
NEWLINE
NEWLINE
JUMP2,N≠Q
ACROSS1/o
2)ACROSS3/o
PSA
CLOSE
**********
```

```
CHAPTERo
VARIABLESı
ı)HALT
READ(P)
READ(R)
Anvı6PR+ı76R+ı28P+ı2oo
JUMP9,7680>An
PRINT(An)o,3
END
9)READ(E)
READ(F)
NEWLINE
Ynvo
I=o(ı)ı5
BI=o
REPEAT
Co=E
I=o(ı)ı
J=ı-2I
JUMPıo,Co>ı.5708
ı3)Cı=JCo
JUMPı2
ıo)JUMPı3,Co>4.7ı24
Cı=JCo-J£
ı2)Bo=ı
B5=XCOS(Cı)
B9=XSIN(Cı)
B6=-B9
Bıo=B5
Bı5=ı
Anvı6I+Yn
x7(An)Bo,ı6
BnvAn+32
Bn=Xı6(An,4,4)
Co=F
REPEAT
I=o(ı)ı5
BI=o
REPEAT
I=o(ı)ı
J=ı-2I
Bo=-J
B5=-J
Bıo=-J
Bı5=J
Anvı6I+Yn
BnvAn+64
x7(Bn)Bo,ı6
Bn=x26(Bn,An,4,4,4)
```

```
REPEAT
READ(G)
READ(H)
READ(U)
READ(V)
READ(A)
READ(B)
READ(C)
READ(D)
I=o(1)31
E1=o
REPEAT
I=o(1)2
Anv64I+144+Yn
x7(An)Eo,32
REPEAT
E9=1/A

I=o(1)15
B1=o
REPEAT
Co=G
C1=H
I=o(1)1
J=1-2I
Bo=1+C1E9
B1=C1
B2=-JCo
B5=1
B7=-B2
B10=1
B11=B1
B15=1
Co=U
C1=V
Anv48I+256+Yn
x7(An)Bo,16
Dnv16I+32+Yn
An=x26(Dn,An,4,4,4)
Dn=x15(An,16)
Cnv48I+192+Yn
Envyn+208
Cn=x17(En,4)
Cn=x28(Dn,4,4)
REPEAT

Eo=1.7320508
E1=xDIVIDE(Eo,AC)
```

```
E2=E1E1
E3=BB
E4=XDIVIDE(E0,BC)
E5=B-A
E6=XDIVIDE(4E2E5E5,E3)
READ(W)
READ(X)
READ(Y)
READ(O)
READ(Q)
READ(S)
READ(G2)
T=XINTPT(.5R)
J=O(1)7
READ(AJ)
REPEAT
Unv Yn+592
4)READ(G0)
READ(G1)


N=O(2)Q
E7=N£/D
E8=E7E7
E10=XDIVIDE(1,E9E9-E8)
E11=E9E10
C0=G
C1=-H
I=O(1)1
B0=E10E8
B1=B0E9
B2=0
B3=0
B4=C1E11-C1B0-E11
B5=-B0
B6=0
B*7=0
B8=-C0B0
B9=-C0B1
B10=B5+C1B1
B11=-B1
B12=C0E11
B13=-B8
B14=E11-C1B0
*
 B15=B0
C0=-U
C1=-V
Bnv161+64+Yn
```

```
Cnv Bn+32
Dnv48I+128+Yn
X7(Cn)Bo,16
Dn=X26(Cn,Bn,4,4,4)
REPEAT
ACROSS1/1
3)REPEAT
XCOS
PSA
CLOSE
**********
```

8.1.1 Vertical Load - Chapter 4

```
CHAPTER4
VARIABLES1
1)G3v1
JUMP3,N≠0
NEWLINE
CAPTION
VERTICAL LOAD OVER WHOLE SURFACE
NEWLINE
3)E22=1/A
E23=1/B
E24=E22E22
E25=E23E23
E26=E8+E25
E27=E8+E26
E28=E8+E22E23
E29=E24E25-E9
E30=12/E20
E31=E26E26
E32=XDIVIDE(E30E29+E27E31,E31E31+E30E25E28E28)
E54=XDIVIDE(4E17W,N£)
E33=E54E25E32
E34=XDIVIDE(E54E27E23-E31E33B,GoCE8E28)
E32=E33-E54
E35=GoE20C/12
E36=BE34
E37=E32E23E15
E38=E35E36
E39=E38E7
E40=E38E25
E41=E39E7
E42=E38E23
E43=-E42E7
E44=-E39E26
```

```
E45=-E42E26
E46=E44-E39E25
E47=-E42E27
E48=E33B
E49=E48/C
E50=E23E15E32/C+GoE36E22
E51=E8E36Go
E52=-E8BE49-E51
E53=E51E23
E54=E7E36Go
L=o(1)R
JUMP6,G2>1
JUMP6,L=R
JUMP2,L>T
6)Co=LD11/R
C1=-E+Co
C2=XCOS(C1)
C3=XSIN(C1)
Bo=E32C3
B1=E47C3
B2=E48C2
B3=E40C2
Anv4L+Vn
X7(An)Bo,4
Bo=E50C2
B1=-E51C2
B2=E52C3
B3=E53C3
Bnv4R+An+4
X7(Bn)Bo,4
JUMP2,S=1
Bo=E37C2
B1=E41C2
B2=E46C2
B3=E43C3
Cnv4R+Bn+4
X7(Cn)Bo,4
JUMP2,S=2
Bo=E48C2
B1=E44C2
B2=E45C3
B3=-E54C2
Dnv4R+Cn+4
X7(Dn)Bo,4
2)REPEAT
J=o(1)15
BJ=o
REPEAT
C1=AAE8
```

```
C1=XDIVIDE(CoC1,C1-1)
B1=XC1
Bo=-B1/A
B5=YC1
B4=-B5/A
Anv16R+Un+112
x7(An)Bo,16
Env16R+Un+96
K=o(1)1
Cnv8K+En
Dnv4RK+4K+Vn
J=o(1)1
Anv4J+Cn
Bnv4RJ+Dn
An=X15(Bn,4)
REPEAT
REPEAT
ACROSS1/5
PSA
XCOS
PSA
CLOSE
**********
```

8.1.2 Radial load asymmetrically distributed over transverse span - Chapter 4

```
CHAPTER4
VARIABLES1
1)G3v1
JUMP3,N≠O
NEWLINE
CAPTION
RADIAL ASYMMETRIC TRANSVERSE LOAD(2)
NEWLINE
3)E22=1/A
E23=£/D13
E24=E22E22
E25=E23E23
E26=E8+E25
E27=E8+E26
E28=E8/B+E22E25
E29=E24E25-E9
E30=12/E20
E31=E26E26
E32=XDIVIDE(-E30E8E28,E31E31+E30E28E28)
E33=XDIVIDE(16E17WE32E23,N££)
```

```
E34=XDIVIDE(-E31E33,GoCE8E28)
E35=GoE20C/12
E36=E34/E23
E37=E33E23E15
E38=E35E36
E39=E38E7
E40=E38E25
E41=E39E7
E42=E38E23
E43=-E42E7
E44=-E39E26
E45=-E42E26
E46=E44-E39E25
E47=-E42E27
E48=E33/E23
E49=E48/C
E50=E49E15E25+GoE36E22
E51=E8E36Go
E52=-E8E49-E51/B
E52=E52/E23
E53=E51E23
E54=E7E36Go
L=o(1)R
JUMP6,G2>1
JUMP6,L=R
JUMP2,L>T
6)Co=L/R-.5
C1=£Co
C2=XSIN(C1)
C3=XCOS(C1)
Bo=-E33C3
B1=-E47C3
B2=E48C2
B3=E40C2
Anv4L+Vn
X7(An)Bo,4
Bo=E50C2
B1=-E51C2
B2=-E52C3
B3=-E53C3
Bnv4R+An+4
X7(Bn)Bo,4
JUMP2,S=1
```

```
Bo=E37C2
B1=E41C2
B2=E46C2
B3=-E43C3
Cnv4R+Bn+4
x7(Cn)Bo,4
JUMP2,S=2
Bo=E48C2
B1=E44C2
B2=-E45C3
B3=-E54C2
Dnv4R+Cn+4
x7(Dn)Bo,4
2)REPEAT
J=o(1)15
BJ=o
REPEAT
C1=AAE8
C1=XDIVIDE(CoC1,C1-1)
B1=XC1
Bo=-B1/A
B5=YC1
B4=-B5/A
Anv16R+Un+112
x7(An)Bo,16
Env16R+Un+96
K=o(1)1
Cnv8K+En
Dnv4RK+4K+Vn
J=o(1)1
Anv4J+Cn
Bnv4RJ+Dn
An=x15(Bn,4)
REPEAT
REPEAT
ACROSS1/5
PSA
xCOS
PSA
CLOSE
**********
```

8.2 Data Tape

The data required for the calculation of a shell consists of 29 numbers. The following table gives these in their correct order.

Computer Programme Symbol	Symbol as used in Theory	Comments
P	P	P + 1 = number of transverse sections where results are required. o represents mid-span, P represents gable end, $P \geq 1$ and an integer.
R	R	R + 1 = number of longitudinal sections where results are required. o represents L.H. shell edge, R represents R.H. shell edge, $R \geq 1$ and an integer.
E	-	See Section 8.2.1
F	-	
G	a_ℓ	a_ℓ, a_r, horizontal distance from the shell edge to the edge beam centroid measured positively away from the shell for left and right hand edges respectively; b_ℓ, b_r, vertical distance from the shell edge to the edge beam centroid measured positively downwards for left and right hand edges respectively.
H	b_ℓ	
U	a_r	
V	b_r	

Computer Programme Symbol	Symbol as used in Theory	Comments
A	R_α	Positive if arching upwards
B	R_β	$\frac{1}{R_\beta} - \frac{1}{R_\alpha} > 0$
C	t	Shell thickness
D	L	Longitudinal span, i.e., from gable to gable.
W	G_s	Shell load/unit area)
X	G_{bl}	Left hand edge beam load/unit length) positive
Y	G_{br}	Right " " " ") downwards
O	-	(Fourier series terms
Q	-	(1st term to be calculated O (Last " " " " Q If O = Q, print out is for term O If O ≠ Q, print out is for sum of terms O to Q. O, Q odd integers and ≥ 1 . Q ≥ O
S	-	S = 1 Shell calculations for n, u only S = 2 " " " n, u, p only S = 3 " " " n, u, p, q
G_2	-	$\|G_2\| > 3$, deletes edge beam calculation $G_2 > 1$ calculates for all sections around arc.

Computer Programme Symbol	Symbol as used in Theory	Comments
A_o	A)	A, edge beam cross sectional area
A_1	I_1) L.H.	I_1, 2nd moment of area about horizontal
A_2	I_2) edge	axis through centroid
A_3	I_3)	I_2, 2nd moment of area about vertical
A_4	A)	axis through centroid
A_5	I_1) R.H.	I_3, twisting moment of inertia
A_6	I_2) edge	
A_7	I_3)	
G_o	E_s	Young's Modulus of shell
G_1	E_b	Young's Modulus of edge beams

8.2.1 E and F for Data Tape

As the angle between the tangent at the shell edge and the horizontal is needed not only in the transformations from shell axes to general shell axes but also in determining the transverse span of the shell, φ , as defined in Section 3.6.2. is inconvenient for direct use on the data tape.

Two new angles are defined:

E is the angle subtended from the "upwards" vertical to the left hand shell edge, measured anticlockwise.

F is the angle subtended from the "upwards" vertical

to the right hand shell edge, measured clockwise.

Fig. 47 shows E and F and gives values of φ, in terms of E and F, for the left and right hand edges situated in any of the four quadrants.

8.3 Computer Results of Test Shells

This section contains the theoretical results of computer calculations on the test shells.

Section 8.3.1 is a typical print out of results and explanations are given beside the results.

In many cases, slight adjustments have been made to the computer programme in order to calculate and print out results at selected sections only. This was achieved in the following manner:

(a) in the cycles, L = 0(1)R

where R = 16

insert Jump 2, L = 1

Jump 2, L = 2

Jump 2, L = 4

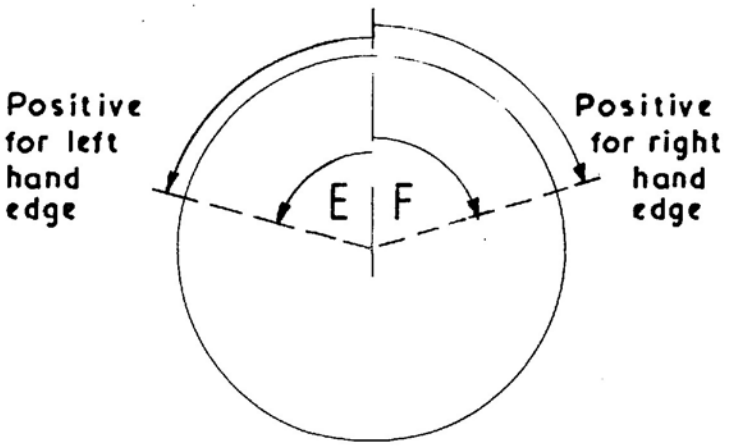
Jump 2, L = 6

Jump 2, L = 7

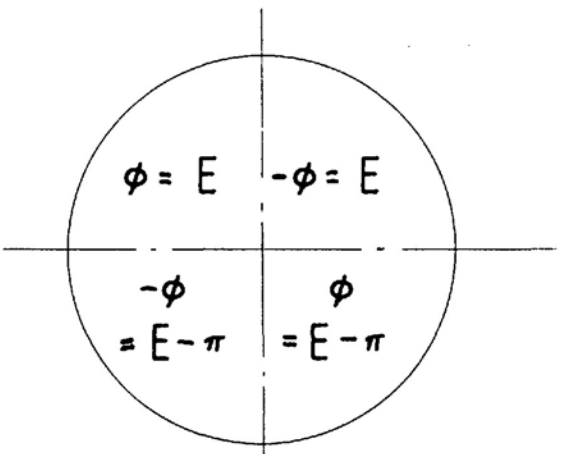
!

2) Repeat

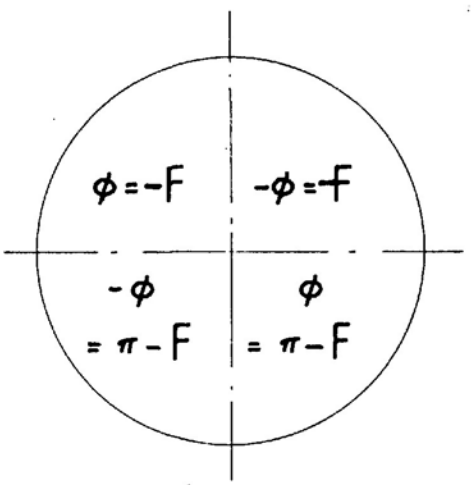
Hence, for these values of L, no calculations were conducted.



E and F



VALUES OF ϕ FOR LEFT HAND EDGE



VALUES OF ϕ FOR RIGHT HAND EDGE

FIG. 47 RELATIONSHIP OF ϕ, E & F.

(b) in the cycles, J = 0(1) P

where P = 8

insert Jump 3, J = 1

Jump 3, J = 2

Jump 3, J = 4

Jump 3, J = 5

Jump 3, J = 6

3) Repeat

Hence, for these values of J, no calculations were conducted.

The sections contain:

8.3.1 - Dead load on shell (vertical load)

8.3.2 - Test A

8.3.3(a) - Test B, $I_3 = .2094$ in^4

(b) - Test B, $I_3 = .00522$ in^4

(c) - Test B, $I_3 = .00522$ in^4 $E_s = 5.4 \times 10^6$ lb/in^2

8.3.4(a) - Test 7, $I_3 = .1677$ in^4

(b) - Test 7, $I_3 = .00522$ in^4

(c) - Test 8, $I_3 = .1677$ in^4

(d) - Test 8, $I_3 = .00522$ in^4

8.3.5 - Test D, $I_3 = .00522$ in^4

8.3.6(a) - Test E, $I_3 = .2094$ in^4

(b) - Test E, $I_3 = .00522$ in^4

8.3.7(a) - Test F, $I_3 = .2094$ in^4

(b) - Test F, $I_3 = .00522$ in^4

8.3.1 Dead load on shell (vertical load)

(Data in order: E, F; G, H, U, V; A, B, C. D; W, X, Y; A_0, A_1, A_2, A_3; A_4, A_5, A_6, A_7; G_0, G_1)

```
 2.32800, -1    2.32800, -1
 1.25000, -1    0.00000,  0    1.25000, -1    0.00000,  0 )
-1.93000,  2    1.9000,   2    7.50000, -1    1.06750,  2 )
-6.50000, -2 )  1.42000, -1    1.42000, -1                )
 5.00000, -1    1.66700, -1    2.61000, -3    5.22000, -3 )
 5.00000, -1    1.66700, -1    2.61000,)-3    5.22000, -3 )
 3.30000,  6    3.00000,  7                               )
```

Data

VERTICAL LOAD OVER WHOLE SURFACE (Powers of 10 beyond comma)

FOURIER SERIES TERM NO. 1

	N_1 ($\overline{N}_1$)	M_1 ($\overline{M}_1$)	M_2 ($\overline{M}_2$)	M_3 ($\overline{M}_3$)	
L.H.EDGE BEAM					
0	7.53, 2	-4.19, 2	2.29, 0	7.78,-78	(Mid span
1	1.86,-77	-5.40,-78	1.73,-77	-4.07, 1	(Gable)

	U ($\overline{U}_\alpha$)	W ($\overline{U}_\gamma$)	V ($\overline{U}_\beta$)	O ($\overline{\theta}_\beta$)	
L.H.EDGE BEAM					
0	-6.54,-74	9.68, -2	-3.38, -2	8.83, -3	(Mid span)
1	-1.53, -2	1.22,-74	-4.23,-75	1.12,-75	(Gable)

	N_{12} ($n_{\alpha\beta}$)	R_2 (r_β)	N_2 (n_β)	M_2 (m_β)	
o					
o	1.86,-77	4.07, 0	-1.04, 0	-6.61, -1	)L.H
1	2.22, 1	1.73,-77	1.73,-77	1.73,-77	)Shell
					)edge
1					
o	1.92,-77	1.69, 0	-1.20, 1	2.65, 1	)¼ arc
1	1.23, 1	1.73,-77	1.73,-77	1.73,-77	)
2					
o	1.80,-77	-1.82, -6	-1.61, 1	3.22, 1	)½ arc
1	1.90, -5	1.73,-77	1.73,-77	1.73,-77	)
4					
o	-7.36,-78	-4.07, 0	-1.04, 0	-6.61, -1	)R.H.
1	-2.22, 1	1.73,-77	1.73,-77	1.73,-77	)shell
					)edge

I

	U (u_α)	W (u_γ)	V (u_β)	O_2 (θ_β)
o				
o	−8.23,−75	8.75, −2	−5.55, −2	8.83, −3
I	−1.55, −2	1.39,−75	−8.57,−76	1.51,−76
I				
o	−2.42,−74	2.57, −1	−3.48, −2	5.75, −3
I	−4.55, −2	4.04,−75	−5.33,−76	1.03,−76
2				
o	−3.04,−74	3.22, −1	3.50, −8	−5.94, −9
I	−5.70, −2	5.07,−75	1.75,−77	6.85,−78
4				
o	−8.23,−75	8.75, −2	5.55, −2	−8.83, −3
I	−1.55, −2	1.39,−75	8.83,−76	−1.26,−76

2

	N1 (n_α)	M1 (m_α)	R1 (r_α)	M12 ($m_{\alpha\beta}$)
o				
o	−4.57, o	8.79, o	1.73,−77	1.73,−77
I	1.73,−77	1.73,−77	−2.20, −1	3.01, 1
I				
o	−1.56, 1	2.58, 1	1.73,−77	1.73,−77
I	1.73,−77	1.73,−77	−2.32, o	1.96, 1
2				
o	−2.14, 1	3.24, 1	1.73,−77	1.73,−77
I	1.73,−77	1.73,−77	−2.85, o	−2.03, −5
4				
o	−4.57, o	8.79, o	1.73,−77	1.73,−77
I	1.73,−77	1.73,−77	−2.20, −1	−3.01, 1

8.3.2 Test A

2.32800, -1 2.32800, -1
1.25000, -1 0.00000, 0 1.25000, -1 0.00000, 0
-1.93000, 2 1.89000, 2 7.50000, -1 1.06750, 2
6.95000, -2 0.00000, 0 0.00000, 0
5.00000, -1 1.66700, -1 2.61000, -3 5.22000, -3
5.00000, -1 1.66700, -1 2.61000, -3 5.22000, -3
3.30000, 6 3.00000, 7
RADIAL LOAD OVER WHOLE SURFACE ($_2$)

FOURIER SERIES TERM NO. 1

	N1	M1	M2	M3
L.H.EDGE BEAM				
0	7.83, 2	-4.39, 2	2.40, 0	7.53,-78
3	6.51, 2	-3.65, 2	2.00, 0	-2.37, 1
7	1.53, 2	-8.56, 1	4.69, -1	-4.19, 1
8	1.88,-77	-5.35,-78	1.76,-77	-4.27, 1

	U	W	V	O
L.H.EDGE BEAM				
0	-6.85,-74	1.01, -1	-3.54, -2	9.26, -3
3	-8.93, -3	8.43, -2	-2.94, -2	7.70, -3
7	-1.58, -2	1.98, -2	-6.91, -3	1.81, -3
8	-1.61, -2	1.27,-74	-4.43,-75	1.17,-75

0

	N12	R2	N2	M2
0				
0	1.88,-77	4.30, 0	-1.10, 0	-6.89, -1
3	1.28, 1	3.57, 0	-9.16, -1	-5.73, -1
7	2.27, 1	8.39, -1	-2.15, -1	-1.34, -1
8	2.31, 1	1.73,-77	1.73,-77	1.73,-77
3				
0	2.07,-77	2.24, 0	-1.05, 1	2.41, 1
3	8.51, 0	1.86, 0	-8.76, 0	2.01, 1
7	1.50, 1	4.37, -1	-2.06, 0	4.71, 0
8	1.53, 1	1.73,-77	1.73,-77	1.73,-77

5

0	1.81,-77	1.33, 0	-1.47, 1	3.04, 1
3	5.57, 0	1.11, 0	-1.22, 1	2.53, 1
7	9.84, 0	2.60, -1	-2.86, 0	5.93, 0
8	1.00, 1	1.73,-77	1.73,-77	1.73,-77

8

0	-4.74,-78	-1.78, -6	-1.72, 1	3.38, 1
3	-6.50, -6	-1.48, -6	-1.43, 1	2.81, 1
7	-1.15, -5	-3.48, -7	-3.35, 0	6.58, 0
8	-1.17, -5	1.73,-77	1.73,-77	1.73,-77

16

0	-6.62,-78	-4.30, 0	-1.10, 0	-6.89, -1
3	-1.28, 1	-3.57, 0	-9.16, -1	-5.73, -1
7	-2.27, 1	-8.39, -1	-2.15, -1	-1.34, -1
8	-2.31, 1	1.73,-77	1.73,-77	1.73,-77

1

U	W	V	O_2

0

0	-8.62,-75	9.16, -2	-5.81, -2	9.26, -3
3	-9.00, -3	7.61, -2	-4.83, -2	7.70, -3
7	-1.59, -2	1.79, -2	-1.13, -2	1.81, -3
8	-1.62, -2	1.45,-75	-8.98,-76	1.58,-76

3

0	-2.19,-74	2.33, -1	-4.37, -2	7.26, -3
3	-2.29, -2	1.93, -1	-3.64, -2	6.03, -3
7	-4.04, -2	4.54, -2	-8.53, -3	1.42, -3
8	-4.12, -2	3.66,-75	-6.73,-76	1.27,-76

5

0	-2.81,-74	2.99, -1	-2.82, -2	4.64, -3
3	-2.93, -2	2.48, -1	-2.35, -2	3.86, -3
7	-5.18, -2	5.82, -2	-5.50, -3	9.05, -4
8	-5.28, -2	4.70,-75	-4.30,-76	8.57,-77

8

0	-3.18,-74	3.37, -1	3.60, -8	-5.93, -9
3	-3.32, -2	2.81, -1	2.99, -8	-4.93, -9
7	-5.86, -2	6.58, -2	7.03, -9	-1.16, -9
8	-5.97, -2	5.31,-75	1.76,-77	6.86,-78

16

0	-8.62,-75	9.16, -2	5.81, -2	-9.26, -3
3	-9.00, -3	7.61, -2	4.83, -2	-7.70, -3
7	-1.59, -2	1.79, -2	1.13, -2	-1.81, -3
8	-1.62, -2	1.45,-75	9.24,-76	-1.32,-76

2

	N1	M1	R1	M12
0				
0	-5.67, 0	9.20, 0	1.73,-77	1.73,-77
3	-4.71, 0	7.65, 0	-1.28, -1	1.76, 1
7	-1.11, 0	1.79, 0	-2.26, -1	3.10, 1
8	1.73,-77	1.73,-77	-2.30, -1	3.16, 1
3				
0	-1.59, 1	2.34, 1	1.73,-77	1.73,-77
3	-1.32, 1	1.94, 1	-1.17, 0	1.38, 1
7	-3.11, 0	4.56, 0	-2.07, 0	2.43, 1
8	1.73,-77	1.73,-77	-2.11, 0	2.48, 1
5				
0	-1.78, 1	3.00, 1	1.73,-77	1.73,-77
3	-1.48, 1	2.49, 1	-1.48, 0	8.80, 0
7	-3.47, 0	5.85, 0	-2.62, 0	1.55, 1
8	1.73,-77	1.73,-77	-2.67, 0	1.58, 1
8				
0	-2.24, 1	3.39, 1	1.73,-77	1.73,-77
3	-1.86, 1	2.82, 1	-1.66, 0	-1.12, -5
7	-4.36, 0	6.61, 0	-2.93, 0	-1.98, -5
8	1.73,-77	1.73,-77	-2.98, 0	-2.02, -5
16				
0	-5.67, 0	9.20, 0	1.73,-77	1.73,-77
3	-4.71, 0	7.65, 0	-1.28, -1	-1.76, 1
7	-1.11, 0	1.79, 0	-2.26, -1	-3.10, 1
8	1.73,-77	1.73,-77	-2.30, -1	-3.16, 1

8.3.3(a) Test B, $I_3 = .2094\ in^4$.

```
 2.20000, -1    2.20000, -1
 1.59000,  0    0.00000,  0    1.59000,  0    0.00000,  0
-1.85000,  2    2.00000,  2    7.50000, -1    1.06750,  2
 6.95000, -2    0.00000,  0    0.00000,  0
 4.50000,  0    4.62500,  0    1.61100,  0    2.09400, -1
 4.50000,  0    4.62500,  0    1.61100,  0    2.09400, -1
 3.30000,  6    3.00000,  7
RADIAL LOAD OVER WHOLE SURFACE (2)

FOURIER  SERIES  TERM  NO.  1
          N1          M1          M2          M3
L.H.EDGE BEAM

  0      -6.98,  1   -5.22,  3    6.34,  2   -7.85,-77
  3      -5.80,  1   -4.34,  3    5.27,  2   -4.00,  2
  7      -1.36,  1   -1.02,  3    1.24,  2   -7.06,  2
  8      -6.34,-78   -2.61,-77    1.77,-77   -7.20,  2

          U           W           V           O
L.H.EDGE BEAM

  0      -3.41,-74    4.34, -2   -1.51, -2    3.89, -3
  3      -4.44, -3    3.61, -2   -1.26, -2    3.24, -3
  7      -7.84, -3    8.47, -3   -2.95, -3    7.60, -4
  8      -7.99, -3    5.46,-75   -1.89,-75    5.02,-76

 0
          N12         R2          N2          M2

  0

  0      -6.27,-78    3.96,  0   -1.27,  0   -1.12,  1
  3      -6.80, -1    3.29,  0   -1.06,  0   -9.29,  0
  7      -1.20,  0    7.72, -1   -2.48, -1   -2.18,  0
  8      -1.22,  0    1.73,-77    1.73,-77    1.73,-77

  3

  0      -4.73,-78    9.69, -1    2.28,  0    1.20,  1
  3      -5.61,  0    8.05, -1    1.90,  0    1.00,  1
  7      -9.91,  0    1.89, -1    4.45, -1    2.35,  0
  8      -1.01,  1    1.73,-77    1.73,-77    1.73,-77
```

5

0	−5.01,−78	4.92, −1	5.13, 0	1.37, 1
3	−3.84, 0	4.09, −1	4.26, 0	1.14, 1
7	−6.78, 0	9.60, −2	1.00, 0	2.68, 0
8	−6.91, 0	1.73,−77	1.73,−77	1.73,−77

8

0	−5.26,−78	2.75, −8	6.81, 0	1.45, 1
3	−7.07, −7	2.29, −8	5.66, 0	1.21, 1
7	−1.25, −6	5.36, −9	1.33, 0	2.84, 0
8	−1.27, −6	1.73,−77	1.73,−77	1.73,−77

16

0	1.79,−77	−3.96, 0	−1.27, 0	−1.12, 1
3	6.80, −1	−3.29, 0	−1.06, 0	−9.29, 0
7	1.20, 0	−7.72, −1	−2.48, −1	−2.18, 0
8	1.22, 0	1.73,−77	1.73,−77	1.73,−77

1

	U	W	V	O_2

0

0	−4.62,−75	4.51, −2	−2.56, −2	3.89, −3
3	−4.83, −3	3.75, −2	−2.13, −2	3.24, −3
7	−8.53, −3	8.80, −3	−4.99, −3	7.60, −4
8	−8.70, −3	7.20,−76	−3.89,−76	7.40,−77

3

0	−1.06,−74	1.08, −1	−1.92, −2	3.27, −3
3	−1.10, −2	9.02, −2	−1.59, −2	2.72, −3
7	−1.95, −2	2.12, −2	−3.74, −3	6.37, −4
8	−1.99, −2	1.71,−75	−2.88,−76	6.42,−77

5

0	−1.34,−74	1.38, −1	−1.23, −2	2.03, −3
3	−1.39, −2	1.15, −1	−1.03, −2	1.69, −3
7	−2.46, −2	2.69, −2	−2.41, −3	3.95, −4
8	−2.51, −2	2.17,−75	−1.80,−76	4.47,−77

8

0	-1.50,-74	1.55, -1	-6.89,-10	8.47,-11
3	-1.57, -2	1.29, -1	-5.73,-10	7.04,-11
7	-2.77, -2	3.02, -2	-1.34,-10	1.65,-11
8	-2.82, -2	2.44,-75	1.03,-77	1.85,-77

16

0	-4.62,-75	4.51, -2	2.56, -2	-3.89, -3
3	-4.83, -3	3.75, -2	2.13, -2	-3.24, -3
7	-8.53, -3	8.80, -3	4.99, -3	-7.60, -4
8	-8.70, -3	7.20,-76	4.15,-76	-4.81,-77

2

	N1	M1	R1	M12
0				
0	-3.03, 1	4.53, 0	1.73,-77	1.73,-77
3	-2.52, 1	3.77, 0	2.91, -1	7.39, 0
7	-5.90, 0	8.84, -1	5.14, -1	1.30, 1
8	1.73,-77	1.73,-77	5.24, -1	1.33, 1

3

0	2.83, 0	1.09, 1	1.73,-77	1.73,-77
3	2.36, 0	9.06, 0	-5.72, -1	6.20, 0
7	5.53, -1	2.13, 0	-1.01, 0	1.09, 1
8	1.73,-77	1.73,-77	-1.03, 0	1.12, 1

5

0	1.37, 1	1.38, 1	1.73,-77	1.73,-77
3	1.14, 1	1.15, 1	-6.75, -1	3.84, 0
7	2.68, 0	2.70, 0	-1.19, 0	6.79, 0
8	1.73,-77	1.73,-77	-1.22, 0	6.92, 0

8

0	1.41, 1	1.55, 1	1.73,-77	1.73,-77
3	1.17, 1	1.29, 1	-7.30, -1	2.21, -7
7	2.75, 0	3.03, 0	-1.29, 0	3.90, -7
8	1.73,-77	1.73,-77	-1.31, 0	3.98, -7

16

0	-3.03, 1	4.53, 0	1.73,-77	1.73,-77
3	-2.52, 1	3.77, 0	2.91, -1	-7.39, 0
7	-5.90, 0	8.84, -1	5.14, -1	-1.30, 1
8	1.73,-77	1.73,-77	5.24, -1	-1.33, 1

8.3.3(b) Test B, $I_3 = .00522\ in^4$.

2.20000,	-1	2.20000,	-1				
1.59000,	0	0.00000,	0	1.59000,	0	0.00000,	0
-1.85000,	2	2.00000,	2	7.50000,	-1	1.06750,	2
6.95000,	-2	0.00000,	0	0.00000,	0		
4.50000,	0	4.62500,	0	1.61100,	0	5.22000,	-3
4.50000,	0	4.62500,	0	1.61100,	0	5.22000,	-3
3.30000,	6	3.00000,	7				

RADIAL LOAD OVER WHOLE SURFACE ($_2$)

FOURIER SERIES TERM NO. 1

	N_1	M_1	M_2	M_3
L.H.EDGE BEAM				
0	-5.49, 2	-6.27, 3	8.01, 2	6.33,-78
3	-4.56, 2	-5.22, 3	6.66, 2	-1.45, 1
7	-1.07, 2	-1.22, 3	1.56, 2	-2.56, 1
8	-5.22,-78	-3.40,-77	1.89,-77	-2.61, 1

	U	W	V	O
L.H.EDGE BEAM				
0	-4.15,-74	5.22, -2	-1.91, -2	5.66, -3
3	-5.40, -3	4.34, -2	-1.59, -2	4.70, -3
7	-9.54, -3	1.02, -2	-3.73, -3	1.10, -3
8	-9.73, -3	6.56,-75	-2.39,-75	7.23,-76

0

	N_{12}	R_2	N_2	M_2
0				
0	-4.63,-78	2.41, 0	-5.19, -1	7.48, 0
3	-8.42, 0	2.00, 0	-4.32, -1	6.22, 0
7	-1.49, 1	4.70, -1	-1.01, -1	1.46, 0
8	-1.52, 1	1.73,-77	1.73,-77	1.73,-77
3				
0	-7.88,-78	9.55, -1	7.54, 0	1.42, 1
3	-7.94, 0	7.94, -1	6.27, 0	1.18, 1
7	-1.40, 1	1.86, -1	1.47, 0	2.77, 0
8	-1.43, 1	1.73,-77	1.73,-77	1.73,-77

5

o	−7.57,−78	6.94, −1	1.12, 1	1.63, 1
3	−4.65, o	5.77, −1	9.32, o	1.35, 1
7	−8.20, o	1.35, −1	2.19, o	3.18, o
8	−8.36, o	1.73,−77	1.73,−77	1.73,−77

8

o	1.91,−77	−1.81, −8	1.32, 1	1.81, 1
3	1.61, −6	−1.51, −8	1.10, 1	1.51, 1
7	2.84, −6	−3.53, −9	2.58, o	3.54, o
8	2.90, −6	1.73,−77	1.73,−77	1.73,−77

16

o	2.07,−77	−2.41, o	−5.19, −1	7.48, o
3	8.42, o	−2.00, o	−4.32, −1	6.22, o
7	1.49, 1	−4.70, −1	−1.01, −1	1.46, o
8	1.52, 1	1.73,−77	1.73,−77	1.73,−77

1

	U	W	V	O_2

o

o	−5.65,−75	5.55, −2	−3.20, −2	5.66, −3
3	−5.90, −3	4.62, −2	−2.66, −2	4.70, −3
7	−1.04, −2	1.08, −2	−6.25, −3	1.10, −3
8	−1.06, −2	8.84,−76	−4.89,−76	1.02,−76

3

o	−1.32,−74	1.36, −1	−2.39, −2	3.93, −3
3	−1.37, −2	1.13, −1	−1.99, −2	3.27, −3
7	−2.42, −2	2.65, −2	−4.67, −3	7.67, −4
8	−2.47, −2	2.14,−75	−3.62,−76	7.46,−77

5

o	−1.66,−74	1.71, −1	−1.54, −2	2.49, −3
3	−1.73, −2	1.42, −1	−1.28, −2	2.07, −3
7	−3.06, −2	3.34, −2	−3.00, −3	4.85, −4
8	−3.12, −2	2.70,−75	−2.28,−76	5.20,−77

0	-1.87,-74	1.92, -1	-2.14,-11	-3.73,-11
3	-1.95, -2	1.60, -1	-1.78,-11	-3.10,-11
7	-3.44, -2	3.75, -2	-4.18,-12	-7.28,-12
8	-3.51, -2	3.03,-75	1.03,-77	8.05,-78

16

0	-5.65,-75	5.55, -2	3.20, -2	-5.66, -3
3	-5.90, -3	4.62, -2	2.66, -2	-4.70, -3
7	-1.04, -2	1.08, -2	6.25, -3	-1.10, -3
8	-1.06, -2	8.84,-76	5.15,-76	-7.58,-77

2

	N1	M1	R1	M12
0				
0	-3.05, 1	5.58, 0	1.73,-77	1.73,-77
3	-2.54, 1	4.64, 0	-3.36, -1	1.07, 1
7	-5.95, 0	1.09, 0	-5.93, -1	1.89, 1
8	1.73,-77	1.73,-77	-6.05, -1	1.93, 1
3				
0	1.76, 1	1.36, 1	1.73,-77	1.73,-77
3	1.46, 1	1.13, 1	-6.88, -1	7.45, 0
7	3.42, 0	2.66, 0	-1.21, 0	1.32, 1
8	1.73,-77	1.73,-77	-1.24, 0	1.34, 1
5				
0	1.80, 1	1.72, 1	1.73,-77	1.73,-77
3	1.50, 1	1.43, 1	-8.14, -1	4.72, 0
7	3.52, 0	3.36, 0	-1.44, 0	8.33, 0
8	1.73,-77	1.73,-77	-1.46, 0	8.49, 0
8				
0	1.68, 1	1.93, 1	1.73,-77	1.73,-77
3	1.40, 1	1.61, 1	-9.09, -1	-2.64, -8
7	3.28, 0	3.77, 0	-1.60, 0	-4.65, -8
8	1.73,-77	1.73,-77	-1.64, 0	-4.75, -8
16				
0	-3.05, 1	5.58, 0	1.73,-77	1.73,-77
3	-2.54, 1	4.64, 0	-3.36, -1	-1.07, 1
7	-5.95, 0	1.09, 0	-5.93, -1	-1.89, 1
8	1.73,-77	1.73,-77	-6.05, -1	-1.93, 1

8.3.3(c) Test B. I_3=.00522in^4 E_s=5.4x10^{6}lb/in^2.

2.20000,	-1	2.20000,	-1				
1.59000,	0	0.00000,	0	1.59000,	0	0.00000,	0
-1.85000,	2	2.00000,	2	7.50000,	-1	1.06750,	2
6.95000,	-2	0.00000,	0	0.00000,	0		
4.50000,	0	4.62500,	0	1.61100,	0	5.22000,	-3
4.50000,	0	4.62500,	0	1.61100,	0	5.22000,	-3
5.40000,	6	3.00000,	7				

RADIAL LOAD OVER WHOLE SURFACE ($_2$)

FOURIER SERIES TERM NO. 1

	N_1	M_1	M_2	M_3
L.H.EDGE BEAM				
0	-2.28, 2	-4.97, 3	5.90, 2	8.10,-78
1	-8.23,-78	-2.42,-77	1.74,-77	-1.91, 1

	U	W	V	O
L.H.EDGE BEAM				
0	-3.26,-74	4.13, -2	-1.41, -2	4.14, -3
1	-7.65, -3	5.20,-75	-1.76,-75	5.32,-76

0

	N_{12}	R_2	N_2	M_2
0				
0	-4.54,-78	2.95, 0	-8.96, -1	7.51, 0
1	-5.91, 0	1.73,-77	1.73,-77	1.73,-77
1				
0	-6.57,-78	1.90, 0	3.84, -1	1.33, 1
1	-9.21, 0	1.73,-77	1.73,-77	1.73,-77
2				
0	-5.80,-78	1.43, 0	1.91, 0	1.57, 1
1	-9.29, 0	1.73,-77	1.73,-77	1.73,-77
3				
0	-6.93,-78	1.21, 0	3.31, 0	1.72, 1
1	-7.86, 0	1.73,-77	1.73,-77	1.73,-77
4				
0	-5.52,-78	1.04, 0	4.43, 0	1.85, 1
1	-6.01, 0	1.73,-77	1.73,-77	1.73,-77

5

0	-8.59,-78	8.41, -1	5.26, 0	1.99, 1
1	-4.24, 0	1.73,-77	1.73,-77	1.73,-77

6

0	-8.46,-78	5.92, -1	5.82, 0	2.10, 1
1	-2.69, 0	1.73,-77	1.73,-77	1.73,-77

7

0	-5.12,-78	3.06, -1	6.14, 0	2.18, 1
1	-1.30, 0	1.73,-77	1.73,-77	1.73,-77

8

0	-4.66,-78	-7.81, -9	6.25, 0	2.21, 1
1	-4.50, -6	1.73,-77	1.73,-77	1.73,-77

16

0	1.90,-77	-2.95, 0	-8.96, -1	7.51, 0
1	5.91, 0	1.73,-77	1.73,-77	1.73,-77

1

	U	W	V	O_2

0

0	-8.84,-75	4.37, -2	-2.42, -2	4.14, -3
1	-8.31, -3	1.38,-75	-7.46,-76	1.43,-76

1

0	-1.29,-74	6.57, -2	-2.27, -2	3.83, -3
1	-1.21, -2	2.07,-75	-6.99,-76	1.33,-76

2

0	-1.67,-74	8.56, -2	-2.06, -2	3.40, -3
1	-1.57, -2	2.70,-75	-6.34,-76	1.20,-76

3

0	-2.01,-74	1.03, -1	-1.80, -2	2.92, -3
1	-1.88, -2	3.24,-75	-5.52,-76	1.05,-76

4

0	-2.29,-74	1.18, -1	-1.50, -2	2.41, -3
1	-2.15, -2	3.70,-75	-4.56,-76	8.85,-77

5

0	-2.52,-74	1.29, -1	-1.16, -2	1.85, -3
1	-2.37, -2	4.07,-75	-3.49,-76	7.10,-77

6

0	-2.69,-74	1.38, -1	-7.86, -3	1.26, -3
1	-2.53, -2	4.34,-75	-2.34,-76	5.24,-77

7

0	-2.79,-74	1.43, -1	-3.98, -3	6.36, -4
1	-2.62, -2	4.50,-75	-1.12,-76	3.29,-77

8

0	-2.83,-74	1.45, -1	1.91,-10	-3.50,-11
1	-2.66, -2	4.56,-75	1.92,-77	8.34,-78

16

0	-8.84,-75	4.37, -2	2.42, -2	-4.14, -3
1	-8.31, -3	1.38,-75	7.72,-76	-1.17,-76

2

	N1	M1	R1	M12
0				
0	-3.39, 1	7.18, 0	1.73,-77	1.73,-77
1	1.73,-77	1.73,-77	-6.53, -1	2.31, 1
1				
0	-8.55, 0	1.08, 1	1.73,-77	1.73,-77
1	1.73,-77	1.73,-77	-1.10, 0	2.14, 1
2				
0	5.67, 0	1.41, 1	1.73,-77	1.73,-77
1	1.73,-77	1.73,-77	-1.34, 0	1.90, 1

3

0	1.09, 1	1.69, 1	1.73,-77	1.73,-77
1	1.73,-77	1.73,-77	-1.51, 0	1.63, 1

4

0	1.14, 1	1.93, 1	1.73,-77	1.73,-77
1	1.73,-77	1.73,-77	-1.66, 0	1.35, 1

5

0	1.03, 1	2.13, 1	1.73,-77	1.73,-77
1	1.73,-77	1.73,-77	-1.80, 0	1.03, 1

6

0	9.02, 0	2.27, 1	1.73,-77	1.73,-77
1	1.73,-77	1.73,-77	-1.91, 0	7.03, 0

7

0	8.21, 0	2.35, 1	1.73,-77	1.73,-77
1	1.73,-77	1.73,-77	-1.98, 0	3.56, 0

8

0	7.94, 0	2.38, 1	1.73,-77	1.73,-77
1	1.73,-77	1.73,-77	-2.00, 0	-4.47, -8

16

0	-3.39, 1	7.18, 0	1.73,-77	1.73,-77
1	1.73,-77	1.73,-77	-6.53, -1	-2.31, 1

8.3.4(a) Test 7, $I_3 = .1677\ in^4$.

2.17000,	-1	2.17000,	-1				
1.32250,	0	0.00000,	0	1.32250,	0	0.00000,	0
-1.82000,	2	2.03000,	2	7.50000,	-1	1.06750,	2
6.95000,	-2	0.00000,	0	0.00000,	0		
3.00000,	0	3.50000,	0	9.42800,	-1	1.67700,	-1
3.00000,	0	3.50000,	0	9.42800,	-1	1.67700,	-1
3.30000,	6	3.00000,	7				

RADIAL LOAD OVER WHOLE SURFACE ($_2$)

FOURIER SERIES TERM NO. 1

	N_1	M_1	M_2	M_3
L.H.EDGE BEAM				
0	2.91, 1	-4.83, 3	3.95, 2	-6.75,-77
3	2.42, 1	-4.02, 3	3.29, 2	-3.52, 2
7	5.67, 0	-9.42, 2	7.71, 1	-6.21, 2
8	1.99,-77	-2.32,-77	1.89,-77	-6.33, 2

	U	W	V	O
L.H.EDGE BEAM				
0	-4.22,-74	5.31, -2	-1.61, -2	4.27, -3
3	-5.50, -3	4.42, -2	-1.34, -2	3.55, -3
7	-9.71, -3	1.04, -2	-3.15, -3	8.34, -4
8	-9.90, -3	6.68,-75	-2.01,-75	5.49,-76

o	N_{12}	R_2	N_2	M_2
0				
0	1.96,-77	4.18, 0	-1.23, 0	-1.07, 1
3	9.09, -1	3.47, 0	-1.02, 0	-8.91, 0
7	1.60, 0	8.15, -1	-2.40, -1	-2.09, 0
8	1.64, 0	1.73,-77	1.73,-77	1.73,-77
3				
0	-7.48,-78	1.01, 0	1.26, 0	1.31, 1
3	-4.64, 0	8.40, -1	1.04, 0	1.09, 1
7	-8.19, 0	1.97, -1	2.45, -1	2.55, 0
8	-8.35, 0	1.73,-77	1.73,-77	1.73,-77

5

0	-4.65,-78	5.25, -1	3.62, 0	1.47, 1
3	-3.18, 0	4.37, -1	3.01, 0	1.22, 1
7	-5.61, 0	1.02, -1	7.07, -1	2.87, 0
8	-5.72, 0	1.73,-77	1.73,-77	1.73,-77

8

0	-5.44,-78	-7.76, -8	5.00, 0	1.56, 1
3	-3.60, -6	-6.45, -8	4.16, 0	1.30, 1
7	-6.36, -6	-1.51, -8	9.76, -1	3.04, 0
8	-6.49, -6	1.73,-77	1.73,-77	1.73,-77

16

0	-5.30,-78	-4.18, 0	-1.23, 0	-1.07, 1
3	-9.09, -1	-3.47, 0	-1.02, 0	-8.91, 0
7	-1.60, 0	-8.15, -1	-2.40, -1	-2.09, 0
8	-1.64, 0	1.73,-77	1.73,-77	1.73,-77

1

	U	W	V	O_2
0				
0	-5.60,-75	5.39, -2	-2.84, -2	4.27, -3
3	-5.85, -3	4.48, -2	-2.36, -2	3.55, -3
7	-1.03, -2	1.05, -2	-5.54, -3	8.34, -4
8	-1.05, -2	8.59,-76	-4.33,-76	8.00,-77
3				
0	-1.22,-74	1.23, -1	-2.11, -2	3.51, -3
3	-1.27, -2	1.02, -1	-1.76, -2	2.92, -3
7	-2.24, -2	2.39, -2	-4.12, -3	6.85, -4
8	-2.29, -2	1.94,-75	-3.19,-76	6.80,-77
5				
0	-1.52,-74	1.54, -1	-1.36, -2	2.18, -3
3	-1.59, -2	1.28, -1	-1.13, -2	1.81, -3
7	-2.81, -2	3.01, -2	-2.64, -3	4.25, -4
8	-2.86, -2	2.43,-75	-2.00,-76	4.71,-77

8

0	-1.70,-74	1.72, -1	2.02, -9	-3.09,-10
3	-1.78, -2	1.43, -1	1.68, -9	-2.57,-10
7	-3.14, -2	3.36, -2	3.95,-10	-6.03,-11
8	-3.20, -2	2.71,-75	2.13,-77	7.87,-78

16

0	-5.60,-75	5.39, -2	2.84, -2	-4.27, -3
3	-5.85, -3	4.48, -2	2.36, -2	-3.55, -3
7	-1.03, -2	1.05, -2	5.54, -3	-8.34, -4
8	-1.05, -2	8.59,-76	4.59,-76	-5.41,-77

2

	N1	M1	R1	M12
0				
0	-3.41, 1	5.42, 0	1.73,-77	1.73,-77
3	-2.83, 1	4.50, 0	2.62, -1	8.11, 0
7	-6.65, 0	1.06, 0	4.62, -1	1.43, 1
8	1.73,-77	1.73,-77	4.71, -1	1.46, 1
3				
0	1.37, 0	1.23, 1	1.73,-77	1.73,-77
3	1.14, 0	1.02, 1	-6.28, -1	6.66, 0
7	2.68, -1	2.40, 0	-1.11, 0	1.18, 1
8	1.73,-77	1.73,-77	-1.13, 0	1.20, 1
5				
0	1.17, 1	1.55, 1	1.73,-77	1.73,-77
3	9.69, 0	1.29, 1	-7.35, -1	4.13, 0
7	2.27, 0	3.02, 0	-1.30, 0	7.29, 0
8	1.73,-77	1.73,-77	-1.32, 0	7.43, 0
8				
0	1.15, 1	1.73, 1	1.73,-77	1.73,-77
3	9.52, 0	1.44, 1	-7.93, -1	-5.19, -7
7	2.23, 0	3.38, 0	-1.40, 0	-9.17, -7
8	1.73,-77	1.73,-77	-1.43, 0	-9.35, -7
16				
0	-3.41, 1	5.42, 0	1.73,-77	1.73,-77
3	-2.83, 1	4.50, 0	2.62, -1	-8.11, 0
7	-6.65, 0	1.06, 0	4.62, -1	-1.43, 1
8	1.73,-77	1.73,-77	4.71, -1	-1.46, 1

8.3.4(b) Test 7. I_3 = .00522 in^4.

2.17000, -1	2.17000, -1				
1.32250, 0	0.00000, 0	1.32250, 0	0.00000, 0		
-1.82000, 2	2.03000, 2	7.50000, -1	1.06750, 2		
6.95000, -2	0.00000, 0	0.00000, 0			
3.00000, 0	3.50000, 0	9.42800, -1	5.22000, -3		
3.00000, 0	3.50000, 0	9.42800, -1	5.22000, -3		
3.30000, 6	3.00000, 7				

RADIAL LOAD OVER WHOLE SURFACE (2)

FOURIER SERIES TERM NO. 1

	N_1	M_1	M_2	M_3
L.H.EDGE BEAM				
0	-3.42, 2	-5.63, 3	4.81, 2	6.09,-78
3	-2.84, 2	-4.68, 3	4.00, 2	-1.50, 1
7	-6.67, 1	-1.10, 3	9.39, 1	-2.65, 1
8	-7.91,-78	-2.91,-77	2.02,-77	-2.70, 1

	U	W	V	O
L.H.EDGE BEAM				
0	-4.98,-74	6.19, -2	-1.96, -2	5.86, -3
3	-6.49, -3	5.15, -2	-1.63, -2	4.87, -3
7	-1.15, -2	1.21, -2	-3.83, -3	1.14, -3
8	-1.17, -2	7.78,-75	-2.45,-75	7.48,-76

0

	N_{12}	R_2	N_2	M_2
0				
0	-8.22,-78	2.91, 0	-7.00, -1	5.81, 0
3	-5.09, 0	2.42, 0	-5.82, -1	4.83, 0
7	-8.98, 0	5.68, -1	-1.36, -1	1.13, 0
8	-9.16, 0	1.73,-77	1.73,-77	1.73,-77
3				
0	-5.92,-78	9.81, -1	5.36, 0	1.51, 1
3	-6.40, 0	8.16, -1	4.46, 0	1.25, 1
7	-1.13, 1	1.91, -1	1.05, 0	2.94, 0
8	-1.15, 1	1.73,-77	1.73,-77	1.73,-77

5

0	-4.59,-78	6.96, -1	8.31, 0	1.70, 1
3	-3.70, 0	5.79, -1	6.91, 0	1.41, 1
7	-6.53, 0	1.36, -1	1.62, 0	3.31, 0
8	-6.65, 0	1.73,-77	1.73,-77	1.73,-77

8

0	1.99,-77	-7.23, -8	9.90, 0	1.87, 1
3	9.01, -7	-6.01, -8	8.23, 0	1.56, 1
7	1.59, -6	-1.41, -8	1.93, 0	3.65, 0
8	1.62, -6	1.73,-77	1.73,-77	1.73,-77

16

0	1.76,-77	-2.91, 0	-7.00, -1	5.81, 0
3	5.09, 0	-2.42, 0	-5.82, -1	4.83, 0
7	8.98, 0	-5.68, -1	-1.36, -1	1.13, 0
8	9.16, 0	1.73,-77	1.73,-77	1.73,-77

1

	U	W	V	O_2

0

0	-6.62,-75	6.38, -2	-3.42, -2	5.86, -3
3	-6.92, -3	5.30, -2	-2.84, -2	4.87, -3
7	-1.22, -2	1.24, -2	-6.67, -3	1.14, -3
8	-1.24, -2	1.01,-75	-5.23,-76	1.05,-76

3

0	-1.46,-74	1.48, -1	-2.54, -2	4.10, -3
3	-1.52, -2	1.23, -1	-2.11, -2	3.41, -3
7	-2.68, -2	2.88, -2	-4.95, -3	7.99, -4
8	-2.74, -2	2.33,-75	-3.85,-76	7.72,-77

5

0	-1.82,-74	1.84, -1	-1.62, -2	2.58, -3
3	-1.90, -2	1.53, -1	-1.35, -2	2.14, -3
7	-3.36, -2	3.60, -2	-3.17, -3	5.03, -4
8	-3.42, -2	2.91,-75	-2.42,-76	5.34,-77

8

0	-2.04,-74	2.06, -1	1.52, -9	-2.85,-10
3	-2.13, -2	1.71, -1	1.27, -9	-2.37,-10
7	-3.76, -2	4.02, -2	2.97,-10	-5.56,-11
8	-3.83, -2	3.25,-75	1.92,-77	8.27,-78

16

0	-6.62,-75	6.38, -2	3.42, -2	-5.86, -3
3	-6.92, -3	5.30, -2	2.84, -2	-4.87, -3
7	-1.22, -2	1.24, -2	6.67, -3	-1.14, -3
8	-1.24, -2	1.01,-75	5.49,-76	-7.90,-77

2

	N1	M1	R1	M12
0				
0	-3.94, 1	6.41, 0	1.73,-77	1.73,-77
3	-3.28, 1	5.33, 0	-2.95, -1	1.11, 1
7	-7.69, 0	1.25, 0	-5.20, -1	1.96, 1
8	1.73,-77	1.73,-77	-5.31, -1	2.00, 1
3				
0	1.37, 1	1.48, 1	1.73,-77	1.73,-77
3	1.14, 1	1.23, 1	-7.36, -1	7.77, 0
7	2.68, 0	2.89, 0	-1.30, 0	1.37, 1
8	1.73,-77	1.73,-77	-1.32, 0	1.40, 1
5				
0	1.48, 1	1.85, 1	1.73,-77	1.73,-77
3	1.23, 1	1.54, 1	-8.58, -1	4.89, 0
7	2.89, 0	3.62, 0	-1.51, 0	8.63, 0
8	1.73,-77	1.73,-77	-1.54, 0	8.80, 0
8				
0	1.31, 1	2.07, 1	1.73,-77	1.73,-77
3	1.09, 1	1.72, 1	-9.51, -1	-4.85, -7
7	2.55, 0	4.04, 0	-1.68, 0	-8.56, -7
8	1.73,-77	1.73,-77	-1.71, 0	-8.73, -7
16				
0	-3.94, 1	6.41, 0	1.73,-77	1.73,-77
3	-3.28, 1	5.33, 0	-2.95, -1	-1.11, 1
7	-7.69, 0	1.25, 0	-5.20, -1	-1.96, 1
8	1.73,-77	1.73,-77	-5.31, -1	-2.00, 1

8.3.4(c) Test 8, I_3 = .1677 in^4.

2.17000, -1 2.17000, -1
2.15750, 0 0.00000, 0 2.15750, 0 0.00000, 0
-1.82000, 2 2.03000, 2 7.50000, -1 1.06750, 2
6.95000, -2 0.00000, 0 0.00000, 0
3.00000, 0 3.50000, 0 2.55900, 0 1.67700, -1
3.00000, 0 3.50000, 0 2.55900, 0 1.67700, -1
3.30000, 6 3.00000, 7
RADIAL LOAD OVER WHOLE SURFACE (2)

FOURIER SERIES TERM NO. 1

	N_1	M_1	M_2	M_3
L.H.EDGE BEAM				
0	-1.21, 2	-4.94, 3	1.13, 3	-7.40,-77
3	-1.01, 2	-4.10, 3	9.41, 2	-3.80, 2
7	-2.36, 1	-9.63, 2	2.21, 2	-6.71, 2
8	-7.11,-78	-2.40,-77	2.14,-77	-6.84, 2

	U	W	V	O
L.H.EDGE BEAM				
0	-4.34,-74	5.43, -2	-1.70, -2	4.62, -3
3	-5.65, -3	4.51, -2	-1.42, -2	3.84, -3
7	-9.98, -3	1.06, -2	-3.32, -3	9.01, -4
8	-1.02, -2	6.82,-75	-2.12,-75	5.93,-76

0

	N_{12}	R_2	N_2	M_2
0				
0	-5.35,-78	3.38, 0	-1.46, 0	-6.12, 0
3	-1.53, 0	2.81, 0	-1.21, 0	-5.09, 0
7	-2.71, 0	6.59, -1	-2.84, -1	-1.19, 0
8	-2.76, 0	1.73,-77	1.73,-77	1.73,-77
3				
0	-4.34,-78	1.09, 0	1.67, 0	1.32, 1
3	-4.43, 0	9.07, -1	1.39, 0	1.10, 1
7	-7.81, 0	2.13, -1	3.25, -1	2.57, 0
8	-7.97, 0	1.73,-77	1.73,-77	1.73,-77

5

0	-7.97,-78	6.01, -1	3.88, 0	1.55, 1
3	-2.95, 0	4.99, -1	3.23, 0	1.29, 1
7	-5.21, 0	1.17, -1	7.57, -1	3.02, 0
8	-5.31, 0	1.73,-77	1.73,-77	1.73,-77

8

0	2.16,-77	2.33, -8	5.17, 0	1.67, 1
3	2.24, -6	1.93, -8	4.30, 0	1.39, 1
7	3.96, -6	4.54, -9	1.01, 0	3.26, 0
8	4.04, -6	1.73,-77	1.73,-77	1.73,-77

16

0	1.86,-77	-3.38, 0	-1.46, 0	-6.12, 0
3	1.53, 0	-2.81, 0	-1.21, 0	-5.09, 0
7	2.71, 0	-6.59, -1	-2.84, -1	-1.19, 0
8	2.76, 0	1.73,-77	1.73,-77	1.73,-77

1

U	W	V	O_2

0

0	-5.99,-75	5.91, -2	-3.05, -2	4.62, -3
3	-6.26, -3	4.91, -2	-2.53, -2	3.84, -3
7	-1.10, -2	1.15, -2	-5.94, -3	9.01, -4
8	-1.13, -2	9.40,-76	-4.65,-76	8.54,-77

3

0	-1.30,-74	1.31, -1	-2.26, -2	3.70, -3
3	-1.36, -2	1.09, -1	-1.88, -2	3.07, -3
7	-2.40, -2	2.56, -2	-4.41, -3	7.21, -4
8	-2.45, -2	2.07,-75	-3.41,-76	7.09,-77

5

0	-1.63,-74	1.65, -1	-1.45, -2	2.32, -3
3	-1.70, -2	1.37, -1	-1.20, -2	1.93, -3
7	-3.00, -2	3.21, -2	-2.83, -3	4.52, -4
8	-3.06, -2	2.60,-75	-2.14,-76	4.93,-77

8

0	-1.82,-74	1.84, -1	-6.88,-10	5.66,-11
3	-1.90, -2	1.53, -1	-5.72,-10	4.71,-11
7	-3.36, -2	3.59, -2	-1.34,-10	1.10,-11
8	-3.42, -2	2.90,-75	1.03,-77	2.04,-77

16

0	-5.99,-75	5.91, -2	3.05, -2	-4.62, -3
3	-6.26, -3	4.91, -2	2.53, -2	-3.84, -3
7	-1.10, -2	1.15, -2	5.94, -3	-9.01, -4
8	-1.13, -2	9.40,-76	4.91,-76	-5.95,-77

2

	NI	MI	RI	MI2
0				
0	-1.69, 1	5.94, 0	1.73,-77	1.73,-77
3	-1.40, 1	4.93, 0	1.03, -1	8.76, 0
7	-3.29, 0	1.16, 0	1.82, -1	1.55, 1
8	1.73,-77	1.73,-77	1.86, -1	1.58, 1
3				
0	3.39, 0	1.32, 1	1.73,-77	1.73,-77
3	2.82, 0	1.10, 1	-6.47, -1	7.01, 0
7	6.61, -1	2.58, 0	-1.14, 0	1.24, 1
8	1.73,-77	1.73,-77	-1.16, 0	1.26, 1
5				
0	1.08, 1	1.65, 1	1.73,-77	1.73,-77
3	8.96, 0	1.38, 1	-7.77, -1	4.40, 0
7	2.10, 0	3.23, 0	-1.37, 0	7.76, 0
8	1.73,-77	1.73,-77	-1.40, 0	7.91, 0
8				
0	1.07, 1	1.85, 1	1.73,-77	1.73,-77
3	8.93, 0	1.54, 1	-8.49, -1	1.51, -7
7	2.10, 0	3.61, 0	-1.50, 0	2.67, -7
8	1.73,-77	1.73,-77	-1.53, 0	2.72, -7
16				
0	-1.69, 1	5.94, 0	1.73,-77	1.73,-77
3	-1.40, 1	4.93, 0	1.03, -1	-8.76, 0
7	-3.29, 0	1.16, 0	1.82, -1	-1.55, 1
8	1.73,-77	1.73,-77	1.86, -1	-1.58, 1

8.3.4(d) Test 8, I_3 = .00522 in^4.

2.17000,	-1	2.17000,	-1				
2.15750,	0	0.00000,	0	2.15750,	0	0.00000,	0
-1.82000,	2	2.03000,	2	7.50000,	-1	1.06750,	2
6.95000,	-2	0.00000,	0	0.00000,	0		
3.00000,	0	3.50000,	0	2.55900,	0	5.22000,	-3
3.00000,	0	3.50000,	0	2.55900,	0	5.22000,	-3
3.30000,	6	3.00000,	7				

RADIAL LOAD OVER WHOLE SURFACE ($_2$)

FOURIER SERIES TERM NO. 1

	N_1	M_1	M_2	M_3
L.H.EDGE BEAM				
0	-5.55, 2	-5.80, 3	1.39, 3	5.60,-78
3	-4.62, 2	-4.82, 3	1.15, 3	-1.61, 1
7	-1.08, 2	-1.13, 3	2.70, 2	-2.84, 1
8	-6.03,-78	-3.04,-77	2.33,-77	-2.89, 1

	U	W	V	O
L.H.EDGE BEAM				
0	-5.17,-74	6.38, -2	-2.08, -2	6.28, -3
3	-6.73, -3	5.30, -2	-1.73, -2	5.22, -3
7	-1.19, -2	1.24, -2	-4.07, -3	1.22, -3
8	-1.21, -2	8.02,-75	-2.60,-75	8.01,-76

0

	N_{12}	R_2	N_2	M_2
0				
0	-4.42,-78	1.88, 0	-6.37, -1	1.10, 1
3	-8.56, 0	1.56, 0	-5.29, -1	9.16, 0
7	-1.51, 1	3.66, -1	-1.24, -1	2.15, 0
8	-1.54, 1	1.73,-77	1.73,-77	1.73,-77
3				
0	-5.19,-78	1.12, 0	6.36, 0	1.52, 1
3	-6.24, 0	9.29, -1	5.29, 0	1.27, 1
7	-1.10, 1	2.18, -1	1.24, 0	2.97, 0
8	-1.12, 1	1.73,-77	1.73,-77	1.73,-77

5

0	-8.12,-78	8.00, -1	9.19, 0	1.81, 1
3	-3.52, 0	6.65, -1	7.64, 0	1.50, 1
7	-6.22, 0	1.56, -1	1.79, 0	3.53, 0
8	-6.34, 0	1.73,-77	1.73,-77	1.73,-77

8

0	1.89,-77	7.57, -8	1.07, 1	2.03, 1
3	1.56, -6	6.29, -8	8.90, 0	1.68, 1
7	2.75, -6	1.48, -8	2.09, 0	3.95, 0
8	2.80, -6	1.73,-77	1.73,-77	1.73,-77

16

0	2.08,-77	-1.88, 0	-6.37, -1	1.10, 1
3	8.56, 0	-1.56, 0	-5.29, -1	9.16, 0
7	1.51, 1	-3.66, -1	-1.24, -1	2.15, 0
8	1.54, 1	1.73,-77	1.73,-77	1.73,-77

1

	U	W	V	O_2

0

0	-7.15,-75	7.10, -2	-3.70, -2	6.28, -3
3	-7.47, -3	5.91, -2	-3.08, -2	5.22, -3
7	-1.32, -2	1.39, -2	-7.22, -3	1.22, -3
8	-1.34, -2	1.13,-75	-5.68,-76	1.11,-76

3

0	-1.58,-74	1.60, -1	-2.74, -2	4.36, -3
3	-1.64, -2	1.33, -1	-2.28, -2	3.63, -3
7	-2.90, -2	3.11, -2	-5.34, -3	8.51, -4
8	-2.96, -2	2.52,-75	-4.17,-76	8.14,-77

5

0	-1.97,-74	1.99, -1	-1.75, -2	2.78, -3
3	-2.06, -2	1.66, -1	-1.46, -2	2.31, -3
7	-3.63, -2	3.89, -2	-3.42, -3	5.42, -4
8	-3.70, -2	3.14,-75	-2.62,-76	5.65,-77

0	-2.20,-74	2.23, -1	-1.63, -9	2.03,-10
3	-2.30, -2	1.85, -1	-1.35, -9	1.69,-10
7	-4.06, -2	4.34, -2	-3.17,-10	3.97,-11
8	-4.14, -2	3.50,-75	1.21,-77	1.96,-77

16

0	-7.15,-75	7.10, -2	3.70, -2	-6.28, -3
3	-7.47, -3	5.91, -2	3.08, -2	-5.22, -3
7	-1.32, -2	1.39, -2	7.22, -3	-1.22, -3
8	-1.34, -2	1.13,-75	5.93,-76	-8.55,-77

2

	N1	M1	R1	M12
0				
0	-1.32, 1	7.14, 0	1.73,-77	1.73,-77
3	-1.10, 1	5.93, 0	-4.77, -1	1.19, 1
7	-2.57, 0	1.39, 0	-8.42, -1	2.10, 1
8	1.73,-77	1.73,-77	-8.58, -1	2.14, 1
3				
0	1.61, 1	1.60, 1	1.73,-77	1.73,-77
3	1.34, 1	1.33, 1	-7.61, -1	8.27, 0
7	3.14, 0	3.13, 0	-1.34, 0	1.46, 1
8	1.73,-77	1.73,-77	-1.37, 0	1.49, 1
5				
0	1.39, 1	2.00, 1	1.73,-77	1.73,-77
3	1.16, 1	1.66, 1	-9.19, -1	5.27, 0
7	2.72, 0	3.90, 0	-1.62, 0	9.30, 0
8	1.73,-77	1.73,-77	-1.65, 0	9.49, 0
8				
0	1.27, 1	2.24, 1	1.73,-77	1.73,-77
3	1.05, 1	1.86, 1	-1.03, 0	4.55, -7
7	2.47, 0	4.36, 0	-1.82, 0	8.04, -7
8	1.73,-77	1.73,-77	-1.85, 0	8.19, -7
16				
0	-1.32, 1	7.14, 0	1.73,-77	1.73,-77
3	-1.10, 1	5.93, 0	-4.77, -1	-1.19, 1
7	-2.57, 0	1.39, 0	-8.42, -1	-2.10, 1
8	1.73,-77	1.73,-77	-8.58, -1	-2.14, 1

8.3.5 Test D, $I_3 = .00522\ in^4$.

2.12500,	-1	2.12500,	-1				
1.81000,	0	0.00000,	0	1.81000,	0	0.00000,	0
-1.79000,	2	2.07000,	2	7.50000,	-1	1.06750,	2
6.95000,	-2	0.00000,	0	0.00000,	0		
4.50000,	0	4.62500,	0	2.00100,	0	5.22000,	-3
4.50000,	0	4.62500,	0	2.00100,	0	5.22000,	-3
3.30000,	6	3.00000,	7				

ASYM RADIAL LOAD OVER LONGL SPAN(2)

FOURIER SERIES TERM NO. 1

	N_1	M_1	M_2	M_3
L.H.EDGE BEAM				
0	3.15,-75	1.59,-75	2.00,-75	4.21, 0
3	2.14, 2	1.07, 2	1.35, 2	1.61, 0
7	8.86, 1	4.44, 1	5.61, 1	-3.89, 0
8	-2.71, -6	-1.36, -6	-1.71, -6	-4.21, 0

	U	W	V	O
L.H.EDGE BEAM				
0	-5.21, -5	-2.02,-76	-6.13,-76	4.19,-76
3	-1.99, -5	-2.23, -4	-6.51, -4	4.22, -4
7	4.81, -5	-9.25, -5	-2.70, -4	1.75, -4
8	5.21, -5	2.83,-12	8.24,-12	-5.35,-12

0

	N_{12}	R_2	N_2	M_2
0				
0	-1.36, 1	1.92,-77	-1.55,-77	4.26,-77
3	-5.20, 0	4.24, -1	-1.94, 0	2.02, 0
7	1.26, 1	1.76, -1	-8.03, -1	8.36, -1
8	1.36, 1	-5.37, -9	2.46, -8	-2.56, -8
3				
0	-1.63, 1	2.15,-77	-2.18,-76	3.18,-77
3	-6.25, 0	7.23, -2	-1.57, 1	1.28, 0
7	1.51, 1	3.00, -2	-6.52, 0	5.31, -1
8	1.63, 1	-9.16,-10	1.99, -7	-1.62, -8

5

0	-1.26, 1	1.78,-77	-3.49,-76	2.38,-77
3	-4.84, 0	2.05, -2	-2.47, 1	7.37, -1
7	1.17, 1	8.50, -3	-1.02, 1	3.05, -1
8	1.26, 1	-2.60,-10	3.12, -7	-9.33, -9

8

0	4.23, -7	1.86,-77	-4.38,-76	1.88,-77
3	1.62, -7	5.71, -9	-3.07, 1	4.00, -1
7	-3.91, -7	2.36, -9	-1.27, 1	1.66, -1
8	-4.23, -7	-7.23,-17	3.89, -7	-5.07, -9

16

0	1.36, 1	-4.63,-78	-1.55,-77	4.26,-77
3	5.20, 0	-4.24, -1	-1.94, 0	2.02, 0
7	-1.26, 1	-1.76, -1	-8.03, -1	8.36, -1
8	-1.36, 1	5.37, -9	2.46, -8	-2.56, -8

1

	U	W	V	O_2
0				
0	2.30, -5	3.65,-77	-3.22,-77	3.83,-77
3	8.79, -6	3.92, -4	-7.50, -4	4.22, -4
7	-2.12, -5	1.62, -4	-3.11, -4	1.75, -4
8	-2.30, -5	-4.96,-12	9.50,-12	-5.35,-12
3				
0	5.32, -4	3.18,-76	-2.08,-77	2.30,-77
3	2.03, -4	5.07, -3	-5.61, -4	1.67, -4
7	-4.91, -4	2.10, -3	-2.33, -4	6.91, -5
8	-5.32, -4	-6.43,-11	7.11,-12	-2.11,-12
5				
0	7.18, -4	3.95,-76	-7.74,-78	1.74,-77
3	2.75, -4	6.35, -3	-3.44, -4	7.33, -5
7	-6.63, -4	2.63, -3	-1.43, -4	3.03, -5
8	-7.18, -4	-8.04,-11	4.36,-12	-9.28,-13

8

0	8.09, -4	4.27,-76	2.14,-77	1.89,-77
3	3.09, -4	6.88, -3	4.19,-12	2.95,-12
7	-7.47, -4	2.85, -3	1.74,-12	1.22,-12
8	-8.09, -4	-8.72,-11	-5.31,-20	-3.73,-20

16

0	2.30, -5	3.65,-77	5.81,-77	-1.24,-77
3	8.79, -6	3.92, -4	7.50, -4	-4.22, -4
7	-2.12, -5	1.62, -4	3.11, -4	-1.75, -4
8	-2.30, -5	-4.96,-12	-9.50,-12	5.35,-12

2

	N1	M1	R1	M12
0				
0	4.71,-77	1.76,-77	2.67, -1	-3.12, 0
3	2.32, 0	1.57, -1	1.02, -1	-1.19, 0
7	9.63, -1	6.52, -2	-2.47, -1	2.88, 0
8	-2.94, -8	-1.99, -9	-2.67, -1	3.12, 0
3				
0	-7.46,-78	4.29,-77	2.93, -1	-1.23, 0
3	-1.39, 0	2.04, 0	1.12, -1	-4.72, -1
7	-5.76, -1	8.45, -1	-2.71, -1	1.14, 0
8	1.76, -8	-2.58, -8	-2.93, -1	1.23, 0
5				
0	-1.17,-76	5.04,-77	2.56, -1	-5.42, -1
3	-8.84, 0	2.55, 0	9.81, -2	-2.07, -1
7	-3.66, 0	1.06, 0	-2.37, -1	5.00, -1
8	1.12, -7	-3.23, -8	-2.56, -1	5.42, -1
8				
0	-1.88,-76	5.36,-77	2.27, -1	-1.82, -8
3	-1.37, 1	2.77, 0	8.70, -2	-6.95, -9
7	-5.66, 0	1.15, 0	-2.10, -1	1.68, -8
8	1.73, -7	-3.50, -8	-2.27, -1	1.82, -8

*16

0	4.71,-77	1.76,-77	2.67, -1	3.12, 0
3	2.32, 0	1.57, -1	1.02, -1	1.19, 0
7	9.63, -1	6.52, -2	-2.47, -1	-2.88, 0
8	-2.94, -8	-1.99, -9	-2.67, -1	-3.12, 0

8.3.6(a) Test E, $I_3 = .2094\ in^4$.

2.12500, -1 2.12500, -1
1.81000, 0 0.00000, 0 1.81000, 0 0.00000, 0
-1.79000, 2 2.07000, 2 7.50000, -1 1.06750, 2
6.95000, -2 0.00000, 0 0.00000, 0
4.50000, 0 4.62500, 0 2.00100, 0 2.09400, -1
4.50000, 0 4.62500, 0 2.00100, 0 2.09400, -1
3.30000, 6 3.00000, 7

RADIAL ASYMMETRIC TRANSVERSE LOAD(2)

FOURIER SERIES TERM NO. 1

	N_1	M_1	M_2	M_3
L.H.EDGE BEAM				
0	3.30, 2	2.28, 3	2.63, 2	4.43,-78
3	2.74, 2	1.90, 3	2.19, 2	-1.86, 1
7	6.43, 1	4.45, 2	5.14, 1	-3.29, 1
8	1.79,-77	3.00,-77	2.08,-77	-3.35, 1

	U	W	V	O
L.H.EDGE BEAM				
0	1.57,-74	-1.90, -2	-5.07, -3	1.81, -4
3	2.05, -3	-1.58, -2	-4.21, -3	1.51, -4
7	3.62, -3	-3.71, -3	-9.89, -4	3.54, -5
8	3.69, -3	-2.37,-75	-6.23,-76	3.57,-77

0

	N_{12}	R_2	N_2	M_2
0				
0	1.77,-77	-2.84, -1	-6.75, -1	2.40, -1
3	5.18, 0	-2.36, -1	-5.61, -1	2.00, -1
7	9.15, 0	-5.54, -2	-1.32, -1	4.68, -2
8	9.33, 0	1.73,-77	1.73,-77	1.73,-77
3				
0	1.81,-77	9.63, -2	-3.25, 0	-2.00, 0
3	7.06, -1	8.01, -2	-2.70, 0	-1.66, 0
7	1.25, 0	1.88, -2	-6.34, -1	-3.90, -1
8	1.27, 0	1.73,-77	1.73,-77	1.73,-77

5

0	-6.88,-78	1.87, -1	-2.83, 0	-1.37, 0
3	-2.03, 0	1.55, -1	-2.35, 0	-1.14, 0
7	-3.59, 0	3.64, -2	-5.51, -1	-2.66, -1
8	-3.66, 0	1.73,-77	1.73,-77	1.73,-77

8

0	-4.55,-78	2.13, -1	-6.93, -7	4.37, -7
3	-3.85, 0	1.77, -1	-5.76, -7	3.64, -7
7	-6.80, 0	4.15, -2	-1.35, -7	8.53, -8
8	-6.94, 0	1.73,-77	1.73,-77	1.73,-77

16

0	1.77,-77	-2.84, -1	6.75, -1	-2.40, -1
3	5.18, 0	-2.36, -1	5.61, -1	-2.00, -1
7	9.15, 0	-5.54, -2	1.32, -1	-4.68, -2
8	9.33, 0	1.73,-77	1.73,-77	1.73,-77

1

	U	W	V	O_2
0				
0	1.84,-75	-1.93, -2	-1.02, -3	1.81, -4
3	1.90, -3	-1.61, -2	-8.45, -4	1.51, -4
7	3.35, -3	-3.77, -3	-1.98, -4	3.54, -5
8	3.42, -3	-2.90,-76	-5.96,-78	1.86,-77
3				
0	1.42,-75	-1.51, -2	-2.43, -3	3.78, -4
3	1.47, -3	-1.26, -2	-2.02, -3	3.14, -4
7	2.59, -3	-2.95, -3	-4.73, -4	7.37, -5
8	2.64, -3	-2.24,-76	-2.51,-77	1.89,-77
5				
0	9.33,-76	-1.00, -2	-3.12, -3	5.42, -4
3	9.59, -4	-8.33, -3	-2.59, -3	4.51, -4
7	1.69, -3	-1.95, -3	-6.08, -4	1.06, -4
8	1.73, -3	-1.44,-76	-3.59,-77	2.15,-77

8

0	-5.80,-78	5.34, -9	-3.54, -3	6.40, -4
3	-5.74,-10	4.44, -9	-2.94, -3	5.32, -4
7	-1.01, -9	1.04, -9	-6.90, -4	1.25, -4
8	-1.03, -9	1.84,-77	-4.25,-77	2.30,-77

16

0	-1.81,-75	1.93, -2	-1.02, -3	1.81, -4
3	-1.90, -3	1.61, -2	-8.45, -4	1.51, -4
7	-3.35, -3	3.77, -3	-1.98, -4	3.54, -5
8	-3.42, -3	3.16,-76	-5.96,-78	1.86,-77

2

	N1	M1	R1	M12
0				
0	-1.80, 1	-1.94, 0	1.73,-77	1.73,-77
3	-1.50, 1	-1.61, 0	2.39, -2	3.44, -1
7	-3.52, 0	-3.79, -1	4.22, -2	6.08, -1
8	1.73,-77	1.73,-77	4.30, -2	6.20, -1
3				
0	-1.68, 1	-1.52, 0	1.73,-77	1.73,-77
3	-1.39, 1	-1.26, 0	9.02, -2	7.17, -1
7	-3.27, 0	-2.97, -1	1.59, -1	1.27, 0
8	1.73,-77	1.73,-77	1.62, -1	1.29, 0
5				
0	-1.28, 1	-1.01, 0	1.73,-77	1.73,-77
3	-1.06, 1	-8.37, -1	6.11, -2	1.03, 0
7	-2.49, 0	-1.96, -1	1.08, -1	1.81, 0
8	1.73,-77	1.73,-77	1.10, -1	1.85, 0
8				
0	-1.03, -6	5.63, -7	1.73,-77	1.73,-77
3	-8.54, -7	4.68, -7	-2.24, -8	1.21, 0
7	-2.00, -7	1.10, -7	-3.96, -8	2.14, 0
8	1.73,-77	1.73,-77	-4.03, -8	2.19, 0
16				
0	1.80, 1	1.94, 0	1.73,-77	1.73,-77
3	1.50, 1	1.61, 0	-2.39, -2	3.44, -1
7	3.52, 0	3.79, -1	-4.22, -2	6.08, -1
8	1.73,-77	1.73,-77	-4.30, -2	6.20, -1

8.3.6(b) Test E, I_3 = .00522 in^4.

2.12500, -1 2.12500, -1
1.81000, 0 0.00000, 0 1.81000, 0 0.00000, 0
-1.79000, 2 2.07000, 2 7.50000, -1 1.06750, 2
6.95000, -2 0.00000, 0 0.00000, 0
4.50000, 0 4.62500, 0 2.00100, 0 5.22000, -3
4.50000, 0 4.62500, 0 2.00100, 0 5.22000, -3
3.30000, 6 3.00000, 7
RADIAL ASYMMETRIC TRANSVERSE LOAD(2)

FOURIER SERIES TERM NO. 1

	N_1	M_1	M_2	M_3
L.H.EDGE BEAM				
0	3.16, 2	2.30, 3	2.66, 2	4.94,-78
3	2.62, 2	1.92, 3	2.21, 2	-5.48, -1
7	6.16, 1	4.50, 2	5.19, 1	-9.67, -1
8	1.77,-77	3.02,-77	2.09,-77	-9.86, -1

	U	W	V	O
L.H.EDGE BEAM				
0	1.59,-74	-1.92, -2	-5.11, -3	2.14, -4
3	2.07, -3	-1.59, -2	-4.25, -3	1.78, -4
7	3.65, -3	-3.74, -3	-9.97, -4	4.17, -5
8	3.72, -3	-2.39,-75	-6.29,-76	3.98,-77

0

	N_{12}	R_2	N_2	M_2
0				
0	1.75,-77	-3.76, -1	-6.40, -1	1.04, 0
3	4.95, 0	-3.13, -1	-5.32, -1	8.61, -1
7	8.74, 0	-7.34, -2	-1.25, -1	2.02, -1
8	8.91, 0	1.73,-77	1.73,-77	1.73,-77
3				
0	1.84,-77	8.76, -2	-3.13, 0	-2.03, 0
3	7.41, -1	7.28, -2	-2.60, 0	-1.69, 0
7	1.31, 0	1.71, -2	-6.11, -1	-3.96, -1
8	1.33, 0	1.73,-77	1.73,-77	1.73,-77

5

0	−7.13,−78	1.90, −1	−2.75, 0	−1.40, 0
3	−1.95, 0	1.58, −1	−2.28, 0	−1.16, 0
7	−3.44, 0	3.71, −2	−5.36, −1	−2.73, −1
8	−3.51, 0	1.73,−77	1.73,−77	1.73,−77

8

0	−4.46,−78	2.14, −1	1.84, −6	7.40, −7
3	−3.76, 0	1.78, −1	1.53, −6	6.15, −7
7	−6.64, 0	4.18, −2	3.59, −7	1.44, −7
8	−6.77, 0	1.73,−77	1.73,−77	1.73,−77

16

0	1.75,−77	−3.76, −1	6.40, −1	−1.04, 0
3	4.95, 0	−3.13, −1	5.32, −1	−8.61, −1
7	8.74, 0	−7.34, −2	1.25, −1	−2.02, −1
8	8.91, 0	1.73,−77	1.73,−77	1.73,−77

1

	U	W	V	O_2
0				
0	1.85,−75	−1.94, −2	−1.03, −3	2.14, −4
3	1.92, −3	−1.62, −2	−8.60, −4	1.78, −4
7	3.38, −3	−3.79, −3	−2.02, −4	4.17, −5
8	3.45, −3	−2.92,−76	−6.55,−78	1.97,−77
3				
0	1.43,−75	−1.52, −2	−2.45, −3	3.75, −4
3	1.48, −3	−1.26, −2	−2.04, −3	3.12, −4
7	2.61, −3	−2.96, −3	−4.78, −4	7.32, −5
8	2.66, −3	−2.25,−76	−2.55,−77	1.88,−77
5				
0	9.38,−76	−1.01, −2	−3.14, −3	5.43, −4
3	9.64, −4	−8.37, −3	−2.61, −3	4.52, −4
7	1.70, −3	−1.96, −3	−6.13, −4	1.06, −4
8	1.74, −3	−1.45,−76	−3.63,−77	2.15,−77

8

0	-4.41,-78	8.05, -9	-3.56, -3	6.43, -4
3	-8.63,-10	6.69, -9	-2.96, -3	5.35, -4
7	-1.52, -9	1.57, -9	-6.95, -4	1.26, -4
8	-1.55, -9	2.12,-77	-4.29,-77	2.30,-77

16

0	-1.82,-75	1.94, -2	-1.03, -3	2.14, -4
3	-1.92, -3	1.62, -2	-8.60, -4	1.78, -4
7	-3.38, -3	3.79, -3	-2.02, -4	4.17, -5
8	-3.45, -3	3.18,-76	-6.55,-78	1.97,-77

2

	N_1	M_1	R_1	M_{12}

0

0	-1.78, 1	-1.95, 0	1.73,-77	1.73,-77
3	-1.48, 1	-1.62, 0	-1.90, -3	4.06, -1
7	-3.47, 0	-3.81, -1	-3.35, -3	7.16, -1
8	1.73,-77	1.73,-77	-3.41, -3	7.30, -1

3

0	-1.62, 1	-1.52, 0	1.73,-77	1.73,-77
3	-1.34, 1	-1.27, 0	9.13, -2	7.12, -1
7	-3.15, 0	-2.97, -1	1.61, -1	1.26, 0
8	1.73,-77	1.73,-77	1.64, -1	1.28, 0

5

0	-1.27, 1	-1.01, 0	1.73,-77	1.73,-77
3	-1.06, 1	-8.41, -1	6.22, -2	1.03, 0
7	-2.48, 0	-1.97, -1	1.10, -1	1.82, 0
8	1.73,-77	1.73,-77	1.12, -1	1.86, 0

8

0	9.11, -7	8.38, -7	1.73,-77	1.73,-77
3	7.57, -7	6.97, -7	-3.73, -8	1.22, 0
7	1.78, -7	1.63, -7	-6.58, -8	2.15, 0
8	1.73,-77	1.73,-77	-6.71, -8	2.20, 0

16

0	1.78, 1	1.95, 0	1.73,-77	1.73,-77
3	1.48, 1	1.62, 0	1.90, -3	4.06, -1
7	3.47, 0	3.81, -1	3.35, -3	7.16, -1
8	1.73,-77	1.73,-77	3.41, -3	7.30, -1

8.3.7(a) Test F, $I_3 = .2094$ in^4.

```
 2.12500, -1    2.12500, -1
 1.81000,  0    0.00000,  0    1.81000,  0    0.00000,  0
-1.79000,  2    2.07000,  2    7.50000, -1    1.06750,  2
 6.95000, -2    0.00000,  0    0.00000,  0
 4.50000,  0    4.62500,  0    2.00100,  0    2.09400, -1
 4.50000,  0    4.62500,  0    2.00100,  0    2.09400, -1
 3.30000,  6    3.00000,  7
RADIAL LOAD OVER WHOLE SURFACE (2)


FOURIER  SERIES  TERM  NO.  1
          N1          M1          M2          M3
L.H.EDGE BEAM

  0      -2.29,  2   -5.59,  3    6.91,  2   -7.09,-77
  3      -1.90,  2   -4.65,  3    5.75,  2   -3.67,  2
  7      -4.46,  1   -1.09,  3    1.35,  2   -6.47,  2
  8      -6.18,-78   -2.89,-77    1.81,-77   -6.60,  2

          U           W           V           O
L.H.EDGE BEAM

  0      -3.79,-74    4.65, -2   -1.33, -2    3.57, -3
  3      -4.94, -3    3.87, -2   -1.11, -2    2.97, -3
  7      -8.72, -3    9.08, -3   -2.59, -3    6.97, -4
  8      -8.89, -3    5.85,-75   -1.66,-75    4.61,-76

  0
          N12         R2          N2          M2

  0

  0      -7.72,-78    3.45,  0   -9.29, -1   -9.11,  0
  3      -3.23,  0    2.87,  0   -7.72, -1   -7.57,  0
  7      -5.70,  0    6.73, -1   -1.81, -1   -1.78,  0
  8      -5.81,  0    1.73,-77    1.73,-77    1.73,-77

  3

  0      -7.64,-78    8.62, -1    4.02,  0    1.09,  1
  3      -6.55,  0    7.16, -1    3.35,  0    9.10,  0
  7      -1.16,  1    1.68, -1    7.85, -1    2.13,  0
  8      -1.18,  1    1.73,-77    1.73,-77    1.73,-77
```

5

0	-7.27,-78	4.41, -1	7.29, 0	1.24, 1
3	-4.38, 0	3.67, -1	6.06, 0	1.03, 1
7	-7.73, 0	8.61, -2	1.42, 0	2.42, 0
8	-7.88, 0	1.73,-77	1.73,-77	1.73,-77

8

0	1.83,-77	7.78, -8	9.21, 0	1.31, 1
3	1.39, -6	6.47, -8	7.66, 0	1.09, 1
7	2.45, -6	1.52, -8	1.80, 0	2.56, 0
8	2.50, -6	1.73,-77	1.73,-77	1.73,-77

16

0	1.89,-77	-3.45, 0	-9.29, -1	-9.11, 0
3	3.23, 0	-2.87, 0	-7.72, -1	-7.57, 0
7	5.70, 0	-6.73, -1	-1.81, -1	-1.78, 0
8	5.81, 0	1.73,-77	1.73,-77	1.73,-77

1

	U	W	V	O_2

0

0	-5.10,-75	4.90, -2	-2.42, -2	3.57, -3
3	-5.33, -3	4.07, -2	-2.01, -2	2.97, -3
7	-9.42, -3	9.56, -3	-4.72, -3	6.97, -4
8	-9.60, -3	7.82,-76	-3.66,-76	6.90,-77

3

0	-1.07,-74	1.07, -1	-1.79, -2	2.95, -3
3	-1.12, -2	8.86, -2	-1.49, -2	2.45, -3
7	-1.98, -2	2.08, -2	-3.49, -3	5.76, -4
8	-2.01, -2	1.68,-75	-2.68,-76	5.92,-77

5

0	-1.33,-74	1.33, -1	-1.15, -2	1.83, -3
3	-1.39, -2	1.11, -1	-9.53, -3	1.52, -3
7	-2.45, -2	2.59, -2	-2.23, -3	3.57, -4
8	-2.50, -2	2.10,-75	-1.67,-76	4.16,-77

8

0	-1.49,-74	1.48, -1	-1.65, -9	2.17,-10
3	-1.55, -2	1.23, -1	-1.37, -9	1.81,-10
7	-2.74, -2	2.89, -2	-3.21,-10	4.24,-11
8	-2.79, -2	2.34,-75	1.18,-77	2.01,-77

16

0	-5.10,-75	4.90, -2	2.42, -2	-3.57, -3
3	-5.33, -3	4.07, -2	2.01, -2	-2.97, -3
7	-9.42, -3	9.56, -3	4.72, -3	-6.97, -4
8	-9.60, -3	7.82,-76	3.92,-76	-4.30,-77

2

	N1	M1	R1	M12
0				
0	-2.17, 1	4.92, 0	1.73,-77	1.73,-77
3	-1.81, 1	4.09, 0	2.17, -1	6.77, 0
7	-4.24, 0	9.61, -1	3.84, -1	1.20, 1
8	1.73,-77	1.73,-77	3.91, -1	1.22, 1

3

0	5.86, 0	1.07, 1	1.73,-77	1.73,-77
3	4.87, 0	8.90, 0	-5.33, -1	5.60, 0
7	1.14, 0	2.09, 0	-9.40, -1	9.88, 0
8	1.73,-77	1.73,-77	-9.59, -1	1.01, 1

5

0	1.56, 1	1.34, 1	1.73,-77	1.73,-77
3	1.30, 1	1.11, 1	-6.24, -1	3.47, 0
7	3.05, 0	2.61, 0	-1.10, 0	6.12, 0
8	1.73,-77	1.73,-77	-1.12, 0	6.24, 0

8

0	1.62, 1	1.49, 1	1.73,-77	1.73,-77
3	1.35, 1	1.24, 1	-6.73, -1	4.57, -7
7	3.17, 0	2.90, 0	-1.19, 0	8.07, -7
8	1.73,-77	1.73,-77	-1.21, 0	8.23, -7

16

0	-2.17, 1	4.92, 0	1.73,-77	1.73,-77
3	-1.81, 1	4.09, 0	2.17, -1	-6.77, 0
7	-4.24, 0	9.61, -1	3.84, -1	-1.20, 1
8	1.73,-77	1.73,-77	3.91, -1	-1.22, 1

8.3.7(b) Test F. $I_3 = .00522\ in^4$.

2.12500,	-1	2.12500,	-1				
1.81000,	0	0.00000,	0	1.81000,	0	0.00000,	0
-1.79000,	2	2.07000,	2	7.50000,	-1	1.06750,	2
6.95000,	-2	0.00000,	0	0.00000,	0		
4.50000,	0	4.62500,	0	2.00100,	0	5.22000,	-3
4.50000,	0	4.62500,	0	2.00100,	0	5.22000,	-3
3.30000,	6	3.00000,	7				

RADIAL LOAD OVER WHOLE SURFACE (2)

FOURIER SERIES TERM NO. 1

	N1	M1	M2	M3
L.H.EDGE BEAM				
0	-6.76, 2	-6.53, 3	8.41, 2	7.15,-78
3	-5.62, 2	-5.43, 3	6.99, 2	-1.27, 1
7	-1.32, 2	-1.27, 3	1.64, 2	-2.24, 1
8	-8.14,-78	-3.59,-77	1.92,-77	-2.28, 1

	U	W	V	O
L.H.EDGE BEAM				
0	-4.47,-74	5.43, -2	-1.62, -2	4.95, -3
3	-5.83, -3	4.52, -2	-1.34, -2	4.12, -3
7	-1.03, -2	1.06, -2	-3.15, -3	9.67, -4
8	-1.05, -2	6.83,-75	-2.02,-75	6.35,-76

0

	N12	R2	N2	M2
0				
0	-7.75,-78	1.90, 0	-1.24, -1	7.43, 0
3	-1.05, 1	1.58, 0	-1.03, -1	6.17, 0
7	-1.85, 1	3.70, -1	-2.43, -2	1.45, 0
8	-1.88, 1	1.73,-77	1.73,-77	1.73,-77
3				
0	-5.18,-78	8.41, -1	8.90, 0	1.24, 1
3	-8.61, 0	6.99, -1	7.40, 0	1.03, 1
7	-1.52, 1	1.64, -1	1.74, 0	2.41, 0
8	-1.55, 1	1.73,-77	1.73,-77	1.73,-77

5

0	-6.13,-78	6.05, -1	1.29, 1	1.42, 1
3	-5.14, 0	5.03, -1	1.07, 1	1.18, 1
7	-9.07, 0	1.18, -1	2.52, 0	2.77, 0
8	-9.25, 0	1.73,-77	1.73,-77	1.73,-77

8

0	1.85,-77	9.69, -8	1.51, 1	1.58, 1
3	3.64, -7	8.06, -8	1.26, 1	1.31, 1
7	6.43, -7	1.89, -8	2.95, 0	3.08, 0
8	6.56, -7	1.73,-77	1.73,-77	1.73,-77

16

0	1.77,-77	-1.90, 0	-1.24, -1	7.43, 0
3	1.05, 1	-1.58, 0	-1.03, -1	6.17, 0
7	1.85, 1	-3.70, -1	-2.43, -2	1.45, 0
8	1.88, 1	1.73,-77	1.73,-77	1.73,-77

1

	U	W	V	O_2
0				
0	-6.04,-75	5.85, -2	-2.92, -2	4.95, -3
3	-6.30, -3	4.86, -2	-2.42, -2	4.12, -3
7	-1.11, -2	1.14, -2	-5.69, -3	9.67, -4
8	-1.13, -2	9.30,-76	-4.44,-76	9.07,-77
3				
0	-1.28,-74	1.28, -1	-2.15, -2	3.43, -3
3	-1.34, -2	1.07, -1	-1.79, -2	2.85, -3
7	-2.37, -2	2.51, -2	-4.20, -3	6.69, -4
8	-2.41, -2	2.03,-75	-3.24,-76	6.67,-77
5				
0	-1.60,-74	1.59, -1	-1.38, -2	2.17, -3
3	-1.67, -2	1.32, -1	-1.14, -2	1.80, -3
7	-2.94, -2	3.11, -2	-2.68, -3	4.23, -4
8	-3.00, -2	2.51,-75	-2.03,-76	4.70,-77

8

0	-1.78,-74	1.78, -1	-1.98, -9	2.66,-10
3	-1.86, -2	1.48, -1	-1.65, -9	2.21,-10
7	-3.28, -2	3.46, -2	-3.86,-10	5.20,-11
8	-3.34, -2	2.80,-75	1.22,-77	1.73,-77

16

0	-6.04,-75	5.85, -2	2.92, -2	-4.95, -3
3	-6.30, -3	4.86, -2	2.42, -2	-4.12, -3
7	-1.11, -2	1.14, -2	5.69, -3	-9.67, -4
8	-1.13, -2	9.30,-76	4.70,-76	-6.48,-77

2

	N1	M1	R1	M12
0				
0	-1.80, 1	5.88, 0	1.73,-77	1.73,-77
3	-1.50, 1	4.89, 0	-3.39, -1	9.40, 0
7	-3.51, 0	1.15, 0	-5.98, -1	1.66, 1
8	1.73,-77	1.73,-77	-6.10, -1	1.69, 1
3				
0	1.86, 1	1.29, 1	1.73,-77	1.73,-77
3	1.55, 1	1.07, 1	-6.15, -1	6.50, 0
7	3.63, 0	2.52, 0	-1.09, 0	1.15, 1
8	1.73,-77	1.73,-77	-1.11, 0	1.17, 1
5				
0	1.93, 1	1.60, 1	1.73,-77	1.73,-77
3	1.61, 1	1.33, 1	-7.27, -1	4.11, 0
7	3.77, 0	3.12, 0	-1.28, 0	7.26, 0
8	1.73,-77	1.73,-77	-1.31, 0	7.40, 0
8				
0	1.90, 1	1.78, 1	1.73,-77	1.73,-77
3	1.58, 1	1.48, 1	-8.08, -1	5.89, -7
7	3.70, 0	3.48, 0	-1.43, 0	1.04, -6
8	1.73,-77	1.73,-77	-1.46, 0	1.06, -6
16				
0	-1.80, 1	5.88, 0	1.73,-77	1.73,-77
3	-1.50, 1	4.89, 0	-3.39, -1	-9.40, 0
7	-3.51, 0	1.15, 0	-5.98, -1	-1.66, 1
8	1.73,-77	1.73,-77	-6.10, -1	-1.69, 1

8.4 Tabulated Theoretical Results - Varying Parameters in Test B

The following tables give the actions and displacements for shells equivalent to the shell in Tests B and show the effect of variations in parameters:-

Section	Parameter Varied
8.4.1	Shell Young's Modulus, E_s
8.4.2	Edge beam I_3
8.4.3	Edge beam I_2
8.4.4	Shell R_α
8.4.5	Shell R_β
8.4.6	Term of Fourier series n
8.4.7	Edge beam A
8.4.8	Edge beam I_1
8.4.9	Shell thickness t
8.4.10	Edge beam a
8.4.11	Variation of shell edges - fixed, free and simply supported

8.4.1 Variation of Shell Young's Modulus

Data:-

$R_\alpha = -185"$ $R_\beta = 200"$ $t = .75"$ $L = 106.75"$

$A = 4.5in^2$ $I_1 = 4.625in^4$ $I_2 = 1.611in^4$ $I_3 = .2094in^4$

$\varphi = .22$ radians $a = 1.59"$ $b = 0"$

E_s = variable $E_b = 30 \times 10^6$ lb./in.^{2} $G_s = 10$ lb./ft.^{2}

Action or Displacement	Longitudinal Location	Location on Arc	$E_s=1.0\times10^6$ lb/in^2	$E_s=3.3\times10^6$ lb/in^2	$E_s=5.4\times10^6$ lb/in^2
n_α	Mid span	Shell edge	-23.9	-30.3	-30.3
(lb/in)	"	$\frac{1}{4}$ arc	18.6	10.7	5.9
	"	$\frac{1}{2}$ arc	26.4	14.1	7.0
n_β	Mid span	Shell edge	-1.09	-1.27	-1.43
(lb/in)	"	$\frac{1}{4}$ arc	9.55	3.84	0.53
	"	$\frac{1}{2}$ arc	15.0	6.81	2.08
$n_{\alpha\beta}$	Gable	Shell edge	-10.7	-1.22	3.69
(lb/in)	"	$\frac{1}{4}$ arc	-16.0	-8.93	-4.08
m_α	Mid span	Shell edge	1.77	4.5	6.1
(in lb/in)	"	$\frac{1}{4}$ arc	5.87	12.5	16.3
	"	$\frac{1}{2}$ arc	7.42	15.5	20.1
m_β	Mid span	Shell edge	-17.1	-11.2	-7.7
(in lb/in)	"	$\frac{1}{4}$ arc	7.4	13.2	16.4
	"	$\frac{1}{2}$ arc	7.4	14.5	18.6
$m_{\alpha\beta}$	Gable	Shell edge	5.51	13.3	17.6
(in lb/in)	"	$\frac{1}{4}$ arc	4.79	9.1	11.5
r_α	Gable	Shell edge	.957	0.52	0.27
(lb/in)	"	$\frac{1}{4}$ arc	-.607	-1.14	-1.45
	"	$\frac{1}{2}$ arc	-.654	-1.31	-1.69
r_β (lb/in)	Mid span	Shell edge	3.60	3.96	4.07
	"	$\frac{1}{4}$ arc	0.31	0.67	0.88

Action or Displacement	Longitudinal Location	Location on Arc	$E_s=1.0\times10^6$ lb/in^2	$E_s=3.3\times10^6$ lb/in^2	$E_s=5.4\times10^6$ lb/in^2
u_α (in)	Gable	Shell edge	-.0118	-.0087	-.0071
	"	$\frac{1}{4}$ arc	-.0345	-.0228	-.0182
	"	$\frac{1}{2}$ arc	-.0435	-.0282	-.0224
u_β (in)	Mid span	Shell edge	-.0395	-.0256	-.0204
	"	$\frac{1}{4}$ arc	-.0253	-.0160	-.0126
u_γ (in)	Mid span	Shell edge	.058	.045	.037
	"	$\frac{1}{4}$ arc	.193	.125	.099
	"	$\frac{1}{2}$ arc	.244	.155	.125
$\overline{N}_1$ (lb)	Mid span	Edge beam	-400	-69.8	192
$\overline{M}_1$ (in lb)	Mid span	"	-6830	-5220	-4306
$\overline{M}_2$ (in lb)	Mid span	"	1080	634	492
$\overline{M}_3$ (in lb)	Gable	"	-984	-720	-571
$\overline{U}_\alpha$ (in)	Gable	"	-.0105	-.0080	-.0066
$\overline{U}_\beta$ (in)	Mid span	"	-.0259	-.0151	-.0118
$\overline{U}_\gamma$ (in)	Mid span	"	.0568	.0434	.0353

8.4.2 Variation of Edge Beam I_3

Data:-

$R_\alpha = -185"$ $R_\beta = 200"$ $t = .75"$ $L = 106.75"$

$A = 4.5in^2$ $I_1 = 4.625in^4$ $I_2 = 1.611in^4$ I_3 = variable

$\varphi = .22$ radians $a = 1.59"$ $b = 0"$

$E_s = 3.3\times10^6$ lb/in^2 $E_b = 30\times10^6$ lb/in^2 $G_s = 10$ lb/ft.^{2}

Action or Displacement	Longitudinal Location	Location on Arc	I_3=0 in^4	I_3=.2094 in^4	I_3=2.0 in^4	I_3=5.0 in^4
n_α (lb/in)	Mid span	Shell edge	-30.5	-30.3	-29.8	-29.8
	"	¼ arc	18.8	10.7	-2.1	-4.7
	"	½ arc	16.9	14.1	9.7	8.9
n_β (lb/in)	Mid span	Shell edge	-0.5	-1.27	-2.49	-2.73
	"	¼ arc	9.8	3.84	-5.50	-7.38
	"	½ arc	13.5	6.81	-3.55	-5.64
$n_{\alpha\beta}$ (lb/in)	Gable	Shell edge	-15.7	-1.22	21.3	25.8
	"	¼ arc	-11.4	-8.93	-5.1	-4.3
m_α (in lb/in)	Mid span	Shell edge	5.6	4.5	2.84	2.50
	"	¼ arc	15.7	12.5	7.56	6.56
	"	½ arc	19.4	15.5	9.44	8.22
m_β (in lb/in)	Mid span	Shell edge	8.2	-11.2	-41.3	-47.4
	"	¼ arc	15.3	13.2	9.9	9.2
	"	½ arc	18.3	14.5	8.7	7.6
$m_{\alpha\beta}$ (in lb/in)	Gable	Shell edge	19.5	13.3	3.56	1.60
	"	¼ arc	11.1	9.1	5.96	5.33
r_α (lb/in)	Gable	Shell edge	-0.65	0.52	2.35	2.72
	"	¼ arc	-1.36	-1.14	-0.80	-0.73
	"	½ arc	-1.65	-1.31	-0.79	-0.69
r_β (lb/in)	Mid span	Shell edge	2.35	3.96	6.46	6.96
	"	¼ arc	0.85	0.67	0.38	0.33

Action or Displacement	Longitudinal Location	Location on Arc	I_3=0in^4	I_3=.2094 in^4	I_3=2.0 in^4	I_3=5.0 in^4
u_α (in)	Gable	Shell edge	-.0107	-.0087	-.0056	-.0050
	"	$\frac{1}{4}$ arc	-.0285	-.0228	-.0139	-.0121
	"	$\frac{1}{2}$ arc	-.0353	-.0282	-.0171	-.0149
u_β (in)	Mid span	Shell edge	-.0323	-.0256	-.0152	-.0131
	"	$\frac{1}{4}$ arc	-.0200	-.0160	-.0096	-.0084
u_γ (in)	Mid span	Shell edge	.056	.045	.0282	.0248
	"	$\frac{1}{4}$ arc	.157	.125	.0753	.0653
	"	$\frac{1}{2}$ arc	.194	.155	.0940	.0818
$\bar{N}_1$(lb)	Mid span	Edge beam	-567	-69.8	704	860
$\bar{M}_1$(in lb)	Mid span	"	-6310	-5220	-3510	-3170
$\bar{M}_2$(in lb)	Mid span	"	807	634	364	309
$\bar{M}_3$(in lb)	Gable	"	0	-720	-1840	-2070
$\bar{U}_\alpha$(in)	Gable	"	-.0098	-.0080	-.0052	-.0046
$\bar{U}_\beta$(in)	Mid span	"	-.0193	-.0151	-.0087	-.0074
$\bar{U}_\gamma$(in)	Mid span	"	.0525	.0434	.0292	.0264

8.4.3 Variation of Edge Beam I_2

Data:-

R_α = -185" R_β = 200" t = .75" L = 106.75"

A = 4.5in^2 I_1 = 4.625in^4 I_2 = variable I_3 = .2094in^4

φ = .22 radians a = 1.59" b = 0"

E_s = 3.3x10^{6}lb/in^2 E_b=30x10^{6}lb/in^2 G_s=10 lb./ft^2

Action or Displacement	Longitudinal Location	Location on Arc	I_2=.5in^4	I_2=1.611 in^4	I_2=3.0in^4
n_α (lb/in)	Mid span	Shell edge	-30.9	-30.3	-29.5
	"	¼ arc	10.5	10.7	10.9
	"	½ arc	14.5	14.1	13.7
n_β (lb/in)	Mid span	Shell edge	-0.97	-1.27	-1.66
	"	¼ arc	4.00	3.84	3.63
	"	½ arc	7.04	6.81	6.51
$n_{\alpha\beta}$ (lb/in)	Gable	Shell edge	-0.42	-1.22	-2.24
	"	¼ arc	-9.10	-8.93	-8.73
m_α (in lb/in)	Mid span	Shell edge	4.5	4.5	4.6
	"	¼ arc	12.5	12.5	12.7
	"	½ arc	15.4	15.5	15.7
m_β (in lb/in)	Mid span	Shell edge	-12.9	-11.2	-9.0
	"	¼ arc	13.2	13.2	13.1
	"	½ arc	14.5	14.5	14.7
$m_{\alpha\beta}$ (in lb/in)	Gable	Shell edge	13.0	13.3	13.7
	"	¼ arc	9.1	9.1	9.1
r_α (lb/in)	Gable	Shell edge	0.63	0.52	0.40
	"	¼ arc	-1.14	-1.14	-1.15
	"	½ arc	-1.31	-1.31	-1.32
r_β (lb/in)	Mid span	Shell edge	4.15	3.96	3.72
	"	¼ arc	0.66	0.67	0.68

Action or Displacement	Longitudinal Location	Location on Arc	$I_2=.5in^4$	$I_2=1.611 in^4$	$I_2=3.0in^4$
u_α (in)	Gable	Shell edge	-.0086	-.0087	-.0088
	"	$\frac{1}{4}$ arc	-.0226	-.0228	-.0230
	"	$\frac{1}{2}$ arc	-.0280	-.0282	-.0284
u_β (in)	Mid span	Shell edge	-.0254	-.0256	-.0258
	"	$\frac{1}{4}$ arc	-.0159	-.0160	-.0161
u_γ (in)	Mid span	Shell edge	.045	.045	.046
	"	$\frac{1}{4}$ arc	.124	.125	.126
	"	$\frac{1}{2}$ arc	.154	.155	.156
$\bar{N}_1$(lb)	Mid span	Edge beam	-42.4	-69.8	-104
$\bar{M}_1$(in lb)	Mid span	"	-5190	-5220	-5260
$\bar{M}_2$(in lb)	Mid span	"	195	634	1190
$\bar{M}_3$(in lb)	Gable	"	-704	-720	-740
$\bar{U}_\alpha$ (in)	Gable	"	-.0079	-.0080	-.0081
$\bar{U}_\beta$ (in)	Mid span	"	-.0150	-.0151	-.0153
$\bar{U}_\gamma$ (in)	Mid span	"	.0432	.0434	.0437

8.4.4 Variation of R_α

Data:-

R_α = variable R_β = 200" t = .75" L = 106.75"

A = $4.5in^2$ I_1 = $4.625in^4$ I_2= $1.611in^4$ I_3= $.2094in^4$

φ = .22 radians a = 1.59" b = 0"

E_s = $3.3x10^6$ lb/in^2 E_b=$30x10^6$ lb/in^2 G_s=10 lb/ft^2

Action or Displacement	Longitudinal Location	Location on Arc	R_α = 180"	R_α = 185"	R_α = 190"	R_α = 195"
n_α (lb/in)	Mid span	Shell edge	-29.8	-30.3	-30.6	-30.9
	"	¼ arc	11.6	10.7	9.6	8.4
	"	½ arc	14.8	14.1	13.2	12.2
n_β (lb/in)	Mid span	Shell edge	-1.17	-1.27	-1.38	-1.49
	"	¼ arc	4.51	3.84	3.09	2.25
	"	½ arc	7.62	6.81	5.87	4.81
$n_{\alpha\beta}$ (lb/in)	Gable	Shell edge	-2.46	-1.22	0.13	1.60
	"	¼ arc	-9.41	-8.93	-8.35	-7.66
m_α (in lb/in)	Mid span	Shell edge	4.6	4.5	4.4	4.3
	"	¼ arc	12.3	12.5	12.8	12.9
	"	½ arc	15.2	15.5	15.9	16.2
m_β (in lb/in)	Mid span	Shell edge	-10.6	-11.2	-11.7	-12.3
	"	¼ arc	12.6	13.2	13.7	14.2
	"	½ arc	13.8	14.5	15.3	15.9
$m_{\alpha\beta}$ (in lb/in)	Gable	Shell edge	12.8	13.3	13.8	14.3
	"	¼ arc	8.7	9.1	9.5	9.9
r_α (lb/in)	Gable	Shell edge	0.49	0.52	0.56	0.60
	"	¼ arc	-1.10	-1.14	-1.18	-1.22
	"	½ arc	-1.26	-1.31	-1.37	-1.42
r_β (lb/in)	Mid span	Shell edge	3.86	3.96	4.05	4.14
	"	¼ arc	0.62	0.67	0.71	0.76

Action or Displacement	Longitudinal Location	Location on Arc	R_α = -180"	R_α = -185"	R_α = -190"	R_α = -195"
u_α (in)	Gable	Shell edge	-.0091	-.0087	-.0083	-.0078
	"	$\frac{1}{4}$ arc	-.0230	-.0228	-.0226	-.0223
	"	$\frac{1}{2}$ arc	-.0283	-.0282	-.0281	-.0279
u_β (in)	Mid span	Shell edge	-.0252	-.0256	-.0260	-.0263
	"	$\frac{1}{4}$ arc	-.0156	-.0160	-.0163	-.0166
u_γ (in)	Mid span	Shell edge	.046	.045	.044	.042
	"	$\frac{1}{4}$ arc	.122	.125	.127	.129
	"	$\frac{1}{2}$ arc	.151	.155	.158	.161
$\overline{N}_1$(lb)	Mid span	Edge beam	-114	-69.8	-22.0	29.6
$\overline{M}_1$(in lb)	Mid span	"	-5370	-5220	-5050	-4860
$\overline{M}_2$(in lb)	Mid span	"	606	634	661	686
$\overline{M}_3$(in lb)	Gable	"	-692	-720	-747	-772
$\overline{U}_\alpha$(in)	Gable	"	-.0085	-.0080	-.0075	-.0070
$\overline{U}_\beta$(in)	Mid span	"	-.0145	-.0151	-.0158	-.0164
$\overline{U}_\gamma$(in)	Mid span	"	.0447	.0434	.0420	.0405

8.4.5 Variation of R_β

Data:

R_α = -185" R_β = variable t = -75" L = 106.75"

A = 4.5in^2 I_1=4.625in^4 I_2=1.611in^4 I_3=.2094in^4

φ = variable a = 1.59" b = 0"

E_s = 3.3x10^{6}lb/in^2 E_b=30x10^{6}lb/in^2 G_s=10 lb/ft^2

Action or Displacement	Longitudinal Variation	Location on Arc	R_β=190" φ=.2320	R_β=195" φ=.2260	R_β=200" φ=.2200	R_β=205" φ=.2146
n_α (lb/in)	Mid span	Shell edge	-37.5	-33.9	-30.3	-27.3
	"	¼ arc	8.6	9.6	10.7	11.5
	"	½ arc	11.1	12.7	14.1	15.3
n_β (lb/in)	Mid span	Shell edge	-1.66	-1.47	-1.27	-1.11
	"	¼ arc	1.80	2.84	3.84	4.67
	"	½ arc	4.19	5.53	6.81	7.87
$n_{\alpha\beta}$ (lb/in)	Gable	Shell edge	2.77	0.76	-1.22	-2.87
	"	¼ arc	-7.24	-8.12	-8.93	-9.60
m_α (in lb/in)	Mid span	Shell edge	4.2	4.4	4.5	4.7
		¼ arc	12.9	12.7	12.5	12.3
		½ arc	16.1	15.9	15.5	15.2
m_β (in lb/in)	Mid span	Shell edge	-11.8	-11.5	-11.2	-10.9
	"	¼ arc	14.1	13.7	13.2	12.7
	"	½ arc	15.8	15.2	14.5	14.0
$m_{\alpha\beta}$ (in lb/in)	Gable	Shell edge	14.4	13.9	13.3	12.8
	"	¼ arc	9.9	9.5	9.1	8.8
r_α (lb/in)	Gable	Shell edge	0.57	0.55	0.52	0.50
	"	¼ arc	-1.21	-1.18	-1.14	-1.11
	"	½ arc	-1.40	-1.36	-1.31	-1.27
r_β (lb/in)	Mid span	Shell edge	4.29	4.13	3.96	3.81
	"	¼ arc	0.73	0.70	0.67	0.64

Action or Displacement	Longitudinal Variation	Location on Arc	R_β=190" φ=.2320	R_β=195" φ=.2260	R_β=200" φ=.2200	R_β=205" φ=2.2146
u_α (in)	Gable	Shell edge	-.0082	-.0085	-.0087	-.0089
	"	¼ arc	-.0234	-.0232	-.0228	-.0224
	"	½ arc	-.0293	-.0289	-.0282	-.0277
u_β (in)	Mid span	Shell edge	-.0276	-.0267	-.0256	-.0247
	"	¼ arc	-.0174	-.0167	-.0160	-.0153
u_γ (in)	Mid span	Shell edge	.042	.044	.045	.046
	"	¼ arc	.128	.127	.125	.123
	"	½ arc	.160	.158	.155	.152
$\bar{N}_1$(lb)	Mid span	Edge Beam	68.0	-1.6	-69.8	-127
$\bar{M}_1$(in. lb)	Mid span	"	-4860	-5040	-5220	-5360
$\bar{M}_2$(in. lb)	Mid span	"	721	679	634	596
$\bar{M}_3$(in. lb)	Gable	"	-781	-752	-720	-692
$\bar{U}_\alpha$(in)	Gable	"	-.0074	-.0077	-.0080	-.0082
$\bar{U}_\beta$ (in)	Mid span	"	-.0172	-.0162	-.0151	-.0142
$\bar{U}_\gamma$ (in)	Mid span	"	.0403	.0420	.0434	.0446

8.4.6 Variation of Term of Fourier Series

Data:

R_α = -185" R_β = 200" t = .75" L = 106.75"

A = 4.5in^2 I_1 = 4.625in^4 I_2=1.611in^4 I_3=.2094in^4

φ = .22 radians a = 1.59" b = 0"

E_s=3.3x10^{6}lb/in^2 E_b=30x10^{6}lb/in^2 G_s=10 lb/ft^2

Action or Displacement	Longitudinal Location	Location on Arc	(Fourier Series Terms) 1st	1st + 3rd	1st + 3rd + 5th
n_α (lb/in)	Mid span	Shell edge	-30.3	-30.2	-30.3
	"	¼ arc	10.7	11.2	11.1
	"	½ arc	14.1	15.3	15.2
n_β (lb/in)	Mid span	Shell edge	-1.27	-0.76	-0.98
	"	¼ arc	3.84	8.54	6.98
	"	½ arc	6.81	13.58	11.63
$n_{\alpha\beta}$ (lb/in)	Gable	Shell edge	-1.22	-3.59	-3.06
	"	¼ arc	-8.93	-10.83	-10.55
m_α (in. lb/in)	Mid span	Shell edge	4.5	4.4	4.5
	"	¼ arc	12.5	11.9	12.3
	"	½ arc	15.5	14.9	15.3
m_β (in. lb/in)	Mid span	Shell edge	-11.2	-10.4	-10.8
	"	¼ arc	13.2	13.0	13.0
	"	½ arc	14.5	14.6	14.6
$m_{\alpha\beta}$ (in. lb/in)	Gable	Shell edge	13.3	13.0	13.1
	"	¼ arc	9.1	9.0	9.1
r_α (lb/in)	Gable	Shell edge	0.52	0.39	0.56
	"	¼ arc	-1.14	-1.04	-1.12
	"	½ arc	-1.31	-1.27	-1.33
r_β (lb/in)	Mid span	Shell edge	3.96	3.66	3.83
	"	¼ arc	0.67	0.68	0.68

Action or Displacement	Longitudinal Location	Location on Arc	(Fourier Series Terms)		
			1st	1st + 3rd	1st + 3rd + 5th
u_α (in)	Gable	Shell edge	-.0087	-.0087	-.0087
	"	$\frac{1}{4}$ arc	-.0228	-.0228	-.0228
	"	$\frac{1}{2}$ arc	-.0282	-.0282	-.0282
u_β (in)	Mid span	Shell edge	-.0256	-.0256	-.0256
	"	$\frac{1}{4}$ arc	-.0160	-.0160	-.0160
u_γ (in)	Mid span	Shell edge	.045	.045	.045
	"	$\frac{1}{4}$ arc	.125	.124	.124
	"	$\frac{1}{2}$ arc	.155	.154	.154
$\bar{N}_1$(lb)	Mid span	Edge beam	-69.8	-96.4	-92.8
$\bar{M}_1$(in. lb)	Mid span	"	-5220	-5190	-5200
$\bar{M}_2$(in. lb)	Mid span	"	634	621	624
$\bar{M}_3$ (in. lb)	Gable	"	-720	-703	-708
$\bar{U}_\alpha$ (in)	Gable	"	-.0080	-.0080	-.0080
$\bar{U}_\beta$ (in)	Mid span	"	-.0151	-.0151	-.0151
$\bar{U}_\gamma$ (in)	Mid span	"	.0434	.0434	.0434

8.4.7 Variation of Edge Beam A

Data:

R_α = -185" R_β = 200" t = .75" L = 106.75"

A = variable I_1=4.625in^4 I_2=1.611in^4 I_3=.2094in^4

φ = .22 radians a = 1.59" b = 0"

E_s = 3.3x10^6 lb/in^2 E_b=30x10^6 lb/in^2 G_s=10 lb/sq.ft.

Action or Displacement	Longitudinal Location	Location on Arc	A = 0.5 in^2	A = 3.0 in^2	A = 4.5 in^2	A = 6.0 in^2
n_α (lb/in)	Mid span	Shell edge	-35.0	-30.8	-30.3	-30.0
	"	¼ arc	10.7	10.7	10.7	10.7
	"	½ arc	13.9	14.1	14.1	14.1
n_β (lb/in)	Mid span	Shell edge	-1.34	-1.28	-1.27	-1.27
	"	¼ arc	3.62	3.82	3.84	3.85
	"	½ arc	6.55	6.78	6.81	6.82
$n_{\alpha\beta}$ (lb/in)	Gable	Shell edge	-0.35	-1.13	-1.22	-1.27
	"	¼ arc	-8.86	-8.93	-8.93	-8.94
m_α (in. lb/in)	Mid span	Shell edge	4.5	4.5	4.5	4.5
	"	¼ arc	12.5	12.5	12.5	12.5
	"	½ arc	15.5	15.5	15.5	15.5
m_β (in. lb/in.)	Mid span	Shell edge	-11.2	-11.2	-11.2	-11.2
	"	¼ arc	13.2	13.2	13.2	13.2
	"	½ arc	14.5	14.5	14.5	14.6
$m_{\alpha\beta}$ (in. lb/in.)	Gable	Shell edge	13.4	13.3	13.3	13.3
	"	¼ arc	9.1	9.1	9.1	9.1

Action or Displacement	Longitudinal Location	Location on Arc	A = 0.5 in^2	A = 3.0 in^2	A = 4.5 in^2	A = 6.0 in^2
r_α	Gable	Shell edge	0.52	0.52	0.52	0.52
(lb/in)	"	$\frac{1}{4}$ arc	-1.15	-1.14	-1.14	-1.14
	"	$\frac{1}{2}$ arc	-1.31	-1.31	-1.31	-1.31
r_β (lb/in)	Mid span	Shell edge	4.07	3.97	3.96	3.95
	"	$\frac{1}{4}$ arc	0.66	0.67	0.67	0.67
u_α (in)	Gable	Shell edge	-.0087	-.0087	-.0087	-.0087
	"	$\frac{1}{4}$ arc	-.0228	-.0228	-.0228	-.0228
	"	$\frac{1}{2}$ arc	-.0282	-.0282	-.0282	-.0282
u_β (in)	Mid span	Shell edge	-.0256	-.0256	-.0256	-.0256
	"	$\frac{1}{4}$ arc	-.0160	-.0160	-.0160	-.0160
u_γ (in)	Mid span	Shell edge	.045	.045	.045	.045
	"	$\frac{1}{4}$ arc	.125	.125	.125	.125
	"	$\frac{1}{2}$ arc	.155	.155	.155	.155
$\overline{N}_1$(lb)	Mid span	Edge beam	-39.7	-66.6	-69.8	-71.5
$\overline{M}_1$(in. lb)	Mid span	"	-5180	-5210	-5220	-5220
$\overline{M}_2$(in lb)	Mid span	"	636	634	634	634
$\overline{M}_3$(in lb)	Gable	"	-727	-721	-720	-720
$\overline{U}_\alpha$ (in)	Gable	"	-.0080	-.0080	-.0080	-.0080
$\overline{U}_\beta$(in)	Mid span	"	-.0152	-.0151	-.0151	-.0151
$\overline{U}_\gamma$(in)	Mid span	"	.0431	.0434	.0434	.0434

8.3.8 Variation of Edge Beam I_1

Data:

R_α = -185" R_β = 200" t = .75" L = 106.75"

A = $4.5 in^2$ I_1 = variable I_2 = $1.611 in^4$ I_3 = $.2094 in^4$

φ = .22 radians a = 1.59" b = 0"

E_s = 3.3×10^6 lb/in^2 E_b = 30×10^6 lb/in^2 G_s = 10 lb/sq.ft.

Action or Displacement	Longitudinal Location	Location on Arc	I_1=0.5 in^4	I_1=3.0 in^4	I_1=4.625 in^4	I_1=6.0 in^4
$n_{\alpha\beta}$ (lb/in)	Mid span	Shell edge	-31.9	-30.7	-30.3	-30.0
	"	¼ arc	-13.5	4.5	10.7	14.3
	"	½ arc	-12.9	7.2	14.1	18.2
n_β (lb/in)	Mid span	Shell edge	-3.4	-1.82	-1.27	-0.9
	"	¼ arc	-14.2	-0.75	3.84	6.6
	"	½ arc	-16.7	0.82	6.81	10.4
n_γ (lb/in)	Gable	Shell edge	29.7	6.67	-1.22	-5.9
	"	¼ arc	7.6	-4.71	-8.93	-11.4
$m_{\alpha\beta}$ (in lb/in)	Mid span	Shell edge	8.5	5.6	4.5	3.9
	"	¼ arc	21.4	14.8	12.5	11.2
	"	½ arc	26.2	18.3	15.5	13.9
m_β (in lb/in)	Mid span	Shell edge	-17.9	-12.9	-11.2	-10.2
	"	¼ arc	21.2	15.2	13.2	11.9
	"	½ arc	23.6	16.9	14.5	13.2
m_γ (in lb/in)	Gable	Shell edge	21.0	15.3	13.3	12.1
	"	¼ arc	14.8	10.5	9.1	8.2

Action or Displacement	Longitudinal Location	Location on Arc	$I_1=0.5$ in^4	$I_1=3.0$ in^4	$I_1=4.625$ in^4	$I_1=6.0$ in^4
r_α (lb/in)	Gable	Shell edge	0.81	0.60	0.52	0.48
	"	$\frac{1}{4}$ arc	-1.87	-1.33	-1.14	-1.03
	"	$\frac{1}{2}$ arc	-2.16	-1.53	-1.31	-1.18
r_β (lb/in)	Mid span	Shell edge	5.75	4.42	3.96	3.69
	"	$\frac{1}{4}$ arc	1.14	0.79	0.67	0.60
u_α (in)	Gable	Shell edge	-.0160	-.0106	-.0087	-.0076
	"	$\frac{1}{4}$ arc	-.0392	-.0270	-.0228	-.0203
	"	$\frac{1}{2}$ arc	-.0481	-.0333	-.0282	-.0252
u_β (in)	Mid span	Shell edge	-.0435	-.0302	-.0256	-.0229
	"	$\frac{1}{4}$ arc	-.0268	-.0187	-.0160	-.0143
u_γ (in)	Mid span	Shell edge	.085	.055	.045	.039
	"	$\frac{1}{4}$ arc	.213	.147	.125	.112
	"	$\frac{1}{2}$ arc	.261	.182	.155	.139
$\overline{N}_1$ (lb)	Mid span	Edge beam	1000	204	-69.8	-233
$\overline{M}_1$ (in. lb)	Mid span	"	-1070	-4160	-5220	-5850
$\overline{M}_2$ (in. lb)	Mid span	"	1000	728	634	578
$\overline{M}_3$ (in. lb)	Gable	"	-1140	-826	-720	-657
$\overline{U}_\alpha$ (in)	Gable	"	-.0149	-.0098	-.0080	-.0070
$\overline{U}_\beta$ (in)	Mid span	"	-.0239	-.0174	-.0151	-.0138
$\overline{U}_\gamma$ (in)	Mid span	"	.0824	.0534	.0434	.0375

8.4.9 Variation of Shell Thickness t

Data:

R_α = -185" R_β = 200" t = variable L = 106.75"

A = 4.5in^2 I_1 = 4.625in^4 I_2 = 1.611in^4 I_3=.2094in^4

φ = .22 radians a = 1.59" b = 0"

E_s = 3.3x10^{6}lb/in^2 E_b=30x10^{6}lb/in^2 G_s=10 lb/sq.ft.

Action or Displacement	Longitudinal Location	Location on Arc	t = 0.7"	t = 0.75"	t = 0.80"
n_α(lb/in)	Mid span	Shell edge	-32.9	-30.3	-27.7
	"	¼ arc	13.2	10.7	8.3
	"	½ arc	16.8	14.1	11.5
n_β(lb/in)	Mid span	Shell edge	-1.25	-1.27	-1.30
	"	¼ arc	5.18	3.84	2.55
	"	½ arc	8.71	6.81	4.96
$n_{\alpha\beta}$ (lb/in)	Gable	Shell edge	-2.8	-1.22	0.29
	"	¼ arc	-10.7	-8.93	-7.25
m_α(in. lb/in)	Mid span	Shell edge	3.9	4.5	5.1
	"	¼ arc	11.1	12.5	14.0
	"	½ arc	13.7	15.5	17.3
m_β(in. lb/in)	Mid span	Shell edge	-12.4	-11.2	-10.0
	"	¼ arc	11.8	13.2	14.5
	"	½ arc	12.9	14.5	16.2
$m_{\alpha\beta}$(in. lb/in)	Gable	Shell edge	11.6	13.3	14.9
	"	¼ arc	8.1	9.1	10.1

Action or Displacement	Longitudinal Location	Location on Arc	t = 0.7"	t = 0.75"	t = 0.80"
r_α (lb/in)	Gable	Shell edge	0.61	0.52	0.43
	"	¼ arc	-1.02	-1.14	-1.27
	"	½ arc	-1.16	-1.31	-1.46
r_β (lb/in)	Mid span	Shell edge	3.99	3.96	3.93
	"	¼ arc	0.57	0.67	0.76
u_α (in)	Gable	Shell edge	-.0093	-.0087	-.0081
	"	¼ arc	-.0247	-.0228	-.0210
	"	½ arc	-.0306	-.0282	-.0260
u_β (in)	Mid span	Shell edge	-.0277	-.0256	-.0236
	"	¼ arc	-.0173	-.0160	-.0147
u_γ (in)	Mid span	Shell edge	.048	.045	.042
	"	¼ arc	.135	.125	.115
	"	½ arc	.168	.155	.142
$\overline{N}_1$ (lb)	Mid span	Edge beam	-125	-69.8	-16.5
$\overline{M}_1$ (in. lb)	Mid span	"	-5590	-5220	-4860
$\overline{M}_2$ (in. lb)	Mid span	"	693	634	579
$\overline{M}_3$ (in. lb)	Gable	"	-773	-720	-667
$\overline{U}_\alpha$ (in)	Gable	"	-.0086	-.0080	-.0074
$\overline{U}_\beta$ (in)	Mid span	"	-.0165	-.0151	-.0138
$\overline{U}_\gamma$ (in)	Mid span	"	.0465	.0434	.0404

8.4.10 Variation of Edge Beam a

Data:

R_α = -185" R_β = 200" t = .75" L = 106.75"

A = 4.5in^2 I_1=4.625in^4 I_2=1.611in^4 I_3=.2094in^4

φ = .22 radians a = variable b = 0"

E_s=3.3x10^{6}lb/in.^{2} E_b=30x10^{6}lb/in.^{2} G_s=10 lb/sq.ft.

Action or Displacement	Longitudinal Location	Location on Arc	a = 0"	a = 1.59"	a = 3.0"
n_α (lb/in)	Mid span	Shell edge	-51.9	-30.3	-6.3
	"	¼ arc	10.8	10.7	10.0
	"	½ arc	14.6	14.1	14.0
n_β (lb/in)	Mid span	Shell edge	-1.48	-1.27	-0.71
	"	¼ arc	2.91	3.84	4.88
	"	½ arc	5.99	6.81	7.78
$n_{\alpha\beta}$ (lb/in)	Gable	Shell edge	4.00	-1.22	-5.66
	"	¼ arc	-9.32	-8.93	-8.64
m_α (in. lb/in)	Mid span	Shell edge	3.9	4.5	5.2
	"	¼ arc	11.2	12.5	13.8
	"	½ arc	13.8	15.5	17.1
m_β (in. lb/in)	Mid span	Shell edge	-15.6	-11.2	-9.0
	"	¼ arc	12.3	13.2	14.0
	"	½ arc	12.9	14.5	16.1
$m_{\alpha\beta}$ (in. lb/in)	Gable	Shell edge	11.8	13.3	14.3
	"	¼ arc	8.2	9.1	10.0

Action or Displacement	Longitudinal Location	Location on Arc	a = 0"	a = 1.59"	a = 3.0"
r_α (lb/in)	Gable	Shell edge	0.81	0.52	0.38
	"	¼ arc	-1.05	-1.14	-1.23
	"	½ arc	-1.17	-1.31	-1.45
r_β	Mid span	Shell edge	4.78	3.96	3.32
(lb/in)	"	¼ arc	0.53	0.67	0.80
u_α	Gable	Shell edge	-.0077	-.0087	-.0096
(in)	"	¼ arc	-.0203	-.0228	-.0251
	"	½ arc	-.0251	-.0282	-.0311
u_β	Mid span	Shell edge	-.0227	-.0256	-.0283
(in)	"	¼ arc	-.0142	-.0160	-.0176
u_γ(in)	Mid span	Shell edge	.038	.045	.052
	"	¼ arc	..111	.125	.138
	"	½ arc	.138	.155	.170
$\overline{N}_1$(lb)	Mid span	Edge beam	108	-69.8	-221
$\overline{M}_1$(in. lb)	Mid span	"	-5080	-5220	-5300
$\overline{M}_2$(in. lb)	Mid span	"	577	634	683
$\overline{M}_3$(in. lb)	Gable	"	-637	-720	-777
$\overline{U}_\alpha$ (in.)	Gable	"	-.0077	-.0080	-.0081
$\overline{U}_\beta$ (in.)	Mid span	"	-.0138	-.0151	-.0163
$\overline{U}_\gamma$(in.)	Mid span	"	.0423	.0434	.0441

8.4.11 Variation of Shell Edges - Fixed, Free and Simply Supported

Common data:

$R_\alpha = -185"$ $R_\beta = 200"$ $t = .75"$ $L = 106.75"$

$\varphi = .22$ radians $E_s = 3.3 \times 10^6$ lb/in^2 $G_s = 10$ lb/ft.^{2}

For the shell with fixed edges:

$A = 1000$in^2 $I_1 = 1000$in^4 $I_2 = 1000$in^4 $I_3 = 1000$in^4

For the shell with free edges:

$A = 0$ $I_1 = 0$ $I_2 = 0$ $I_3 = 0$

For the shell with flexible edge beams:

$A = 4.5$in^2 $I_1 = 4.625$in^4 $I_2 = 1.611$in^4 $I_3 = .2094$in^4

$E_b = 30 \times 10^6$ lb/in^2 $a = 1.59"$ $b = 0$

Action or Displacement	Longitudinal Location	Location on Arc	Flexible E.B's.	Fixed	Free	Simply Supported
n_α (lb/in)	Mid span	Shell edge	-30.3	-3.6	207	-4.4
	"	¼ arc	10.7	8.4	-31.5	41.3
	"	½ arc	14.1	11.8	-26.6	48.6
n_β (lb/in)	Mid span	Shell edge	-1.27	-12.3	0	2.0
	"	¼ arc	3.84	-7.1	-13.4	28.1
	"	½ arc	6.81	-4.7	-19.2	38.0
$n_{\alpha\beta}$ (in. lb/in.)	Gable	Shell edge	-1.22	-7.15	0	-4.59
	"	¼ arc	-8.93	-7.10	18.4	-2.99
m_α (in. lb/in.)	Mid span	Shell edge	4.5	.010	16.4	0.14
	"	¼ arc	12.5	.385	36.5	2.67
	"	½ arc	15.5	.538	44.9	3.60

Action or Displacement	Longitudinal Location	Location on Arc	Flexible E.B's.	Fixed	Free	Simply Supported
m_β (in. lb/in.)	Mid span	Shell edge	-11.2	-5.77	0	0.76
	"	$\frac{1}{4}$ arc	13.2	0.91	31.6	3.79
	"	$\frac{1}{2}$ arc	14.5	0.69	41.1	4.61
$m_{\alpha\beta}$ (in. lb/in.)	Gable	Shell edge	13.3	.012	33.1	4.81
	"	$\frac{1}{4}$ arc	9.1	.499	24.8	2.77
r_α (lb/in)	Gable	Shell edge	0.52	.339	-0.48	-.049
	"	$\frac{1}{4}$ arc	-1.14	-.065	-2.94	-.302
	"	$\frac{1}{2}$ arc	-1.31	-.057	-3.74	-.377
r_β (lb/in)	Mid span	Shell edge	3.96	.886	0	.935
	"	$\frac{1}{4}$ arc	0.67	.023	2.62	.204
u_α (in)	Gable	Shell edge	-.0087	-.0001	-.0271	-.0003
	"	$\frac{1}{4}$ arc	-.0228	-.0006	-.0672	-.0043
	"	$\frac{1}{2}$ arc	-.0282	-.0008	-.0824	-.0059
u_β (in)	Mid span	Shell edge	-.0256	-.0006	-.0753	-.0057
	"	$\frac{1}{4}$ arc	-.0160	-.0005	-.0459	-.0039
u_γ (in)	Mid span	Shell edge	.045	.0001	.163	.0014
	"	$\frac{1}{4}$ arc	.125	.0038	.363	.0266
	"	$\frac{1}{2}$ arc	.155	.0054	.447	.0359

8.5 Calculation of Theoretical Edge Beam Strains

Consider the theoretical edge beam results for test B (with $I_3 = .2094 in^4$) under 10 lb./ft^2 load:-

Axial force $\bar{N}_1$ = - 69.8 lb (+ve is tension)

Longitudinal bending moment $\bar{M}_1$ = - 5220 in.lb. (+ve is hogging)

Transverse bending moment $\bar{M}_2$ = 634 in. lb. (+ve gives tension in fibres away from the shell).

As the strain gauges were located on the outer face of the 2" x $\frac{1}{4}$" beam and at $\frac{7}{8}$" above and below the centroid, theory gives:

Stress at top strain gauge = $\frac{-69.8}{4.5} - \frac{5220 \times \frac{7}{8}}{4.625} - \frac{634 \times 1.34}{1.611}$

= - 15 - 990 - 530

= - 1535 lb./in^2 (i.e., compression)

Stress at bottom strain gauge = - 15 + 990 - 530

= 445 lb./in^2 (i.e., tension)

As edge beam E = 30 x 10^6 lb/in.^{2}

Top gauge strain = - 50 x 10^{-6} in/in.

Bottom gauge strain = 15 x 10^{-6} in/in.

8.6 Check on accuracy of computer programme

8.6.1 Comparison with McNamee's cylindrical shell

McNamee[22] using Jenkins'[20] theory calculates a symmetrical cylindrical shell with the following data:

R_β = 40' t = .208333' L = 60'

A = 1.75 ft.^{2} I_1 = 1.78646 ft^4 I_2 = .0364583 ft^4

I_3 = .0729165 ft^4 $E_s = E_b$ = 7.2 x 10^8 lb/ft^2

φ = .5236 radians a = b = 0'

G_s = 100 lb./ft^2(vertical) G_b = 200 lb./ft.

For the computer programme, R_α was made 1×10^{20} ft.

The results are compared in the following table:

Action or Displacement	Longitudinal Location	Location on Arc	McNamee's results	Computer results
n_α	Mid span	Shell edge	20,000	19,500
(lb/ft)	"	$\frac{1}{4}$ arc	-15,000	-14,400
	"	$\frac{1}{2}$ arc	-9,100	-9,350
n_β	Mid span	Shell edge	-220	-224
(lb/ft)	"	$\frac{1}{4}$ arc	-4,700	-4,660
	"	$\frac{1}{2}$ arc	-6,100	-6,110
$n_{\alpha\beta}$	Gable	Shell edge	8,700	8,570
(lb/ft.)	"	$\frac{1}{4}$ arc	6,400	6,470
m_α (lb)	Mid span	Shell edge	120	112
m_β (lb)	Mid span	Shell edge	-130	-181
	"	$\frac{1}{4}$ arc	190	206
	"	$\frac{1}{2}$ arc	-770	-751
r_β	Mid span	Shell edge	390	397
(lb/ft)	"	$\frac{1}{4}$ arc	-170	-162
u_γ (ft)	Mid span	Shell edge	.08	.0755
$\overline{N}_1$ (lb)	Mid span	Edge beam	~~1.7~~ 1.65 x 10^5	1.64×10^5
$\overline{M}_1$(ft.lb)	Mid span	"	~~4.0~~ -2.184 x 10^5	-2.66×10^5
$\overline{M}_3$(ft.lb)	Gable	"	~~2680~~ -2.470	-3450
$\overline{M}_2$(ft.lb)	Mid span	"	-1.6x10^3 -1.81 x 10^3	-1.48×10^3

8.6.2 Comparison with Bouma's doubly curved shells

Bouma[8] calculates 4 doubly curved shells without edge beams under radial load.

Common data for the 4 shells:

R_β = 1156 cm. t = 7 cm. a = b = 0

$A = I_1 = I_2 = I_3 = 0.$ φ = .597145 radians

$E_s = 2 \times 10^5$ kgm/cm.^{2} G_s = .019 kgm/cm.^{2}

(a) Elliptic paraboloid with "rise" of 200 cm.

R_α = 1990.74 cm. L = 1739.31 cm.

Action or Displacement	Longitudinal Location	Location on Arc	Bouma's results	Computer results
u_γ (cm)	Mid span	Shell edge	132	126
	"	½ arc	51	48
n_α (kgm/cm)	Mid span	Shell edge	2094	2020
	"	½ arc	<10	- 1
m_β (kgm)	Mid span	½ arc	- 1619	- 1550

(b) Cylindrical Shell

$R_\alpha = 1 \times 10^{20}$ cm. L = 1800 cm.

Action or Displacement	Longitudinal Location	Location on Arc	Bouma's results	Computer results
u_γ (cm)	Mid span	Shell edge	32 or 17	15
	"	½ arc	< 5	- 2
n_α (kgm/cm)	Mid span	Shell edge	875	916
	"	½ arc	70	94
m_β (kgm)	Mid span	½ arc	-500	-522

(c) Hyperbolic paraboloid with "rise" of 50 cm.

$R_\alpha = - 8091.66$ cm. L = 1796.29 cm.

Action or Displacement	Longitudinal Location	Location on Arc	Bouma's results	Computer results
u_γ (cm)	Mid span	¼ arc	.9	.8
n_α (kgm/cm)	Mid span	Shell edge	271	285
	"	½ arc	- 157	- 152
m_β (kgm)	Mid span	½ arc	- 58	- 47

(d) Hyperbolic paraboloid with "rise" of 200 cm.

R_α = - 1990.74 cm. L = 1739.31 cm.

Action or Displacement	Longitudinal Location	Location on Arc	Bouma's results	Computer results
u_γ (cm)	Mid span	Shell edge	< 5	- 3.5
	"	½ arc	70	66
n_α (kgm/cm)	Mid span	Shell edge	498	472
	"	½ arc	- 91	- 84
m_β (kgm)	Mid span	½ arc	2235	2120

8.6.3 Integration of forces across a section

Consider the cylindrical shell in section 8.6.1 which is under vertical load.

At mid-span, $\overline{N}_1$ = 164,000 lb.

n_α = 19,500 lb/ft. at the shell edge

- 7,090 lb/ft at ⅛ arc

- 14,400 lb/ft at ¼ arc

- 11,700 lb/ft at ⅜ arc

- 9,350 lb/ft at ½ arc

As R_β = 40' and φ = .5236 radians, the integration of n_α across the mid-span section gives, using Simpson's rule, a resultant force of,

$$\frac{1}{3} \times \frac{40}{4} \times .5236 \times \left[19{,}500 + 4\,(-7090 - 11{,}700) + 2\,(-14{,}400) + (-9350) \right]$$

= - 164,000 lb, which balances the edge beam force.

9. EXPERIMENTAL TEST RESULTS

9.1 Slab Test Results

Refer Section 6.2.1.

9.1.1 Method of Calculation

(a) For E from moment-deflection curves:

Moment of $\frac{M}{EI}$ diagram about support for $\frac{1}{2}$ unit loads applied at the third points of a simply supported span of 16" $= \frac{71.7}{EI}$

Assuming a homogeneous uncracked section,

$$I = \frac{6 \times (\frac{3}{4})^3}{12} = .211 \text{ in}^4.$$

If δ = mid-span deflection

and P = total load applied

$$\frac{\delta}{P} = \frac{71.7}{EI}$$

But mid-span moment = 2.67 in. lb. for P = 1.

Hence, $$E = \frac{71.7}{.211} \times \frac{P}{\delta}$$

$$= 127.5 \times \frac{M}{\delta}$$

(b) For E from moment-strain curves:

Assuming a homogeneous uncracked section,

$$f = \frac{My}{I} = Ee$$

where e = average strain in outer fibres.

Hence, $$E = \frac{y}{I} \frac{M}{e}$$

$$= \frac{3}{8} \times \frac{1}{.211} \times \frac{M}{e} = 1.78 \times \frac{M}{e}$$

9.1.2 Slab 2 Results

Slab 2 - longitudinal reinforcing in lower layers.

Moment in. lb.	Deflection in x 10^4	Strain Top Surface in./in. x 10^6		Strain Bottom Surface in./in. x 10^6		Average Outer Fibre Strain in./in. x 10^6
0	0	0	0	0	0	0
104	34	-31	-33	36	30	32
138	44	-40	-41	46	41	42
177	63	-57	-51	65	59	57
231	80	-74	-70	83	74	73
286	99	-92	-87	99	90	91
343	118	-110	-106	119	107	110
398	137	-129	-123	139	128	129
456	154	-144	-142	158	144	144
512	172	-164	-166	176	160	165
571	193	-182	-186	196	178	184
630	221	-202	-210	197	198	206
690	1st crack					
0	0	0	0	0	0	0
177	67	-60	-58	57	57	58
286	108	-95	-98	90	91	94
398	155	-131	-138	122	128	130
512	210	-165	-178	152	150	161
630	250	-201	-221	192	197	202

These results are plotted in Figs. 17 and 18.

9.2 Best Parabolae for Radii of Curvature

Refer section 6.3.2.

Consider a parabola,

$$x^2 = \frac{y}{a} - b$$

If, x_i = value of x

y_i = observed value of y

$a(x_i^2 + b)$ = predicted value of y

$a(x_i^2+b)-y_i$ = discrepancy between predicted and observed values of y

z = sum of squares of discrepancy of y

$$= a^2(\Sigma x_i^4 + 2b\ \Sigma x_i^2 + Nb^2) + \Sigma y_i^2 - 2(\Sigma x_i^2 y_i^2 + b\Sigma y_i)$$

where N = number of positions i

Then, $$0 = \frac{\partial z}{\partial a}$$

$$= 2a(\Sigma x_i^4 + 2b\Sigma x_i^2 + Nb^2) - 2(\Sigma x_i^2 y_i + b\Sigma y_i)$$

and $$0 = \frac{\partial z}{\partial b}$$

$$= 2a^2(\Sigma x_i^2 + Nb) - 2a\Sigma y_i$$

From these two equations,

$$a = \frac{\Sigma y_i}{\Sigma x_i^2 + Nb}$$

$$b = \frac{(\Sigma x_i^2 y_i)(\Sigma x_i^2) - (\Sigma y_i)(\Sigma x_i^4)}{(\Sigma y_i)(\Sigma x_i^2) - N \Sigma x_i^2 y_i}$$

which are the coefficients of the best parabola passing through the N points.

9.3 Conversion of strains to shell actions

With three strain gauges mounted in the α, β and θ (45° to α and β) directions at each point on top and bottom surfaces, and since,

Direct strain = $\frac{1}{2}$ (Top fibre strain + Bottom fibre strain)

Bending strain (in outer fibre) = $\frac{1}{2}$ (Bottom fibre strain - Top fibre strain),

the 6 gauge readings when adjusted will give,

$\varepsilon_{\alpha d}$, $\varepsilon_{\beta d}$, $\varepsilon_{\theta d}$	Direct strains
$\varepsilon_{\alpha m}$, $\varepsilon_{\beta m}$, $\varepsilon_{\theta m}$	Bending strains

The normal strain along the line making θ with the axis is,

$$\varepsilon_{\theta} = \frac{\varepsilon_{\alpha} + \varepsilon_{\beta}}{2} + \frac{\varepsilon_{\alpha} - \varepsilon_{\beta}}{2} \cos 2\theta + \frac{1}{2}\varepsilon_{\alpha\beta} \sin 2\theta$$

When $\theta = 45^{\circ}$, $\cos 2\theta = 0$, $\sin 2\theta = 1$, and thus, the shear strain,

$$\varepsilon_{\alpha\beta} = 2\varepsilon_{\theta} - \varepsilon_{\alpha} - \varepsilon_{\beta}$$

Also,

$$n_{\alpha} = \frac{E}{1-\mu^2}(\varepsilon_{\alpha d} + \mu\varepsilon_{\beta d}) \quad \text{lb/in}^2$$

$$= \frac{3}{4}\frac{E}{1-\mu^2}(\varepsilon_{\alpha d} + \mu\varepsilon_{\beta d}) \quad \text{lb/in} \quad - - - \quad (1)$$

for a $\frac{3}{4}$" thickness

μ = Poisson's ratio

$$n_{\beta} = \frac{3}{4}\frac{E}{1-\mu^2}(\varepsilon_{\beta d} + \mu\varepsilon_{\alpha d}) \quad \text{lb/in} \quad - - - \quad (2)$$

$$n_{\alpha\beta} = \frac{3}{4}\frac{E}{2(1+\mu)}(2\varepsilon_{\theta d} - \varepsilon_{\alpha d} - \varepsilon_{\beta d}) \text{ lb/in} \quad - \quad - \quad (3)$$

$$m_{\alpha} = \frac{t^2}{6}\frac{E}{1-\mu^2}(\varepsilon_{\alpha m} + \mu\varepsilon_{\beta m}) \text{ in. lb./in.} \quad - \quad - \quad - \quad (4)$$

$$m_{\beta} = \frac{t^2}{6}\frac{E}{1-\mu^2}(\varepsilon_{\beta m} + \mu\varepsilon_{\alpha m}) \text{ in. lb./in.} \quad - \quad - \quad - \quad (5)$$

$$m_{\alpha\beta} = \frac{t^2}{6}\frac{E}{2(1+\mu)}(2\varepsilon_{\theta m} - \varepsilon_{\alpha m} - \varepsilon_{\beta m}) \text{ in. lb./in.} \quad - \quad (6)$$

The stresses and moments of equations (1) to (6) were calculated on the computer with,

$$E = 5.4 \times 10^6 \text{ lb./in}^2$$

$$\mu = .18$$

9.4 Experimental Shell Actions

The shell stresses and moments as obtained from the concrete strain readings are tabulated for tests 3, 4, 7, 8 and 10. The results were reduced on the computer, using the method of Section 9.3, and the print-outs from a teleprinter are given directly.

The strain results of test 8 were reduced using two different values of Poisson's ratio, viz., 0.18, as for the other tests, and 0, the value often adopted when analysing cracked reinforced concrete. As anticipated, the stresses and moments are somewhat altered in some parts of the shell, but the same pattern of results remains.

The strain gauge locations are given in Fig. 16.

TEST NO. 3

SHELL ACTIONS(IN. AND LB. UNITS)

POSN.	ACTION	LOAD(LB./SQ.FT.) 1.61	4.26	6.66
1				
	N_1	29	25	19
	N_2	40	43	30
	N_{12}	-6	27	50
	M_1	4	12	15
	M_2	1	8	11
	M_{12}	2	3	5
4				
	N_1	51	102	168
	N_2	35	50	56
	N_{12}	-15	-30	-63
	M_1	7	22	34
	M_2	0	9	14
	M_{12}	1	-4	-9
6				
	N_1	10	3	-2
	N_2	19	29	24
	N_{12}	-4	4	7
	M_1	1	9	13
	M_2	-2	6	10
	M_{12}	3	0	-0
8				
	N_1	-3	-20	-37
	N_2	0	-8	-27
	N_{12}	-6	20	20
	M_1	-0	6	9
	M_2	-4	2	4
	M_{12}	2	2	1
16				
	N_1	11	7	1
	N_2	23	28	15
	N_{12}	-14	3	0
	M_1	2	10	13
	M_2	-1	6	9
	M_{12}	1	0	-1
19				
	N_1	2	8	3
	N_2	31	33	26
	N_{12}	-10	0	5
	M_1	0	10	13
	M_2	-0	7	11
	M_{12}	2	-0	-1

TEST NO. 3

SHELL ACTIONS(IN. AND LB. UNITS)

POSN.	ACTION	LOAD(LB./SQ.FT.)		
		1.61	4.26	6.66
21				
	N_1	32	125	174
	N_2	18	45	39
	N_{12}	-32	-41	-62
	M_1	12	29	42
	M_2	6	16	19
	M_{12}	-8	-14	-19
23				
	N_1	-36	-42	-63
	N_2	-29	-51	-59
	N_{12}	9	24	33
	M_1	4	9	13
	M_2	-0	4	7
	M_{12}	-3	-6	-7
34				
	N_1	-28	-53	-91
	N_2	-13	-28	-49
	N_{12}	13	42	65
	M_1	5	7	9
	M_2	2	7	8
	M_{12}	-2	-4	-3
35				
	N_1	-40	-54	-82
	N_2	-20	-38	-53
	N_{12}	15	33	37
	M_1	3	7	10
	M_2	1	6	8
	M_{12}	-2	-5	-6
36				
	N_1	-33	-43	-74
	N_2	-14	-31	-67
	N_{12}	6	18	22
	M_1	4	8	11
	M_2	2	7	6
	M_{12}	-3	-7	-8
37				
	N_1	-27	-32	-50
	N_2	-7	-24	-42
	N_{12}	6	7	-4
	M_1	5	10	15
	M_2	2	8	9
	M_{12}	-3	-8	-11

TEST NO. 4

SHELL ACTIONS(IN. AND LB. UNITS)

POSN.	ACTION	LOAD(LB./SQ.FT.) 1.82	4.26	6.66
1				
	N_1	6	21	23
	N_2	14	33	51
	N_{12}	11	31	42
	M_1	5	11	17
	M_2	2	7	13
	M_{12}	1	3	6
6				
	N_1	−4	−6	−9
	N_2	8	11	19
	N_{12}	−0	16	12
	M_1	4	8	13
	M_2	2	4	9
	M_{12}	0	1	2
8				
	N_1	−5	−10	−20
	N_2	4	−8	−15
	N_{12}	2	15	6
	M_1	3	8	12
	M_2	1	2	5
	M_{12}	0	1	1
16				
	N_1	1	0	12
	N_2	10	19	27
	N_{12}	−3	2	−7
	M_1	4	9	16
	M_2	2	6	10
	M_{12}	−0	−1	−0
19				
	N_1	2	−5	−9
	N_2	16	18	23
	N_{12}	−1	8	−3
	M_1	4	8	13
	M_2	3	5	10
	M_{12}	0	0	0

TEST NO. 4

SHELL ACTIONS(IN. AND LB. UNITS)

POSN.	ACTION	LOAD(LB./SQ.FT.) 1.82	4.26	6.66
21				
	N_1	27	28	159
	N_2	-4	28	23
	N_{12}	10	-8	-43
	M_1	10	14	41
	M_2	6	8	13
	M_{12}	-5	-7	-14
23				
	N_1	-22	-30	-65
	N_2	-24	-16	-36
	N_{12}	21	19	25
	M_1	4	6	13
	M_2	3	2	5
	M_{12}	-3	-3	-5
35				
	N_1	-27	-39	-93
	N_2	-21	-10	-25
	N_{12}	26	20	35
	M_1	4	5	10
	M_2	4	3	7
	M_{12}	-3	-3	-4
36				
	N_1	-28	-41	-66
	N_2	-32	-20	-15
	N_{12}	22	20	5
	M_1	3	5	13
	M_2	2	2	8
	M_{12}	-3	-3	-8
37				
	N_1	-17	-13	-50
	N_2	-16	8	-16
	N_{12}	12	-8	-13
	M_1	5	8	15
	M_2	4	5	8
	M_{12}	-4	-7	-10

TEST NO. 7

SHELL ACTIONS(IN. AND LB. UNITS)

POSN.	ACTION	LOAD(LB./SQ.FT.) 1.77	4.48	7.34	10.15	4.32
1						
	N_1	15	21	-11	5	-15
	N_2	21	37	21	43	25
	N_{12}	4	39	80	92	44
	M_1	4	14	21	28	13
	M_2	2	11	17	20	8
	M_{12}	2	3	5	9	5
6						
	N_1	15	4	-37	-28	-27
	N_2	22	25	-6	25	17
	N_{12}	-5	6	21	7	8
	M_1	4	12	18	24	11
	M_2	2	10	14	18	7
	M_{12}	1	-1	-2	-1	1
8						
	N_1	5	-9	-66	-66	-45
	N_2	14	-9	-60	-51	-15
	N_{12}	-10	12	28	17	11
	M_1	3	10	15	19	9
	M_2	1	5	7	8	3
	M_{12}	0	-0	-1	0	1
16						
	N_1	5	-6	-41	-26	-26
	N_2	16	10	-30	-2	1
	N_{12}	-7	9	26	8	8
	M_1	3	11	18	24	11
	M_2	2	8	11	14	5
	M_{12}	1	-1	-2	-1	1
19						
	N_1	5	-5	-49	-52	-31
	N_2	15	14	-18	-5	6
	N_{12}	-6	7	21	5	-5
	M_1	3	11	17	21	11
	M_2	1	8	12	14	5
	M_{12}	1	-1	-2	-1	-1

TEST NO. 7

SHELL ACTIONS(IN. AND LB. UNITS)

POSN.	ACTION	LOAD(LB./SQ.FT.)				
		1.77	4.48	7.34	10.15	4.32
21						
	N_1	16	102	172	292	130
	N_2	4	18	17	53	26
	N_{12}	-7	-29	-63	-111	-48
	M_1	13	32	52	72	35
	M_2	5	15	20	29	14
	M_{12}	-4	-13	-22	-31	-15
23						
	N_1	-43	-58	-105	-109	-71
	N_2	-19	-41	-71	-85	-43
	N_{12}	12	33	32	48	34
	M_1	5	11	17	21	10
	M_2	2	7	10	12	6
	M_{12}	-1	-6	-10	-11	-5
35						
	N_1	-50	-82	-141	-169	-82
	N_2	-21	-40	-72	-101	-56
	N_{12}	12	35	45	54	27
	M_1	4	9	13	14	9
	M_2	2	7	9	10	4
	M_{12}	-1	-5	-8	-10	-6
36						
	N_1	-50	-76	-118	-142	-64
	N_2	-28	-44	-75	-81	-40
	N_{12}	11	21	25	29	20
	M_1	4	9	15	17	11
	M_2	1	7	9	13	6
	M_{12}	-1	-7	-11	-13	-7
37						
	N_1	-39	-56	-95	-119	-62
	N_2	-16	-29	-59	-84	-35
	N_{12}	-2	5	-6	-12	1
	M_1	6	12	18	20	11
	M_2	3	9	11	12	7
	M_{12}	-3	-9	-15	-18	-9

TEST NO. 8 (Poisson's ratio = .18)

SHELL ACTIONS(IN. AND LB. UNITS)

POSN.	ACTION	LOAD(LB./SQ.FT.) 2.18	4.52	7.39	9.99	4.74
1						
	N_1	26	16	21	28	-13
	N_2	52	50	88	55	18
	N_{12}	5	23	46	103	58
	M_1	7	16	22	32	15
	M_2	3	12	13	28	14
	M_{12}	4	7	9	7	4
6						
	N_1	15	-0	-9	-14	-19
	N_2	41	33	50	1	-15
	N_{12}	-17	-15	-10	28	6
	M_1	6	14	18	27	14
	M_2	1	10	8	21	10
	M_{12}	1	2	2	-2	-2
8						
	N_1	11	-13	-30	-54	-39
	N_2	25	1	1	-62	-43
	N_{12}	-10	0	2	42	19
	M_1	5	13	16	22	11
	M_2	-1	6	2	13	7
	M_{12}	2	4	4	-0	-1
16						
	N_1	15	2	-14	-20	-26
	N_2	46	29	34	-16	-26
	N_{12}	-14	-15	-3	32	17
	M_1	6	15	18	26	13
	M_2	2	9	6	19	9
	M_{12}	2	2	3	-2	-1
19						
	N_1	15	3	-17	-29	-24
	N_2	46	34	49	-7	-15
	N_{12}	-14	-21	-24	10	-5
	M_1	6	15	17	25	13
	M_2	2	10	8	20	10
	M_{12}	2	1	0	-5	-4

TEST NO. 8 (Poisson's ratio = .18)

SHELL ACTIONS(IN. AND LB. UNITS)

POSN.	ACTION	LOAD(LB./SQ.FT.) 2.18	4.52	7.39	9.99	4.74
21						
	N_1	43	154	251	344	188
	N_2	22	56	61	74	24
	N_{12}	-17	-53	-96	-123	-71
	M_1	17	35	63	85	46
	M_2	6	14	23	33	18
	M_{12}	-5	-14	-28	-38	-22
23						
	N_1	-27	-11	-81	-116	-68
	N_2	-0	6	-39	-59	-47
	N_{12}	4	5	48	70	36
	M_1	8	14	21	27	14
	M_2	3	8	11	16	9
	M_{12}	-3	-7	-10	-14	-8
35						
	N_1	-38	-44	-129	-171	-95
	N_2	-2	-5	-53	-84	-57
	N_{12}	11	24	59	90	51
	M_1	6	10	15	21	11
	M_2	3	7	9	13	8
	M_{12}	-2	-5	-9	-12	-6
36						
	N_1	-28	-34	-107	-150	-84
	N_2	-5	-7	-41	-82	-56
	N_{12}	0	2	28	46	30
	M_1	8	12	18	23	12
	M_2	3	6	10	13	8
	M_{12}	-3	-8	-13	-17	-9
37						
	N_1	-33	-24	-94	-119	-63
	N_2	-7	-7	-56	-80	-51
	N_{12}	6	-3	14	23	9
	M_1	7	13	20	27	15
	M_2	3	6	8	13	9
	M_{12}	-2	-8	-15	-20	-12

TEST NO. 8 (Poisson's ratio = 0)

SHELL ACTIONS(IN. AND LB. UNITS)

POSN.	ACTION	LOAD(LB./SQ.FT.)				
		2.18	4.52	7.39	9.99	4.74
1						
	N_1	17	7	5	18	-16
	N_2	48	47	85	50	20
	N_{12}	6	28	54	122	68
	M_1	7	14	20	27	12
	M_2	1	9	9	22	12
	M_{12}	5	8	11	8	5
6						
	N_1	8	-6	-18	-14	-17
	N_2	38	33	52	3	-11
	N_{12}	-20	-18	-12	33	8
	M_1	6	13	17	23	12
	M_2	0	7	5	16	8
	M_{12}	2	2	2	-3	-3
8						
	N_1	7	-13	-30	-43	-31
	N_2	23	3	6	-53	-36
	N_{12}	-12	1	2	50	22
	M_1	5	12	15	19	10
	M_2	-2	3	-1	9	5
	M_{12}	3	4	4	-1	-1
16						
	N_1	7	-3	-20	-18	-21
	N_2	44	28	36	-12	-21
	N_{12}	-17	-17	-3	37	20
	M_1	5	13	16	22	11
	M_2	1	7	3	14	6
	M_{12}	2	2	4	-2	-1
19						
	N_1	7	-3	-25	-28	-21
	N_2	44	33	52	-2	-11
	N_{12}	-17	-25	-28	12	-6
	M_1	5	13	16	21	11
	M_2	1	7	5	15	8
	M_{12}	2	1	0	-5	-4

TEST NO. 8 (Poisson's ratio = 0)

SHELL ACTIONS(IN. AND LB. UNITS)

POSN.	ACTION	LOAD(LB./SQ.FT.)				
		2.18	4.52	7.39	9.99	4.74
21						
	N_1	39	144	240	330	184
	N_2	15	28	16	12	-9
	N_{12}	-20	-62	-113	-145	-84
	M_1	15	33	59	79	43
	M_2	3	8	12	17	10
	M_{12}	-6	-17	-33	-45	-26
23						
	N_1	-27	-12	-74	-105	-59
	N_2	4	8	-24	-38	-35
	N_{12}	5	6	57	83	43
	M_1	7	13	19	25	12
	M_2	2	5	7	11	7
	M_{12}	-3	-8	-12	-17	-10
35						
	N_1	-37	-43	-119	-156	-84
	N_2	4	3	-29	-53	-40
	N_{12}	13	29	69	106	61
	M_1	6	9	14	18	9
	M_2	2	5	6	9	6
	M_{12}	-2	-6	-11	-14	-8
36						
	N_1	-27	-33	-99	-135	-74
	N_2	0	-1	-22	-55	-41
	N_{12}	0	2	33	54	35
	M_1	7	10	16	21	11
	M_2	1	4	7	9	6
	M_{12}	-4	-9	-15	-20	-11
37						
	N_1	-32	-23	-84	-105	-54
	N_2	-1	-2	-39	-58	-40
	N_{12}	8	-4	16	27	10
	M_1	7	12	18	25	13
	M_2	1	4	5	9	6
	M_{12}	-3	-10	-17	-24	-14

TEST NO. 10

SHELL ACTIONS(IN. AND LB. UNITS)

POSN.	ACTION	LOAD(LB./SQ.FT.)			
		5.30	10.76	15.23	8.48
1					
	N_1	-1	4	6	23
	N_2	-8	17	-0	35
	N_{12}	25	63	85	40
	M_1	6	13	20	11
	M_2	6	12	19	10
	M_{12}	1	1	2	1
6					
	N_1	2	-12	-22	6
	N_2	-3	-6	-21	11
	N_{12}	9	47	46	24
	M_1	6	12	17	9
	M_2	7	9	17	7
	M_{12}	-1	-1	-3	-1
8					
	N_1	-9	-33	-47	-2
	N_2	-25	-45	-71	-15
	N_{12}	23	50	60	30
	M_1	5	9	14	8
	M_2	4	4	10	3
	M_{12}	0	-1	-1	0
16					
	N_1	-5	-13	-10	14
	N_2	-12	-2	-23	21
	N_{12}	20	20	21	14
	M_1	5	11	18	10
	M_2	5	9	16	8
	M_{12}	-0	-5	-6	-2
19					
	N_1	-0	-8	-13	12
	N_2	-11	-1	-13	11
	N_{12}	14	33	30	9
	M_1	6	12	18	10
	M_2	6	9	17	7
	M_{12}	-1	-3	-5	-3

TEST NO. 10

SHELL ACTIONS(IN. AND LB. UNITS)

POSN.	ACTION	LOAD(LB./SQ.FT.) 5.30	10.76	15.23	8.48
21					
	N_1	20	107	177	101
	N_2	-14	3	34	22
	N_{12}	-1	-32	-55	-32
	M_1	13	30	45	23
	M_2	5	13	20	12
	M_{12}	-2	-10	-17	-9
23					
	N_1	-29	-49	-60	-26
	N_2	-17	-40	-54	-26
	N_{12}	11	24	29	27
	M_1	7	10	16	8
	M_2	4	8	9	6
	M_{12}	-1	-3	-7	-2
35					
	N_1	-50	-58	-94	-36
	N_2	-26	-47	-60	-23
	N_{12}	13	12	34	25
	M_1	4	9	11	6
	M_2	3	7	8	7
	M_{12}	-1	-4	-6	-2
36					
	N_1	-32	-56	-80	-24
	N_2	-19	-28	-46	-25
	N_{12}	-4	-6	10	3
	M_1	6	9	13	8
	M_2	4	9	10	6
	M_{12}	-3	-6	-9	-5
37					
	N_1	-34	-36	-54	-22
	N_2	-18	-38	-38	-25
	N_{12}	-9	36	-17	-9
	M_1	6	12	16	8
	M_2	4	8	11	6
	M_{12}	-3	-1	-12	-6

9.5 Experimental Deflection Results

The deflection results of all gauges for tests 1 to 12 are given. The results were reduced on the computer and the print-outs from a teleprinter are given directly.

The deflection gauge locations are given in Fig. 15.

TEST NO. 1

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	1.82	4.43	7.03	9.64	4.43
1	49	110	196		198
2	48	108	192	307	193
3	46	104	184	296	185
4	43	97	172	277	172
5	39	87	154	248	152
6	34	76	134	214	131
7	27	60	108	173	106
8	18	41	74	119	72
9	13	30	55	90	52
10	48	107	189		
11	32	73	131	208	127
12	12	29	53	86	50
13	44	99	175	263	175
14	31	69	123	196	121
15	11	28	52	85	52
16	39	87	153	230	151
17	39	86	152	242	151
18	37	83	147	236	147
19	34	77	138	222	138
20	33	72	126	203	126
21	27	61	109	173	107
22	22	50	89	142	87
23	16	36	63	104	61
24	9	23	46	76	45
25	32	73	129	194	126
26	23	53	94	150	92
27	9	21	39	66	39
28	25	56	100	149	97
29	9	33	57	114	67
30	7	17	32	53	31
31	17	39	69	104	67
32	14	31	57	92	58
33	5	12	24	40	23
34	7	17	32		31
35	8	18	33	54	33
36	7	15	27	44	29
37	4	10	19	30	19
38	3	7	13	22	13
39	36	82	144	240	144
40	35	78	135	228	137
41	37	83	147	235	147
42	28	64	114	185	113
43	27	60	104	169	103
44	28	65	113	182	111

TEST NO. 1

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	1.82	4.43	7.03	9.64	4.43
45	17	39	70	113	69
46	16	37	64	104	63
47	19	41	71	111	67
48		24	45	72	43
49	11	25	45	71	43
50	12	29	50	80	46
51	9	19	33	55	33
52	9	19	33	55	33
53	9	20	36	57	35
54	7	16	29	47	29
55	6	14	25	42	26
56	7	17	29	49	31
57	4	10	20	33	20
58	4	9	16	27	
59	5	11	19	30	18
60	3	8	15	23	15
61	3	6	11	17	10
62	4	9	17	24	14
63	44	99	174	292	175
64	33	74	130	211	129
65	19	43	75	121	73
66	13	29	51	81	49
67	27	76	147	232	147
68	10	21	38	57	36
69	5	8	14	25	17
70	4	8	14	25	16
71	2	3	4	7	5
72	0	0	0	0	0
73	0	0	0	0	0
74	0	0	0	1	0
75	0	0	0	0	0
76	0	0	0	0	0
77	0	0	0	0	0
78	1	3	6	10	5
79	0	0	1	1	0
80	0	1	4	8	4
81	2	4	7	12	8
82	0	1	1	1	1
83	2	5	9	16	10
84	-2	-5	-11	-20	-13
85	0	0	0	0	0
86	-2	-4	-9	-18	-12
87	-1	-2	-3	-3	-2
88	0	0	0	0	0
89	0	0	0	0	0

TEST NO. 2

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	2.08	4.32	6.93	9.52	11.88	4.69	0.00
1	59	130	221	328		340	
2	57	127	214	319		351	
3	55	123	207	308		338	
4	52	116	196	291	512	319	232
5	46	104	175	261	460	281	203
6	40	89	150	224	384	235	169
7	33	73	123	183	316	189	138
8	23	52	89	134	234	135	100
9	17	40	68	103	175	101	78
10	57	127	213	316		346	
11	39	87	148	220		202	139
12	17	39	66	100	168	97	75
13	52	117	196	290	491	319	
14	37	83	140	208	346	222	165
15	15	37	64	97	165	96	73
16	45	102	172	253	424	273	205
17	45	101	169	250	435	271	205
18	44	99	165	244	428	265	199
19	41	92	154	229	406	249	184
20	38	85	144	214	392	240	178
21	32	73	124	185	319	205	152
22	27	61	104	155	267	168	125
23	18	43	75	114	200	121	90
24	14	32	55	84	142	85	63
25	38	86	145	213	356	229	172
26	28	64	108	161	283	185	140
27	11	26	46	71	121	71	52
28	28	68	161	164	272	172	131
29	33	62	88	141	230	158	125
30	9	22	39	59	102	61	46
31	20	45	76	112	186	117	90
32	16	38	65	97	170	109	85
33	6	16	28	42	75	46	35
34	9	22	37	54	90	57	44
35	10	22	37	56	98	60	47
36	8	18	31	46	81	52	42
37	5	13	22	33	62	39	32
38	3	9	18	25	42	28	23
39	43	96	161	239	450	270	199
40	41	91	153	226	421	253	186
41	44	98	165	244	429	269	197
42	35	78	130	192	358	221	168
43	33	72	119	177	334	209	162
44	35	78	131	194	340	208	153

TEST NO. 2

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	2.08	4.32	6.93	9.52	11.88	4.69	0.00
45	22	49	81	121	232	137	107
46	21	46	76	114	223	136	109
47	21	46	79	119	207	116	88
48	14	33		65	145	77	57
49	14	33	54	83	163	95	75
50	17	38	63	95	159	92	85
51	10	22	37	54	98	59	48
52	9	21	37	54	97	57	45
53	10	24	40	59	103	63	47
54	9	20	33	49	88	55	44
55	8	17	29	43	77	47	38
56	9	19	33	48	89	56	43
57	6	15	24	36	71	45	35
58	5	12	19	29	56	34	29
59	5	13	22	33	64	40	32
60	4	10	17	26	52	32	24
61	3	8	14	21	43	26	21
62	4	10	18	27	48	27	19
63	51	116	195	290			
64	41	89	146	218		243	
65	24	53	87	131	249	146	116
66	16	37	60	91	181	102	82
67	47	104	174	250	412	255	180
68	11	24	40	59	101	60	45
69	2	7	13	20	44	28	21
70	3	8	14	22	46	30	23
71	1	2	3	5	9	6	5
72	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0
76	0	0	0	0	0	0	0
77	0	0	0	0	0	0	0
78	1	4	8	12	22	14	12
79	0	0	0	0	-2	-2	-3
80	1		8	12	23	15	9
81	2	5	9	13	24	15	11
82	0	0	0	1	1	1	1
83	2	6	11	17	31	20	16
84	-3	-8	-14	-20	-39	-28	-26
85	0	0	1	1	1	1	-1
86	-2	-7	-13	-18		-26	-20
87	0	-1	-2	-3	-5	-5	-3
88	0	0	0	0	0	0	0
89	0	0	0	0	0	0	

TEST NO. 3

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	1.61	4.26	6.66	0.00
1	36	79	120	8
2	34	75	113	7
3	32	73	109	7
4	30	68	102	6
5	27	61	93	5
6	23	53	79	4
7	19	43	64	3
8	7	24	40	0
9	10	23	35	1
10	35	76	116	7
11		20	46	0
12	10	22	34	1
13	33	71	107	7
14	22	49	74	5
15	10	22	33	0
16	28	62	93	6
17	26	59	88	5
18	26	58	87	6
19	24	54	82	5
20	22	51	76	5
21	5	30	52	0
22	16	36	54	3
23		10	24	0
24	8	19	29	-1
25	24	52	79	6
26	11	33	52	0
27	7	17	26	0
28	4	27	47	0
29	14	32	47	4
30	5	13	20	-1
31	13	28	42	3
32	10	23	35	2
33	4	10	15	-2
34	6	14	21	2
35	6	13	20	1
36	0	0	2	0
37	3	8	13	1
38	2	6	9	-2
39	26	58	87	5
40	24	54	82	5
41	25	57	86	5
42	22	66	90	
43	21	46	68	4
44	22	51	73	3

TEST NO. 3

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	1.61	4.26	6.66	0.00
45	13	29	43	2
46	12	28	42	2
47	13	28	41	3
48	8	18	28	1
49	8	19	28	2
50	10	21	32	1
51	6	14	20	1
52	7	14	21	2
53	7	15	22	2
54	6	13	20	2
55	5	12	17	2
56	6	12	18	1
57	4	10	15	1
58	3	7	11	3
59	4	8	13	5
60	2	6	10	1
61	2	4	7	0
62	2	6	10	0
63	32	72	106	6
64	25	55	81	6
65	14	34	48	2
66	10	22	34	2
67	29	63	94	6
68	7	14	21	1
69	2	5	7	1
70	3	6	8	1
71	0	1	1	2
72	0	0	0	0
73	0	0	0	0
74	0	0	0	0
75	0	0	0	0
76	0	0	0	0
77	0	0	0	0
78	0	2	4	-3
79	0	0	0	0
80	1	3	4	1
81	1	3	5	0
82	0	0	0	0
83	2	5	8	2
84	-3	-6	-10	-2
85	0	9	9	8
86	-2	-6	-9	-3
87	0	1	0	1
88	0	0	0	0
89	0	0	0	0

TEST NO. 4

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	1.82	4.26	6.66	0.00
1	30	69	112	-1
2	29	66	106	-1
3	28	64	103	-1
4	27	60	97	-1
5	25	55	88	0
6	21	47	76	0
7	17	38	62	0
8	7	23	40	0
9	9	21	33	0
10	29	67	109	-1
11		19	47	0
12	9	20	32	0
13	27	62	100	-1
14	19	43	70	-1
15	8	20	32	-1
16	23	56	87	-1
17	23	52	84	0
18	22	51	81	-1
19	22	48	77	0
20	20	45	72	-1
21	7	29	52	0
22	15	32	52	0
23		10	25	0
24	7	18	28	0
25	18	45	73	-1
26	13	32	52	0
27	6	15	24	-1
28	4	26	47	0
29	13	29	45	1
30	4	11	19	-3
31	10	24	39	0
32	9	21	34	0
33	4	9	15	-3
34	4	12	19	-1
35	5	12	19	0
36	0	0	2	0
37	3	7	11	0
38	2	5	9	-4
39	22	51	82	-1
40	21	48	77	-1
41	22	51	82	0
42	18	41	66	-1
43	17	39	64	-1
44	19	45	69	-1

TEST NO. 4

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	1.82	4.26	6.66	0.00
45	11	26	41	0
46	11	25	39	0
47	10	24	38	-1
48	7	16	27	0
49	6	15	26	-1
50	9	20	31	0
51	5	12	19	0
52	5	12	19	-1
53	6	13	20	0
54	5	11	17	0
55	4	9	15	-1
56	5	11	17	0
57	4	8	13	0
58	0	4	8	1
59	-1	3	8	-4
60	2	5	9	0
61	2	4	6	0
62	2	6	9	0
63	28	66	99	0
64	20	47	75	-1
65	13	29	46	0
66	8	19	31	0
67	24	55	89	-1
68	6	13	20	0
69	2	4	7	0
70	3	5	7	1
71	1	1	1	4
72	0	0	0	0
73	0	0	0	0
74	0	0	0	0
75	0	0	0	0
76	0	0	0	0
77	0	0	0	0
78	0	2	4	
79	0	0	0	0
80	0	1	3	0
81	1	3	5	0
82	0	0	0	0
83	2	4	7	0
84	-2	-5	-9	-1
85	0	0	0	-2
86	0	-3	-6	0
87	0	0	-1	0
88	0	0	0	0
89	0	0	0	0

TEST NO. 5

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	4.42	9.26	12.08	0.00
1	74	161	202	13
2	71	153	204	12
3	69	148	198	11
4	65	140	186	10
5	58	124	166	8
6	51	109	145	8
7	41	88	117	6
8	32	66	88	4
9	23	48	64	3
10	72	156	199	13
11	50	106	140	8
12	21	46	61	3
13	66	143	183	11
14	48	102	135	9
15	21	46	60	5
16	58	126	160	11
17	56	119	159	9
18	55	117	156	9
19	52	110	147	8
20	48	103	137	8
21	44	92	122	9
22	36	76	100	6
23	27	57	76	5
24	18	40	52	3
25	49	107	136	10
26	38	80	105	8
27	16	36	47	3
28	37	82	105	7
29	31	65	86	6
30	13	28	37	3
31	26	57	72	5
32	23	49	65	5
33	10	21	27	2
34	14	30	38	4
35	13	27	36	2
36	11	25	33	2
37	8	18	24	2
38	6	13	17	2
39	54	117	150	8
40	51	110	141	9
41	55	117	148	9
42	44	96	122	7
43	36	83	107	2
44	46	94	118	7

TEST NO. 5

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	4.42	9.26	12.08	0.00
45	27	58	74	5
46	25	55	70	4
47	26	55	69	3
48	17	39	49	4
49	16	37	48	2
50	21	44	55	3
51	13	28	35	2
52	13	27	35	2
53	14	29	37	3
54	11	24	32	2
55	10	21	27	1
56	11	24	61	2
57	9	20	26	3
58	6	14	18	1
59	8	18	23	8
60	6	14	18	3
61	3	9	11	0
62	6	14	18	1
63	65	141	179	10
64	50	108	137	8
65	30	64	83	4
66	20	44	57	3
67	58	126	160	10
68	13	27	35	1
69	4	10	13	2
70	4	9	12	1
71	2	3	4	1
72	0	0	0	0
73	0	0	0	0
74	0	0	0	0
75	0	0	0	0
76	0	0	0	0
77	0	0	0	0
78	2	6	9	1
79	0	0	0	0
80	3	6	9	2
81	3	8	10	1
82	0	0	0	0
83	4	10	13	1
84	-6	-13	-18	-3
85	0	0	0	0
86	-4	-11	-16	-4
87	-1	-2	-3	-1
88	0	0	0	0
89	0	0	0	0

TEST NO. 6

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	6.97	14.90	0.00	14.72	7.02	0.00
1	114	243	12	243	131	14
2	109	238	11	239	129	12
3	106	231	10	231	125	12
4	99	217	9	217	117	10
5	89	194	7	194	104	8
6	77	169	6	168	90	8
7	63	138	5	137	74	6
8	47	103	3	103	54	4
9	34	75	2	75	39	3
10	109	235	12	236	127	14
11	76	165	7	165	88	8
12	33	72	2	72	37	2
13	101	216	11	217	116	12
14	73	158	7	158	85	8
15	30	68	-1	69	34	0
16	88	189	10	189	101	11
17	85	186	8	187	101	9
18	84	183	8	183	99	9
19	79	173	7	173	94	8
20	74	161	6	161	87	7
21	65	142	6	143	77	7
22	54	117	4	118	63	6
23	41	89	3	90	48	4
24	27	61	1	61	31	2
25	75	160	9	160	85	10
26	56	113	5	124	66	6
27	24	53	1	54	27	2
28	58	124	6	125	65	8
29	46	102	5	102	55	6
30	19	42	1	42	21	2
31	40	85	4	85	45	5
32	35	77	4	77	42	5
33	15	31	1	32	17	2
34	21	43	3	44	24	3
35	20	44	2	44	24	3
36	17	38	2	39	20	2
37	13	28	2	28	16	2
38	9	19	1	19	10	1
39	75	172	1	172	90	2
40	77	168	7	168	91	8
41	83	182	7	182	98	8
42	67	146	6	147	78	7
43	59	130	2	131	69	3
44	22			100	33	

TEST NO. 6

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	6.97	14.90	0.00	14.72	7.02	0.00
45	40	88	4	88	47	4
46	37	83	2	83	43	2
47	40	86	3	85	46	3
48	26	58	2	59	29	2
49	26	57	2	57	29	2
50	31	68	2	68	35	2
51	19	41	2	42	23	2
52	19	41	1	42	22	1
53	20	44	1	44	24	2
54	18	39	3	39	22	3
55	14	32	1	132	17	1
56	17	39	2	39	21	2
57	13	30	2	30	17	3
58	9	21	0	21	11	1
59	5	20	0	20	8	
60	9	21	1	21	12	2
61	6	14	0	14	7	0
62	10	22	1	22	11	1
63	93	211	4	211	111	5
64	75	163	6	164	87	7
65	42	95	1	95	82	1
66	31	68	3	69	35	3
67	83	186	3	186	97	4
68	19	42	1	42	22	1
69	8	15	2	15	10	2
70	7	14	2	14	9	2
71	2	3	0	4	2	0
72	0	0	0	0	0	0
73	0	0	0	0	0	0
74	0	0	0	0	0	0
75	0	0	0	0	0	0
76	0	0	0	0	0	0
77	0	0	0	0	0	0
78	4	10	0	10	6	1
79	0	0	0	0	0	0
80	4	10	1	10	6	1
81	5	11	1	11	6	1
82	0	0	0	0	0	0
83	6	14	1	15	8	1
84	-9	-20	-2	-21	-13	-3
85	0	0	0	0	0	0
86	-7	-19	-3	-19	-12	-3
87	-2	-3	0	-3	-2	0
88	0	0	0	0	0	0
89	0	-2	-1	-1	-1	-1

TEST NO. 7

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	1.77	4.48	7.34	10.15	4.32	0.00
1	35	85	138	189	88	3
2	35	84	136	187	88	8
3	34	81	131	181	85	8
4	32	76	123	171	80	7
5	29	69	112	154	73	7
6	25	60	97	133	61	4
7	20	49	79	109	50	3
8	16	37	59	82	37	2
9	12	28	44	61	28	3
10	35	83	134	184	86	3
11	26	60	96	131	60	5
12	12	27	42	58	27	3
13	33	77	124	170	79	3
14	25	57	91	126	58	5
15	12	26	42	58	27	3
16	30	68	109	149	70	4
17	28	66	107	147	69	6
18	27	64	104	144	68	6
19	25	61	99	136	64	6
20	24	57	92	127	60	6
21	22	51	82	113	52	4
22	18	42	59	94	43	4
23	13	32	52	71	33	3
24	10	23	37	51	24	3
25	25	57	92	126	59	4
26	19	44	71	98	46	4
27	9	20	32	45	21	2
28	20	45	73	98	47	5
29	16	36	58	80	38	4
30	6	15	24	35	17	2
31	13	30	49	67	31	3
32	11	27	43	70	28	3
33	5	12	19	27	14	2
34	7	16	25	34	17	3
35	7	15	25	34	16	2
36	6	14	22	30	14	2
37	4	10	16	22	11	2
38	3	6	11	16	8	2
39	26	63	103	141	66	1
40	24	59	96	133	59	2
41	26	63	103	142	66	5
42	21	51	83	114	53	4
43	19	47	76	105	48	6
44						

TEST NO. 7

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	1.77	4.48	7.34	10.15	4.32	0.00
45	13	31	51	70	33	4
46	12	29	48	67	31	3
47	14	31	51	69	32	2
48	8	20	33	46	22	3
49	8	20	33	46	21	3
50	11	25	40	55	25	2
51	6	14	23	32	15	1
52	6	15	24	32	15	1
53	7	16	26	36	17	2
54	5	13	22	30	13	1
55	5	11	18	25	12	1
56	5	13	21	30	14	1
57	4	10	17	23	11	2
58	0	5	10	14	5	0
59	4	9	15	21	10	1
60	3	7	12	17	9	2
61	1	4	7	10	4	0
62	3	8	12	17	8	1
63	35	79	123	169	79	0
64	24	58	94	130	61	5
65	14	35	56	77	37	3
66	10	23	39	53	24	3
67	28	68	110	151	68	5
68	6	15	24	33	16	1
69	1	4	8	11	5	-1
70	1	4	7	10	5	0
71	1	1	2	3	2	1
72	0	0	0	0	0	0
73	0	0	0	0	0	0
74	0	0	0	0	0	0
75	0	0	0	0	0	0
76	0	0	0	0	0	0
77	0	0	0	0	0	0
78	1	3	6	9	5	2
79	0	0	0	0	0	0
80	2	4	6	9	5	2
81	1	4	6	9	5	1
82	0	0	0	1	1	1
83	2	5	8	12	6	1
84	-2	-6	-11	-16	-6	-2
85	0	0	0	0	0	0
86	-3	-6	-11	-15	-10	-3
87	-1	-1	-2	-3	-2	-1
88	0	0	0	0	0	0
89	0	0	0	0	0	0

TEST NO. 8

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	2.18	4.52	7.39	9.99	4.74	0.00
1	41	89	148	199	104	4
2	41	87	146	195	103	4
3	39	84	140	189	99	3
4	38	81	134	180	94	4
5	34	73	120	162	85	4
6	30	64	105	141	73	3
7	24	52	86	115	60	2
8	18	39	65	87	45	2
9	14	30	49	66	34	2
10	40	87	144	193	101	5
11	29	62	102	138	72	3
12	12	27	45	60	31	1
13	36	79	131	176	93	4
14	28	60	98	132	69	3
15	11	26	45	61	32	2
16	31	68	115	153	81	3
17	32	69	114	153	81	3
18	32	68	112	150	79	3
19	30	64	106	143	75	3
20	28	60	100	134	70	3
21	25	53	88	119	62	2
22	21	44	74	99	52	2
23	16	34	57	76	41	2
24	10	23	40	53	29	2
25	26	57	97	130	68	3
26	22	46	77	104	55	2
27	9	20	36	48	26	2
28	19	43	75	99	53	2
29	17	37	62	84	44	1
30	7	16	29	38	21	1
31	14	30	51	69	36	1
32	13	28	47	63	34	2
33	5	13	22	30	17	1
34	7	15	26	35	19	1
35	8	16	27	36	19	1
36	6	14	23	32	16	1
37	5	10	18	24	13	1
38	3	7	13	18	10	1
39	31	66	109	146	76	3
40	28	63	104	139	73	3
41	31	67	110	149	78	3
42	25	53	88	119	61	2
43	22	49	82	110	57	2
44	25	53	88	118	61	1

TEST NO. 8

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	2.18	4.52	7.39	9.99	4.74	0.00
45	15	32	54	72	37	1
46	13	30	51	69	35	0
47	15	31	53	71	37	1
48	9	20	35	47	25	1
49	7	19	34	47	23	-1
50	12	26	43	57	29	1
51	7	15	25	34	18	1
52	7	16	26	35	18	1
53	8	17	28	36	19	1
54	6	14	23	30	16	0
55	6	12	20	27	14	1
56	6	13	22	30	16	0
57	4	10	17	23	12	1
58	3	8	14	18	10	1
59	5	10	16	22	12	1
60	3	7	12	17	10	1
61	1	4	8	11	6	0
62	2	7	13	17	9	0
63	43	77	129	174	90	1
64	28	60	100	134	70	2
65	13	33	56	77	38	-3
66	9	23	40	55	28	0
67	32	70	116	156	81	2
68	7	15	25	34	18	0
69	2	5	9	12	7	0
70	1	3	6	9	5	-1
71	0	0	1	2	1	0
72	0	0	0	0	0	0
73	0	0	0	0	0	0
74	0	0	0	0	0	0
75	0	0	0	0	0	0
76	0	0	0	0	0	0
77	0	0	0	0	0	0
78	1	3	6	8	5	1
79	0	0	0	0	0	0
80	1	3	5	8	5	1
81	1	4	6	8	5	0
82	0	0	0	0	1	0
83	2	5	8	11	6	0
84	-3	-7	-12	-15	-9	-1
85	0	0	0	0	0	0
86	-1	-5	-9	-12	-8	-1
87	0	0	-1	-2	-1	0
88	0	0	0	0	0	0
89	0	0	0	0	0	0

TEST NO. 9

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	5.66	10.97	15.75	8.00	0.00
1	40	82	124	63	5
2	37	78	116	61	4
3	36	76	114	60	4
4	34	71	107	57	4
5	30	63	95	50	3
6	26	54	82	43	3
7	22	45	68	36	3
8	15	33	49	26	2
9	11	24	36	19	1
10	38	78	117	60	5
11	26	54	80	42	3
12	11	22	34	17	1
13	34	71	107	54	4
14	24	50	75	39	3
15	9	21	33	16	0
16	28	60	91	46	4
17	28	59	88	46	3
18	27	57	86	45	3
19	26	55	82	44	3
20	24	51	76	40	3
21	21	44	66	34	2
22	17	37	55	29	2
23	12	27	41	22	2
24	8	18	29	13	1
25	24	50	77	38	4
26	18	38	57	29	1
27	6	15	24	11	0
28	17	37	58	28	2
29	14	30	45	24	1
30	4	11	18	8	0
31	12	26	40	20	2
32	10	22	34	17	1
33	4	9	14	7	1
34	5	12	19	9	1
35	6	13	19	10	1
36	5	11	16	9	1
37	3	7	11	6	0
38	2	5	8	3	0
39	28	58	87	46	4
40	29	60	87	47	3
41	30	63	93	50	4
42	22	46	69	36	3
43	23	48	71	38	3
44	24	50	74	39	2

TEST NO. 9

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	5.66	10.97	15.75	8.00	0.00
45	13	28	42	22	2
46	13	29	44	22	1
47	14	29	44	24	2
48	9	18	28	14	1
49	9	19	29	15	1
50	10	21	32	17	1
51	6	12	19	10	1
52	7	15	24	12	1
53	7	16	24	12	1
54	6	12	18	9	1
55	5	11	18	9	0
56	6	14	20	11	1
57	3	8	12	6	1
58	4	8	13	6	0
59	4	9	14	7	1
60	2	5	8	4	0
61	2	5	8	4	1
62	3	7	10	5	1
63	27	67	100	49	-5
64	27	56	83	44	4
65	14	31	48	123	-1
66	10	22	34	17	1
67	33	68	102	53	4
68	7	16	24	12	1
69	2	5	8	4	0
70	1	3	5	3	-1
71	0	0	1	0	0
72	0	0	0	0	0
73	0	0	0	0	0
74	0	0	0	0	0
75	0	0	0	0	0
76	0	0	0	0	0
77	0	0	0	0	0
78	0	2	3	2	0
79	0	0	0	0	0
80	1	2	4	3	1
81	1	3	5	3	0
82	0	0	0	0	0
83	1	3	6	3	0
84	-1	-3	-6	-3	0
85	0	0	0	0	0
86	-1	-2	-4	-2	-1
87	0	0	0	0	0
88	0	0	0	0	0
89	0	0	0	0	0

TEST NO. 10

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	5.30	10.76	15.23	8.48	0.00
1	36	79	116	65	8
2	34	76	110	63	6
3	33	74	107	61	6
4	30	69	100	57	5
5	27	60	89	50	4
6	25	53	77	44	4
7	19	43	62	35	2
8	13	31	44	24	1
10	35	78	114	63	7
11	25	54	78	45	4
13	32	73	107	59	7
14	24	52	76	43	4
16	29	66	96	53	7
17	28	63	91	52	5
18	28	62	89	51	5
19	26	57	83	47	4
20	25	54	78	45	5
21	22	48	70	39	4
22	17	38	55	31	2
23	12	29	42	23	2
25	25	56	82	45	6
26	20	43	62	35	4
28	19	44	65	35	5
29	16	36	52	30	4
31	14	32	46	25	4
32	12	27	39	22	3
34	8	18	26	14	3
35	7	16	23	14	2
36	6	15	21	13	2
37	5	11	16	10	2
39	27	62	90	50	6
40	24	53	77	44	5
41	25	56	80	46	4
42	22	50	73	40	6
43	18	42	60	34	4
44	20	42	62	35	2

TEST NO. 10

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	5.30	10.76	15.23	8.48	0.00
45	13	29	43	24	4
46	10	27	39	21	3
47	12	24	35	19	0
48	7	19	27	15	3
49	4	15	24	13	1
51	7	16	23	13	2
52	5	13	18	10	2
53	5	11	17	9	0
54	7	15	22	13	2
55	4	10	14	8	1
56	5	9	13	7	-1
57	4	10	15	8	2
58	3	8	11	7	1
59	3	5	7	3	-2
60	3	7	10	6	1
61	2	5	7	5	2
63	32	73	105	58	5
64	24	53	77	44	6
65	13	32	46	25	4
66	8	21	30	17	3
67	26	58	85	48	5
68	5	10	15	8	0
72	0	0	0	0	0
73	0	0	0	0	0
74	0	0	0	0	0
75	0	0	0	0	0
76	0	0	0	0	0
77	0	0	0	0	0
79	0	0	0	0	0
80	1	4	5	4	2
81	1	3	5	3	0
82	0	0	0	1	1
86	-3	-8	-13	-7	-2
87	-1	-2	-2	-1	-1
88	0	0	0	0	0
89	0	0	0	0	0

TEST NO. 11

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	5.57	11.10	14.70	7.81	0.00
1	33	73	102	51	4
2	33	71	100	51	3
3	32	71	99	50	2
4	32	68	96	49	2
5	29	62	88	45	2
6	26	57	79	40	2
7	23	48	67	35	2
8	18	38	53	26	2
9	15	31	43	22	2
10	31	70	98	48	3
11	26	56	78	40	3
12	14	30	41	21	2
13	28	64	90	44	3
14	25	54	75	38	3
15	13	29	41	19	2
16	24	56	79	38	3
17	25	55	78	39	2
18	23	53	76	37	1
19	25	55	77	40	2
20	25	52	84	38	2
21	22	49	68	34	3
22	19	41	57	29	2
23	15	33	46	23	2
24	11	25	35	17	2
25	20	47	67	31	3
26	19	43	59	30	3
27	10	22	31	15	2
28	15	36	51	24	2
29	16	35	48	24	2
30	7	16	23	11	1
31	11	26	36	17	2
32	12	26	36	18	1
33	6	12	17	9	1
34	6	14	19	9	2
35	7	14	20	10	1
36	5	12	18	9	0
37	4	9	14	7	0
38	4	7	10	5	1
39	22	48	68	34	3
40	22	47	66	34	2
41	27	58	81	42	2
42	16	37	52	25	2
43	14	33	47	24	2
44	22	48	67	34	1

TEST NO. 11

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	5.57	11.10	14.70	7.81	0.00
45	8	19	27	13	1
46	11	17	25	11	0
47	16	33	46	24	1
48	3	8	12	5	0
49	3	7	12	5	-1
50	14	28	38	20	1
51	5	11	16	8	1
52	4	10	15	7	0
53	7	15	20	10	1
54	5	10	15	7	1
55	3	7	11	5	0
56	6	13	18	9	0
57	3	6	9	4	1
58					
59	4	9	13	6	0
60	2	4	6	3	1
61	1	2	3	1	0
62	4	8	11	5	0
63	41	62	86	41	1
64	18	42	59	29	2
65	12	20	29	13	0
66	3	9	14	6	0
67	26	57	81	41	2
68	6	12	17	9	1
69	0	0	1	0	0
70	0	0	0	0	0
71	0	0	0	0	0
72	0	0	0	0	0
73	0	0	0	0	0
74	0	0	0	0	0
75	0	0	0	0	0
76	0	0	0	0	0
77	0	0	0	0	0
78	1	3	4	3	1
79	0	0	0	0	0
80	1	2	3	2	1
81	1	2	3	1	0
82	0	0	0	0	0
83	2	5	7	3	1
84	-2	-5	-8	-3	0
85	0	0	0	0	0
86	-3	-5	-8	-4	-1
87	-1	-1	-2	-1	0
88	0	0	0	0	0
89	-1	-1	-2	-2	-2

TEST NO. 12A

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	6.82	14.60	22.05	29.80	38.20
1	110	241	371	522	705
2	108	235	364	513	
3	104	226	351	497	672
4	98	213	331	468	
5	88	190	295	416	561
6	75	164	254	357	
7	62	135	209	295	397
8	44	98	153	217	
9	33	73	114	162	221
10	107	233	360	506	
11	75	162	252	355	478
12	31	68	107	152	
13	98	215	331	465	628
14	71	155	241	341	
15	30	68	106	152	
16	86	188	290	406	
17	85	185	286	402	543
18	83	180	279	394	
19	79	171	265	375	509
20	73	159	247	352	
21	64	141	220	313	424
22	52	114	179	255	
23	38	85	134	191	
24	25	59	93	133	183
25	72	159	244	342	459
26	56	123	192	276	
27	22	52	83	119	
28	56	124	189	264	
29	45	99	156	226	311
30	17	41	66	95	132
31	39	86	131	183	246
32	34	75	118	172	
33	13	31	51	74	
34	20	44	67	94	
35	20	43	67	95	129
36	16	38	57	83	116
37	11	27	34	56	
38	7	18	32	47	68
39	80	175	272	381	514
40	79	169	261	369	502
41	83	180	277	391	526
42	63	140	219	307	416
43	61	132	205	290	395
44	65	142	219	308	415

TEST NO. 12A

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	6.82	14.60	22.05	29.80	38.20
45	40	87	134	189	
46	38	84	131	185	
47	39	84	130	183	
48	26	58	90	128	173
49	25	56	88	124	168
50	30	65	101	144	196
51	19	42	64	91	124
52	19	41	65	90	121
53	20	44	68	96	129
54	18	39	60	85	117
55	15	32	50	72	99
56	17	37	57	83	113
57	12	29	50	66	
58	10	22	25	52	
59	11	25	40	60	
60	8	20	31	46	64
61	6	14	22	33	56
62	8	19	31	46	64
63	98	214	331	464	627
64	74	162	251	351	475
65	45	98	150	211	
66	30	66	103	146	198
67	88	191	294	413	559
68	11	33	55	80	108
69	6	15	23	33	44
70	4	10	15	22	27
71	1	2	3	5	6
72	0	0	0	0	0
73	0	1	1	1	1
74	0	0	0	1	1
75	0	0	0	0	0
76	0	1	1	1	1
77	0	0	0	0	0
78	3	10	17	25	35
79	0	0	1	1	1
80	3	9	16	24	34
81	5	10	17	25	35
82	0	1	2	3	3
83	6	14	21	32	45
84	-8	-19	-34	-52	-77
85	0	-1	-1	-1	-1
86	-6	-17	-29	-47	-70
87	-1	-3	-5	-7	-10
88	0	0	0	0	0
89	0	-1	-2	-5	-5

TEST NO. 12B

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	29.65	45.80	59.70	74.90	91.30
1	471	788	1113	1463	1812
3	446	750	1062	1402	1738
5	376	634	907	1203	1510
7	273	459	656		
9	151	258	370	499	635
11	321	544	775	1032	1299
13	419	705	1005	1329	1657
17	362	362	623	913	1206
19	337	567	812	1083	1353
21	277	472	675	906	1145
24	128	224	359	475	600
25	310	516	731	972	1215
29	198	341	490	672	856
30	88	155	229	317	413
31	166	276	392	520	651
35	85	143	204	255	329
36	72	126	187	238	312
38	41	80	126	184	247
39	347	588	838	1125	1408
40	335	566	800	1056	1322
41	353	594	849	1136	1425
42	284	480	692	932	1177
43	264	452	644	851	1071
44	281	475	686	922	1164

TEST NO. 12B

DEFLECTION(IN.X1000)

GAUGE NO. LOAD(LB./SQ.FT.)

	29.65	45.80	59.70	74.90	91.30
48	120	204	294	396	508
49	118	199	285	381	485
50	133	230	336	460	594
51	82	140	200	271	343
52					
53	86	144	205	275	348
54	77	134	196	270	446
55	65	110	159	215	274
56	73	125	183	251	322
60	42	76	121	176	247
61	32	57	89	129	
62	43	76	127	191	265
63	422	708	1003	1323	1645
64	322	543	773	1028	1294
66	137	234	337	451	573
67	372	626	882	1165	1447
68	78	129		185	243
69	30	53	78		101
70	18	28	42	53	
71	5	3	3	3	3
72	0	0	0	0	0
73	1	2	2	2	3
74	1	1	2	2	3
75	0	0	1	1	2
76	0	1	1		1
77	0	0	1	1	1
78	22	46	63		127
79	1	2	1	-2	-5
80	22	41	58	48	
81	22	39	59	82	107
82		2	4	5	7
83	28	52	83	118	154
84	-40	-79	-136	-181	-181
85	-1	-5	-4	-7	
86	-41	-78	-134	-174	-174
87	-6	-12	-19	-29	
88	0	0	0	0	1
89	-5	-6	-4	-3	-1

9.6 Experimental edge beam strains

The edge beam strain gauges were located on the outside face of the 2" x $\frac{1}{4}$" edge beam and at $\frac{7}{8}$" above and below the axis. Tensile strains are positive.

Results:-

Test 5 Load (lb/sq.ft.)	4.42	9.26	12.08		
Top (Strain	-8.5	-25	-30		
Bottom x 10^{-6})	22	32.5	44.5		
Test 6 Load (lb/sq.ft.)	6.97	14.90	14.72	7.02	
Top (Strain	-15		-40	-19	
Bottom x 10^{-6})	28	50	48	25	
Test 7 Load (lb/sq.ft.)	1.77	4.48	7.34	10.15	4.32
Top (Strain	-2.5	-12.5	-25	-40	-17.5
Bottom x 10^{-6})	3.5	17	25.5	34.5	14
Test 8 Load (lb/sq.ft.)	2.18	4.52	7.39	9.99	4.74
Top (Strain	-7.5	-12.5	-25	-35	-20
Bottom x 10^{-6})	12.5	27.5	32.5	45	20
Test 10 Load (lb/sq.ft.)	5.30	10.76	15.23	8.48	
Top (Strain	-10	-15	-22.5	-7.5	
Bottom x 10^{-6})	3.5	14.5	20.5	14	
Test 12(a) Load (lb/sq.ft.)	6.82	14.60	22.05	29.80	38.20
Top (Strain	-19.5	-38	-51.5	-86	-113
Bottom x 10^{-6})	23.5	52	85.5	103.5	137