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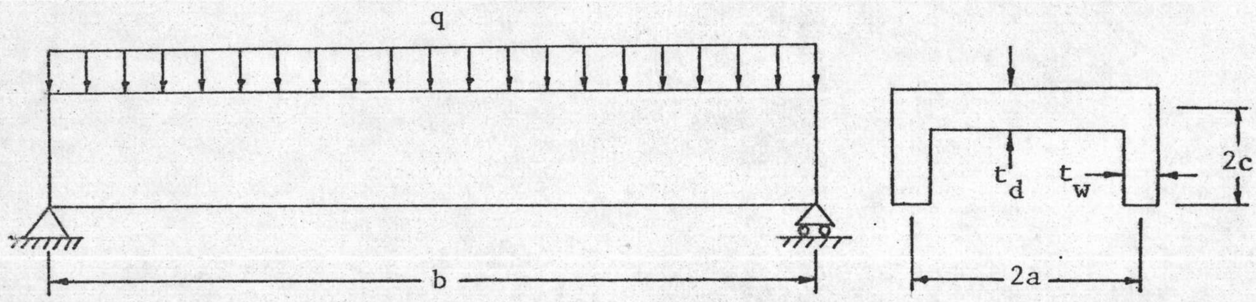


Fig.1 Simply Supported Inverted Channel Floor Unit.

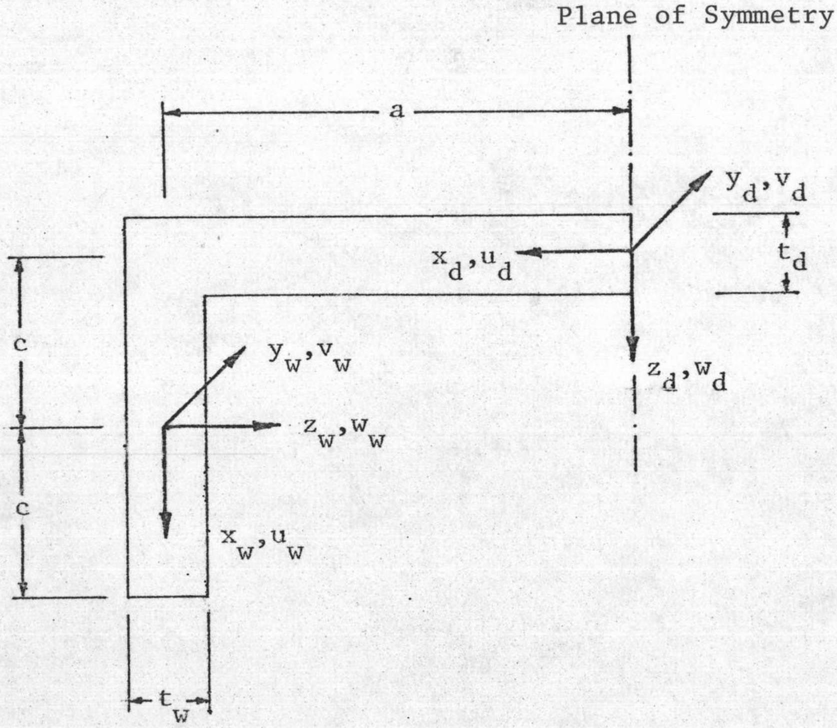
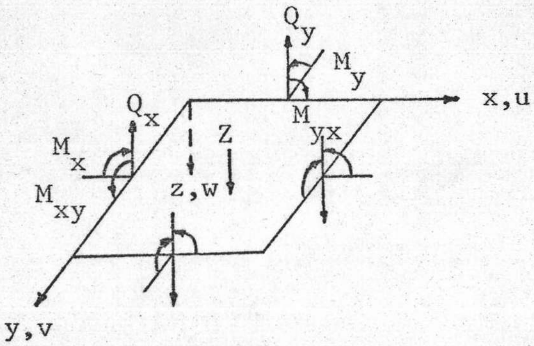
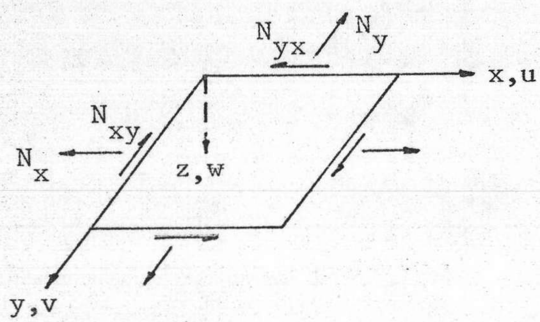


Fig.2 Orientation of Coordinate Axes.



a) Bending Stress Resultants.



b) Membrane Stress Resultants.

Fig.3 Positive Directions of Stress Resultants and Load Components.

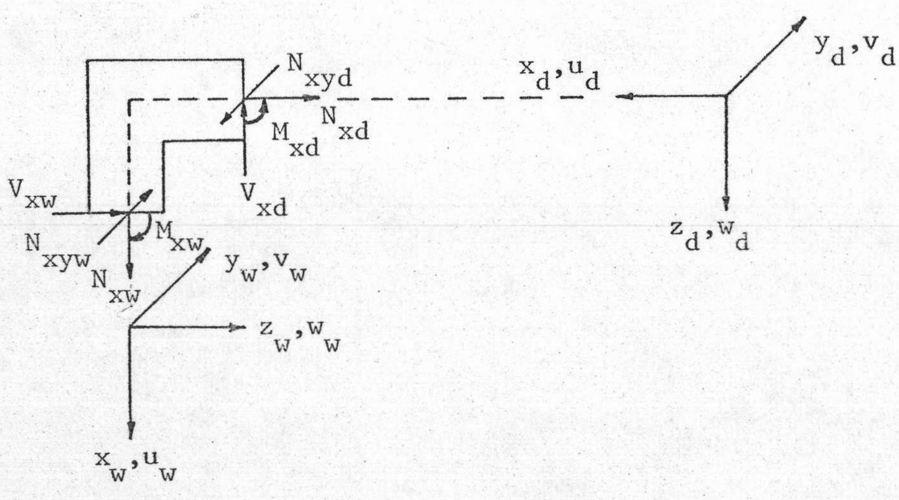
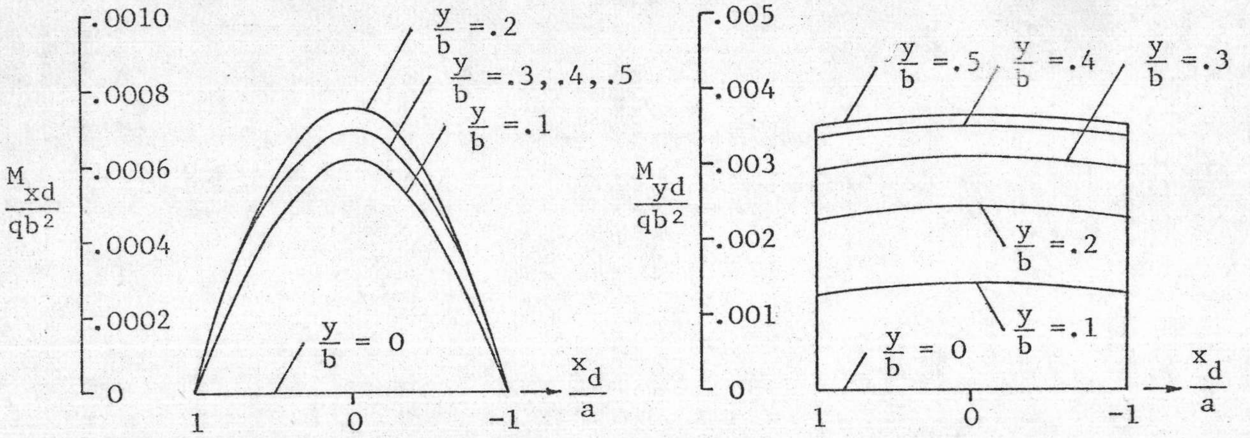
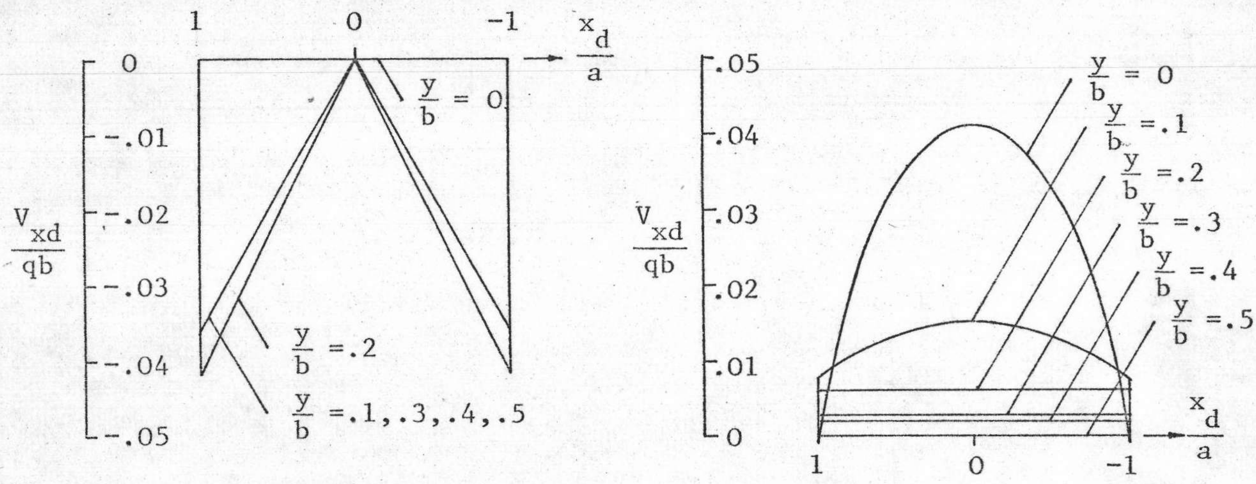


Fig.4 Positive Directions of the Stress Resultants and Displacements at the Joint.

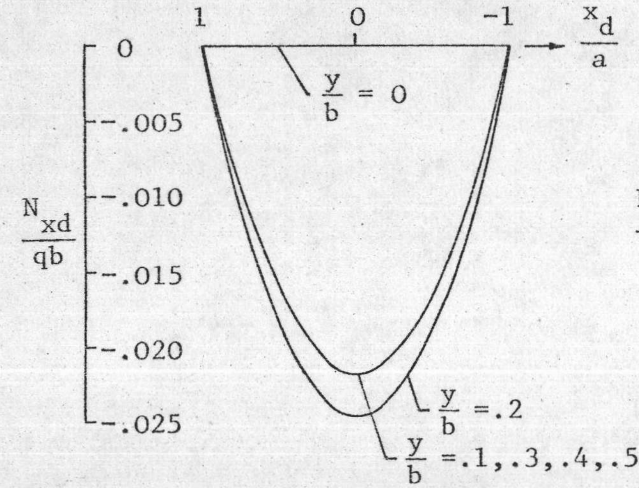


a) Transverse Bending Moment, M_{xd}.   b) Longitudinal Bending Moment, M_{yd}.

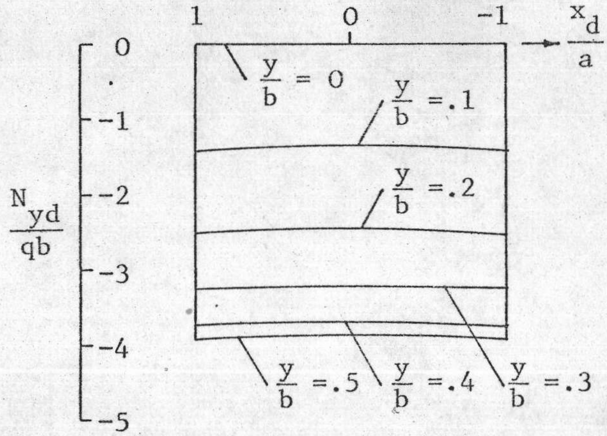


c) Transverse Shearing Force, V_{xd}.   d) Longitudinal Shearing Force, V_{yd}.

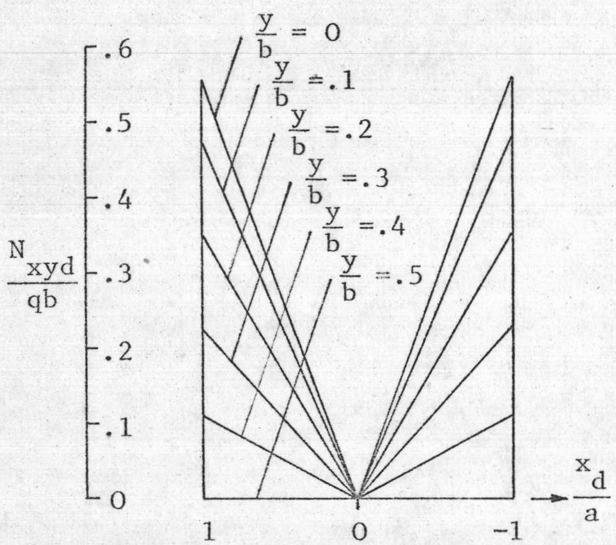
Fig.5 Stress Resultants and Displacements: 2a = 30 cm., 2c = 15 cm., $t_d = t_w$ = 4 cm., b = 400 cm.



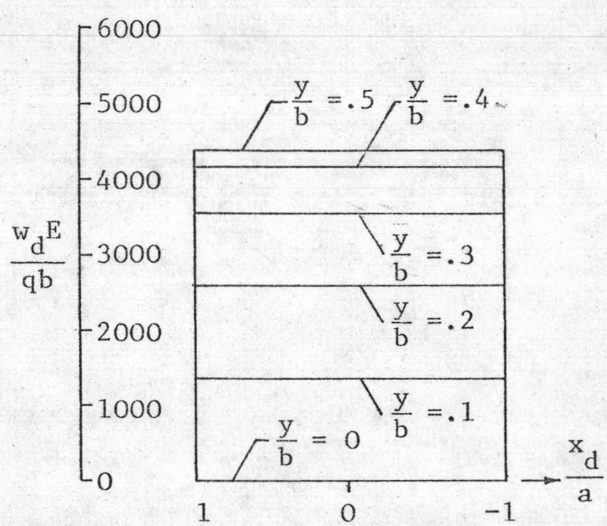
e) Transverse Normal Force, N_{xd}.



f) Longitudinal Normal Force, N_{yd}.



g) Membrane Shearing Force, N_{xyd}.

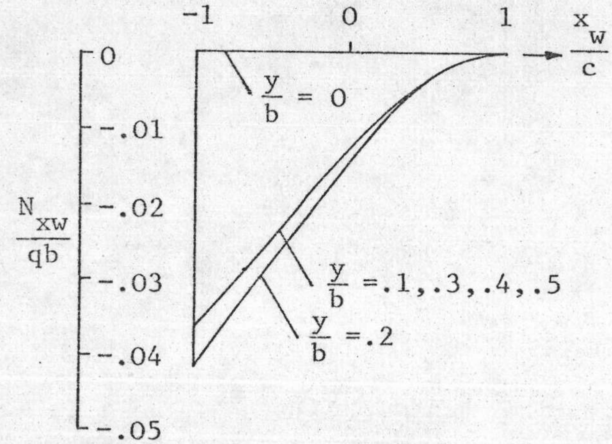


h) Normal Displacement Component, w_d.

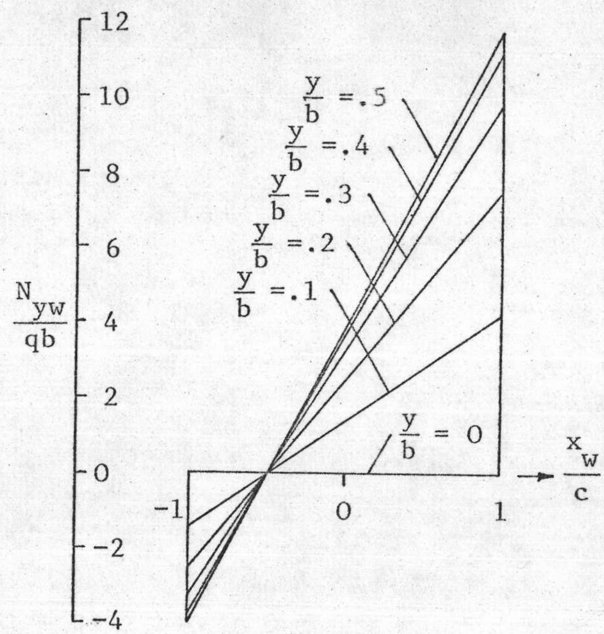
Fig.5 Stress Resultants and Displacements: 2a = 30 cm.,

2c = 15 cm., $t_d = t_w = 4$ cm., b = 400 cm.

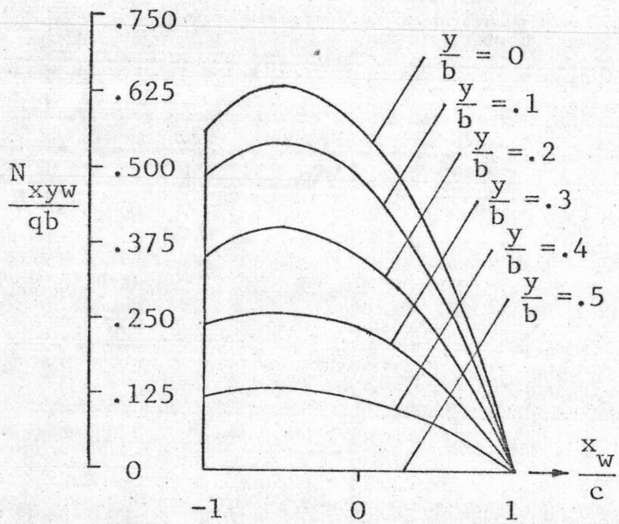
(Continued)



i) Transverse Normal Force, N_{xw}.



j) Longitudinal Normal Force, N_{yw}.

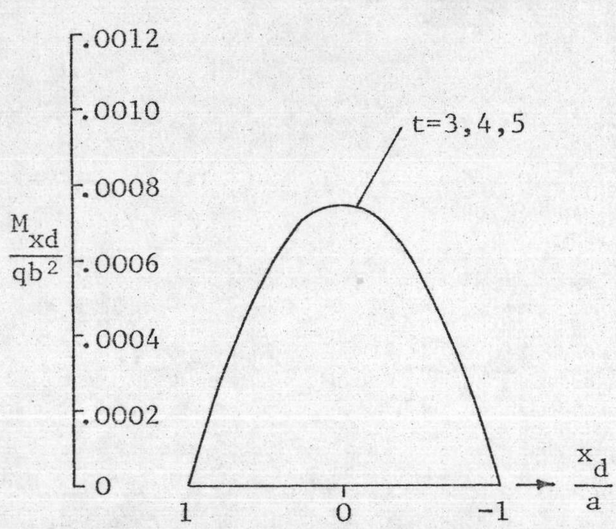


k) Membrane Shearing Force, N_{xyw}.

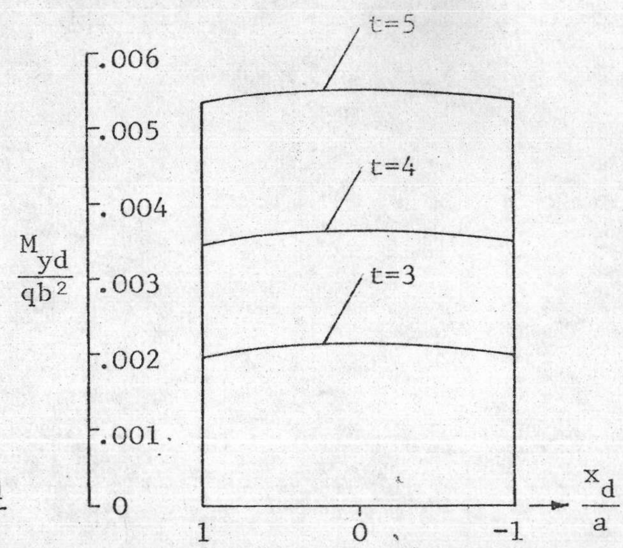
Fig.5 Stress Resultants and Displacements: 2a = 30 cm.,

2c = 15 cm., $t_d = t_w$ = 4 cm., b = 400 cm.

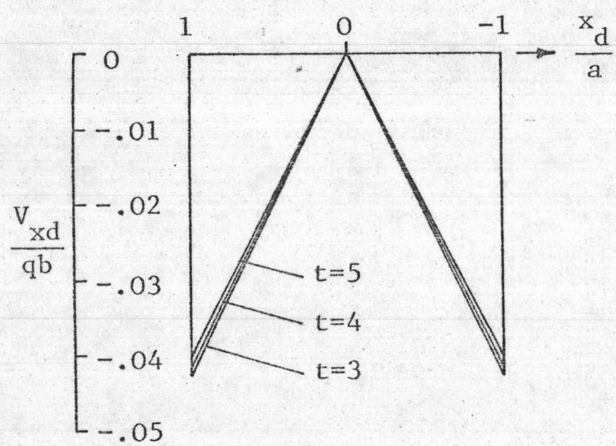
(Continued)



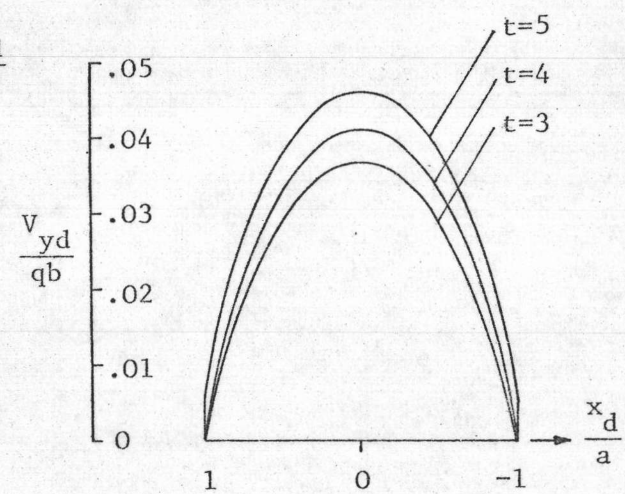
a) Transverse Bending Moment, M_{xd}, at $y/b = 0.2$.



b) Longitudinal Bending Moment, M_{yd}, at $y/b = 0.5$.

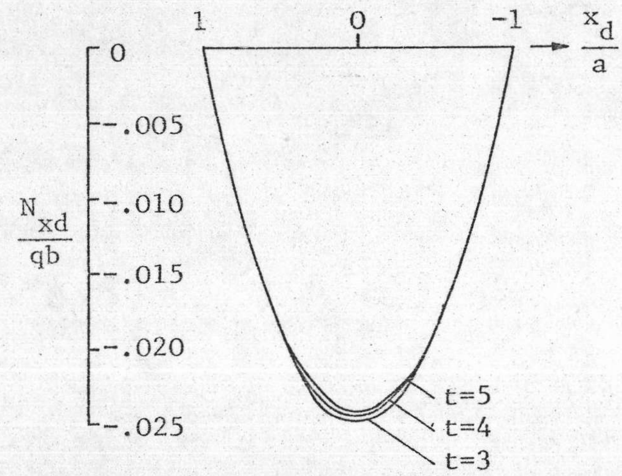


c) Transverse Shearing Force, V_{xd}, at $y/b = 0.2$.

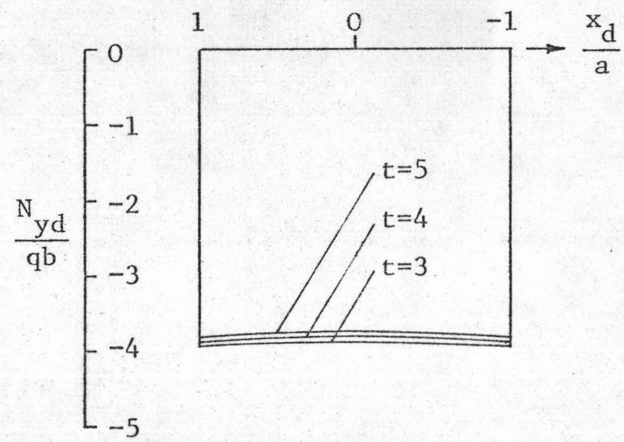


d) Longitudinal Shearing Force, V_{yd}, at $y/b = 0$.

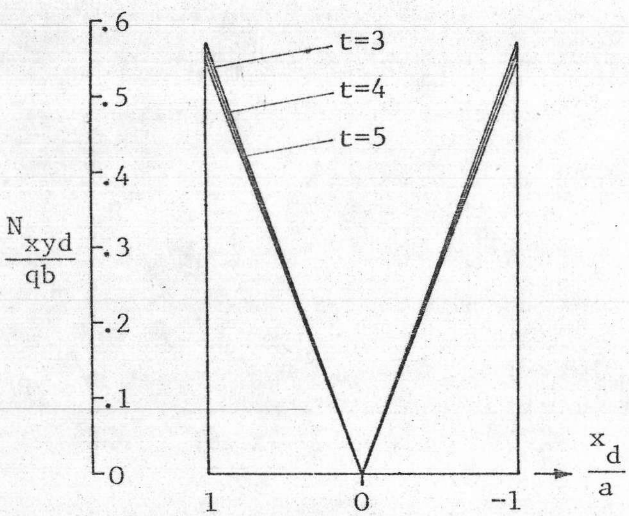
Fig.6 Comparison of Stress Resultants and Displacements Between Various Thickness: 2a = 30 cm., 2c = 15 cm., b = 400 cm., $t_d = t_w$ = 3, 4 and 5 cm.



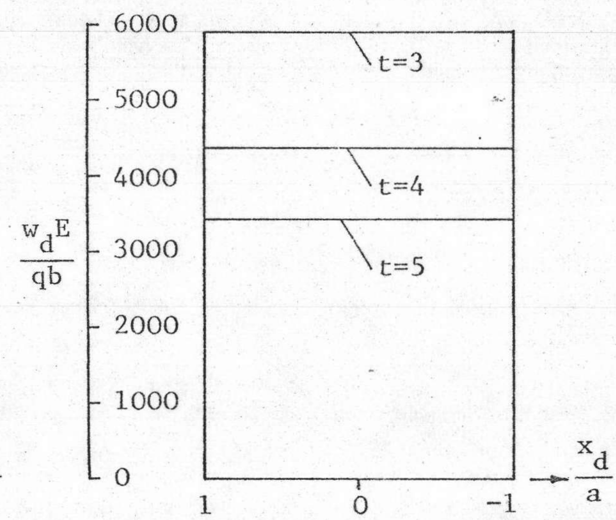
e) Transverse Normal Force, N_{xd}, at y/b = 0.2 .



f) Longitudinal Normal Force, N_{yd}, at y/b = 0.5 .



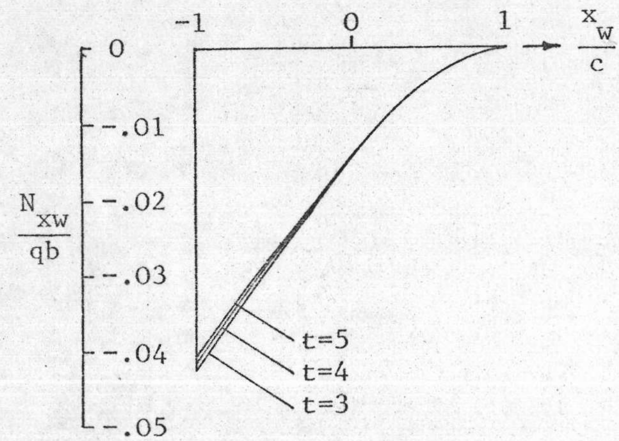
g) Membrane Shearing Force, N_{xyd}, at y/b = 0.



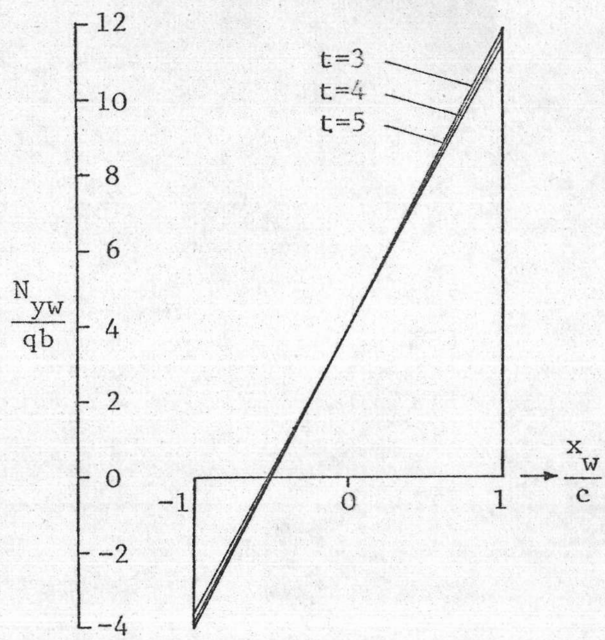
h) Normal Displacements Component, w_d, at y/b = 0.5 .

Fig.6 Comparison of Stress Resultants and Displacements Between Various Thickness: 2a = 30 cm., 2c = 15 cm., b = 400 cm., $t_d = t_w$ = 3, 4 and 5 cm.

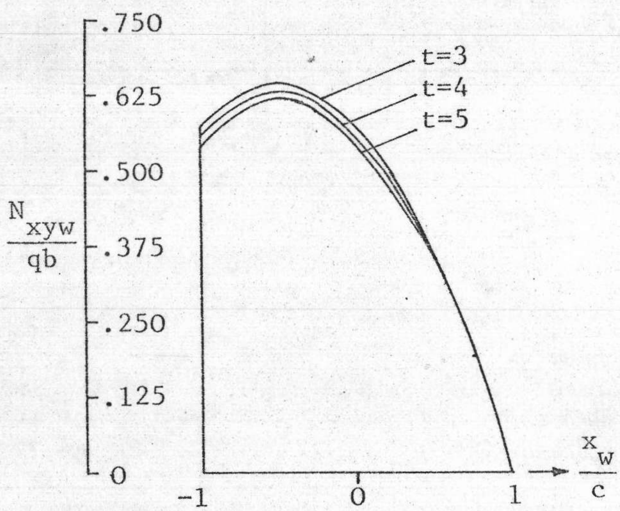
(Continued)



i) Transverse Normal Force, N_{xw}, at $y/b = 0.2$.



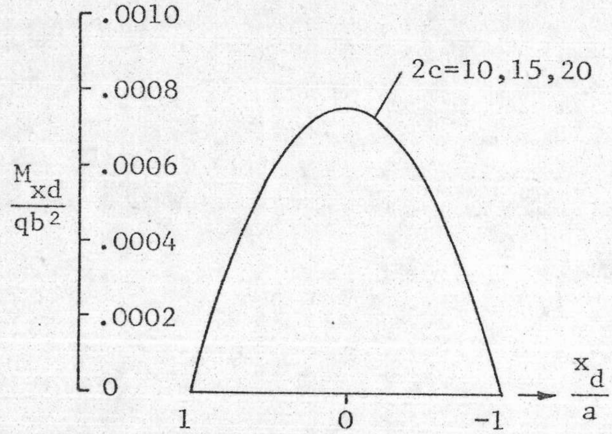
j) Longitudinal Normal Force, N_{yw}, at $y/b = 0.5$.



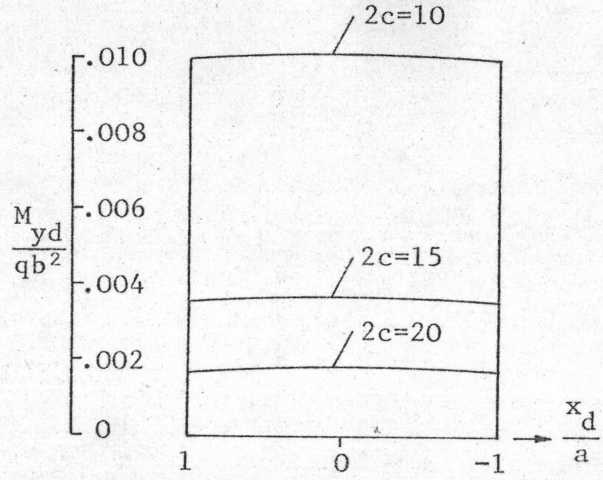
k) Membrane Shearing Force, N_{xyw}, at $y/b = 0$.

Fig.6 Comparison of Stress Resultants and Displacements Between Various Thickness: 2a = 30 cm., 2c = 15 cm., b = 400 cm., $t_d = t_w$ = 3, 4 and 5 cm.

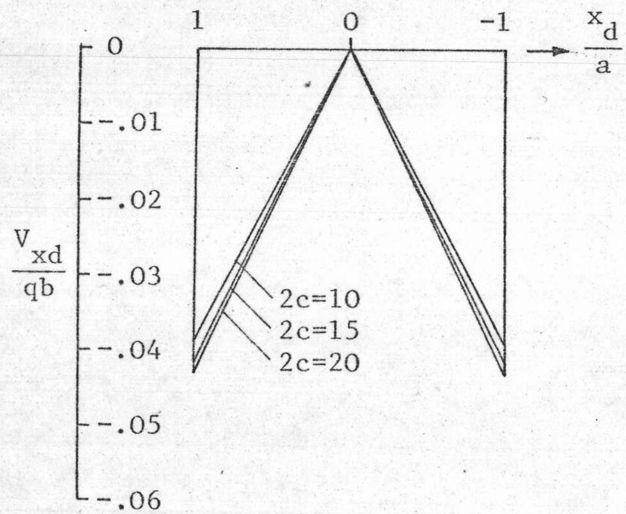
(Continued)



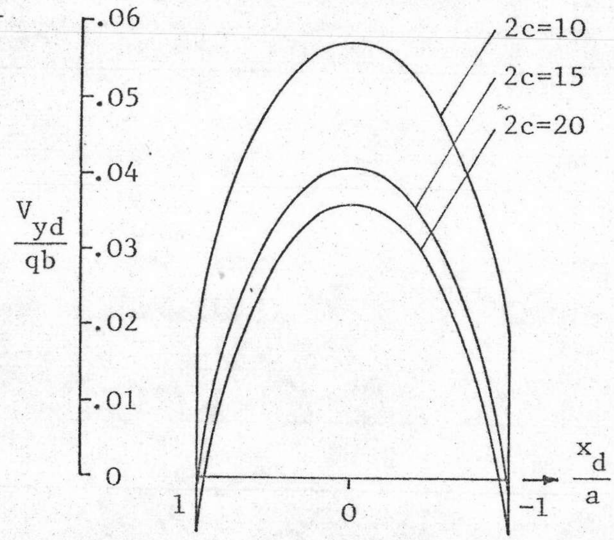
a) Transverse Bending Moment, M_{xd}, at $y/b = 0.2$.



b) Longitudinal Bending Moment, M_{yd}, at $y/b = 0.5$.

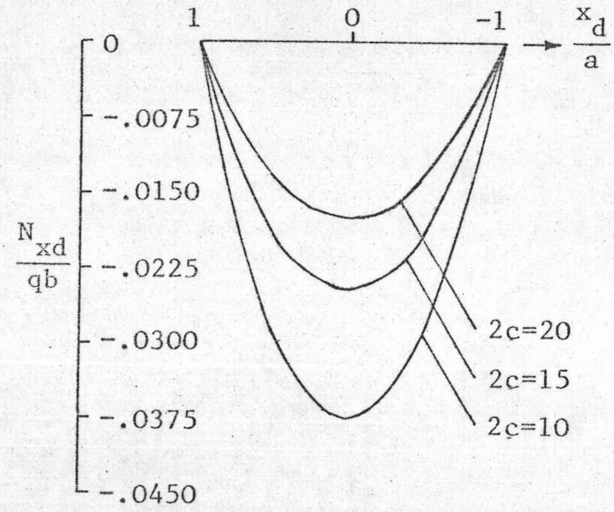


c) Transverse Shearing Force, V_{xd}, at $y/b = 0.2$.

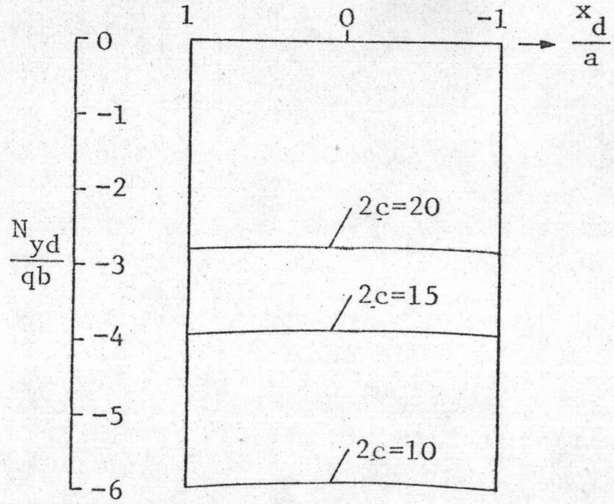


d) Longitudinal Shearing Force, V_{yd}, at $y/b = 0$.

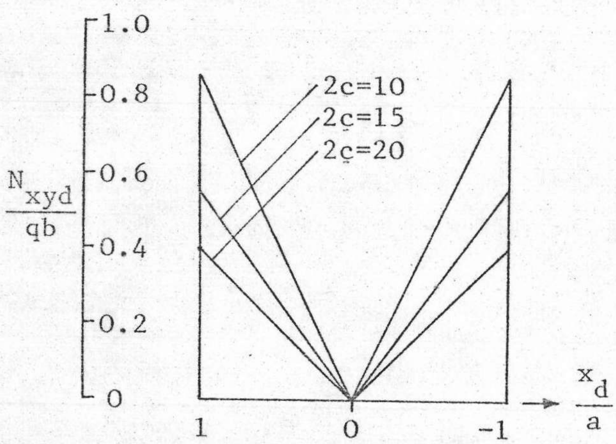
Fig.7 Comparison of Stress Resultants and Displacements Between Various Depths: $2a = 30$ cm., $t_d = t_w = 4$ cm., $b = 400$ cm., $2c = 10$, 15 and 20 cm.



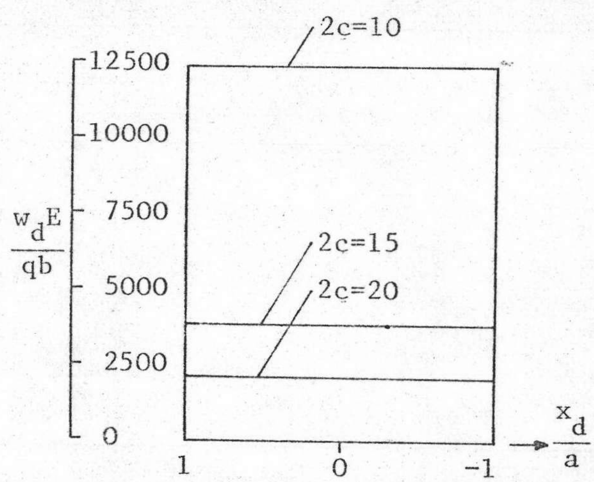
e) Transverse Normal Force, N_{xd}, at $y/b = 0.2$.



f) Longitudinal Normal Force, N_{yd}, at $y/b = 0.5$.



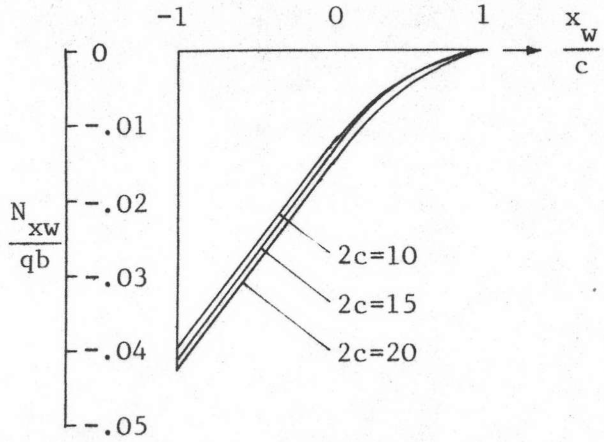
g) Membrane Shearing Force, N_{xyd}, at $y/b = 0$.



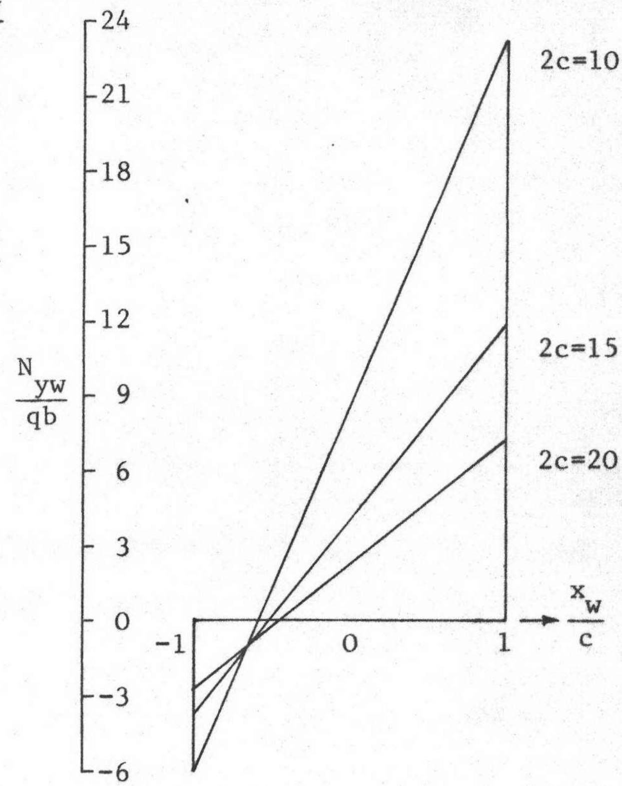
h) Normal Displacement Component, w_d, at $y/b = 0.5$.

Fig.7 Comparison of Stress Resultants and Displacements Between Various Depths: $2a = 30$ cm., $t_d = t_w = 4$ cm., $b = 400$ cm., $2c = 10$, 15 and 20 cm.

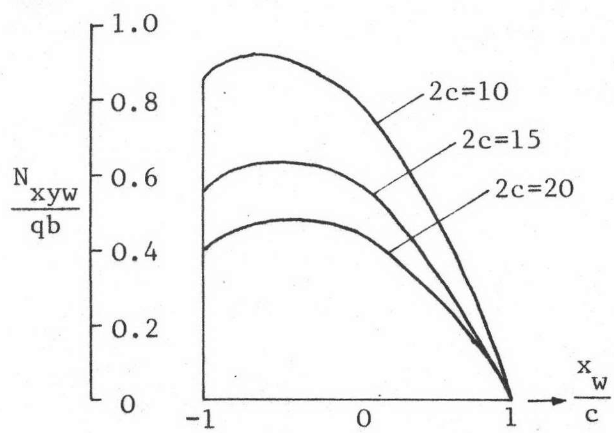
(Continued)



i) Transverse Normal Force, N_{xw}, at $y/b = 0.2$.



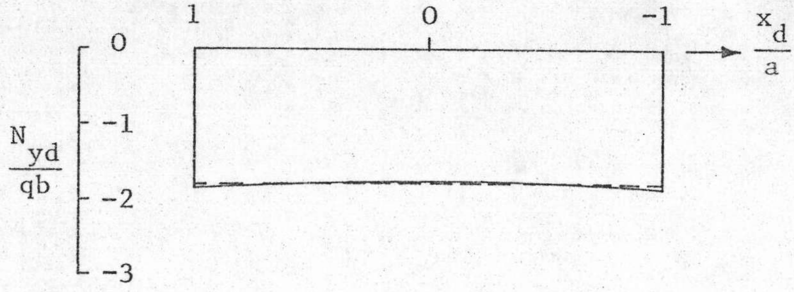
j) Longitudinal Normal Force, N_{yw}, at $y/b = 0.5$.



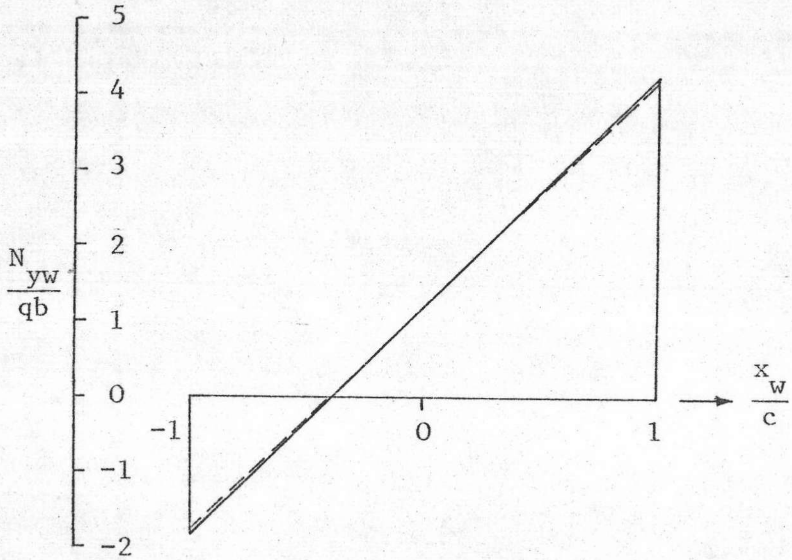
k) Membrane Shearing Force, N_{xyw}, at $y/b = 0$.

Fig.7 Comparison of Stress Resultants and Displacements Between Various Depths: 2a = 30 cm., $t_d = t_w$ = 4 cm., b = 400 cm., 2c = 10, 15 and 20 cm.

(Continued)



a) Longitudinal Normal Force, N_{yd}, at y/b = 0.5 .



b) Longitudinal Normal Force, N_{yw}, at y/b = 0.5 .

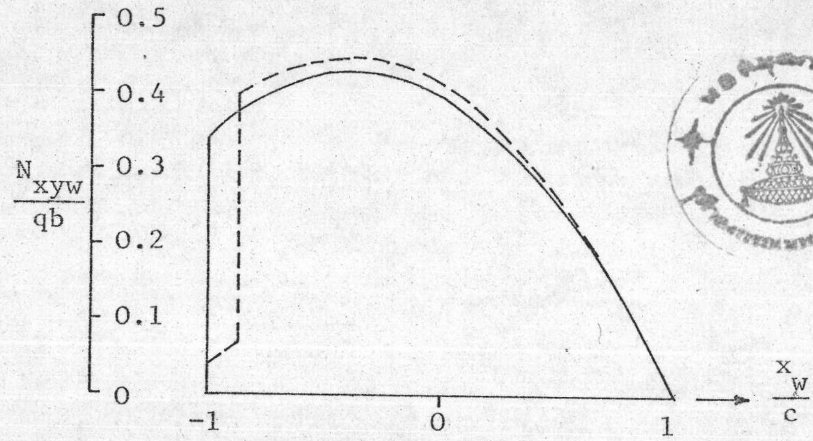
Fig.8 Comparison of Stress Resultants and Displacements

Between the Proposed Method and Simple Bending Theory:

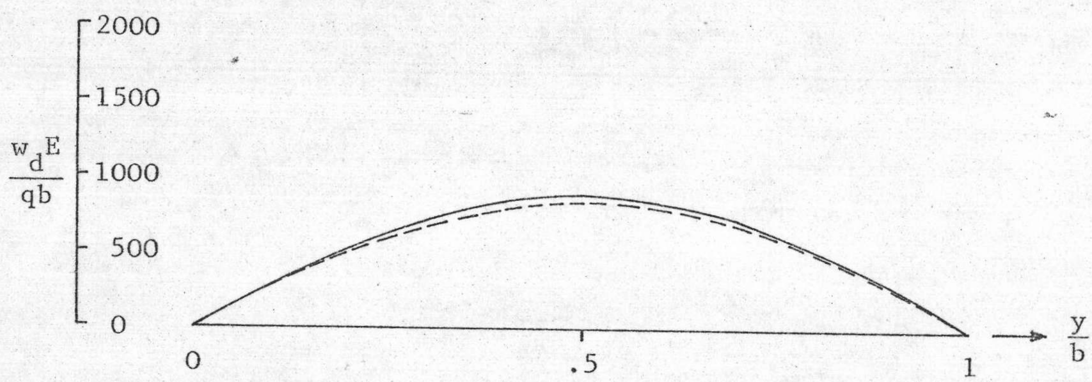
2a = 40 cm., 2c = 30 cm., $t_d = t_w$ = 4 cm., b = 400 cm.

——————— Proposed Method

– – – – – – Simple Bending Theory



c) Membrane Shearing Force, N_{xyw}, at $y/b = 0$.



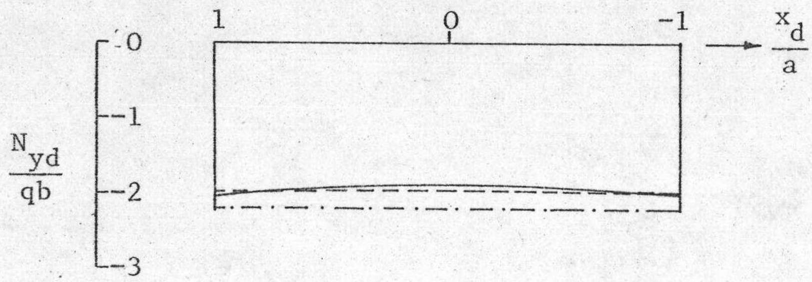
d) Normal Displacement Component, w_d, at $x_d = 0$.

Fig.8 Comparison of Stress Resultants and Displacements Between the Proposed Method and Simple Bending Theory: $2a = 40$ cm., $2c = 30$ cm., $t_d = t_w = 4$ cm., $b = 400$ cm.

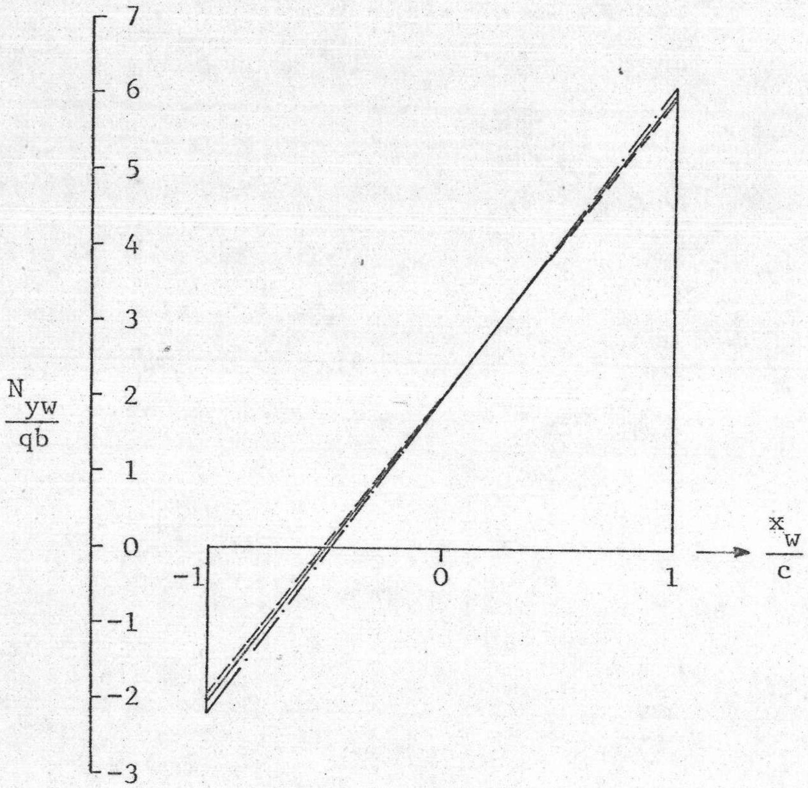
———————— Proposed Method

– – – – – – Simple Bending Theory

(Continued)



a) Longitudinal Normal Force, N_{yd}, at y/b = 0.5.



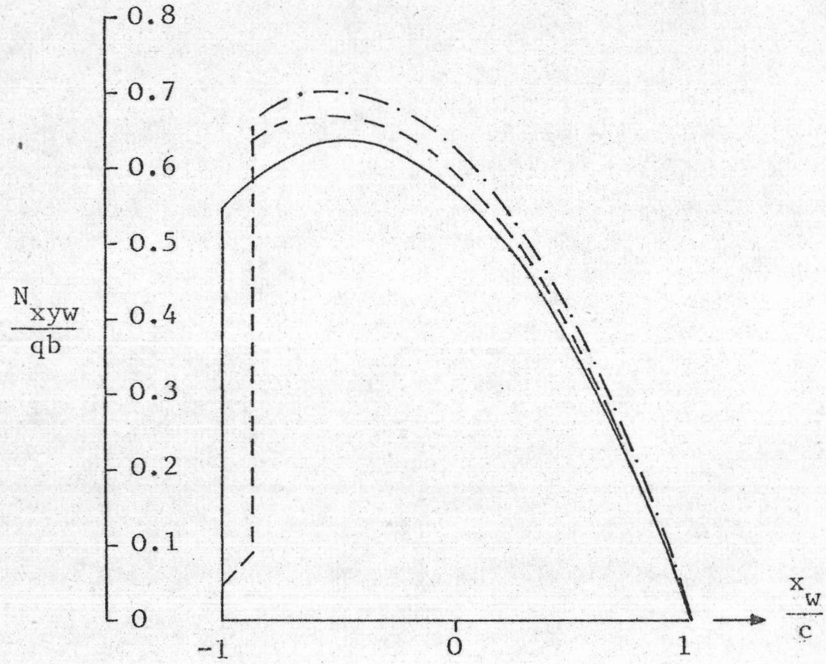
b) Longitudinal Normal Force N_{yw}, at y/b = 0.5

Fig.9 Comparison of Stress Resultants and Displacements Between the Proposed Method and Simple Bending Theory: 2a = 60 cm., 2c = 30 cm., $t_d = t_w$ = 4 cm., b = 400 cm.

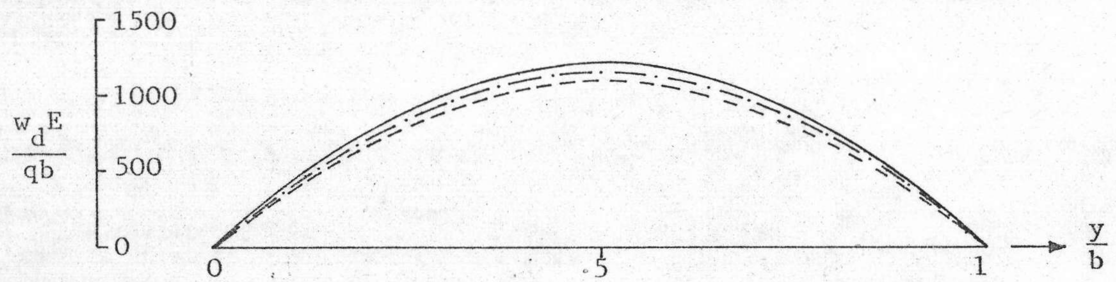
——————— Proposed Method

— — — — — — Simple Bending Theory

—·—·—·—·— Simple Bending Theory Using Effective Width Criteria



c) Membrane Shearing Force, N_{xyw}, at $y/b = 0$.



d) Normal Displacement Component, w_d, at $x_d = 0$.

Fig.9 Comparison of Stress Resultants and Displacements

Between the Proposed Method and Simple Bending Theory:

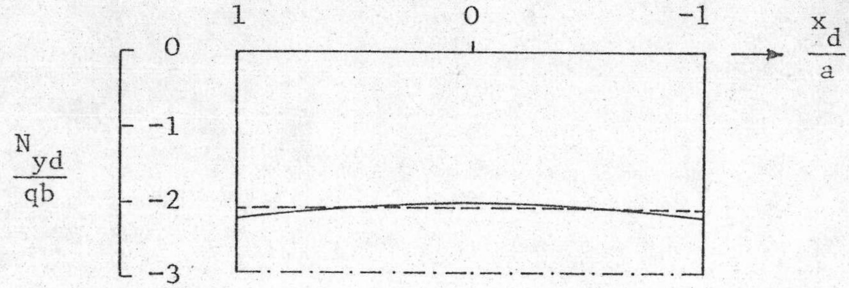
$2a = 60$ cm., $2c = 30$ cm., $t_d = t_w = 4$ cm., $b = 400$ cm.

——————— Proposed Method

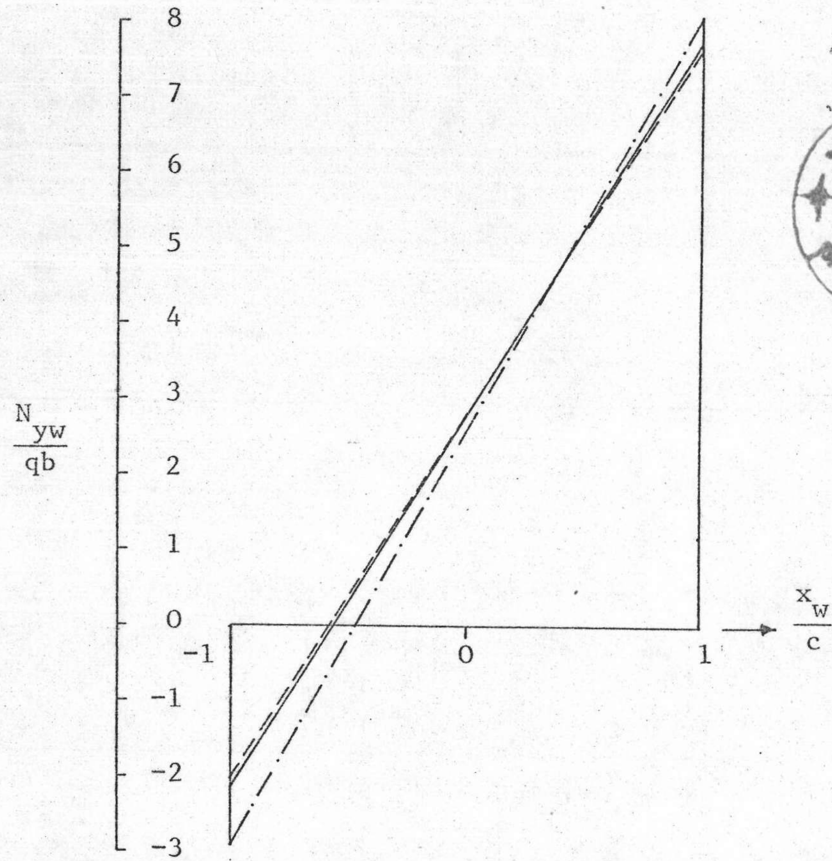
– – – – – – Simple Bending Theory

–·–·–·–·– Simple Bending Theory Using Effective Width Criteria

(Continued)



a) Longitudinal Force, N_{yd}, at y/b = 0.5.



b) Longitudinal Force, N_{yw}, at y/b = 0.5

Fig.10 Comparison of Stress Resultants and Displacements

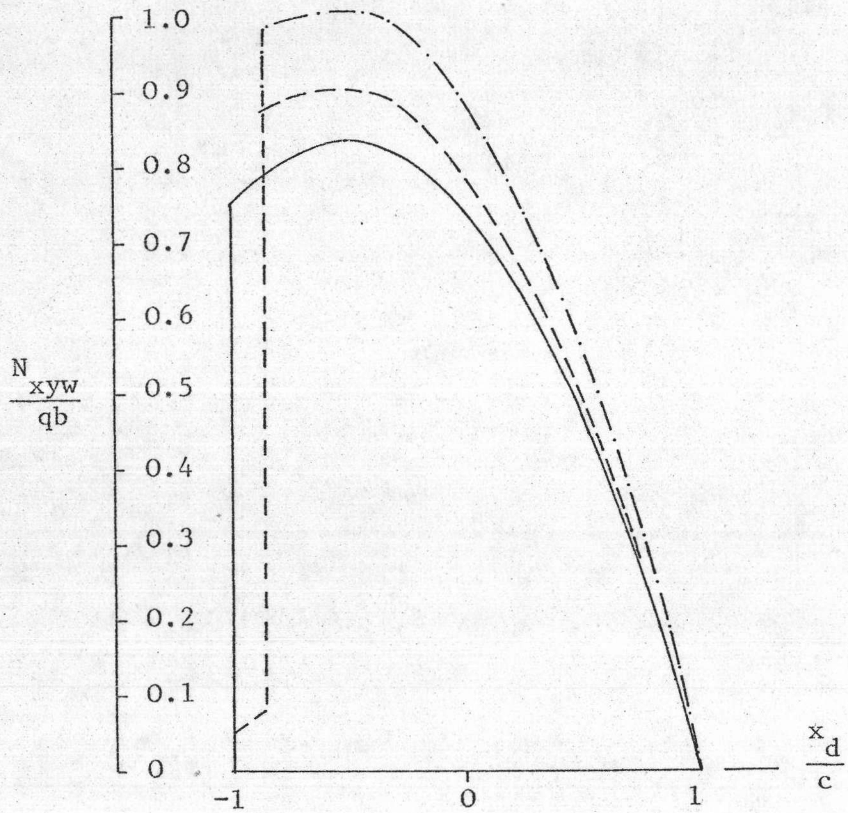
Between the Proposed Method and Simple Bending Theory:

2a = 80 cm., 2c = 30 cm., $t_d = t_w$ = 4 cm., b = 400 cm.

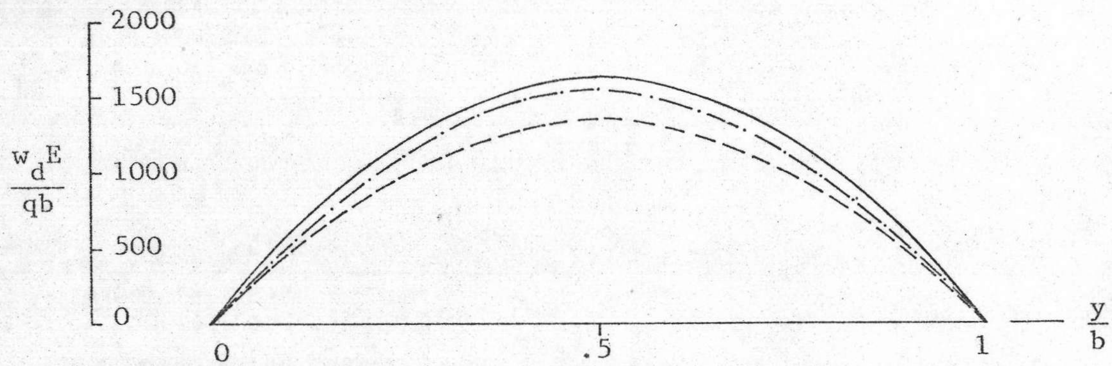
———————— Proposed Method

– – – – – – Simple Bending Theory

—·—·—·—·— Simple Bending Theory Using Effective Width Criteria



c) Membrane Shearing Force, N_{xyw}, at y/d = 0.



d) Normal Displacement Component, w_d, at x_d = 0.

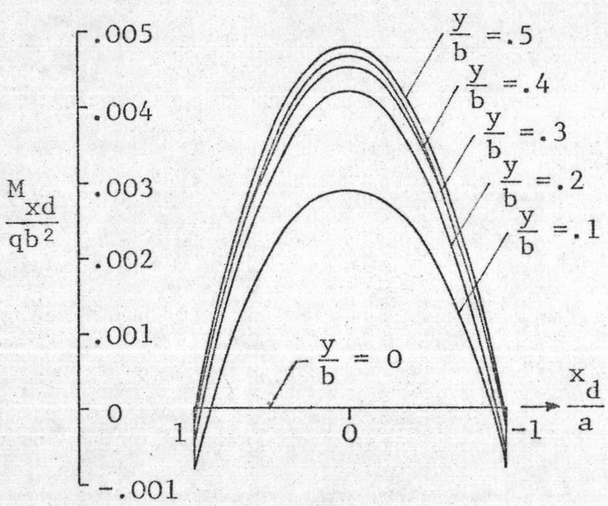
Fig.10 Comparison of Stress Resultant and Displacements Between the Proposed Method and Simple Bending Theory: 2a = 80 cm., 2c = 30 cm., $t_d = t_w$ = 4 cm., b = 400 cm.

——————— Proposed Mehtod

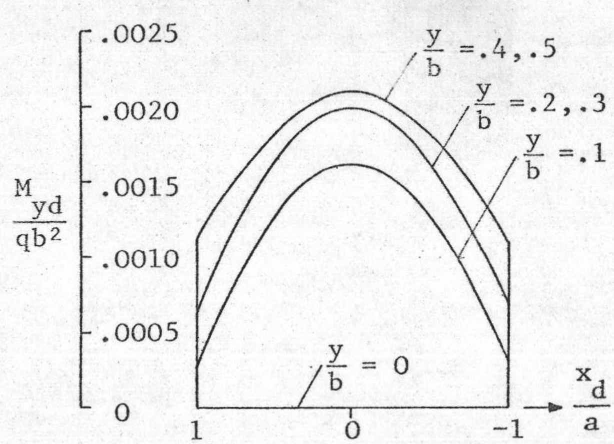
– – – – – – Simple Bending Theory

–·–·–·–·– Simple Bending Theory Using Effective Width Criteria

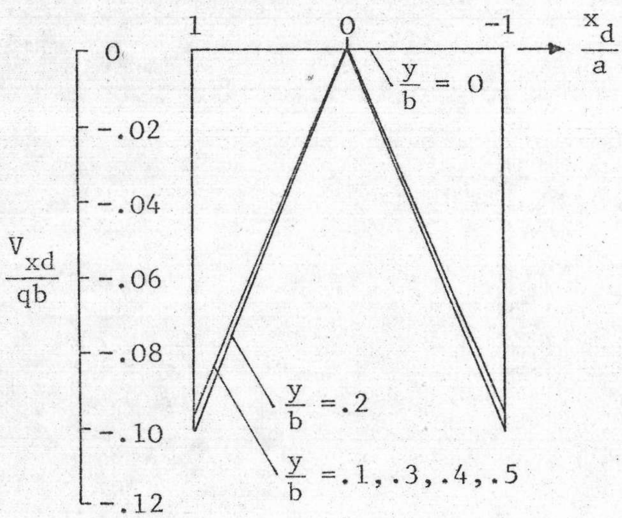
(Continued)



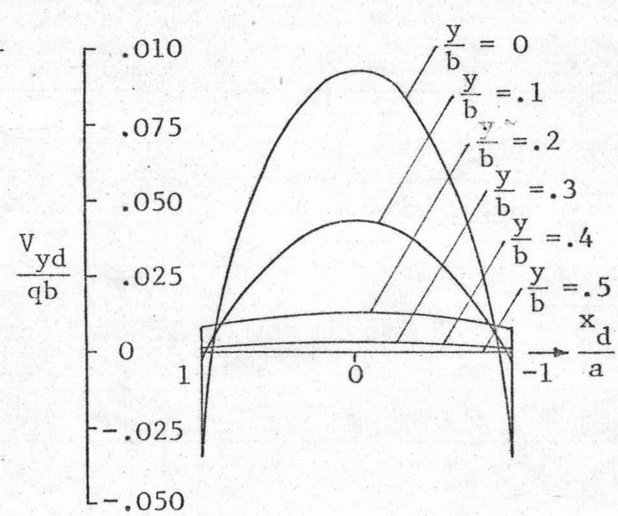
a) Transverse Bending M¼ment, M_{xd}.



b) Longitudinal Bending Moment, M_{yd}.



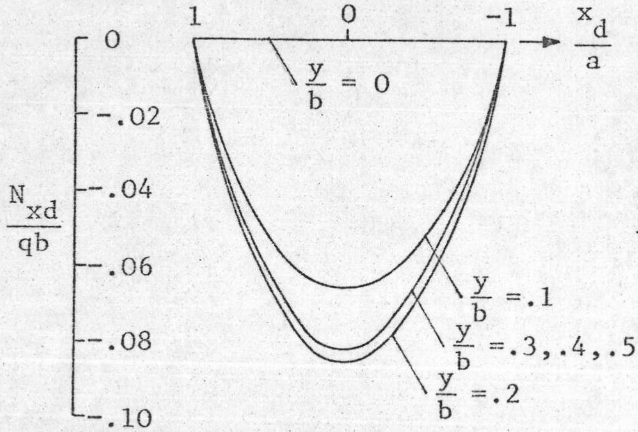
c) Transverse Shearing Force, V_{xd}.



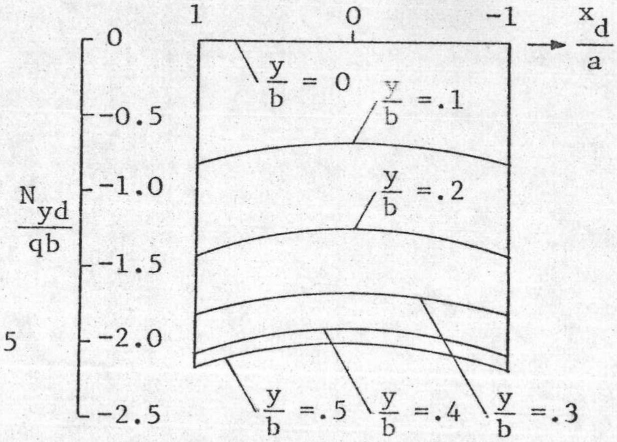
d) Longitudinal Shearing Force, V_{yd}.

Fig. 11 Stress Resultants and Displacements: 2a = 80 cm.,

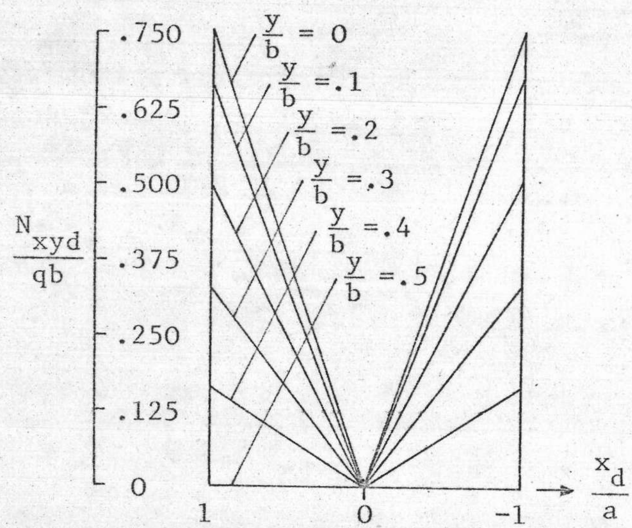
2c = 30 cm., t_d = t_w = 4 cm., b = 400 cm.



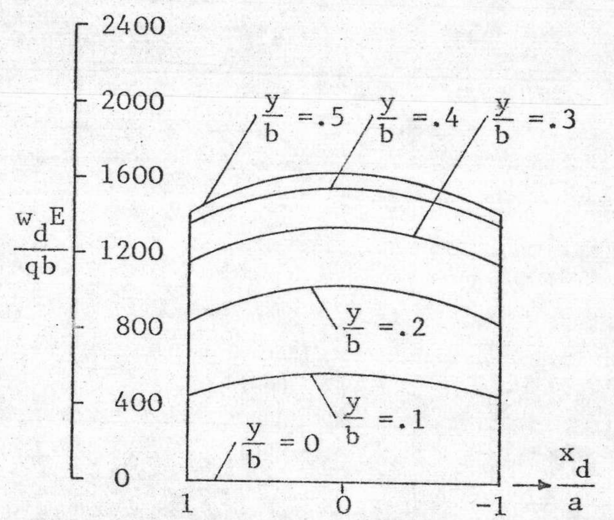
e) Transverse Normal Force, N_{xd}.



f) Longitudinal Normal Force, N_{yd}.



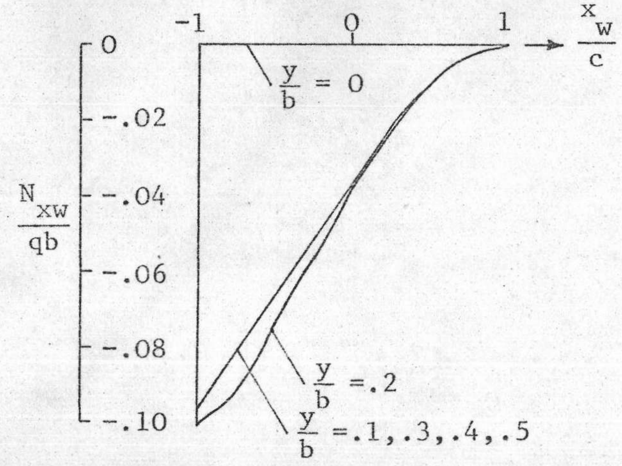
g) Membrane Shearing Force, N_{xyd}.



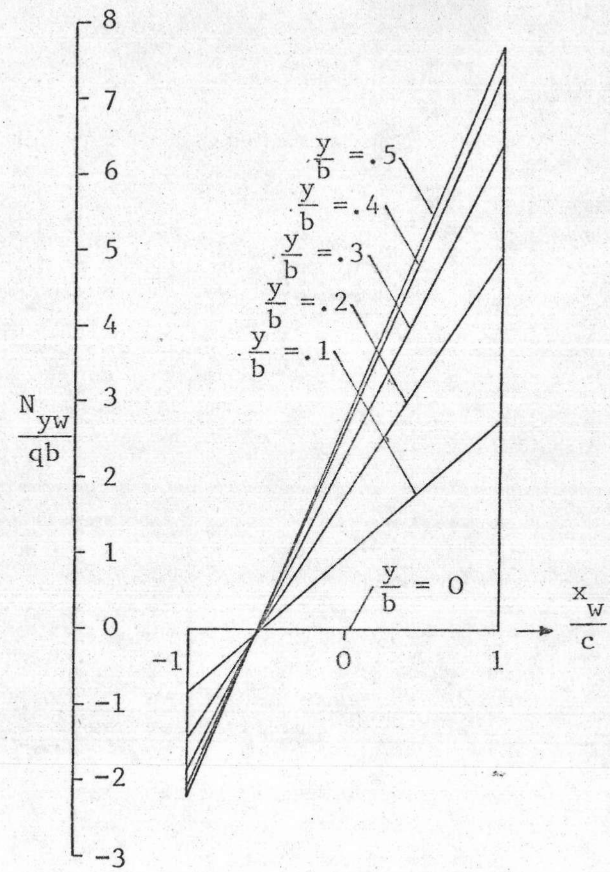
h) Normal Displacements Component, w_d.

Fig.11 Stress Resultants and Displacements: 2a = 80 cm., 2c = 30 cm., $t_d = t_w$ = 4 cm., b = 400 cm.

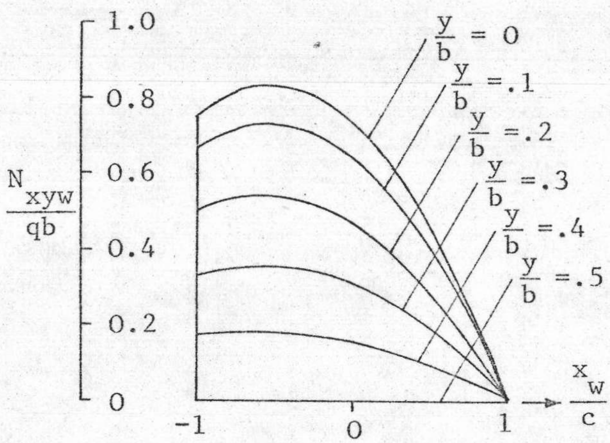
(Continued)



i) Transverse Normal Force, N_{xw}.



j) Longitudinal Normal Force, N_{yw}.

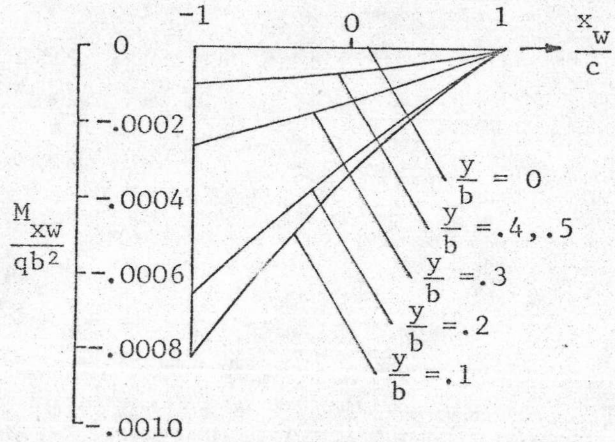


k) Membrane Shearing Force, N_{xyw}.

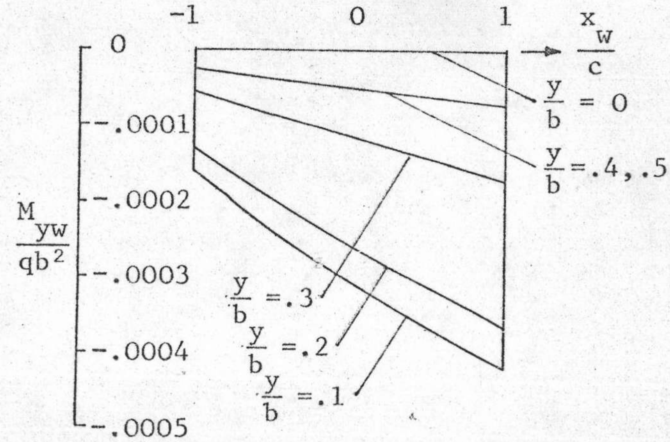
Fig.11 Stress Resultants and Displacements: 2a = 80 cm.,

2c = 30 cm., $t_d = t_w$ = 4 cm., b = 400 cm.

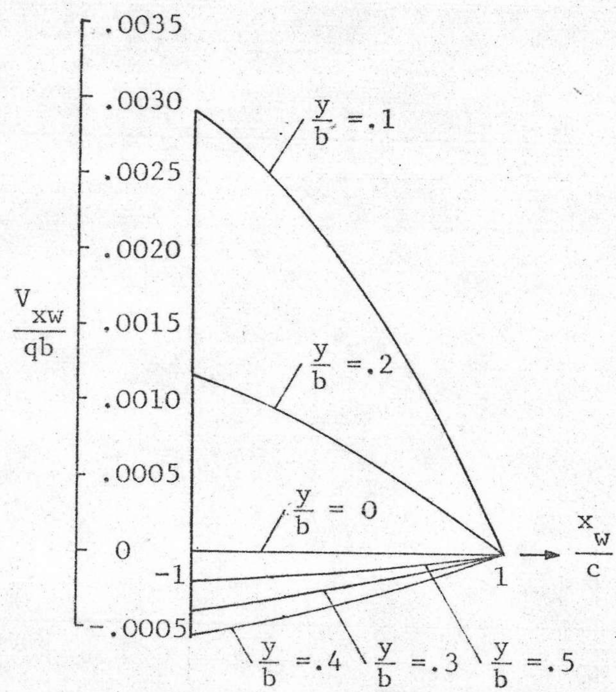
(Continued)



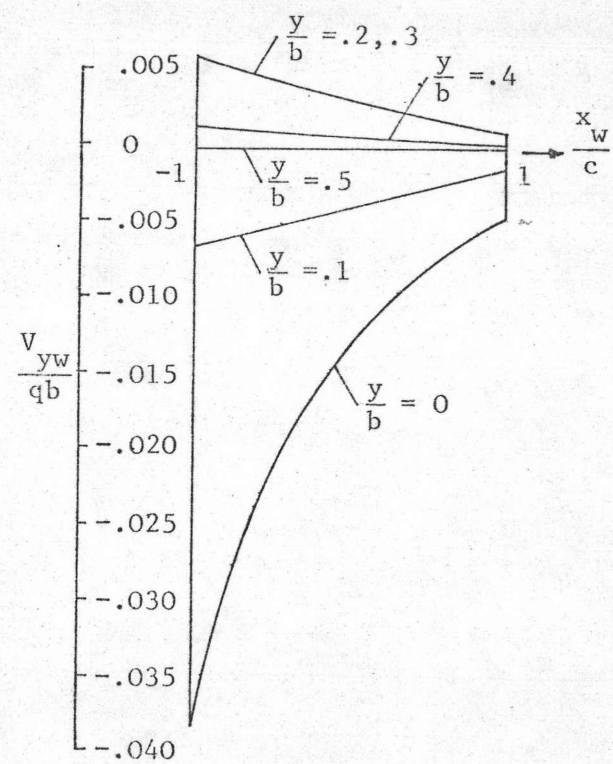
1) Transverse Bending Moment, M_{xw}.



m) Longitudinal Bending Moment, M_{yw}.



n) Transverse Shearing Force, V_{xw}.

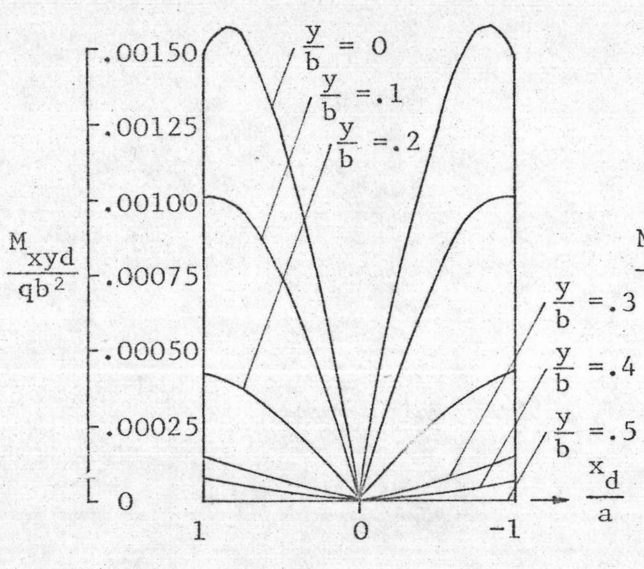


o) Longitudinal Shearing Force, V_{yw}.

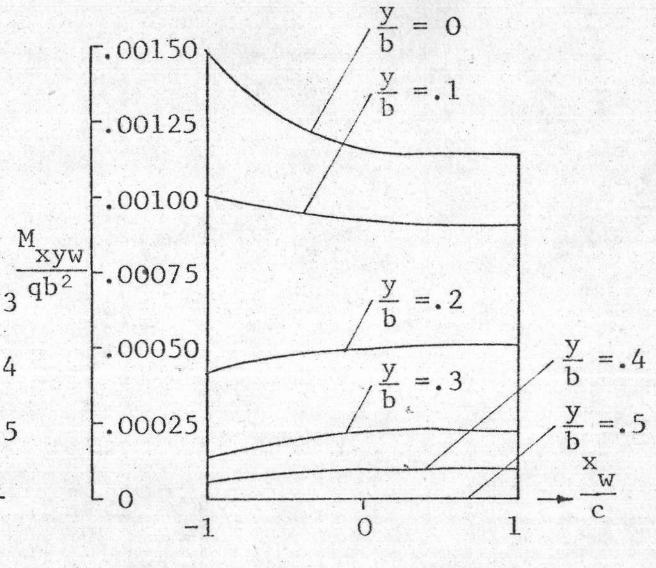
Fig.11 Stress Resultants and Displacements: 2a = 80 cm.,

2c = 30 cm., $t_d = t_w$ = 4 cm., b = 400 cm.

(Continued)



p) Torsional Bending Moment, M_{xyd}.



q) Torsional Bending Moment, M_{xyw}.

Fig.11 Stress Resultants and Displacements: 2a = 80 cm., 2c = 30 cm., $t_d = t_w$ = 4 cm., b = 400 cm.

(Continued)

APPENDIX

APPENDIX

COMPUTER PROGRAM

<u>Main Program</u>

```
C      INVERTED CHANNEL FLOOR UNIT UNDER UNIFORMLY DISTRIBUTED LOAD
C
C      DIMENSIONLESS PARAMETERS INVOLVED ARE
C      1)POISSON'S RATIO               : NU=ANU
C      2)HALF-WIDTH/SPAN RATIO         : A/B=RAB
C      3)HALF-DEPTH/SPAN RATIO         : C/B=RCB
C      4)DECK THICKNESS/SPAN RATIO     : TD/B=RDB
C      5)DECK/WEB THICKNESS RATIO      : TD/TW=RDW
C
C      DETERMINATION OF THE TWEVE CONSTANTS OF INTEGRATION
C
       REAL MXD,MYD,MXYD,MXW,MYW,MXYW,NXD,NYD,NXYD,NXW,NYW,NXYW
       DIMENSION C(12,12),D(12),E(144),A1(100),A2(100),A3(100),A4(100),
     -           B1(100),B2(100),B3(100),B4(100),B5(100),B6(100),B7(100),
     -           B8(100),TU(6,14),TV(6,14),TW(6,14),TMX(6,14),TMY(6,14),
     -           TMXY(6,14),TVX(6,14),TVY(6,14),TTWP(6,14),TNX(6,14),
     -           TNY(6,14),TNXY(6,14),EU(6,14),EV(6,14),EW(6,14),
     -           EMX(6,14),EMY(6,14),EMXY(6,14),EVX(6,14),EVY(6,14),
     -           EWP(6,14),ENX(6,14),ENY(6,14),ENXY(6,14),X(14)
       SINH(X)=(EXP(X)-EXP(-X))/2.
       COSH(X)=(EXP(X)+EXP(-X))/2.
       TANH(X)=(EXP(X)-EXP(-X))/(EXP(X)+EXP(-X))
C
C      GIVEN DATA :
       ANU=0.20
       SPAN=400.
       WIDTH=30.
       DEPTH=15.
       TDECK= 4.
       TWEB = 4.
C
       RAB=WIDTH/SPAN/2.
       RCB=DEPTH/SPAN/2.
       RDB=TDECK/SPAN/
       RDW=TDECK/TWEB
       OPNU=1.+ANU
       OMNU=1.-ANU
       RDB2=RDB**2
       RWD3=(1./RDW)**3
       PI=3.141592653
```

```
C
C     DETERMINATION OF CONSTANTS OF INTEGRATION FOR N=1,3,5,...,199
      DO 999 N=1,200,2
      AN=N
      ANP=AN*PI
      ANP5=ANP**5
      BA=ANP*RAB
      BC=ANP*RCB
      TWP=ANP/(12.*OPNU)
      TWM=ANP/(12.*OMNU)
      TBA=TANH(BA)
      TBC=TANH(BC)
      ATBA=BA*TBA
      CTBC=BC*TBC
C     INITIALIZATION
      DO 115 I=1,12
      DO 115 J=1,12
115   C(I,J)=0.
      DO 222 K=1,12
222   D(K)=0.
C     NON-ZERO COEFFICIENTS : C
      C(1,1)=OMNU*TBC
      C(1,2)=OMNU*BC+2.*TBC
      C(1,3)=OMNU
      C(1,4)=OMNU*CTBC+2.[illegible]
      C(2,1)=OMNU
      C(2,2)=OMNU*CTBC-OPNU
      C(2,3)=C(1,1)
      C(2,4)=OMNU*BC-OPNU*TBC
      C(3,1)=-OMNU*ANP*RWD3
      C(3,2)=-ANP*RWD3*(OMNU*CTBC-OPNU)
      C(3,3)=-C(3,1)*TBC
      C(3,4)=C(2,4)*ANP*RWD3
      C(3,7)=1.
      C(3,8)=ATBA
      C(4,1)=TBC
      C(4,2)=BC
      C(4,3)=-1.
      C(4,4)=-CTBC
      C(4,7)=TWM*RDB2*TBA
      C(4,8)=(TWM*BA-TWP*TBA)*RDB2
      C(5,1)=C(1,1)*RWD3
      C(5,2)=C(1,2)*RWD3
      C(5,3)=-OMNU*RWD3
      C(5,4)=-C(1,4)*RWD3
      C(5,5)=OMNU
      C(5,6)=OMNU*ATBA+2.
      C(6,1)=-1.
      C(6,2)=-CTBC-1.
      C(6,3)=TBC
      C(6,4)=BC+TBC
```

```
      C(6,5)=TBA
      C(6,6)=BA+TBA
      C(7,7)=TBA
      C(7,8)=C(6,6)
      C(7,9)=-1.
      C(7,10)=C(6,2)
      C(7,11)=TBC
      C(7,12)=C(6,4)
      C(8,7)=OPNU
      C(8,8)=OPNU*ATBA+2.
      C(8,9)=OPNU*RDW*TBC
      C(8,10)=RDW*(OPNU*BC+2.*TBC)
      C(8,11)=-OPNU*RDW
      C(8,12)=-RDW*(OPNU*CTBC+2.)
      C(9,5)=OMNU*ANP*TBA
      C(9,6)=ANP*(OMNU*BA-OPNU*TBA)
      C(9,9)=-TBC
      C(9,10)=-BC
      C(9,11)=1.
      C(9,12)=CTBC
      C(10,5)=1.
      C(10,6)=ATBA
      C(10,9)=TWM*RDW*RDB2
      C(10,10)=RDW*RDB2*(TWM*CTBC-TWP)
      C(10,11)=-TWM*RDW*RDB2*TBC
      C(10,12)=-RDW*RDB2*(TWM*BC-TWP*TBC)
      C(11,9)=TBC
      C(11,10)=BC
      C(11,11)=1.
      C(11,12)=CTBC
      C(12,9)=1.
      C(12,10)=-C(6,2)
      C(12,11)=TBC
      C(12,12)=BC+TBC
C     NON-ZERO COEFFICIENTS : D
      D(5)=4.*ANU/ANP5
      D(10)=-4./ANP5
C     REARRANGE COEFFICIENTS COLUMNWISE
      K=1
      DO 333 J=1,12
      DO 333 I=1,12
      E(K)=C(I,J)
      K=K+1
333   CONTINUE
C     SOLVE SIMULTANEOUS EQUATIONS
      MTX=12
      CALL SIMQ(E,D,MTX)
      M=(N+1)/2
C     CONSTANTS OF INTEGRATION OBTAINED ARE
      B1(M)=D(1)
      B2(M)=D(2)
```

```
      B3(M)=D(3)
      B4(M)=D(4)
      A1(M)=D(5)
      A2(M)=D(6)
      A3(M)=D(7)
      A4(M)=D(8)
      B5(M)=D(9)
      B6(M)=D(10)
      B7(M)=D(11)
      B8(M)=D(12)
999   CONTINUE
C
C     DETERMINATION OF DISPLACEMENTS AND STRESS RESULTANTS
C
      RDB3=RDB**3
      RWB=RDB/RDW
      RBW=1./RWB
      RBD=1./RDB
      WWMU=12.*(1.-ANU**2)/RDB3
C     SET INTERVAL OF POINTS TO BE CONSIDERED
      YI=1./10.
      XDI=1./4.
      XWI=1./4.
C     FIRST POINTS
      PY=0.
      JY=1
6     PXD=0.
      JX=1
      PXW=-1.
C
C     DECK PLATE
C     SET INITIAL VALUES
10    TUD=0.
      TVD=0.
      TWD=0.
      TMXD=0.
      TMYD=0.
      TMXYD=0.
      TVXD=0.
      TVYD=0.
      TWDP=0.
      TNXD=0.
      TNYD=0.
      TNXYD=0.
C     SET INDEX VALUES
      KUD=1
      KVD=1
      KWD=1
      KMXD=1
      KMYD=1
      KMXYD=1
```

```
      KVXD=1
      KVYD=1
      KWDP=1
      KNXD=1
      KNYD=1
      KNXYD=1
C     SET SUMMATION INDEX
      N=1
15    M=(N+1)/2
      AN=N
      ANP=AN*PI
      ANP2=ANP**2
      ANP3=ANP**3
      ANP5=ANP**5
      BA=ANP*RAB
      BY=ANP*PY
      BXD=PXD*BA
      SBY=SIN(BY)
      CBY=COS(BY)
      CBA=COSH(BA)
      SBXD=SINH(BXD)
      CBXD=COSH(BXD)
      SXD=SBXD/CBA
      CXD=CBXD/CBA
      BXSXD=BXD*SXD
      BXCXD=BXD*CXD
C     CHECK INDEX VALUE INDICATING WHETHER TO SKIP THIS PART OR NOT
      IF(KUD.EQ.2) GO TO 101
      UD=-RBD*ANP*(A3(M)*OPNU*SXD+A4(M)*(OPNU*BXCXD-OMNU*SXD))*SBY
C     SUMMATION
      TUD=TUD+UD
C     CHECK THAT THE PARTIAL SUM IS NOT ZERO TO AVOID OVERFLOW
      IF(TUD.NE.O.) GO TO 61
      EUD=O.
      GO TO 62
C     THE PERCENTAGE OF THE LAST TERM TO THE PARTIAL SUM
61    EUD=ABS(UD/TUD)*100.
C     CHECK WHETHER THE LAST TERM IS LESS THAN 0.25 PERCENT OF THE
C     PARTIAL SUM AND RESET THE INDEX VALUE
62    IF(EUD.LE.O.25) KUD=2
C     REGISTER THE RESULT AND ERROR
      TU(JY,JX)=TUD
      EU(JY,JX)=EUD
C     REPEAT THE ABOVE PROCEDURE TO OBTAIN OTHER RESULTS
101   IF(KVD.EQ.2) GO TO 102
      VD=-RBD*ANP*(A3(M)*OPNU*CXD+A4(M)*(OPNU*BXSXD+2.*CXD))*CBY
      TVD=TVD+VD
      IF(TVD.NE.O.) GO TO 63
      EVD=O.
      GO TO 64
63    EVD=ABS(VD/TVD)*100.
```

```
64    IF(EVD.LE.0.25) KVD=2
      TV(JY,JX)=TVD
      EV(JY,JX)=EVD
102   IF(KWD.EQ.2) GO TO 103
      WD=WWMU*(4./ANP5+A1(M)*CXD+A2(M)*BXSXD)*SBY
      TWD=TWD+WD
      IF(TWD.NE.0.) GO TO 65
      EWD=0.
      GO TO 66
65    EWD=ABS(WD/TWD)*100.
66    IF(EWD.LE.0.25) KWD=2
      TW(JY,JX)=TWD
      EW(JY,JX)=EWD
103   IF(KMXD.EQ.2) GO TO 104
      MXD=(4.*ANU/ANP3-ANP2*A1(M)*OMNU*CXD-ANP2*A2(M)*(OMNU*BXSXD
     -    +2.*CXD))*SBY
      TMXD=TMXD+MXD
      IF(TMXD.NE.0.) GO TO 67
      EMXD=0.
      GO TO 68
67    EMXD=ABS(MXD/TMXD)*100.
68    IF(EMXD.LE.0.25) KMXD=2
      TMX(JY,JX)=TMXD
      EMX(JY,JX)=EMXD
104   IF(KMYD.EQ.2) GO TO 105
      MYD=(4./ANP3+ANP2*A1(M)*OMNU*CXD+ANP2*A2(M)*(OMNU*BXSXD
     -    -2.*ANU*CXD))*SBY
      TMYD=TMYD+MYD
      IF(TMYD.NE.0.) GO TO 69
      EMYD=0.
      GO TO 70
69    EMYD=ABS(MYD/TMYD)*100.
70    IF(EMYD.LE.0.25) KMYD=2
      TMY(JY,JX)=TMYD
      EMY(JY,JX)=EMYD
105   IF(KMXYD.EQ.2) GO TO 106
      MXYD=-OMNU*ANP2*(A1(M)*SXD+A2(M)*(BXCXD+SXD))*CBY
      TMXYD=TMXYD+MXYD
      IF(TMXYD.NE.0.) GO TO 71
      EMXYD=0.
      GO TO 72
71    EMXYD=ABS(MXYD/TMXYD)*100.
72    IF(EMXYD.LE.0.25) KMXYD=2
      TMXY(JY,JX)=TMXYD
      EMXY(JY,JX)=EMXYD
106   IF(KVXD.EQ.2) GO TO 107
      VXD=ANP3*(A1(M)*OMNU*SXD+A2(M)*(OMNU*BXCXD-OPNU*SXD))*SBY
      TVXD=TVXD+VXD
      IF(TVXD.NE.0.) GO TO 73
      EVXD=0.
      GO TO 74
73    EVXD=ABS(VXD/TVXD)*100.
```

```
74     IF(EVXD.LE.0.25) KVXD=2
       TVX(JY,JX)=TVXD
       EVX(JY,JX)=EVXD
107    IF(KVYD.EQ.2) GO TO 108
       VYD=(4./ANP2-ANP3*A1(M)*OMNU*CXD-ANP3*A2(M)*(OMNU*BXSXD
     -      +2.*(2.-ANU)*CXD))*CBY
       TVYD=TVYD+VYD
       IF(TVYD.NE.0.) GO TO 75
       EVYD=0.
       GO TO 76
75     EVYD=ABS(VYD/TVYD)*100.
76     IF(EVYD.LE.0.25) KVYD=2
       TVY(JY,JX)=TVYD
       EVY(JY,JX)=EVYD
108    IF(KNXD.EQ.2) GO TO 109
       NXD=-ANP2*(A3(M)*CXD+A4(M)*BXSXD)*SBY
       TNXD=TNXD+NXD
       IF(TNXD.NE.0.) GO TO 77
       ENXD=0.
       GO TO 78
77     ENXD=ABS(NXD/TNXD)*100.
78     IF(ENXD.LE.0.25) KNXD=2
       TNX(JY,JX)=TNXD
       ENX(JY,JX)=ENXD
109    IF(KNYD.EQ.2) GO TO 110
       NYD=ANP2*(A3(M)*CXD+A4(M)*(BXSXD+2.*CXD))*SBY
       TNYD=TNYD+NYD
       IF(TNYD.NE.0.) GO TO 79
       ENYD=0.
       GO TO 80
79     ENYD=ABS(NYD/TNYD)*100.
80     IF(ENYD.LE.0.25) KNYD=2
       TNY(JY,JX)=TNYD
       ENY(JY,JX)=ENYD
110    IF(KNXYD.EQ.2) GO TO 111
       NXYD=-ANP2*(A3(M)*SXD+A4(M)*(BXCXD+SXD))*CBY
       TNXYD=TNXYD+NXYD
       IF(TNXYD.NE.0.) GO TO 81
       ENXYD=0.
       GO TO 82
81     ENXYD=ABS(NXYD/TNXYD)*100.
82     IF(ENXYD.LE.0.25) KNXYD=2
       TNXY(JY,JX)=TNXYD
       ENXY(JY,JX)=ENXYD
111    IF(KWDP.EQ.2) GO TO 112
       WDP=WWMU*ANP*A1(M)*SXD+A2(M)*(SXD+BXCXD))*SBY
       TWDP=TWDP+WDP
       IF(TWDP.NE.0.) GO TO 83
       EWDP=0.
       GO TO 84
83     EWDP=ABS(WDP/TWDP)*100.
```

```
84      IF(EWDP.LE.0.25) KWDP=2
        TTWP(JY,JX)=TWDP
        EWP(JY,JX)=EWDP
C       IF THE SUMMATION REACHED 100 TERMS,GO ON TO SOLVE THE NEXT POINT
112     IF(N.EQ.199) GO TO 20
C       THE NEXT SUMMATION INDEX
        N=N+2
C       IF ALL THE LAST TERMS ARE NOT LESS THAN 0.25 PERCENT OF THEIR
C       PARTIAL SUMS,GO BACK TO ADD MORE TERMS
        KKKD=KUD+KVD+KWD+KMXD+KMYD+KMXYD+KVXD+KVYD+KNXD+KNYD+KNXYD+KWDP
        IF(KKKD.LT.24) GO TO 15
C       THE NEXT POINT
20      PXD=PXD+XDI
        JX=JX+1
C       IF ALL REQUIRED POINTS ON DECK PLATE ARE SOLVED,GO ON TO WEB PLATE
        IF(PXD.GT.1.0) GO TO 35
        GO TO 10
C       WEB PLATE
C       SET INITIAL VALUES
35      TUW=0.
        TVW=0.
        TWW=0.
        TMXW=0.
        TMYW=0.
        TMXYW=0.
        TVXW=0.
        TVYW=0.
        TWWP=0.
        TNXW=0.
        TNYW=0.
        TNXYW=0.
C       SET INDEX VALUES
        KUW=1
        KVW=1
        KWW=1
        KMXW=1
        KMYW=1
        KMXYW=1
        KVXW=1
        KVYW=1
        KWWP=1
        KNXW=1
        KNYW=1
        KNXYW=1
C       SET SUMMATION INDEX
        N=1
40      M=(N+1)/2
        AN=N
        ANP=AN*PI
        ANP2=ANP**2
        ANP3=ANP**3
        ANP5=ANP**5
```

```
      BC=ANP*RCB
      BY=ANP*PY
      BXW=PXW*BC
      SBY=SIN(BY)
      CBY=COS(BY)
      CBC=COSH(BC)
      SBXW=SINH(BXW)
      CBXW=COSH(BXW)
      SXW=SBXW/CBC
      CXW=CBXW/CBC
      BXSXW=BXW*SXW
      BXCXW=BXW*CXW
C     CHECK INDEX VALUE INDICATING WHETHER TO SKIP THIS PART OR NOT
      IF(KUW.EQ.2) GO TO 201
      UW=-RBW*ANP*(B5(M)*OPNU*CXW+B6(M)*(OPNU*BXSXW-OMNU*CXW)
     -   +B7(M)*OPNU*SXW+B8(M)*(OPNU*BXCXW-OMNU*SXW))*SBY
C     SUMMATION
      TUW=TUW+UW
C     CHECK THAT THE PARTIAL SUM IS NOT ZERO TO AVOID OVERFLOW
      IF(TUW.NE.O.) GO TO 161
      EUW=O.
      GO TO 162
C     THE PERCENTAGE OF THE LAST TERM TO THE PARTIAL SUM
161   EUW=ABS(UW/TUW)*100.
C     CHECK WHETHER THE LAST TERM IS LESS THAN 0.25 PERCENT OF THE
C     PARTIAL SUM AND RESET THE INDEX VALUE
162   IF(EUW.LE.0.25) KUW=2
C     REGISTER THE RESULT AND ERROR
      TU(JY,JX)=TUW
      EU(JY,JX)=EUW
C     REPEAT THE ABOVE PROCEDURE TO OBTAIN OTHER RESULTS
201   IF(KVW.EQ.2) GO TO 202
      VW=-RBW*ANP*(B5(M)*OPNU*SXW+B6(M)*(OPNU*BXCXW+2.*SXW)
     -   +B7(M)*OPNU*CXW+B8(M)*(OPNU*BXSXW+2.*CXW))*CBY
      TVW=TVW+VW
      IF(TVW.NE.O.) GO TO 163
      EVW=O.
      GO TO 164
163   EVW=ABS(VW/TVW)*100.
164   IF(EVW.LE.0.25) KVW=2
      TV(JY,JX)=TVW
      EV(JY,JX)=EVW
202   IF(KWW.EQ.2) GO TO 203
      WW=WWMU*(B1(M)*SXW+B2(M)*BXCXW+B3(M)*CXW+B4(M)*BXSXW)*SBY
      TWW=TWW+WW
      IF(TWW.NE.O.) GO TO 165
      EWW=O.
      GO TO 166
165   EWW=ABS(WW/TWW)*100.
166   IF(EWW.LE.0.25) KWW=2
      TW(JY,JX)=TWW
      EW(JY,JX)=EWW
```

```
203   IF(KMXW.EQ.2) GO TO 204
      MXW=-RWD3*ANP2*(B1(M)*OMNU*SXW+B2(M)*(OMNU*BXCXW+2.*SXW)
     -     +B3(M)*OMNU*CXW+B4(M)*(OMNU*BXSXW+2.*CXW))*SBY
      TMXW=TMXW+MXW
      IF(TMXW.NE.0.) GO TO 167
      EMXW=0.
      GO TO 168
167   EMXW=ABS(MXW/TMXW)*100.
168   IF(EMXW.LE.0.25) KMXW=2
      TMX(JY,JX)=TMXW
      EMX(JY,JX)=EMXW
204   IF(KMYW.EQ.2) GO TO 205
      MYW=RWD3*ANP2*(B1(M)*OMNU*SXW+B2(M)*(OMNU*BXCXW-2.*ANU*SXW)
     -     +B3(M)*OMNU*CXW+B4(M)*(OMNU*BXSXW-2.*ANU*CXW))*SBY
      TMYW=TMYW+MYW
      IF(TMYW.NE.0.) GO TO 169
      EMYW=0.
      GO TO 170
169   EMYW=ABS(MYW/TMYW)*100.
170   IF(EMYW.LE.0.25) KMYW=2
      TMY(JY,JX)=TMYW
      EMY(JY,JX)=EMYW
205   IF(KMXYW.EQ.2) GO TO 206
      MXYW=-RWD3*OMNU*ANP2*(B1(M)*CXW+B2(M)*(BXSXW+CXW)+B3(M)*SXW
     -     +B4(M)*(BXCXW+SXW))*CBY
      TMXYW=TMXYW+MXYW
      IF(TMXYW.NE.0.) GO TO 171
      EMXYW=0.
      GO TO 172
171   EMXYW=ABS(MXYW/TMXYW)*100.
172   IF(EMXYW.LE.0.25) KMXYW=2
      TMXY(JY,JX)=TMXYW
      EMXY(JY,JX)=EMXYW
206   IF(KVXW.EQ.2) GO TO 207
      VXW=RWD3*ANP3*(B1(M)*OMNU*CXW+B2(M)*(OMNU*BXSXW-OPNU*CXW)
     -     +B3(M)*OMNU*SXW+B4(M)*(OMNU*BXCXW-OPNU*SXW))*SBY
      TVXW=TVXW+VXW
      IF(TVXW.NE.0.) GO TO 173
      EVXW=0.
      GO TO 174
173   EVXW=ABS(VXW/TVXW)*100.
174   IF(EVXW.LE.0.25) KVXW=2
      TVX(JY,JX)=TVXW
      EVX(JY,JX)=EVXW
207   IF(KVYW.EQ.2) GO TO 208
      VYW=-RWD3*ANP3*(B1(M)*OMNU*SXW+B2(M)*(OMNU*BXCXW+2.*(2.-ANU)*SXW)
     -     +B3(M)*OMNU*CXW+B4(M)*(OMNU*BXSXW+2.*(2.-ANU)*CXW))*CBY
      TVYW=TVYW+VYW
      IF(TVYW.NE.0.) GO TO 175
      EVYW=0.
      GO TO 176
175   EVYW=ABS(VYW/TVYW)*100.
```

```
176   IF(EVYW.LE.0.25) KVYW=2
      TVY(JY,JX)=TVYW
      EVY(JY,JX)=EVYW
208   IF(KNXW.EQ.2) GO TO 209
      NXW=-ANP2*(B5(M)*SXW+B6(M)*BXCXW+B7(M)*CXW+B8(M)*BXSXW)*SBY
      TNXW=TNXW+NXW
      IF(TNXW.NE.0.) GO TO 177
      ENXW=0.
      GO TO 178
177   ENXW=ABS(NXW/TNXW)*100.
178   IF(ENXW.LE.0.25) KNXW=2
      TNX(JY,JX)=TNXW
      ENX(JY,JX)=ENXW
209   IF(KNYW.EQ.2) GO TO 210
      NYW=ANP2*(B5(M)*SXW+B6(M)*(BXCXW+2.*SXW)+B7(M)*CXW+B8(M)
     -     *(BXSXW+2.*CXW))*SBY
      TNYW=TNYW+NYW
      IF(TNYW.NE.0.) GO TO 179
      ENYW=0.
      GO TO 180
179   ENYW=ABS(NYW/TNYW)*100.
180   IF(ENYW.LE.0.25) KNYW=2
      TNY(JY,JX)=TNYW
      ENY(JY,JX)=ENYW
210   IF(KNXYW.EQ.2) GO TO 211
      NXYW=-ANP2*(B5(M)*CXW+B6(M)*(BXSXW+CXW)+B7(M)*SXW+B8(M)
     -     *(BXCXW+SXW))*CBY
      TNXYW=TNXYW+NXYW
      IF(TNXYW.NE.0.) GO TO 181
      ENXYW=0.
      GO TO 182
181   ENXYW=ABS(NXYW/TNXYW)*100.
182   IF(ENXYW.LE.0.25) KNXYW=2
      TNXY(JY,JX)=TNXYW
      ENXY(JY,JX)=ENXYW
211   IF(KWWP.EQ.2) GO TO 212
      WWP=WWMU*ANP*(B1(M)*CXW+B2(M)*(CXW+BXSXW)+B3(M)*SXW+B4(M)
     -     *(SXW+BXCXW))*SBY
      TWWP=TWWP+WWP
      IF(TWWP.NE.0.) GO TO 183
      EWWP=0.
      GO TO 184
183   EWWP=ABS(WWP/TWWP)*100.
184   IF(EWWP.LE.0.25) KWWP=2
      TTWP(JY,JX)=TWWP
      EWP(JY,JX)=EWWP
C     IF THE SUMMATION REACHED 100 TERMS?GO ON TO SOLVE THE NEXT POINT
212   IF(N.EQ.199) GO TO 45
C     THE NEXT SUMMATION INDEX
      N=N+2
```

```
C       IF ALL THE LAST TERMS ARE NOT LESS THAN 0.25 PERCENT OF THEIR
C       PARTIAL SUMS,GO BACK TO ADD MORE TERMS
        KKKW=KUW+KVW+KWW+KMXW+KMYW+KMXYW+KVXW+KVYW+KNXW+KNYW+KNXYW+KWWP
        IF(KKKW.LT.24) GO TO 40
C       THE NEXT POINT
45      PXW=PXW+XWI
C       IF ALL REQUIRED POINTS ON WEB PLATE ARE SOLVED,GO ON TO ANOTHER SECTION
        IF(PXW.GT.1.0) GO TO 60
        JX=JX+1
        GO TO 35
C       THE NEXT SECTION
60      PY=PY+YI
C       IF ALL REQUIRED SECTIONS ARE SOLVED,PRINT THE RESULTS
        IF(PY.GT.0.5) GO TO 499
        JY=JY+1
        GO TO 6
C       VALUE OF XD AND XW
        X(1)=0.
        X(2)=0.25
        X(3)=0.50
        X(4)=0.75
        X(5)=1.
        X(6)=-1.
        X(7)=-0.75
        X(8)=-0.50
        X(9)=-0.25
        X(10)=0.
        X(11)=0.25
        X(12)=0.50
        X(13)=0.75
        X(14)=1.
C       WRITE STATEMENTS AND FORMATS
499     WRITE(9,500) WIDTH,DEPTH,TDECK,TWEB,SPAN
        WRITE(9,501)
        WRITE(9,502)
        WRITE(9,526) (X(J),((TU(I,J),EU(I,J)),I=1,6),J=1,5)
        WRITE(9,514)
        WRITE(9,526) (X(J),((TU(I,J),EU(I,J)),I=1,6),J=6,14)
        WRITE(9,500) WIDTH,DEPTH,TDECK,TWEB,SPAN
        WRITE(9,501)
        WRITE(9,503)
        WRITE(9,526) (X(J),((TV(I,J),EV(I,J)),I=1,6),J=1,5)
        WRITE(9,515)
        WRITE(9,526) (X(J),((TV(I,J),EV(I,J)),I=1,6),J=6,14)
        WRITE(9,500) WIDTH,DEPTH,TDECK,TWEB,SPAN
        WRITE(9,501)
        WRITE(9,504)
        WRITE(9,526) (X(J),((TW(I,J),EW(I,J)),I=1,6),J=1,5)
        WRITE(9,516)
        WRITE(9,526) (X(J),((TW(I,J),EW(I,J)),I=1,6),J=6,14)
```

```
WRITE(9,500) WIDTH,DEPTH,TDECK,TWEB,SPAN
WRITE(9,501)
WRITE(9,505)
WRITE(9,526) (X(J),((TMX(I,J),EMX(I,J)),I=1,6),J=1,5)
WRITE(9,517)
WRITE(9,526) (X(J),((TMX(I,J),EMX(I,J)),I=1,6),J=6,14)
WRITE(9,500) WIDTH,DEPTH,TDECK,TWEB,SPAN
WRITE(9,501)
WRITE(9,506)
WRITE(9,526) (X(J),((TMY(I,J),EMY(I,J)),I=1,6),J=1,5)
WRITE(9,518)
WRITE(9,526) (X(J),((TMY(I,J),EMY(I,J)),I=1,6),J=6,14)
WRITE(9,500) WIDTH,DEPTH,TDECK,TWEB,SPAN
WRITE(9,501)
WRITE(9,507)
WRITE(9,526) (X(J),((TMXY(I,J),EMXY(I,J)),I=1,6),J=1,5)
WRITE(9,519)
WRITE(9,526) (X(J),((TMXY(I,J),EMXY(I,J)),I=1,6),J=6,14)
WRITE(9,500) WIDTH,DEPTH,TDECK,TWEB,SPAN
WRITE(9,501)
WRITE(9,508)
WRITE(9,526) (X(J),((TVX(I,J),EVX(I,J)),I=1,6),J=1,5)
WRITE(9,520)
WRITE(9,526) (X(J),((TVX(I,J),EVX(I,J)),I=1,6),J=6,14)
WRITE(9,500) WIDTH,DEPTH,TDECK,TWEB,SPAN
WRITE(9,501)
WRITE(9,509)
WRITE(9,526) (X(J),((TVY(I,J),EVY(I,J)),I=1,6),J=1,5)
WRITE(9,521)
WRITE(9,526) (X(J),((TVY(I,J),EVY(I,J)),I=1,6),J=6,14)
WRITE(9,500) WIDTH,DEPTH,TDECK,TWEB,SPAN
WRITE(9,501)
WRITE(9,510)
WRITE(9,526) (X(J),((TTWP(I,J),EWP(I,J)),I=1,6),J=1,5)
WRITE(9,522)
WRITE(9,526) (X(J),((TTWP(I,J),EWP(I,J)),I=1,6),J=6,14)
WRITE(9,500) WIDTH,DEPTH,TDECK,TWEB,SPAN
WRITE(9,501)
WRITE(9,511)
WRITE(9,526) (X(J),((TNX(I,J),ENX(I,J)),I=1,6),J=1,5)
WRITE(9,523)
WRITE(9,526) (X(J),((TNX(I,J),ENX(I,J)),I=1,6),J=6,14)
WRITE(9,500) WIDTH,DEPTH,TDECK,TWEB,SPAN
WRITE(9,501)
WRITE(9,512)
WRITE(9,526) (X(J),((TNY(I,J),ENY(I,J)),I=1,6),J=1,5)
WRITE(9,524)
WRITE(9,526) (X(J),((TNY(I,J),ENY(I,J)),I=1,6),J=6,14)
WRITE(9,500) WIDTH,DEPTH,TDECK,TWEB,SPAN
WRITE(9,501)
WRITE(9,513)
```

```
      WRITE(9,526) (X(J),((TNXY(I,J),ENXY(I,J)),I=1,6),J=1,5)
      WRITE(9,525)
      WRITE(9,526) (X(J),((TNXY(I,J),ENXY(I,J)),I 1,6),J=6,14)
500   FORMAT(1H1,1X,'WIDTH =',F4.1,' CM',' DEPTH =',F4.1,' CM',' DECK
     -THICKNESS =',F3.1,' CM',' WEB THICKNESS =',F3.1,' CM',' SPAN =',
     -F5.1,' CM')
501   FORMAT(/,6X,'Y',10X,'0.0',17X,'0.1',17X,'0.2',17X,'0.3',17X,'0.4',
     -17X,'0.5')
502   FORMAT(/,2X,'UD'/4X,'XD'//)
503   FORMAT(/,2X,'VD'/4X,'XD'//)
504   FORMAT(/,2X,'WD'/4X,'XD'//)
505   FORMAT(/,2X,'MXD'/4X,'XD'//)
506   FORMAT(/,2X,'MYD'/4X,'XD'//)
507   FORMAT(/,2X,'MXYD'/4X,'XD'//)
508   FORMAT(/,2X,'VXD'/4X,'XD'//)
509   FORMAT(/,2X,'VYD'/4X,'XD'//)
510   FORMAT(/,2X,'WDP'/4X,'XD'//)
511   FORMAT(/,2X,'NXD'/4X,'XD'//)
512   FORMAT(/,2X,'NYD'/4X,'XD'//)
513   FORMAT(/,2X,'NXYD'/4X,'XD'//)
514   FORMAT(///,2X,'UW'/4X,'XW'//)
515   FORMAT(///,2X,'VW'/4X,'XW'//)
516   FORMAT(///,2X,'WW'/4X,'XW'//)
517   FORMAT(///,2X,'MXW'/4X,'XW'//)
518   FORMAT(///,2X,'MYW'/4X,'XW'//)
519   FORMAT(///,2X,'MXYW'/4X,'XW'//)
520   FORMAT(///,2X,'VXW'/4X,'XW'//)
521   FORMAT(///,2X,'VYW'/4X,'XW'//)
522   FORMAT(///,2X,'WWP'/4X,'XW'//)
523   FORMAT(///,2X,'NXW'/4X,'XW'//)
524   FORMAT(///,2X,'NYW'/4X,'XW'//)
525   FORMAT(///,2X,'NXYW'/4X,'XW'//)
526   FORMAT((2X,F5.2,3X,6(E12.5,1X,F5.2,2X))/)
      STOP
      END
```

in which $UD = \frac{u_d E}{qb}$; $VD = \frac{v_d E}{qb}$; $WD = \frac{w_d E}{qb}$; $UW = \frac{u_w E}{qb}$; $VW = \frac{v_w E}{qb}$; $WW = \frac{w_w E}{qb}$;

$MXD = \frac{M_{xd}}{qb^2}$; $MYD = \frac{M_{yd}}{qb^2}$; $MXYD = \frac{M_{xyd}}{qb^2}$; $MXW = \frac{M_{xw}}{qb^2}$; $MYW = \frac{M_{yw}}{qb^2}$; $MXYW = \frac{M_{xyw}}{qb^2}$;

$VXD = \frac{V_{xd}}{qb}$; $VYD = \frac{V_{yd}}{qb}$; $VXW = \frac{V_{xw}}{qb}$; $VYW = \frac{V_{yw}}{qb}$; $WDP = \frac{\partial w_d}{\partial x_d}$; $WWP = \frac{\partial w_w}{\partial x_w}$;

$NXD = \frac{N_{xd}}{qb}$; $NYD = \frac{N_{yd}}{qb}$; $NXYD = \frac{N_{xyd}}{qb}$; $NXW = \frac{N_{xw}}{qb}$; $NYW = \frac{N_{yw}}{qb}$; $NXYW = \frac{N_{xyw}}{qb}$.

Subprogram

```
      SUBROUTINE SIMQ(A,B,N)
6     SUBPROGRAM TO SOLVE SIMULTANEOUS EQUATIONS
      DIMENSION A(1),B(1)
      JJ=-N
      DO 65 J=1,N
      JY=J+1
      JJ=JJ+N+1
      BIGA=0
      IT=JJ-J
      DO 30 I=J,N
      IJ=IT+I
      IF(ABS(BIGA)-ABS(A(IJ))) 20,30,30
20    BIGA=A(IJ)
      IMAX=I
30    CONTINUE
40    I1=J+N*(J-2)
      IT=IMAX-J
      DO 50 K=J,N
      I1=I1+N
      I2=I1+IT
      SAVE=A(I1)
      A(I1)=A(I2)
      A(I2)=SAVE
50    A(I1)=A(I1)/BIGA
      SAVE=B(IMAX)
      B(IMAX)=B(J)
      B(J)=SAVE/BIGA
      IF(J-N) 55,70,55
55    IQS=N*(J-1)
      DO 65 IX=JY,N
      IXJ=IQS+IX
      IT=J-IX
      DO 60 JX=JY,N
      IXJX=N*(JX-1)+IX
      JJX=IXJX+IT
60    A(IXJX)=A(IXJX)-(A(IXJ)*A(JJX))
65    B(IX)=B(IX)-(B(J)*A(IXJ))
70    NY=N-1
      IT=N*N
      DO 80 J=1,NY
      IA=IT-J
      IB=N-J
      IC=N
      DO 80 K=1,J
      B(IB)=B(IB)-A(IA)*B(IC)
      IA=IA-N
80    IC=IC-1
      RETURN
      END
```

VITA

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