



ภาคผนวก

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

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ภาคผนวก ก

โปรแกรมคอมพิวเตอร์คำนวณ
ความเค้นเพิ่มขึ้นแผ่กระจายตามความลึก
สำหรับหาค่าโมดูลัสยืดหยุ่น

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

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```

c      Stress z, SigmaZZ, SigmaYY, SigmaXX
      Implicit Double Precision (A-H, O-Z)
      Integer i, j, Nf
      Dimension P(40), SigmaX(40), SigmaY(40), SigmaZ(40),
      1x(40), y(40), A(40), B(40), Df(40), zp(10)

c      Footing I-7
      DATA A/1.0d0, 2.2d0, 3.5d0, 1.75d0, 1.0d0, 3.5d0, 4.0d0, 3.1d0, 1.5d0,
      11.0d0, 5.0d0, 5.1d0, 1.0d0, 5.4d0, 5.1d0, 1.0d0, 5.0d0, 5.75d0, 4.75d0,
      21.0d0, 5.1d0, 5.1d0, 5.1d0, 5.1d0, 1.75d0, 1.75d0, 4.75d0, 5.1d0, 5.1d0,
      34.5d0, 4.75d0, 4.75d0, 5.5d0, 4.75d0, 4.75d0, 5.1d0, 4.75d0, 4.75d0,
      44.75d0, 4.75d0/
      DATA B/1.0d0, 2.2d0, 3.5d0, 1.75d0, 1.0d0, 3.5d0, 4.0d0, 2.9d0, 2.9d0,
      11.0d0, 7.2d0, 5.1d0, 1.0d0, 7.6d0, 5.1d0, 1.0d0, 7.2d0, 5.75d0, 4.75d0,
      21.0d0, 5.1d0, 5.1d0, 5.1d0, 5.1d0, 1.75d0, 1.75d0, 4.75d0, 8.8d0, 8.8d0,
      38.5d0, 4.75d0, 4.75d0, 11.45d0, 4.75d0, 4.75d0, 5.1d0, 4.75d0, 4.75d0,
      44.75d0, 4.75d0/
      DATA P/3.9470d0, 52.5281d0, 96.3550d0, 37.7731d0, 9.6199d0, 120.4910d0,
      1164.9712d0, 96.3775d0, 104.6952d0, 13.1652d0, 403.7422d0, 303.9215d0,
      212.3859d0, 426.8345d0, 288.7862d0, 13.3310d0, 491.9904d0, 374.0549d0,
      3219.4589d0, 10.2521d0, 267.3566d0, 274.7659d0, 281.0568d0, 376.8159d0,
      47.8310d0, 10.1206d0, 209.1264d0, 445.0620d0, 447.3163d0, 442.0654d0,
      5228.9372d0, 224.6825d0, 607.9054d0, 243.6955d0, 249.9761d0, 255.9878d0,
      6, 252.8969d0, 262.0063d0, 256.8434d0, 234.7853d0/

c      Footing I-7
c      DATA x/28.0d0, 28.0d0, 28.0d0, 28.0d0, 24.0d0, 24.0d0, 24.0d0, 24.0d0,
c      124.0d0, 16.0d0, 16.0d0, 16.0d0, 8.0d0, 8.0d0, 8.0d0, 0.0d0, 0.0d0, 0.0d0,
c      20.0d0, 8.0d0, 8.0d0, 8.0d0, 8.0d0, 8.0d0, 16.0d0, 16.0d0, 16.0d0, 17.6d0,
c      318.15d0, 18.1d0, 20.0d0, 20.0d0, 20.95d0, 28.0d0, 28.0d0, 28.0d0, 28.0d0,
c      428.0d0, 28.0d0, 28.0d0/
c      DATA y/17.7d0, 14.0d0, 7.0d0, 3.0d0, 17.7d0, 14.0d0, 7.0d0, 3.0d0, 0.0d0,
c      117.7d0, 11.3d0, 0.0d0, 17.7d0, 11.55d0, 0.0d0, 17.7d0, 11.3d0, 0.0d0, 7.0d
c      2, 17.7d0, 14.0d0, 7.0d0, 0.0d0, 7.0d0, 28.0d0, 21.0d0, 14.0d0, 7.0d0, 0.0d
c      37.0d0, 14.0d0, 28.0d0, 18.93d0, 28.0d0, 21.0d0, 14.0d0, 7.0d0, 0.0d0, 7.0
c      4, 14.0d0/

c      Footing C-6
c      DATA x/20.0d0, 20.0d0, 20.0d0, 20.0d0, 16.0d0, 16.0d0, 16.0d0, 16.0d0,
c      116.0d0, 8.0d0, 8.0d0, 8.0d0, 0.0d0, 0.0d0, 0.0d0, 8.0d0, 8.0d0, 8.0d0,
c      28.0d0, 16.0d0, 16.0d0, 16.0d0, 16.0d0, 16.0d0, 16.0d0, 24.0d0, 24.0d0,
c      325.8d0, 26.15d0, 26.10d0, 28.0d0, 28.0d0, 28.95d0, 36.0d0, 36.0d0,
c      436.0d0, 36.0d0, 36.0d0, 36.0d0, 36.0d0/
c      DATA y/6.15d0, 2.45d0, 4.55d0, 8.55d0, 6.15d0, 2.45d0, 4.55d0, 8.55d0,
c      111.55d0, 6.15d0, 0.25d0, 11.55d0, 6.15d0, 0.0d0, 11.55d0, 6.15d0, 0.25d0,
c      211.55d0, 18.55d0, 6.15d0, 2.45d0, 4.55d0, 11.55d0, 18.55d0, 16.45d0,
c      39.45d0, 2.45d0, 4.55d0, 11.55d0, 18.55d0, 25.55d0, 16.45d0, 7.38d0,
c      416.45d0, 9.45d0, 2.45d0, 4.55d0, 11.55d0, 18.55d0, 25.55d0/

```

```

DATA x/44.0d0,44.0d0,44.0d0,44.0d0,40.0d0,40.0d0,40.0d0,40.0d0,
140.0d0,32.0d0,32.0d0,32.0d0,24.0d0,24.0d0,24.0d0,16.0d0,16.0d0,
216.0d0,16.0d0,8.0d0,8.0d0,8.0d0,8.0d0,8.0d0,8.0d0,0.0d0,0.0d0,0.0d0,
31.8d0,2.15d0,2.10d0,4.0d0,4.0d0,4.95d0,12.0d0,12.0d0,12.0d0,
412.0d0,12.0d0,12.0d0,12.0d0/
DATA y/3.7d0,0.0d0,7.0d0,11.0d0,3.7d0,0.0d0,7.0d0,11.0d0,14.0d0,
13.7d0,2.7d0,14.0d0,3.7d0,2.45d0,14.0d0,3.7d0,2.7d0,14.0d0,21.0d0,
23.7d0,0.0d0,7.0d0,14.0d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0,14.0d0,
321.0d0,28.0d0,14.0d0,4.93d0,14.0d0,7.0d0,0.0d0,7.0d0,14.0d0,
421.0d0,28.0d0/

c      Footing C-10
c      DATA x/48.95d0,48.95d0,48.95d0,48.95d0,44.95d0,44.95d0,44.95d
0,
c      144.95d0,44.95d0,36.95d0,36.95d0,36.95d0,28.95d0,28.95d0,28.95d0,
c      220.95d0,20.95d0,20.95d0,20.95d0,12.95d0,12.95d0,12.95d0,12.95d0,
c      312.95d0,4.95d0,4.95d0,4.95d0,3.15d0,2.80d0,2.85d0,0.95d0,0.95d0,
c      40.00d0,7.05d0,7.05d0,7.05d0,7.05d0,7.05d0,7.05d0,7.05d0/
c      DATA y/1.23d0,4.93d0,11.93d0,15.93d0,1.23d0,4.93d0,11.93d0,
c      115.93d0,18.93d0,1.23d0,7.63d0,18.93d0,1.23d0,7.38d0,18.93d0,
c      21.23d0,7.63d0,18.93d0,25.92d0,1.23d0,4.93d0,11.93d0,18.93d0,
c      325.93d0,9.08d0,2.08d0,4.93d0,11.93d0,18.93d0,25.93d0,12.93d0,
c      49.08d0,0.00d0,9.08d0,2.08d0,4.93d0,11.93d0,18.93d0,25.93d0,
c      532.93d0/

c      Footing G-10
c      DATA x/45.8d0,45.8d0,45.8d0,45.8d0,41.8d0,41.8d0,41.8d0,41.8d0,
c      141.8d0,33.8d0,33.8d0,33.8d0,25.8d0,25.8d0,25.8d0,17.8d0,17.8d0,
c      217.8d0,17.8d0,9.8d0,9.8d0,9.8d0,9.8d0,9.8d0,1.8d0,1.8d0,1.8d0,
c      30.0d0,0.35d0,0.30d0,2.2d0,2.2d0,3.15d0,10.2d0,10.2d0,10.2d0,
c      410.2d0,10.2d0,10.2d0,10.2d0/
c      DATA y/10.7d0,7.0d0,0.0d0,4.0d0,10.7d0,7.0d0,0.0d0,4.0d0,7.0d0,
c      110.7d0,4.3d0,7.0d0,10.7d0,4.55d0,7.0d0,10.7d0,4.3d0,7.0d0,14.0d0,
c      210.7d0,7.0d0,0.0d0,7.0d0,14.0d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0,
c      314.0d0,21.0d0,21.0d0,11.93d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0,
c      414.0d0,21.0d0/

c      Footing I-10
c      DATA x/46.15d0,46.15d0,46.15d0,46.15d0,42.15d0,42.15d0,42.15d0,
142.15d0,42.15d0,34.15d0,34.15d0,34.15d0,26.15d0,26.15d0,26.15d0,
218.15d0,18.15d0,18.15d0,18.15d0,10.15d0,10.15d0,10.15d0,10.15d0,
310.15d0,2.15d0,2.15d0,2.15d0,0.35d0,0.0d0,0.05d0,1.85d0,1.85d0,
42.8d0,9.85d0,9.85d0,9.85d0,9.85d0,9.85d0,9.85d0,9.85d0/
c      DATA y/17.7d0,14.0d0,7.0d0,3.0d0,17.7d0,14.0d0,7.0d0,3.0d0,0.0d0,
117.7d0,11.3d0,0.0d0,17.7d0,11.55d0,0.0d0,17.7d0,11.3d0,0.0d0,
27.0d0,17.7d0,14.0d0,7.0d0,0.0d0,7.0d0,28.0d0,21.0d0,14.0d0,7.0d0,
30.0d0,7.0d0,14.0d0,28.0d0,18.93d0,28.0d0,21.0d0,14.0d0,7.0d0,
40.0d0,7.0d0,14.0d0/

DATA Df/1.25d0,2.0d0,2.5d0,1.85d0,1.3d0,2.5d0,2.43d0,2.0d0,2.0d0,
11.2d0,2.8d0,2.5d0,1.13d0,2.8d0,2.5d0,1.17d0,2.75d0,2.3d0,2.15d0,
21.3d0, 2.0d0,2.0d0,2.2d0,2.0d0,2.44d0,2.37d0,2.4d0,2.4d0,2.40d0,

32.44d0,2.0d0,2.44d0,2.4d0,3.83d0,3.6d0,3.5d0,2.0d0,2.17d0,2.0d0,

```



```
DATA zp/1.25d0,2.75d0,4.25d0,5.75d0,6.95d0,8.35d0,9.85d0,11.35d0,
112.85d0,14.35d0/
```

```
Open (1,File='stress.dat',status='unknown',Access='Append')
Write(1,*) 'Footing I-10'
Write(1,*) 'Z SigmaZ'
Nf=40
```

```
zp=2.5d0
```

```
Pi=3.14159265d0
```

```
Do j=1,10
```

```
SigmaZZ=0.0d0
```

```
SigmaYY=0.0d0
```

```
SigmaXX=0.0d0
```

```
Do i=1,Nf
```

```
z=zp(j)-Df(i)
```

```
If ( z .LE. 0.0d0 ) then
```

```
SigmaZ(i)=0.0d0
```

```
Else
```

```
aa=A(i)/2.0d0
```

```
bb=B(i)/2.0d0
```

```
pL=P(i)/(A(i)*B(i))
```

```
x1=x(i)+aa
```

```
x2=x(i)-aa
```

```
y1=y(i)+bb
```

```
y2=y(i)-bb
```

```
x1z=x1*x1+z*z
```

```
x2z=x2*x2+z*z
```

```
y1z=y1*y1+z*z
```

```
y2z=y2*y2+z*z
```

```
x1y1z=Dsqrt(x1*x1+y1*y1+z*z)
```

```
x2y1z=Dsqrt(x2*x2+y1*y1+z*z)
```

```
x1y2z=Dsqrt(x1*x1+y2*y2+z*z)
```

```
x2y2z=Dsqrt(x2*x2+y2*y2+z*z)
```

```
SigmaZ(i)=pL/(2.0d0*Pi)*
```

```
1*(Datan(x1*y1/z/x1y1z)+x1*y1*z*(1.0d0/x1z+1.0d0/y1z:/x1y1z)
```

```
2-(Datan(x2*y1/z/x2y1z)+x2*y1*z*(1.0d0/x2z+1.0d0/y1z:/x2y1z)
```

```
3-(Datan(x1*y2/z/x1y2z)+x1*y2*z*(1.0d0/x1z+1.0d0/y2z:/x1y2z)
```

```
4+(Datan(x2*y2/z/x2y2z)+x2*y2*z*(1.0d0/x2z+1.0d0/y2z:/x2y2z))
```

```
SigmaZZ=SigmaZZ+SigmaZ(i)
```

```

SigmaY(i)=pL/(2.0d0*Pi)*
1*(Datan(x1*y1/z/x1y1z)-x1*y1*z*(1.0d0/y1z)/x1y1z)
2-(Datan(x2*y1/z/x2y1z)-x2*y1*z*(1.0d0/y1z)/x2y1z)
3-(Datan(x1*y2/z/x1y2z)-x1*y2*z*(1.0d0/y2z)/x1y2z)
4+(Datan(x2*y2/z/x2y2z)-x2*y2*z*(1.0d0/y2z)/x2y2z)
SigmaYY=SigmaYY+SigmaY(i)

SigmaX(i)=pL/(2.0d0*Pi)*
1*(Datan(x1*y1/z/x1y1z)-x1*y1*z*(1.0d0/x1z)/x1y1z)
2-(Datan(x2*y1/z/x2y1z)-x2*y1*z*(1.0d0/x2z)/x2y1z)
3-(Datan(x1*y2/z/x1y2z)-x1*y2*z*(1.0d0/x1z)/x1y2z)
4+(Datan(x2*y2/z/x2y2z)-x2*y2*z*(1.0d0/x2z)/x2y2z)
End if
SigmaXX=SigmaXX+SigmaX(i)

End Do

print*,zp(j),SigmaZZ
Write(1,*) zp(j),SigmaZZ
End Do

Close(1)
End

```

Footing I-7

Z	SigmaZ
1.2500000000000000	5.689645336163760E-009
2.7500000000000000	11.286384538348720
4.2500000000000000	9.877355524821356
5.6500000000000000	7.662144138432830
6.9500000000000000	6.158387826613088
8.3500000000000000	5.190033381475854
9.8500000000000000	4.590411085952887
11.3500000000000000	4.212054012164240
12.8500000000000000	3.937584277283261
14.3500000000000000	3.714437753791417

Footing C-6

Z	SigmaZ
1.2500000000000000	1.231789669088059E-006
2.7500000000000000	3.143533053042605E-003
4.2500000000000000	9.848507894280131
5.6500000000000000	8.100456658264678
6.9500000000000000	6.553610039959530
8.3500000000000000	5.403689187653263
9.8500000000000000	4.622733847054921
11.3500000000000000	4.108618681702960
12.8500000000000000	3.738599616185783
14.3500000000000000	3.450270837891421

Footing C-10

Z	SigmaZ
1.2500000000000000	1.314733152301219E-009
2.7500000000000000	9.645386666776885
4.2500000000000000	8.893607512260175
5.6500000000000000	7.523948228051339
6.9500000000000000	6.473755514370377
8.3500000000000000	5.682268954781194
9.8500000000000000	5.081371610179495
11.3500000000000000	4.619156537591652
12.8500000000000000	4.236401591274198
14.3500000000000000	3.906605087968558

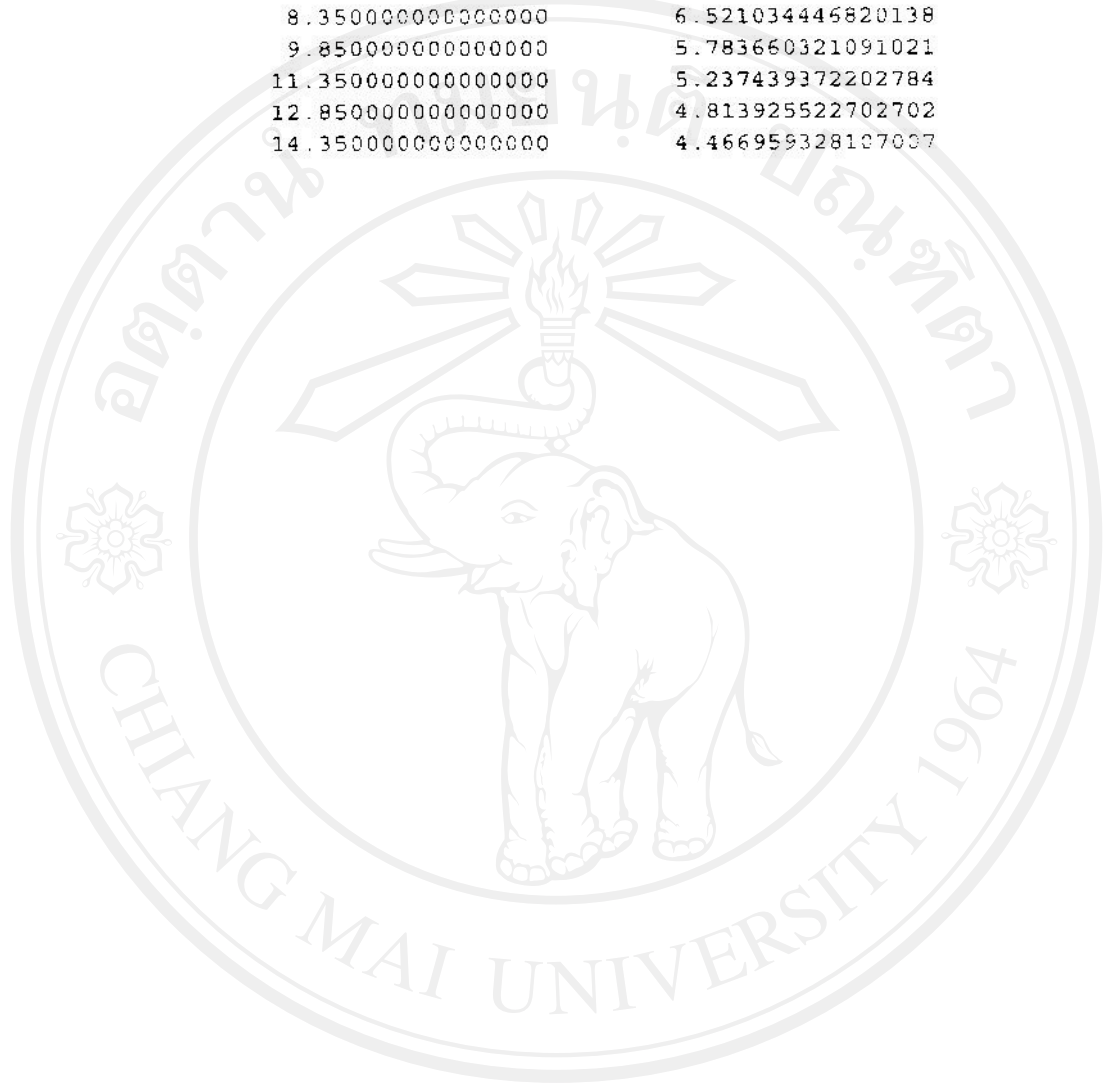
Footing G-10

Z	SigmaZ
1.2500000000000000	1.461424255754481E-009
2.7500000000000000	9.911130453568129
4.2500000000000000	9.247222434668604
5.6500000000000000	7.964713768445382
6.9500000000000000	6.898056255464864
8.3500000000000000	6.068592211331172
9.8500000000000000	5.468108718119808
11.3500000000000000	5.046877359435796
12.8500000000000000	4.721777393468124
14.3500000000000000	4.447070983697006

Footing I-10

Z	SigmaZ
1.2500000000000000	6.468604266115845E-010
2.7500000000000000	9.962853454835758
4.2500000000000000	9.504350162443899

5.6500000000000000	8.470568560188793
6.9500000000000000	7.441117744473996
8.3500000000000000	6.521034446820138
9.8500000000000000	5.783660321091021
11.3500000000000000	5.237439372202784
12.8500000000000000	4.813925522702702
14.3500000000000000	4.466959328107007



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

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โปรแกรมคอมพิวเตอร์คำนวณ
ความเค้นเพิ่มขึ้นแผ่กระจายตามความลึก
สำหรับหาค่าความเครียดในแนวแกน

```

Stress (z,SigmaZZ,SigmaYY,SigmaXX)
Implicit Double Precision (A-H,C-Z)
Integer i,j,Nf
Dimension P(40),SigmaX(40),SigmaY(40),SigmaZ(40),
1x(40),y(40),A(40),B(40),Df(40),zp(10)

```

Footing I-7

```

DATA A/1.0d0,2.2d0,3.5d0,1.75d0,1.0d0,3.5d0,4.0d0,3.5d0,3.5d0,
11.0d0,5.0d0,5.1d0,1.0d0,5.4d0,5.1d0,1.0d0,5.0d0,5.75d0,4.75d0,
21.0d0,5.1d0,5.1d0,5.1d0,5.1d0,1.75d0,1.75d0,4.75d0,5.1d0,5.1d0,
34.5d0,4.75d0,4.75d0,5.5d0,4.75d0,4.75d0,5.1d0,4.75d0,4.75d0,
44.75d0,4.75d0/
DATA B/1.0d0,2.2d0,3.5d0,1.75d0,1.0d0,3.5d0,4.0d0,2.9d0,2.9d0,
11.0d0,7.2d0,5.1d0,1.0d0,7.6d0,5.1d0,1.0d0,7.2d0,5.75d0,4.75d0,
21.0d0,5.1d0,5.1d0,5.1d0,5.1d0,1.75d0,1.75d0,4.75d0,8.8d0,8.8d0,
38.5d0,4.75d0,4.75d0,11.45d0,4.75d0,4.75d0,5.1d0,4.75d0,4.75d0,
44.75d0,4.75d0/
DATA P/3.9470d0,52.5281d0,96.3550d0,37.7731d0,9.6199d0,120.4910d0
1164.9712d0,96.3775d0,104.6952d0,13.1652d0,403.7422d0,303.9115d0,
212.3859d0,426.8345d0,288.7862d0,13.3310d0,491.9904d0,374.0549d0,
3219.4589d0,10.2521d0,267.3566d0,274.7659d0,281.0568d0,276.6199d0,
47.8310d0,10.1206d0,209.1264d0,445.0620d0,447.3163d0,422.0654d0,
5228.9372d0,224.6825d0,607.9054d0,243.6955d0,249.9761d0,255.9878d0,
6,252.8969d0,262.0063d0,256.8434d0,234.7853d0/

```

Footing I-7

```

DATA x/28.0d0,28.0d0,28.0d0,28.0d0,24.0d0,24.0d0,24.0d0,24.0d0,
124.0d0,16.0d0,16.0d0,16.0d0,8.0d0,8.0d0,8.0d0,0.0d0,0.0d0,0.0d0,
20.0d0,8.0d0,8.0d0,8.0d0,8.0d0,8.0d0,16.0d0,16.0d0,16.0d0,17.8d0,
318.15d0,18.1d0,20.0d0,20.0d0,20.95d0,28.0d0,28.0d0,28.0d0,28.0d0
428.0d0,28.0d0,28.0d0/
DATA y/17.7d0,14.0d0,7.0d0,3.0d0,17.7d0,14.0d0,7.0d0,3.0d0,0.0d0,
117.7d0,11.3d0,0.0d0,17.7d0,11.55d0,0.0d0,17.7d0,11.3d0,0.0d0,7.0d
2,17.7d0,14.0d0,7.0d0,0.0d0,7.0d0,28.0d0,21.0d0,14.0d0,7.0d0,0.0d
37.0d0,14.0d0,28.0d0,18.93d0,28.0d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0
4,14.0d0/

```

Footing C-6

```

DATA x/20.0d0,20.0d0,20.0d0,20.0d0,16.0d0,16.0d0,16.0d0,16.0d0,
116.0d0,8.0d0,8.0d0,8.0d0,0.0d0,0.0d0,0.0d0,8.0d0,8.0d0,8.0d0,
28.0d0,16.0d0,16.0d0,16.0d0,16.0d0,16.0d0,24.0d0,24.0d0,24.0d0,
325.8d0,26.15d0,26.10d0,28.0d0,28.0d0,28.95d0,36.0d0,36.0d0,
436.0d0,36.0d0,36.0d0,36.0d0,36.0d0/
DATA y/6.15d0,2.45d0,4.55d0,8.55d0,6.15d0,2.45d0,4.55d0,8.55d0,
111.55d0,6.15d0,0.25d0,11.55d0,6.15d0,0.0d0,11.55d0,6.15d0,0.25d0,
211.55d0,18.55d0,6.15d0,2.45d0,4.55d0,11.55d0,18.55d0,16.45d0,
39.45d0,2.45d0,4.55d0,11.55d0,18.55d0,25.55d0,16.45d0,7.38d0,
416.45d0,9.45d0,2.45d0,4.55d0,11.55d0,18.55d0,25.55d0/

```

DATA x/44.0d0,44.0d0,44.0d0,44.0d0,40.0d0,40.0d0,40.0d0,40.0d0,
 140.0d0,32.0d0,32.0d0,32.0d0,24.0d0,24.0d0,24.0d0,16.0d0,16.0d0,
 216.0d0,16.0d0,8.0d0,8.0d0,8.0d0,8.0d0,8.0d0,8.0d0,0.0d0,0.0d0,0.0d0,
 31.8d0,2.15d0,2.10d0,4.0d0,4.0d0,4.95d0,12.0d0,12.0d0,12.0d0,
 412.0d0,12.0d0,12.0d0,12.0d0/
 DATA y/3.7d0,0.0d0,7.0d0,11.0d0,3.7d0,0.0d0,7.0d0,11.0d0,14.0d0,
 13.7d0,2.7d0,14.0d0,3.7d0,2.45d0,14.0d0,3.7d0,2.7d0,14.0d0,21.0d0,
 23.7d0,0.0d0,7.0d0,14.0d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0,14.0d0,
 321.0d0,28.0d0,14.0d0,4.93d0,14.0d0,7.0d0,0.0d0,7.0d0,14.0d0,
 421.0d0,28.0d0/

Footing C-10

DATA x/48.95d0,48.95d0,48.95d0,48.95d0,44.95d0,44.95d0,44.95d0,
 144.95d0,44.95d0,36.95d0,36.95d0,36.95d0,28.95d0,28.95d0,28.95d0,
 220.95d0,20.95d0,20.95d0,20.95d0,12.95d0,12.95d0,12.95d0,12.95d0,
 312.95d0,4.95d0,4.95d0,4.95d0,3.15d0,2.80d0,2.85d0,0.95d0,0.95d0,
 40.00d0,7.05d0,7.05d0,7.05d0,7.05d0,7.05d0,7.05d0,7.05d0/
 DATA y/1.23d0,4.93d0,11.93d0,15.93d0,1.23d0,4.93d0,11.93d0,
 115.93d0,18.93d0,1.23d0,7.63d0,18.93d0,1.23d0,7.38d0,18.93d0,
 21.23d0,7.63d0,18.93d0,25.92d0,1.23d0,4.93d0,11.93d0,18.93d0,
 325.93d0,9.08d0,2.08d0,4.93d0,11.93d0,18.93d0,25.93d0,32.93d0,
 49.08d0,0.00d0,9.08d0,2.08d0,4.93d0,11.93d0,18.93d0,25.93d0,
 532.93d0/

Footing G-10

DATA x/45.8d0,45.8d0,45.8d0,45.8d0,41.8d0,41.8d0,41.8d0,41.8d0,
 141.8d0,33.8d0,33.8d0,33.8d0,25.8d0,25.8d0,25.8d0,17.8d0,17.8d0,
 217.8d0,17.8d0,9.8d0,9.8d0,9.8d0,9.8d0,9.8d0,1.8d0,1.8d0,1.8d0,
 30.0d0,0.35d0,0.30d0,2.2d0,2.2d0,3.15d0,10.2d0,10.2d0,10.2d0,
 410.2d0,10.2d0,10.2d0,10.2d0/
 DATA y/10.7d0,7.0d0,0.0d0,4.0d0,10.7d0,7.0d0,0.0d0,4.0d0,7.0d0,
 110.7d0,4.3d0,7.0d0,10.7d0,4.55d0,7.0d0,10.7d0,4.3d0,7.0d0,14.0d0,
 210.7d0,7.0d0,0.0d0,7.0d0,14.0d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0,
 314.0d0,21.0d0,21.0d0,11.93d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0,
 414.0d0,21.0d0/

Footing I-10

DATA x/46.15d0,46.15d0,46.15d0,46.15d0,42.15d0,42.15d0,42.15d0,
 142.15d0,42.15d0,34.15d0,34.15d0,34.15d0,26.15d0,26.15d0,26.15d0,
 218.15d0,18.15d0,18.15d0,18.15d0,10.15d0,10.15d0,10.15d0,10.15d0,
 310.15d0,2.15d0,2.15d0,2.15d0,0.35d0,0.0d0,0.05d0,1.85d0,1.85d0,
 42.8d0,9.85d0,9.85d0,9.85d0,9.85d0,9.85d0,9.85d0,9.85d0/
 DATA y/17.7d0,14.0d0,7.0d0,3.0d0,17.7d0,14.0d0,7.0d0,3.0d0,0.0d0,
 117.7d0,11.3d0,0.0d0,17.7d0,11.55d0,0.0d0,17.7d0,11.3d0,0.0d0,
 27.0d0,17.7d0,14.0d0,7.0d0,0.0d0,7.0d0,28.0d0,21.0d0,14.0d0,7.0d0,
 30.0d0,7.0d0,14.0d0,28.0d0,18.93d0,28.0d0,21.0d0,14.0d0,7.0d0,
 40.0d0,7.0d0,14.0d0/

DATA Df/1.25d0,2.0d0,2.5d0,1.85d0,1.3d0,2.5d0,2.43d0,2.0d0,2.0d0,
 11.2d0,2.8d0,2.5d0,1.13d0,2.8d0,2.5d0,1.17d0,2.75d0,2.3d0,2.15d0,
 21.3d0,2.0d0,2.0d0,2.2d0,2.0d0,2.44d0,2.37d0,2.4d0,2.4d0,2.4d0,
 32.44d0,2.0d0,2.44d0,2.4d0,3.83d0,3.6d0,3.5d0,2.0d0,2.17d0,2.0d0,

```
DATA zp/2.450d0,3.215d0,4.645d0,6.075d0,7.505d0,8.935d0,10.36
111.830d0,13.330d0,14.830d0/
```

```
Open f1,File='stressla.dat',status='unknown',Access='Append',
Write(f1,*, 'Footing I-10'
Write(f1,*, '                                Z          SigmaZ'
Nf=40
```

```
zp=2.5d0
```

```
Pi=3.14159265d0
```

```
Do j=1,10
```

```
SigmaZZ=0.0d0
```

```
SigmaYY=0.0d0
```

```
SigmaXX=0.0d0
```

```
Do i=1,Nf
```

```
z=zp(j)-Df(i)
```

```
If ( z .LE. 0.0d0 ) then
```

```
SigmaZ(i)=0.0d0
```

```
Else
```

```
aa=A(i)/2.0d0
```

```
bb=B(i)/2.0d0
```

```
if ( i .NE. 29 ) then
```

```
P(i)=0.0d0
```

```
end if
```

```
pL=P(i)/(A(i)*B(i))
```

```
x1=x(i)+aa
```

```
x2=x(i)-aa
```

```
y1=y(i)+bb
```

```
y2=y(i)-bb
```

```
x1z=x1*x1+z*z
```

```
x2z=x2*x2+z*z
```

```
y1z=y1*y1+z*z
```

```
y2z=y2*y2+z*z
```

```
x1y1z=Dsqrt(x1*x1+y1*y1+z*z)
```

```
x2y1z=Dsqrt(x2*x2+y1*y1+z*z)
```

```
x1y2z=Dsqrt(x1*x1+y2*y2+z*z)
```

```
x2y2z=Dsqrt(x2*x2+y2*y2+z*z)
```

```
SigmaZ(i)=pL/(2.0d0*Pi)*;
```

```
1-(Datan(x1*y1/z/x1y1z)+x1*y1*z*(1.0d0/x1z+1.0d0/y1z)/x1y1z)
```

```
2-(Datan(x2*y1/z/x2y1z)+x2*y1*z*(1.0d0/x2z+1.0d0/y1z)/x2y1z)
```

```
3-(Datan(x1*y2/z/x1y2z)+x1*y2*z*(1.0d0/x1z+1.0d0/y2z)/x1y2z)
```



```

4+ (Datan(x2*y2/z/x2y2z)-x2*y2*z*(1.0d0/x2z+1.0d0/y2z)
SigmaZZ=SigmaZZ+SigmaZ(i)

```

```

SigmaY(i)=pL/(2.0d0*Pi)*(
1 (Datan(x1*y1/z/x1y1z)-x1*y1*z*(1.0d0/y1z)/x1y1z)
2- (Datan(x2*y1/z/x2y1z)-x2*y1*z*(1.0d0/y1z)/x2y1z)
3- (Datan(x1*y2/z/x1y2z)-x1*y2*z*(1.0d0/y2z)/x1y2z)
4+ (Datan(x2*y2/z/x2y2z)-x2*y2*z*(1.0d0/y2z)/x2y2z)
SigmaYY=SigmaYY+SigmaY(i)

```

```

SigmaX(i)=pL/(2.0d0*Pi)*(
1 (Datan(x1*y1/z/x1y1z)-x1*y1*z*(1.0d0/x1z)/x1y1z)
2- (Datan(x2*y1/z/x2y1z)-x2*y1*z*(1.0d0/x2z)/x2y1z)
3- (Datan(x1*y2/z/x1y2z)-x1*y2*z*(1.0d0/x1z)/x1y2z)
4+ (Datan(x2*y2/z/x2y2z)-x2*y2*z*(1.0d0/x2z)/x2y2z)
End if
SigmaXX=SigmaXX+SigmaX(i)

```

```

End Do

```

```

print*,zp(j),SigmaZZ
Write(1,*) zp(j),SigmaZZ
End Do

```

```

Close(1)
End

```


Footing I-7

Z	SigmaZ
2.4000000000000000	11.313604209983910
3.2150000000000000	11.096629146978730
4.6450000000000000	9.239694052260997
6.0750000000000000	7.094718071677445
7.5050000000000000	5.709010776834770
8.9350000000000001	4.917975491336733
10.3650000000000000	4.443420629441317
11.8350000000000000	4.115351986584021
13.3300000000000000	3.862086145483043
14.8300000000000000	3.649622290812873

Footing C-6

Z	SigmaZ
3.4650000000000000	10.340811310567100
4.7950000000000000	9.235926966014224
6.1250000000000000	7.486518189445828
6.8400000000000000	6.666696934904248
8.2700000000000000	5.456478724937495
9.6999999999999999	4.686076176587465
11.1750000000000000	4.159503336153977
12.6750000000000000	3.776728267074587
14.1750000000000000	3.480890312882969

Footing C-10

Z	SigmaZ
2.4500000000000000	9.653184482771401
3.2150000000000000	9.560664628600831
4.6450000000000000	8.516105656140713
6.0750000000000000	7.143396730336419
7.5050000000000000	6.124298424123092
8.9350000000000001	5.425384048722883
10.3650000000000000	4.911024577210175
11.8300000000000000	4.489723016333288
13.3300000000000000	4.125879008924566
14.8300000000000000	3.809995828153618

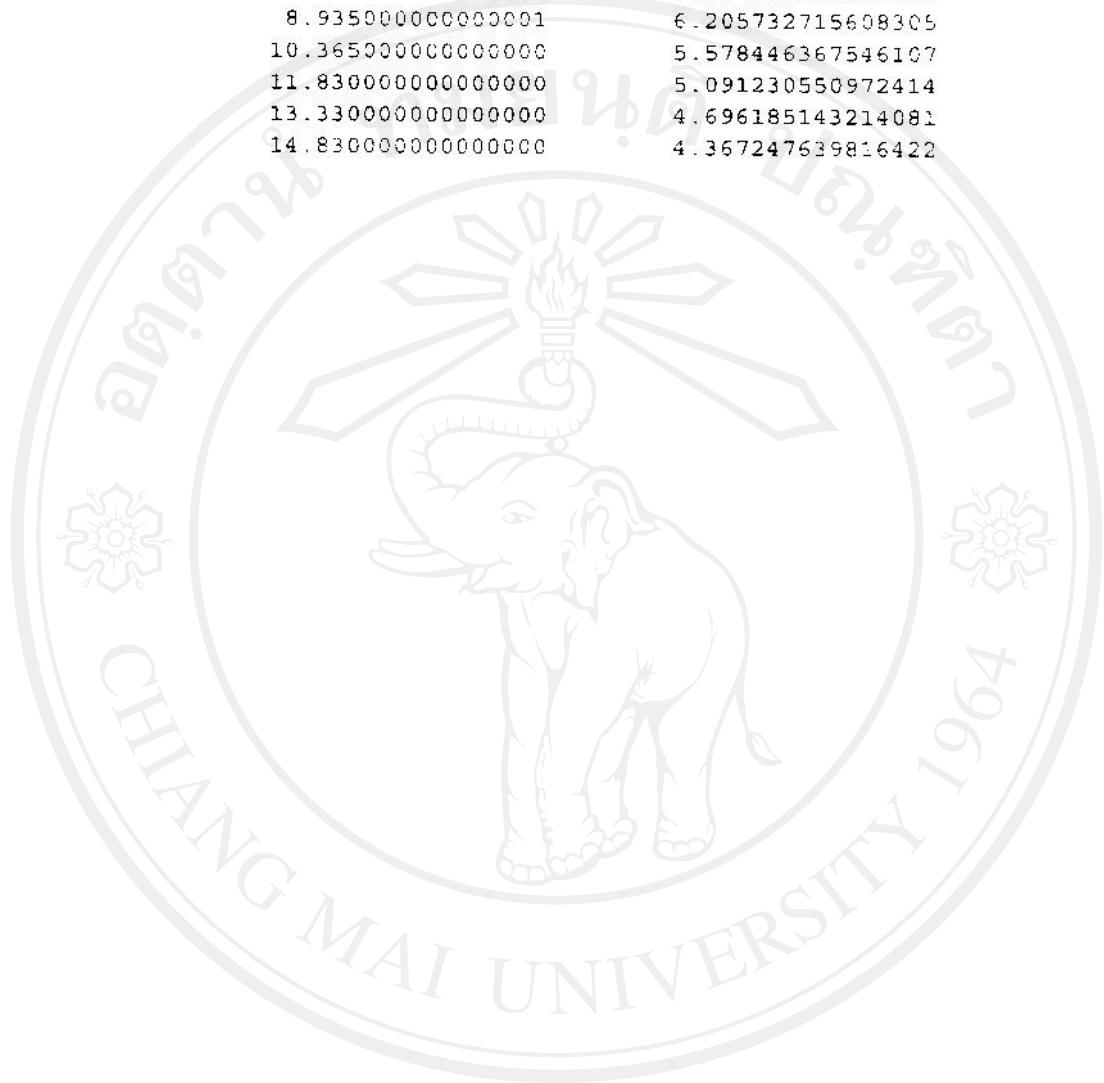
Footing G-10

Z	SigmaZ
2.4500000000000000	9.917100626413125
3.2150000000000000	9.837683277475044
4.6450000000000000	8.904924505897940
6.0750000000000000	7.586388405536740
7.5050000000000000	6.531192065513264
8.9350000000000001	5.805891730961578
10.3650000000000000	5.308407388318217
11.8300000000000000	4.935190224333299
13.3300000000000000	4.629815347476055
14.8300000000000000	4.365688479060922

Footing I-10

Z	SigmaZ
2.4500000000000000	9.967225464269106
3.2150000000000000	9.913389650799969
4.6450000000000000	9.248964296101189

6.075000000000000	8.123977064725036
7.505000000000000	7.047944826687034
8.935000000000001	6.205732715608305
10.365000000000000	5.578446367546107
11.830000000000000	5.091230550972414
13.330000000000000	4.696185143214081
14.830000000000000	4.367247639816422



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Z	SigmaZ
2.4000000000000000	11.313213133326810
3.2150000000000000	11.072085185849820
4.6450000000000000	8.960936980655550
6.0750000000000000	6.305271520638996
7.5050000000000000	4.353226711451070
8.9350000000000001	3.084861156137665
10.3650000000000000	2.264066032306861
11.8350000000000000	1.705206182769372
13.3300000000000000	1.318359942715121
14.8300000000000000	1.045642571395694

Footing C-6

Z	SigmaZ
3.4650000000000000	10.324588552236930
4.7950000000000000	9.069801748963849
6.1250000000000000	6.970290589701029
6.8400000000000000	5.916507716217828
8.2700000000000000	4.245371774742799
9.6999999999999999	3.102513124226818
11.1750000000000000	2.310078894423564
12.6750000000000000	1.762952799625574
14.1750000000000000	1.381876276653621

Footing C-10

Z	SigmaZ
2.4500000000000000	9.653096749595932
3.2150000000000000	9.551234062626955
4.6450000000000000	8.361318441718497
6.0750000000000000	6.594413085306932
7.5050000000000000	5.056369745708735
8.9350000000000001	3.887706413531397
10.3650000000000000	3.029332388831957
11.8300000000000000	2.387084272299144
13.3300000000000000	1.905255829200127
14.8300000000000000	1.547744078261897

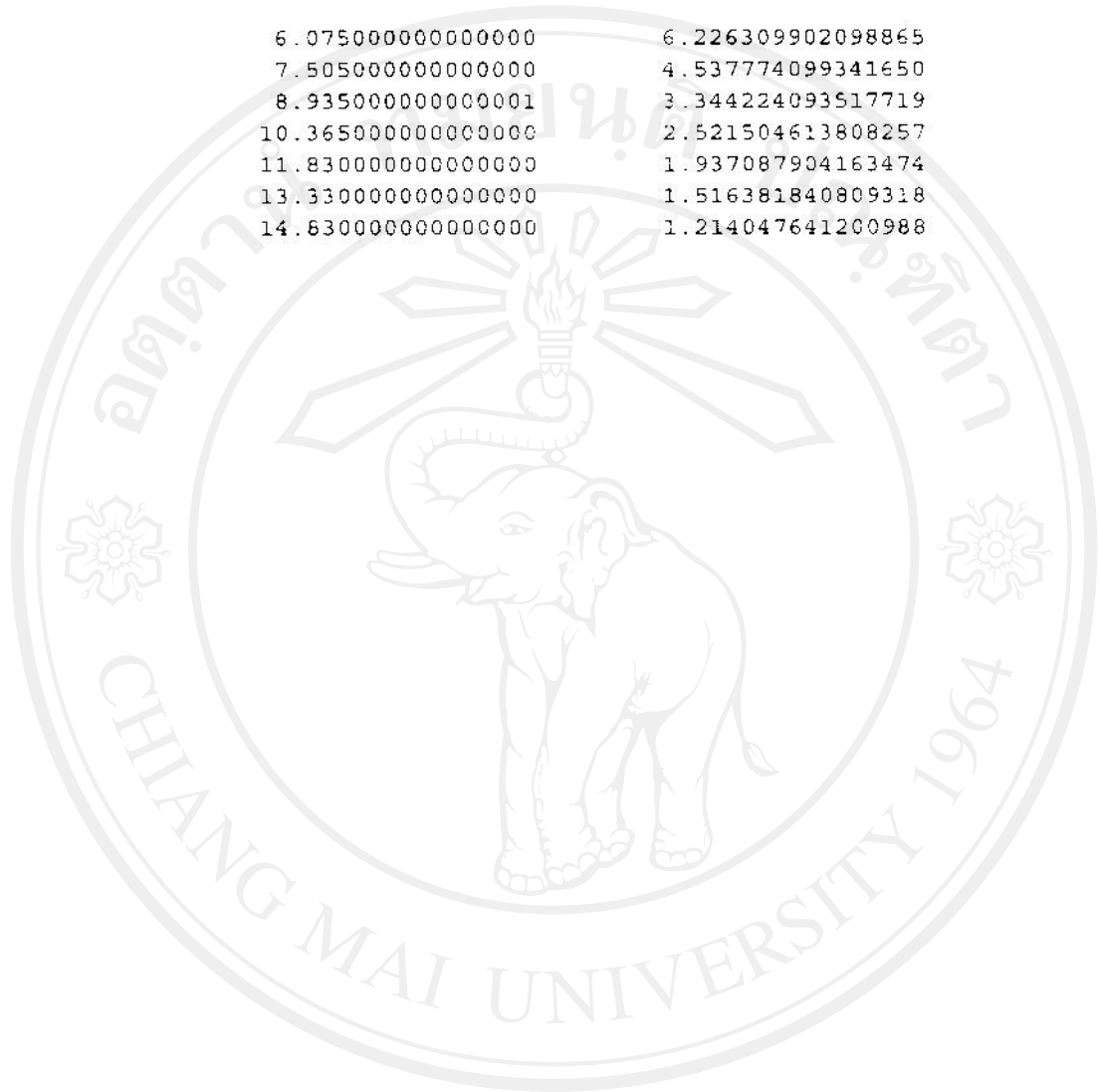
Footing G-10

Z	SigmaZ
2.4500000000000000	9.916676098375419
3.2150000000000000	9.780377009225420
4.6450000000000000	8.273757172499385
6.0750000000000000	6.194931724258483
7.5050000000000000	4.514905484555769
8.9350000000000001	3.327370506080781
10.3650000000000000	2.508797212242725
11.8300000000000000	1.927325735285756
13.3300000000000000	1.508739866698970
14.8300000000000000	1.207929313750010

Footing I-10

Z	SigmaZ
2.4500000000000000	9.966905421320465
3.2150000000000000	9.829915958612016
4.6450000000000000	8.315664886017874

6.075000000000000	6.226309902098865
7.505000000000000	4.537774099341650
8.935000000000001	3.344224093517719
10.365000000000000	2.521504613808257
11.830000000000000	1.937087904163474
13.330000000000000	1.516381840809318
14.630000000000000	1.214047641200988



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ภาคผนวก ก

โปรแกรมคอมพิวเตอร์คำนวณ
ระยะทอดตัวโดยวิธีทฤษฎีการยืดหยุ่น

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

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Settlement

Implicit Double Precision: 1A H,0-3

Double Precision 1,mu,1i,Irb,Irt

Integer 1,j,jh,Nf,Ns

Dimension P(40),H(6),E(6),rho(40),rhoa(6),

1x(40),y(40),A(40),B(40)

Footing I-7

DATA A/1.0d0,2.2d0,3.5d0,1.75d0,1.0d0,3.5d0,4.0d0,3.5d0,3.5d0,
11.0d0,5.0d0,5.1d0,1.0d0,5.4d0,5.1d0,1.0d0,5.0d0,5.75d0,4.75d0,
21.0d0,5.1d0,5.1d0,5.1d0,5.1d0,1.75d0,1.75d0,4.75d0,5.1d0,5.1d0,
34.5d0,4.75d0,4.75d0,5.5d0,4.75d0,4.75d0,5.1d0,4.75d0,4.75d0,
44.75d0,4.75d0/

DATA B/1.0d0,2.2d0,3.5d0,1.75d0,1.0d0,3.5d0,4.0d0,2.9d0,2.9d0,
11.0d0,7.2d0,5.1d0,1.0d0,7.6d0,5.1d0,1.0d0,7.2d0,5.75d0,4.75d0,
21.0d0,5.1d0,5.1d0,5.1d0,5.1d0,1.75d0,1.75d0,4.75d0,8.8d0,8.8d0,
38.5d0,4.75d0,4.75d0,11.45d0,4.75d0,4.75d0,5.1d0,4.75d0,4.75d0,
44.75d0,4.75d0/

DATA P/3.9470d0,52.5281d0,96.3550d0,37.7731d0,9.4199d0,120.4910d0,
1164.9712d0,96.3775d0,104.6952d0,13.1652d0,403.7422d0,303.9115d0,
212.3859d0,426.8345d0,288.7862d0,13.3310d0,491.9904d0,374.0549d0,
3219.4589d0,10.2521d0,267.3566d0,274.7659d0,281.0568d0,276.6199d0,
47.8310d0,10.1206d0,209.1264d0,445.0620d0,447.3163d0,422.0654d0,
5228.9372d0,224.6825d0,607.9054d0,243.6955d0,249.9761d0,255.9878d0,
6.252.8969d0,262.0063d0,256.8434d0,234.7853d0/

Footing I-7

DATA x/28.0d0,28.0d0,28.0d0,28.0d0,24.0d0,24.0d0,24.0d0,24.0d0,
124.0d0,16.0d0,16.0d0,16.0d0,8.0d0,8.0d0,8.0d0,0.0d0,0.0d0,0.0d0,
20.0d0,8.0d0,8.0d0,8.0d0,8.0d0,8.0d0,16.0d0,16.0d0,16.0d0,17.8d0,
318.15d0,18.1d0,20.0d0,20.0d0,20.95d0,28.0d0,28.0d0,28.0d0,28.0d0,
428.0d0,28.0d0,28.0d0/

DATA y/17.7d0,14.0d0,7.0d0,3.0d0,17.7d0,14.0d0,7.0d0,3.0d0,0.0d0,
117.7d0,11.3d0,0.0d0,17.7d0,11.55d0,0.0d0,17.7d0,11.3d0,0.0d0,7.0d0

2,17.7d0,14.0d0,7.0d0,0.0d0,7.0d0,28.0d0,21.0d0,14.0d0,7.0d0,0.0d0

37.0d0,14.0d0,28.0d0,18.93d0,28.0d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0

4,14.0d0/

Footing C-6

DATA x/20.0d0,20.0d0,20.0d0,20.0d0,16.0d0,16.0d0,16.0d0,16.0d0,
116.0d0,8.0d0,8.0d0,8.0d0,0.0d0,0.0d0,0.0d0,8.0d0,8.0d0,8.0d0,
28.0d0,16.0d0,16.0d0,16.0d0,16.0d0,16.0d0,24.0d0,24.0d0,24.0d0,
325.8d0,26.15d0,26.10d0,28.0d0,28.0d0,28.95d0,36.0d0,36.0d0,
436.0d0,36.0d0,36.0d0,36.0d0,36.0d0/

DATA y/6.15d0,2.45d0,4.55d0,8.55d0,6.15d0,2.45d0,4.55d0,8.55d0,
111.55d0,6.15d0,0.25d0,11.55d0,6.15d0,0.0d0,11.55d0,6.15d0,0.25d0,
211.55d0,18.55d0,6.15d0,2.45d0,4.55d0,11.55d0,18.55d0,16.45d0,
39.45d0,2.45d0,4.55d0,11.55d0,18.55d0,25.55d0,16.45d0,7.38d0,
416.45d0,9.45d0,2.45d0,4.55d0,11.55d0,18.55d0,25.55d0/

Footing C-9

DATA x/44.0d0,44.0d0,44.0d0,44.0d0,40.0d0,40.0d0,40.0d0,40.0d0,
140.0d0,32.0d0,32.0d0,32.0d0,24.0d0,24.0d0,24.0d0,16.0d0,16.0d0,
216.0d0,16.0d0,8.0d0,8.0d0,8.0d0,8.0d0,8.0d0,8.0d0,0.0d0,0.0d0,0.0d0,
31.8d0,2.15d0,2.10d0,4.0d0,4.0d0,4.95d0,12.0d0,12.0d0,12.0d0,
412.0d0,12.0d0,12.0d0,12.0d0/
DATA y/3.7d0,0.0d0,7.0d0,11.0d0,3.7d0,0.0d0,7.0d0,11.0d0,14.0d0,
13.7d0,2.7d0,14.0d0,3.7d0,2.45d0,14.0d0,3.7d0,2.7d0,14.0d0,21.0d0,
23.7d0,0.0d0,7.0d0,14.0d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0,14.0d0,
321.0d0,28.0d0,14.0d0,4.93d0,14.0d0,7.0d0,0.0d0,7.0d0,14.0d0,
421.0d0,28.0d0/

Footing C-10

DATA x/48.95d0,48.95d0,48.95d0,48.95d0,44.95d0,44.95d0,44.95d0,
144.95d0,44.95d0,36.95d0,36.95d0,36.95d0,28.95d0,28.95d0,28.95d0,
220.95d0,20.95d0,20.95d0,20.95d0,12.95d0,12.95d0,12.95d0,12.95d0,
312.95d0,4.95d0,4.95d0,4.95d0,3.15d0,2.80d0,2.85d0,2.95d0,0.95d0,
40.00d0,7.05d0,7.05d0,7.05d0,7.05d0,7.05d0,7.05d0,7.05d0/
DATA y/1.23d0,4.93d0,11.93d0,18.93d0,1.23d0,4.93d0,11.93d0,
105.93d0,18.93d0,1.23d0,7.63d0,18.93d0,1.23d0,7.38d0,18.93d0,
21.23d0,7.63d0,18.93d0,25.92d0,1.23d0,4.93d0,11.93d0,18.93d0,
325.93d0,9.08d0,2.08d0,4.93d0,11.93d0,18.93d0,25.93d0,32.93d0,
49.08d0,0.00d0,9.08d0,2.08d0,4.93d0,11.93d0,18.93d0,25.93d0,
532.93d0/

Footing G-10

DATA x/45.8d0,45.8d0,45.8d0,45.8d0,41.8d0,41.8d0,41.8d0,41.8d0,
141.8d0,33.8d0,33.8d0,33.8d0,25.8d0,25.8d0,25.8d0,17.8d0,17.8d0,
217.8d0,17.8d0,9.8d0,9.8d0,9.8d0,9.8d0,9.8d0,1.8d0,1.8d0,1.8d0,
30.0d0,0.35d0,0.30d0,2.2d0,2.2d0,3.15d0,10.2d0,10.2d0,10.2d0,
410.2d0,10.2d0,10.2d0,10.2d0/
DATA y/10.7d0,7.0d0,0.0d0,4.0d0,10.7d0,7.0d0,0.0d0,4.0d0,7.0d0,
110.7d0,4.3d0,7.0d0,10.7d0,4.55d0,7.0d0,10.7d0,4.3d0,7.0d0,14.0d0,
210.7d0,7.0d0,0.0d0,7.0d0,14.0d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0,
314.0d0,21.0d0,21.0d0,11.93d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0,
414.0d0,21.0d0/

Footing I-10

DATA x/46.15d0,46.15d0,46.15d0,46.15d0,42.15d0,42.15d0,42.15d0,
142.15d0,42.15d0,34.15d0,34.15d0,34.15d0,26.15d0,26.15d0,26.15d0,
218.15d0,18.15d0,18.15d0,18.15d0,10.15d0,10.15d0,10.15d0,10.15d0,
310.15d0,2.15d0,2.15d0,2.15d0,0.35d0,0.30d0,0.05d0,1.85d0,1.85d0,
42.8d0,9.85d0,9.85d0,9.85d0,9.85d0,9.85d0,9.85d0,9.85d0/
DATA y/17.7d0,14.0d0,7.0d0,3.0d0,17.7d0,14.0d0,7.0d0,3.0d0,0.0d0,
117.7d0,11.3d0,0.0d0,17.7d0,11.55d0,0.0d0,17.7d0,11.3d0,0.0d0,
27.0d0,17.7d0,14.0d0,7.0d0,0.0d0,7.0d0,28.0d0,21.0d0,14.0d0,7.0d0,
30.0d0,7.0d0,14.0d0,28.0d0,18.93d0,28.0d0,21.0d0,14.0d0,7.0d0,
40.0d0,7.0d0,14.0d0/

DATA H/3.20d0,2.05d0,2.2d0,2.25d0,1.5d0,2.0d0/

DATA E/580.63d0,1942.50d0,5838.46d0,4538.46d0,5230.77d0,1750.00d0

```
Open #1,File='settlemmr.dat',
Write #1,* 'Footing I-10'
```

```
Nf=40
Ns=29
```

```
PI=3.141592653d0
```

```
mu=0.5d0
```

```
rhot=0.0d0
```

```
Do i=1,Nf
```

```
  rhot(i)=0.0d0
```

```
  aa=A(i)/2.0d0
```

```
  bb=B(i)/2.0d0
```

```
  if (i.EQ. Ns) then
```

```
    A(i)=A(i)/2.0d0
```

```
    B(i)=B(i)/2.0d0
```

```
    X(i)=A(i)+1.0d-8
```

```
    Y(i)=B(i)+1.0d-8
```

```
    P(i)=P(i)/4.0d0
```

```
  Else
```

```
    P(i)=0.0d0
```

```
  end if
```

```
  pL=P(i)/(A(i)*B(i))
```

```
  x1=x(i)+aa
```

```
  x2=x(i)-aa
```

```
  y1=y(i)+bb
```

```
  y2=y(i)-bb
```

```
  Do j=1,6
```

```
    If (j.EQ. 1) then
```

```
      l=Dabs(x1/y1)
```

```
      ds=0.0d0
```

```
      Do jh=1,j
```

```
        ds=ds+H(jh)
```

```
      End do
```

```
      d=Dabs(ds/y1)
```

```
      Call Irho(l,d,mu,Ir)
```

```
      Irb=Ir
```

```
      d=Dabs(0.0d0)
```

```
      Call Irho(l,d,mu,Ir)
```

```
      Irt=Ir
```

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```

rhod1=pL*y1*(1.0d0-mu*mu)*((Irt-Irb)/E(j)

l=Dabs(x2/y1)
d=Dabs(ds/y1)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs(0.0d0)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod2=pL*y1*(1.0d0-mu*mu)*((Irt-Irb)/E(j)

l=Dabs(x1/y2)
d=Dabs(ds/y2)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs(0.0d0)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod3=pL*y2*(1.0d0-mu*mu)*((Irt-Irb)/E(j)

l=Dabs(x2/y2)
d=Dabs(ds/y2)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs(0.0d0)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod4=pL*y2*(1.0d0-mu*mu)*((Irt-Irb)/E(j)

rhod(j)=rhod1-rhod2-rhod3+rhod4

Else
l=Dabs(x1/y1)
ds=3.0d0
Do jh=1,j
ds=ds-H(jh)
End do
d=Dabs(ds/y1)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs((ds-H(j))/y1)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod1=pL*y1*(1.0d0-mu*mu)*((Irt-Irb)/E(j)

l=Dabs(x2/y1)
d=Dabs(ds/y1)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs((ds-H(j))/y1)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod2=pL*y1*(1.0d0-mu*mu)*((Irt-Irb)/E(j)

```

```

l=Dabs(x1/y2)
d=Dabs(ds/y2)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs(0.0d0)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod3=pL*y2*(1.0d0-mu*mu)*((Irt-Irb)/E(j))

l=Dabs(x2/y2)
d=Dabs(ds/y2)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs(0.0d0)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod4=pL*y2*(1.0d0-mu*mu)*((Irt-Irb)/E(j))

rhod(j)=rhod1-rhod2-rhod3+rhod4

Else
l=Dabs(x1/y1)
ds=0.0d0
Do jh=1,j
ds=ds+H(jh)
End do
d=Dabs(ds/y1)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs((ds-H(j))/y1)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod1=pL*y1*(1.0d0-mu*mu)*((Irt-Irb)/E(j))

l=Dabs(x2/y1)
d=Dabs(ds/y1)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs((ds-H(j))/y1)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod2=pL*y1*(1.0d0-mu*mu)*((Irt-Irb)/E(j))

l=Dabs(x1/y2)
d=Dabs(ds/y2)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs((ds-H(j))/y2)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod3=pL*y2*(1.0d0-mu*mu)*((Irt-Irb)/E(j))

l=Dabs(x2/y2)
d=Dabs(ds/y2)

```

```

Call Irho(1,d,mu,Ir)
Irb=Ir
d=Dabs((ds-H(j))/y2)
Call Irho(1,d,mu,Ir)
Irt=Ir
rhod4=pL*y2*(1.0d0-mu*mu)*((Irt-Irb)/E(j))

rhod(j)=rhod1-rhod2-rhod3+rhod4

End if

rho(i)=rho(i)+rhod(j)
End do

If (i.EQ.Ns) then
rho(i)=4.0d0*rho(i)
End if

rhot=rhot+rho(i)

End Do
Write(1,*) 'Initial Settlement=',rhot
Write(1,*) 'Initial Settlement:its self=',rhot
print*,rhot

Close(1)
End

Subroutine Irho(1,d,mu,Ir)
Implicit Double Precision (A-H,O-Z)
Double Precision 1,mu,Ir

Pi=3.14159265d0

If (Dabs(d).LE.1.0d-8) then
Ir=(1*Dlog((1.0d0+Dsqrt(1.0d0+1*1))/1)+
1Dlog(1+Dsqrt(1.0d0+1*1)))/Pi
Else
Ir=(1*Dlog((1.0d0+Dsqrt(1.0d0+1*1))/1)+Dlog(1+Dsqrt(1.0d0+1*
1/Pi-(1*Dlog((1.0d0+Dsqrt(1.0d0+1*1))*Dsqrt(1*1+d*d)/
2(1*(1.0d0+Dsqrt(1.0d0+1*1+d*d))))+Dlog(1+Dsqrt(1.0d0+1*1)+
3*Dsqrt(1.0d0+d*d))/(1+Dsqrt(1.0d0-1*1+d*d)))))/Pi

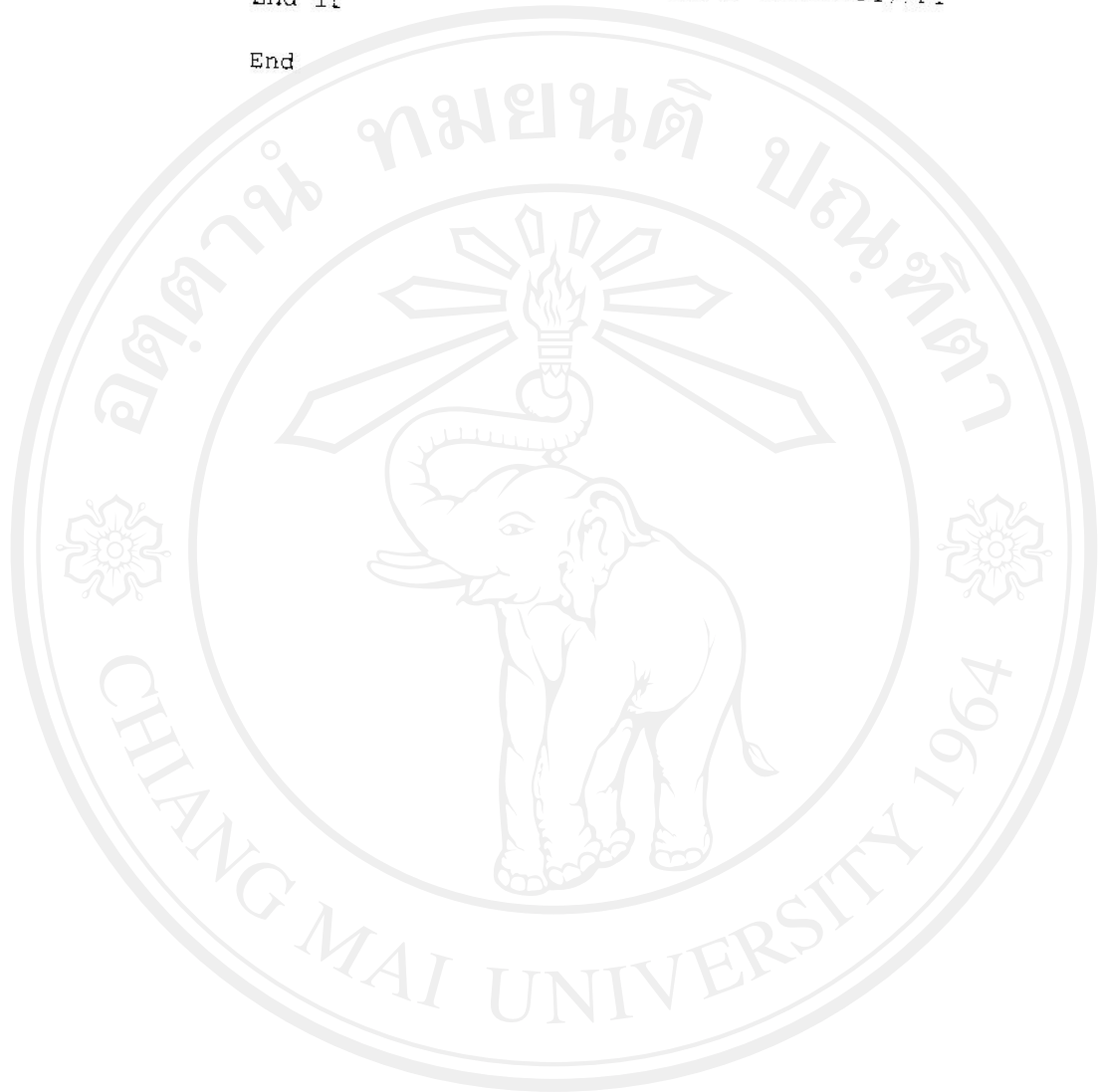
4-(1.0d0-2.0d0*mu)/(1.0d0-mu)*0.5d0*d*
5Datan(1/(d*Dsqrt(1.0d0+1*1+d*d)))/Pi
5(Datan(Dsqrt(1.0d0+1*1+d*d)/1)+

```

```

c      6Data(n,1*Dsqrt(1.0d0+1*i+d*d)/d)-0.5d0*Pi)/Pi
      End if
End

```



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Settlement
 Implicit Double Precision I(A-H,O-Z)
 Double Precision I,mu,Ix,Irb,Irt
 Integer i,j,jh,Nf,Ns
 Dimension P(40),H(6),E(6),rho(40),rhod(6),
 lx(40),y(40),A(40),B(40)

Footing I-7

DATA A/1.0d0,2.2d0,3.5d0,1.75d0,1.0d0,3.5d0,4.0d0,3.5d0,3.5d0,
 11.0d0,5.0d0,5.1d0,1.0d0,5.4d0,5.1d0,1.0d0,5.0d0,5.75d0,4.75d0,
 21.0d0,5.1d0,5.1d0,5.1d0,5.1d0,1.75d0,1.75d0,4.75d0,5.1d0,5.1d0,
 34.5d0,4.75d0,4.75d0,5.5d0,4.75d0,4.75d0,5.1d0,4.75d0,4.75d0,
 44.75d0,4.75d0/
 DATA B/1.0d0,2.2d0,3.5d0,1.75d0,1.0d0,3.5d0,4.0d0,2.9d0,2.9d0,
 11.0d0,7.2d0,5.1d0,1.0d0,7.6d0,5.1d0,1.0d0,7.2d0,5.75d0,4.75d0,
 21.0d0,5.1d0,5.1d0,5.1d0,5.1d0,1.75d0,1.75d0,4.75d0,8.8d0,8.8d0,
 38.5d0,4.75d0,4.75d0,11.45d0,4.75d0,4.75d0,5.1d0,4.75d0,4.75d0,
 44.75d0,4.75d0/
 DATA P/3.9470d0,52.5281d0,96.3550d0,37.7731d0,9.6199d0,120.4910d0
 1164.9712d0,96.3775d0,104.6952d0,13.1652d0,403.7422d0,303.9115d0,
 212.3859d0,426.8345d0,288.7862d0,13.3310d0,491.9904d0,374.0549d0,
 3219.4589d0,10.2521d0,267.3566d0,274.7659d0,281.0568d0,276.6199d0,
 47.8310d0,10.1206d0,209.1264d0,445.0620d0,447.3163d0,427.0654d0,
 5228.9372d0,224.6825d0,607.9054d0,243.6955d0,249.8791d0,255.9878d0
 6,252.8969d0,262.0063d0,256.8434d0,234.7853d0/

Footing I-7

DATA x/28.0d0,28.0d0,28.0d0,28.0d0,24.0d0,24.0d0,24.0d0,24.0d0,
 124.0d0,16.0d0,16.0d0,16.0d0,8.0d0,8.0d0,8.0d0,0.0d0,0.0d0,0.0d0,
 20.0d0,8.0d0,8.0d0,8.0d0,8.0d0,8.0d0,16.0d0,16.0d0,16.0d0,17.8d0,
 318.15d0,18.1d0,20.0d0,20.0d0,20.95d0,28.0d0,28.0d0,28.0d0,28.0d0
 428.0d0,28.0d0,28.0d0/
 DATA y/17.7d0,14.0d0,7.0d0,3.0d0,17.7d0,14.0d0,7.0d0,3.0d0,0.0d0,
 117.7d0,11.3d0,0.0d0,17.7d0,11.55d0,0.0d0,17.7d0,11.3d0,0.0d0,7.0d0
 2,17.7d0,14.0d0,7.0d0,0.0d0,7.0d0,28.0d0,21.0d0,14.0d0,7.0d0,0.0d0
 37.0d0,14.0d0,28.0d0,18.93d0,28.0d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0
 4,14.0d0/

Footing C-6

DATA x/20.0d0,20.0d0,20.0d0,20.0d0,16.0d0,16.0d0,16.0d0,16.0d0,
 116.0d0,8.0d0,8.0d0,8.0d0,0.0d0,0.0d0,0.0d0,0.0d0,8.0d0,8.0d0,8.0d0,
 28.0d0,16.0d0,16.0d0,16.0d0,16.0d0,16.0d0,24.0d0,24.0d0,24.0d0,
 325.8d0,26.15d0,26.10d0,28.0d0,28.0d0,28.95d0,36.0d0,36.0d0,
 436.0d0,36.0d0,36.0d0,36.0d0,36.0d0/
 DATA y/6.15d0,2.45d0,4.55d0,8.55d0,6.15d0,2.45d0,4.55d0,8.55d0,
 111.55d0,6.15d0,0.25d0,11.55d0,6.15d0,0.0d0,11.55d0,6.15d0,0.25d0,
 211.55d0,18.55d0,6.15d0,2.45d0,4.55d0,11.55d0,18.55d0,16.45d0,
 39.45d0,2.45d0,4.55d0,11.55d0,18.55d0,25.55d0,16.45d0,7.38d0,
 416.45d0,9.45d0,2.45d0,4.55d0,11.55d0,18.55d0,25.55d0/

Footing C-9

DATA x/44.0d0,44.0d0,44.0d0,44.0d0,40.0d0,40.0d0,40.0d0,40.0d0,
140.0d0,32.0d0,32.0d0,32.0d0,24.0d0,24.0d0,24.0d0,14.0d0,14.0d0,
216.0d0,16.0d0,8.0d0,8.0d0,8.0d0,8.0d0,8.0d0,8.0d0,8.0d0,8.0d0,
31.8d0,2.15d0,2.10d0,4.0d0,4.0d0,4.95d0,12.0d0,12.0d0,12.0d0,
412.0d0,12.0d0,12.0d0,12.0d0/
DATA y/3.7d0,0.0d0,7.0d0,11.0d0,3.7d0,0.0d0,7.0d0,11.0d0,14.0d0,
13.7d0,2.7d0,14.0d0,3.7d0,2.45d0,14.0d0,3.7d0,2.7d0,14.0d0,21.0d0,
23.7d0,0.0d0,7.0d0,14.0d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0,14.0d0,
321.0d0,28.0d0,14.0d0,4.93d0,14.0d0,7.0d0,0.0d0,7.0d0,14.0d0,
421.0d0,28.0d0/

Footing C-10

DATA x/48.95d0,48.95d0,48.95d0,48.95d0,44.95d0,44.95d0,44.95d0,
144.95d0,44.95d0,36.95d0,36.95d0,36.95d0,28.95d0,28.95d0,28.95d0,
220.95d0,20.95d0,20.95d0,20.95d0,12.95d0,12.95d0,12.95d0,12.95d0,
312.95d0,4.95d0,4.95d0,4.95d0,3.15d0,2.80d0,2.85d0,0.95d0,0.95d0,
40.00d0,7.05d0,7.05d0,7.05d0,7.05d0,7.05d0,7.05d0,7.05d0/
DATA y/1.23d0,4.93d0,11.93d0,18.93d0,1.23d0,4.93d0,11.93d0,
15.93d0,18.93d0,1.23d0,7.63d0,18.93d0,1.23d0,7.38d0,18.93d0,
21.23d0,7.63d0,18.93d0,25.92d0,1.23d0,4.93d0,11.93d0,18.93d0,
325.93d0,9.08d0,2.08d0,4.93d0,11.93d0,18.93d0,25.93d0,32.93d0,
49.08d0,0.00d0,9.08d0,2.08d0,4.93d0,11.93d0,18.93d0,25.93d0,
532.93d0/

Footing G-10

DATA x/45.8d0,45.8d0,45.8d0,45.8d0,41.8d0,41.8d0,41.8d0,41.8d0,
141.8d0,33.8d0,33.8d0,33.8d0,25.8d0,25.8d0,25.8d0,17.8d0,17.8d0,
217.8d0,17.8d0,9.8d0,9.8d0,9.8d0,9.8d0,9.8d0,9.8d0,1.8d0,1.8d0,1.8d0,
30.0d0,0.35d0,0.30d0,2.2d0,2.2d0,3.15d0,10.2d0,10.2d0,10.2d0,
410.2d0,10.2d0,10.2d0,10.2d0/
DATA y/10.7d0,7.0d0,0.0d0,4.0d0,10.7d0,7.0d0,0.0d0,4.0d0,7.0d0,
110.7d0,4.3d0,7.0d0,10.7d0,4.55d0,7.0d0,10.7d0,4.3d0,7.0d0,14.0d0,
210.7d0,7.0d0,0.0d0,7.0d0,14.0d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0,
314.0d0,21.0d0,21.0d0,11.93d0,21.0d0,14.0d0,7.0d0,0.0d0,7.0d0,
414.0d0,21.0d0/

Footing I-10

DATA x/46.15d0,46.15d0,46.15d0,46.15d0,42.15d0,42.15d0,42.15d0,
142.15d0,42.15d0,34.15d0,34.15d0,34.15d0,26.15d0,26.15d0,26.15d0,
218.15d0,18.15d0,18.15d0,18.15d0,10.15d0,10.15d0,10.15d0,10.15d0,
310.15d0,2.15d0,2.15d0,2.15d0,0.35d0,0.0d0,0.05d0,1.85d0,1.85d0,
42.8d0,9.85d0,9.85d0,9.85d0,9.85d0,9.85d0,9.85d0,9.85d0,9.85d0/
DATA y/17.7d0,14.0d0,7.0d0,3.0d0,17.7d0,14.0d0,7.0d0,3.0d0,0.0d0,
117.7d0,11.3d0,0.0d0,17.7d0,11.55d0,0.0d0,17.7d0,11.3d0,0.0d0,
27.0d0,17.7d0,14.0d0,7.0d0,0.0d0,7.0d0,28.0d0,21.0d0,14.0d0,7.0d0,
30.0d0,7.0d0,14.0d0,28.0d0,18.93d0,28.0d0,21.0d0,14.0d0,7.0d0,
40.0d0,7.0d0,14.0d0/

DATA H/3.20d0,2.05d0,2.2d0,2.25d0,1.5d0,2.0d0/

DATA E/425.80d0,1424.50d0,4281.54d0,3328.20d0,3835.90d0,1283.33d0

```

Open (1,File='settlemnt.dat',status='unknown',Access='Append';
mu=0.1d0
Write(1,*) 'Poisson ratio',mu
Write(1,*) 'Footing I-10'

Nf=40
Ns=29

Pi=3.14159265d0

rhot=0.0d0

Do i=1,Nf
  rhot(i)=0.0d0

  aa=A(i)/2.0d0
  bb=B(i)/2.0d0

  if ( i .EQ. Ns ) then
    A(i)=A(i)/2.0d0
    B(i)=B(i)/2.0d0
    X(i)=A(i)+1.0d-8
    Y(i)=B(i)+1.0d-8
    P(i)=P(i)/4.0d0
  Else
    P(i)=0.0d0
  end if
  pL=P(i)/(A(i)*B(i))

  x1=x(i)+aa
  x2=x(i)-aa

  y1=y(i)+bb
  y2=y(i)-bb
  Do j=1,6
    If ( j .EQ. 1 ) then
      l=Dabs(x1/y1)
      ds=0.0d0
      Do jh=1,j
        ds=ds+H(jh)
      End do
      d=Dabs(ds/y1)
      Call Irho(l,d,mu,Ir)
      Irb=Ir
      d=Dabs(0.0d0)
    
```



```

Call Irho(l,d,mu,Ir)
Irt=Ir
rhod1=pL*y1*(1.0d0-mu*mu)*((Irt-Irb)/E(j))

l=Dabs(x2/y1)
d=Dabs(ds/y1)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs(0.0d0)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod2=pL*y1*(1.0d0-mu*mu)*((Irt-Irb)/E(j))

l=Dabs(x1/y2)
d=Dabs(ds/y2)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs(0.0d0)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod3=pL*y2*(1.0d0-mu*mu)*((Irt-Irb)/E(j))

l=Dabs(x2/y2)
d=Dabs(ds/y2)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs(0.0d0)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod4=pL*y2*(1.0d0-mu*mu)*((Irt-Irb)/E(j))

rhod(j)=rhod1-rhod2-rhod3+rhod4

Else
l=Dabs(x1/y1)
ds=0.0d0
Do jh=1,j
ds=ds+H(jh)
End do
d=Dabs(ds/y1)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs((ds-H(j))/y1)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod1=pL*y1*(1.0d0-mu*mu)*((Irt-Irb)/E(j))
l=Dabs(x2/y1)
d=Dabs(ds/y1)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs((ds-H(j))/y1)
Call Irho(l,d,mu,Ir)
Irt=Ir

```

```
rhod2=pL*y1*(1.0d0-mu*mu)*(Irt-Irb)/E(j)
```

```
l=Dabs(x1/y2)
d=Dabs(ds/y2)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs((ds-H(j))/y2)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod3=pL*y2*(1.0d0-mu*mu)*(Irt-Irb)/E(j)
```

```
l=Dabs(x2/y2)
d=Dabs(ds/y2)
Call Irho(l,d,mu,Ir)
Irb=Ir
d=Dabs((ds-H(j))/y2)
Call Irho(l,d,mu,Ir)
Irt=Ir
rhod4=pL*y2*(1.0d0-mu*mu)*(Irt-Irb)/E(j)
```

```
rhod(j)=rhod1-rhod2-rhod3+rhod4
```

```
End if
```

```
rho(i)=rho(i)+rhod(j)
End do
```

```
If (i .EQ. Ns) then
rho(i)=4.0d0*rho(i)
End if
```

```
rhot=rhot+rho(i)
```

```
End Do
```

```
Write(1,*) 'Total Settlement=',rhot
Write(1,*) 'Total Settlement(its self)='
print*,rhot
```

```
Close(1)
End
```

```
Subroutine Irho (l,d,mu,Ir)
Implicit Double Precision (A-H,O-Z)
Double Precision l,mu,Ir
```

```
Pi=3.14159265d0
```

```
If ( Dabs(d) .LE. 1.0d-8 ) then
Ir=(1*Dlog((1.0d0+Dsqrt(1.0d0+1*1))/1)+
1Dlog(1+Dsqrt(1.0d0+1*1)))/Pi
```



```

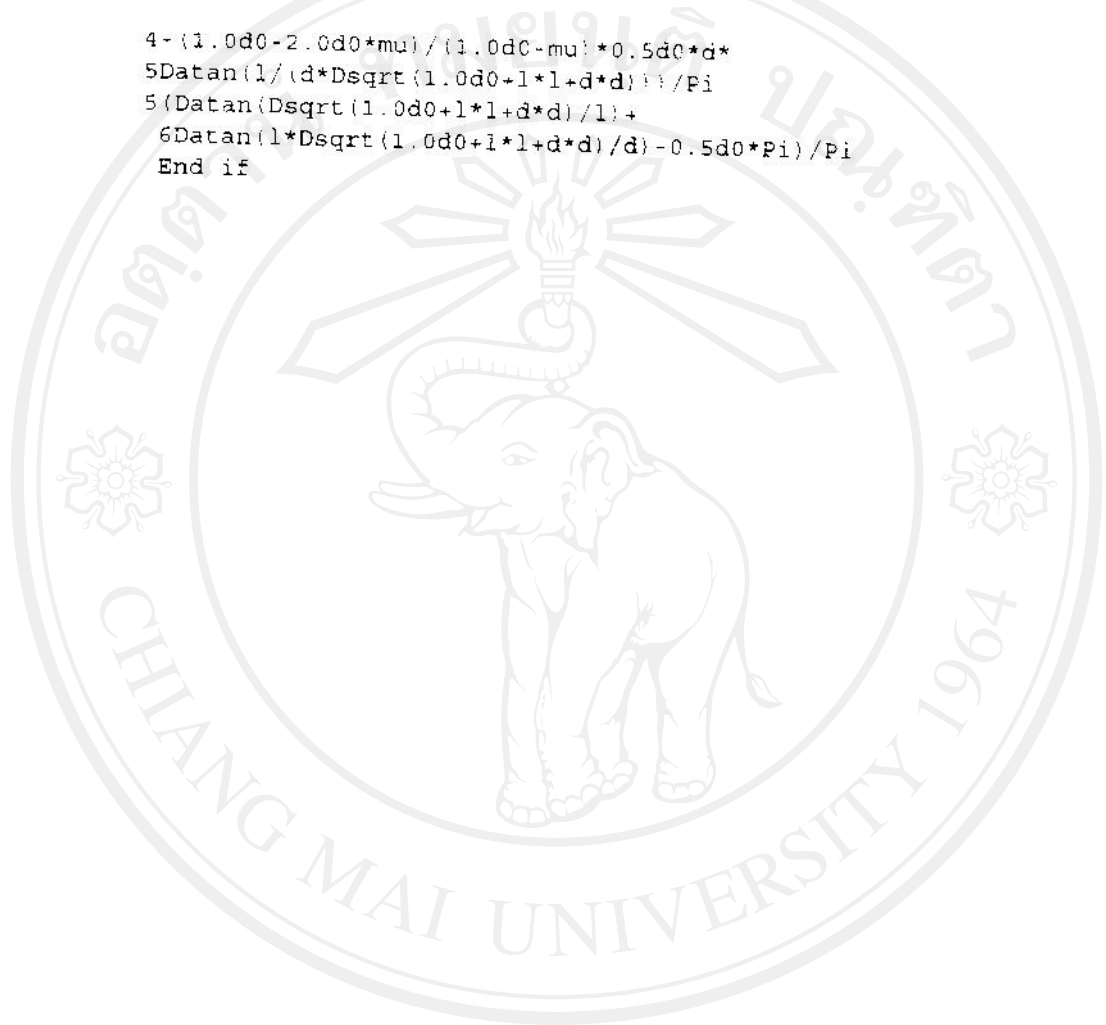
1r=(1*Dlog((1.0d0+Dsqrt(1.0d0-1*1+.../1)+Dlog(1+Dsqrt(1.0d0-1
1/Pi-1*Dlog((1.0d0+Dsqrt(1.0d0+1*1+...*Dsqrt(1*1+d*d)
2(1*(1.0d0+Dsqrt(1.0d0+1*1+d*d))))+Dlog(1+Dsqrt(1.0d0-1*1+
3*Dsqrt(1.0d0+d*d)/(1+Dsqrt(1.0d0+1*1+d*d)))))/Pi

```

```

4-(1.0d0-2.0d0*mu)/(1.0d0-mu)*0.5d0*d*
5Datan(1/(d*Dsqrt(1.0d0+1*1+d*d)))/Pi
5(Datan(Dsqrt(1.0d0+1*1+d*d)/1)+
6Datan(1*Dsqrt(1.0d0+1*1+d*d)/d)-0.5d0*Pi)/Pi
End if

```



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Footing I-7

Initial Settlement(its self) = 3.3561846050001927E-002

Initial Settlement= 2.917328161821945E-002

Footing C-6

Initial Settlement(its self)= 2.597344050053904E-002

Initial Settlement= 2.250692523947176E-002

Footing C-10

Initial Settlement(its self)= 2.665539779874075E-002

Initial Settlement= 2.258606203956179E-002

Footing G-10

Initial Settlement(its self)= 2.962321842124657E-002

Initial Settlement= 2.519641295671242E-002

Footing I-10

Initial Settlement(its self)= 3.101559338941578E-002

Initial Settlement= 2.680837258607600E-002

Poisson ratio 3.000000000000000E-001

Footing I-7

Total Settlement(its self)= 6.769996107825527E-002

Total Settlement= 6.758189720815014E-002

Footing C-6

Total Settlement(its self)= 5.559095531595862E-002

Total Settlement= 5.584123527283496E-002

Footing C-10

Total Settlement(its self)= 5.799457875468162E-002

Total Settlement= 5.877562464675899E-002

Footing G-10

Total Settlement(its self)= 6.044933106402715E-002

Total Settlement= 6.132130005124870E-002

Footing I-10

Total Settlement(its self)= 6.267510327446681E-002

Total Settlement= 6.284829072048943E-002

Poisson ratio 2.000000000000000E-001

Footing I-7

Total Settlement(its self)= 8.477036927003522E-002

Total Settlement= 8.678754155453047E-002

Footing C-6

Total Settlement(its self)= 7.040075726016520E-002

Total Settlement= 7.250941305511857E-002

Footing C-10

Total Settlement(its self)= 7.366524934735956E-002

Total Settlement= 7.687144956279698E-002

Footing C-10
 Total Settlement(its self)= 7.586253513020931E-002
 Total Settlement= 7.938390497572666E-002

Footing I-10
 Total Settlement(its self)= 7.850500495912352E-002
 Total Settlement= 8.086840655765601E-002

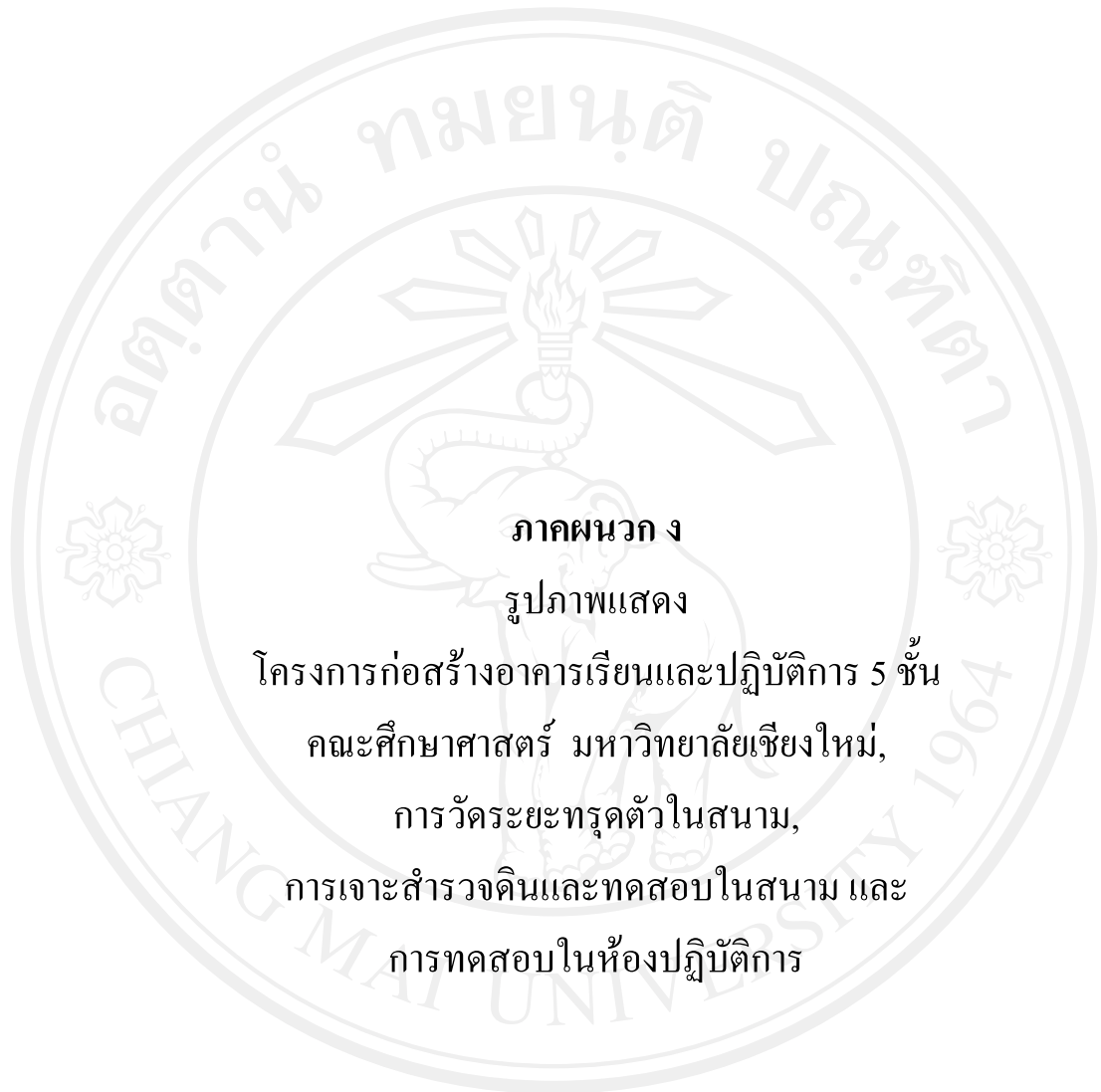
Poisson ratio 1.000000000000000E-001
 Footing I-7
 Total Settlement(its self)= 1.018377940889822E-001
 Total Settlement= 1.059902474287536E-001

Footing C-6
 Total Settlement(its self)= 8.520828714000781E-002
 Total Settlement= 8.917535893062382E-002

Footing C-10
 Total Settlement(its self)= 8.933355172449449E-002
 Total Settlement= 9.496496637745018E-002

Footing G-10
 Total Settlement(its self)= 9.127465759466298E-002
 Total Settlement= 9.744546678838079E-002

Footing I-10
 Total Settlement(its self)= 9.433346093582418E-002
 Total Settlement= 9.888709341392421E-002



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รูป ง-1 ด้านหน้าโครงการก่อสร้างอาคารเรียนและปฏิบัติการ 5 ชั้น
คณะศึกษาศาสตร์ มหาวิทยาลัยเชียงใหม่



รูป ง-2 ด้านข้างโครงการก่อสร้างอาคารเรียนและปฏิบัติการ 5 ชั้น
คณะศึกษาศาสตร์ มหาวิทยาลัยเชียงใหม่



รูป ง-3 วัดระยะทวัดตัวในสนาม



รูป ง-4 วัดระยะทวัดตัวในสนาม



รูป ง-5 เจาะสำรวจดินและทดสอบในสนาม



รูป ง-6 ทดสอบการอัดตัวภายใต้น้ำมีติเดียวในห้องปฏิบัติการ



รูป ง-7 ทดสอบแรงอัดสามแกนในห้องปฏิบัติการ



รูป ง-8 ตัวอย่างดินและชุดอุปกรณ์ทดสอบการอัดตัวคายนํ้ามิติเดียวในห้องปฏิบัติการ



รูป ง-9 ตัวอย่างดินและชุดอุปกรณ์ทดสอบแรงอัดสามแกนในห้องปฏิบัติการ

ประวัติผู้เขียน

ชื่อ – สกุล	นายอัศรชาติ ปินรง
วัน เดือน ปี เกิด	2 พฤศจิกายน 2523
ประวัติการศึกษา	สำเร็จการศึกษามัธยมศึกษาตอนต้น โรงเรียนจักรคำคณาทร จังหวัด ลำพูน ปีการศึกษา 2538 สำเร็จการศึกษามัธยมศึกษาตอนปลาย โรงเรียนจักรคำคณาทร จังหวัด ลำพูน ปีการศึกษา 2541 สำเร็จการศึกษาปริญญาวิศวกรรมศาสตรบัณฑิต สาขาวิศวกรรมโยธา มหาวิทยาลัยนเรศวร ปีการศึกษา 2546
ประวัติการทำงาน	2547 – 2549 วิศวกรโยธาปฏิบัติงาน บริษัท นันทวัน จำกัด (Thai Obayashi Corp.,Ltd.)