CHARACTER Input\*20,OUTPUT\*20

WRITE(\*,\*) 'Input Data File name:'

READ (\*,\*)Input

OPEN (11,FILE="Input.txt",STATUS='OLD')

WRITE(\*,\*) 'Output File name:'

READ (\*,\*)OUTPUT

OPEN(12,FILE="output.txt",STATUS='UNKNOWN')

WRITE(12,\*)'\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*'

WRITE(12,\*)'\* Program for Analysis of Space Trusses \*'

WRITE(12,\*)'\* School of Civil Engineering CSU \*'

WRITE(12,\*)'\* 2016.5.20 Designed By Hexinli \*'

WRITE(12,\*)'\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*'

WRITE(12,\*)' '

WRITE(12,\*)'\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*'

WRITE(12,\*)'\*\*\*\*\*\*\*\*\*\*\*\*\*The Input Data\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*'

WRITE(12,\*)'\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*'

WRITE(12,100)

READ(11,\*)NF,NP,NE,NM,NR,NCF,ND

WRITE(12,110)NF,NP,NE,NM,NR,NCF,ND

100 FORMAT(6X,'The General Information'/2X,'NF',5X,'NP',5X,'NE',5X,'NM',5X,'NR',5X,'NCF',5X,'ND')

110 FORMAT(2X,I2,6I7)

NPF=NF\*NP

NDF=ND\*NF

CALL ANALYSE(NF,NP,NE,NM,NR,NCF,ND,NPF,NDF)

END

!\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

!总计算程序

SUBROUTINE ANALYSE(NF,NP,NE,NM,NR,NCF,ND,NPF,NDF)

DIMENSION X(NP),Y(NP),Z(NP),MM(NE),ME(ND,NE),IT(NF,NP),RR(ND,NR), NAE(NE),AE(1,2),PF(4,NCF),LMT(NDF,NE),MAXA(NPF),CKK(1000),V(NPF),DIST(NPF),PP(NPF),FF(NPF),SG(NE),SM(NE)

READ(11,\*)(X(I),Y(I),Z(I),I=1,NP)

READ(11,\*)(MM(I),ME(1,I),ME(2,I),NAE(I),I=1,NE)

READ(11,\*)(RR(1,J),RR(2,J),J=1,NR)

READ(11,\*)(AE(1,J),J=1,2)

WRITE(12,120)

WRITE(12,121)(I,X(I),Y(I),Z(I),I=1,NP)

WRITE(12,130)

WRITE(12,131)(MM(I),ME(1,I),ME(2,I),NAE(I),I=1,NE)

WRITE(12,140)

WRITE(12,141)(INT(RR(1,J)),RR(2,J),J=1,NR)

WRITE(12,150)

WRITE(12,151)(AE(1,J),J=1,2)

IF(NCF/=0)THEN

READ(11,\*)((PF(I,J),I=1,4),J=1,NCF)

WRITE(12,160)

WRITE(12,161)(INT(PF(1,J)),PF(2,J),PF(3,J),PF(4,J),J=1,NCF)

ENDIF

120 FORMAT(/6X,'The Information of Joints'/2x,'Joint',5X,'X',5X,'Y',5X,'Z')

121 FORMAT(1X,I4,3F8.1)

130 FORMAT(/6X,'The Information of Members'/2x,'Member',2X,'START',4X,'END',6X,'NAE')

131 FORMAT(1X,I4,3I8)

140 FORMAT(/6X,'The Information of SUPPORTS'/2x,'Joint',5X,'S')

141 FORMAT(1X,I4,F8.3)

150 FORMAT(/6X,'The Information of Sections'/4x,'E0',8X,'A0')

151 FORMAT(1X,1PE8.2,F8.4)

160 FORMAT(/6X,'The Loading at Joints'/2x,'Joint',5X,'FX',5X,'FY',7X,'FZ')

161 FORMAT(1X,I4,3F8.2)

CALL FLMT(NP,NE,NN,NNM,NR,RR,ND,NF,NDF,ME,IT,LMT)

CALL FMAXA(NNM,NE,LMT,MAXA,NWK,NPF,NDF)

CALL LP(V,PP,IT,PF,NN,NCF,NF,NP,NPF)

CALL CONKB(NP,NE,NM,NWK,ME,X,Y,Z,AE,NAE,LMT,MAXA,CKK,NNM)

ISH=1

CALL LDLT(CKK,MAXA,NN,ISH,IOUT,NWK,NNM)

CALL REBACK(CKK,V,MAXA,NN,NWK,NNM)

CALL DISPLS(NP,NE,NPF,NM,NN,IT,V,DIST,AE,NAE,X,Y,Z,PP,FF,SG,SM,ME,NR,RR,NF)

END

!\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

!矩阵转置子程序

SUBROUTINE MAT(M,N,A,B)

DIMENSION A(M,N),B(N,M)

DO I=1,M

DO J=1,N

B(J,I)=A(I,J)

END DO

END DO

RETURN

END

!单元刚度矩阵的形成

SUBROUTINE FKE(NP,NE,NM,IE,X,Y,Z,ME,NAE,AE,AKE)

DIMENSION X(NP),Y(NP),Z(NP),ME(2,NE),NAE(NE),AE(2,NM) ,AKE(2,2)

N1=ME(1,IE)

N2=ME(2,IE)

X1=X(N1);Y1=Y(N1);Z1=Z(N1)

X2=X(N2);Y2=Y(N2);Z2=Z(N2)

BL=SQRT((X2-X1)\*\*2+(Y2-Y1)\*\*2+(Z2-Z1)\*\*2)

NMI=NAE(IE)

E0=AE(1,NMI);A0=AE(2,NMI)

C=E0\*A0/BL

AKE(1,1)=C

AKE(1,2)=-C

AKE(2,1)=-C

AKE(2,2)=C

RETURN

END

!单元坐标转换矩阵

SUBROUTINE FT(IE,NP,NE,X,Y,Z,ME,T)

DIMENSION X(NP),Y(NP),Z(NP),ME(2,NE),T(2,6)

T=0

N1=ME(1,IE);N2=ME(2,IE)

X1=X(N1);Y1=Y(N1);Z1=Z(N1)

X2=X(N2);Y2=Y(N2);Z2=Z(N2)

BL=SQRT((X2-X1)\*\*2+(Y2-Y1)\*\*2+(Z2-Z1)\*\*2)

CX=(X2-X1)/BL

CY=(Y2-Y1)/BL

CZ=(Z2-Z1)/BL

T(1,1)=CX;T(2,4)=CX

T(1,2)=CY;T(2,5)=CY

T(1,3)=CZ;T(2,6)=CZ

RETURN

END

!生成单元联系数组LMT

SUBROUTINE FLMT(NP,NE,NN,NNM,NR,RR,ND,NF,NDF,ME,IT,LMT)

DIMENSION IT(NF,NP),LMT(NDF,NE),ME(ND,NE),RR(2,NR)

NN=0;NNM=0;IT=0;LMT=0

N=0

DO I=1,NP

C=0

DO K=1,NR

KR=RR(1,K)

IF(KR.EQ.I) C=RR(2,K)

ENDDO

NC=C !NC=0,提取了整数部分

C=C-NC !C=0.\*\*\*,例如C=0.111

DO J=1,NF

C=C\*10.0 !例如C=1.21

L=C+0.1

C=C-L

IF(L.EQ.0)THEN

N=N+1

IT(J,I)=N

ELSE

IT(J,I)=0

ENDIF

ENDDO

ENDDO

NN=N

NNM=NN+1

DO IE=1,NE

DO I=1,ND

NI=ME(I,IE)

DO J=1,NF

LMT((I-1)\*NF+J,IE)=IT(J,NI)

ENDDO

ENDDO

ENDDO

RETURN

END

!二维总刚中对角线元地址数组

SUBROUTINE FMAXA(NNM,NE,LMT,MAXA,NWK,NPF,NDF)

DIMENSION MAXA(NPF),LMT(NDF,NE)

MAXA=0;NWK=0

MAXA(1)=1

DO I=2,NNM

IP=I-1

IG=IP

DO IE=1,NE

DO J=1,NDF

IF(LMT(J,IE).EQ.IP) THEN

DO K=1,NDF

IF(LMT(K,IE).GT.0.AND.LMT(K,IE).LE.IG) IG=LMT(K,IE)

ENDDO

END IF

ENDDO

ENDDO

MAXA(I)= MAXA(I-1)+IP-IG+1

ENDDO

NWK= MAXA(NNM)-1

RETURN

END

!生成一维存储结构总刚度矩阵

SUBROUTINE CONKB(NP,NE,NM,NWK,ME,X,Y,Z,AE,NAE,LMT,MAXA,CKK,NNM)

DIMENSION CKK(NWK),X(NP),Y(NP),Z(NP),AE(2,NM),NAE(NE),LMT(6,NE),ME(2,NE),MAXA(NNM),AK(6,2),AKE(2,2),T(2,6),TT(6,2),TAK(6,6)

CKK=0

DO 10 IE=1,NE

TAK=0

CALL FKE(NP,NE,NM,IE,X,Y,Z,ME,NAE,AE,AKE)

CALL FT(IE,NP,NE,X,Y,Z,ME,T)

CALL MAT(2,6,T,TT)

AK=MATMUL(TT,AKE)

TAK=MATMUL(AK,T) !总体坐标系下的单元刚度矩阵

DO 220 I=1,6

DO 220 J=1,6

NI=LMT(I,IE)

NJ=LMT(J,IE)

IF((NJ-NI).GE.0.AND.NI\*NJ.GT.0) THEN

IJ=MAXA(NJ)+NJ-NI

CKK(IJ)=CKK(IJ)+TAK(I,J)

ENDIF

220 CONTINUE

10 CONTINUE

RETURN

END

!生成荷载矩阵

SUBROUTINE LP(V,PP,IT,PF,NN,NCF,NF,NP,NPF)

DIMENSION V(NN),PP(NPF),IT(NF,NP),PF(4,NCF)

V=0

PP=0

DO I=1,NF

DO J=1,NP

DO K=1,NCF

IF(J.EQ.PF(1,K).AND.IT(I,J).NE.0)THEN

V(IT(I,J))=PF(I+1,K)

ENDIF

ENDDO

ENDDO

ENDDO

DO K=1,NCF

DO I=1,NP

IF(I.EQ.PF(1,K))THEN

PP(NF\*(I-1)+1)=PF(2,K)

PP(NF\*(I-1)+2)=PF(3,K)

PP(NF\*(I-1)+3)=PF(4,K)

ENDIF

ENDDO

ENDDO

RETURN

END

!对一维结构总刚度矩阵进行矩阵分解（LDLT）

SUBROUTINE LDLT(A,MAXA,NN,ISH,IOUT,NWK,NNM)

DIMENSION A(NWK),MAXA(NNM)

IF(NN.EQ.1) RETURN

DO 200 N=1,NN

KN=MAXA(N)

KL=KN+1

KU=MAXA(N+1)-1

KH=KU-KL

IF(KH)304,240,210

210 K=N-KH

IC=0

KLT=KU

DO 260 J=1,KH

KLT=KLT-1

IC=IC+1

KI=MAXA(K)

ND=MAXA(K+1)-KI-1

IF(ND) 260,260,270

270 KK=MIN0(IC,ND)

C=0.0

DO 280 L=1,KK

280 C=C+A(KI+L)\*A(KLT+L)

A(KLT)=A(KLT)-C

260 K=K+1

240 K=N

B=0.0

DO 300 KK=KL,KU

K=K-1

KI=MAXA(K)

C=A(KK)/A(KI)

IF(ABS(C).LT.1.0E+07) GOTO 290

WRITE(IOUT,2010) N,C

STOP

290 B=B+C\*A(KK)

300 A(KK)=C

A(KN)=A(KN)-B

304 IF(A(KN)) 310,310,200

310 IF(ISH.EQ.0) GOTO 320

IF(A(KN).EQ.0.0) A(KN)=-1.0E-16

GOTO 200

320 WRITE(IOUT,2000) N,A(KN)

STOP

200 CONTINUE

RETURN

2000 FORMAT(//,' Stop-stiffness matrix not positive + definite',//,'no positive& pivot for equation',I4,//,' pivot =',E20.10)

2010 FORMAT(//,' Stop-strum sequence check failed + because of multiplier& growth for column + number',I4,//,' Multiplier = ',E20.8)

END

!回代，求得节点位移

SUBROUTINE REBACK(A,V,MAXA,NN,NWK,NNM)

DIMENSION A(NWK),V(NN,1),MAXA(NNM)

NIP=1

DO IP=1,NIP

DO 400 N=1,NN

KL=MAXA(N)+1

KU=MAXA(N+1)-1

IF(KU-KL) 400,410,410

410 K=N

C=0.0

DO 420 KK=KL,KU

K=K-1

420 C=C+A(KK)\*V(K,IP)

V(N,IP)=V(N,IP)-C

400 CONTINUE

DO 480 N=1,NN

K=MAXA(N)

480 V(N,IP)=V(N,IP)/A(K)

IF(NN.EQ.1)RETURN

N=NN

DO 500 L=2,NN

KL=MAXA(N)+1

KU=MAXA(N+1)-1

IF(KU-KL) 500,510,510

510 K=N

DO 520 KK=KL,KU

K=K-1

520 V(K,IP)=V(K,IP)-A(KK)\*V(N,IP)

500 N=N-1

ENDDO

RETURN

END

!求解杆件内力、支反力和位移

SUBROUTINE DISPLS(NP,NE,NPF,NM,NN,IT,FTOOL,DIST,AE,NAE, X,Y, Z,PP,FF,SG,SM,ME,NR,RR,NF)

DIMENSION IT(3,NP),DIST(NPF),FTOOL(NPF),X(NP),Y(NP),Z(NP),T(2,6),TT(6,2), AE(2,NM),ME(2,NE),NAE(NE), UE(6),U(2),AKE(2,2),FE1(2),FE(6),FF(NPF),PP(NPF), SG(NE),SM(NE),FF2(NPF),RR(2,NR),FL(3\*NR)

SG=0;SM=0;FF=0;FF2=0

DO I=1,NP

DO J=1,NF

LAB=IT(J,I)

IF(LAB.EQ.0) THEN

DIST(3\*(I-1)+J)=0.0

ELSEIF(LAB.GT.0.AND.LAB.LE.NN) THEN

DIST(3\*(I-1)+J)=FTOOL(LAB)

ENDIF

ENDDO

ENDDO

DO IE=1,NE

N1=ME(1,IE);N2=ME(2,IE)

DO J=1,NF

UE(J)=DIST(3\*(N1-1)+J)

UE(3+J)=DIST(3\*(N2-1)+J)

ENDDO

CALL FT(IE,NP,NE,X,Y,Z,ME,T)

CALL FKE(NP,NE,NM,IE,X,Y,Z,ME,NAE,AE,AKE)

U=MATMUL(T,UE)

FE1=MATMUL(AKE,U)

CALL MAT(2,6,T,TT)

FE=MATMUL(TT,FE1)

DO J=1,NF

FF(3\*(N1-1)+J)=FF(3\*(N1-1)+J)+FE(J)

FF(3\*(N2-1)+J)=FF(3\*(N2-1)+J)+FE(3+J)

ENDDO

ISW=NAE(IE)

AO=AE(2,ISW)

SG(IE)=FE1(2)

SM(IE)=FE1(2)/AO

DO I=1,NPF

FF2(I)=FF(I)-PP(I)

ENDDO

ENDDO

DO I=1,NP

DO J=1,NF

LAB=IT(J,I)

IF(LAB.EQ.0)THEN

K=K+1

FL(K)=FF2(3\*(I-1)+J)

ENDIF

ENDDO

ENDDO

WRITE(12,\*)' '

WRITE(12,\*)'\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*'

WRITE(12,\*)'\*\*\*\*\*\*\*\*\*The Results of Calculation\*\*\*\*\*\*\*\*\*\*'

WRITE(12,\*)'\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*'

WRITE(12,600)

WRITE(12,610)(I,DIST(3\*I-2)\*1000,DIST(3\*I-1)\*1000,&

DIST(3\*I)\*1000, I=1,NP)

WRITE(12,620)

WRITE(12,630)(IE,SG(IE),SM(IE)/1000,IE=1,NE)

WRITE(12,640)

WRITE(12,650)(INT(RR(1,I)),FL(3\*I-2),FL(3\*I-1),FL(3\*I),I=1,NR)

600 FORMAT(6X,'The Joint Displacement'/2x,'Joint',6X,'X(mm)',8X,'Y(mm)',6X,'Z(mm)')

610 FORMAT(1X,I4,2X,1P3E12.2)

620 FORMAT(//6X,'The Terminal Forces'/2x,'Member', 6X,'FN(kN)',6X,'σ(MPa)')

630 FORMAT(3X,I4,2X,F8.2,6X,F8.2)

640 FORMAT(//6X,'The Bearing Force'/2x,'Joint',8X,'X',8X,'Y',8X,'Z')

650 FORMAT(2X,I4,2X,3F10.2)

RETURN

END