

# Adding PARAM K6ROT

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In case file:  
PARAM,K6ROT,100.0  
to support this:

1. Define K6ROT variable  
in Source\Modules\PARAMS.f90

```
PARAMS.f90
429 CHARACTER( 8*BYTE) :: SOLLIB = 'SPARSE' !! If 'BANDED ', use LAPACK and ARPACK for eqn soln and eigens.
430 ! If 'SPARSE ', use value determined by parameter SPARSE_FLAVOR
431 ! defined in field 4 of the PARAM, SOLLIB entry
432 -----
433 REAL(DOUBLE) :: K6ROT = 100.0 ! Ratio: (shear thick/total plate thick) for a plate using PCOMP props.
```

2. Read in K6ROT  
in Source\LK1\L1A-BD\BD\_PARAM.f90

```
BD_PARAM.f90
2845 ! K6ROT sets the ...
2846
2847 ELSE IF (JCARD(2)(1:8) == 'K6ROT ') THEN
2848   PARNAM = 'K6ROT '
2849   CALL R8FLD ( JCARD(3), JF(3), R8PARM )
2850   IF (IERRFL(3) == 'N') THEN
2851     IF (R8PARM >= 0) THEN
2852       K6ROT = R8PARM
2853     ELSE
2854       WRITE(ERR,1147) PARNAM,k6ROT,R8PARM
2855       IF (SUPINFO == 'N') THEN
2856         WRITE(F06,1147) PARNAM,k6ROT,R8PARM
2857       ENDIF
2858       K6ROT = R8PARM
2859     ENDIF
2860   ENDIF
2861
2862 CALL BD_IMBEDDED_BLANK ( JCARD,0,3,0,0,0,0,0,0 ) ! Make sure that there are no imbedded blanks in field 3
2863 CALL CARD_FLDS_NOT_BLANK ( JCARD,0,0,4,5,6,7,8,9 ) ! Issue warning if fields 4-9 not blank
2864 CALL CRDERR ( CARD ) ! CRDERR prints errors found when reading fields
2865
2866 write(*,*) 'K6ROT = ', K6ROT
```

3. Use K6ROT  
For TRIA3 element, adding pseudo stiffness Ksita on top of KE

$$K_e = K_e + K_{sita}$$
$$K_{sita} = (10^{-6}) * G * t * |J| * K6ROT$$

Where:  
G: shear modulus  
t: thickness  
J: Jacobian

in Source\EMG\EMG2\ELMOFF.f90  
Get G,t,J and added on top of Ke

```
ELMOFF.f90 x
203
204 ! Set KE = KE1 for 6*ELGP by 6*ELGP terms
205 DO J=1,6*ELGP
206 DO K=1,6*ELGP
207 KE(J,K) = KE1(J,K)
208 ENDDO
209 ENDDO
210
```

Changed to:

```
ELMOFF.f90 x
207 IF (OPT(4) == 'Y') THEN
208 ! 4) KE = element linea stiffness matrix , if OPT(4) = 'Y'
209
210 DO J=1,6*ELGP
211 DO K=1,6*ELGP
212 KE1(J,K) = KE(J,K)
213 ENDDO
214 ENDDO
215
216 ! Mult E'*KE*E
217
218 CALL MATMULT_FFF ( KE1, E , 6*ELGP, 6*ELGP, 6*ELGP, DUM_KE )
219 CALL MATMULT_FFF_T ( E , DUM_KE, 6*ELGP, 6*ELGP, 6*ELGP, KE1 )
220
221 ! Set KE = KE1 for 6*ELGP by 6*ELGP terms
222 if (isDebug==1) then
223 write(*,*) '-----'
224 write(*,*) 'ELMOFF:'
225 write(*,*) 'calculate Ksita (pseudo stiffness)'
226 write(*,*) 'Ksita = 10^(-6)*G*t*|J|*K^ROT'
227 write(*,*) 'NMATL = ',NMATL
228 write(*,*) 'G (Shear modulus) = RMATL(NMATL,2) = ', RMATL(NMATL,2)
229 write(*,*) 'NPSHEL = ',NPSHEL
230 write(*,*) 'T (thickness) = RPSHEL(NPSHEL,1) = ', RPSHEL(NPSHEL,1)
231 end if
232
```

```

ELMOFF.f90
233      !Get |J|
234
235      !below code copied from QDEL1.f90
236      !copy start
237      ! Calculate side diffs
238
239      XSD(1) = XEL(1,1) - XEL(2,1)           ! x coord diffs (in local elem coords)
240      XSD(2) = XEL(2,1) - XEL(3,1)
241      XSD(3) = XEL(3,1) - XEL(4,1)
242      XSD(4) = XEL(4,1) - XEL(1,1)
243
244      YSD(1) = XEL(1,2) - XEL(2,2)           ! y coord diffs (in local elem coords)
245      YSD(2) = XEL(2,2) - XEL(3,2)
246      YSD(3) = XEL(3,2) - XEL(4,2)
247      YSD(4) = XEL(4,2) - XEL(1,2)
248
249      IF ((DEBUG(6) > 0) .AND. (WRT_BUG(0) > 0)) THEN
250          WRITE(BUG,*) ' Element side differences in x, y coords:'
251          WRITE(BUG,*) ' -----'
252          WRITE(BUG,98761) XSD(1), YSD(1)
253          WRITE(BUG,98762) XSD(2), YSD(2)
254          WRITE(BUG,98763) XSD(3), YSD(3)
255          WRITE(BUG,98764) XSD(4), YSD(4)
256          WRITE(BUG,*)
257      ENDIF

```

```

ELMOFF.f90
259      ! Calculate area by Gaussian integration
260
261      AREA = ZERO
262      CALL ORDER_GAUSS ( 2, SSS, HHH )
263      DO I=1,2
264          DO J=1,2
265              CALL JAC2D ( SSS(I), SSS(J), XSD, YSD, 'N', JAC, JACI, DETJ )
266              AREA = AREA + HHH(I)*HHH(J)*DETJ
267          ENDDO
268      ENDDO
269
270      ! If AREA <= 0, set error and return
271
272      IF (AREA < EPS1) THEN
273          NUM_EMG_FATAL_ERRS = NUM_EMG_FATAL_ERRS + 1
274          FATAL_ERR = FATAL_ERR + 1
275          IF (WRT_ERR > 0) THEN
276              WRITE(ERR,1925) EID, TYPE, 'AREA', AREA
277              WRITE(F06,1925) EID, TYPE, 'AREA', AREA
278          ELSE
279              IF (NUM_EMG_FATAL_ERRS <= MEFE) THEN
280                  ERR_SUB_NAM(NUM_EMG_FATAL_ERRS) = SUBR_NAME
281                  EMG_IFE(NUM_EMG_FATAL_ERRS,1) = 1925
282                  EMG_RFE(NUM_EMG_FATAL_ERRS,1) = AREA
283              ENDIF
284          ENDIF
285          if (isDebug==1) write(*,*) 'AREA <= 0 ++++++'
286          RETURN
287      ENDIF
288      !copy end

```

ELMOFF190

```
290 Ksita=10.0**(-6.0)*RMATL(NMATL,2)*RPSHEL(NPSHEL,1)*abs(DETJ)*K6ROT
291 if (isDebug==1) then
292   write(*,*) 'abs(DETJ) = ', abs(DETJ)
293   write(*,*) 'Ksita = ', Ksita
294 end if
295
296 !INTEGER(LONG)          :: ELGP          = 0
297 !The number of grid points that the the current elem connects to
298 DO J=1,6*ELGP
299   if (isDebug==1) write(*,*) 'J = ',J
300   DO K=1,6*ELGP
301     KE(J,K) = KEL(J,K)+Ksita
302     if (isDebug==1) write(*,*) 'K = ',K, 'KE(J,K) = ',KE(J,K), 'KEL(J,K) = ',KEL(J,K), 'Ksita = ',Ksita
303   ENDDO
304 ENDDO
305
306 ENDIF
```