

Chapter 3 KENLAYER Computer Program

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1 (1) NPROB
Problem 3.1
2 0 1 1 (3) MATL NDAMA NPY NLG
0.001 (4) DEL
2 1 80 1 0 (5) NL NZ ICL NSTD NUNIT
12 (6) TH
0.35 0.35 (7) PR
0 (8) ZC
1 (9) NBOND
3000 3000 (11) E
0 (13) LOAD
6 100 (14) CR CP
1 (16) NR
0 (17) RC
2 2 (25) NOLAY ITENOL
1 0 2 0 (26) LAYNO NCLAY
12 12 (27) ZCNOL
0 0 0 0 0.01 (28) RCNOL XCNOL YCNOL SLD DELNOL
1 (29) RELAX
145 0 (30) GAM
0.55 0.6 (31) K2 K0
0.55 0.6 (31) K2 K0
0 3000 (33) PHI K1
0 3000 (33) PHI K1
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Answer: 0.05339 in.

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1 (1) NPROB
PROBLEM 3.2
1 0 1 1 (3) MATL NDAMA NPY NLG
0.001 (4) DEL
2 2 80 5 0 (5) NL NZ ICL NSTD NUNIT
8 (6) TH
0.5 0.5 (7) PR
0 8 (8) ZC
1 (9) NBOND
200000 10000 (11) E
0 (13) LOAD
6.308 80 (14) CR CP
1 (16) NR
0 (17) R
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*Answer: 0.02512 in.
0.02347 in.
11.394 psi*

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1 (1) NPROB
PROBLEM 3.3
1 0 1 1 (3) MATL NDAMA NPY NLG
0.001 (4) DEL
2 1 80 9 0 (5) NL NZ ICL NSTD NUNIT
8 (6) TH
0.5 0.5 (7) PR
8 (8) ZC
1 (9) NBOND
1500000 30000 (11) E
2 (13) LOAD
12.616 100 (14) CR CP
1 (19) NPT
60 28 0 0 (20) XW YW XPT
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*Answer: -2.065E-04
0.05709 in.*

1 (1) NPROB
 PROBLEM 3.4
 1 0 1 1 (3) MATL NDAMA NPY NLG
 0.001 (4) DEL
 3 2 80 9 0 (5) NL NZ ICL NSTD NUNIT
 5.75 23 (6) TH
 0.5 0.5 0.5 (7) PR
 5.75 28.7501 (8) ZC
 1 (9) NBOND
 400000 20000 10000 (11) E
 0 (13) LOAD
 9.213 150 (14) CR CP
 1 (16) NR
 0 (17) RC

ANSWER:
 -7.259E-04
 1.065E-03

2 (1) NPROB
 PROBLEM 3.5(a)
 2 0 1 1 (3) MATL NDAMA NPY NLG
 0.001 (4) DEL
 4 2 80 9 0 (5) NL NZ ICL NSID NUNIT
 8 2 2 (6) TH
 0.45 0.3 0.3 0.4 (7) PR
 8 12.0001 (8) ZC
 1 (9) NBOND
 500000 30000 15000 5000 (11) E
 0 (13) LOAD
 4.5 75 (14) CR CP
 1 (16) NR
 0 (17) RC
 3 15 (25) NOLAY ITENOL
 2 0 3 0 4 1 (26) LAYNO NCLAY
 9 11 13 (27) ZCNOL
 0 0 0 0 0.01 (28) RCNOL XCNOL YCNOL SLD DELNOL
 0.5 (29) RELAX
 145 135 135 130 (30) GAM
 0.5 0.6 (31) K2 K0
 0.5 0.6 (31) K2 K0
 6.2 1110 178 0.8 (31) K2 K3 K4 K0
 0 10000 (33) PHI K1
 0 10000 (33) PHI K1
 1827 7682 3020 (33) EMIN EMAX K1

ANSWER:
 -1.019E-04
 2.845E-04

PROBLEM 3.5(b)
 2 0 1 1 (3) MATL NDAMA NPY NLG
 0.001 (4) DEL
 3 2 80 9 0 (5) NL NZ ICL NSTD NUNIT
 8 4 (6) TH
 0.45 0.3 0.4 (7) PR
 8 12.0001 (8) ZC
 1 (9) NBOND
 500000 20000 5000 (11) E
 0 (13) LOAD
 4.5 75 (14) CR CP
 1 (16) NR
 0 (17) RC
 2 15 (25) NOLAY ITENOL
 2 0 3 1 (26) LAYNO NCLAY
 9 13 (27) ZCNOL
 0 0 0 0 0.01 (28) RCNOL XCNOL YCNOL SLD DELNOL
 0.5 (29) RELAX
 145 135 130 (30) GAM
 0.5 0.6 (31) K2 K0
 6.2 1110 178 0.8 (31) K2 K3 K4 K0
 10000 10000 (33) PHI K1
 1827 7682 3020 (33) EMIN EMAX K1

ANSWER:
 -1.040E-04
 2.853E-04

1 (1) NPROB
 PROBLEM 3.6
 2 1 1 1 (3) MATL NDAMA NPY NLG
 0.001 (4) DEL
 3 0 80 9 0 (5) NL NZ ICL NSTD NUNIT
 4 8 (6) TH
 0.4 0.3 0.45 (7) PR
 1 (9) NBOND
 400000 10000 10000 (11) E
 1 (13) LOAD
 4.5 75 (14) CR CP
 3 (19) NPT
 0 13.5 0 0 0 4.5 0 6.75 (20) XW YW XPT
 1 15 (25) NOLAY ITENOL
 2 0 (26) LAYNO NCLAY
 6 (27) ZCNOL
 0 0 0 0 0.01 (28) RCNOL XCNOL YCNOL SLD DELNOL
 0.5 (29) RELAX
 145 135 0 (30) GAM
 0.5 0.6 (31) K2 K0
 8000 8000 (33) PHI K1
 1 1 (46) NLBT NLTC
 1 (47) LNBT
 3 (48) LNTC
 36500 (49) TNLR
 0.0796 3.291 0.854 (50) FT1 FT2 FT3
 1.365E-09 4.477 (51) FT4 FT5

answer: 5.49 years

1 (1) NPROB
 PROBLEM 3.7
 2 1 1 1 (3) MATL NDAMA NPY NLG
 0.001 (4) DEL
 6 0 80 9 0 (5) NL NZ ICL NSTD NUNIT
 4 2 2 2 2 (6) TH
 0.4 0.3 0.3 0.3 0.3 0.45 (7) PR
 1 (9) NBOND
 400000 50000 40000 30000 20000 10000 (11) E
 1 (13) LOAD
 4.5 75 (14) CR CP
 3 (19) NPT
 0 13.5 0 0 0 4.5 0 6.75 (20) XW YW XPT
 4 15 (25) NOLAY ITENOL
 2 0 3 0 4 0 5 0 (26) LAYNO NCLAY
 5 7 9 11 (27) ZCNOL
 0 0 0 0 0.01 (28) RCNOL XCNOL YCNOL SLD DELNOL
 0.5 (29) RELAX
 145 135 135 135 135 130 (30) GAM
 0.5 0.6 (31) K2 K0
 0.5 0.6 (31) K2 K0
 0.5 0.6 (31) K2 K0
 0.5 0.6 (31) K2 K0
 0 8000 (33) PHI K1
 0 8000 (33) PHI K1
 0 8000 (33) PHI K1
 0 8000 (33) PHI K1
 1 1 (46) NLBT NLTC
 1 (47) LNBT
 6 (48) LNTC
 36500 (49) TNLR
 .0796 3.291 .854 (50) FT1 FT2 FT3
 1.365E-09 4.477 (51) FT4 FT5

answer: 5.08 years

1 (1) NPROB
 PROBLEM 3.8
 2 0 1 1 (3) MATL NDAMA NPY NLG
 0.001 (4) DEL
 3 1 80 9 0 (5) NL NZ ICL NSTD NUNIT
 4 8 (6) TH
 0.4 0.3 0.45 (7) PR
 6 (8) ZC
 1 (9) NBOND
 400000 8000 10000 (11) E
 1 (13) LOAD
 4.5 75 (14) CR CP
 1 (19) NPT
 0 13.5 0 6.75 (20) XW YW XPT
 1 15 (25) NOLAY ITENOL
 2 0 (26) LAYNO NCLAY
 6 (27) ZCNOL
 0 0 0 0 0.01 (28) RCNOL XCNOL YCNOL SLD DELNOL
 0.5 (29) RELAX
 145 135 0 (30) GAM
 0.5 0.6 (31) K2 K0
 8000 8000 (33) PHI KI

ANSWER: $2.956E+04$ psi
 14,003 psi
 1.113 psi
 -3,083 psi

1 (1) NPROB
 PROBLEM 3.9
 3 0 1 1 (3) MATL NDAMA NPY NLG
 0.001 (4) DEL
 2 1 80 1 0 (5) NL NZ ICL NSTD NUNIT
 8 (6) TH
 0.5 0.5 (7) PR
 0 (8) ZC
 1 (9) NBOND
 0 10000 (11) E
 0 (13) LOAD
 6 75 (14) CR CP
 1 (16) NR
 0 (17) RC
 0 (36) DUR
 1 1 (37) NVL LNV
 6 (38) NTYME
 0 0.01 0.1 1 10 100 (39) TYME
 0.113 70 (41) BETA TEMPREF
 0.000002 2.37E-06 3.81E-06 4.38E-06 4.57E-06 0.0000046 (42) CREEP
 70 (44) TEMP

ANSWER: 0.01561 in., 0.01657 in.,
 0.01957 in., 0.02056 in.,
 0.02087 in., 0.02092 in.

1 (1) NPROB
 PROBLEM 3.10
 3 1 1 1 (3) MATL NDAMA NPY NLG
 0.001 (4) DEL
 2 0 80 9 0 (5) NL NZ ICL NSTD NUNIT
 8 (6) TH
 0.5 0.5 (7) PR
 1 (9) NBOND
 0 10000 (11) E
 0 (13) LOAD
 6 75 (14) CR CP
 1 (16) NR
 0 (17) RC
 0.1 (36) DUR
 1 1 (37) NVL LNV
 11 (38) NTYME
 0.001 0.003 0.01 0.03 0.1 0.3 1 3 10 30 100 (39) TYME

ANSWER: 21.09 years

0.113 70 (41) BETA TEMPREF
 2.04E-06 2.12E-06 2.37E-06 2.92E-06 3.81E-06 4.19E-06 4.38E-06
 4.49E-06 4.57E-06 0.0000046 0.0000046 (42) CREEP
 70 (44) TEMP
 1 1 (46) NLBT NLTC
 1 (47) LNBT
 2 (48) LNTC
 100000 (49) TNLR
 0.0796 3.291 0.854 (50) FT1 FT2 FT3
 1.365E-09 4.477 (51) FT4 FT5

1 (1) NPROB
 PROBLEM 3.11
 1 (1) 1 1 (3) MATL NDAMA NPY NLG
 0.001 (4) DEL
 3 0 80 9 0 (5) NL NZ ICL NSTD NUNIT
 6 8 (6) TH
 0.4 0.35 0.45 (7) PR
 1 (9) NBOND
 740000 23000 11000 (11) E
 2 (13) LOAD
 4.52 70 (14) CR CP
 3 (19) NPT
 48 13.5 0 0 0 3.375 0 6.75 (20) XW YW XPT
 1 1 (46) NLBT NLTC
 1 (47) LNBT
 3 (48) LNTC
 200000 (49) TNLR
 0.0796 3.291 0.854 (50) FT1 FT2 FT3
 1.365E-09 4.477 (51) FT4 FT5

*NDAMA should be 2 to get the following:
 Damage ratio due to max. tensile
 strain = 0.04357 and that due
 to differential strain = 0.008804*

answer: 19.09 years

3 (1) NPROB
 Problem 3-12(a)
 2 1 1 1 (3) MATL NDAMA NPY NLG
 0.001 (4) DEL
 7 2 80 9 0 (5) NL NZ ICL NSTD NUNIT
 2 2 2 2 2 2 (6) TH
 0.35 0.35 0.35 0.35 0.35 0.35 0.45 (7) PR
 1 (9) NBOND
 120000 100000 80000 68000 40000 20000 5000 (11) E
 0 (13) LOAD
 6 100 (14) CR CP
 1 (16) NR
 0 (17) RC
 7 15 (25) NOLAY ITENOL
 1 0 2 0 3 0 4 0 5 0 6 0 7 1 (26) LAYNO NCLAY
 1 3 5 7 9 11 13 (27) ZCNOL
 0 0 0 0 0.01 (28) RCNOL XCNOL YCNOL SLD DELNOL
 0.5 (29) RELAX
 135 135 135 135 135 135 115 (30) GAM
 0.5 0.6 (31) K2 K0
 0.5 0.6 (31) K2 K0
 0.5 0.6 (31) K2 K0
 0.5 0.6 (31) K2 K0
 0.5 0.6 (31) K2 K0
 0.5 0.6 (31) K2 K0
 6.2 1110 178 0.8 (31) K2 K3 K4 K0
 0 10000 (33) PHI K1
 0 10000 (33) PHI K1
 0 10000 (33) PHI K1
 0 10000 (33) PHI K1
 0 10000 (33) PHI K1

0 10000 (33) PHI K1
1827 7682 3020 (33) EMIN EMAX K1
0 1 (46) NLBT NLTC
7 (48) LNTC
1000 (49) TNLR
1.365E-09 4.477 (51) FT4 FT5

answer: 1.89 years

Problem 3-12(b)

2 2 1 1 (3) MATL NDAMA NPY NLG
0.001 (4) DEL
2 2 80 9 0 (5) NL NZ ICL NSTD NUNIT
12 (6) TH
0.35 0.45 (7) PR
1 (9) NBOND
10000 3020 (11) E
0 (13) LOAD
6 100 (14) CR CP
1 (16) NR
0 (17) RC
2 15 (25) NOLAY ITENOL
1 0 2 1 (26) LAYNO NCLAY
4 13 (27) ZCNOL
0 0 0 0 0.01 (28) RCNOL XCNOL YCNOL SLD DELNOL
0.5 (29) RELAX
135 115 (30) GAM
0.5 0.6 (31) K2 K0
6.2 1110 178 0.8 (31) K2 K3 K4 K0
10000 10000 (33) PHI K1
1827 7682 3020 (33) EMIN EMAX K1

answer: 24.22 years

0 1 (46) NLBT NLTC
2 (48) LNTC

1000 (49) TNLR

1.365E-09 4.477 (51) FT4 FT5

Problem 3-12(c)

2 2 1 1 (3) MATL NDAMA NPY NLG
0.001 (4) DEL
2 2 80 9 0 (5) NL NZ ICL NSTD NUNIT
12 (6) TH
0.35 0.45 (7) PR
1 (9) NBOND
10000 3020 (11) E
0 (13) LOAD
6 100 (14) CR CP
1 (16) NR
0 (17) RC
2 15 (25) NOLAY ITENOL
1 0 2 1 (26) LAYNO NCLAY
6 13 (27) ZCNOL
0 0 0 0 0.01 (28) RCNOL XCNOL YCNOL SLD DELNOL
0.5 (29) RELAX
135 115 (30) GAM
0.5 0.6 (31) K2 K0
6.2 1110 178 0.8 (31) K2 K3 K4 K0
40 10000 (33) PHI K1
1827 7682 3020 (33) EMIN EMAX K1
0 1 (46) NLBT NLTC
2 (48) LNTC
1000 (49) TNLR
1.365E-09 4.477 (51) FT4 FT5

answer: 7.75 years

2 (1) NPROB
 PROBLEM 3-13(a)
 3 1 1 1 (3) MATL NDAMA NPY NLG
 0.001 (4) DEL
 2 2 80 9 0 (5) NL NZ ICL NSTD NUNIT
 10 (6) TH
 0.5 0.5 (7) PR
 1 (9) NBOND
 0 0 (11) E
 0 (13) LOAD
 10 100 (14) CR CP
 1 (16) NR
 0 (17) RC
 0.1 (36) DUR
 2 1 2 (37) NVL LNV
 7 (38) NTYME
 0.01 0.03 0.1 0.3 1 3 10 (39) TYME
 0 0 (41) BETA TEMPREF
 1.02E-06 1.06E-06 1.21E-06 1.59E-06 2.68E-06 4.84E-06 9.27E-06 (42) CREEP
 0 0 (41) BETA TEMPREF
 0.000105 0.000289 0.000732 0.00125 0.00195 0.00359 0.00732 (42) CREEP
 0 0 (44) TEMP
 1 1 (46) NLBT NLTC
 1 (47) LNBT
 2 (48) LNTC
 60000 (49) TNLR
 0.0796 3.291 0.854 (50) FT1 FT2 FT3
 1.365E-09 4.477 (51) FT4 FT5

ANSWER: 11.62 years

PROBLEM 3-13(b)
 3 1 1 1 (3) MATL NDAMA NPY NLG
 0.001 (4) DEL
 2 2 80 9 0 (5) NL NZ ICL NSTD NUNIT
 10 (6) TH
 0.5 0.5 (7) PR
 1 (9) NBOND
 0 0 (11) E
 0 (13) LOAD
 10 100 (14) CR CP
 1 (16) NR
 0 (17) RC
 0.2 (36) DUR
 2 1 2 (37) NVL LNV
 7 (38) NTYME
 0.01 0.03 0.1 0.3 1 3 10 (39) TYME
 0 0 (41) BETA TEMPREF
 1.02E-06 1.06E-06 1.21E-06 1.59E-06 2.68E-06 4.84E-06 9.27E-06 (42) CREEP
 0 0 (41) BETA TEMPREF
 0.000105 0.000289 0.000732 0.00125 0.00195 0.00359 0.00732 (42) CREEP
 0 0 (44) TEMP
 1 0 (46) NLBT NLTC
 2 (47) LNBT
 60000 (49) TNLR
 0.0796 3.291 0.854 (50) FT1 FT2 FT3

ANSWER: 7.54 years

1 (1) NPROB
PROBLEM 3-14
4 1 2 2 (3) MATL NDAMA NPY NLG
0.001 (4) DEL
6 0 80 9 0 (5) NL NZ ICL NSTD NUNIT
6 2 2 2 2 (6) TH
0.4 0.35 0.35 0.35 0.35 0.45 (7) PR
1 (9) NBOND
0 7500 7500 7500 7500 3020 (11) E
0 10000 10000 10000 10000 12340 (11) E
0 (13) LOAD
5.35 100 (14) CR CP
1 (16) NR
0 (17) RC
1 (13) LOAD
4.52 70 (14) CR CP
3 (19) NPT
0 13.5 0 0 0 3.375 0 6.75 (20) XW YW XPT
5 15 (25) NOLAY ITENOL
2 0 3 0 4 0 5 0 6 1 (26) LAYNO NCLAY
7 9 11 13 15 (27) ZCNOL
0 0 6.75 0 0.01 (28) RCNOL XCNOL YCNOL SLD DELNOL
0.5 0.5 (29) RELAX
145 135 135 135 135 125 (30) GAM
0.5 0.6 (31) K2 K0
0.5 0.6 (31) K2 K0
0.5 0.6 (31) K2 K0
0.5 0.6 (31) K2 K0
6.2 1110 178 0.8 (31) K2 K3 K4 K0
0 7500 (33) PHI K1
0 7500 (33) PHI K1
0 7500 (33) PHI K1
0 7500 (33) PHI K1
1827 7682 3020 (33) EMIN EMAX K1
0 10000 (33) PHI K1
0 10000 (33) PHI K1
0 10000 (33) PHI K1
0 10000 (33) PHI K1
7605 17002 12340 (33) EMIN EMAX K1
0.1 (36) DUR
1 1 (37) NVL LNV
11 (38) NTYME
0.001 0.003 0.01 0.03 0.1 0.3 1 3 10 30 100 (39) TYME
0.113 70 (41) BETA TEMPREF
3.7E-07 5.2E-07 8.6E-07 1.45E-06 0.0000025 0.000004 0.0000062 0.0000086
0.000012 0.000016 0.000019 (42) CREEP
60 (44) TEMP
80 (44) TEMP
1 1 (46) NLBT NLTC
1 (47) LNBT
3 (48) LNTC
9125 18250 (49) TNLR
9125 18250 (49) TNLR
0.0796 3.291 0.854 (50) FT1 FT2 FT3
1.365E-09 4.477 (51) FT4 FT5

Answer: 25.15 years