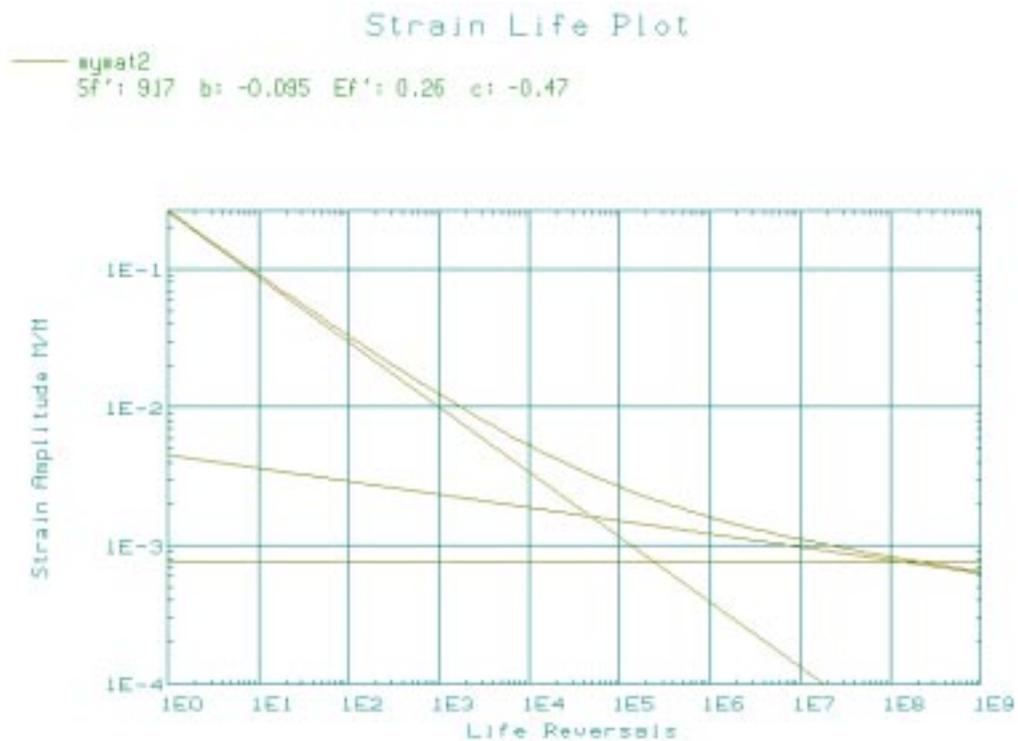


LESSON 2

Materials Data and Using the Materials Database Manager, PFMAT



Objectives:

- Increase your familiarity with the P/FATIGUE material data base manager



Exercise Description:

This exercise is designed to increase your familiarity with the P3/FATIGUE material data base manager. The materials database to which it interfaces has a structure which supports all the types of materials data (listed below) associated with the three methods of fatigue life estimation:

- monotonic data
- stress-life data
- strain-life data
- cyclic stress-strain data
- multi-environment crack growth data

By using this database, all users of P3/FATIGUE have access to all the necessary data in one central location.

PFMAT may be accessed from the P3/FATIGUE Main Menu by picking option 1 (within PATRAN 3); it may be run outside of PATRAN 3 by typing **pfmat**; or it may be operated in batch.

The objective of this exercise is to see how to input the materials data in the database by using PFMAT. You will run PFMAT in two ways:

- outside of PATRAN interactively
- operated in batch mode

A component was tested under a constant amplitude, fully reversed loading conditions to produce S-N data as shown in Table 2-1.

To ensure proper execution of this exercise, make sure you are in the **ex02** directory of your PAT318 account.

Step 1 Problem Description

Table 2-1 Material Properties for MYMAT

Material Properties	MYMAT
Stress Range Intercept, SRI1 (MPa)	10710
Slope b1,	-0.3333
Transition life, NC1 (cycles)	1.0E7
Slope b2,	-0.2
Fatigue Limit, FL (MPa)	10
Standard error, SE	0.2
Young's Modulus, E (MPa)	205800
UTS (MPa)	700
Ratio R	-1

Step 2 Entering Data

Run PFMAT outside PATRAN interactively to create this material by typing the following commands. As with PTIME, you may accomplish these tasks by using the mouse if you are using the Xwindow driver or you may use the hot keys (first capitalized letter) and arrow keys to select options:

- pfmat** Starts PFMAT program.
- Create** Create option
- data set 1** You may have two materials loaded from the database into the database manager at once. We will create this material entry in data set 1.
- <RETURN>** No password creates a local copy of database.

Now you are in the position where you need to input the material parameters. You are presented with various screen pages in which you must enter these parameters. The first page consists of the material name and descriptions.

- Primary name** **MYMAT** - enter the name of the material you are creating.
- Alternative names** You may give your material other names if you wish.

Reference You may enter a reference.

Comments You may enter two lines of comments.

When each page is filled in appropriately press **F1** or click on **OK** in the top header bar.

The second page consists of generic materials data. It should be noted that the units for all the material parameters are in the SI unit system. (Stress in MPa). You can change the units in which you work by setting the preferences from the PFMAT main menu. The only parameters fields that need to be filled out on the second page are:

UTS **700** MPa - Ultimate tensile strength.

E **205800** MPa - Young's Modulus.

Note: UTS and E must be present when specifying generic data.

Press **F1** to accept this page of data.

Since we are interested in total life analysis, then you only need to input the stress data on the third page. (Use the arrow, the mouse, or return keys to move to the correct field.)

SR11: **10710** MPa - Stress Range Intercept

b1: **-0.3333** - First fatigue strength exponent.

Nc1: **1.0E7** cycles - Fatigue transition point.

b2: **-0.2** - Second fatigue strength exponent.

FL: **10** MPa - Stress range fatigue limit.

SE: **0.2** - Standard error of Log(N).

Press **F1** to accept the data on this page.

Since you have no fracture mechanics (LEFM) data, press **F1** to accept the last page by leaving it empty. The data is now entered and a new entry will exist in the database under the name MYMAT. To confirm its existence, press **Return** to go back to the main menu and note the entry on the top of the window just below the top header bar.

Press **X** to exit from PFMAT.

The whole of PFMAT cannot be operated in batch. However, to automate the creation of the material database, the **C**reate option may be operated from batch mode. This will be useful for users who have an existing materials database in ASCII format and wish to transfer their data to P/FATIGUE.

The batch file command line points to a file which contains a list of keywords, materials parameters and values required to describe those particular materials. The command below references to the ASCII file **mat1.mat**.

pfmat @mat1.mat

The format of this ASCII file is:

/<keyword>=<value>

The possible keywords and their function are described below:

- | | |
|---------------------|--|
| /OPT ion= | Batch operation is restricted to the Create and eXit options of PFMAT. This keyword is mandatory and must appear as the first and last lines in the file.
(/OPT= CREATE, /OPT=EXIT) |
| /INDB = | This is mandatory. It means, put the material IN the DAtabase.
(/INDB=YES) |
| /MATNO = | This specifies whether you are loading material data into material dataset number 1 or 2. This keyword is optional.
(/MATNO=1) |
| /PASS word= | If you wish to load the data into the central database you must supply the password. This keyword is optional and a local database must be present if it is not supplied.
(/PASS=MYDATA) |
| /PRI mary= | This is the primary name you are giving to the material you are loading. This keyword is mandatory.
(/PRI=MYMAT) |
| /SEC ondary= | This is the secondary name you are giving to the material you are loading. This keyword is optional and you may have up to |

**Step 3 Batch
Operation**

- nine.
 (/SEC=MEGALLOY)
- /REFERence= A character string up to 64 characters.
 (/REF=From some handbook)
- /COMment= A character string up to 64 characters and a
 second one up to 32 characters.
 (/COM=High strength steel)
- /TYPE= A material code. See the User Guide for a
 description.
 (/TYPE=99)

The next set of keywords are generic data. UTS and E *must* be present when specifying generic data. The units must be compatible with the preference setting in PFMAT.

- /YS= Yield strength in stress units.
 (/YS=324)
- /UTS= Ultimate tensile strength in stress units.
 (/UTS=552)
- /E1= Young's Modulus in stress units.
 (/E1=2.034E5)
- /K1C= Fracture toughness in units of MPa*m^{1/2} or
 KSI*inch^{1/2}.
 (/K1C=121)
- /N1= Work hardening exponent.
 (/N1=0.21)
- /K2= Work hardening coefficient in units of
 stress.
 (/K1=965)
- /ME= Elastic Poisson's ratio.
 (/ME=0.3)
- /MP= Plastic Poisson's ratio.
 (/MP=0.5)

The next set of keywords define the strain life (ϵ -N) dataset. Either all must be present or none when defining strain life data.

- /ESF = Fatigue strength coefficient in stress

	units. (/ESF=917)
/EB =	Fatigue strength exponent. (/EB=-0.095)
/EC =	Fatigue ductility exponent. (/EC=-0.47)
/EF =	Fatigue ductility coefficient. (/EF=0.26)
/EN1 =	Cyclic Hardening exponent. (/EN1=0.19)
/EK =	Cyclic strength coefficient in stress units. (/EK=1103)
/ENC =	Cut-off (reversals). (/ENC=2E8)
/ESE =	Standard Error of Log (N) (/ESE=0)

The next set of keywords define the stress life (S-N) dataset. Either all must be present or none when defining strain life data.

/SNT=	S-N type - Either Material or Component. (/SNT=M)
/SRI1 =	Stress range intercept in stress units. (/SRI1=8948)
/B1 =	First fatigue strength exponent. (/B1=-0.2)
/NC1 =	Fatigue transition point (cycles). (/NC1=2E8)
/B2 =	Second fatigue strength exponent. (/B2=-0.1)
/SFL =	Stress range fatigue limit in stress units. (/SFL=10)
/SE =	Standard error of Log (N) (/SE=0.137)
/RRAT =	R ratio (/RRA=-1)

The next set of keywords define the linear elastic fracture mechanics (LEFM) dataset. Either all must be present or none when defining strain life data.

/ENV =	Environment, max 30 chars. (/ENV=air)
/FL =	Unnotched fatigue strength in stress units. (/FL=226)
/C =	Paris law coefficient (m/cycle or inches/cycle). (/C=3E-12)
/M =	Paris law exponent. (/M=3.43)
/D0 =	Delta K threshold at R=0 (MPa*m ^{1/2} or KSI*inch ^{1/2}). (/D0=8)
/D1 =	Delta K threshold at R->1 (MPa*m ^{1/2} or KSI*inch ^{1/2}). (/D1=2)
/RC =	Stress ratio at threshold knee. (/RC=0.75)
/K1SCC =	Stress corrosion threshold (MPa*m ^{1/2} or KSI*inch ^{1/2}) (/K1S=121)

The file **MAT1.MAT** is an ASCII file which contains the following keywords:

```
/OPT = CREATE
/INDB = YES
/PASS=
/PRI=MYMAT2
/SEC=MEGALLOY
/REF=Data from somewhere
/COM=Example for class
/MATNO=2
/TYPE=99
/UTS=552
/E1=2.034E5
/YS=324
/K1C=121
/N1=0.21
/K2=965
/ME=0.3
/MP=0.5
/ESF=917
/EB=-0.095
/EC=-0.47
/EF=0.26
/EN1=0.19
/EK=1103
/ENC=2E8
/ESE=0
/SNT=M
/SRI1=1102
/B1=0
/NC1=1E2
/B2=-0.602
/SFL=0
/SE=0
/RRAT=-1
/ENV=Air
/FL=226
/C=3E-12
/M=3.43
/D0=8
/D1=2
/RC=0.75
/K1S=121
/ENV=Sea Water
/FL=200
```

```
/C=2E-12  
/M=2.43  
/D0=7  
/D1=3  
/RC=0.85  
/K1SCC=100  
/OPT = EXIT
```

Read this file into PFMAT by issuing the following command:

PFMAT @mat1.mat

Then enter PFMAT and see if the material was loaded properly. You should see both the material you added earlier manually and the one you entered in batch mode. (Check the upper left corner below the top header bar.) If one or both are not there, load them into the database manager by using the **Load** option. Load the material MYMAT into data set one and MYMAT2 into dataset 2.

Check to see that the data was loaded properly also by selecting the **Tabulate** option and subsequently **Data values** from the PFMAT main menu. You will be presented with a number of pages tabulating the data values for each material loaded into the database manager. You may also experiment with the material curve plots. However we will go into more detail on these in later exercises.

If you have problems reading this file, check the file called batlog.lst, which gives a detailed account of which batch commands were processed and if there were any errors. One error you may encounter is datavalues not being in the proper range. One way to get around this is to set the material checking flag off under the **Preferences** option in the main menu.

