

## Stress Concentrations and Plasticity Corrections. Part 2

Exercise with a fitted strain-life-stress curve

- Step 1. Get the fitted curve for the merged AA-7075-T6xx data and place it into a local folder. The file is linked on this page:  
<http://fde.uwaterloo.ca/Fde/Materials/Alum/AA7xxx/aa7xxx.html>

In my case, after a view source, I copy/pasted the file into a local file called "merged7075T6xx\_fitted.html"

- Step 2. For plotting only, create a file that draws the elastic modulus line

```
# emod69980mpa.txt
# A file that plots elastic line
    0      0
0.002858 200
0.008574  600
0.010003 700
0.014290 1000.
```

In my case I placed the above data into a text file called "emod69980mpa.txt"

Step 3. Plot the two files in the same gnuplot window. You can use the gnuplot commands:

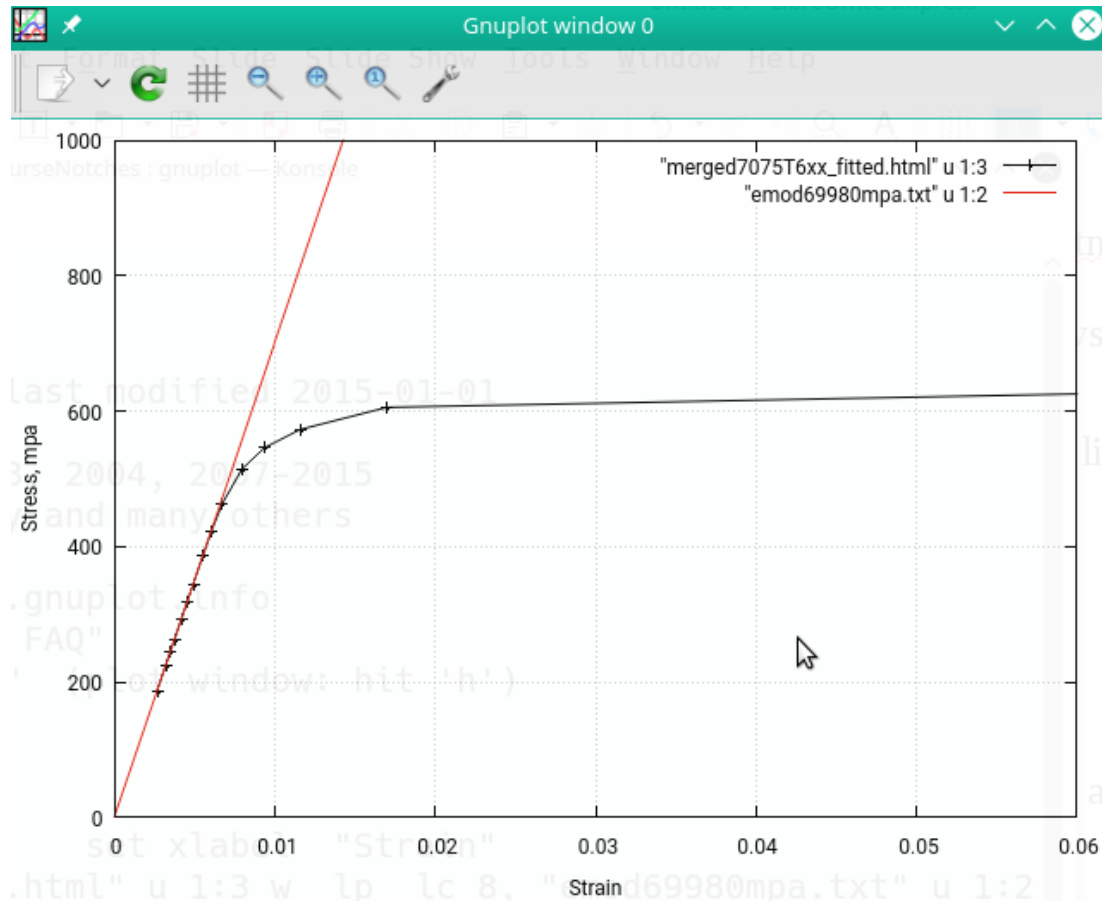
```
set grid
```

```
set ylabel "Stress, mpa" ; set xlabel "Strain"
```

```
set xrange [0.0:0.06]
```

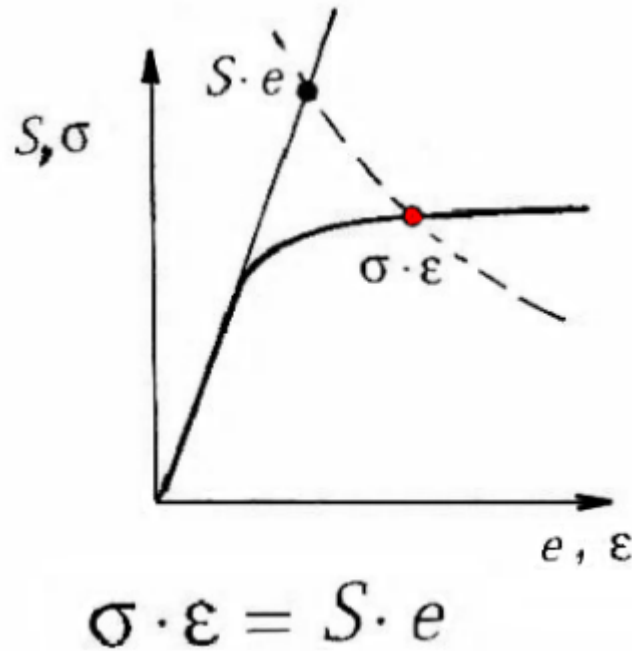
```
plot "merged7075T6xx_fitted.html" u 1:3 w lp lc 8, "emod69980mpa.txt" u 1:2 w l lc 7
```

You should end up with a plot that looks like this:



Step 4 : For an elastic FEA stress of 650 mpa compute the equal energy (Stress \* Strain) on the cyclic curve.

i.e. Solve the formula



Note that in gnuplot the cursor co-ordinates are displayed in the lower right corner of the window.

-or use a spreadsheet like libreoffice or Excel

## AA 7xxx Series Aluminum Fatigue Data file index :

Web Page: <http://fde.uwaterloo.ca/Fde/Material/Alum/AA7xxx/aa7xxx.html>

Updates: Aug.20 1999, Mar1-2009, Oct2010, Jan2012

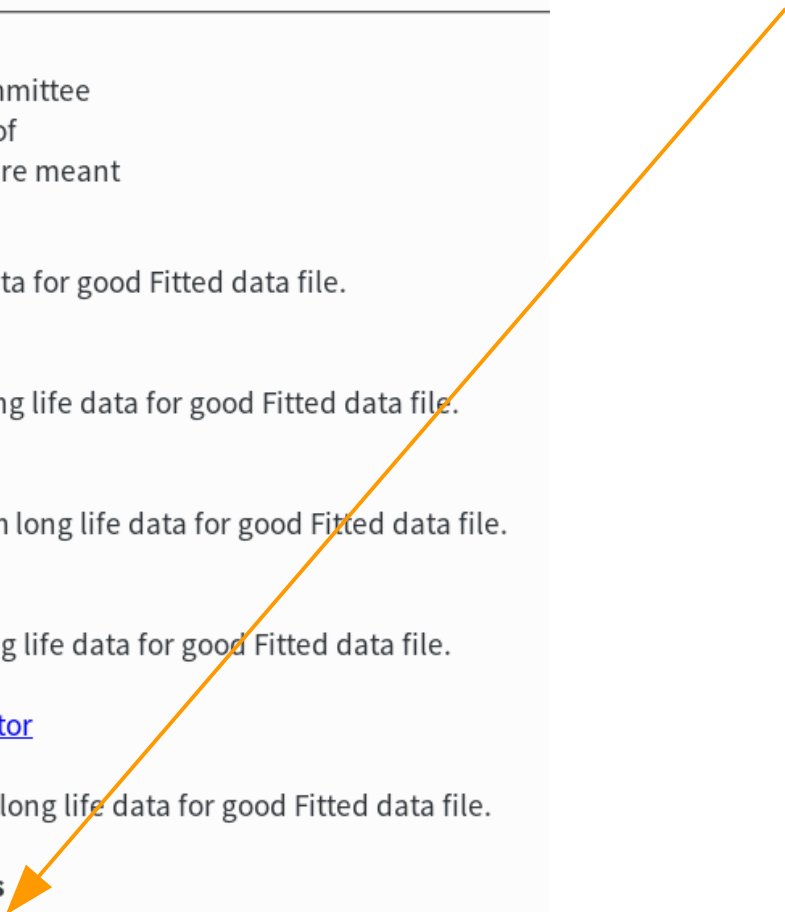
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The files in this directory are offered by the F.D.& E. committee members as a set of example files for the construction of web based material fatigue property databases. They are meant for information and research use only, not for design.

- [AA 7005-T5 \(Chung/Abel\)](#) Not enough long life data for good Fitted data file.
- 
- [AA 7049-T6 \(Ramusat/Vidal 1979\)](#) Not enough long life data for good Fitted data file.
- 
- [AA 7050-T7351 \(Ramusat/Vidal 1979\)](#) Not enough long life data for good Fitted data file.
- 
- [AA 7075-T6 \(Endo/Morrow 1969\)](#) Not enough long life data for good Fitted data file.
- [AA 7075-T651 \(Kurath 1984\)](#) | [Fitted](#) | [Calculator](#)
- [AA 7075-T651 \(Ramusat/Vidal 1979\)](#) Not enough long life data for good Fitted data file.
- **Merged AA 7075-T6xx composed of above 3 files**
  - [Merged AA 7075-T6xx](#) | [Fitted](#) | [Calculator](#) | [Stress-Strain Simulator](#)
  - [Compare plot of Fitted vs Raw Strain-2Nf](#)
  - [Compare plot of Fitted vs Raw Neuber-2Nf](#)

Check your results with the on-line calculator.

Click here



The calculator web page will present as follows:

### 1. Your Material (Digital-Fitted Curves):

```
#  
#with this program; if not, write to the Free Software Foundation, Inc.,  
#59 Temple Place -Suite 330, Boston, MA 02111-1307, USA. Try also their  
#web site: http://www.gnu.org/copyleft/gpl.html  
#  
# Note: Fitted Data !!  
# of a Merged Data File. AA7075_T6xx Aluminum Wrought  
# -  
# Ref.1: M.Sc. Thesis by P. Kurath Univ. of Illinois.  
# Ref.2: ENDO T.,J.MORROW, ASTM J. OF MATERIALS, VOL.4,P.159, 1969  
# Ref.3 : G.Ramusat and G.Vidal, "Fatigue oligocyclique de six alliages  
# d'aluminium en efforts et en deformations imposes," Memoires Scientifiques  
# Revue Metallurgie 75, 1978, p.22-26
```

2.  History Magnification or Multiplication factor

Place the 650 value into the Smax box

### 3. Enter Elastic $K_t$ \*Nominal (or Finite Element) Stress History (Rainflow counted cycle sets) Below:

MPa !

• Cycle Set #1:	Smax <input type="text" value="650"/>	Smin <input type="text" value="0.0"/>	Cycles <input type="text" value="1"/>
• Cycle Set #2:	Smax <input type="text"/>	Smin <input type="text"/>	Cycles <input type="text"/>
• Cycle Set #3:	Smax <input type="text"/>	Smin <input type="text"/>	Cycles <input type="text"/>
• Cycle Set #4:	Smax <input type="text"/>	Smin <input type="text"/>	Cycles <input type="text"/>
• Cycle Set #5:	Smax <input type="text"/>	Smin <input type="text"/>	Cycles <input type="text"/>
• Cycle Set #6:	Smax <input type="text"/>	Smin <input type="text"/>	Cycles <input type="text"/>

The calculator expects a fatigue cycle, thus enter 0 for Smin and a 1 for number of cycles.

4.  (Page will be submitted to UoWaterloo Website)

Then click on "CALCULATE" to send the file to the server.

The server should return a page that contains the plasticity corrected hot-spot stress and strain

### F.D.& E. saefcalc3.f from UoWaterloo Calc. Site

Tue Apr 4 22:50:34 EDT 2017

#Name= Merged #NAME= AA7075T6xx #Name= Aluminum #Sy= 480 average of (492,468) #Su= 566 average of (553,578) mpa #BHN= 1  
#read\_a\_line: # #MagFactor 1.0 650 0.0 1

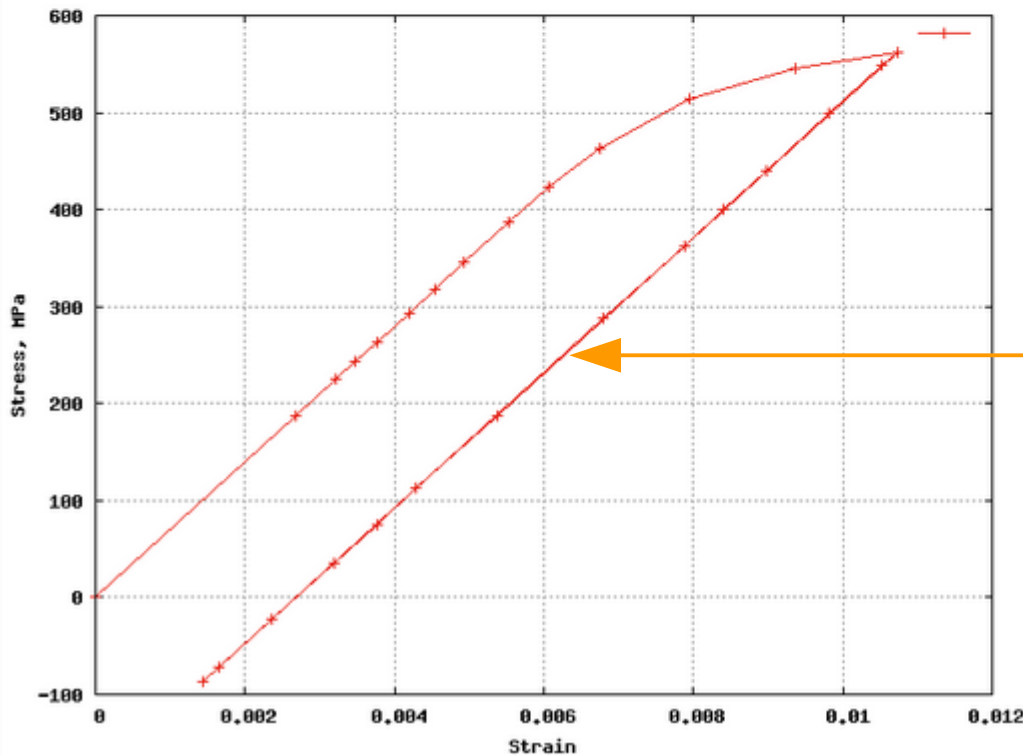
#### Nominal and Local Stress-Strain:

#xcalc2	Loop	Smax	Smin	N	Sigmax	Sigmin	Delta	Epsmax	Epsmin	DeltaEps	%Eps	%SWaT	%Sts	%Morr	%Goodm
#xcalc2	1	650.0	0.0	1.0	563.	-87.	650.	0.01073	0.00144	0.00929	100.0	100.0	100.0	100.0	100.0

#### Life Predictions (history repetitions):

#xcalc3	StrainLife_Reps	SWaT_Life_Reps	StressLife_Reps	Morrow_Reps	Goodman_Reps (Reps= Repetitions)
#xcalc3	27264.5	4221.0	27264.6	2154.2	393.9

#### Local Stress and Strain Response:



It also returns the expected fatigue life for this one cycle.

This is the hot-spot stress-strain hysteresis loop. It is fully elastic.

Hit the back button and try some different values for Smin

That completes the chapter on Stress Concentrations and Plasticity Corrections. With the use of the calculator page you have also learned how to perform a fatigue life prediction for a simple FEA stress input history.

The next chapter will focus on the methods that are used to predict the fatigue damage given a plasticity corrected hot-spot stress and strain history.