## **ANSYS - Fatigue Analysis**

This tip will use the Tensile Bar tutorial to demonstrate fatigue analysis in Mechanical. It is recommended to become familiar with the tensile bar tutorial before you proceed. Please download the workbench model here.

Please also see related discussion in this document.

## Procedure

The provided workbench file already has the solution for the problem. Restore the downloaded archive and double click on *Engineering Data*. In Engineering Data, click on Structural Steel and click on Alternating Stress Mean Stress.

Outline of Schematic B2: Engineering Data 🗾 🔻 🗸									
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1	Contents of Engineering Data	8	ource	e Description					
2	= Haterial								
3	Structural Steel	)	Fatigue Data at zero mean stress comes from 1998 ASME BPV Code, Section 8, Div 2, Tabl -110.1			from able	5		
*	Click here to add a new material								
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11	Shear Modulus	_			1.1157E+07	psi	-		
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13	Interpolation Log-Log								
14	Scale				1				1
15	Offset				0	psi			
16	🗉 🔀 Strain-Life Parameters								
17	Display Curve Type				Strain-Life 🔹				-

The window on the right shows tabulated alternating stress for steel and its mean stress.



Tip

If you wish to use a new material to perform fatigue analysis, you must enter its alternating stresses at specific cycles before you specify its isotropic properties. The data for alternating stresses for various materials can be found in most strength of materials textbooks.

Verify that the Tensile Ultimate Strength is specified:

Outline	of Schematic B2: Engineerir	ig Dat	а	⊸ д х
	A	в	с	D
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2	Material			
3	Structural Steel		<b>R</b>	Fatigue Data at zero mean stress comes from 1998 ASME BPV Code, Section 8, Div 2, Table 5 -110.1
*	Click here to add a new material			

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21	Ductility Exponent	-0.47				
22	Cyclic Strength Coefficient	1.4504E+05	psi			1
23	Cyclic Strain Hardening Exponent	0.2				1
24	🔁 Tensile Yield Strength	36259	psi			
25	🔁 Compressive Yield Strength	36259	psi			=
26	🔁 Tensile Ultimate Strength	66717	psi			1
27	🔁 Compressive Ultimate Strength	0	psi			-

## Click on Return to Project.

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1	Contents of Engineering Data	8	ource	Desc	ription						
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3	Structural Steel	F 1		Fatigue Data at zero mea 1998 ASME BPV Code, Se -110.1	atigue Data at zero mean stress comes from 998 ASME BPV Code, Section 8, Div 2, Table 10.1						
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Double click on Model to launch ANSYS Mechanical. The boundary conditions have already been setup and the solution is provided.

Right click on Solution and insert Fatigue Tool.

Outline  Project  Model (84)  Coordinate  Coordinate	re Body Systems <b>sctural (BS)</b> sis Settings Support	#			
	Insert Clear Generated Data alb Rename Open Solver Files Directory	,	Stress Tool Deformation Strain Stress Energy Linearized Stress	• • •	
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Adaptive Mesh Refinem Max Refinement Loops Refinement Depth Information Status	ent 1. 2. Done		Contact Tool Probe Coordinate Systems & User Defined Result Commands		

Highlight Fatigue Tool and select Goodman for Mean Stress Theory.

De	tails of "Fatigue Tool"		<b></b>					
-	Materials		-					
	Fatigue Strength Factor (Kf)	1.						
-	Loading							
	Туре	Ratio						
	Loading Ratio	-1.						
	Scale Factor	1.						
=	Definition							
	Display Time	End Time						
-	Options							
	Analysis Type	Stress Life						
	Mean Stress Theory	Goodman 🔹 🔻						
	Stress Component Equivalent (Von Mises)							
-	Life Units							
	Units Name cycles							

There are a number of options from the fatigue tool you can choose to include in the analysis, choose them accordingly. For demonstration, only life, safety factor, and alternating stress will be evaluated. Right click on Fatigue tool and insert Life, Safety Factor, and Equivalent Alternating Stress.

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Scale Factor  Definition	1.	E	N	<b>@</b>	Probe
Display Time  Options	End Time		ſ		Commands

Click on Solve to generate new results. Zoom in on the right side of the bar by right click and drag. The fatigue analysis of a tensile bar subjected to a point load is shown below:





## A Specifying the loading ratio to get a loading scheme in ANSYS

Consider the case where the load varies smoothly between 500N and -1000N on each cycle. You first perform static loading at -1000N. For the fatigue portion, you must specify the loading ratio in the Fatigue tool (under "Loading Type", select "Ratio") to let ANSYS know what your load cycle will be. This is where ANSYS will know the ratio of your loading scheme (which is varying from 500N to -1000N). This value should be set to -0.5. The resulting sinusoidal graph produced on the right, should vary from an amplitude of 1 to -0.5. ANSYS uses the -1000N in the static loading as a starting point. What this means in ANSYS is that the static loading boundary condition of -1000N is going to be applied as the "max" (ie -1000\*1 = -1000N) and then for the "min" it will be 500N (ie -1000\*-0.5 =500N).