

Altair MotionView 2019 Tutorials

MV-8050: Using the Leaf Spring Builder

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# MV-8050: Using the Leaf Spring Builder

# Introduction

The purpose of this tutorial is to introduce you to the **Leaf Spring Builder** utility. In this tutorial, you will learn how to:

- Access the Leaf Spring Builder utility in MotionView
- Populate a leaf spring model with data and save the data in an .lpf file
- Generate a MotionView file (.mdl) of the leaf spring
- Open the model in MotionView
- Create a test of the model and exercise the test using the utility

The Leaf Spring Builder is a utility designed to work with MotionView and the vehicle modeling libraries included with MotionView. Spring geometry, bushing rates and a number of other physical constants are required as input to the model. Reasonable defaults for data are included for many fields, which will make the model run. Accurate data should be substituted as it becomes available. The output of the utility is a beam and mass model of a leaf spring, in either a MotionView system definition file or a complete MotionView model.

To learn more about the Leaf Spring Builder, see the *Leaf Spring Modeling* topic.

# **Required Files**

Copy the files listed in the table below, located in the mbd\_modeling\leafspring \leaf profiles folder, to the <working directory>.

File Name	File
Comma Separated Values files	Leaf_1.csv
	Leaf_2.csv
	Leaf_3.csv
	Leaf_4.csv

These .csv files contain coordinate pairs that represent the geometry of the centerline of the leaf. The leaf in this tutorial was created by measuring geometry from a light truck rear suspension. The rear suspension in this example has a GAWR of 3950 lbs.

# Step 1: Accessing the Leaf Spring Builder.

To build a leaf spring model, you must first load the **MBD-Vehicle Dynamics Tools** preference file in MotionView. Once loaded, HyperWorks remembers and automatically loads the **MBD-Vehicle Dynamics Tools** preference file each time you start HyperWorks. To load the **MBD-Vehicle Dynamics Tools** preference file follow the steps below.



#### Launching MotionView

1. Start a new MotionView session.

The MotionView window is displayed.



### Loading the Vehicle Dynamics Tools Preference File

2. Click *File > Load > Preference File* from the MotionView **Menu** bar.



The **Preferences** dialog is displayed.



3. From the **Preferences** dialog, select *MBD-Vehicle Dynamics Tools* and click *Load*.

Registered Pre	ferences		
Multi-Disciplin	ary Tools		
Vehicle Safet	y Tools		
···· NVH Utilities			
- HyperForm U	tilities		
MBD-Vehic	e Dynamics Tool	S	
···· MD Plugin			
Model Identifi	cation Tool		
Aerospace T	ools		
HyperWorks(	default)		
¢			>

# **Displaying the Leaf Spring Builder**

4. Click Vehicle Tools > Leaf Spring Builder.

Edit	View	Vehicle Tools	SolverM	ode	Model
- 🎉	• 🛃 •	Road Tools Leaf Spring B	Builder	- -	: 📩 🐔
ects	Project	Example mo	dels 🕨		
≜ Mo	odel	Update Mod	el		
じ Bo	odies <mark>(1</mark>	)			

# The Leaf Spring Dialog window opens.

💗 Leaf Spring Dialog						×
File Tools Examples						
Leaf Spring Components	Canvas					
General	-					
E-     Leaves (1)	10 -					
E Clips (1)	1.0					
- Axle						
Bernals (1)     Ruchings (1)	0.8 -					
B Contacts (1)						
- A Shackle	0.6 -					
- Build						
🕀 🛄 Test (1)						
	0.4 -					
	0.2 -					
	0.0 -					
	0.0	0.2	0.4	0.6	0.8	1.0
	🔺 🌳 🌳 🕎 Q				×=C	0.956989 y=0.74397
						Build <u>Cancel</u>



# Step 2: Building a Leaf Spring Model.

Using the Leaf Spring Builder you can define the properties of a leaf spring model, by entering the data about the number of leaves, the leaf shapes, cross-sections, material properties, and contact properties, the shackle length if your spring employs a shackle, the nominal axle load and other information to create a MDL system definition. The system definition can be imported into a suspension or full vehicle model. You can also test the leaf spring by applying a load and plotting the load versus deflection in the Leaf Spring Builder. The Leaf Spring Builder user interface has four parts as shown in the following image:



- **Browser**: Used for navigating and selecting leaf spring components.
- **Property Editor**: Used for entering and modifying data.
- Help Section: Used for describing the data you enter.
- **Visualization Canvas**: Used for viewing leaf shapes. When you select data in the browser the leaf spring builder displays the corresponding editor, visualization canvas and help section.



The following steps show you the process involved in creating a leaf spring model using the components of the Leaf Spring Builder.

#### General

1. Click on the *General* option in the Leaf Spring Components browser section.

🚏 Leaf Spring Dialog						×
File Tools Examples						
Leaf Spring Components	Canvas					
General						
E Leaves (1)	10 -					
E Clips (1)	1.0 -					
Axle						
Materials (1)	0.8 -					
E Contacts (1)						
- A Shackle	0.6					
- & ClipDetails	0.6 -					
Build						
	0.4 -					
	0.2 -					
	0.2 -					
	0.0 7		d'4	a's		1
	0.0	0.2	0.4	0.6	0.8	1.0
	# 🔶 🖗 🖸 Q	B tz ty				
General	-	Hel	p section			
Inputs Units						
		1				$\bigcirc$
Interpolation Scheme:	Linear					$\mathcal{Q}$
Data Shape Condition:	Free			Ó	Axie	
Disalar Matian Calus W	fedeus		$(\bigcirc)_{D}$	44		$\left( \begin{array}{c} 0 \end{array} \right)$
<ul> <li>Display MotionSolve w</li> </ul>	indow					
			4/			
			Front			
			Rebound			Shackle Eye
		Z	Clip	Graduated	÷	
			× X Leaf	Leaf Central Cla	mp Auxiliary	
					Leai	
						Build Cancel
						a cheer

The entire leaf model is displayed in the **Help** section.

#### **Primary Systems Selection**

2. Select the *Linear* and *Pre-Assembly* options from the **Interpolation Scheme** and **Data Shape Condition** drop-down menus.

General	
Inputs Units	
Interpolation Scheme:	Linear
Data Shape Condition:	Pre-Assembly
🔽 Display MotionSolve Window	



3. Default units are set in the **Units** tab.

C General	
Inputs	Units
Units -	
Length:	Millimeter 🗾
Mass:	Kilogram 💌
Force:	Newton 💌
Angle:	Radian 💌
Time:	Second 🗾

Leaves: Leaves components allow you to add leaves to the leaf spring.

4. Right-click on the *Leaves* component and click *Add a Leaf*, to add leaves.



A **Leaf 2** component is added to the leaves component. In a similar manner, add two additional leaves (for a total four).





### Leaf 1

5. Click on the *Leaf 1* component and see where the required data can be entered under **Leaf Data**.



6. Browse and locate the required .csv file, Leaf 1.csv for the Shape Input field.

OR

 You can specify the required values for the X coordinate, Z coordinate and width and thickness variation manually for the leaf profile.

**Note** If the leaf is a constant thickness (and/or width), you need to specify the values only in the first row. The same value will be used along the entire length of the leaf.

Leaf Data								
Shape	Details							
Shape Input	t 💋 C:\Prog	ram Files\Alt	tair\tutorials\n	1v_hv_hg\mb	d_modeling	Jeafspring\Je	af_profiles\Leaf_1.csv	
	nt Width 🗖	Constant Thi	ckness <b>F</b>	Constant Rad	dius Save I	Leaf Shape		
	×	Y	Z	Width	Thickness	Radius		
1	-596.324890	0.0	164.911872;	64.0	7.0	0.0		^
2	-577.409851	0.0	158.210486	64.0	7.0	0.0		
3	-559.523742	0.0	148.668479;	64.0	7.0	0.0		
4	-541.588989	0.0	139.214988	64.0	7.0	0.0		
-			1000 0 174 FO	~ ~ ~ ~				~
Total numbe	er of points: 6	5.0						



#### The Leaf 1 graphics are displayed in the **Canvas** section.

 Click on the *Details* tab and select the *Master* option from the **Type** drop-down menu. Enter the Leaf 1 data for the **Details** tab as shown in the following image.

Leaf Data					
Shape Deta	uls				
Position in Stack :	· · · ·	1			
Туре:	Master	•	Material:	Steel	•
Front Leaf Length:	596.3	25	No. of Beams in front:		15
Rear Leaf Length:	604.	14	No. of Beams in rear :		15
Shear Area Ratio Y:		0	Shear Area Ratio Z:		0
Angle with x-axis:		0			
Bolt Location X: [	0	Y: [	0 Z: [	0	1

The Leaf 1 graphics in the **Canvas** section are changed accordingly.

# Leaf 2

8. Click on the *Leaf 2* component and enter the required data under *Leaf Data* in the **Shape** tab.

-Leaf Data					
Shape	Details	Contacts	Tip Contacts		
Shape Input	2				
Constant V	Width 🗖 Const	ant Thickness 🛛 🖡	Constant Radius	Save Leaf Shape	
_	X Y	Z	Width Thick	ness Radius	
1	0.0	0.0 0.0	0.0	0.0 0.0	
Total number	of points: 1.0				



9. Browse and locate the required .csv file, Leaf\_2.csv, for the **Shape Input** field. Enter the **Width** and **Thickness** as shown in the image below.

eat Data.								
Shape	Details	Cor	ntacts	Tip Contacts	3			
Shape Input	C:\Progr	am Files\Alt	tair\tutorials\n	nv_hv_hg\mb	d_modeling	leafspring\lea	af_profiles\L	.eaf_2.csv
🗖 Constan	tWidth 🗖 C	Constant Thi	ckness 🗖	Constant Ra	dius Save I	Leaf Shape		
	X	Y	Z	Width	Thickness	Radius		
1	-548.0	0.0	3.89900207!	64.0	7.0	0.0		-
2	-521.666076	0.0	-10.0122375	64.0	7.0	0.0		
3	-496.141143	0.0	-25.3544311	64.0	7.0	0.0		
4	-470.041564	0.0	-39.7003173	64.0	7.0	0.0		



The Leaf 2 graphics are displayed in the **Canvas** section.



10. Click on the **Details** tab and select the **Graduated** option from the **Type** drop-down menu. Enter the Leaf 2 values for the **Details** tab as shown in the following image.

Leaf Data					
Shape Deta	ils Contacts	Tip Contacts			
Position in Stack :	2	Ē			
Type: Front Leaf Length: Rear Leaf Length: Shear Area Ratio Y:	Master Master Graduated Rebound Auxiliary	<ul> <li>Material:</li> <li>No. of Beams i</li> <li>No. of Beams i</li> <li>Shear Area Ra</li> </ul>	Steel	▼ 10 10 0	
Leaf Data Shape	Details )	Contacts T	īp Contacts		
Type:	Graduated	<	Material:	Steel	•
Front Leaf Leng	th:	548.0	No. of Beams in front:		15
RearLeafLeng	th:	560.0	No. of Beams in rear :		15
Shear Area Rat	io Y:	0	Shear Area Ratio Z:		0
Angle with x-axis	s:	0	Spacer thickness :		0
Bolt Location	×:	0 Y:	0 Z:		0

11. Click on the *Contacts* tab and enter the value 12 in the **Total number of Contact points** field and hit **Enter**.

The Contacts table for Leaf 2 is generated based upon the values entered.

-Leaf Data-				
Shape	Details	Contacts	Tip Contacts	
	Direction	Distance from Centr	Contact Type	
1	Front <	0	METAL_MET 💌	*
2	Front 🗸	0	METAL_MET 🔻	
3	Rear 🗸	0	METAL_MET 💌	
4	Front 🗸	0	METAL_MET 💌	
5	Rear 💌	0	METAL_MET 💌	~
Total numb	er of Contact points	12		•



. -

S. No	Direction	Distance	Contact Type
1	Front	95	METAL_METAL
2	Front	155	METAL_METAL
3	Front	234	METAL_METAL
4	Front	311	METAL_METAL
5	Front	385	METAL_METAL
6	Front	457	METAL_METAL
7	Rear	105	METAL_METAL
8	Rear	155	METAL_METAL
9	Rear	234	METAL_METAL
10	Rear	311	METAL_METAL
11	Rear	385	METAL_METAL
12	Rear	457	METAL_METAL

12. Enter the following data into the **Contacts** table.

1	Front	-	95.0	METAL_MET	
2	Front	•	155.0	METAL_MET 👻	
3	Rear	•	234.0	METAL_MET 💌	
4	Front	•	311.0	METAL_MET 💌	
5	Rear	-	385.0	METAL_MET 💌	

13. The entered contact points are plotted on Leaf 2 as shown in the following image in the **Canvas** section.



14. For this example, leave the **Tip Liners** (**Front** and **Rear**) set to **Off** in the **Tip Contacts** tab.

-Leat Data	Y	\	\\
Shape	Details	Contacts	Tip Contacts
F Front Tip L	.iner <b>F</b> RearTi	p Liner	
Front Tip Col Contact Prop	ntact	Contact F	Contacts rop: METAL_ME



# Leaf 3

15. Browse and locate the required .csv file, Leaf\_3.csv, for the **Shape Input** field.

hape	Details	Cor	itacts	Tip Contacts	3			
hape Input	C:\Progra	am Files\Alt	tair\tutorials\n	nv_hv_hg\mb	d_modeling	leafspring\leaf	_profiles\Leaf_3.csv	
Constan	tWidth 🗖 C	onstant Thi	ckness <b>F</b>	Constant Ra	dius Save I	.eaf Shape		
	×	Y	Z	Width	Thickness	Radius		
1	-457.0	0.0	-237.302993	64.0	7.0	0.0		
2	-446.171539	0.0	-243.192153	64.0	7.0	0.0		
3	-435.343078	0.0	-249.081329	64.0	7.0	0.0		
4	-424.514617	0.0	-254.970489	64.0	7.0	0.0		
					<u> </u>			

The Leaf 3 graphics are displayed in the **Canvas** section.

16. Click on the **Details** tab and select the **Graduated** option from the **Type** drop-down menu. Enter the Leaf 3 values for the **Details** tab as shown in the following image.

Shape Deta	uils Contacts	Tip Contacts	
Position in Stack :	3		
Туре:	Graduated 🗨	Material:	Steel 💌
Front Leaf Length:	457.0	No. of Beams in front:	15
Rear Leaf Length:	463.0	No. of Beams in rear :	15
Shear Area Ratio Y:	0	Shear Area Ratio Z:	0
Angle with x-axis:	0	Spacer thickness :	0
Bolt Location X: [	0 Y:	0 Z:	0

17. Click on the *Contacts* tab and enter the value 10 in the **Total number of Contact points** field and hit **Enter**.



S. No	Direction	Distance	Contact Type
1	Front	95	METAL_METAL
2	Front	155	METAL_METAL
3	Front	234	METAL_METAL
4	Front	311	METAL_METAL
5	Front	385	METAL_METAL
6	Rear	105	METAL_METAL
7	Rear	155	METAL_METAL
8	Rear	234	METAL_METAL
9	Rear	311	METAL_METAL
10	Rear	385	METAL_METAL

18. Enter the following data into the **Contacts** table.

Direction     Distance from Centr     Contact Type       1     Front     95.0     METAL_MET       2     Front     155.0     METAL_MET       3     Rear     234.0     METAL_MET       4     Front     311.0     METAL_MET
1         Front         95.0         METAL_MET           2         Front         155.0         METAL_MET           3         Rear         234.0         METAL_MET           4         Front         311.0         METAL_MET
2         Front         ▼         155.0         METAL_MET         ▼           3         Rear         ▼         234.0         METAL_MET         ▼           4         Front         ▼         311.0         METAL_MET         ▼
3         Rear         ✓         234.0         METAL_MET         ✓           4         Front         ✓         311.0         METAL_MET         ✓
4 Front    311.0 METAL_MET
Rear 💽 385.0 METAL_MET



19. The entered contact points are plotted on Leaf 3 as shown in the following image in the **Canvas** section.



#### Leaf 4

20. Browse and locate the required .csv file, Leaf 4.csv, for the Shape Input field.

-Leaf Data								
Shape	Details	Cor	ntacts	Tip Contacts	3			
Shape Input	C:\Prog	ram Files\Alt	tair\tutorials\n	nv_hv_hg\mb	d_modeling	\leafspring\lea	f_profiles\Leaf_4.csv	
🗖 Constar	nt Width 🔳	Constant Thi	ckness <b>F</b>	Constant Ra	dius Save	Leaf Shape		
	×	Y	Z	Width	Thickness	Radius		
1	-337.0	0.0	-471.424022	64.0	12.7	0.0		^
2	-319.563079	0.0	-471.112941	64.0	12.7	0.0		
3	-302.124176	0.0	-470.932491	64.0	12.7	0.0		
4	-284.68396	0.0	-470.934425	64.0	12.7	0.0		
-	1 000 0 10000r							~
Total numbe	er of points: 4	0.0						

The Leaf 4 graphics are displayed in the **Canvas** section.

21. Click on the **Details** tab and select the **Graduated** option from the **Type** drop-down menu. Enter the Leaf 4 values for the **Details** tab as shown in the following image.

Shape Deta	ils Contacts	Ì	Fip Contacts		
Position in Stack :		4			
Туре:	Graduated	•	Material:	Steel	-]
Front Leaf Length:	3:	37.0	No. of Beams in front:	1	5
Rear Leaf Length:	3	43.0	No. of Beams in rear :	1	5
Shear Area Ratio Y:		0	Shear Area Ratio Z:		0
Angle with x-axis:		0	Spacer thickness :		0
Bolt Location X: [	0	Y:	0 Z: [	0	



# 22. Click on the *Contacts* tab and enter the value 8 in the **Total number of Contact points** field and hit **Enter**.

23. Enter the following data into the **Contacts** table.

S. No	Direction	Distance	Contact Type
1	Front	95	METAL_METAL
2	Front	155	METAL_METAL
3	Front	234	METAL_METAL
4	Front	311	METAL_METAL
5	Rear	105	METAL_METAL
6	Rear	155	METAL_METAL
7	Rear	234	METAL_METAL
8	Rear	311	METAL_METAL

-Leaf Data-						
Shape	Details		Contacts	Tip Contacts		
	Direction		Distance from Centr	Contact Typ	e	
1	Front	•	95.0	METAL_MET	•	*
2	Front	•	155.0	METAL_MET	•	
3	Rear	•	234.0	METAL_MET	•	
4	Front	•	311.0	METAL_MET	•	
5	Rear	•	105.0	METAL_MET	•	
	lr			·		

Total number of Contact points: 8

24. The entered contact points are plotted on Leaf 4 as shown in the following image in the **Canvas** section.



**Leaf Ends**: Leaf ends parameters provide the details about the eye hook types at front and at the rear ends. Three spring eye types are supported.

Leat Spring Components
The General
🕂 📂 Leaves (4)
Leaf_1
🚽 — Leaf_3
🖻 📂 LeafEnds (2)
Front leaf end
Rear_leaf_end
🖽 📮 Clips (1)
Haterials (1)
En Eusnings (1)
Shecklo
A ClinDetails
Build
⊡ 🖹 Test (1)
L



- 25. Click on the *Front\_leaf\_end* option and enter the following data in the **Leaf Ends** section.
  - Select *Spring Eye* from the **Leaf End Type** drop-down menu.

Leaf Ends		
Leaf End Type:	None 👻	
	Spring Eye	
	Slipper End	
	None	
Leaf Ends		
Leaf End Type:	Spring Eye 💌	Type: Berlin 💌
		Inner Radius: 20.0
		Eve Position: Front
		Bushing
		, Bushing
		🔽 Spring Eye Location
		×: -624.973
		Y: 0
		Z: 184.0

26. Click on the *Rear\_leaf\_end* option and enter the following data in the *Leaf Ends* section.

-LeafEnds						
LOUILINGS						
Leaf End Type:	Spring Eye	-	Туре:	Berlin	•	
			Inner Radius:		20.0	
			Eye Position:	Rear	-	
			🗖 Bushing			
			🔽 Spring Ey	e Location		
			X:		636.027	
			Y:		0	
			Z:		139.5	

**Clip**: Clip parameter is used to define the Clip properties. The number of clips added in the clips parameter are reflected in the **Clip Details**.

-Leaf Spring Components	
🗂 🛈 General	
🖻 📂 Leaves (4)	
Leaf_4	
🖻 📂 LeafEnds (2)	
Front_leaf_end	
Rear_leaf_end	
🖻 📂 Clips (1)	
Clip 1	
🖳 🔔 Axle	
🖻 🚞 Materials (1)	
🕀 😂 Bushings (1)	
🖻 🚞 Contacts (1)	
🚽 🦰 Shackle	
🖳 🖧 ClipDetails	
Build	
⊞·≌ Test (1)	



# 27. Click on the *Clips* component and enter the following data in the **Clip Properties** section.



# 28. Click on the **Axle** component and enter the following data in the **Axle Properties** section.

-Axle properties		
Туре:	UnderSlung	•
Front Inactive Length:		76.196
Rear Inactive Length:		76.196
Leaf Pack Thickness:		
Load on Leaf Pack:		3000.0

#### Materials

29. Click on the *Materials* component and enter the following data in the **Material Properties** section.

-Material Properties	
Young's Modulus:	205000.0
Shear Modulus:	80000.0
Density:	7.8e-06
Beam Damping Ratio:	0.001



#### **Bushings**

30. Click on the **Bushings** component and use the default values under **Bushing Properties**.

Bushing Properties	
Type of Bushing:	Linear 🔹
Translational Stiffness Properties	Rotational Stiffness Properties
Kx: 10000.0	Ktx: 500000.0
Ку: 10000.0	Kty: 500000.0
Kz: 5000.0	Ktz: 5000.0
Translational Damping Properties	Rotational Damping Properties
Cx: 50.0	Cbc 5000.0
Cy: 50.0	Cty: 5000.0
Cz: 25.0	Ctz: 500.0
Force Preloads	Torsional Preloads
Fx: 0	Tx: 0
Fy: 0	Ty: 0
Fz: 0	Tz: 0

#### Contacts

 Click on the *Contacts* component (by default there is only one contact METAL\_METAL). Right-click on the *Contacts* component and add one more contact named METAL\_PLASTIC.

**Note** Right-click to rename the contact after you have added it.

32. Click on the *METAL\_METAL* contact and enter the following data in the **Contact Properties** section.





33. Click on the *METAL\_PLASTIC* contact and enter the following data in the **Contact Properties** section.



34. Now for this example, go back to the **Clips** component and click on the **Clip\_1** option and update the **Contact Property** to the **METAL\_PLASTIC** contact.

Clips (1)	(1) 2) METAL PLASTIC	* <b>•</b> •	
Clip Properties-			
Туре:	Pin Clip		•
Height:			24.0
Width:			64.0
Pin Diameter:			3.75
Depth:			3.75
Contact Property:	METAL_PLASTI	C	<b>-</b>



#### Shackle

35. Click on the *Shackle* component and enter the following data in the **Shackle Properties** section.

Shackle Properties			
Location:	Rear 🗾	Туре:	Compression 💌
Mass:	1.0	Inertia IXX:	500.0
Thickness:	15.0	Inertia IYY:	500.0
Length(Lss):	88.768	Inertia IZZ:	500.0
Shackle Center Offset:	20.0	Mounting len.(Lcc):	1284.883
🗖 Bushing			

### **Clip Details**

- 36. Click on the *ClipDetails* option and enter 1 in the **Total number of Clips** field, with respect to the number of clips added in the **Clips** component.
- 37. Enter the following data for the **Clip 1** component.

-ClipDetails			
Direction	Distance	Clip	
1 Front	450	Clip_1	•
Total number of Clips:	1		



# **Step 3: Importing the Leaf Spring Model into MotionView.**

The Leaf Spring Builder saves the data in an .lpf file. The file can be saved and loaded in the Leaf Spring Builder interface. The file is readable and is in TiemOrbit format. To make model changes, edit the spring data in the interface and build a new leaf spring system definition.

- Click on the *Build* option and browse and locate the required path for the <working directory>. Enter test\_leaf\_1, as the file name in the **Output File Label** field and view the choices available for building the leaf spring model.
- 2. Select the *Assemble leaves and apply preload* radio button and the *Write Property File* check box and click on the *Build* button.

Build		Help section
Working Directory: Output File Label:	C:\Users\swaaths\Documents hest_lead_1 Assemble leaves and apply preload	Assemble leaves and apply preload: Generates system definition (.mdl), Can only be imported.
Run modes:	C Assemble leaves C Apply preload on assembled leaves r Data Input IF Write Property File	Assemble Leaves: Generates model file (.mdl), Can directly be loaded in MV Apply preload on assembled leaves: Generates system definition (.mdl), Can only be imported.
		Build Concel

- 3. The **Leaf Builder Message** window opens. The message window shows the model checks that are performed before the test job is submitted to the MotionSolve.
- 4. Click **OK** to exit the window.

👘 Leaf	Builder Message X
(	Checking references and data in General Checking references and data in Leaf_1 Checking references and data in Front_leaf_end Checking references and data in Rear_leaf_end Checking references and data in Clip_1 Checking references and data in Axle Checking references and data in BUSHING Checking references and data in METAL_METAL Checking references and data in Steel Checking references and data in ClipDetails Checking references and data in Leaf_2 Checking references and data in Leaf_4 Checking references and data in METAL_PLASTIC Checking references and data in Stael



5. MotionSolve is invoked in the background and it displays several windows as it runs, in order to generate the leaf spring MDL system definition file.



- 6. Once the MotionSolve process is done, close the **Leaf Spring Builder** dialog.
- 7. The Leaf Builder Message window is displayed.



- 8. Click the **OK** button in the **Leaf Builder Message** dialog.
- 9. From the **Project** browser, click on the *Model* as shown in the following image.





10. Click on the *Import/Export* tab in the panel area.

<u>4</u> -9		the_model	XVA
÷.	Properties	@ Import	
1	Options	C Export	
_	Initial Conditions		[3]
	System Translation	Select file:	
-	Import/Export		Import

11. Use the **Select file** browser and locate the generated .mdl file from the <working directory> and click *Import*.

C Export	
Select file:	E:/Leaf Spring/test_leaf_1.mdl
	Import

12. The **Import Definition** window is displayed. Use the default options in the window and click **OK**.

🛆 Import Definition		X
Select a definition:	System 🝷	OK
sysdet_leaf def_sys_leaf_1 def_sys_leaf_2 def_sys_leaf_3	•	Cancel
Label:		
Leaf Spring System		
Variable:		
sys_leaf		
Note:		
	<u>_</u>	
4	× >	



13. Leaf Spring system is shown in the **Project** browser. Click on it and resolve the attachments.

ė- 🔂 🕹	Leaf Spring System	sys_leaf	
⊕- <b>≧</b>	Data Sets (1)		
🕀 🔛	Joints (1)		
🕀 🔂	Master Leaf	sys_leaf_1	-
ф- 💽	Graduated Leaf	sys_leaf_2	
🕀 🔂	Graduated Leaf	sys_leaf_3	-
🖻 🔂	Auxiliary Leaf	sys_leaf_4	
🖻 💽	Bebound Clip 1	sys_clip_1	

Allachments	Add	Variable	Label	Selection	Attachment Tag	
Options	Dalata	b_axle_body	Vehicle Aule Body	Body	MODEL_SUSPENSION_AVLE	avle_body
Initial Conditions	Distore	ushida kodu	Vahiela Beeks	Rode	VENICIE BODY	ushirla hodu
System Translation	Edit	Verificie_body	venue body	the last		Verificie_body
Import/Export		m_deflect_leaf	Spring orient, marker	Maker	UHENTATION_MARKER	(none)

14. The Leaf Spring is displayed in the MotionView graphics window.







# Step 4: Testing the Leaf Spring Model.

Testing can be performed with either force or motion applied at the axle center, and can be run in quasi-static or transient analysis simulations. Quasi-static analysis is used as an example in the following.

1. Return to the **Leaf Spring Builder** and click on the **Test** component in the browser.

💗 Leaf Spring Dialog						:
File Tools Examples						
Leat Spring Components  General  Leaves (4)  Leaf 1  Leaf 2  Leaf 2	1.0 -					
	0.8 -					
Axle  Materials (1)  With the second	0.4 -					
Contacts (2) METAL_METAL METAL_PLASTIC - \[3\] Shackle - \[2\] ClipDetails	0.2 - 0.0 n 0.0	0.2	0.4	0.6	0.8	1.0
Euild Test (1) Test 1	<u>*</u> **	<b>B</b> 5/ 1/2				
Test Inputs Test Type: Spring and Shackle Run No: Test Dir.: C\Users\jschultz\Desktop File Label: test_	Motion Inputs Actuator: Motion Offset Disp : Jounce Disp : Rebound Disp :			F		
Simulation Settings Step Size: 0.001 Print Interval: 0.01 Simulation Type: Quasi-static 💌	End Time: IF Build Leaf Run Test Rig	10.0			Force/Motio	on
						Build <u>C</u> an





 Browse and locate the required **Testing Directory** and enter the following data: select *Force* as the **Test Rig Type** and the *Quasi-static* analysis as the **Simulation Type** (as shown in the following **Test** section). Click on the *Run Test Rig* button.

Test	
Inputs	Force Inputs
Run No: 1	Offset Force : 0
Test Dir.: 💋 C:\Users\swaaths\Document	Jounce Force : 1000.0
File Label: test_	Rebound Force: 0
Actuator: Force	
Simulation Settings	
Step Size: 0.001	End Time: 10.0
Print Interval: 0.01	Puild act 0#
Simulation Type: Quasi-static 🔹	
	Run Test Rig

3. The **Leaf Builder Message** window opens. The message window shows the model checks that are performed before the test job is submitted to MotionSolve. Click **OK** to exit the window.

U	Checking references and data in General Checking references and data in LEAF1
	Checking references and data in Rear Eve Hook
	Checking references and data in Front Eve Hook
	Checking references and data in CLIP_1
	Checking references and data in Axle
	Checking references and data in STEEL
	Checking references and data in BUSHING
	Checking references and data in METAL_PLASTIC
	Checking references and data in Shackle
	Checking references and data in ClipDetails
	Checking references and data in Build
	Checking references and data in METAL_METAL
	Checking references and data in LEAF2
	Checking references and data in LEAF3
	Checking references and data in LEAF4



4. MotionSolve is invoked in the background and displays several windows as it runs.

xxCPU speed 2500 MHzxxxx3176 MB RAM, 20369 MB swapxxxxMachine Epsilon : 2.2204E-16xxxxMachine Epsilon : 2.2204E-16xxxxxxxxCOPYRIGHT (C) 2004-2016Altair Engineering, Inc.xxAll Rights Reserved. Copyright notice does not imply publication.xxxxContains trade secrets of Altair Engineering, Inc.xxxxDecompilation or disassembly of this software strictly prohibited.xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx	C:\Windows\system32\cmd.exe	_ 0	x
<pre>xx 3176 MB RAM, 20369 MB swap xx Machine Epsilon : 2.2204E-16 xx xx Machine Epsilon : 2.2204E-16 xx xx xx COPYRIGHT (C) 2004-2016 Altair Engineering, Inc. xx xx All Rights Reserved. Copyright notice does not imply publication. xx xx All Rights Reserved. Copyright notice does not imply publication. xx xx Contains trade secrets of Altair Engineering, Inc. xx xx Decompilation or disassembly of this software strictly prohibited. xx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx</pre>	XX CPU speed 2500 MHz	××	^
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<pre>xx</pre>	Machine Engilon - 2 22045-16	N N	
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	Directory : C:\Program Files\Altair\2017\hwsolvers\motionsolve\bir nuadr : HWVERSION_2017_Dec 12 2016_00:16:53 (H3D 14.000000) nuwriter : HWVERSION_2017_Dec 12 2016_00:22:22 (H3D 14.000000) nusolver : HWVERSION_2017_Dec 12 2016_00:11:41 msautoutils : HWVERSION_2017_Dec 12 2016_00:21:17 mbdtire : HWVERSION_2017_Dec 12 2016_00:20:16 cdtire : HWVERSION_2017_Dec 12 2016_00:22:33 ctimsg : HWVERSION_2017_Dec 12 2016_00:22:47 nuanima : HWVERSION_2017_Dec 12 2016_00:15:26 (H3D 14.000000) 04-JAN-2017 11:33:34 INFO: Parsing XML file [test_leaf_1_Temp.xml]	\win64	
			~

5. Once the run process is completed, the following F-D Curve is generated in the Leaf Builder.



