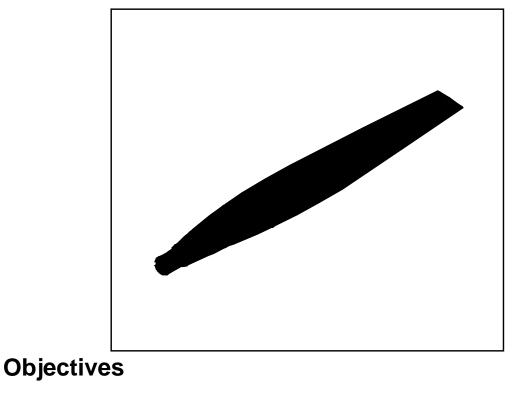
LESSON 11

Mass Properties Calculations



■ Import a unigraphics express file and apply mass properties to the propeller.

Suggested Exercise Steps

- Open a new database and name it fin.db.
- Import the Express Neutral file prop_11.1.exp
- Create the material properties for steel and apply it to the model
- Review the Mass Properties
- Create a projection of the model, then create a surface from that projection. Define a field to represent the thickness of the model
- Again review the Mass Properties and compare it to the previous results
- Mesh the base of the solid

Exercise Procedure

1. Create a new database named **fin.db**.

File/New ...

New Database Name:

fin

Based on Model

MSC/NASTRAN

Structural

OK

The New Model Preferences form appears.

Tolerance:

Analysis Code:

Analysis Type:

OK

2. Import an Express Neutral file.

File/Import...

Object:

Source:

Import File:

Model Express Neutral prop_11.1.exp Open a New Database

Import a Express Neutral File Apply

A message form appears.

2	Mess	60t .	1 1
Question in application SGM by ap	plication ASM		1916
Curve 7 already exists at the specified location to create the next Curve. Do you wish to create a duplicate Curve?			
Yes For All	Yes	No	No for All

No For All

Close the *Import Summary* form.

OK	

The *Import Tolerances* form appears. A tolerance mismatch may have caused the model to import improperly. The model should therefore be re-imported with a new model tolerance.

inport 1	toierarcei
Warningt	
The model geometry is as expected using the Tolerance value.	nay not have imported current Global Model
Global Model Toleran	ce .
0.016005	
Attentiont	
shortest curve length i If the model prometry press Cancel. If you no import using the Sugg press Apply.	came in as expected.
Suggested Model Tol	erance
0.0212057	95996 Bir
1	Reset
Apply	Cancel

Apply

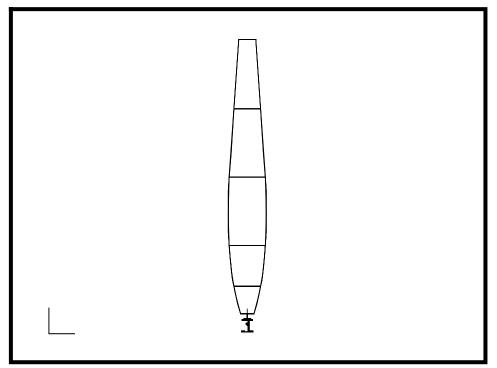
A message form appears. Again, do not duplicate geometry.

A new *Import Summary* form appears.

mport Summary			
Start Time	End Time	Elapsed Time	CPU Time
16-Aug-90 11:43:14 18-4	Mg-90 11:44:20	00:01:00	00:00:00
ET			
Express Neutral File Imported			
/planets/users/chalelew/	prop_11.1.exp		
EI			11
Express Neutral Geometry			
Geometry Typ	265	Quantity	Imported
Ordinary B-rep Solid		1	
Line		6	
Arc		1	
8-Spline Curve		7	
E1			
PATRAN Geometry			
Geometry Typ	orn.	Quantity	Created
Curve		14	
Solid		1	
er			
OK			



The imported model should appear as shown below.



3. To keep the imported solid separate from geometry that will be created later in the exercise, create a group named **solid** and add all solids to it.

Group/Create...

Action:

New Group Name:

Create	
solid	

■ Unpost All Other Groups

In order to select **Solid 1**, use the following entity select icons:



Geometric Entity

Entity Selection:

Solid	1	

Solid

Create

steel

Isotropic

Manual Input

Apply
Cancel

4. Create a material named **steel**.

♦ Materials

Action:

Object:

Method:

Material Name:

Input Properties...

The Input Options form appears.

30e6
0.3
0.0029

Apply

The phrase **Linear Elastic - [,,,,] - [Active]** appears in the *Current Constitutive Models* box.

Cancel

Create a New Material

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5. Create a property set to apply to the solid model. Name it **fin_3d_solid**.

♦ Properties

Action:	Create
Dimension:	3D
Type:	Solid
Property Set Name:	fin_3d_solid

steel

Solid 1

Create a **Property Set**

Input Properties...

The Input Properties form appears.

Material Name:

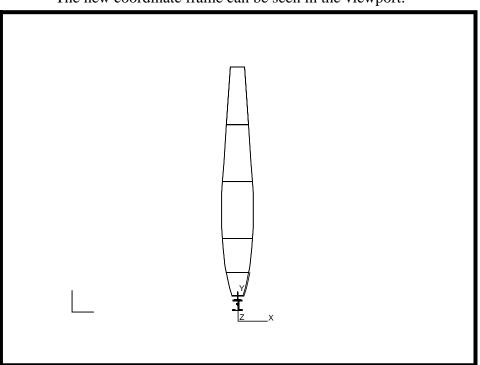
Select Members:

Add	
Apply	

Create a user-defined coordinate frame at the base of the fin.

♦ Geometry

Action:	Create
Object:	Coord
Method:	3Point
Origin:	[0 -2 0]
Point on Axis 3:	[0 -2 1]
Point on Plane 1-3:	[1 -2 0]
Apply	



The new coordinate frame can be seen in the viewport.

6. Determine the mass properties for the solid model of the fin.

Tools/Mass Properties...

Action:

Show	
3D	

Group

solid

Geometry

Dimension:

Define Region...

The *Region for Mass Properties* form appears.

Region:

Include:

Select Groups:

OK

Relative to Coordinate Frame:

select newly created Coord 1

■ Create Princ. Coord. Frame

Apply

Determine Mass Properties The Mass Properties Display form appears.

	COCCID 05	CG(CID 1)	I-Principal	Radii of Gyr.	Mass	Volume
Í	4,4655-04	4,4655-04	6.314E+00	7,248E+00	1.202E-01	4.145E+01
1	0.028E+00	1,1038+01	6,227E+00	7.198E+00		
	-4.8441-06	+4.844E+06	9,0065-02	8.940E-01		0.
ND	anded Cell Va s Property Dis					
48	s Property Dis	play Option Spal Inertias, a	nd Others		ections in User	

View the inertia tensor.

	and the second second	1		×	4		÷
	0.0007.01	1 × 02 × 0 × 1	0 1015 00		1 0000 01	1 A 1017 117	ł
ĸ	2.085E+01	-5.934E-04	9,461E-03	1.602E+01	-4,861E-04	9.461E-03	
t.	-5.9345-04	9,606E-02	7,5732-06	-4,0612-04	9.0062-02	6,4098-06	J
Z i	9.4612-03	7.5732-06	2.0532+01	9,4612-03	5.405E+06	1.6115+01	ł
	sanded Cell Va						
Las	is Property Dis	play Option	of Others	Particular of Tab	anotheres in the se	Reading to a	
1 10	is Property Dis	play Option cipal Inertias, ar	nd Others		rections in User rections in Ref.		

Cancel

Close the Mass Properties Form.

Cancel

7. Create a group named **fin_2d**. This group will contain a 2D projection of the solid model.

Group/Create...

Action:

Create

New Group Name:

fin_2d

■ Make Current

Unpost All Other Groups

Apply	
Cancel	

8. Create a 2D projection of the solid fin geometry.

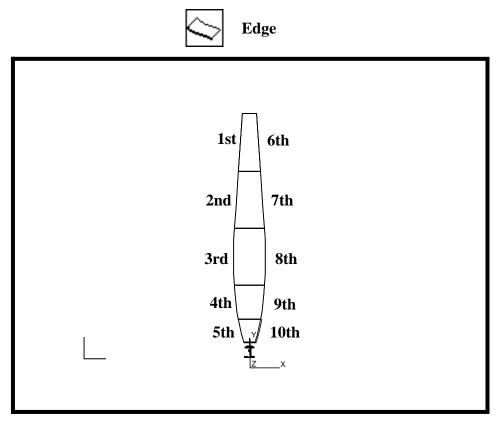
Create a Projection

♦ Geometry

Action:	Create
Object	Curve
Method	Project
Project Onto:	Plane
Option:	Normal to Plane
□ Auto Execute	



Select the curves that define the left and right sides of the blade. Click on the **Edge** icon to select the edge of the solid, and shift-click to select the edges in the following order:



Curve List:see figure abovePlane List:Coord 0.3

To select Coord 0.3 click on the Axis 3 icon

3 ∟

Then hold down the middle mouse button to rotate the coordinate axis until you can screen select the Z axis.

Apply

9. Unpost all other groups to view the projection only

Group/Post...

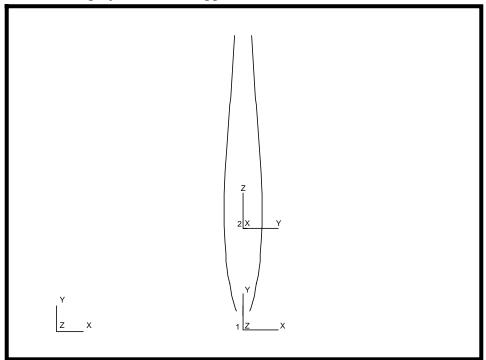
Action:

Select Groups to Post:

Post	
fin_2d	

Apply Cancel

The projected curves appear as follows.



10. Create a surface using the two projected curves.

Action:	Create
Object:	Surface
Method:	Curve
Option:	2 Curve

To select the curves, be sure to use the following entity select icon:

	Curve
--	-------

Starting Curve List:

Ending Curve List:

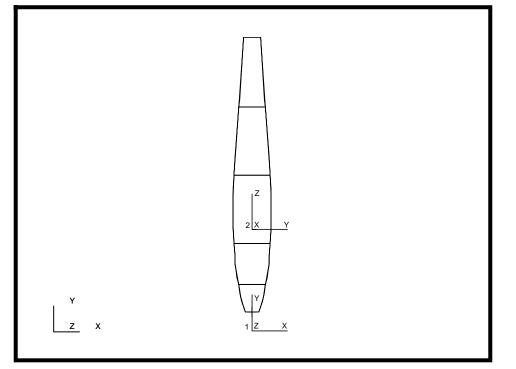
The function autoexecutes.

select all curves on left side

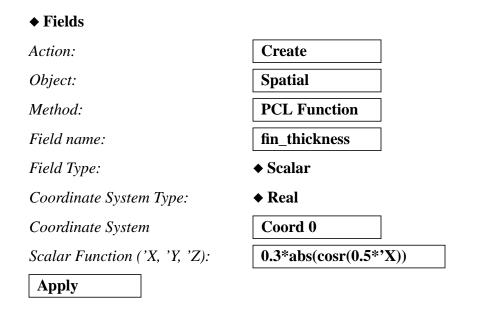
select all curves on right side

The surface should appear as follows:.

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11. Create a field to represent the thickness of the surface.



12. Create a property set for the 2D surface model.

♦ Properties

Action:

Create

Create a Field

1

D'	•
Dimer	nsion
Dinter	ibion.

Type:

2D	
Shell	
fin_2d_shell	

Property Set Name:
Input Properties...

The Input Properties form appears.

Material Name:

Thickness:

OK

m:steel

f:fin_thickness

Select Members:

Surface 1:5	
-------------	--

Add	
Apply	

13. Check the mass properties for the surface.

Tools/Mass Properties...

Action:

Dimension:

Show	
3D	

Define Region...

The Region for Mass Properties form appears.

Select Groups:

OK	
Apply	

Determine Mass Properties

fin_2d

LESSON 11

The *Mass Properties Display* form appears. Compare the inertia tensor to the one calculated for the solid.

		Time	2	×	¥	2
ĸ	2,477E+01	-1,4408-06	-1,971E-06	2.018E+01	-1.3L1E-06	-1.971E-05
۷.	-1.4402-06	6.507E-02	-1,9615-07	-1,3115-06	6.9072-02	-0.0102-00
z	-1.9712-05	-1.5612-07	2,4535+01	-1.971E-05	-6.8185-08	2.0258+01
	anded Cell Va					
las	s Property Dis	play Option cipal Inertias, a	nd Others			- Specified Fram Cartesian Frame



Check the *Warnings* form. Note that the curves and points were excluded from the calculation.

warning Message		warnings
The specified entit	ies that were excluded because of the indicated	7
warning condition	are: Point 69:76 Carve 15:24	

UK

14. Calculate mass properties again using the 2D plane stress. The thickness of the blade is set to 1 by default.

Action:

Show
2D Plane Stress

Dimension:

Apply

The *Mass Properties Display* form appears. Compare the inertia tensor to the ones previously generated.

	1	TIME	2	×	¥	2
6	9.145E+01	+6,901E-06	0,000E+00	7,4450+01	-6.265E-06	0,000E+00
r.	-6,9011-06	2.770E-01	0,000E+00	-6.2652-06	2,770E-01	0.000E+00
2	00+2000.0	0.0002+00	9,1722+01	0.000E+00	0.00000+00	7,472E+01
	anded Cell Va					
	s Property Dis	play Option cipal Inertias, ar	nd Others		ections in User actions in Ref.	

Cancel	
Cancel	

Close the warning form.

OK	

15. Tet mesh the base of the solid model of the fin. The geometry of the blade is very simple to mesh, so it will not be discussed. Besides, the base of the fin is usually where the focus of the analysis is directed, as that is usually the region of highest stresses.

Post the **solid** group and unpost all other groups.

Group/Post...

Select Groups to Post:

Apply	
Cancel	

Create a plane at the base of the blade to cut the solid.

♦ Geometry

Action:	Create
Object:	Plane
Method	Vector Normal
Plane Offset Distance:	0.35

Create a Surface Mesh

Vector List:	Coord 0.2	
Break the solid using the plane.		
Action:	Edit	
Object:	Solid	
Method:	Break	
Option:	Plane	
□ Auto Execute		
Solid List:	Solid 1	
Break Plane List:	Plane 1	
Apply		

A message form appears. Do not delete the original solids.

8	. Messa	600	12
Question from application \$	GM		
Do you wish to delete the origi	naf solitbi?		<u>8</u>
Yes for All	Yes	No	No For All

No For All

Clean up the display using the following toolbar icon:



Refresh Graphics

Create a new group named **solid_with_tetmesh** and add the base of the newly trimmed solid to it. Unpost all other groups.

Group/Create...

Action:

Create

New Group Name:

■ Unpost All Other Groups

Entity Selection

Solid 2 (the base of the fin)

Apply

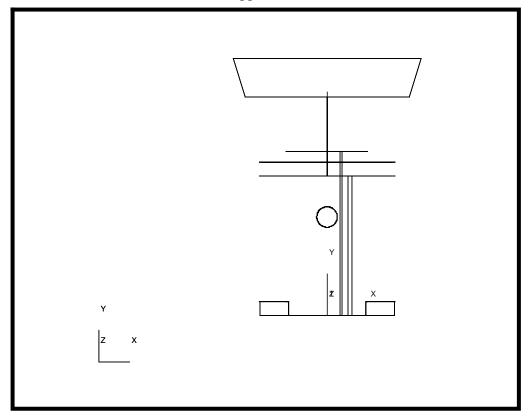
Cancel

Now, zoom in on the base of the fin using the following toolbar icon:



View Corners

The new solid should appear as follows.



Now, mesh the solid base.

◆ Finite Elements	
Action:	Create
Object:	Mesh
Method	Solid
Global Edge Length:	0.31
Mesher:	♦ Tetmesh
Input List:	select the base solid
Apply	

16. Conduct a Mass Properties calculation on the base of the fin.

First, assign properties to the base of the solid.

♦ Properties

Action:	Create
Dimension:	3D
Type:	Solid
Property Set Name:	base_props
Input Properties	

The Input Properties form appears.

Material Name:

steel	
Decer	

OK

In order to select the tet elements of the new mesh, use the following entity select icon:



Select Members:

select all solid elements

Add	
Apply	

Now, create a group called **mesh**.

Group/Create...

Action:

New Group Name:

Create	
mesh	

■ Unpost All Other Groups

Entity Selection

Add All FEM

Apply

17. Perform a Mass Properties calculation on the base.

Tools/Mass Properties...

LESSON 11

Action:

Dimension:

 Show

 3D

Define Region...

The Region for Mass Properties form appears.

Include:

Select Groups:

FEM	
mesh	

OK

■ Create Princ. Coord. Frame

Apply

This ends the exercise.