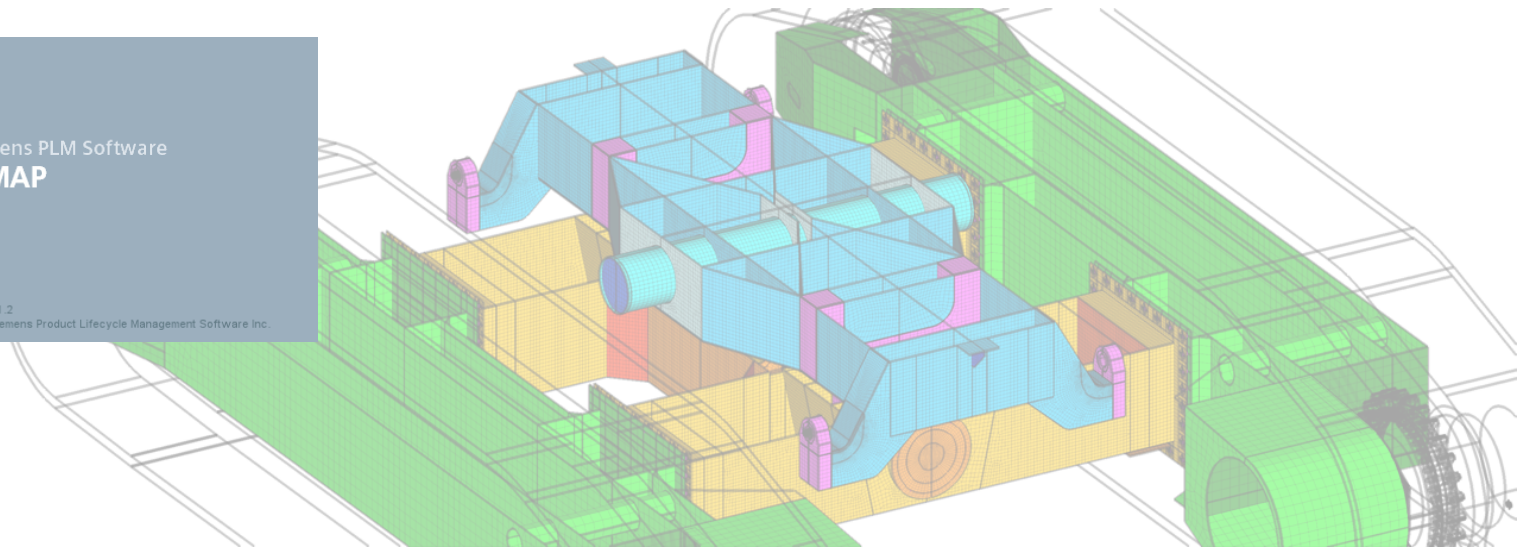


Siemens PLM Software
FEMAP
Version 11.2
© 2015 Siemens Product Lifecycle Management Software Inc.



Surface Modeling and Plate Meshing

A Seminar for FEMAP v11.2.1 Users

George Laird, PhD, PE | Principal Mechanical Engineer
Adrian Jensen, PE | Senior Staff Mechanical Engineer



LS-DYNA Sales, Support & Consulting

www.PredictiveEngineering.com



Siemens PLM Software Sales & Support
CAD | CAM | CAE | Teamcenter

www.AppliedCAX.com

TABLE OF CONTENTS

1.	OVERVIEW OF WHAT WE ARE GOING TO DO	4
1.1	SEMINAR OUTLINE	4
2.	WHY.....	5
2.1	MESH QUALITY.....	6
2.2	MESH QUALITY IS OFTEN IMPORTANT WHEN YOU FINISH THE PROJECT	7
2.3	WHERE THE FEW IS OFTEN BETTER THEN THE MANY.....	8
2.4	CLEAN SURFACE GEOMETRY LEADS TO A QUALITY QUAD DOMINATE MESH	9
2.4.1	Meshing Toolbox	9
3.	EARLY EFFORT LEADS TO COMPLETE ANALYSIS BENEFIT	10
3.1	WORKFLOW FOR SOLID CHUNK OF JUNK TO BEAUTIFUL SKIN OF CREAM	10
3.2	HOW TO GET THERE	10
4.	LET’S START LEARNING TO BE A SURFACE MESH GURU	11
5.	CREATING CLEAN SKINS.....	12
5.1	MIDSURFACE THE CHUNK.....	12
5.2	LOCATE FREE EDGES	13
5.3	GEOMETRY EDITING – EXTEND / LINEAR / SURFACE (SINGLE SURFACE MODE)	14
5.4	GEOMETRY EDITING – PROJECT CURVE/IMPRINT OPTIONS	15
5.5	GEOMETRY EDITING – PROJECT/MOVE POINT (THE “IT CAN DO THAT?” COMMAND).....	16
6.	MESHING FROM A FOUNDATION OF A SINGLE COHERENT SKIN.....	17
6.1	THE BIG DEMO MOVE FOR NEWBIES	18
6.1.1	Modify / Update Elements / Midsurface Thickness and Offset.....	18
6.2	LET’S MAKE IT LOOK PRETTY	19

6.2.1	Feature Removal / Loops (Add Surface Mesh Point)	19
6.2.2	Geometry Editing / Washer / Offset Type, Distance (0.1)	20
6.2.3	Geometry Editing / Pad / Offset Type, Distance (0.1), Add Washer	21
6.3	ELEMENT QUALITY CHECK.....	22
7.	CLOSING COMMENTS.....	23
8.	RESOURCES.....	23
9.	WHAT’S NEXT?	24

1. OVERVIEW OF WHAT WE ARE GOING TO DO

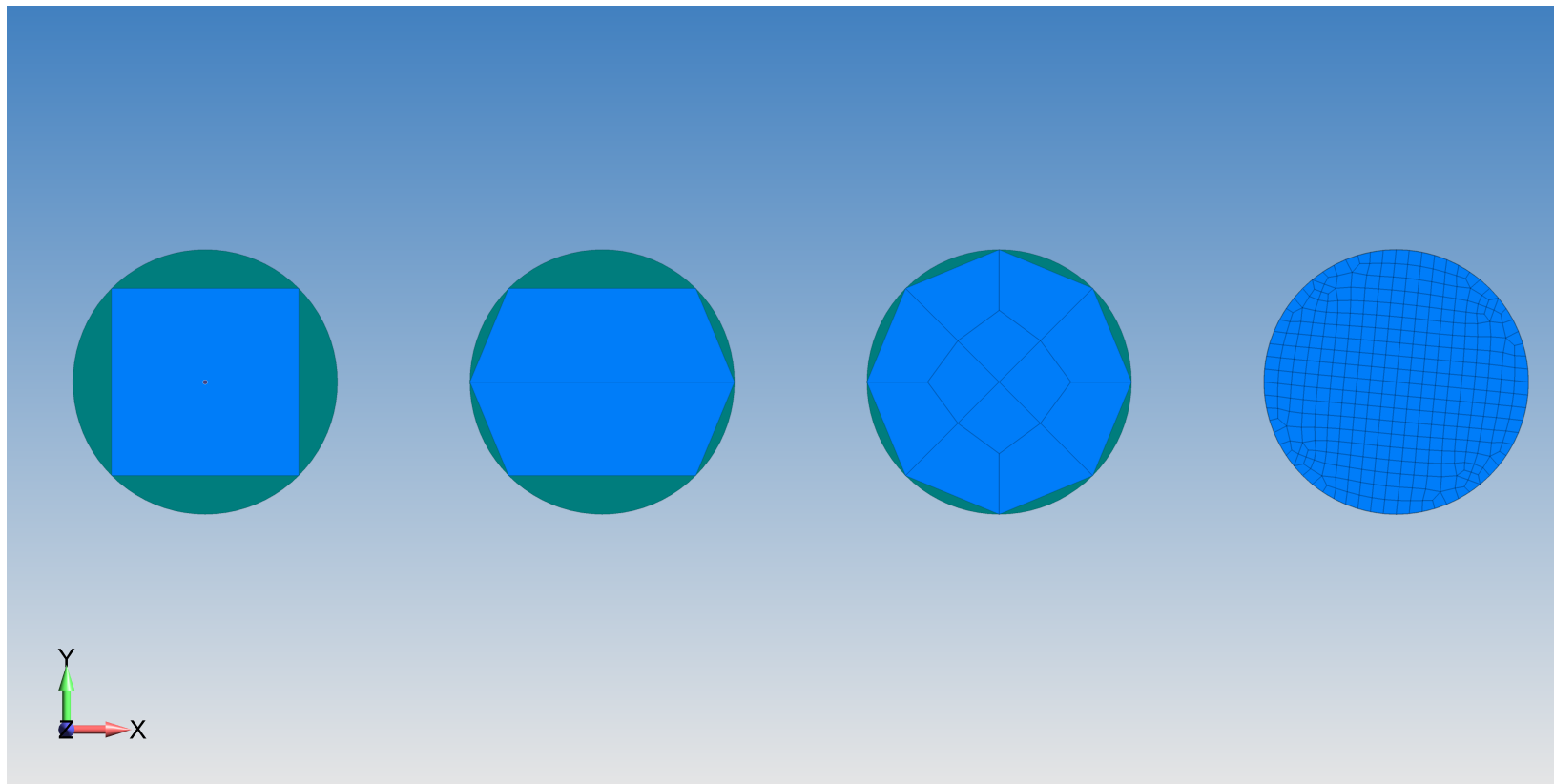
Congratulations! This is a technical seminar and we do these seminars to improve the skill sets of our analysis clients using FEMAP, NX Nastran and LS-DYNA. Since you are watching, you should be commended for taking the time to sharpen up your skill set.

1.1 SEMINAR OUTLINE

1. We'll discuss the basis about why it is important to carefully build your geometry and how it leads to a quality mesh
2. How to create surface geometry from “rangy” solid geometry
 - a. Workflow
 - b. Manifold versus non-manifold
 - c. Using the Meshing Toolbox from Entity Locator to Move Point
3. Meshing skin geometry
 - a. Mapped meshing, washers, box options within Meshing Toolbox
 - b. Contouring mesh metrics from warping, Jacobian to Explicit Time Step
 - c. Updating Mesh thickness via elements or surfaces
4. How to continue the learning process

2. WHY

A lot of these operations might seem like overkill to many simulation engineers with the premise that poor element quality can be made up for by just increasing the mesh density. I mean isn't that the foundation of the FEA method? More is better since one is converging to the theoretical geometric ideal?

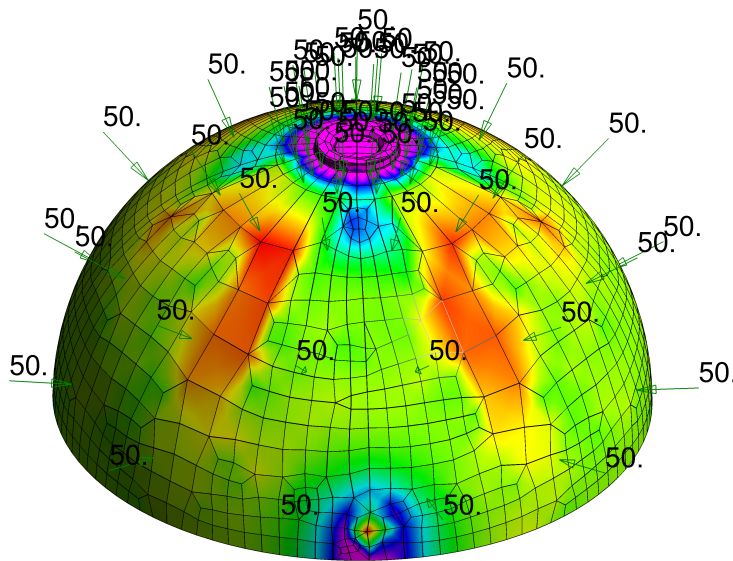


Usually the brute force approach works okay but there is no free lunch

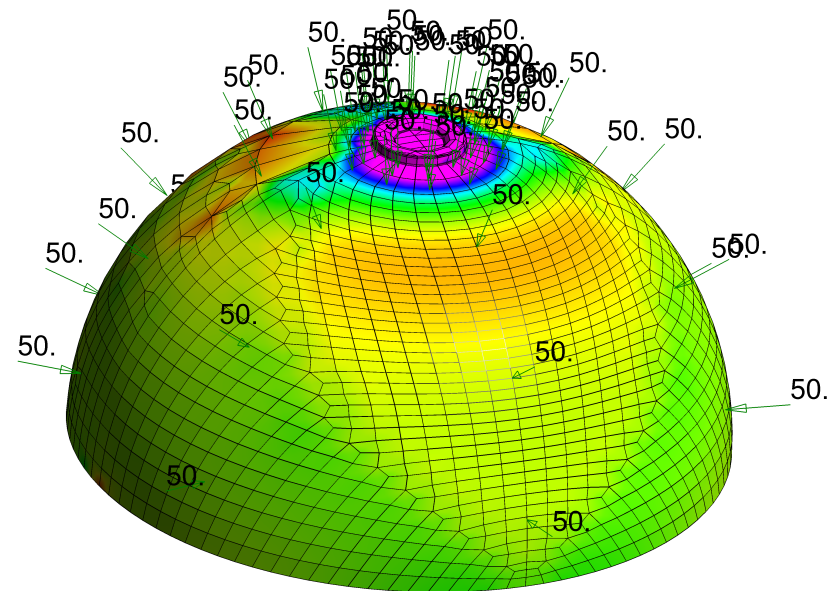
2.1 MESH QUALITY

The mesh bogie man is still popular but is rarely seen anymore since everyone typically over-meshes their structures

An exaggeration of a bad mesh



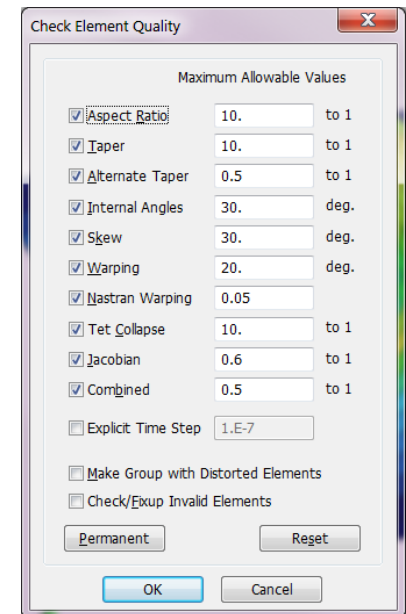
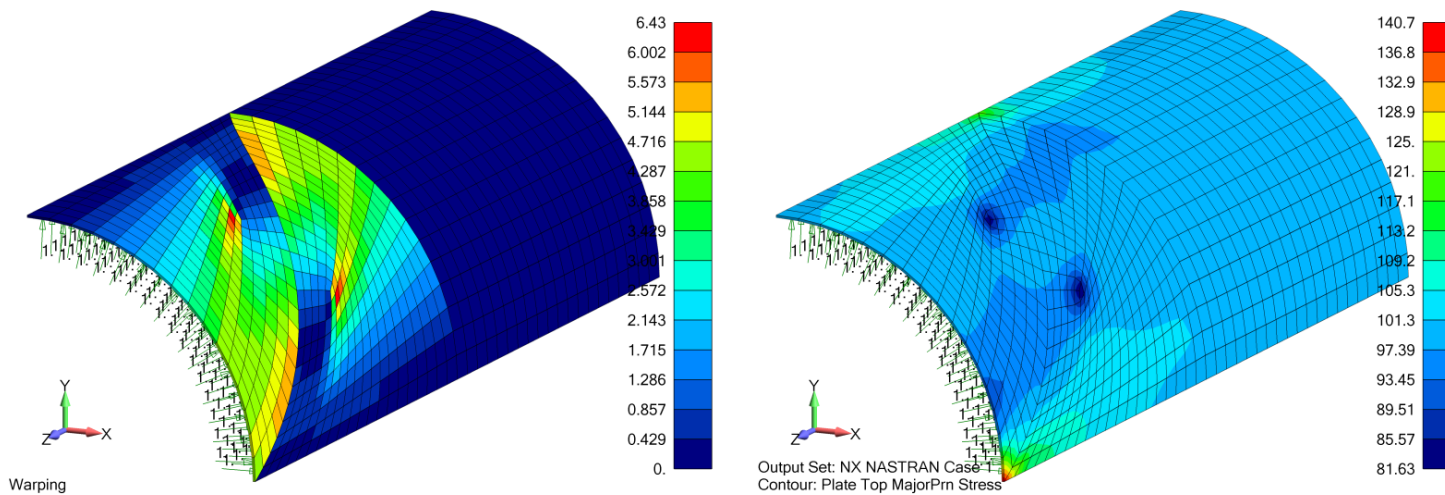
A more normal mesh



2.2 MESH QUALITY IS OFTEN IMPORTANT WHEN YOU FINISH THE PROJECT

This example is from our FEMAP and NX Nastran class. It is just a friendly reminder about the importance of mesh quality. The stress should be a uniform 100 psi but thanks to warping, you can get a range of values.

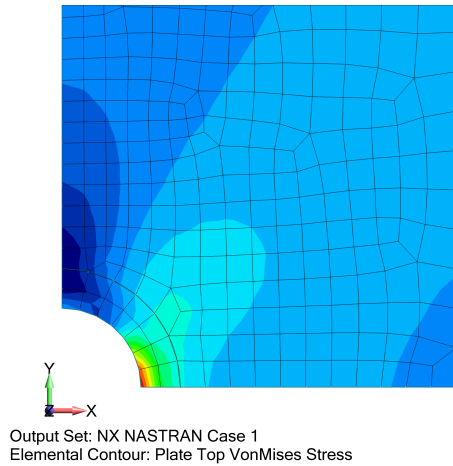
In the heat of battle to get a model built and running, it can be oh so easy to just “run and gun”; that is to say, get it meshed, loaded up and analyzed. Often times it is only in the documentation stage where meshing irregularities become glaringly apparent.



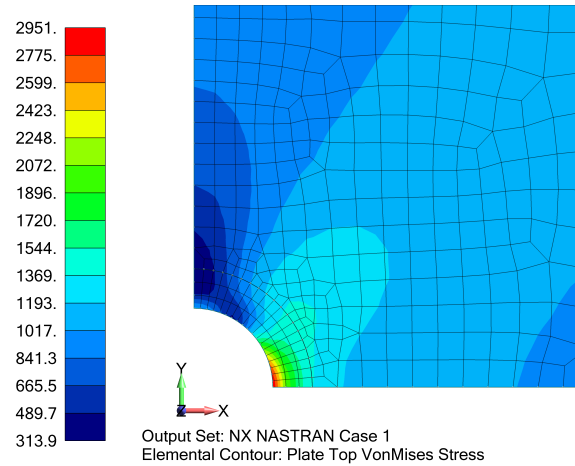
2.3 WHERE THE FEW IS OFTEN BETTER THEN THE MANY

Sort of an old example but it gets the point across

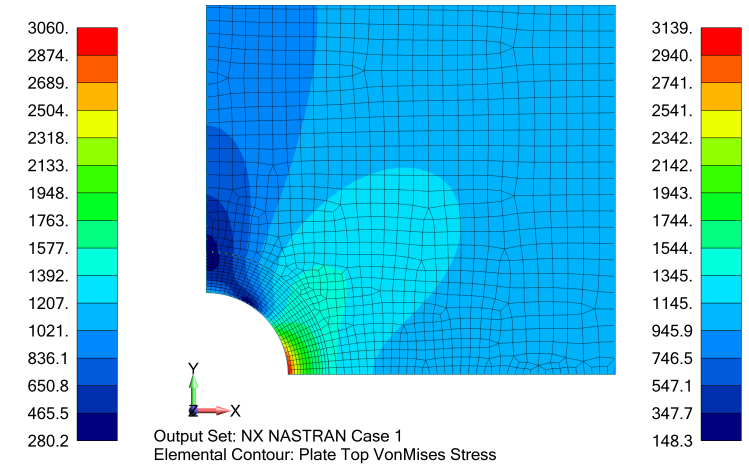
Okay



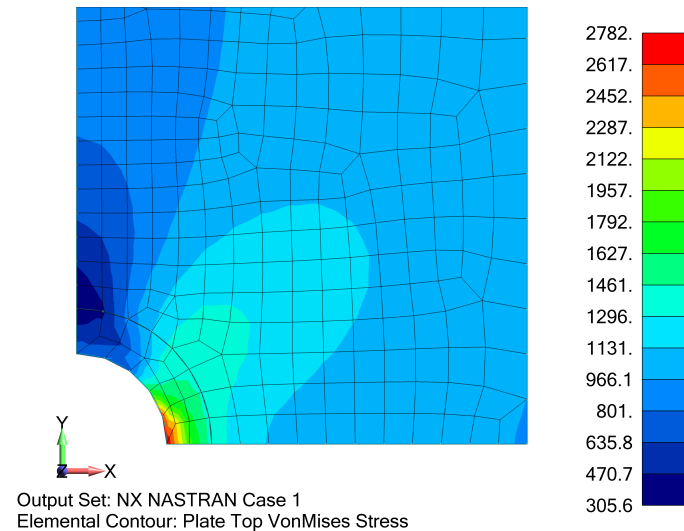
Done



Over Done



What Managers Worry About



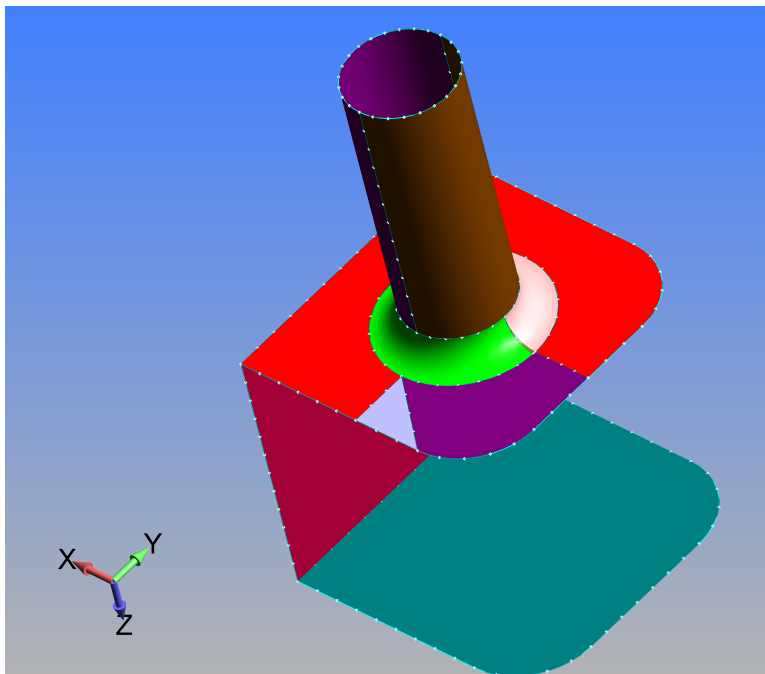
2.4 CLEAN SURFACE GEOMETRY LEADS TO A QUALITY QUAD DOMINATE MESH

2.4.1 MESHING TOOLBOX

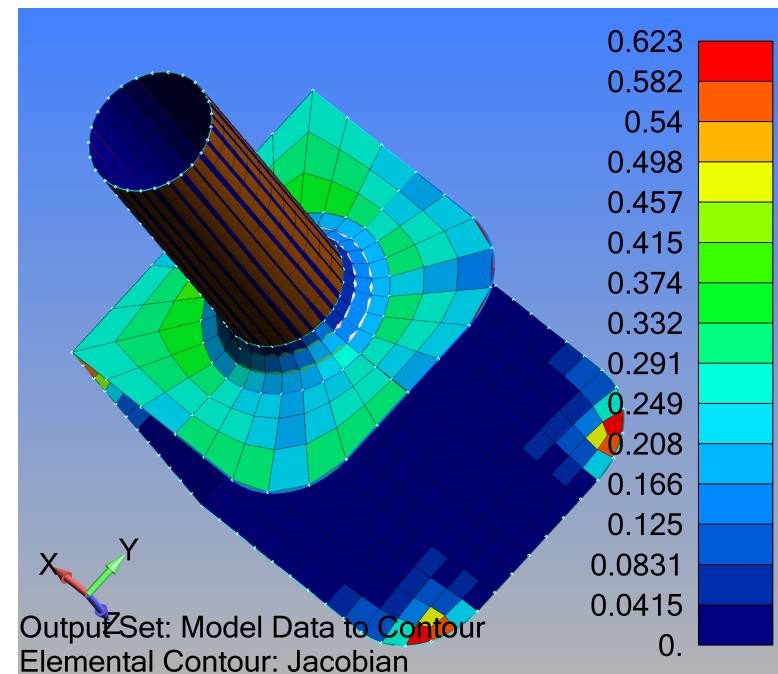
From deep in the archives of Femap'ing comes the First Meshing Toolbox Example. It is such an important tool that this is the first introduction. The key concept is that you can mesh or not mesh the part but that all operations within the Meshing Toolbox can simultaneously update the mesh (or not if you don't want).

Regular Surface Patterns = Regular Quad-Dominant Mesh

Usual Suspects



New and Improved



3. EARLY EFFORT LEADS TO COMPLETE ANALYSIS BENEFIT

It takes time to do surface geometry and even more time to do it cleanly.

3.1 WORKFLOW FOR SOLID CHUNK OF JUNK TO BEAUTIFUL SKIN OF CREAM

- ⊖ Clean Solid Geometry
 - Remove blends / Check for Small Holes / Don't try to mid-surface the impossible
- ⊖ Automatic Midsurface or Offset Tangent Surface or Build from Scratch
 - Don't get attached to one method think a bit prior to jumping
- ⊖ Manifold First and Check for Continuity (free edges)
- ⊖ Non-Manifold Add
- ⊖ Prepare Geometry for Easy Quad Dominant Meshing

3.2 HOW TO GET THERE

Hey give yourself some credit – your're watching this seminar – half-the-battle “an open mind to new stuff...”

Look at our other Surface Technique Seminars under Applied CAx and especially the Femapv11.2 Update Seminar

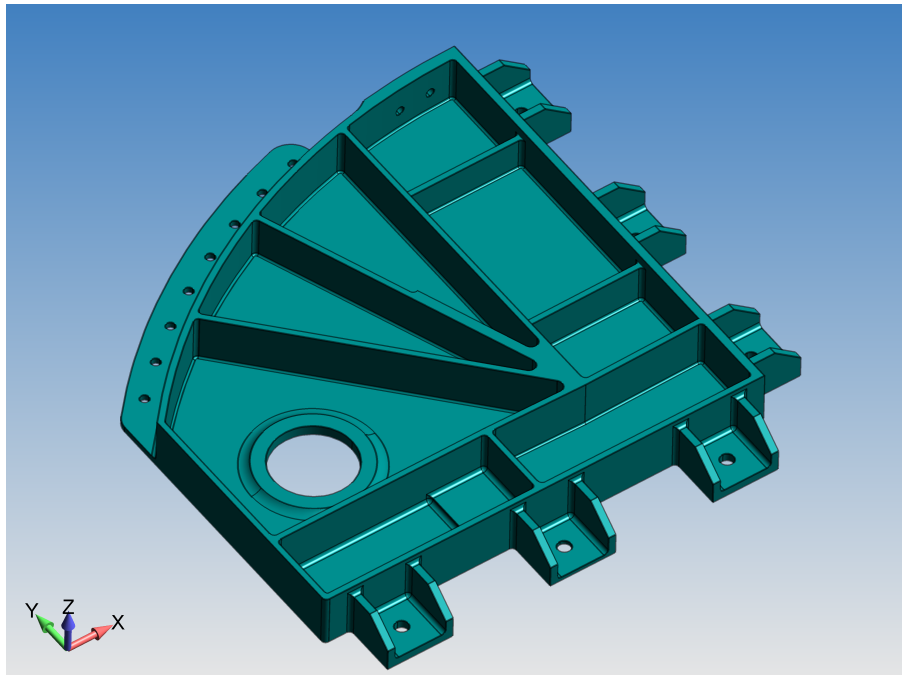
Read the manual – it is nicely done and has useful and very applicable suggestions. It is written by simulation engineers for other simulation engineers. They try to think like someone having to beat geometry into form.

4. LET'S START LEARNING TO BE A SURFACE MESH GURU

We are going to go through the process from start to finish and try to show as many of the geometry preparation features possible within FEMAP. We won't cover'em all. It would be too time consuming.

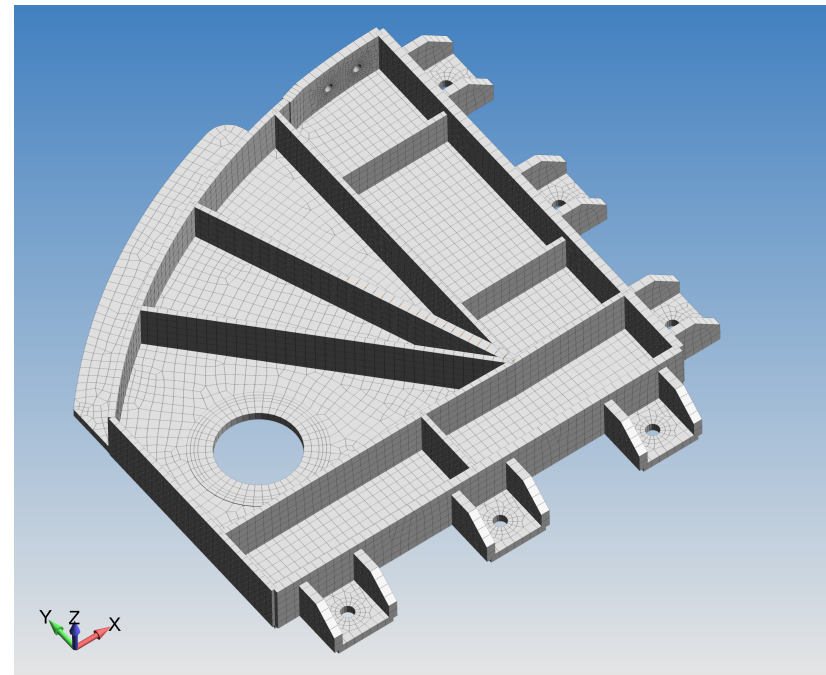
Solid Geometry

Challenges: variable thickness sections, rounded edges, large fillets that effect thickness changes and un-necessary holes



Final Meshed Part

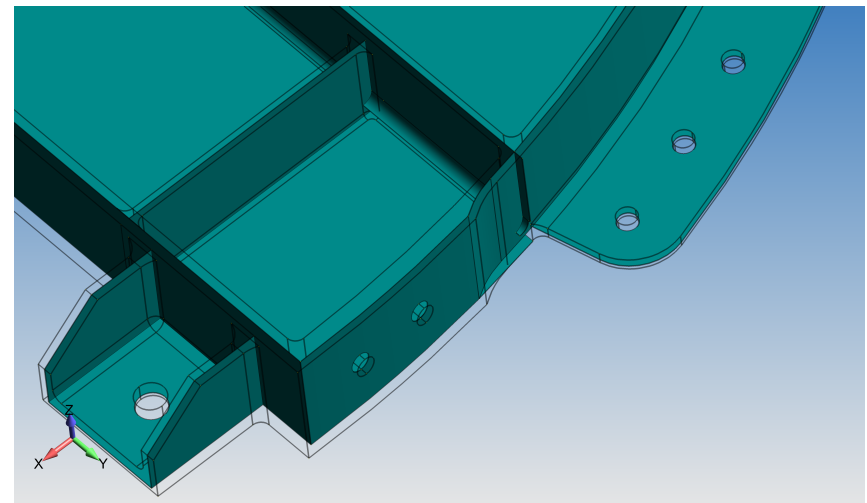
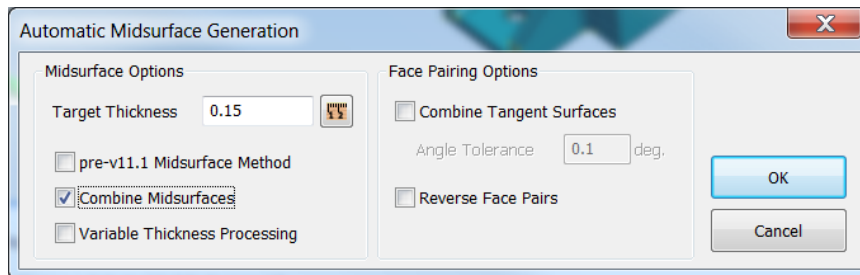
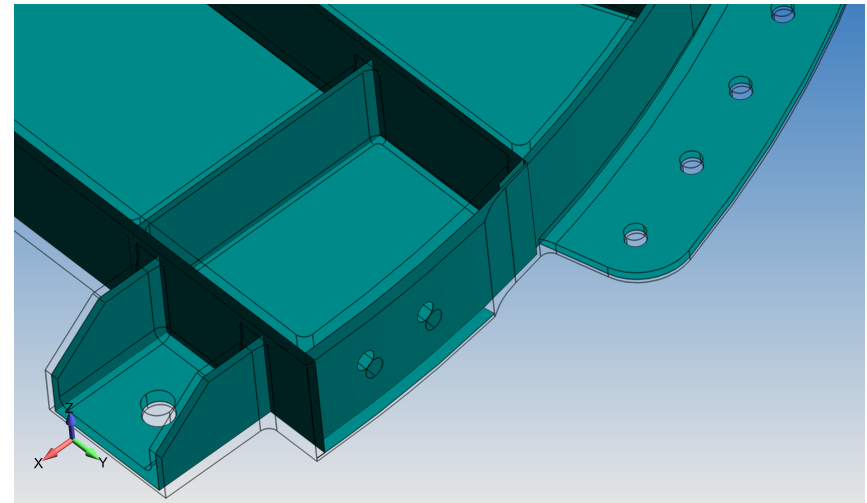
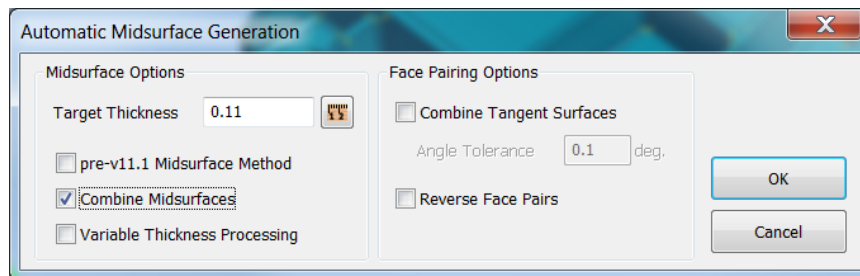
Clean quad dominant mesh with high-quality and low node count that reflects original part



5. CREATING CLEAN SKINS

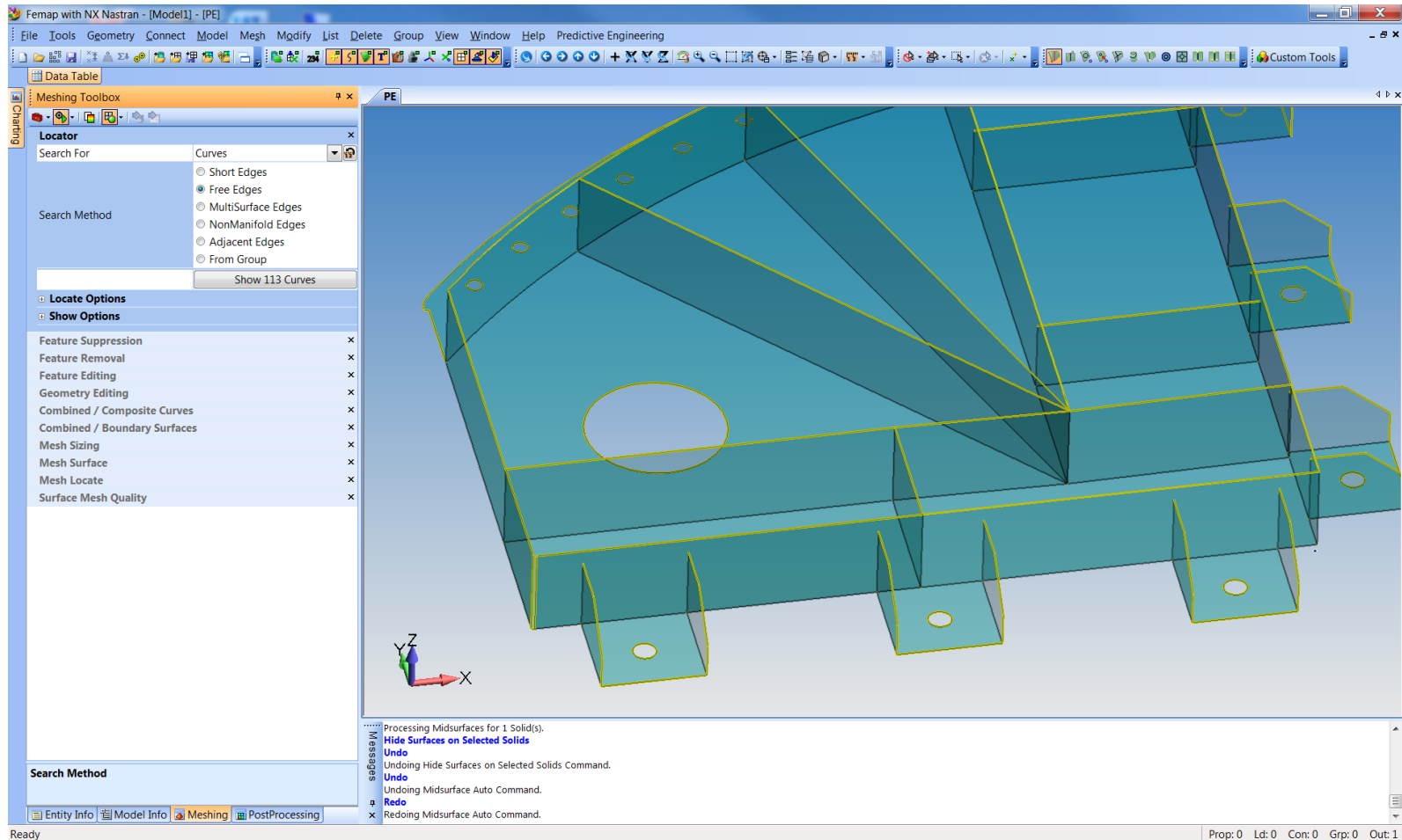
5.1 MIDSURFACE THE CHUNK

One has to explore a bit with the Target Thickness. Several new options – **IMPORTANTLY** “Combine Midsurfaces”



5.2 LOCATE FREE EDGES

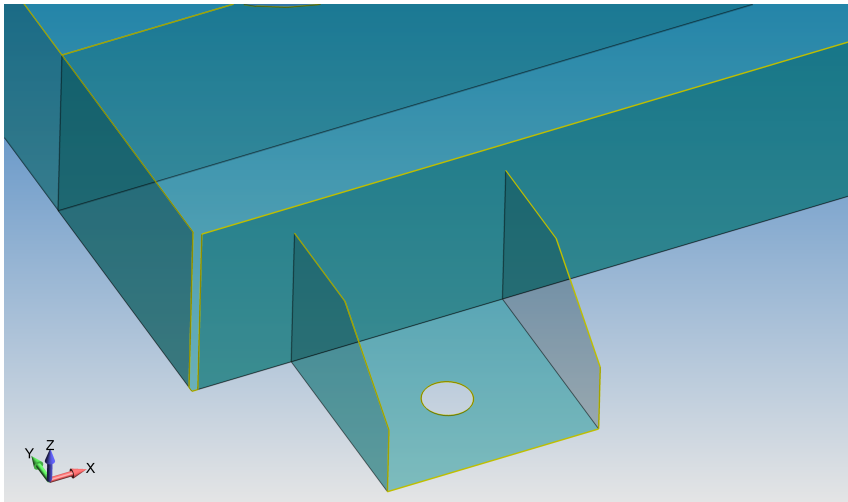
I have been remiss in not using the Entity Locator. The idea is to inspect what you have and quickly see if you are heading down the right path or it is time to bail. One can “locate” curves, surfaces or elements. Note that when one has used “Combine Midsurfaces” you have a general body that is continuous (i.e., non-manifold add has been used).



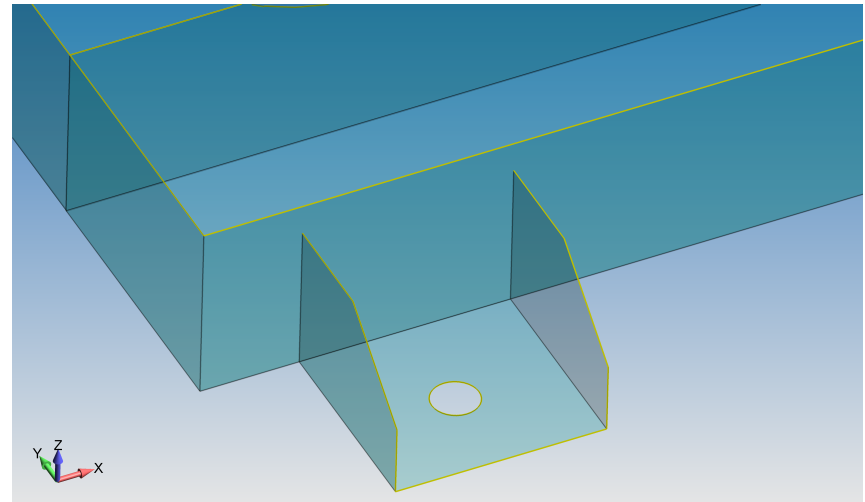
5.3 GEOMETRY EDITING – EXTEND / LINEAR / SURFACE (SINGLE SURFACE MODE)

This is a handy way to close up a corner. The logic is to pick your destination surface and then the curve of the surface you want to extend. The reason for Single Surface Mode is that we are extending to one surface.

Fixing a Loose Corner

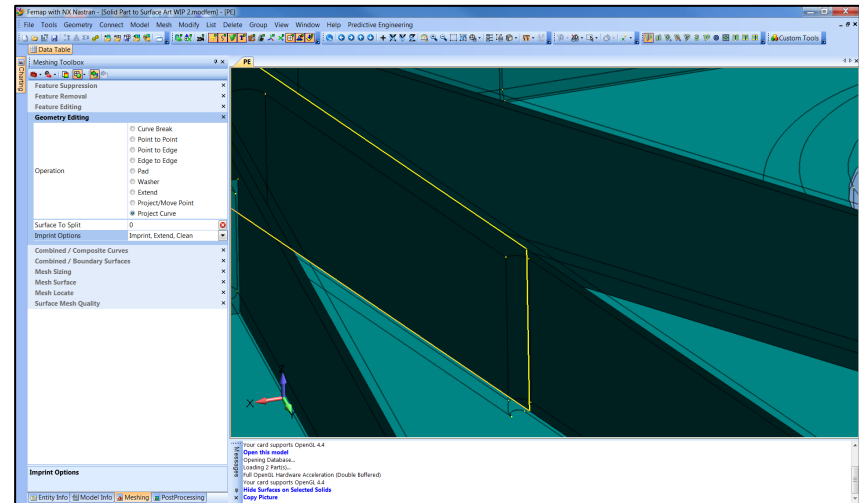
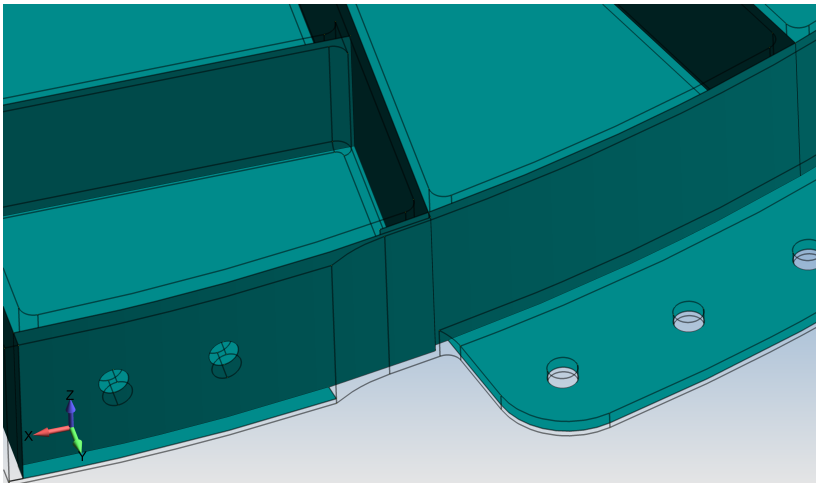
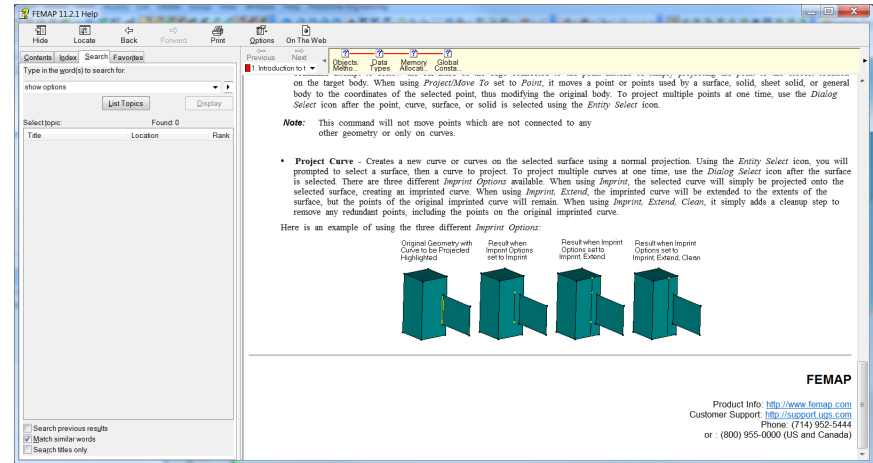
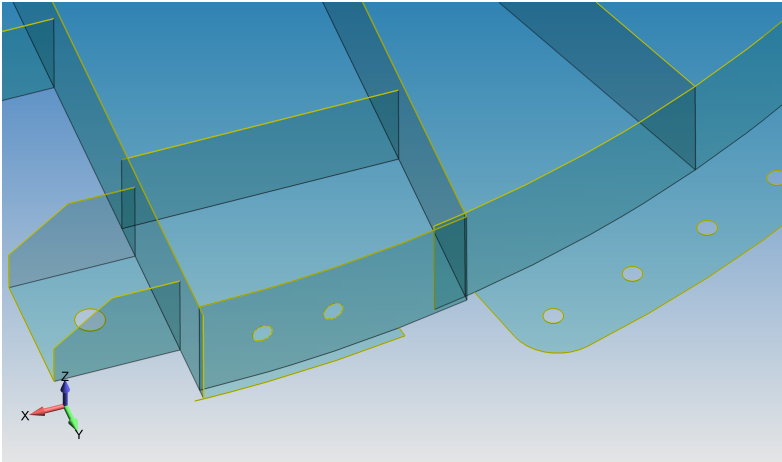


Locate Free Edges



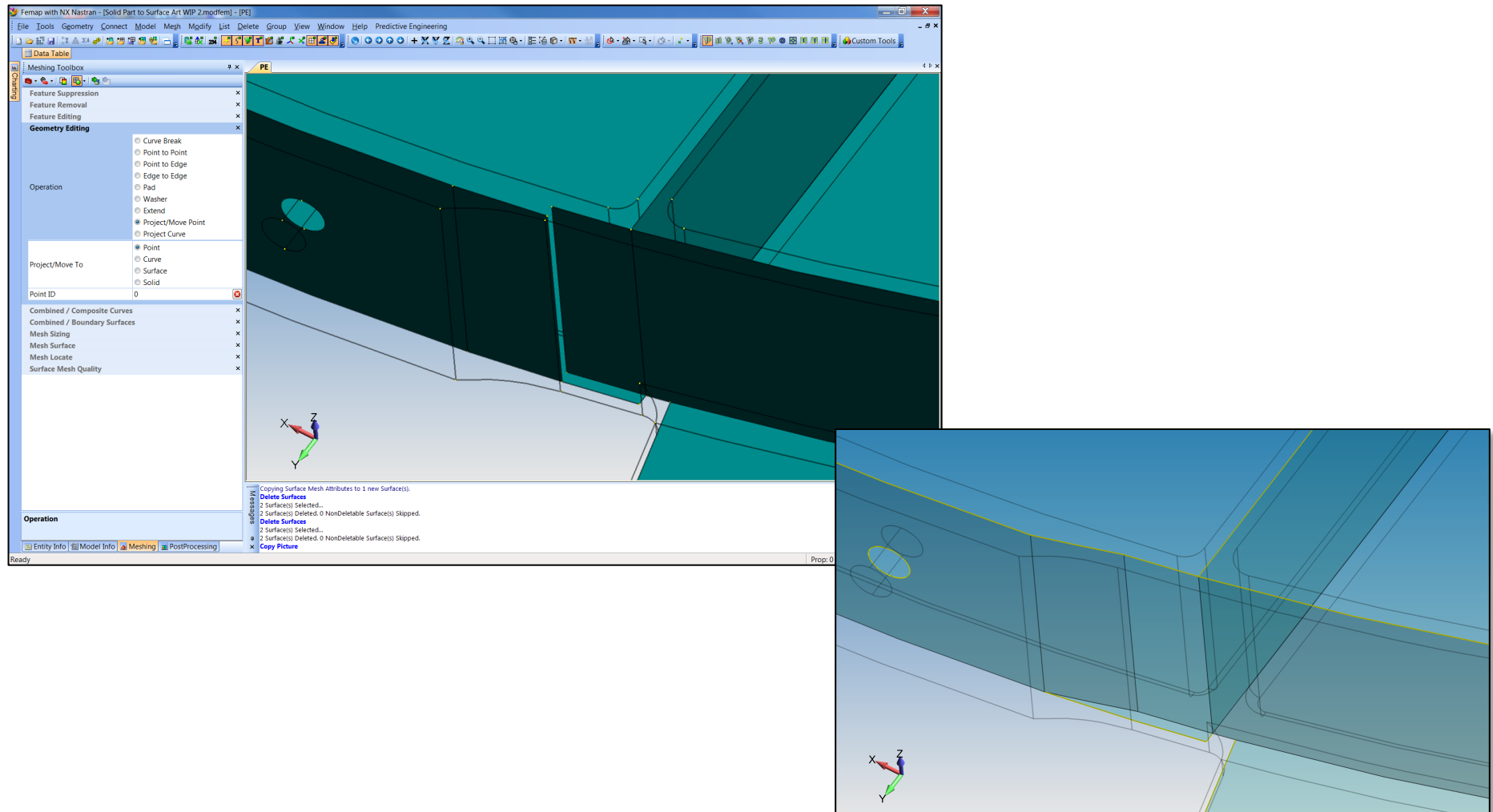
5.4 GEOMETRY EDITING – PROJECT CURVE/IMPRINT OPTIONS

Now comes the fun stuff of trying to fit the geometry into what we want to mesh. This option has several sub-options – never be too proud to just read the manual. We are going to use just Imprint and then the complete Imprint, Extend, Clean to get what we want.



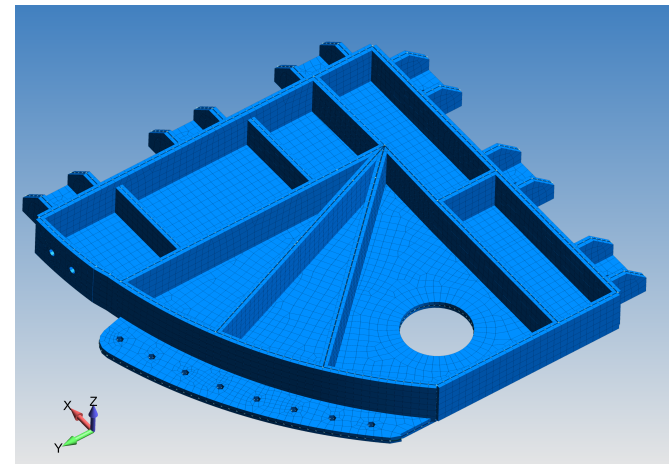
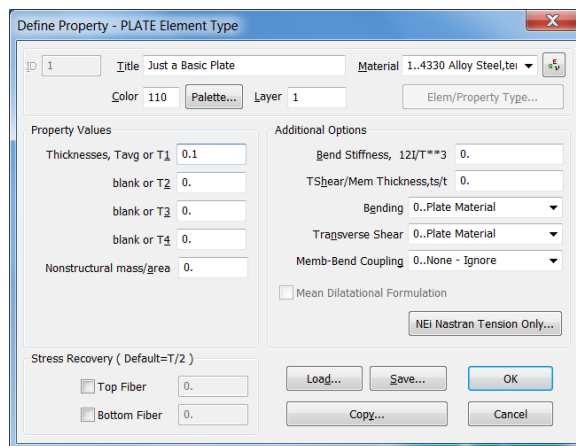
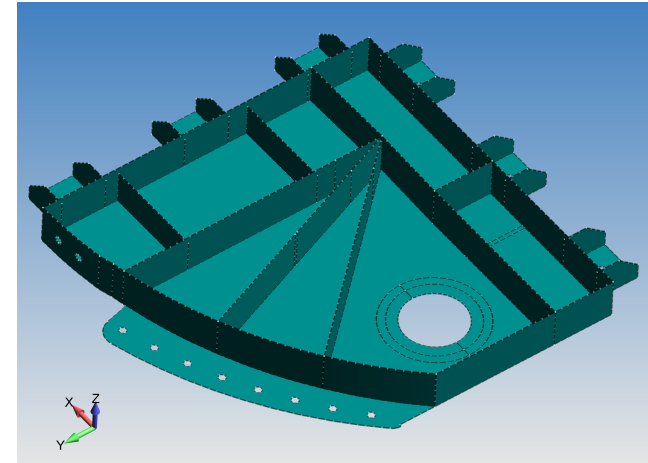
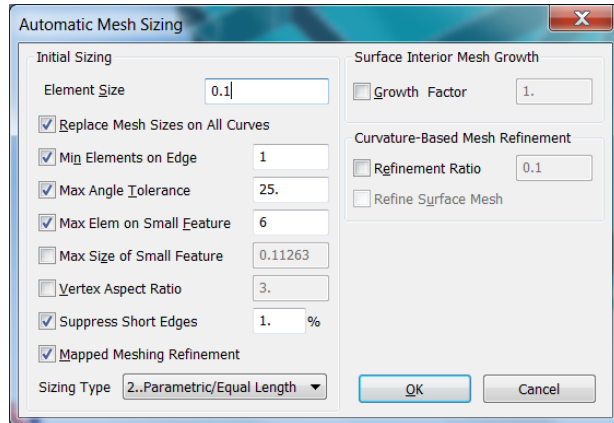
5.5 GEOMETRY EDITING – PROJECT/MOVE POINT (THE “IT CAN DO THAT?” COMMAND)

Okay, after deleting a few extraneous surfaces, we’re ready to close up the gap by moving over the surface. What is cool is that since it is all joined, when you move the surface it seals it (the Entity Locator tool). This command can do more than you think for morphing existing geometry into new shapes.



6. MESHING FROM A FOUNDATION OF A SINGLE COHERENT SKIN

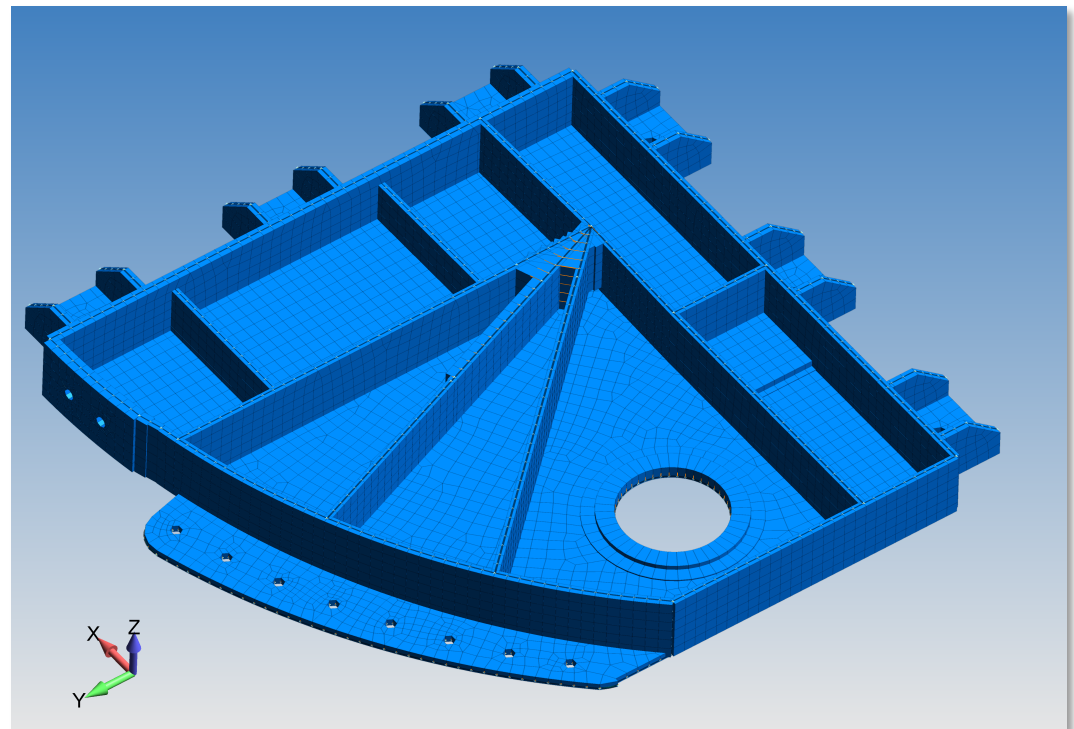
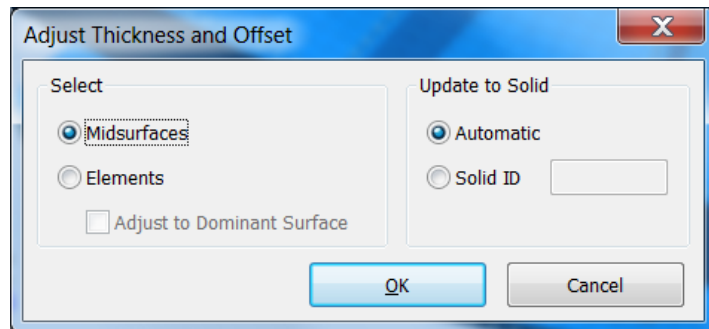
Starting with our clean skin doesn't mean that we can't go back and change stuff that is meshed it just means we have a pretty good place to move forward from.



6.1 THE BIG DEMO MOVE FOR NEWBIES

6.1.1 MODIFY / UPDATE ELEMENTS / MIDSURFACE THICKNESS AND OFFSET

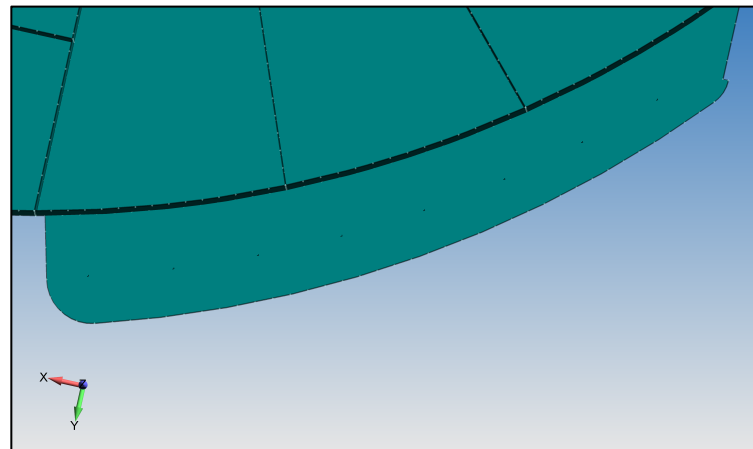
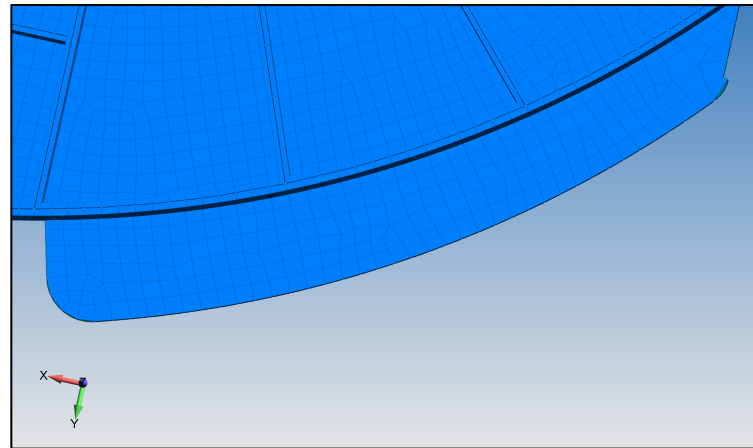
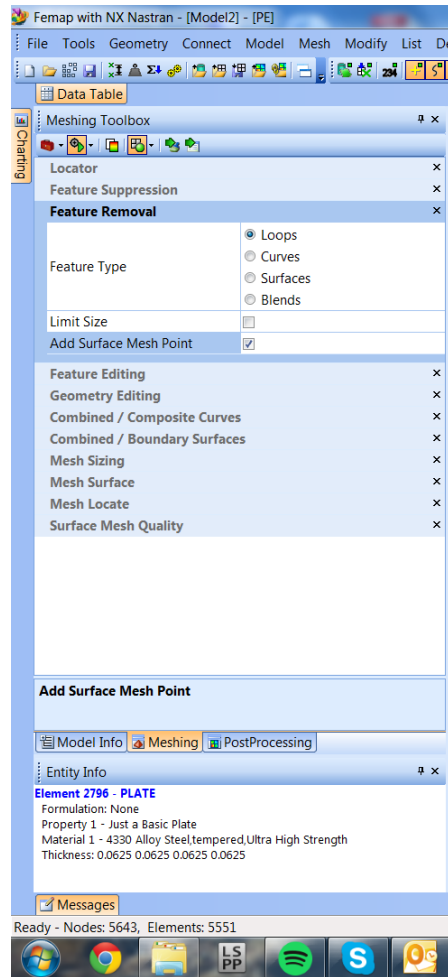
This command takes the linked midsurface skin and updates the elements (not property) to match the thickness of the original geometry. There are limitations. If you delete surfaces created in the original step – you break the associativity to the original solid. That is why it is important to work on the original skin within the Meshing Toolbox. Since it updates the elements, one doesn't have individual control over the sections via "Properties".



6.2 LET'S MAKE IT LOOK PRETTY

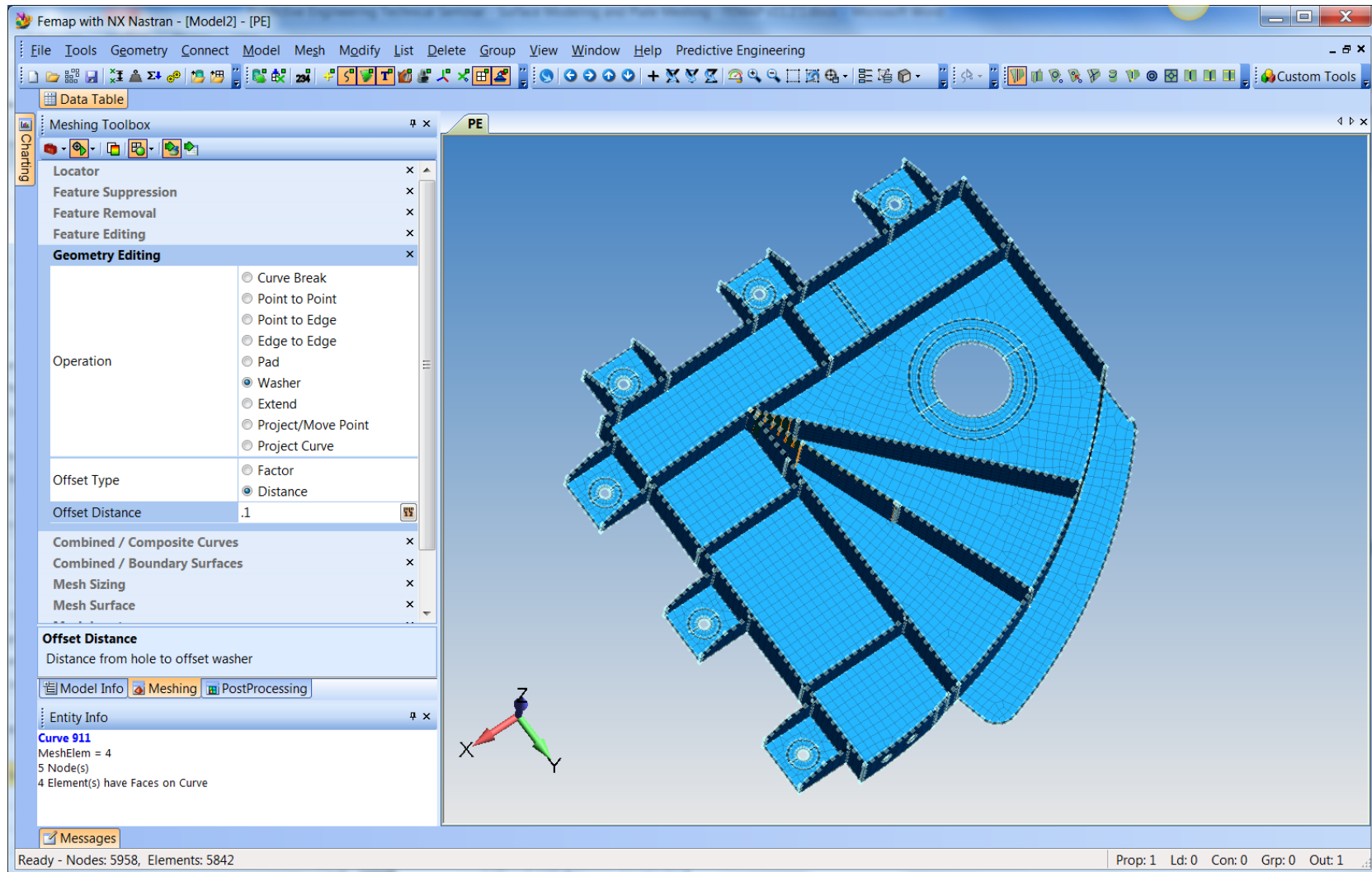
We'll now do some cleanup on the mesh to get something that is more analysis friendly.

6.2.1 FEATURE REMOVAL / LOOPS (ADD SURFACE MESH POINT)

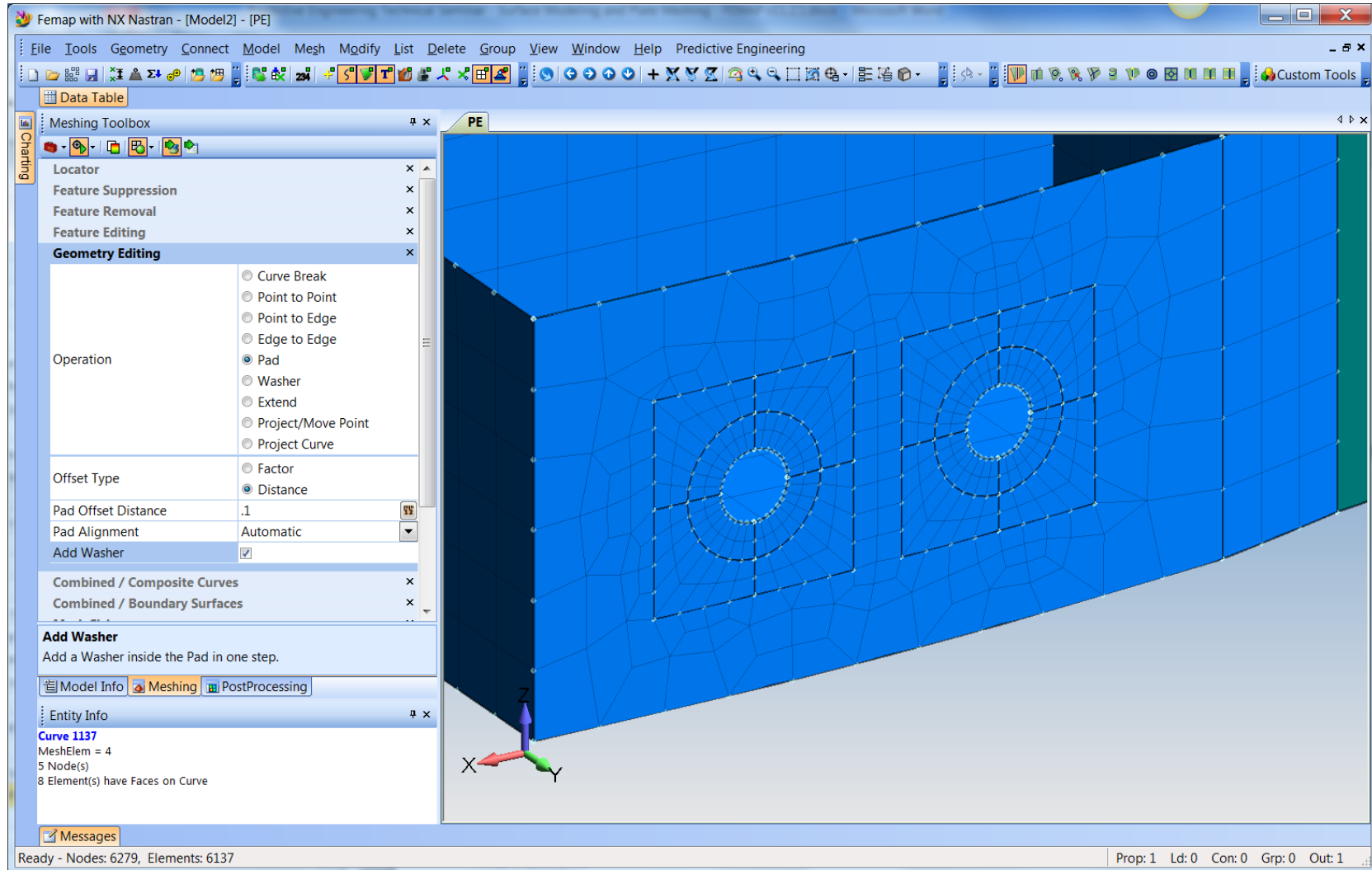


6.2.2 GEOMETRY EDITING / WASHER / OFFSET TYPE, DISTANCE (0.1)

This is nothing new but it is interesting to see how it works so well.



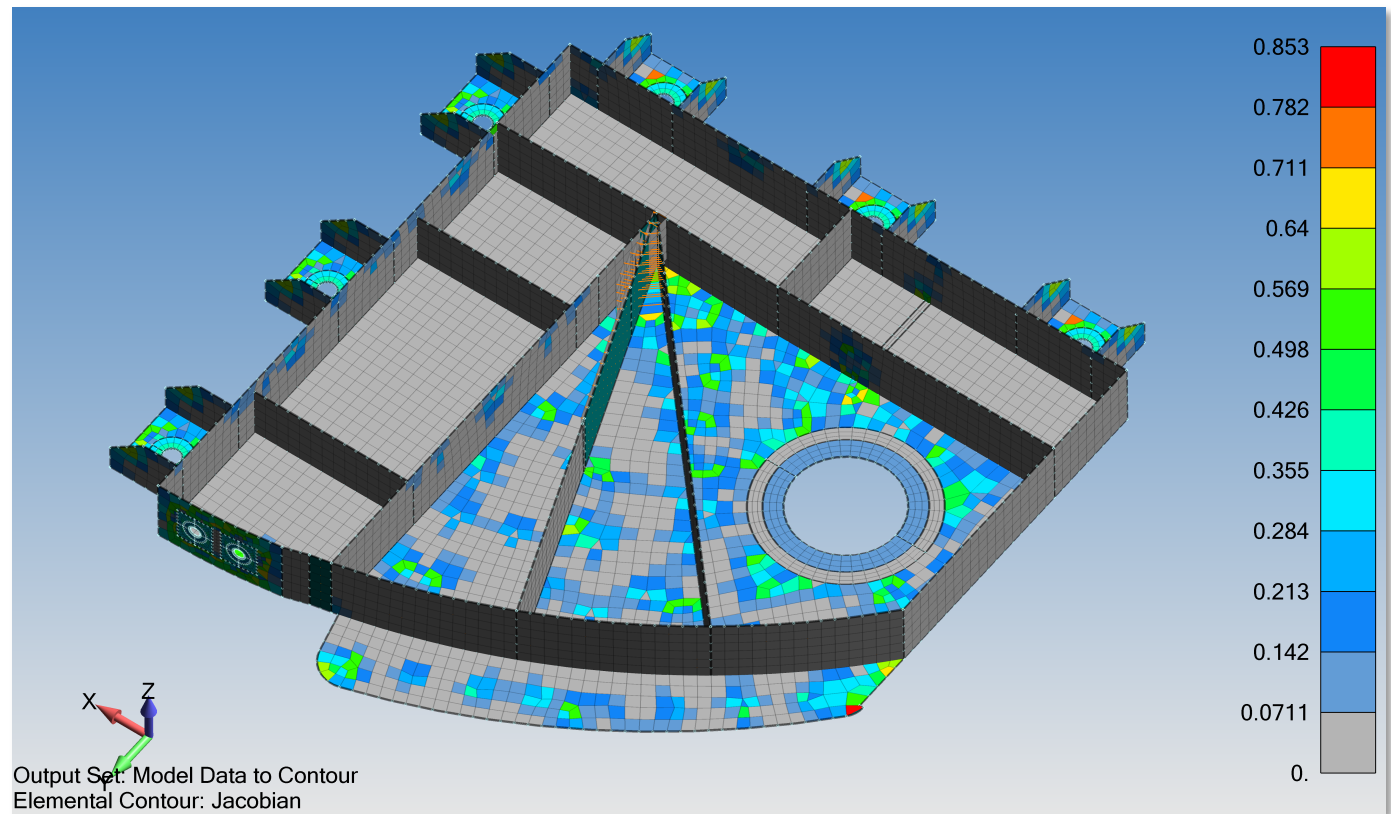
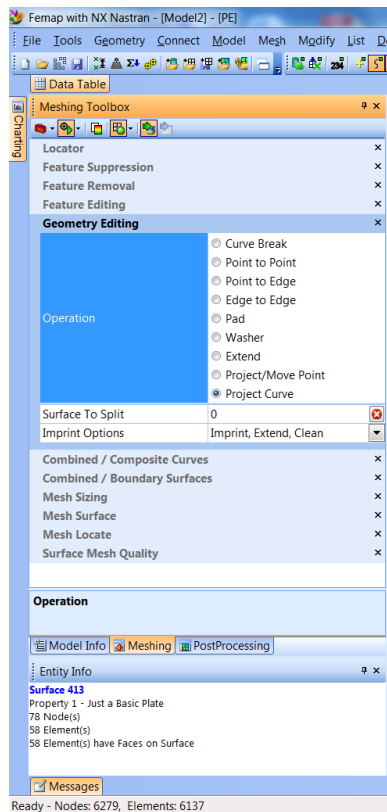
6.2.3 GEOMETRY EDITING / PAD / OFFSET TYPE, DISTANCE (0.1), ADD WASHER



6.3 ELEMENT QUALITY CHECK

Once everything is sealed up and meshed, an element quality check can be done.

One of the advantages of a clean skin is that changes to the mesh can be quickly made to improve the quality.



7. CLOSING COMMENTS

You guys did great – you made it through the seminar!

8. RESOURCES

www.AppliedCAX.com – “API of the Month”

FEMAP Manual

9. WHAT'S NEXT?

FEMAP Symposium September 23, 2015

Applied CAX
 We do this every day

Home Purchase Software Resources and Support Training About Us

You are here: Home / Femap Symposium 2015 - Greater Seattle area

Femap Symposium 2015

Everett, WA | September 23, 2015

Femap Symposium Menu

- Overview - Femap Symposium 2015
- Key Speakers and Lead Participants
- Informational PDF
- Why attend?
- Schedule
- Directions to the Future of Flight Center
- Nearby Lodging
- Register

Femap Symposium 2015 - Everett, Washington

September 23rd, 2015

Hosted by Applied CAX and Siemens PLM

This one-day free event will be held at Boeing's Future of Flight Aviation Center near Everett, Washington. Among other things it will focus on best practices for analysis efficiency for aerospace simulation engineers and aerospace suppliers. Stress engineers from all fields can use this session to find methods for shortening analysis timelines and creating process efficiencies.



Future of Flight Aviation Center
 8415 Paine Field Blvd
 Mukilteo, WA 98275

REGISTER

PATRICK SAFARIAN ANNOUNCED AS KEYNOTE SPEAKER



Applied CAX is pleased to announce Patrick Safarian as our keynote speaker for our 2015 Femap Symposium.

Mr. Safarian has over 20 years of experience at The Boeing Company and the FAA, and is best known in the aircraft industry as an expert in structural analysis.

FEMAP and NX Nastran Training October 19-23, 2015

Applied CAX
 We do this every day

Home Purchase Software Resources and Support Training About Us

You are here: Home / Training / Femap Training / Femap and NX Nastran Training Courses

Femap and NX Nastran Training: Foundation to Advanced to Customization

Femap and NX Nastran Training

Femap and NX Nastran Training: Foundation to Advanced to Customization

Next Class: October 19-23rd, 2015 in beautiful Portland, Oregon. Info and registration options

This week-long Femap training course taught by Predictive Engineering and Applied CAX takes the user from the ground floor through FEA best practices. It then moves into advanced subjects dealing with manifold and non-manifold surface modeling, detailed plate meshing, and tet versus hex meshing. The optional final day finishes with a focus on customization and automation using Excel and Femap's own API interface.

The course is fast-paced and follows a workshop format with theory, practice, and Q&A sessions. Sessions are created and managed by George Laird, PhD, PE, and Adrian Jensen, PE, experienced simulation engineers who have used Femap & NX Nastran on a daily basis for longer than they can remember. Attendees will receive information on where to find free Femap training resources, and will have a chance to get answers to their FEA questions.

FEMAP TRAINING COURSE OUTLINE:

Foundation of FEA Modeling with Femap + NX Nastran (Two Days)

- FEA theoretical background w.r.t Beam, Isoparametric and special elements
- Tour of Femap interface: Preferences, Panes, Toolboxes, Help and Tips & Tricks
- Femap modeling workflow for Beam, Plate and Solid (BPS) element
- Static stress analysis and results interpretation of BPS elements
- Introduction to Plate and Solid modeling with surface and solid geometry and Mesh Toolbox

October 19, 2015 8:00 am - October 23, 2015 4:00 pm (Save to cal)

Predictive Engineering

This nearly week-long course taught by Predictive Engineering and Applied CAX takes the user from the ground floor through FEA best practices. It then moves into advanced subjects dealing with ...

READ MORE

NEXT CLASS: October 19-23rd, 2015 in beautiful Portland, Oregon. Info and registration options

This week-long Femap training course taught by Predictive Engineering and Applied CAX takes the user from the ground floor through FEA best practices. It then moves into advanced subjects dealing with manifold and non-manifold surface modeling, detailed plate meshing, and tet versus hex meshing. The optional final day finishes with a focus on customization and automation using Excel and Femap's own API interface.

The course is fast-paced and follows a workshop format with theory, practice, and Q&A sessions. Sessions are created and managed by George Laird, PhD, PE, and Adrian Jensen, PE, experienced simulation engineers who have used Femap & NX Nastran on a daily basis for longer than they can remember. Attendees will receive information on where to find free Femap training resources, and will have a chance to get answers to their FEA questions.

FEMAP TRAINING COURSE OUTLINE:
Foundation of FEA Modeling with Femap + NX Nastran (Two Days)

- FEA theoretical background w.r.t Beam, Isoparametric and special elements
- Tour of Femap interface: Preferences, Panes, Toolboxes, Help and Tips & Tricks
- Femap modeling workflow for Beam, Plate and Solid (BPS) element
- Static stress analysis and results interpretation of BPS elements
- Introduction to Plate and Solid modeling with surface and solid geometry and Mesh Toolbox

