LATTICE STYLE OPTIMIZATION STUDY
RACE CAR BRAKE PEDAL

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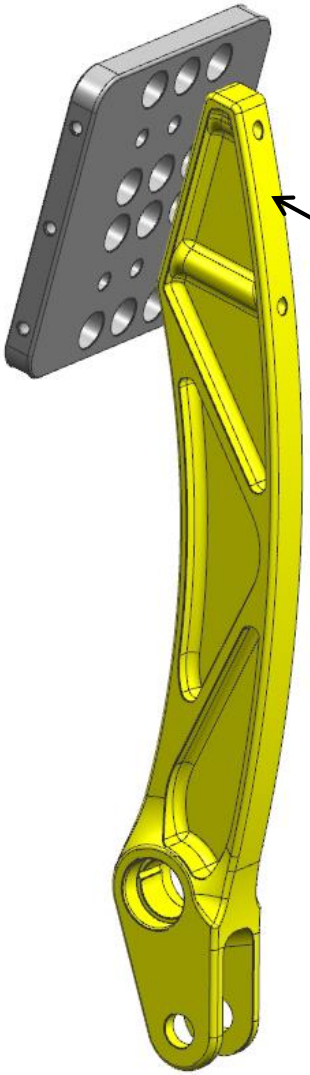
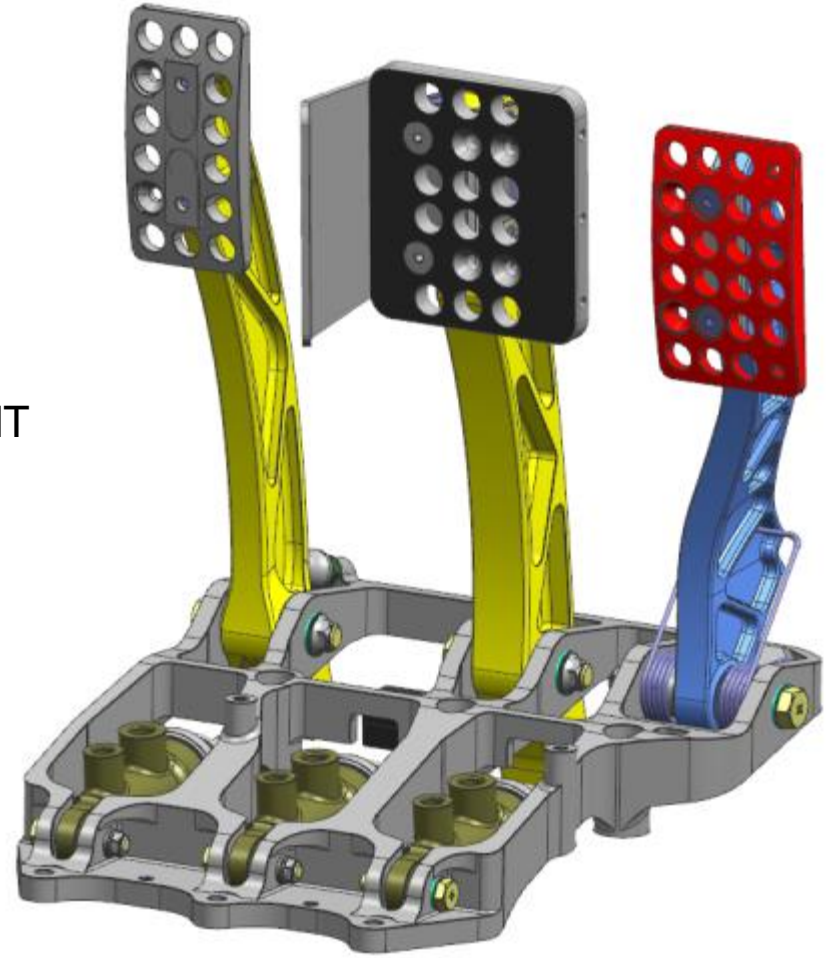
PRATT & MILLER ENGINEERING

OPTIMIZATION AND FILE CLEANUP

RACE CAR PEDALS USED IN CHAMPIONSHIP WINNING CORVETTE, CADILLAC AND CAMARO



NOTICE HOW PAD FACE IS OFFSET ON THE ARM THUS CREATING A MOMENT ABOUT THE Z AXIS



OPTIMIZATION AND FILE CLEANUP

10 STEP GUIDE TO CREATING LATTICE OPTIMIZED PARTS

1. **CREATE DESIGN SPACE MODEL AND LOAD CASES – JUST LIKE A STANDARD OPTIMIZATION**
2. **USE A COURSE GRID SIZE**
3. **START WITH A SLIGHTLY SMALLER VOLUME TO ACCOUNT FOR BEAM GROWTH**
4. **IDENTIFY UPPER AND LOWER BOUNDS FOR OPTIMIZATION AND BEAM SIZE**
5. **OPTIMIZATION RESULTS ARE THEN TRANSFERRED TO MATERIALISE FOR STL CREATION**
6. **CREATE BEAM STL – NOTICE SIZE IMPACT ON REFINEMENT**
7. **CREATE SURFACE WRAP OF SOLIDS WITH INFLATION**
8. **CREATE ADDITIONAL FILL AREAS AND MERGE ALL TOGETHER**
9. **IMPORT FINAL BUILD SOLID AND INTERSECT WITH ABOVE**
10. **PRINT IT!**

OPTIMIZATION AND FILE CLEANUP

	Mass	Displacement	Percent Weight Delta From Full Volume	Displacement Ratio From Full Volume	Percent Weight Delta From Current	Displacement Ratio From Current
Full Volume	423.1	0.744	100.0%	100.0%		
Webbed Pedal	226.3	3.112	53.5%	29.1%		
Lattic Optimized	218.0	2.217	51.5%	44.7%	3.7%	128.8%

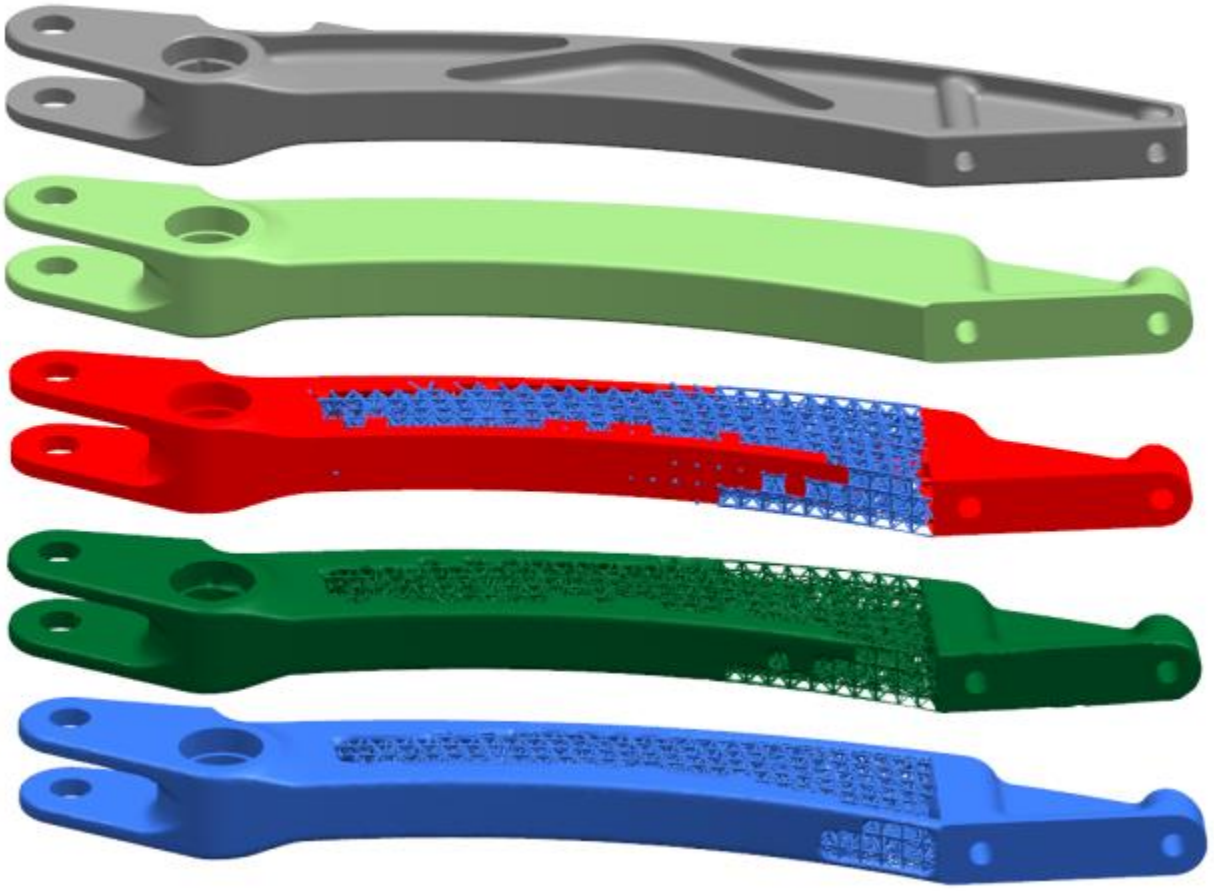
CURRENT MACHINED PEDAL

DESIGN SPACE AVAILABLE

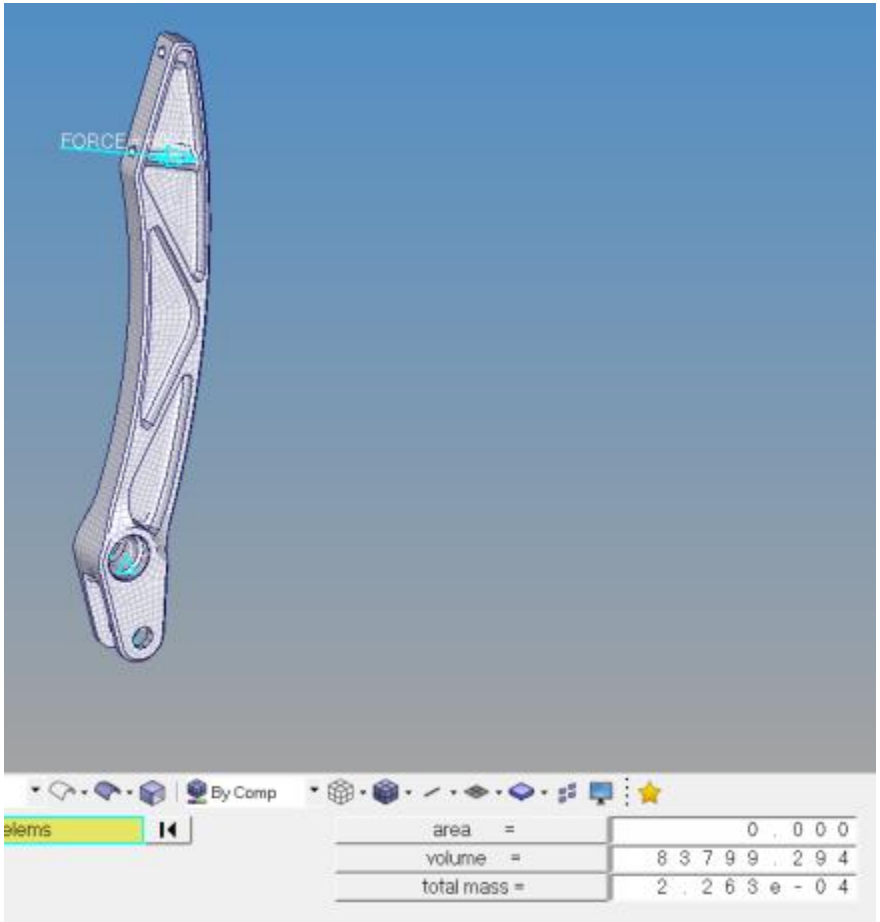
RAW OPTIMIZED PEDAL

SMOOTHED STL PEDAL

FINAL LATTICE DESIGN

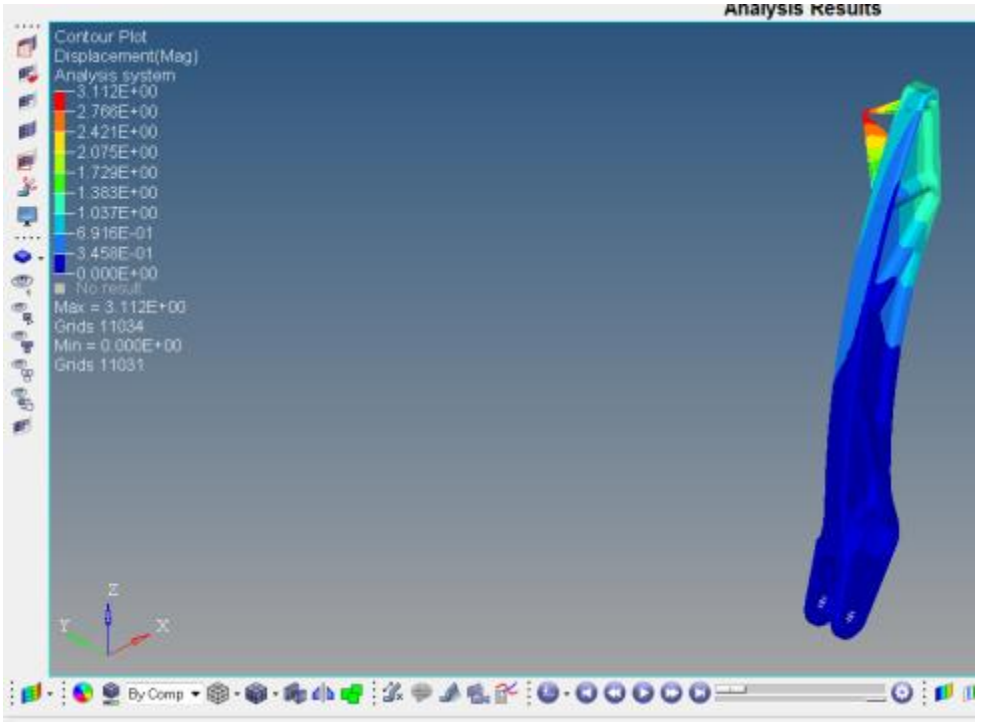


OPTIMIZATION AND FILE CLEANUP

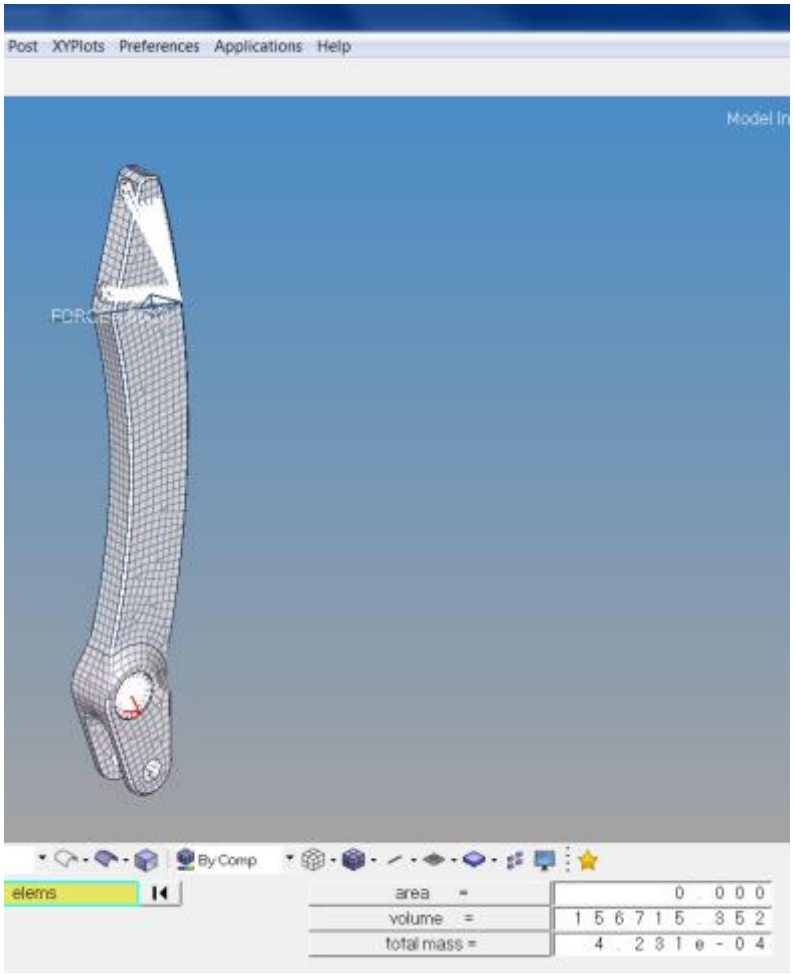


CURRENT DESIGN SPECS

226.3 g
3.11 mm

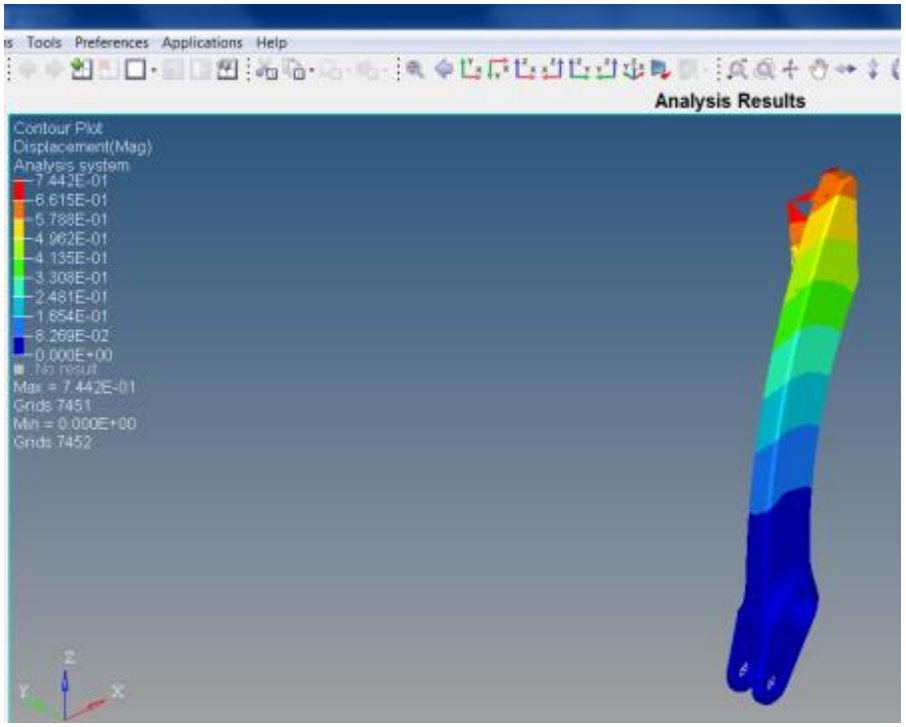


OPTIMIZATION AND FILE CLEANUP



SPACE CLAIM MAXIMUMS

423.1 g
0.744 mm

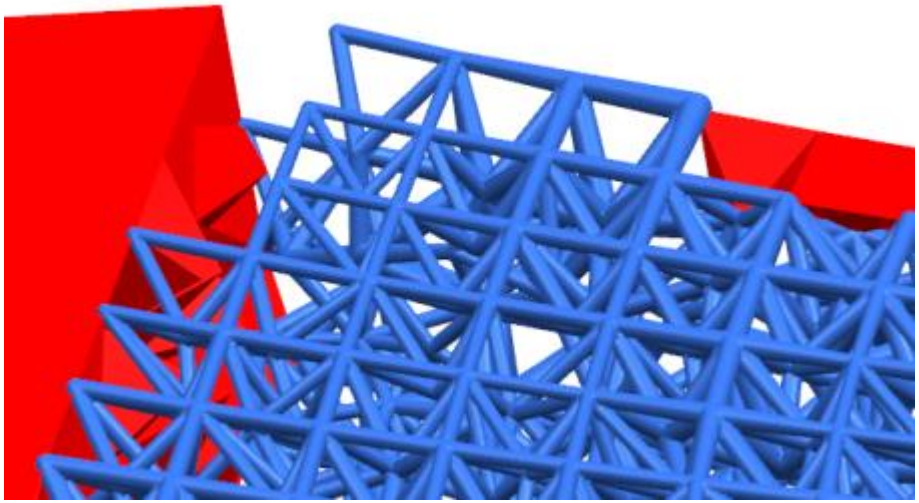


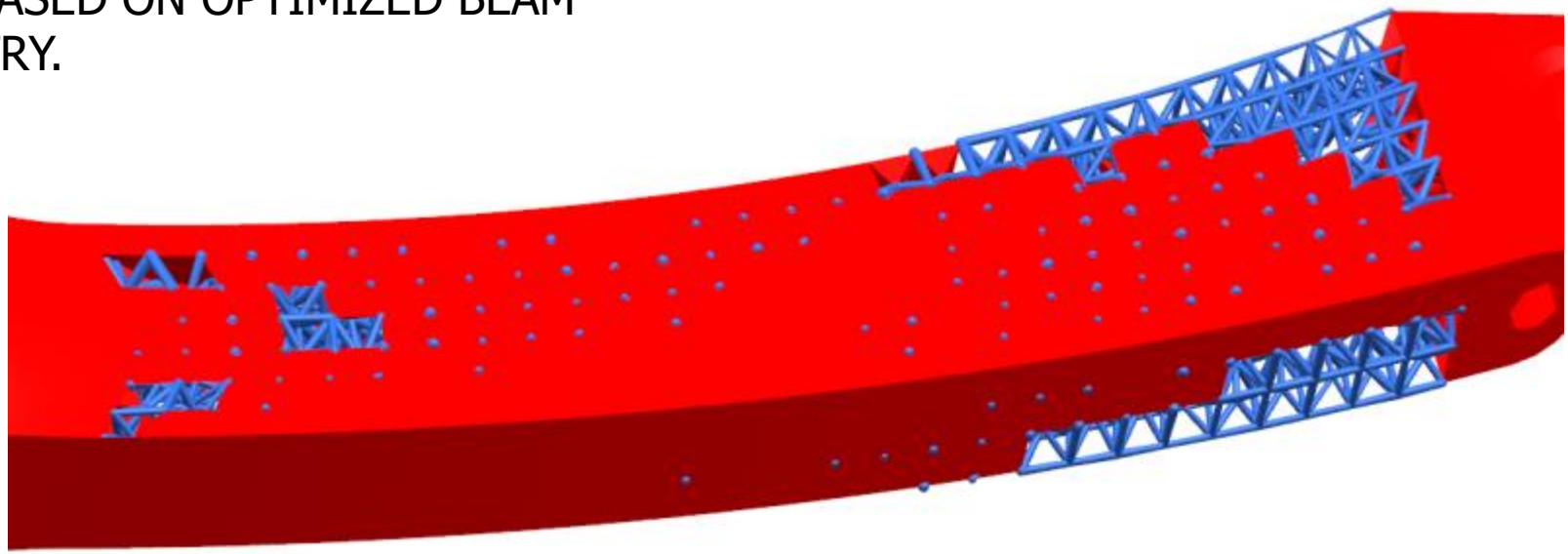
OPTIMIZATION AND FILE CLEANUP

LATTICE STRUCTURE AFTER STL CREATION IN MATERIALISE.

NOTICE HOW THE BEAMS ARE NOW OUTSIDE THE ORIGINAL PART SURFACE DUE TO BEAM INFLATION.

ALSO NOTICE HOW THE BEAMS TAPER BASED ON OPTIMIZED BEAM GEOMETRY.





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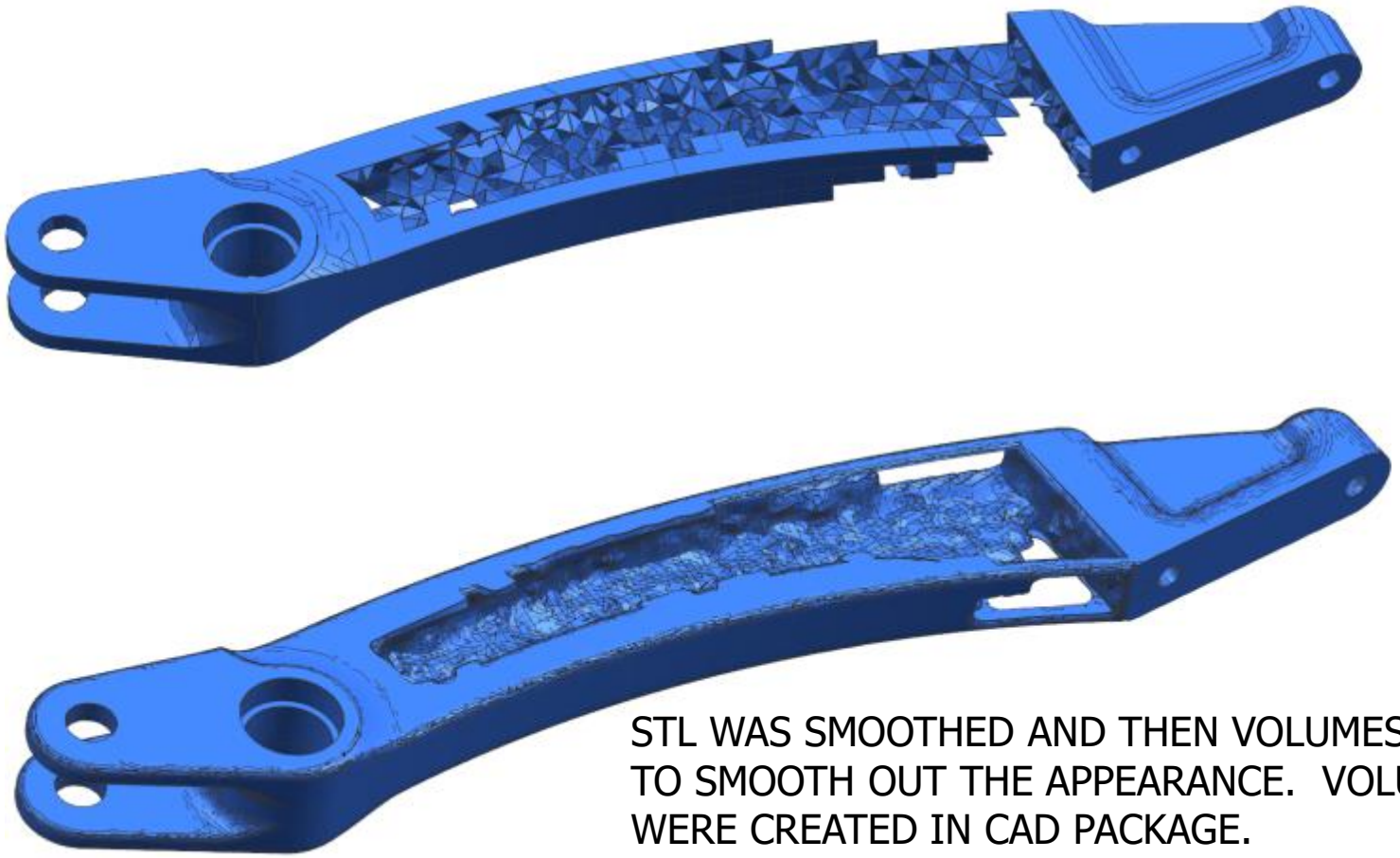
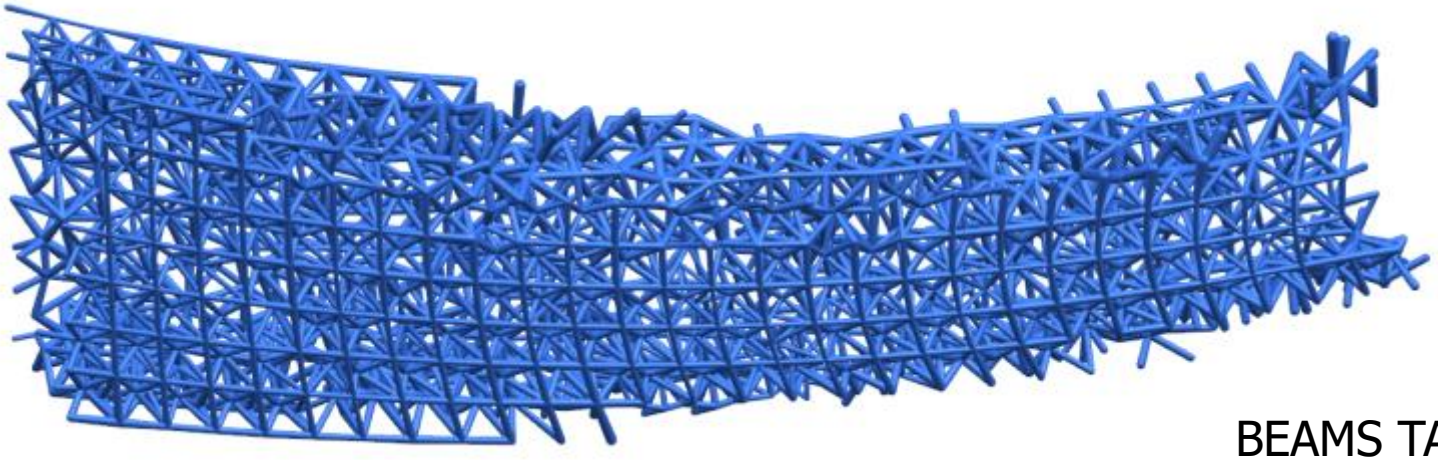
TETRAHEDRAL FEA AREA AND THE FINAL SOLID AREA



STL WAS SMOOTHED AND THEN VOLUMES ADDED TO SMOOTH OUT THE APPEARANCE. VOLUMES WERE CREATED IN CAD PACKAGE.

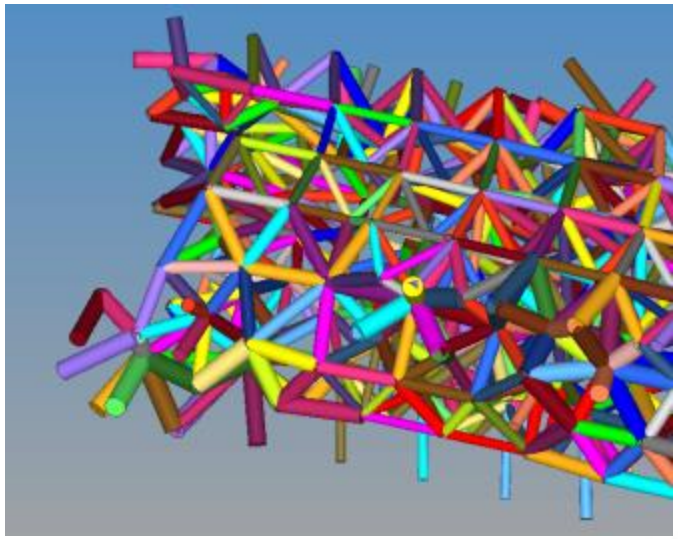
OPTIMIZATION AND FILE CLEANUP

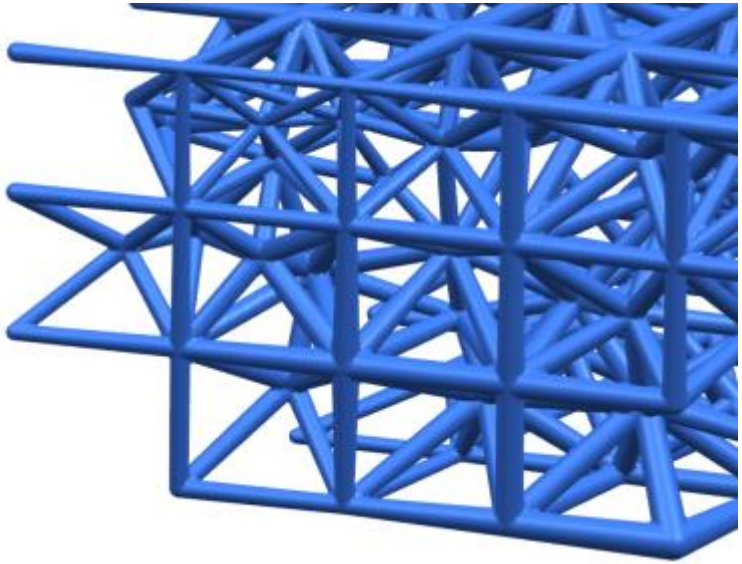
BEAM ELEMENTS AFTER STL CREATION



BEAMS TAPERED AND VARIABLE THICKNESS

OPTIMIZED BEAMS IN OPTISTRUCT





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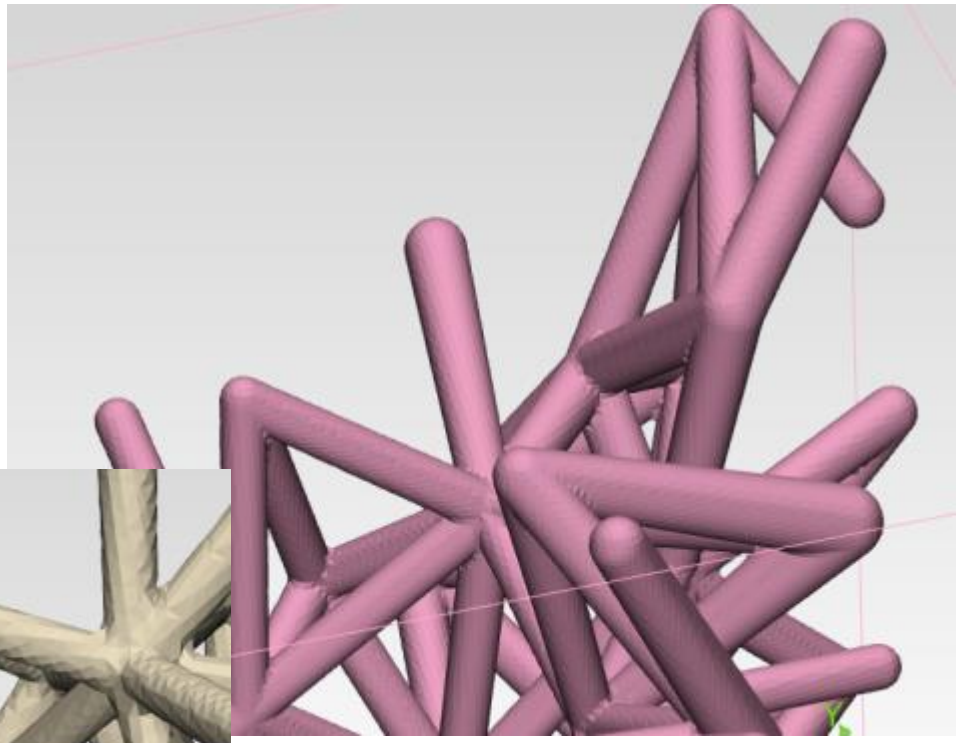
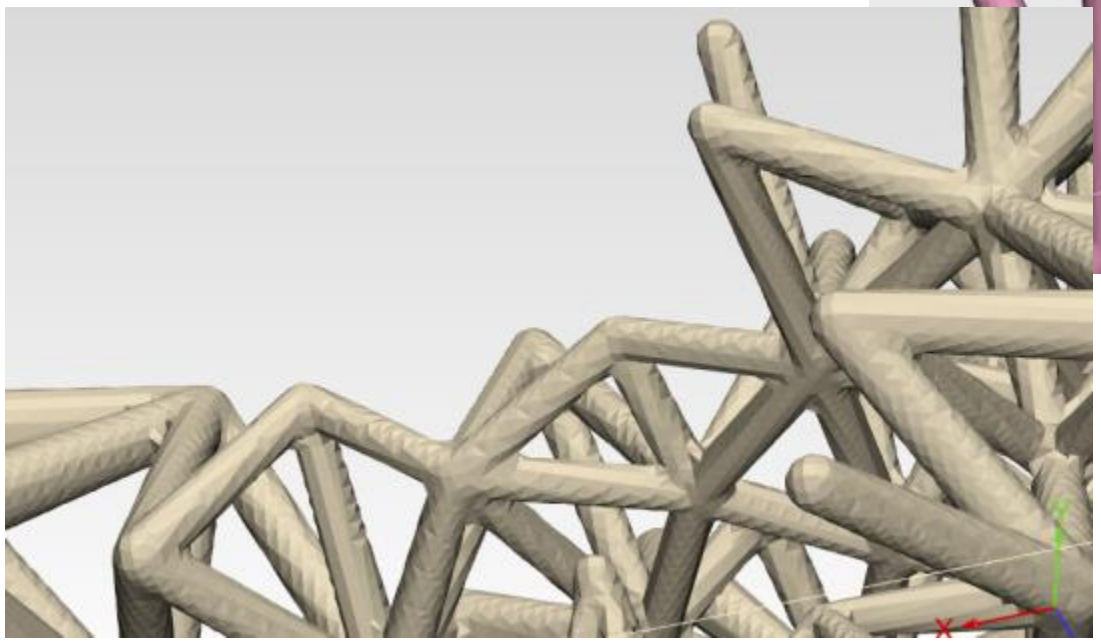
FACETING RESOLUTION ON LATTICE BEAMS.

FINE MESH IS SET TO 0.1
COURSE MESH IS SET TO 0.2

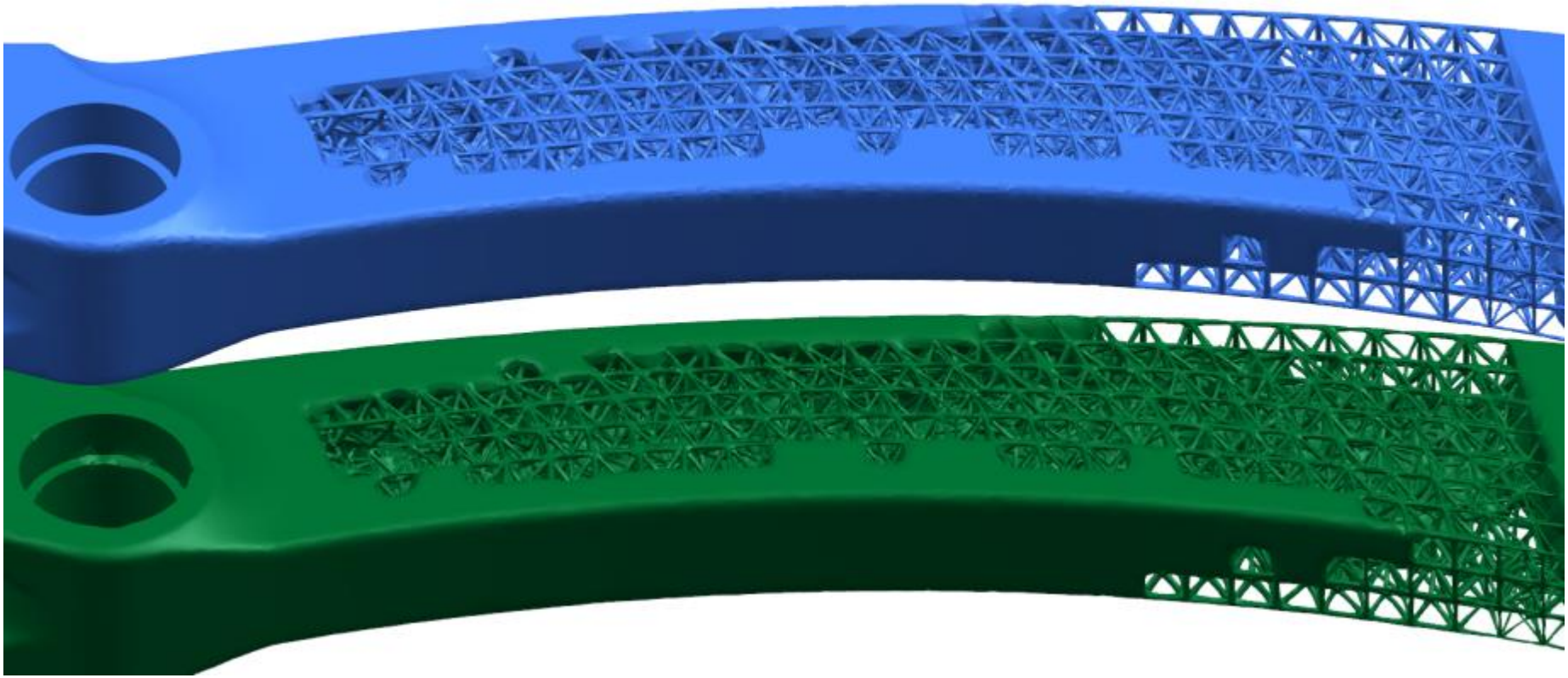




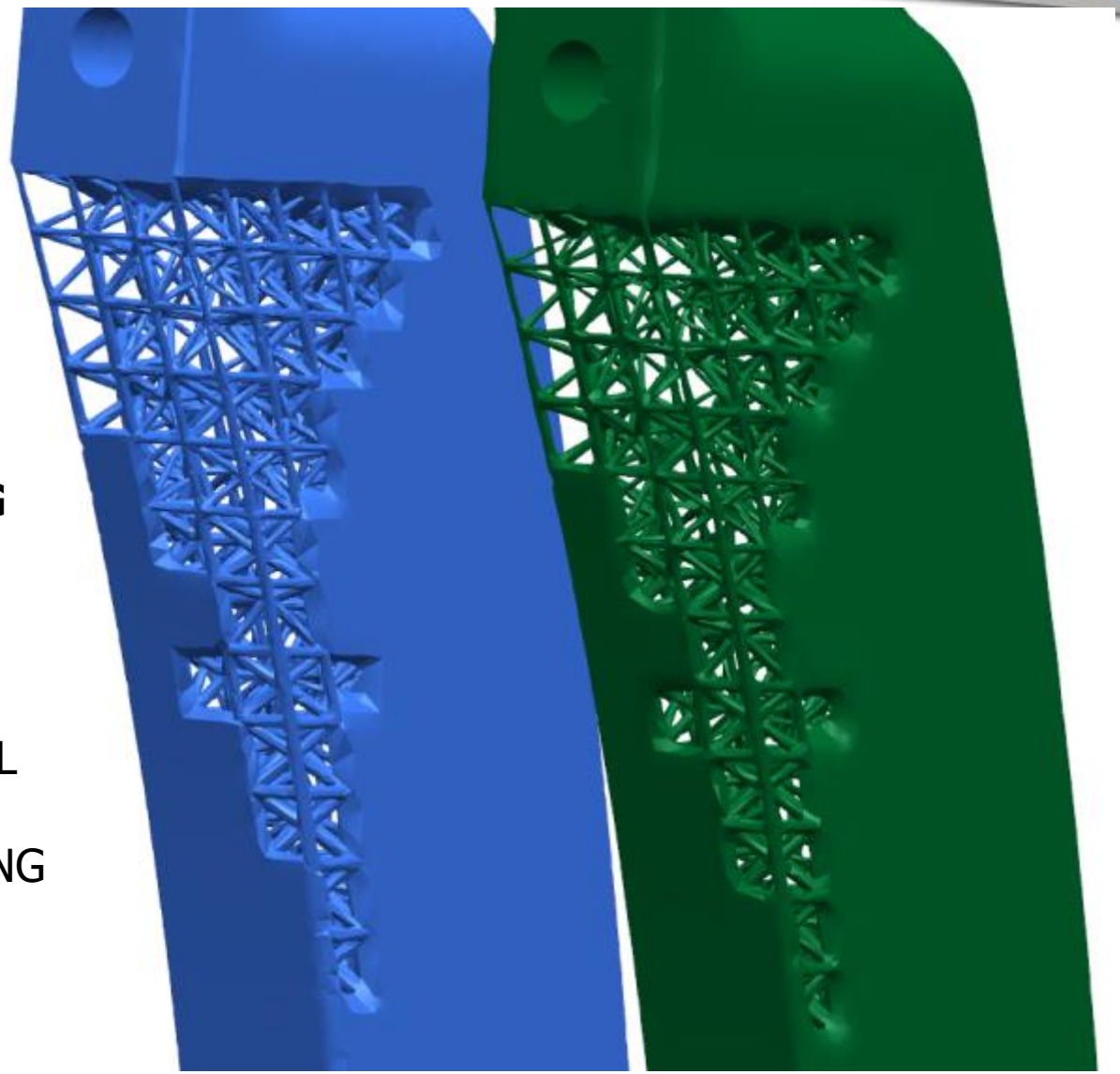
OPTIMIZATION AND FILE CLEANUP

SMOOTHING THE RESULT FILE

PART LOOKS BETTER BUT ALSO HAS SOME ERRORS CREATED IN THE BEARING BORES. WHEN TO SMOOTH YOUR PART IS CRITICAL AND WHEN TO INTERSECT THE PART WITH YOUR DESIRED FINAL VOLUME IS ALSO CRITICAL



OPTIMIZATION AND FILE CLEANUP



ADDITIONAL SMOOTHING

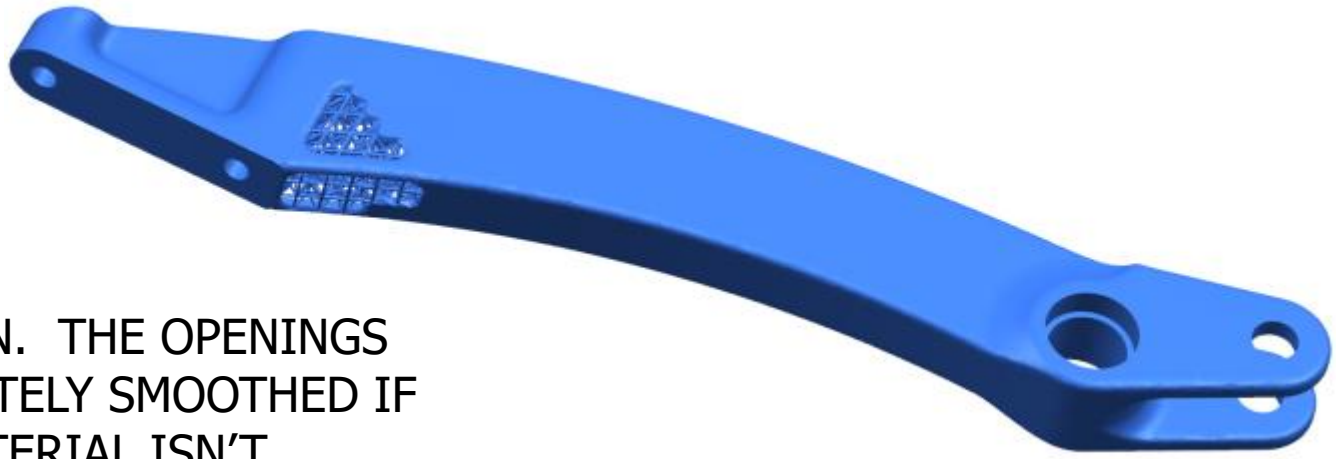
EVEN WITH ADDITIONAL SMOOTHING, THE PART STILL LOOKS TOO DISCRETIZED. SOME OPEN EDGE SMOOTHING WOULD BE USEFULL.

OPTIMIZATION AND FILE CLEANUP

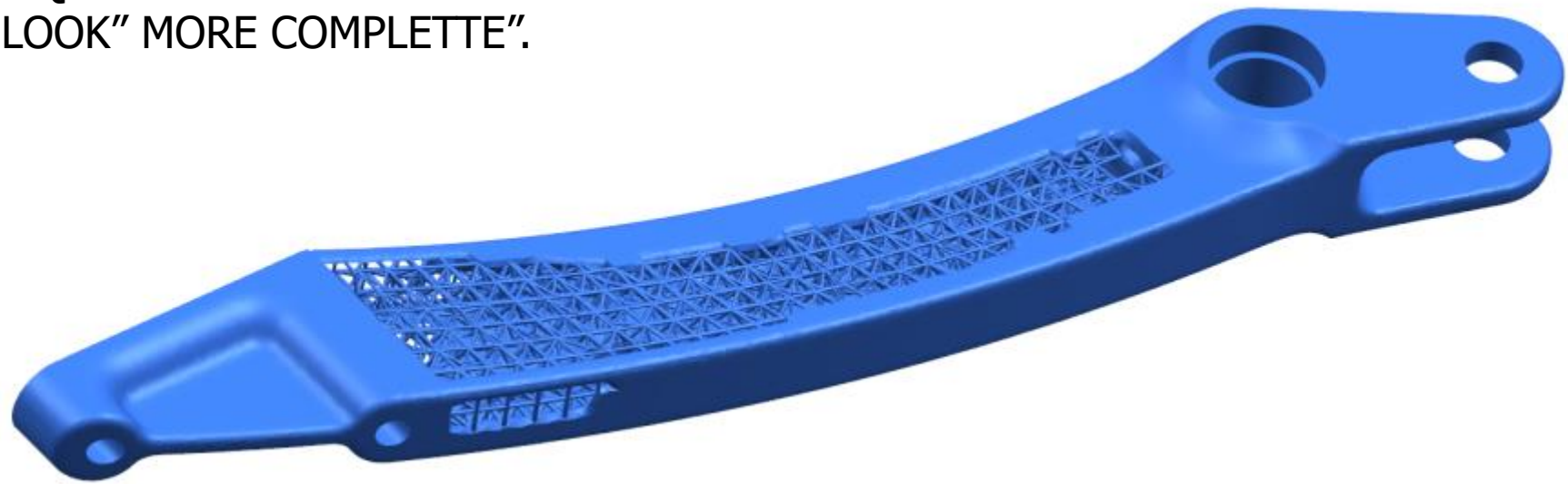
EDGES OF SOLID ELEMENTS DID NOT LOOK PROPER AND THE BEAM END STUCK PAST SOME OF THE SURFACES.

A VOLUME WAS CREATED IN CAD THAT OFFSET THE OUTER SURFACE BY 0.75MM AND RETRIMMED THE OPEN FACES FOR A MORE AGREEABLE EDGE.

OPTIMIZATION AND FILE CLEANUP



FINAL PART SHOWN. THE OPENINGS COULD BE COMPLETELY SMOOTHED IF DESIRED. THE MATERIAL ISN'T REQUIRED FOR THE PART BUT MAKES IT "LOOK" MORE COMPLETTE".



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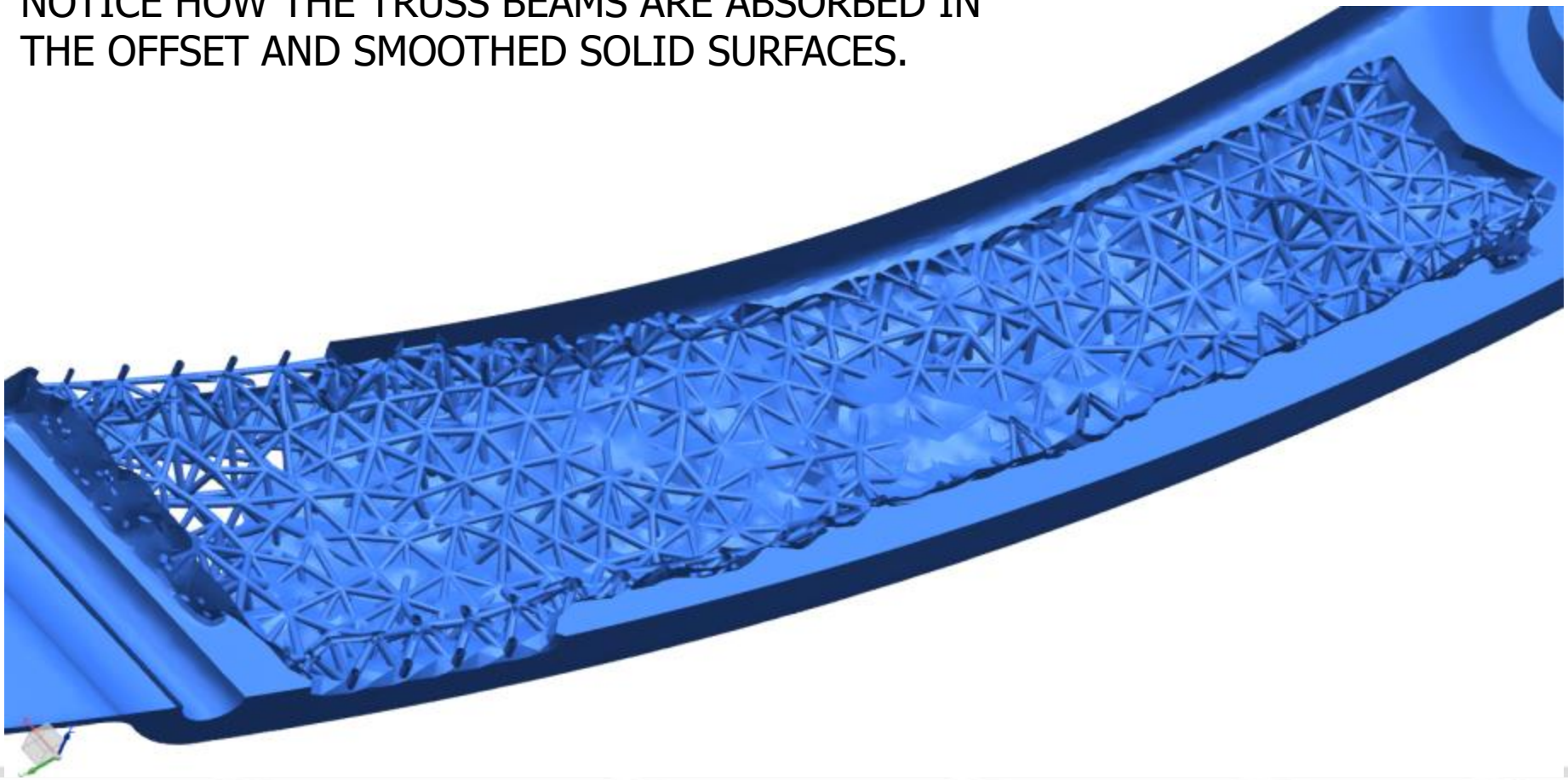
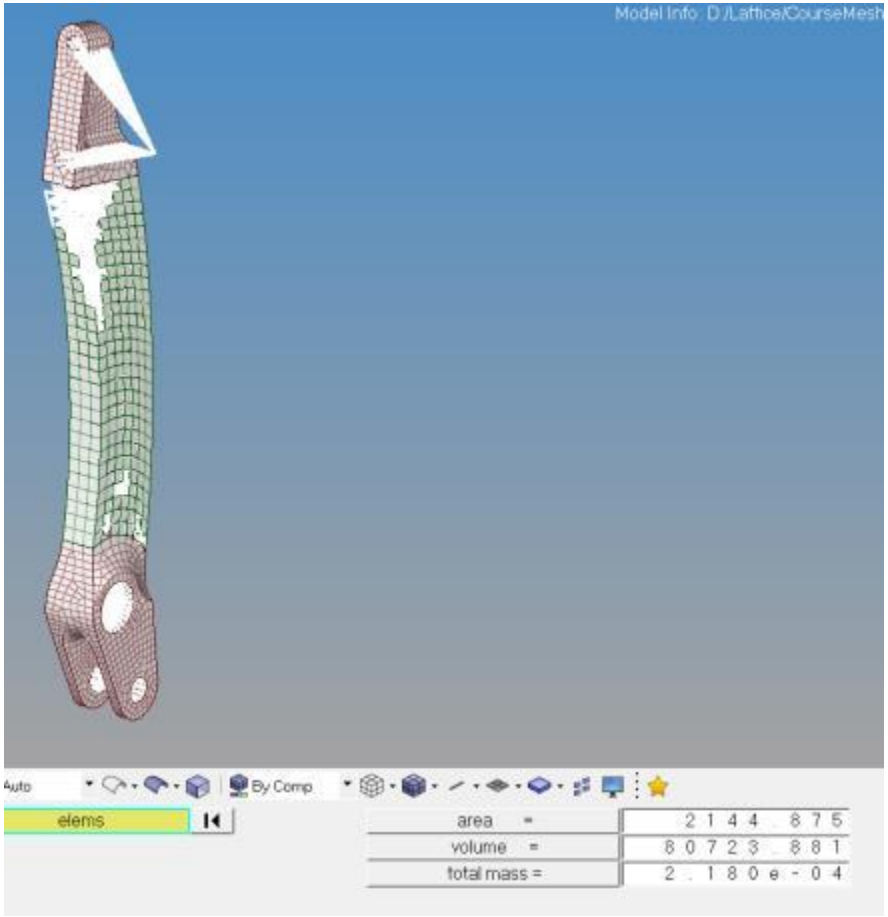
INTERIOR OF MESH

NOTICE HOW THE TRUSS BEAMS ARE ABSORBED IN THE OFFSET AND SMOOTHED SOLID SURFACES.



OPTIMIZATION AND FILE CLEANUP

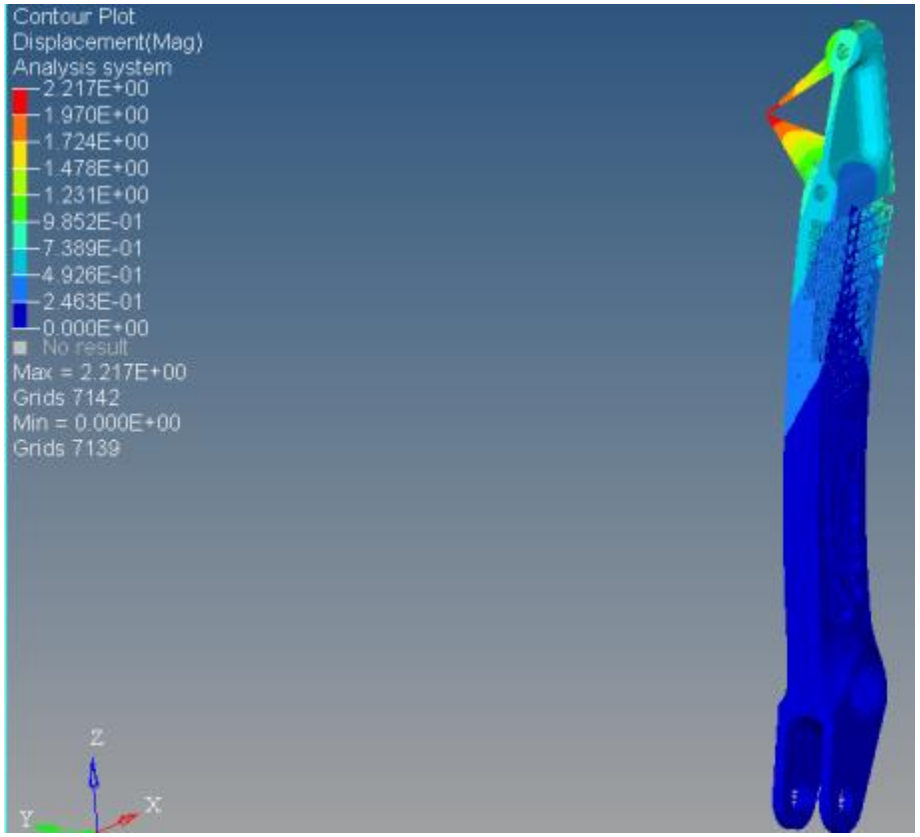


FINAL PART ANALYSIS WAS CONDUCTED ON THE "BEAM" VERSION AND NOT THE FINAL STL.

LATTICE OPTIMIZED DESIGN SPECS

218.0 g
2.217 mm

28% STIFFER, 3% LIGHTER



QUESTIONS?

THANK YOU