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FINITE ELEMENTS ANALYSIS OF COMPRESSOR CAP

PROBLEM DESCRIPTION:

The compressor caps fabricated out of cast iron failed due to loads applied on the cap bolts (around the perimeter of the cap) and the center jack bolt. It is required to perform engineering investigation and evaluation of the design of the compressor cap.

It is required to perform the Finite element analysis to check for the existing design of the compressor cap and offer the modified design, if necessary.

FEA MODEL & RESULTS:

The Finite elements analysis was performed using FEA software ANSYS.

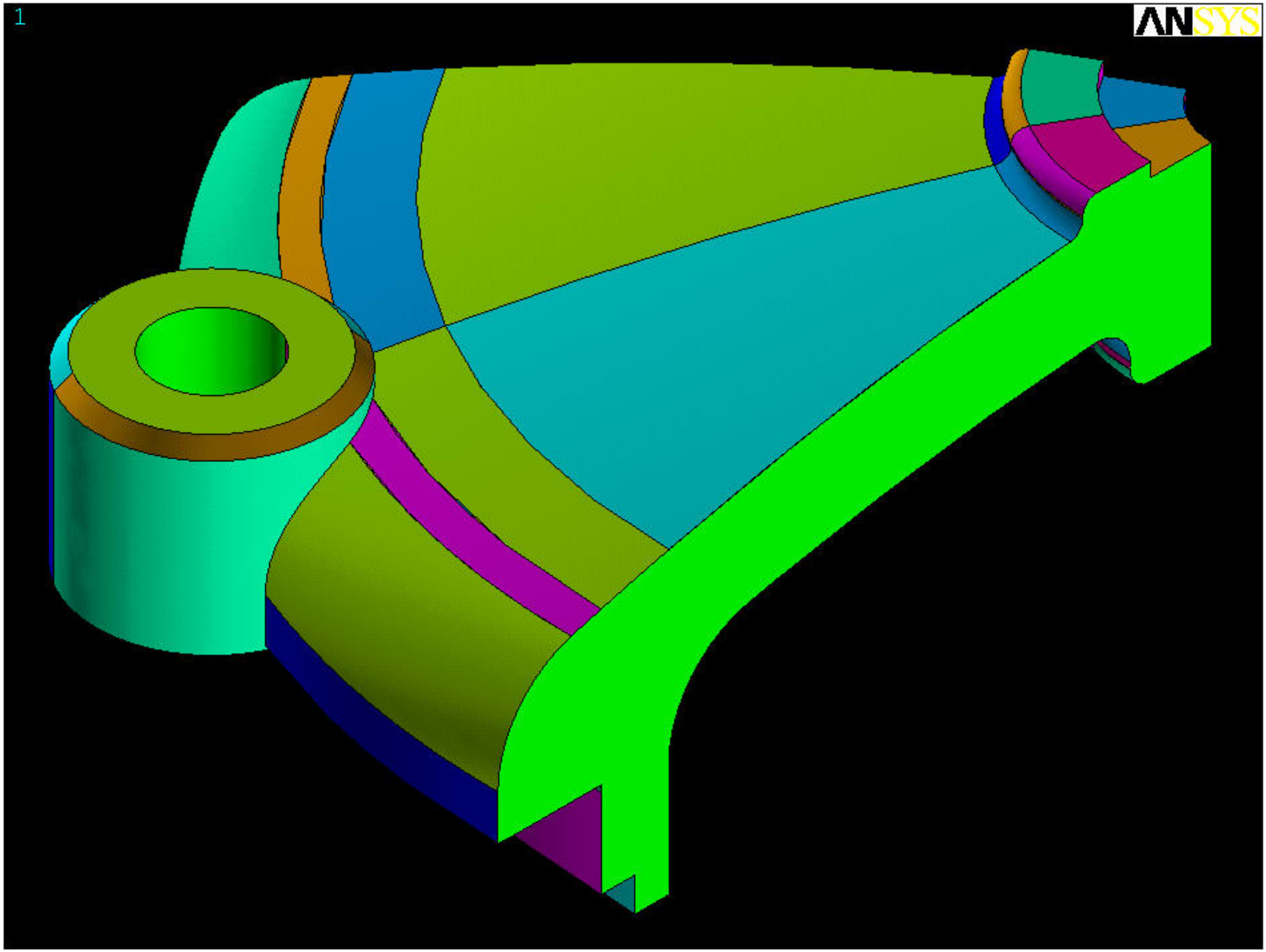
The loadings considered in the model are from two sources. The first set of loads is from six (6) compressor cap bolts. Two cases of this load were considered; one load case to seat the compressor cap gasket and other load case to cause the local failure of the compressor cap. The second set of loads is from center jack bolt. Two cases of this load were considered; one load case to seat the valve gasket and other load case from acorn nut pushing on the central seating surface of the cap. Several cases with different loading combinations were analyzed.

The 10 noded tetrahedron elements were used for the FEA model. To avoid the computer memory overrun problems, the size of FEA model was limited to $1/6^{th}$ size sliced by symmetry in the compressor cap. The symmetry boundary conditions were applied to all the nodes on the sides of the one sixth (1/6th) model.

The exact material specification for the compressor cap was not known. Hence, the measured value of tensile strength was used for calculation purposes. From the results of the analysis, it was found that the stresses in the dished portion of the cap were well within allowable stress levels. However, the localized high stresses (beyond the measured tensile strength of the material) in the cast iron cap near the center jack bolt and the near the cap bolts located at the perimeter were causing the failure of the compressor cap.

A re-design using cast steel (e.g. SA-216 Grade WCB or Grade WCC) with the current cap dimensions led to acceptable stress levels in the compressor cap. Based on the above analysis, it was recommended to replace the compressor cap material from cast iron to cast steel.

The attached FEA plots show the model and results for one of the cases analyzed.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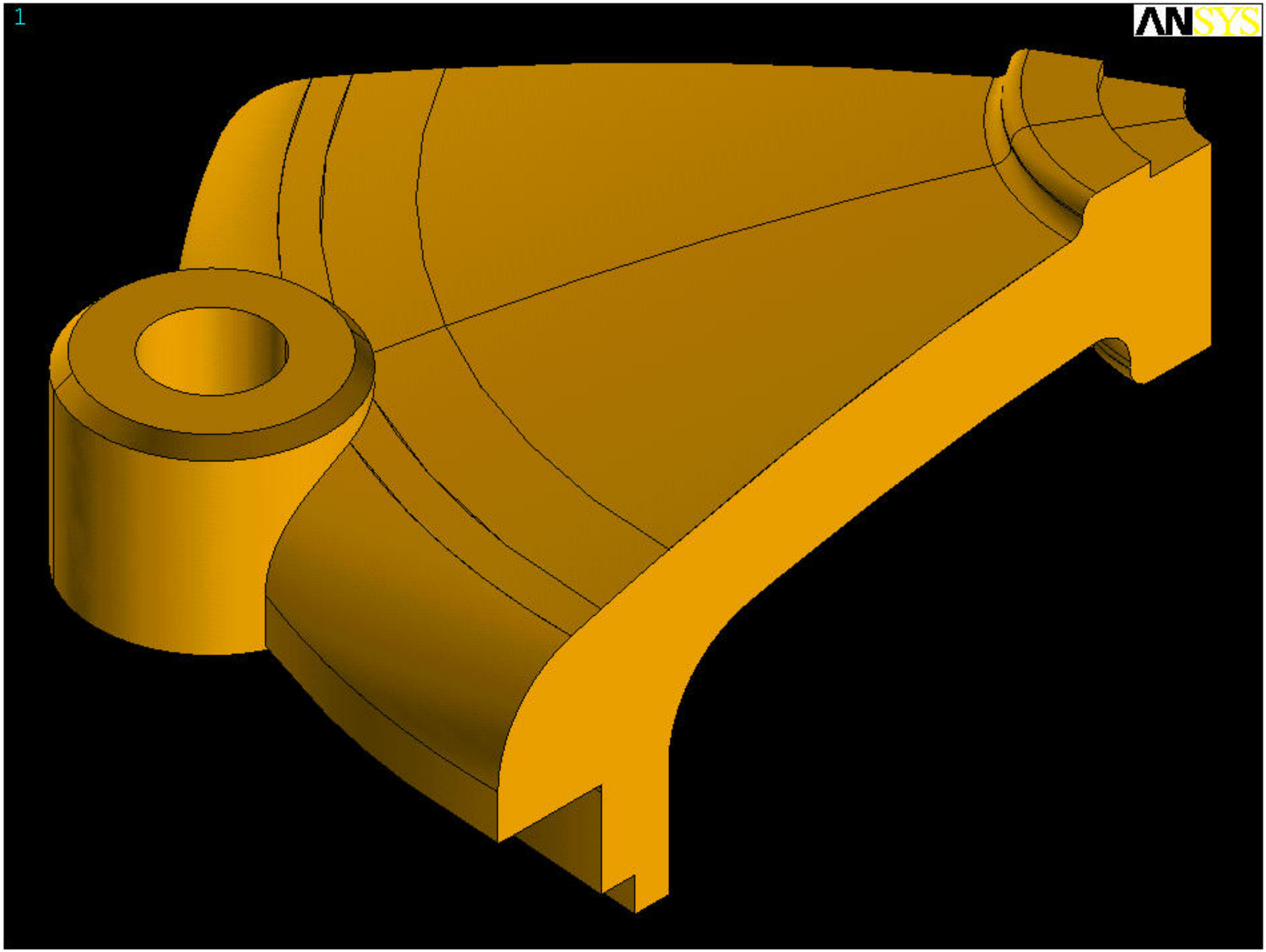
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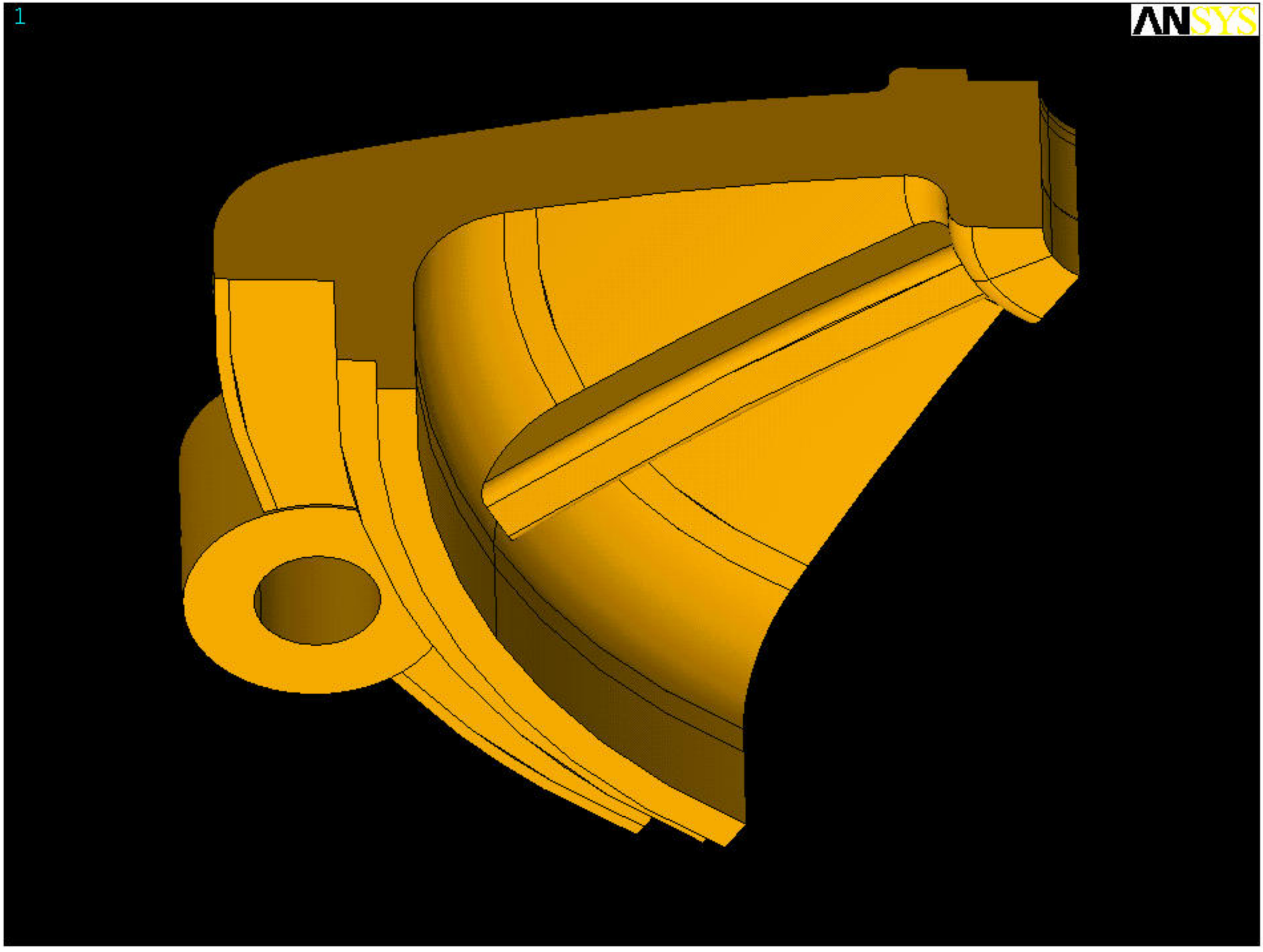
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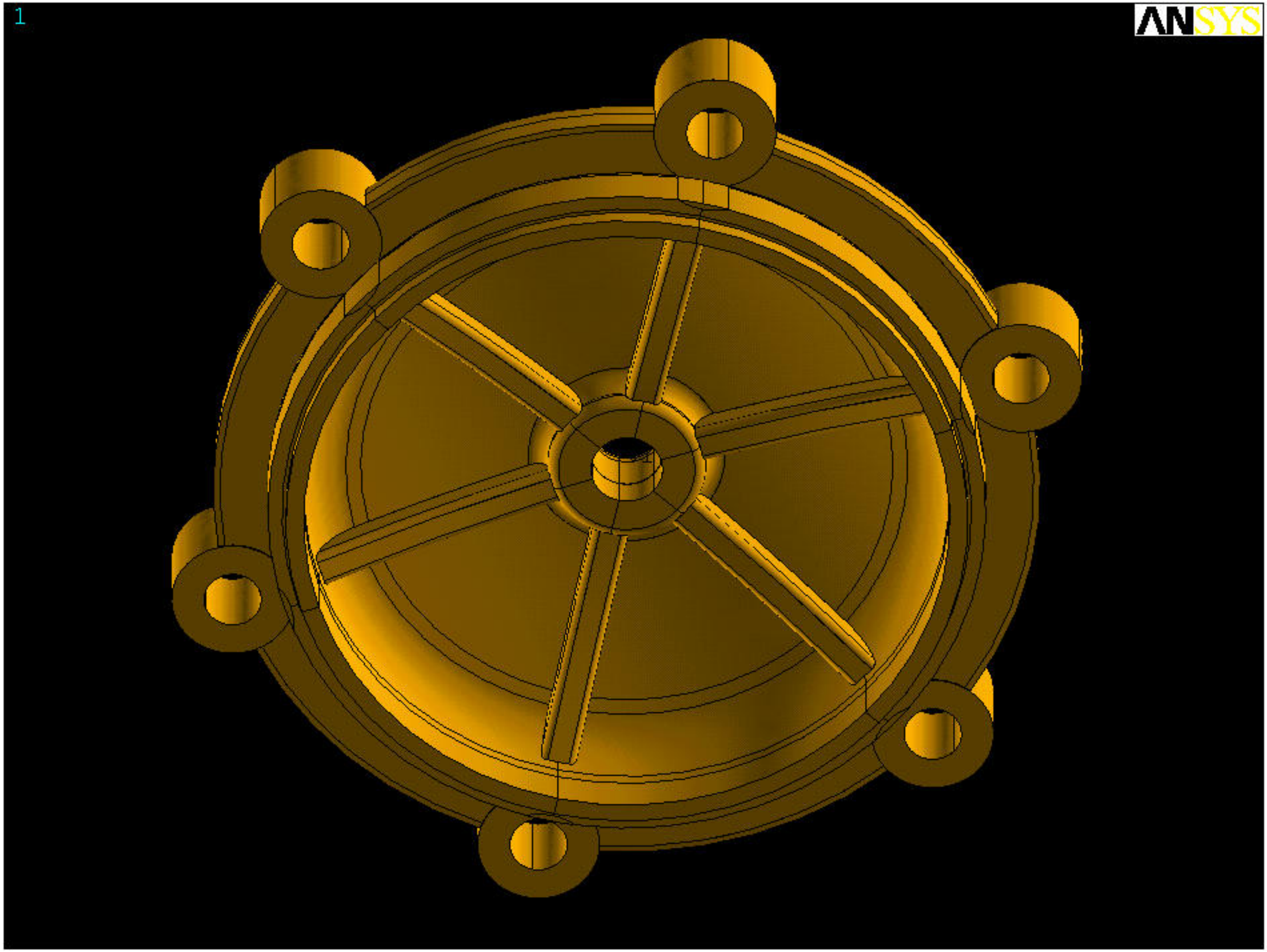
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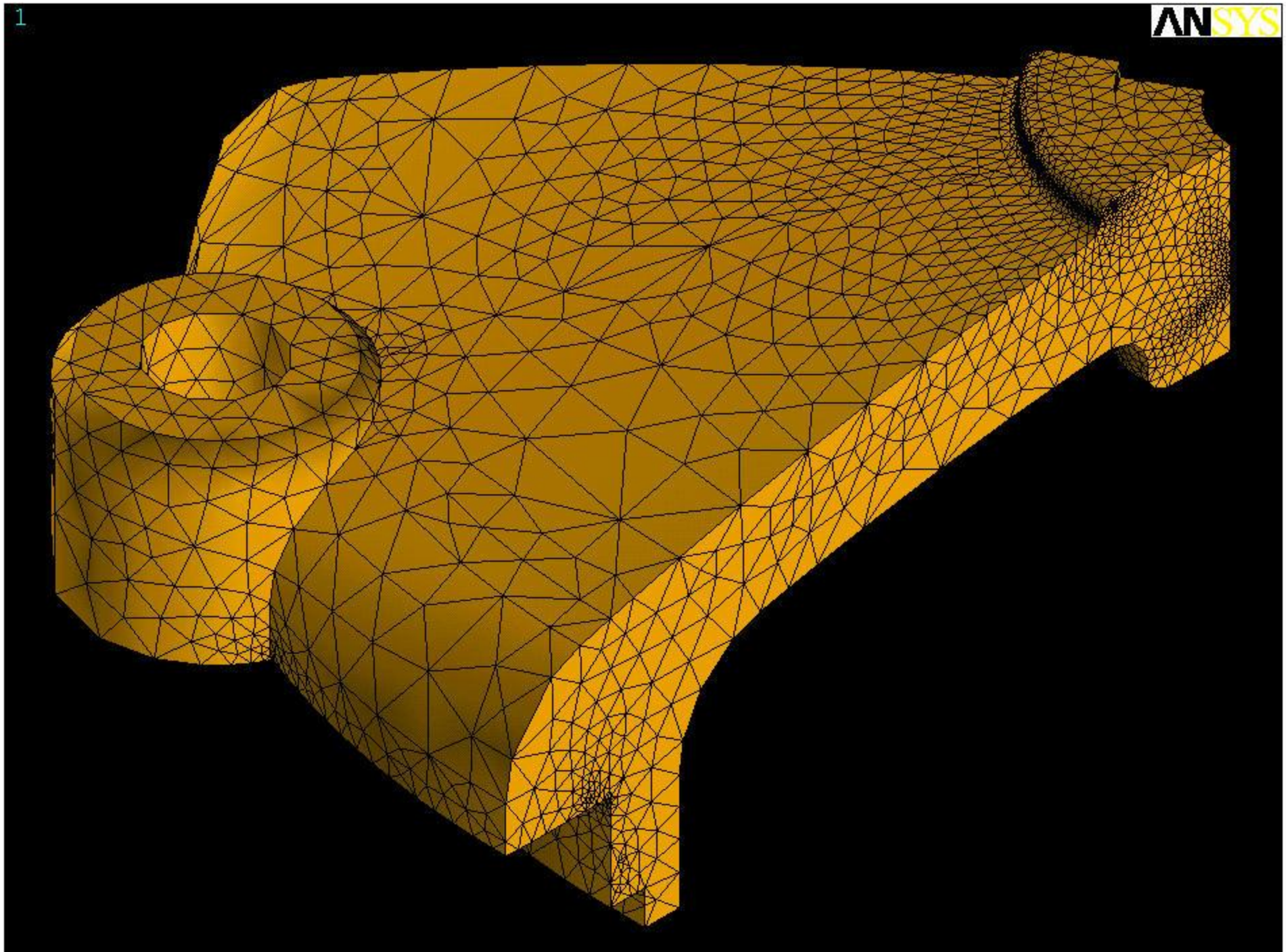
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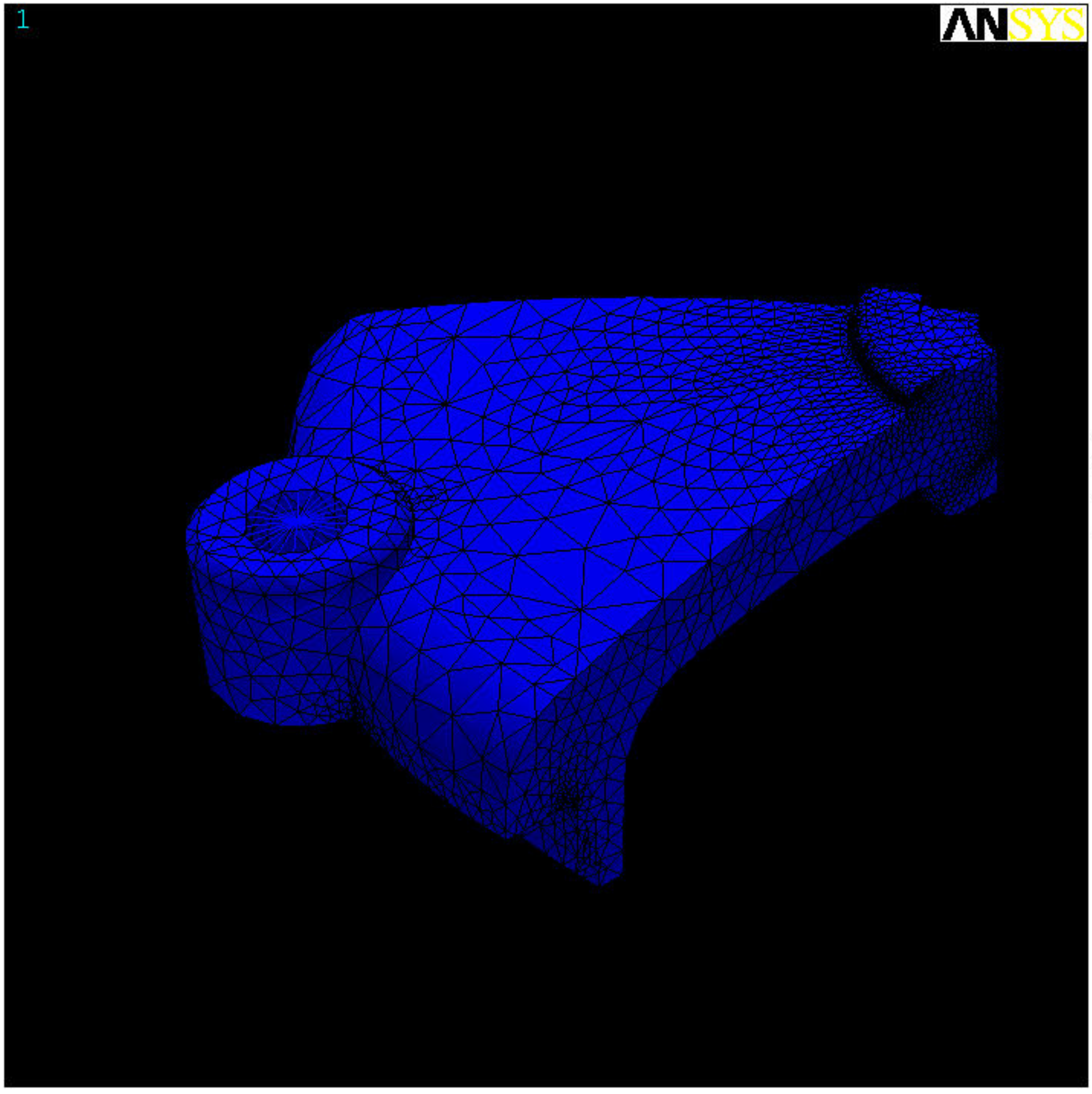

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TIME=1
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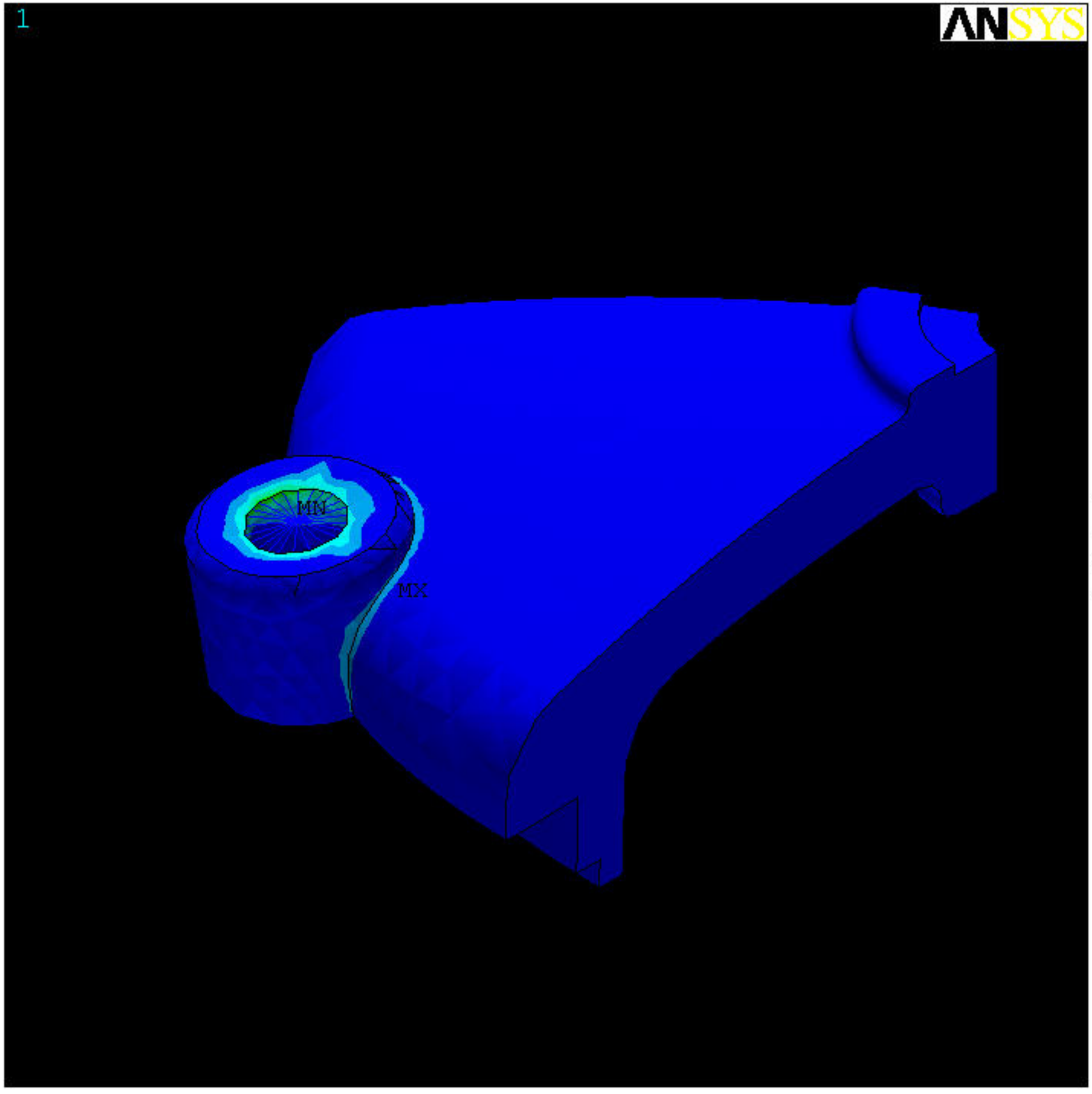
EFACET=1
AVRES=Mat
DMX =.004267

DSCA=65.482
XV =1
YV =1
ZV =1
*DIST=4.084
*XF =-2.215
*YF =17.232
*ZF =3.11
Z-BUFFER



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TIME=1
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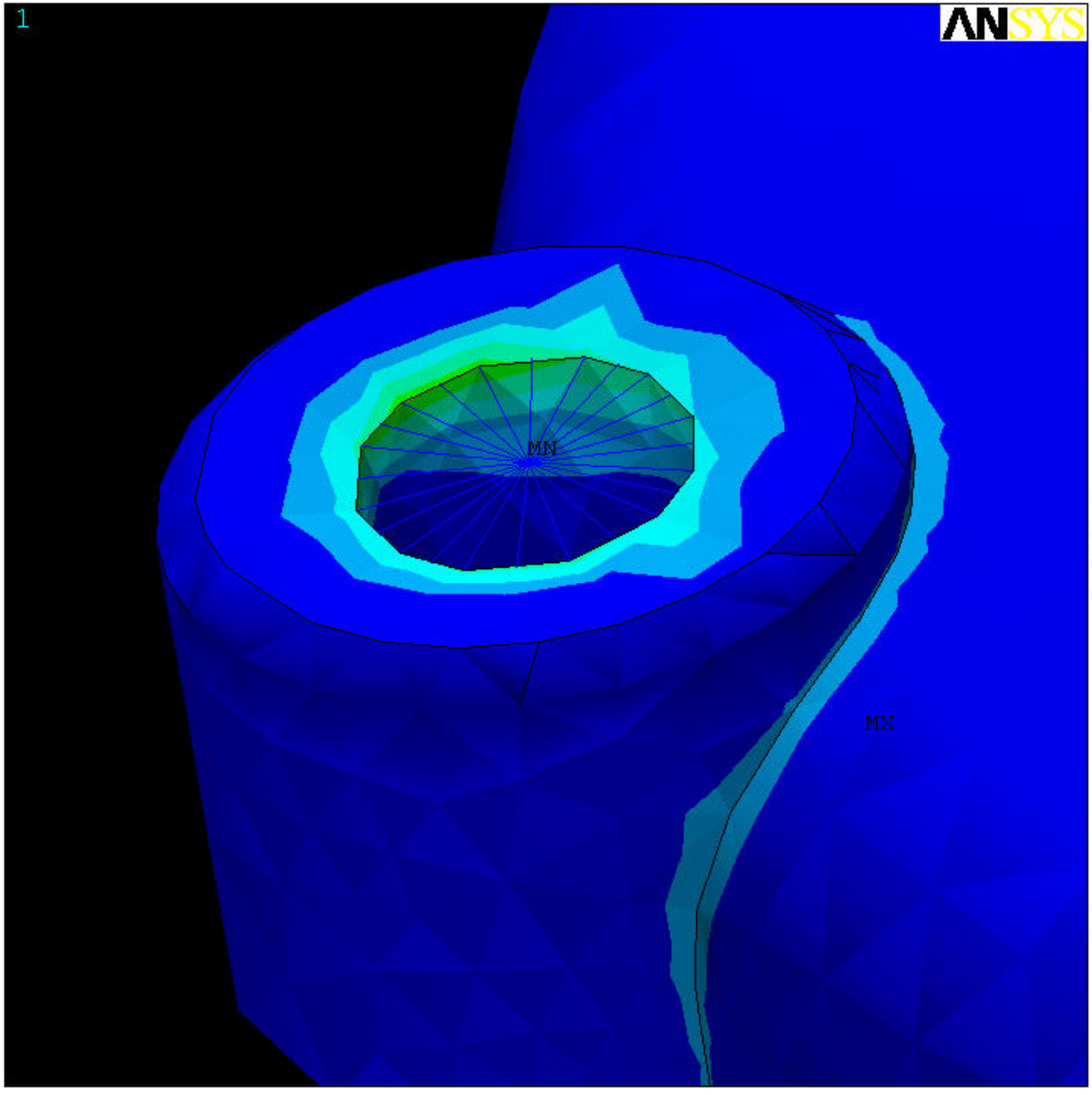
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.004267
SMN =44.024
SMX =119258

XV =1
YV =1
ZV =1
*DIST=4.084
*XF =-2.215
*YF =17.232
*ZF =3.11
Z-BUFFER

44.024
13290
26536
39782
53028
66274
79520
92766
106012
119258



NODAL SOLUTION
STEP=1
SUB =1
TIME=1
SEQV (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.004267
SMN =44.024
SMX =119258

XV =1
YV =1
ZV =1
*DIST=1.24
*XF =-4.815
*YF =15.925
*ZF =3.11
Z-BUFFER

44.024
13290
26536
39782
53028
66274
79520
92766
106012
119258