PRESSURE EQUIPMENT ENGINEERING SERVICES, INC.

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FINITE ELEMENTS ANALYSIS OF FLAT REINFORCED COVER

PROBLEM DESCRIPTION:

A stainless steel pressure vessel containing the rotary mixer blades was to be designed with the two end flat covers. To avoid the excessive thickness for the flat welded covers, it was decided to use relatively thin flat covers and reinforce the covers using radial stiffeners. The height of the stiffeners was tapered as they were welded from an inner ring to outer edges of the cover.

The three dimensional finite element analysis was to be performed for the flat cover and the associated stiffeners with the following objectives:

(1) To accurately size the stiffeners and avoid any overstressing of the flat cover, stiffeners or flat cover to stiffeners junctures.
(2) To ensure compliance with ASME B&PV Code Section VIII, Div.-1.
(3) To ensure that any part of the flat cover does not deform excessively.

FEA MODEL & RESULTS:

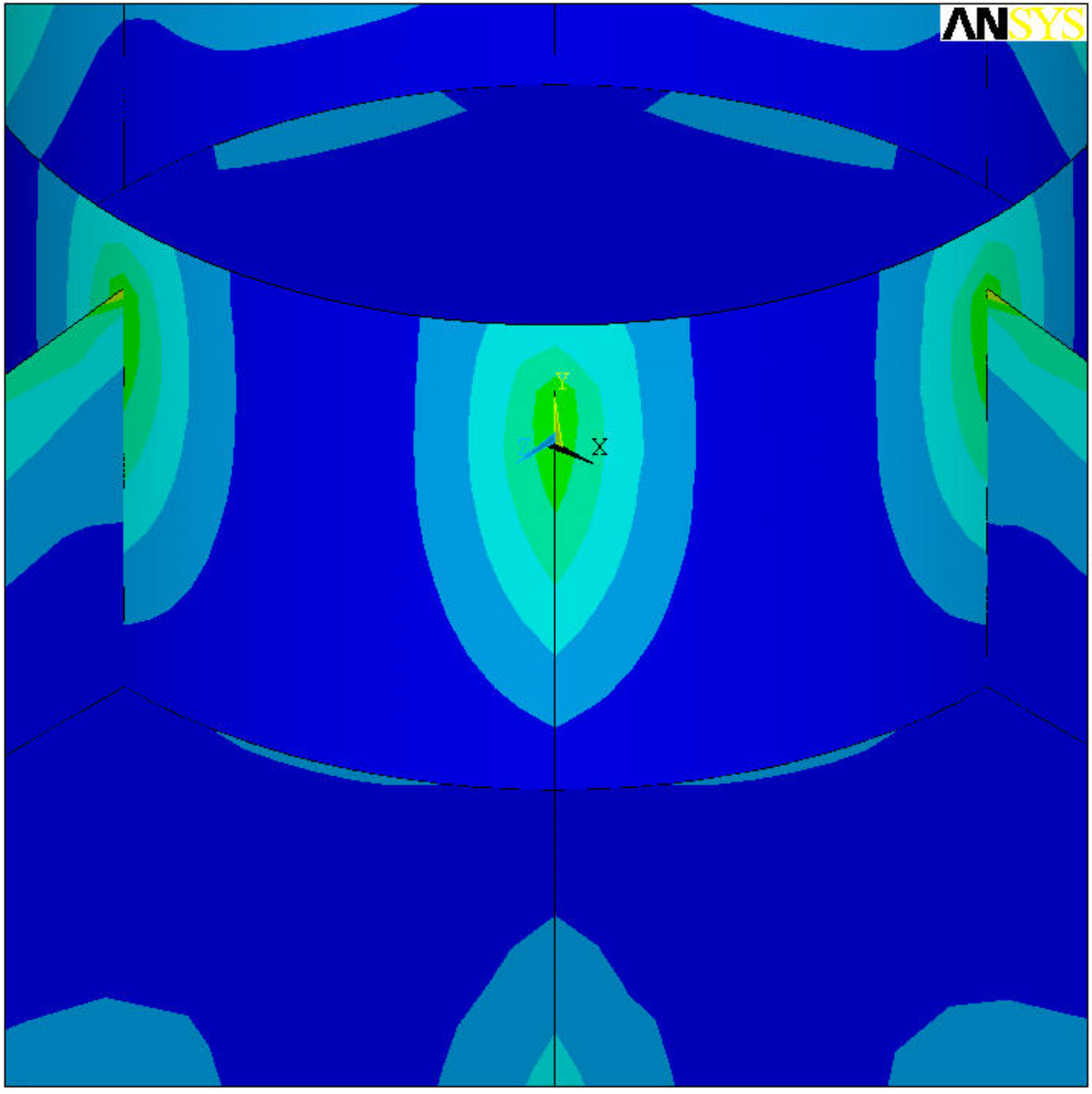
The 3-D finite element analysis was performed using the FEA software ANSYS. The finite element model consisted of the flat cover and the radial stiffeners as described below.

To obtain the desired internal pressure rating for the vessel flat cover, eight radial stiffeners were welded from an inner ring to outer edges of the cover. The heights of the stiffeners and inner ring were adjusted by doing FEA iterations. The thickness of the middle and ends of the stiffeners were adjusted by doing FEA iterations to comply with the allowable stress criteria of the ASME Code.

The pressure loading (50 psig) was applied to all the internal surfaces of the flat covers. The stress analysis results for the flat covers and the stiffeners were checked against the ASME code, Section VIII, Div.-2, Appendix-4 criteria. Based on the results of finite Element Analysis, all the stresses in the flat covers and the stiffeners were within the Code allowable stress limits for the final design. The displacement values for the flat covers were also small and acceptable.

Based on the results of the three dimensional finite element analysis, the final design of the flat covers with the radial stiffeners was certified to be in code compliance with ASME B&PV Code, Section VIII, Div.-1.

The attached FEA plots show the FEA model and results.



NODAL SOLUTION
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SUB =1
TIME=1
SINT (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =.068491
SMN =279.584
SMX =51108

XV =1
YV =1
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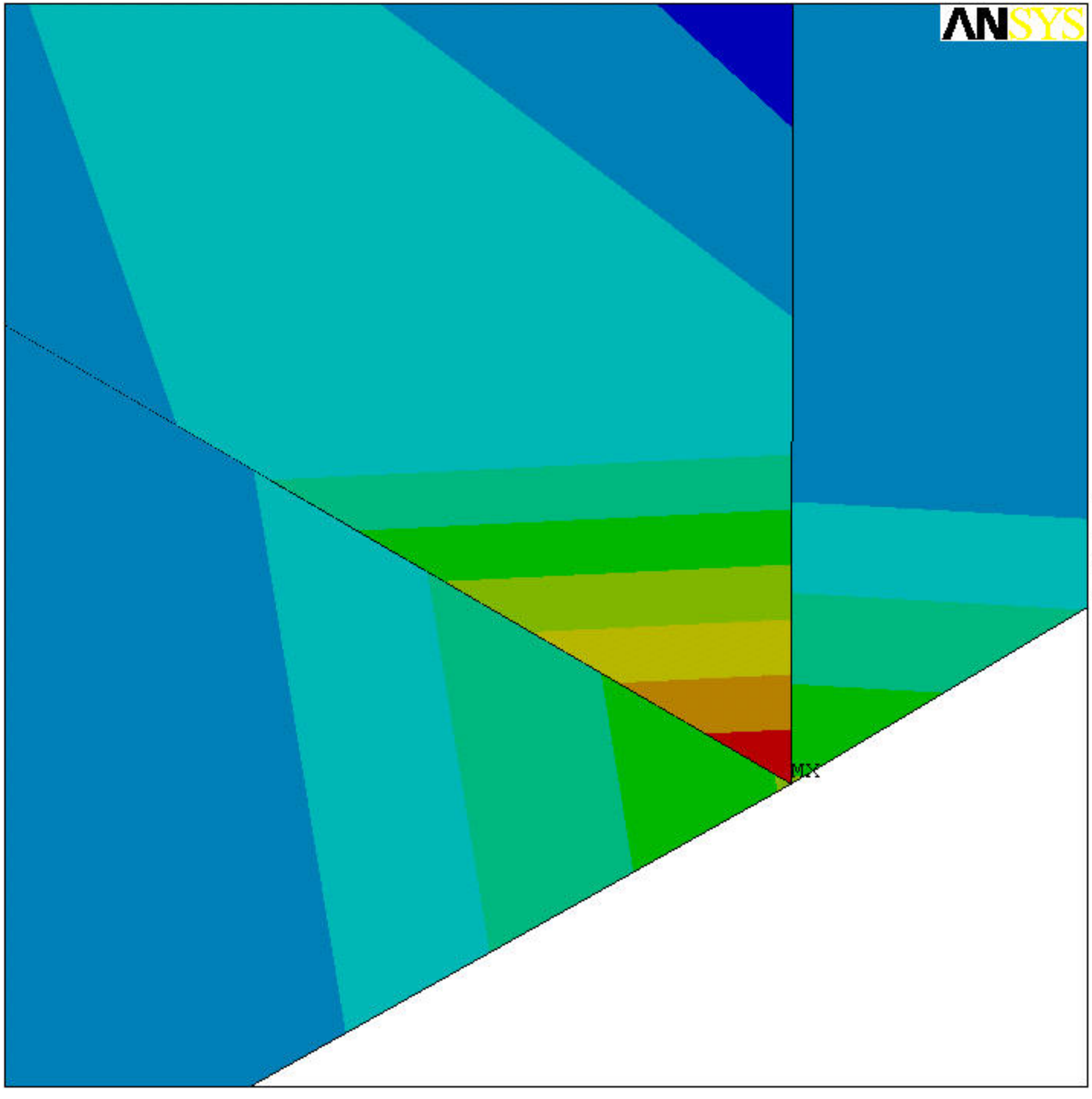
Z-BUFFER



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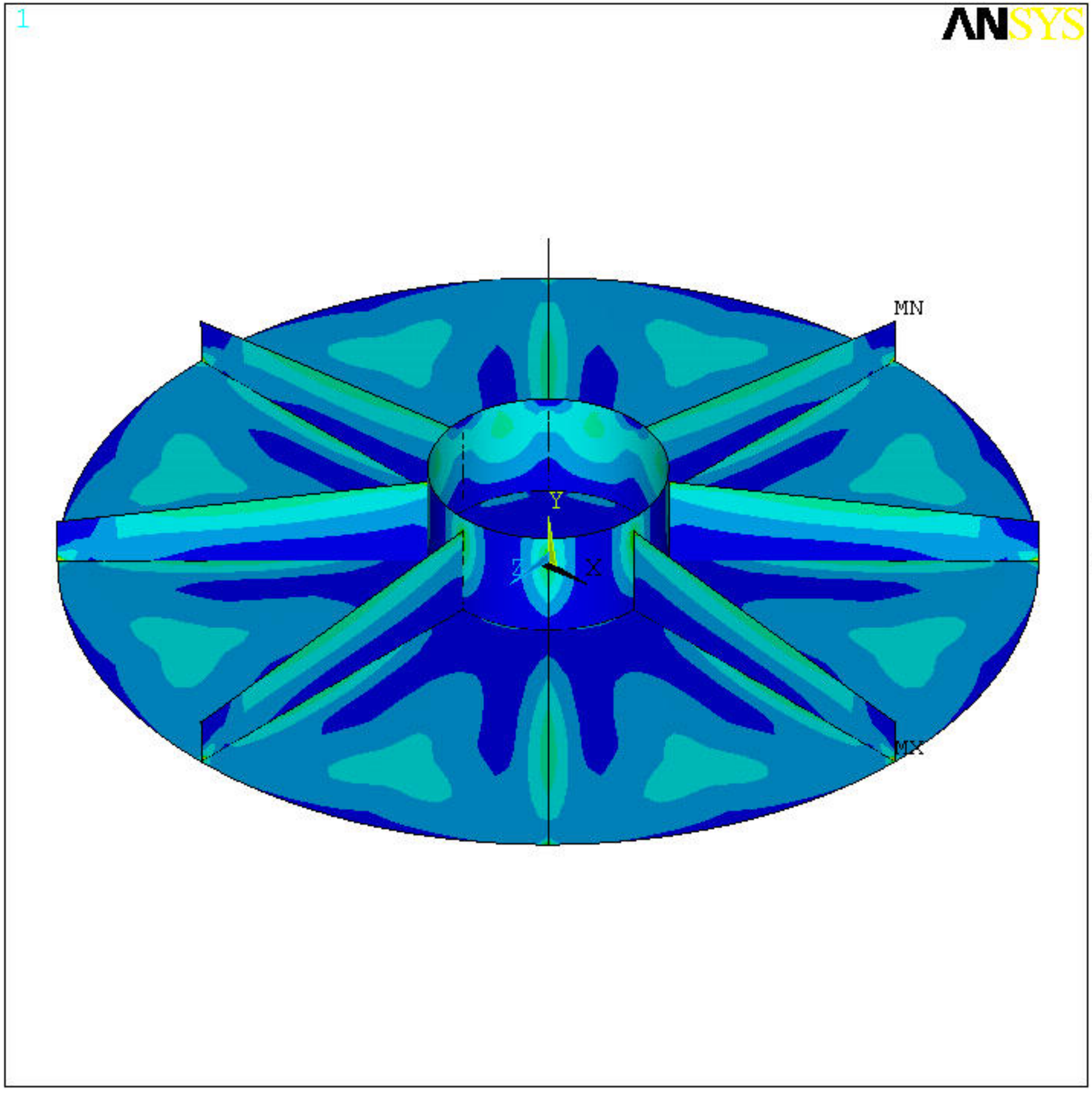

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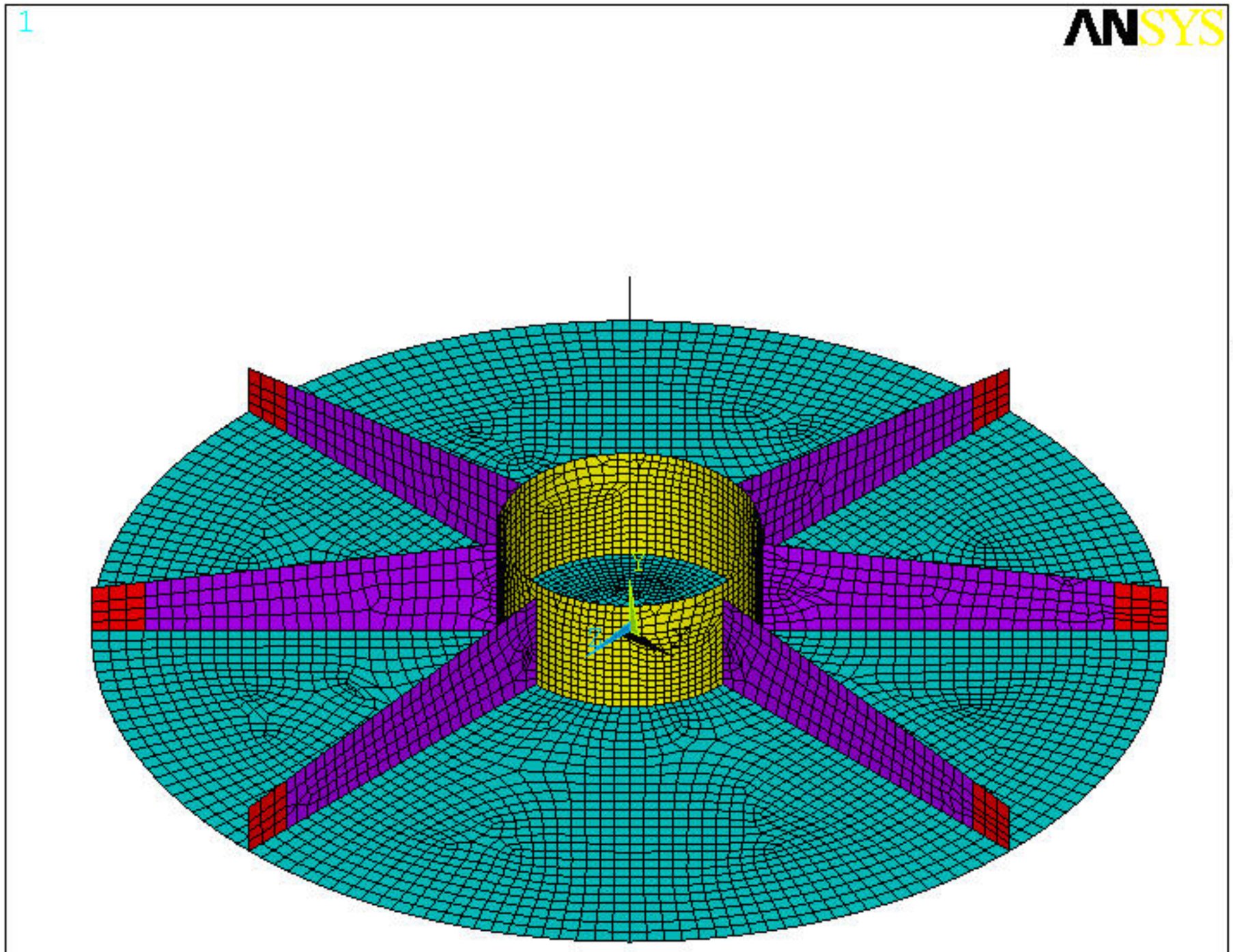

DISPLACEMENT
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AVRES=Mat
DMX =.068491

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XV =1
YV =1
ZV =1
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*YF =.555159
Z-BUFFER

1

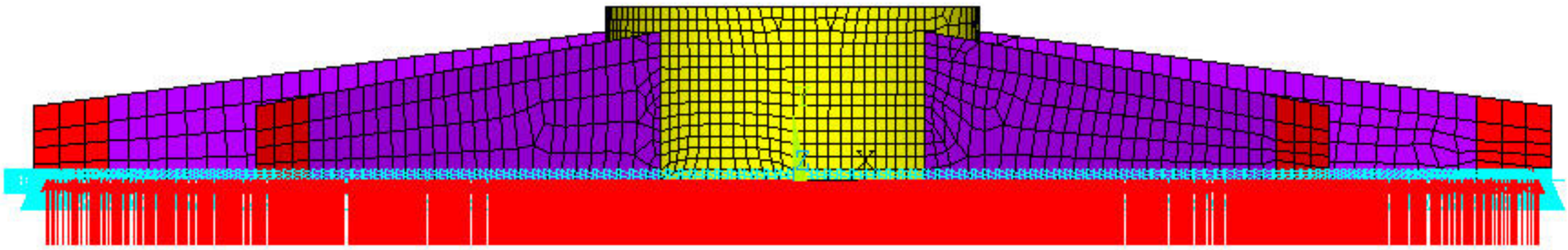
ANSYS

ELEMENTS

REAL NUM

U

PRES-NORM
50



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ELEMENTS

REAL NUM

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PRES-NORM
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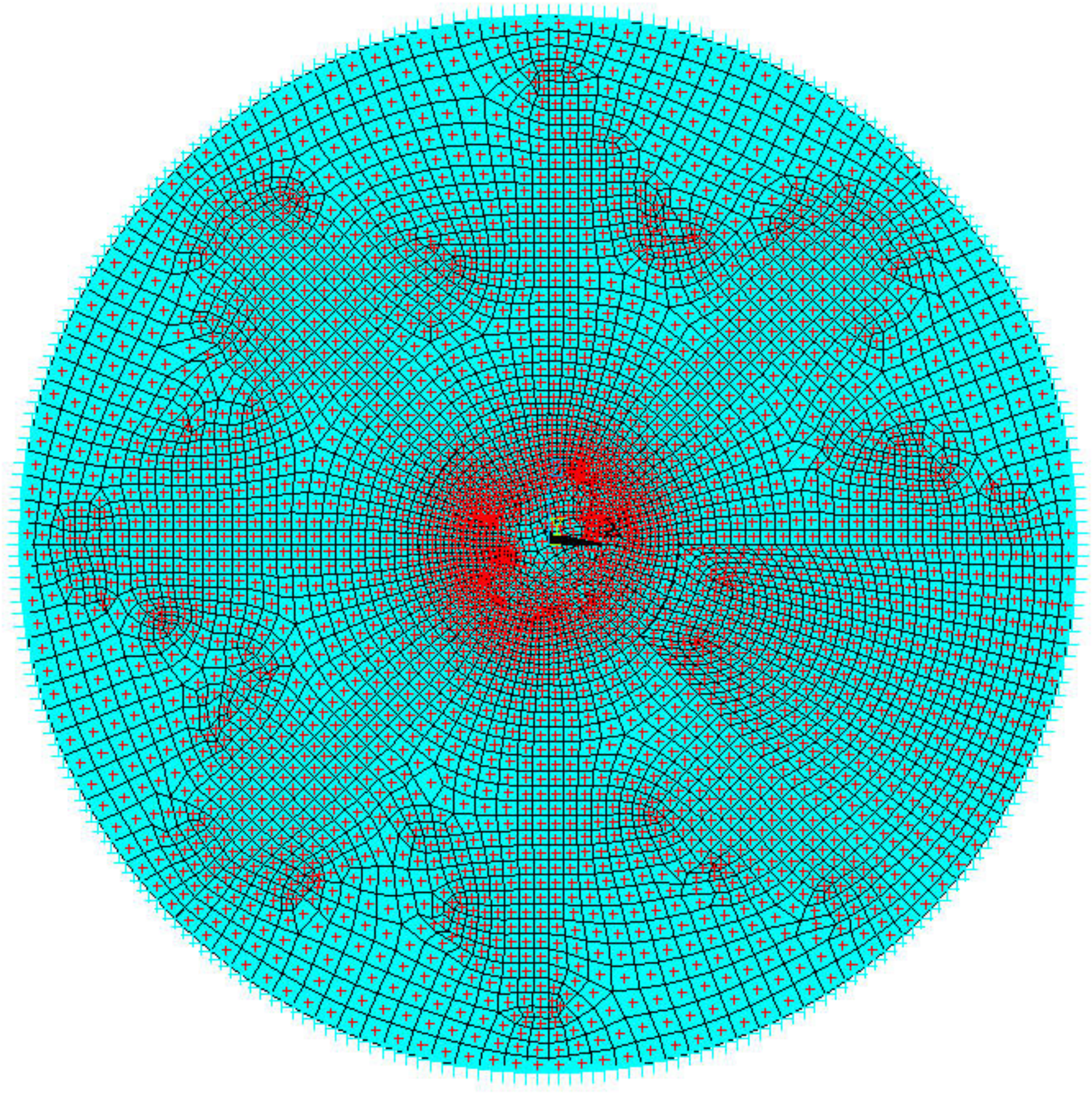
ANSYS



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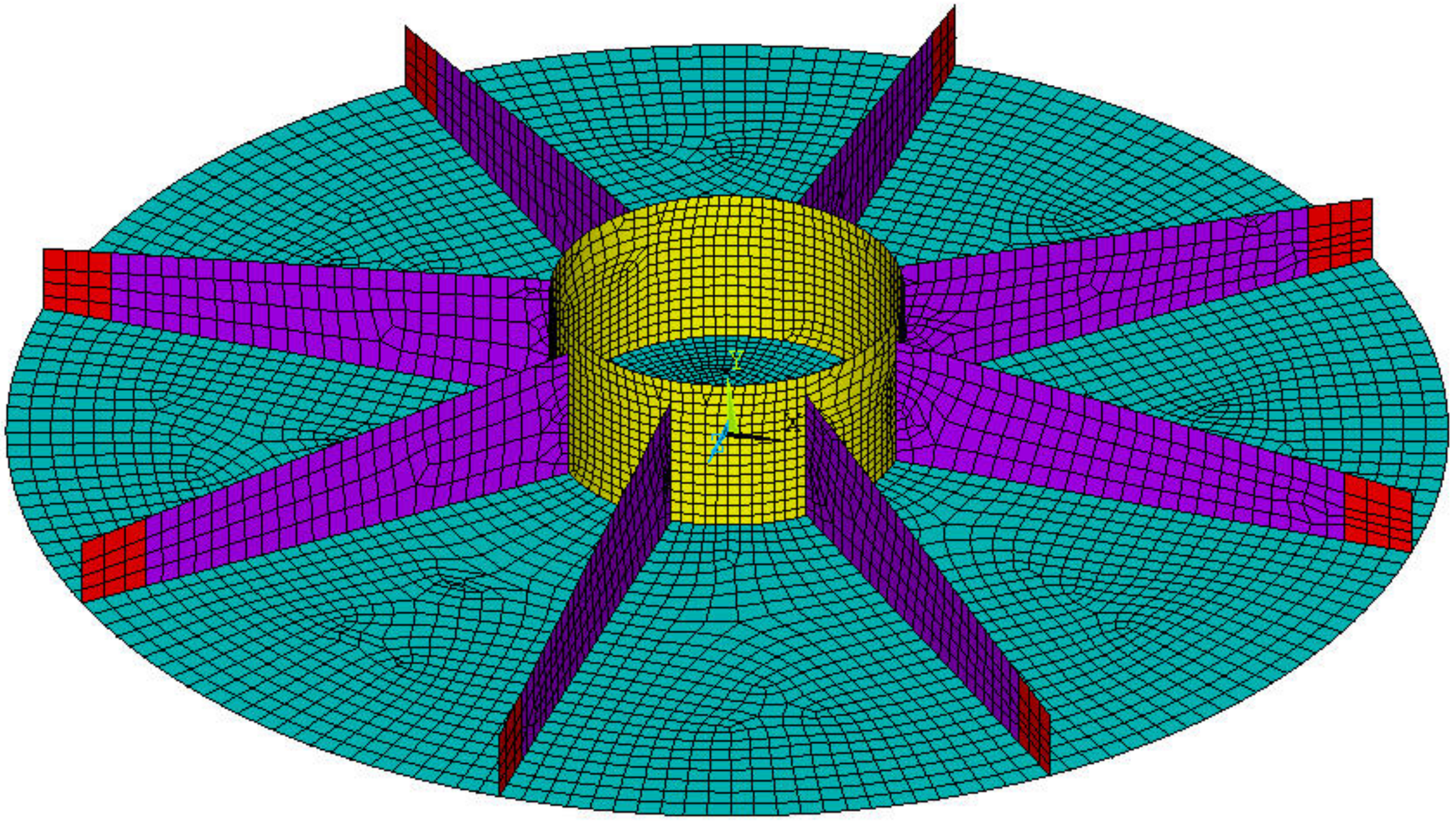
ANSYS



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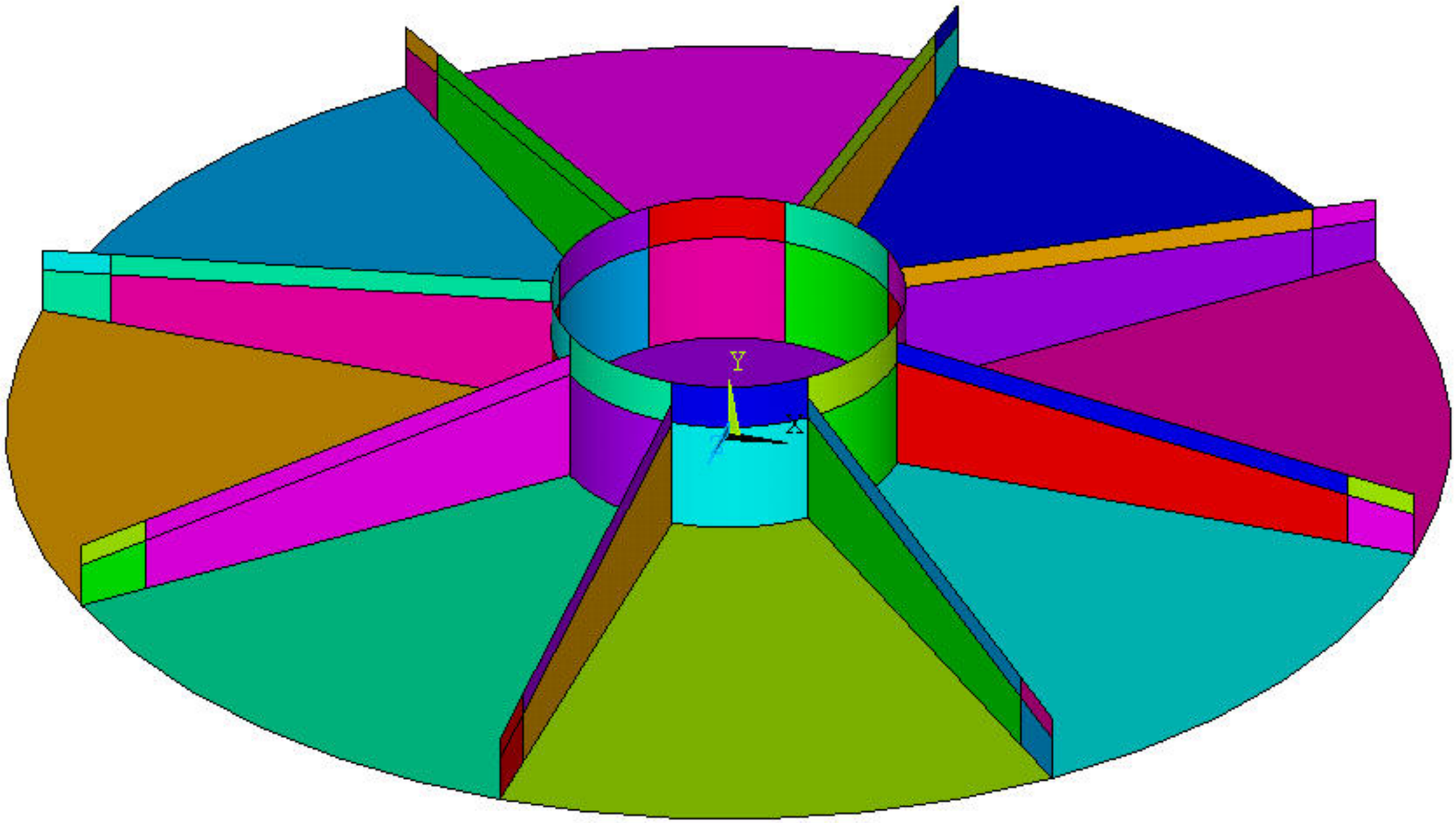
ANSYS

AREAS

AREA NUM



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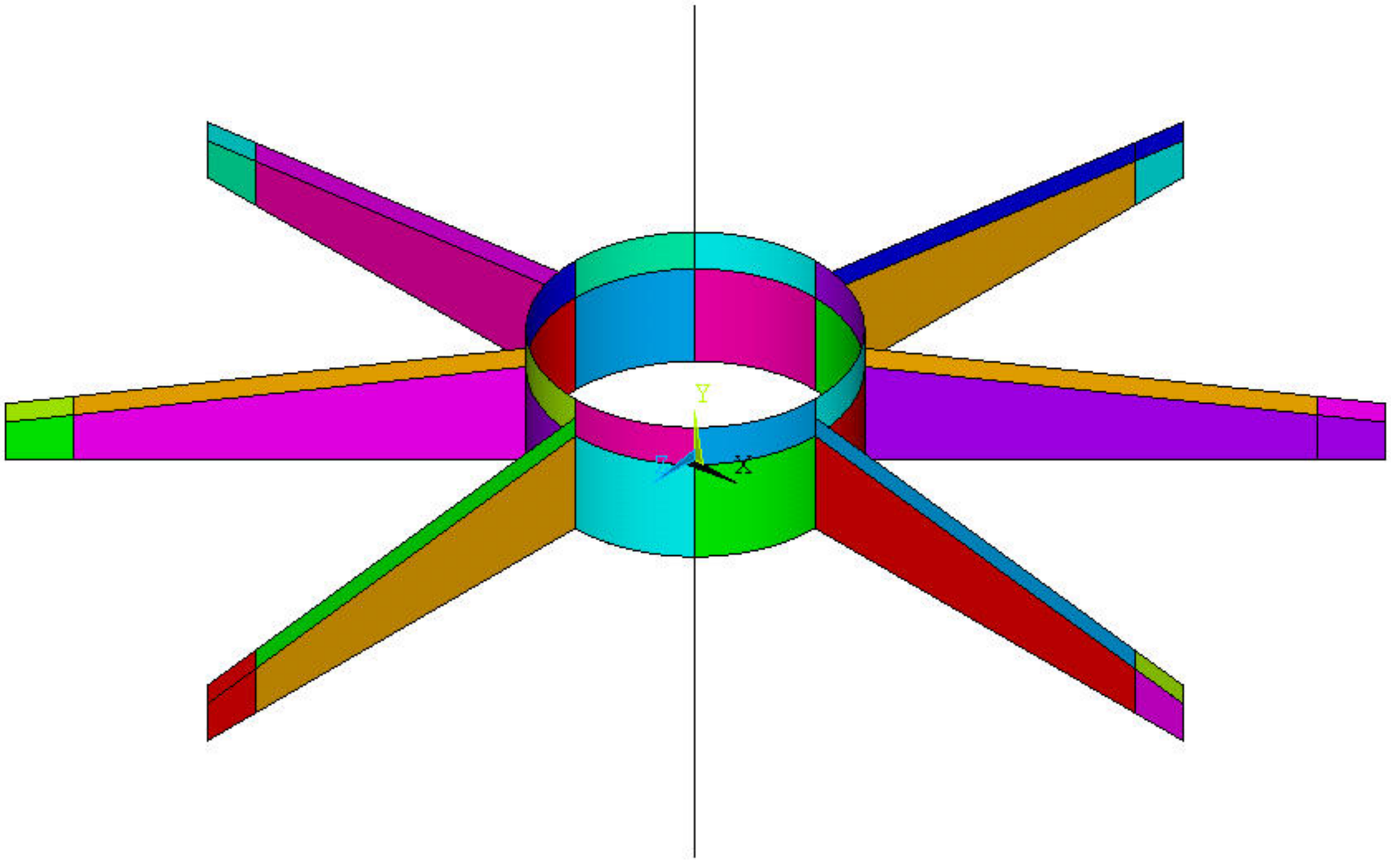

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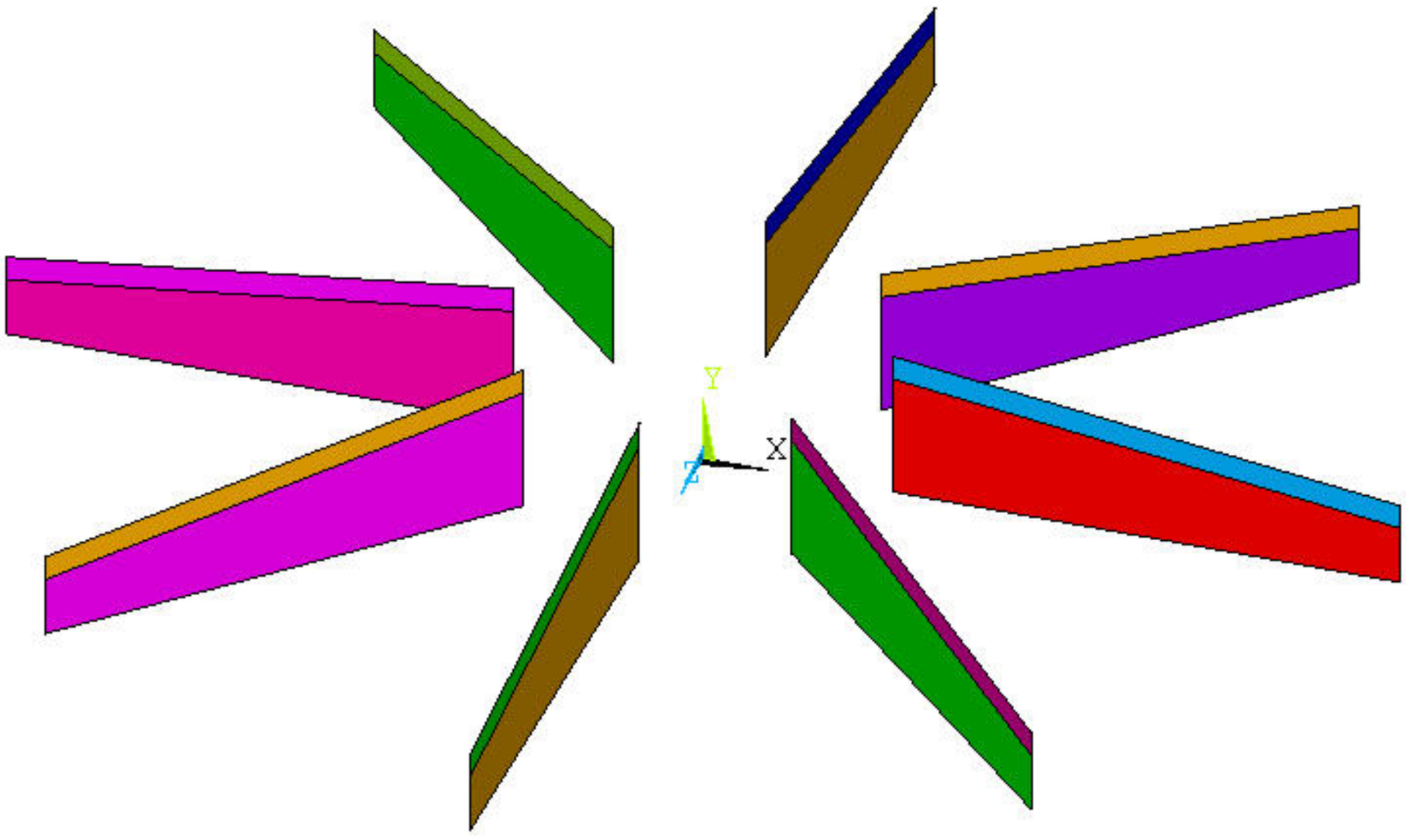

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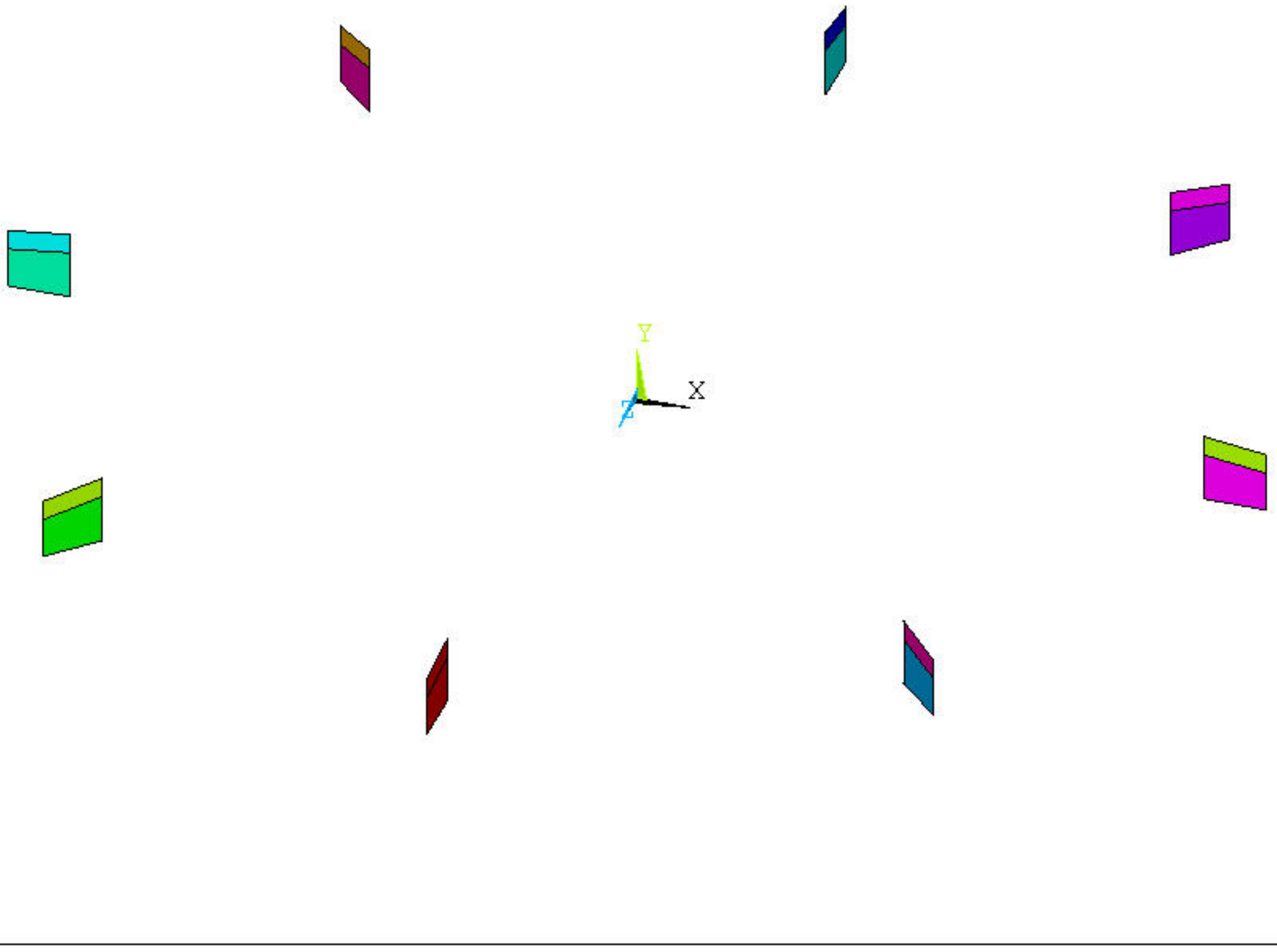

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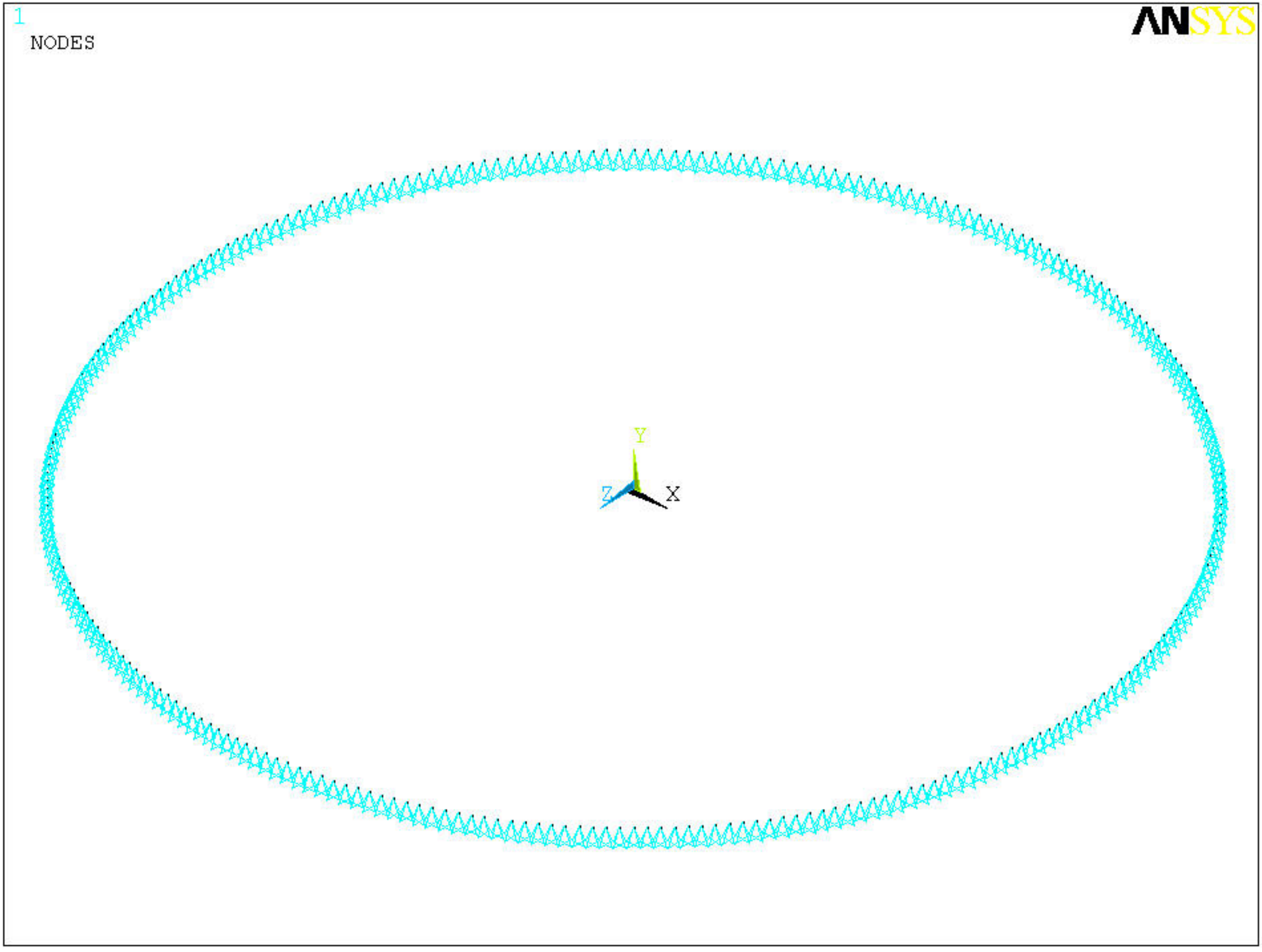

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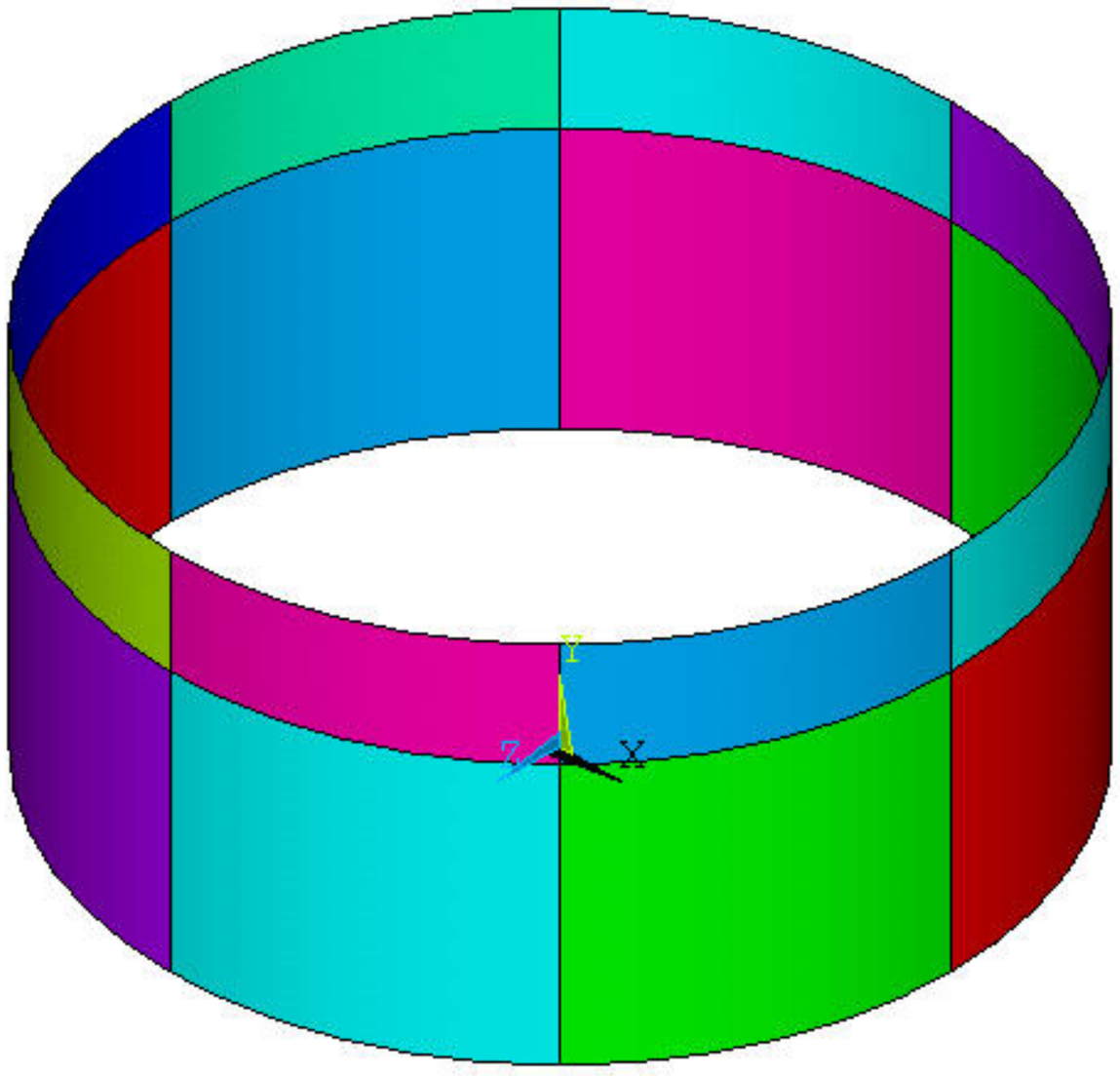

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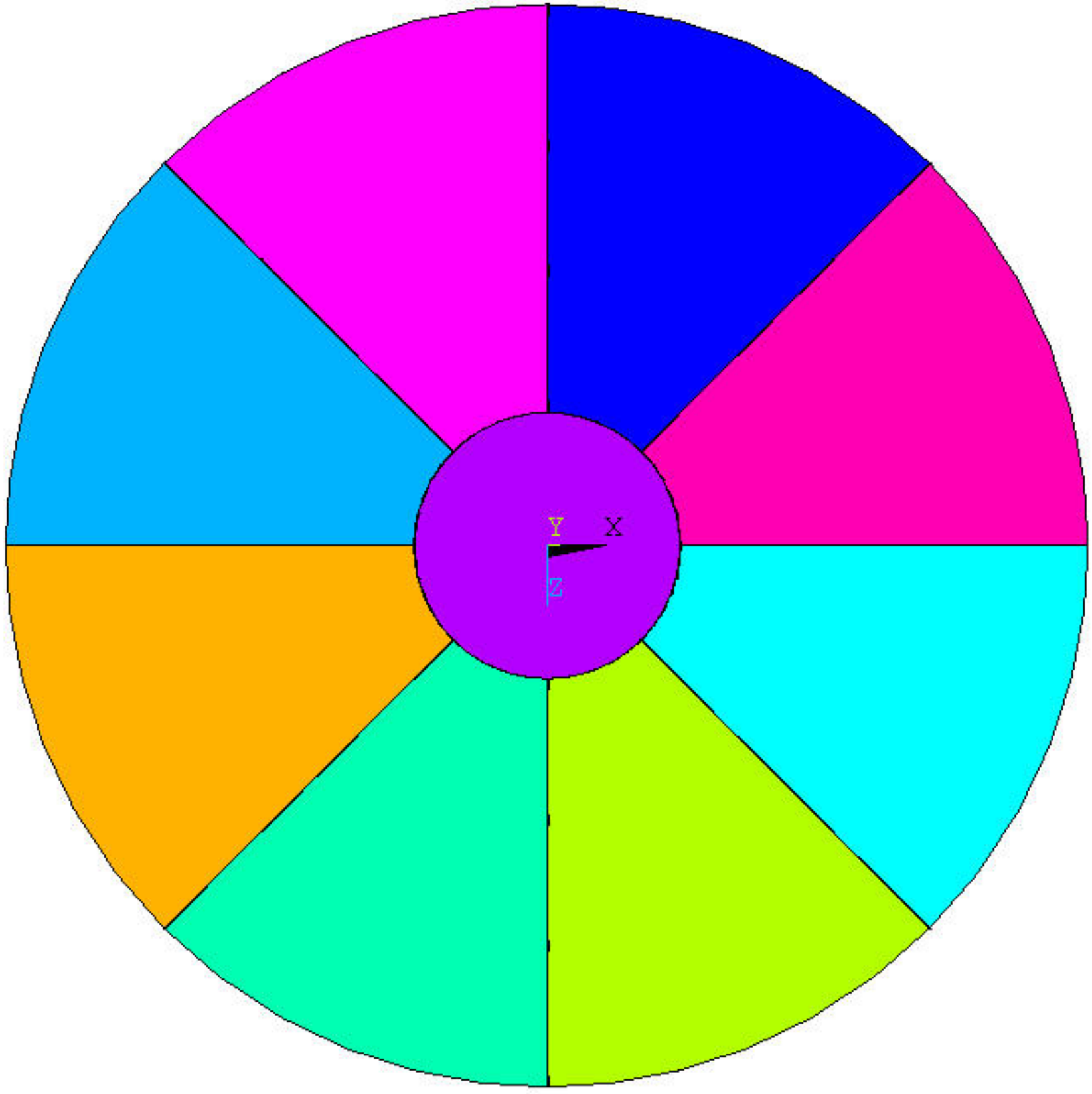
ANSYS