PRESSURE EQUIPMENT ENGINEERING SERVICES, INC.

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FINITE ELEMENTS ANALYSIS OF COKE DRUM SKIRT

PROBLEM DESCRIPTION:

The concrete table top octagon faces spalled from underneath the four Coke drums at a major refinery. This led to reduced support for the base plate and the skirt of the Coke drum.

It was required to perform the finite element analysis of the coke drum skirt and base plate to check the mechanical integrity of the skirt (and hence the Coke drum) due to reduced support provided by the reduced amount of concrete underneath the base plate. It was also required to check the mechanical integrity of the skirt and the base plate for the current and future concrete loss scenarios. The future concrete loss scenario was based on approximately 6” wide concrete loss beyond the current concrete loss.

It was also required to determine the code compliance of the support skirt per the stress values listed for ASME Boiler & Pressure Vessel Code, Section VIII, Div. -1 materials.

FEA MODEL & RESULTS:

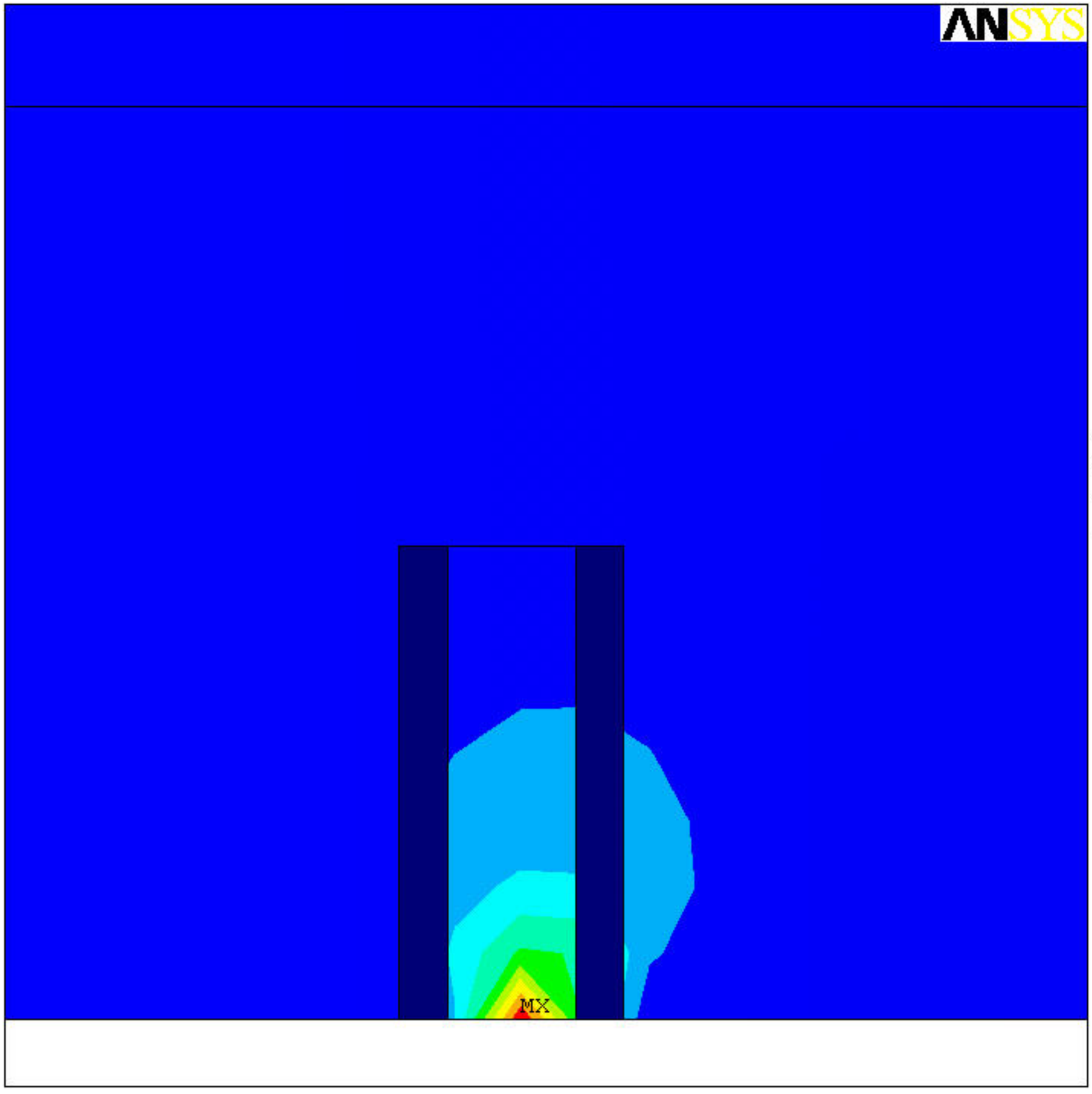
The 3-D FEA model of the vessel skirt and the base plate was generated using FEA software ANSYS. The dead load, live load, wind shear and wind moment at the top of the support skirt were calculated for the entire Coke drum separately and were applied to the FEA model.

The analysis was performed for six (6) load cases. The first load case involved the entire base plate supporting the skirt. The subsequent load cases involved removal of the support from the base plate in stages. This was based on future concrete losses beyond the current concrete loss scenario from underneath the base plate. The future concrete losses were based on additional 1.25”, 2”, 2”, and 2.5” wide losses of concrete.

The stress analysis results for the Coke drum skirt 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 support skirt and the base plate were within the Code allowable stress limits for all the six load cases. Thus, the support skirt, base plate and the Coke drum vessel were considered fit for service for the reduced base plate support scenarios (current and future).

The current design for the skirt and base plate 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 for one of the load cases.



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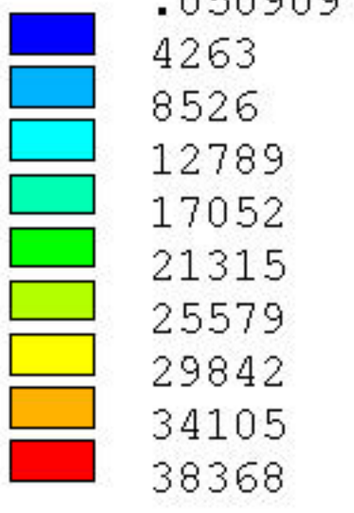

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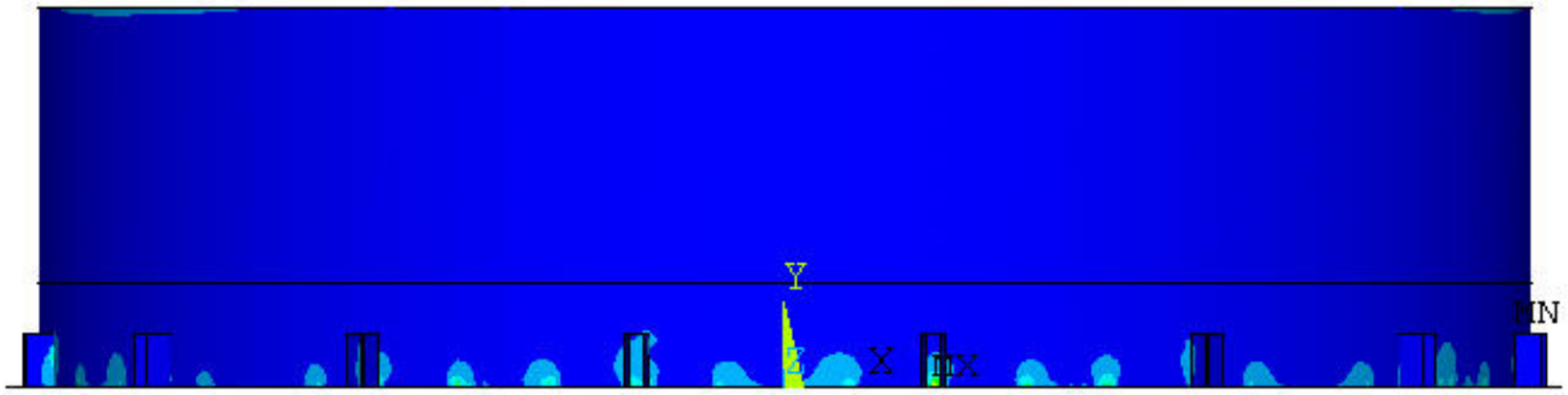
ANSYS



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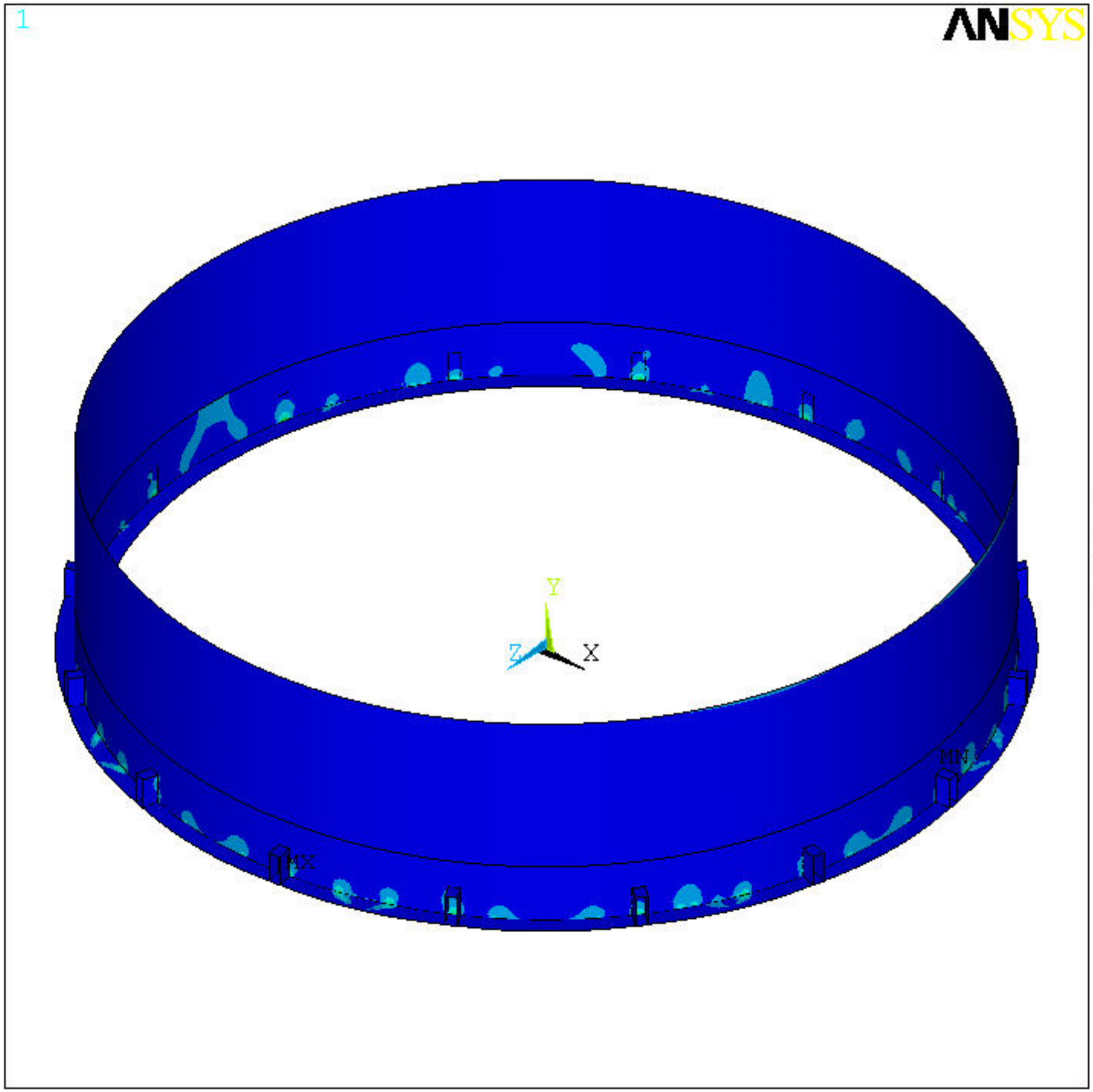

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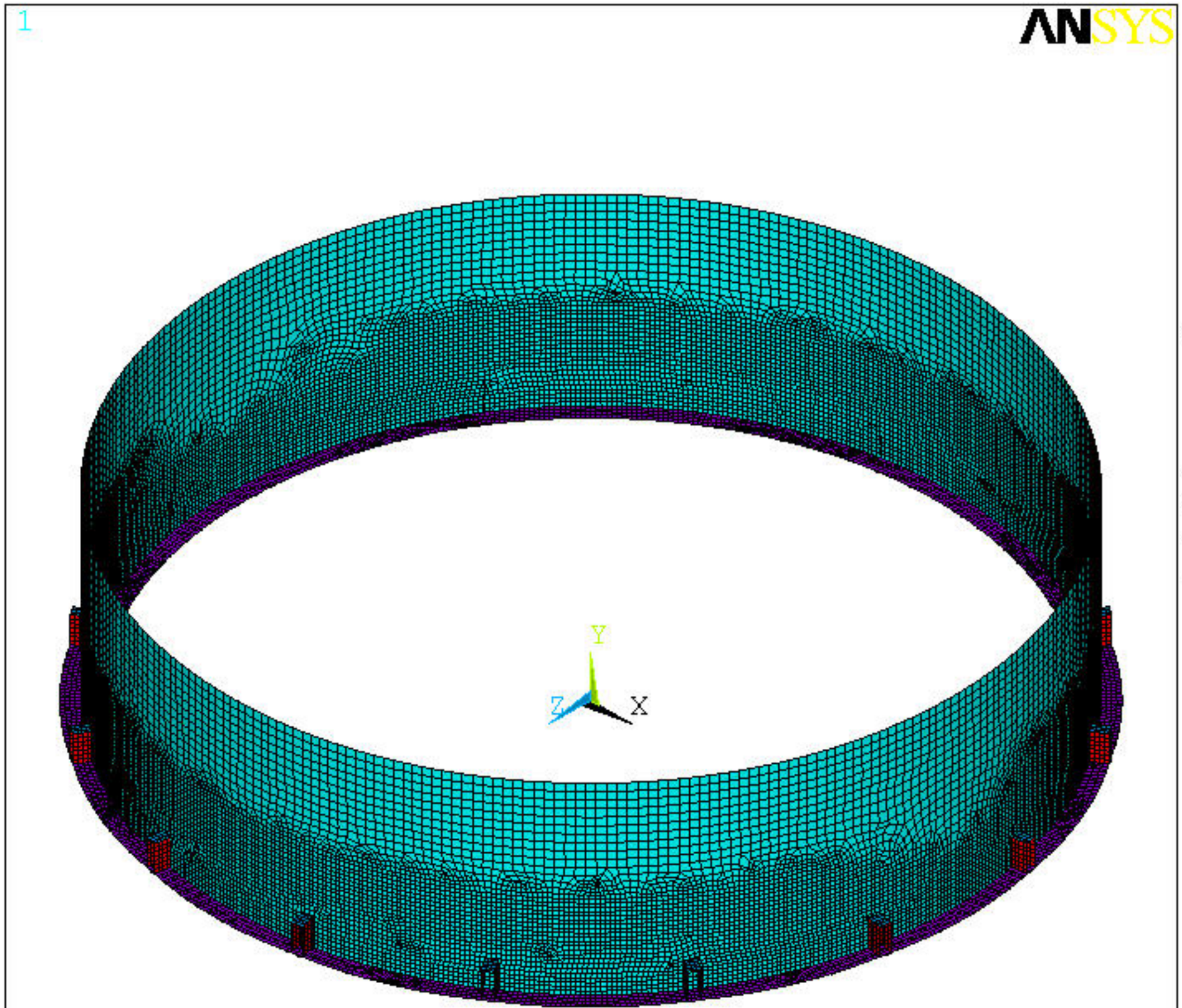

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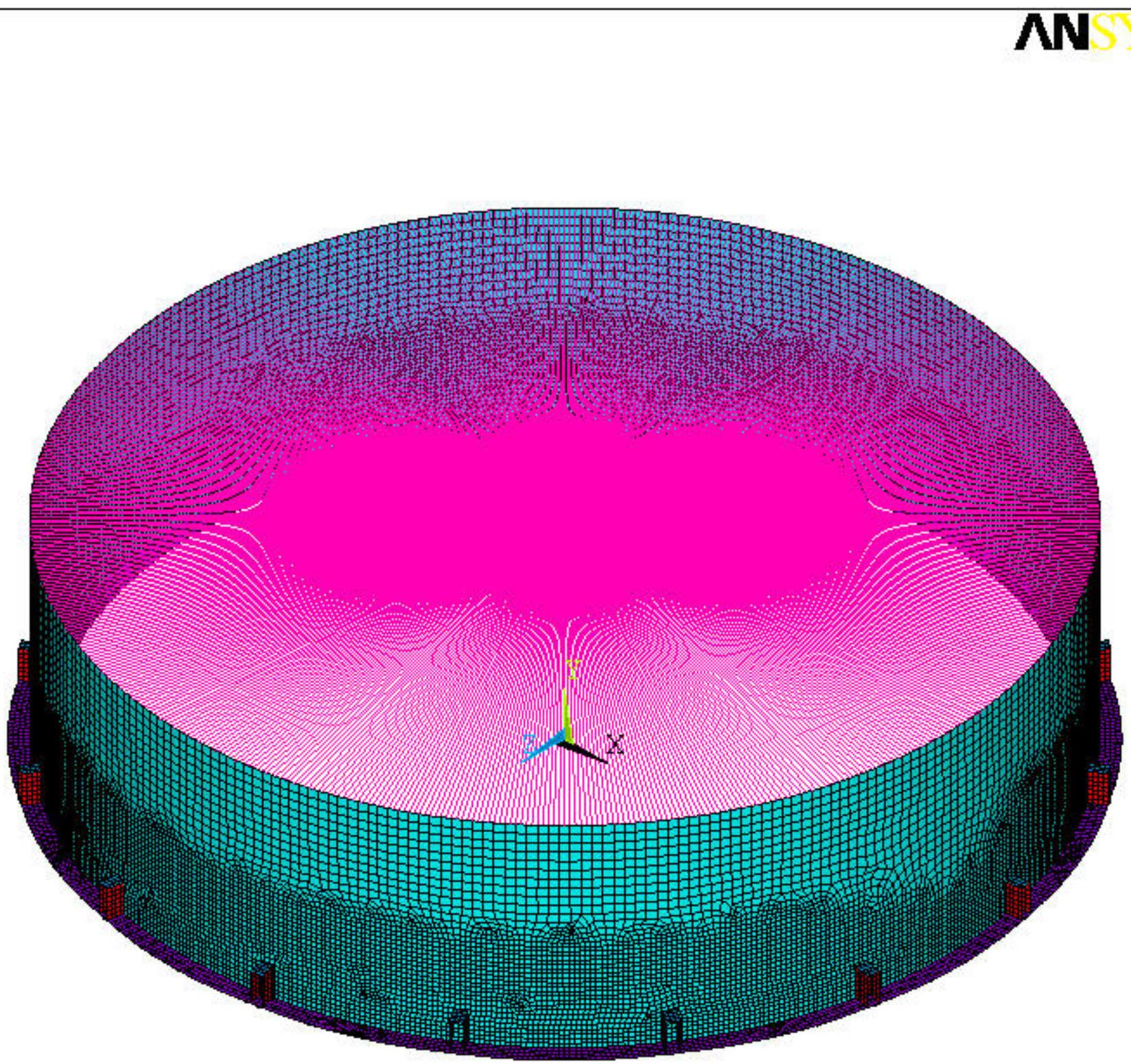

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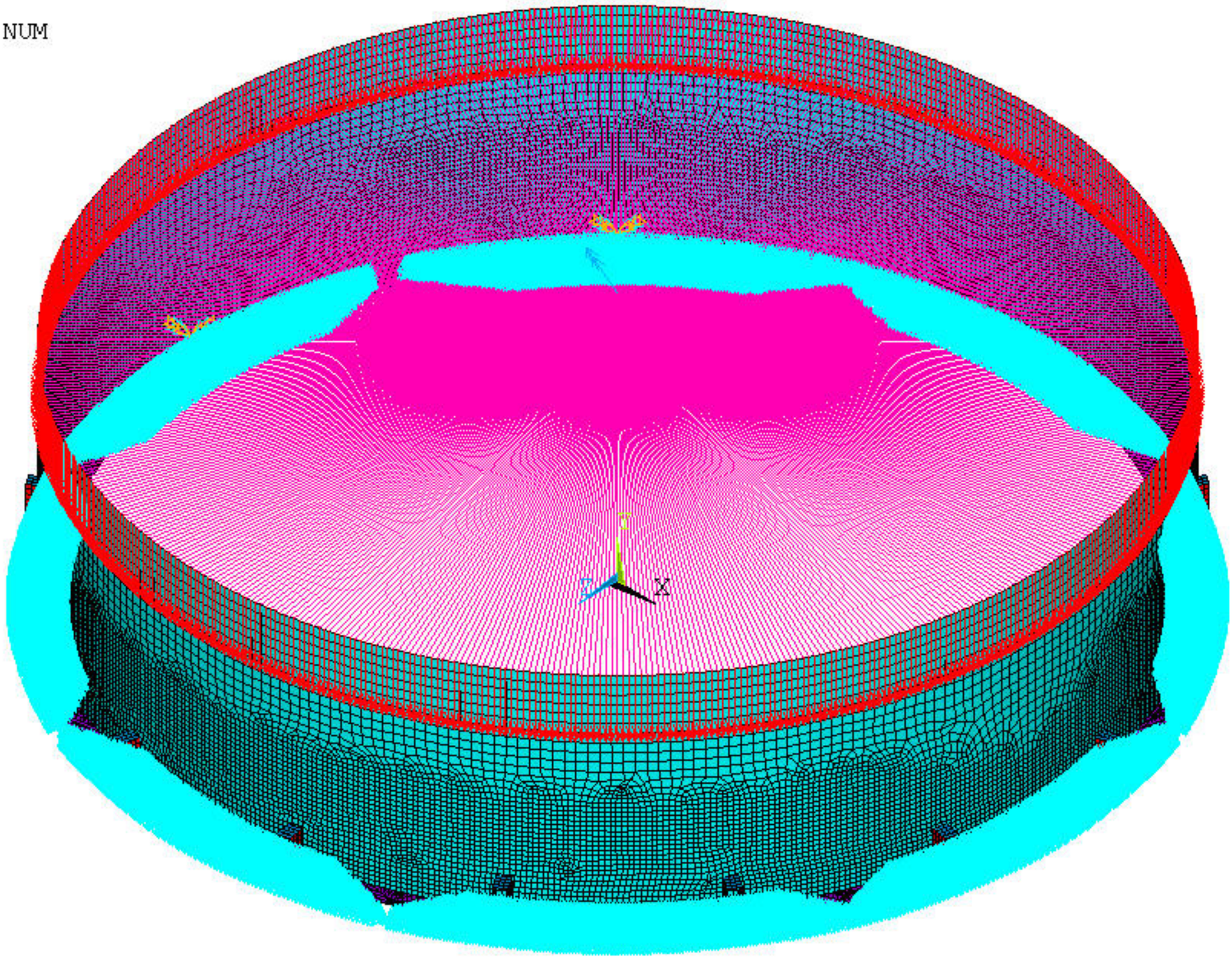

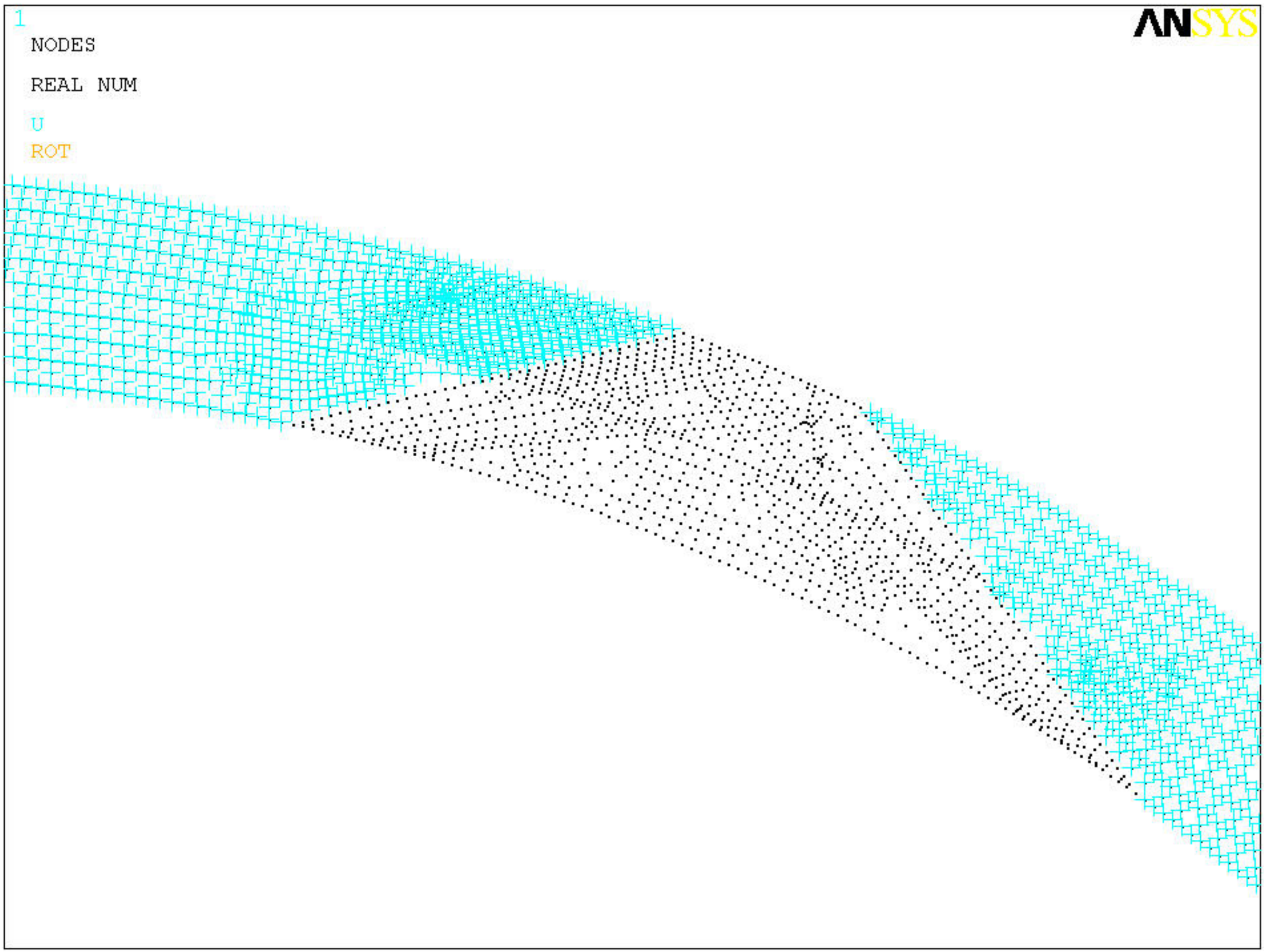
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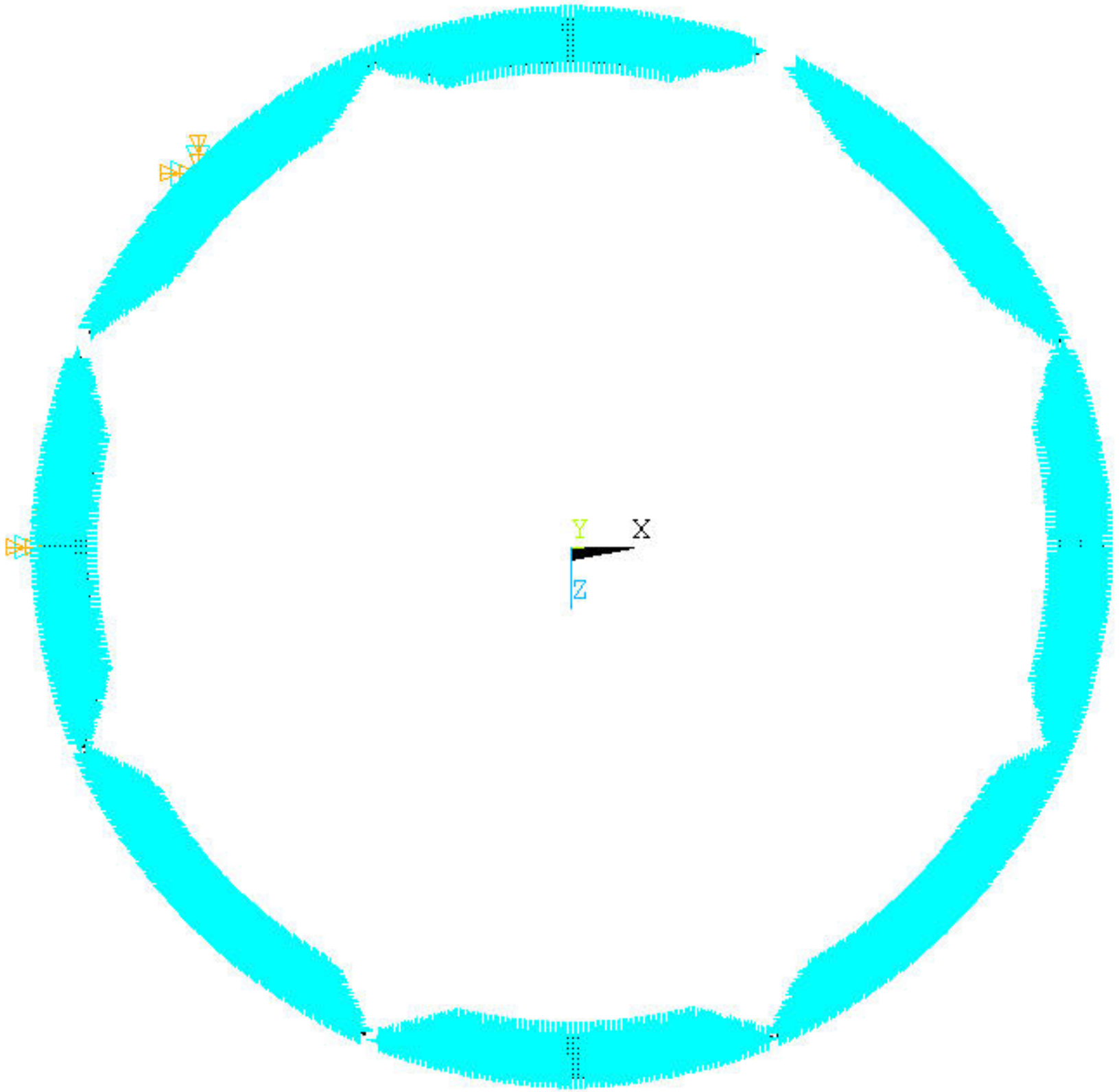

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AREAS

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