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FINITE ELEMENTS ANALYSIS OF CYLINDRICAL VESSEL WITH LARGE RECTANGULAR OPENINGS

PROBLEM DESCRIPTION:

A stainless steel pressure vessel containing the rotary mixer blades was to be designed with two large rectangular openings to be used as inspection ports.

It was decided to perform the three dimensional finite element analysis for the cylindrical shell and the two rectangular nozzles with the following objectives:

- (1) To ensure compliance with ASME B&PV Code Section VIII, Div.-1.
- (2) To ensure that any part of the vessel does not deform excessively.

FEA MODEL & RESULTS:

To obtain the desired internal pressure rating for the vessel shell, the following modifications were proposed and modeled for the FEA model. A new reinforcing pad was installed around each of the two rectangular nozzles. The fillet radii were introduced for the rectangular nozzles to reduce the stress concentration factor at the juncture with the cylinder and thus reduce the thickness of the reinforcement pad.

The 3-D finite element analysis was performed using the FEA software ANSYS. The finite element model consisted of the cylindrical shell with two large rectangular openings and the associated reinforcing pads. To avoid the distortion of the ends of the rectangular nozzles, the end flanges were modeled as fairly stiff radial spider beams at the end of each nozzle.

The pressure loading (50 psig) was applied to all the internal surfaces of the shell and nozzles. The stress analysis results for the cylindrical shell and nozzles 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 vessel shell and the nozzles were within the Code allowable stress limits. The displacement values in the shell and nozzles were also small and acceptable.

Based on the results of the three dimensional finite element analysis, the current design of the vessel with the two closely spaced rectangular openings 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.

1

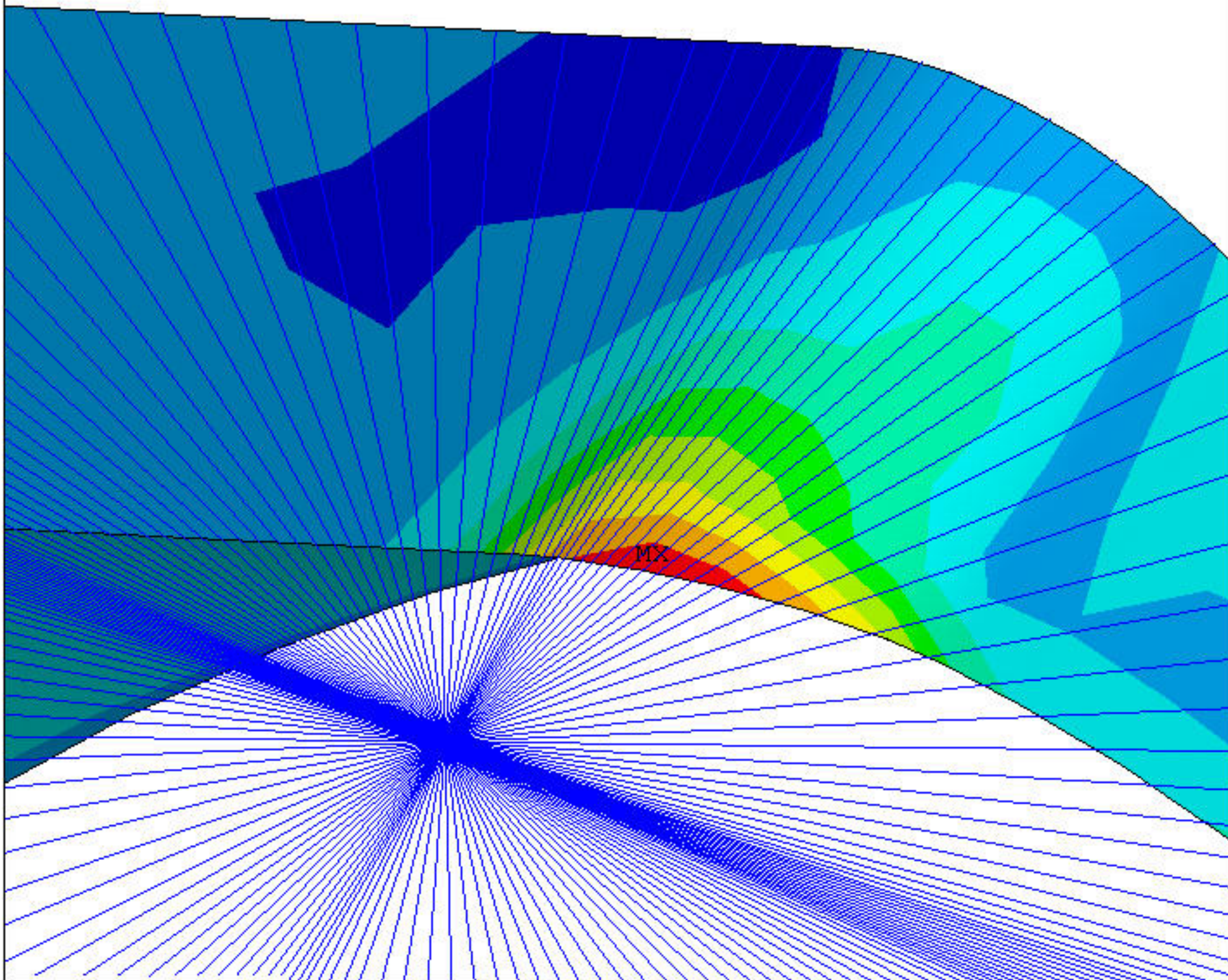
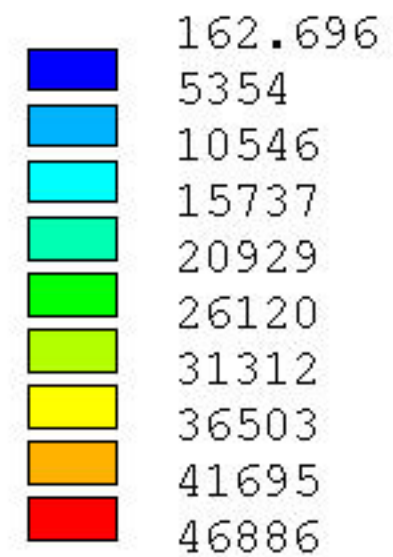
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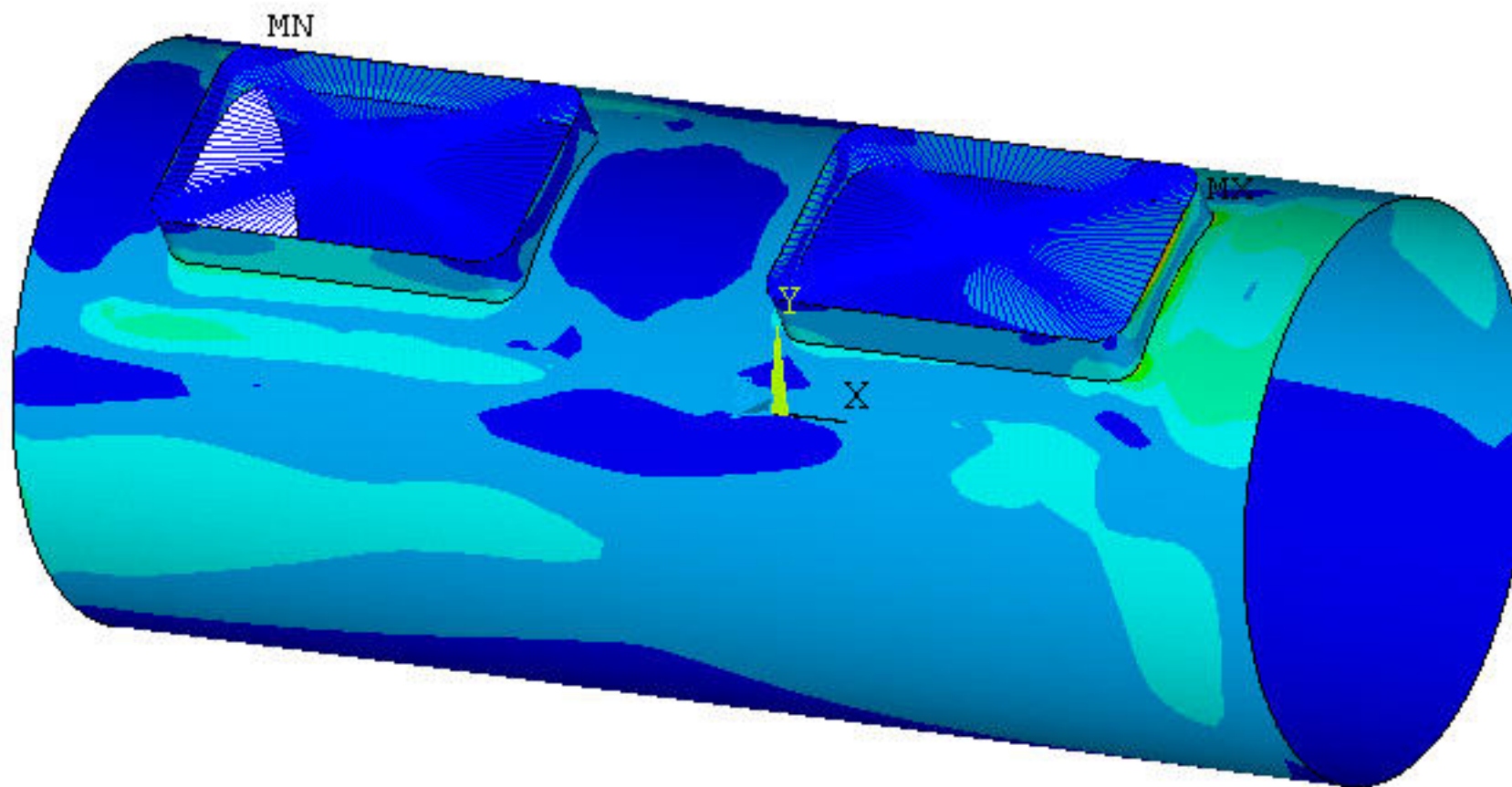
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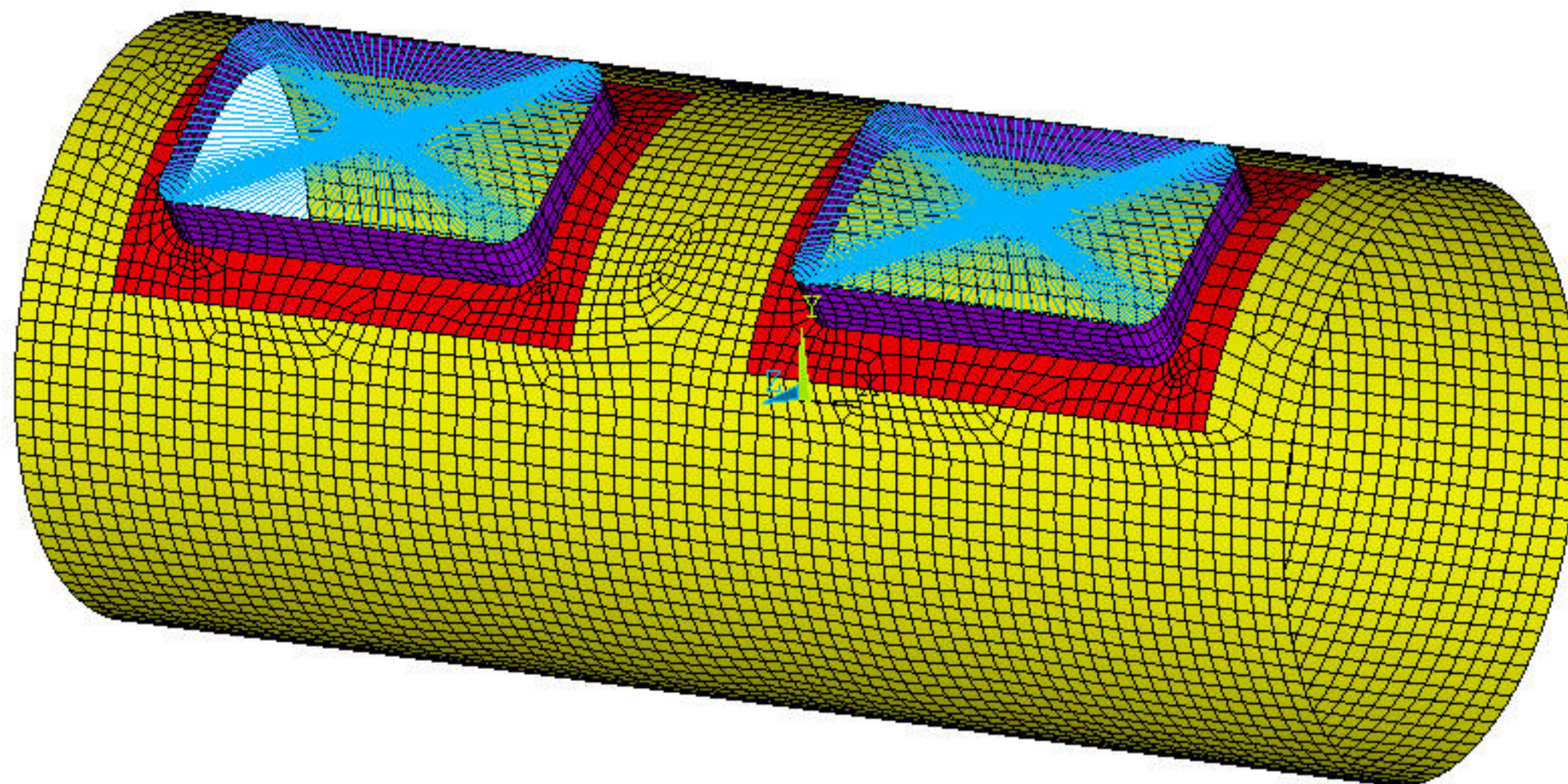
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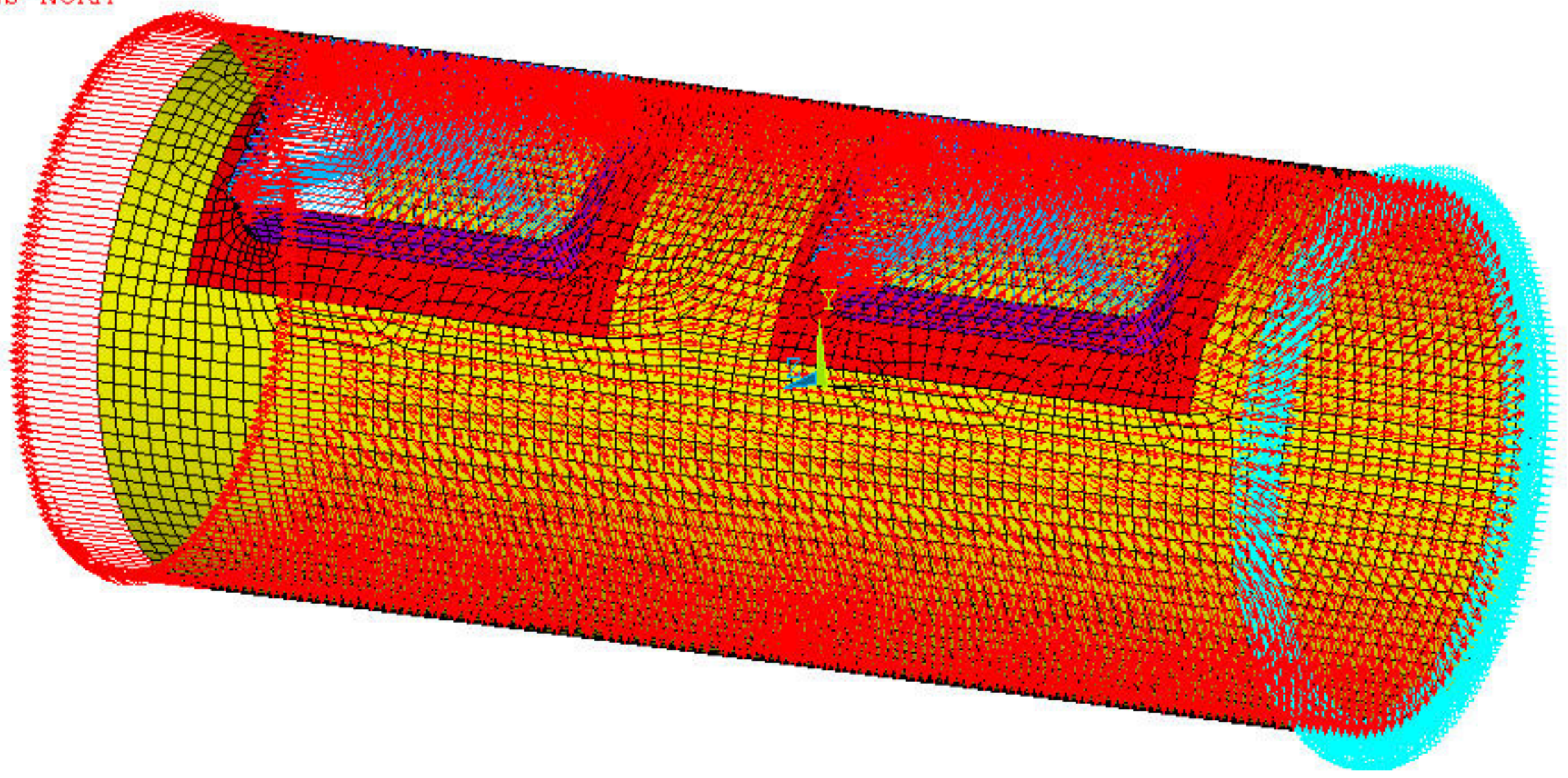
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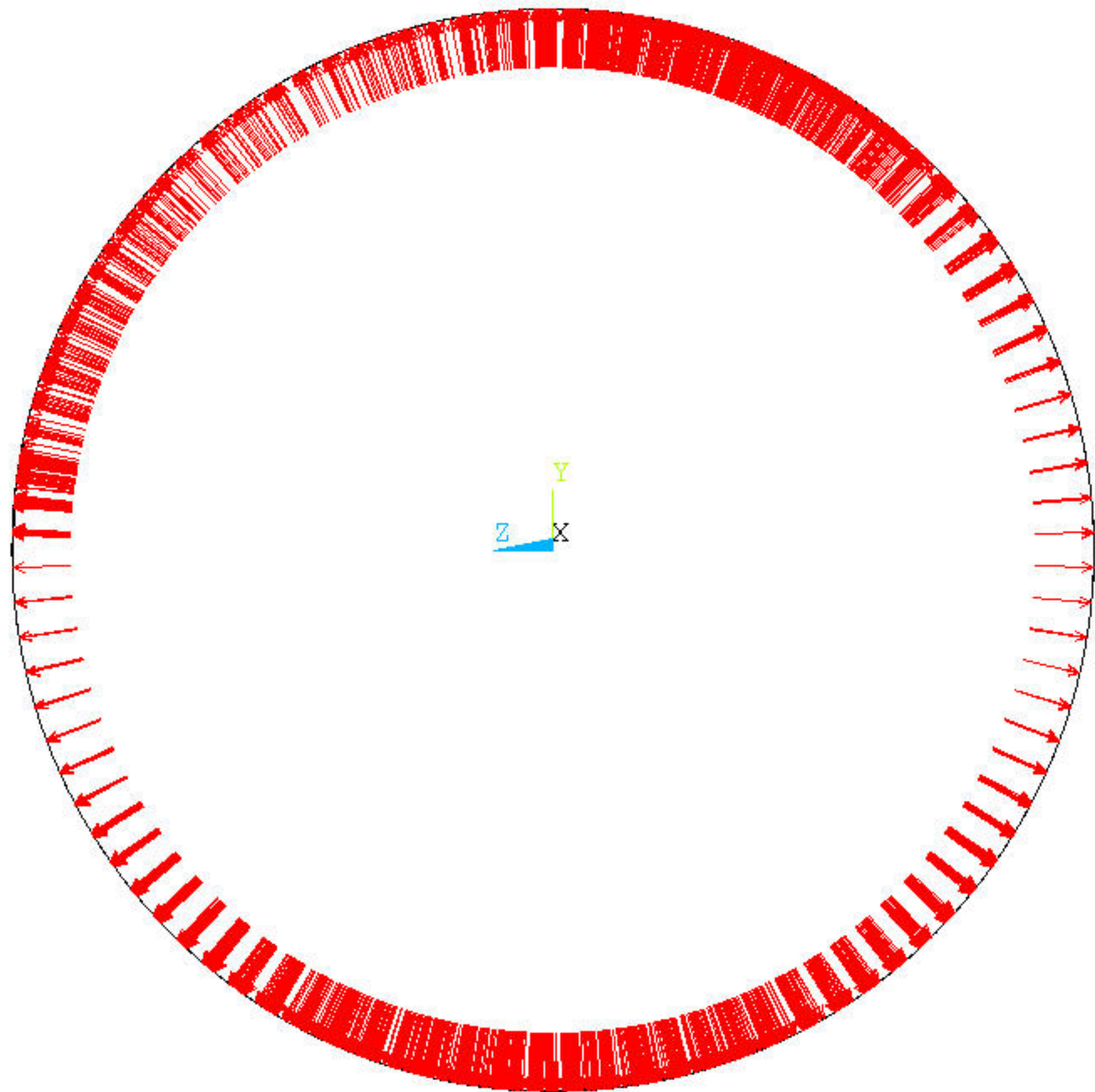
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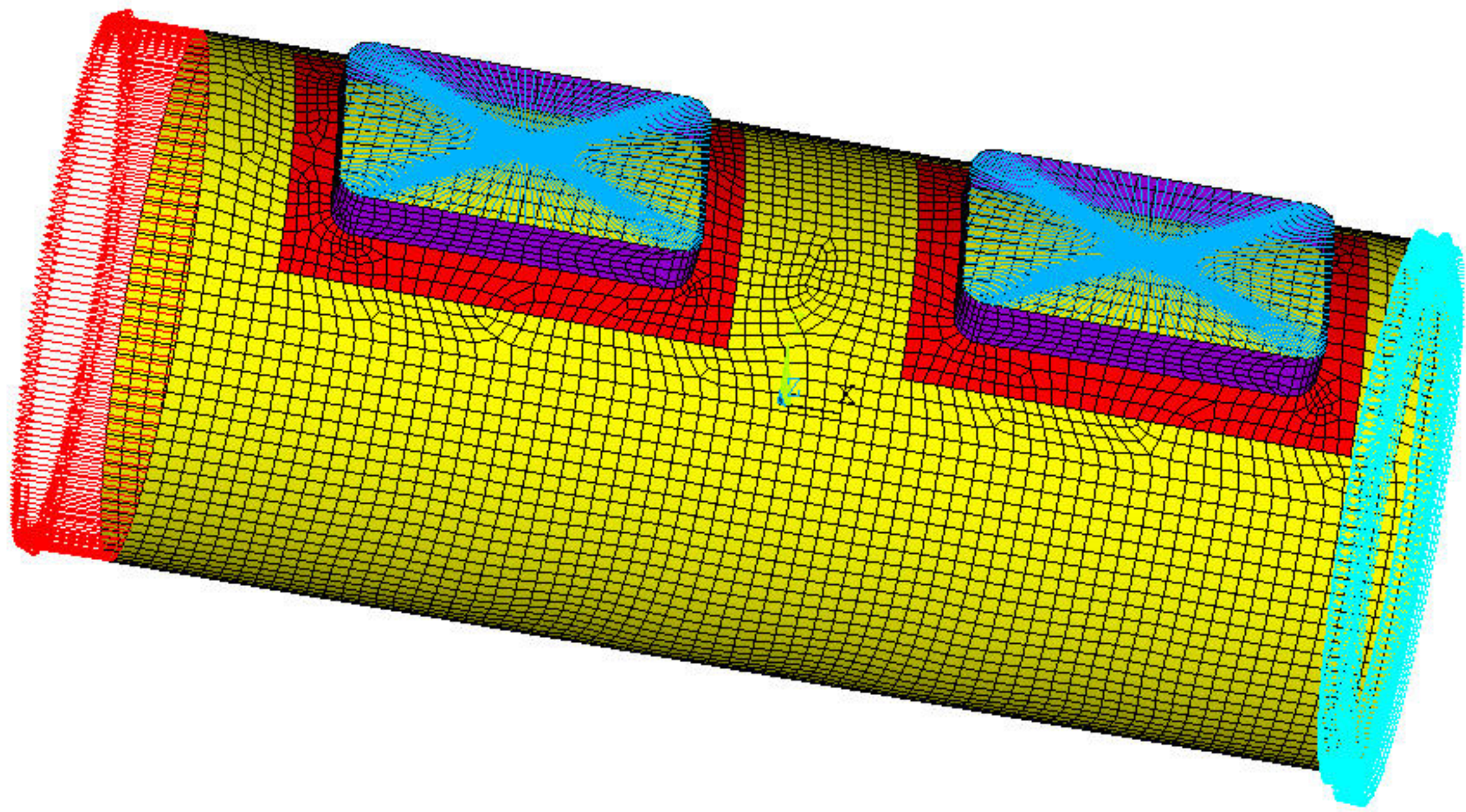
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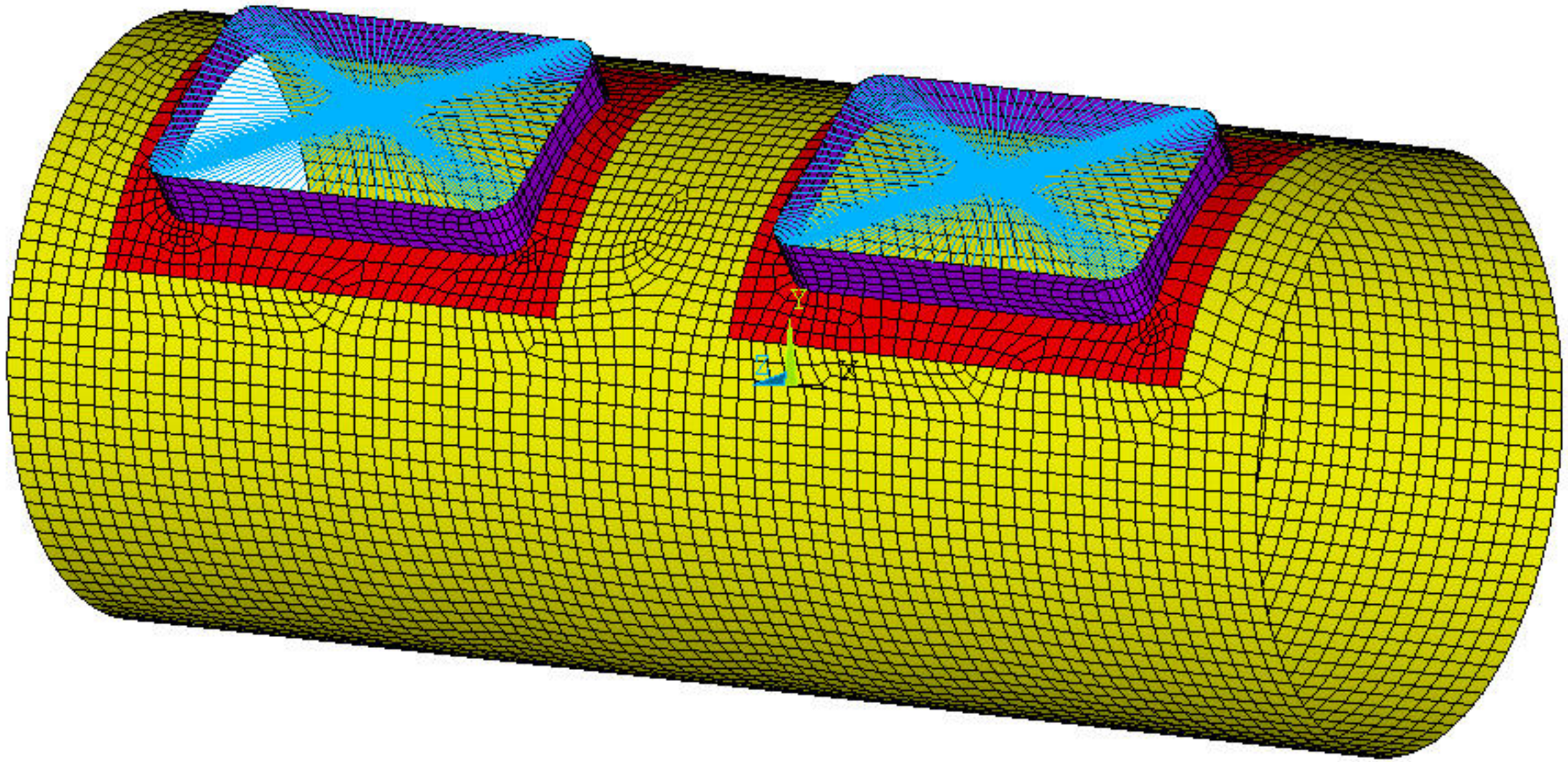
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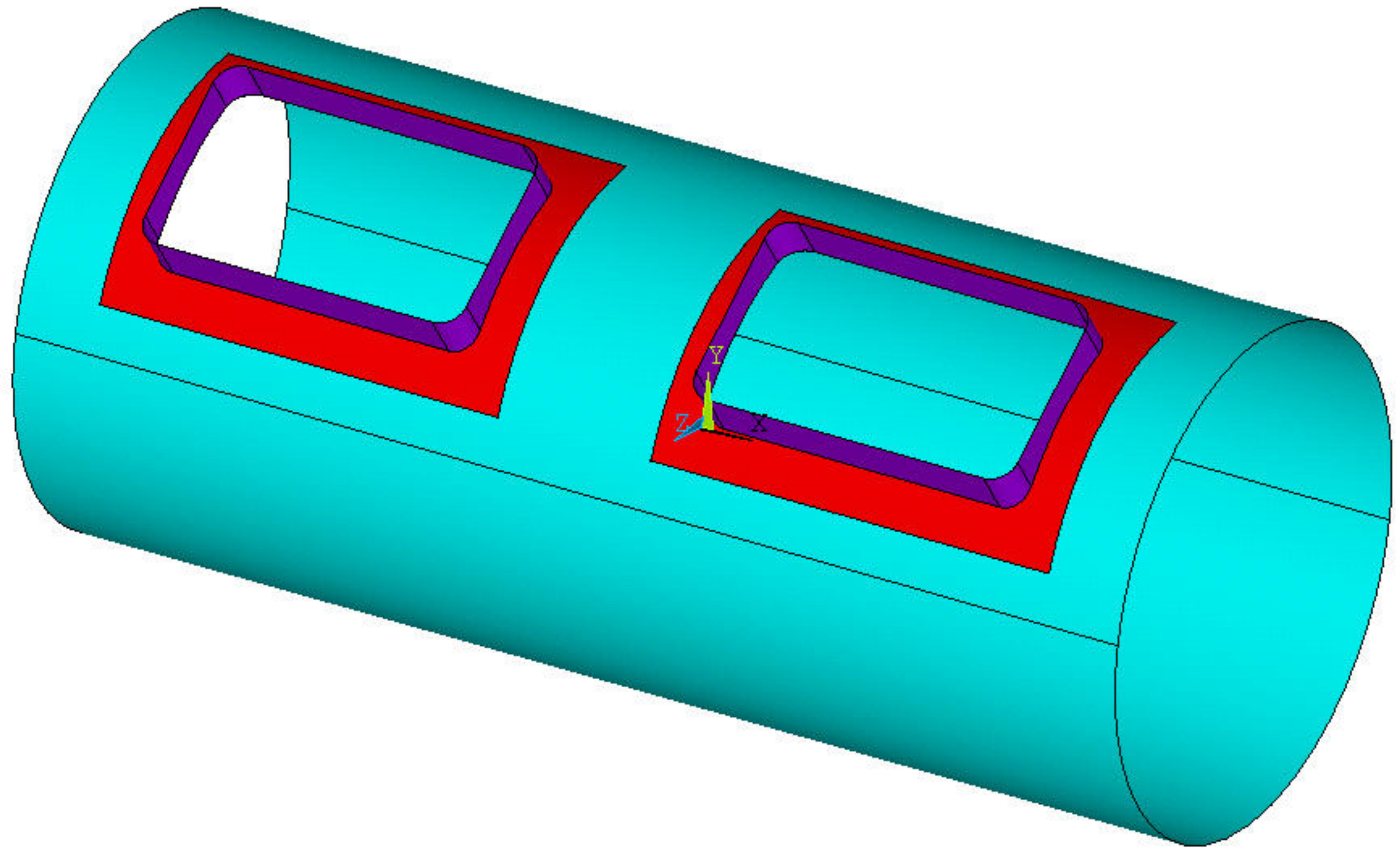
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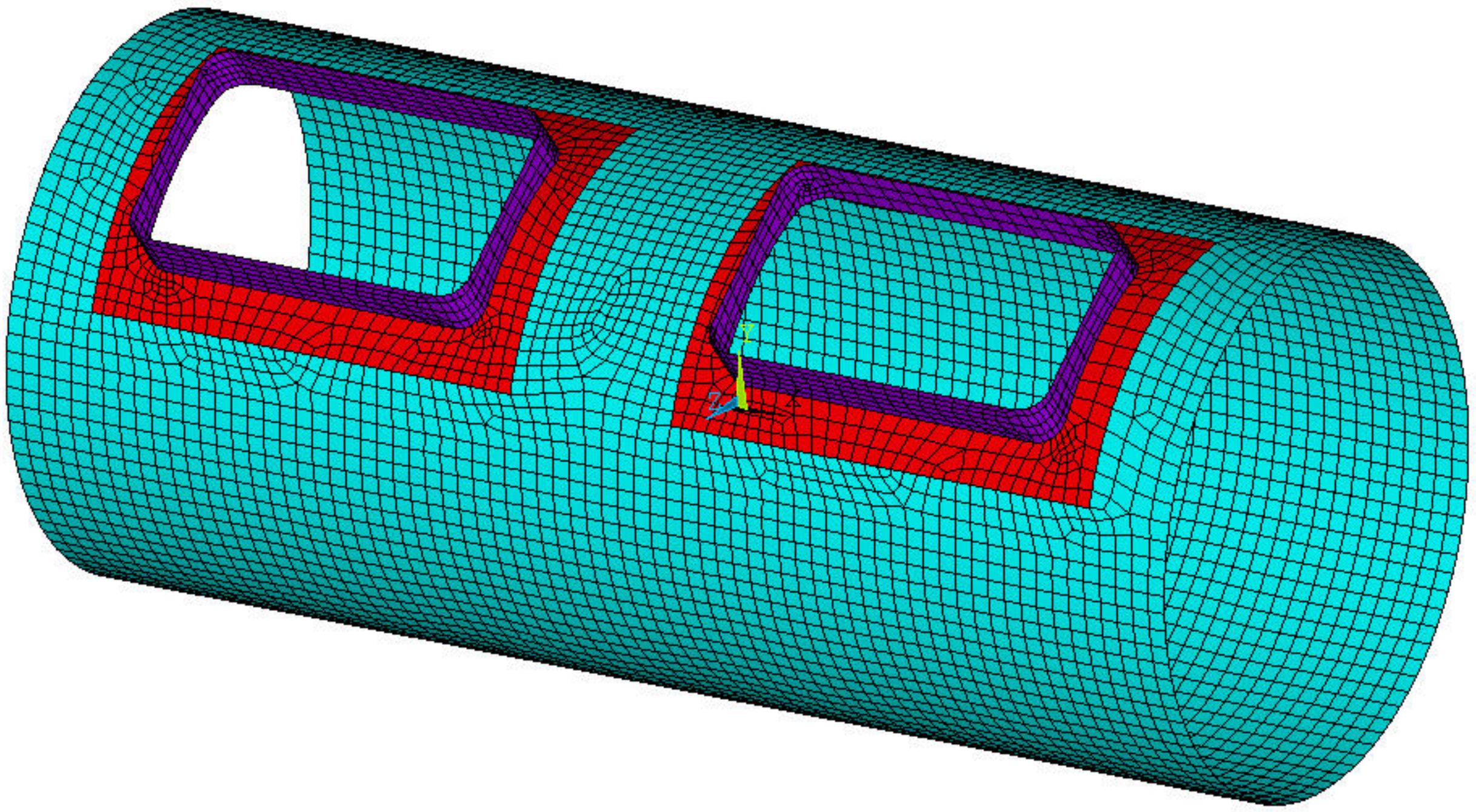
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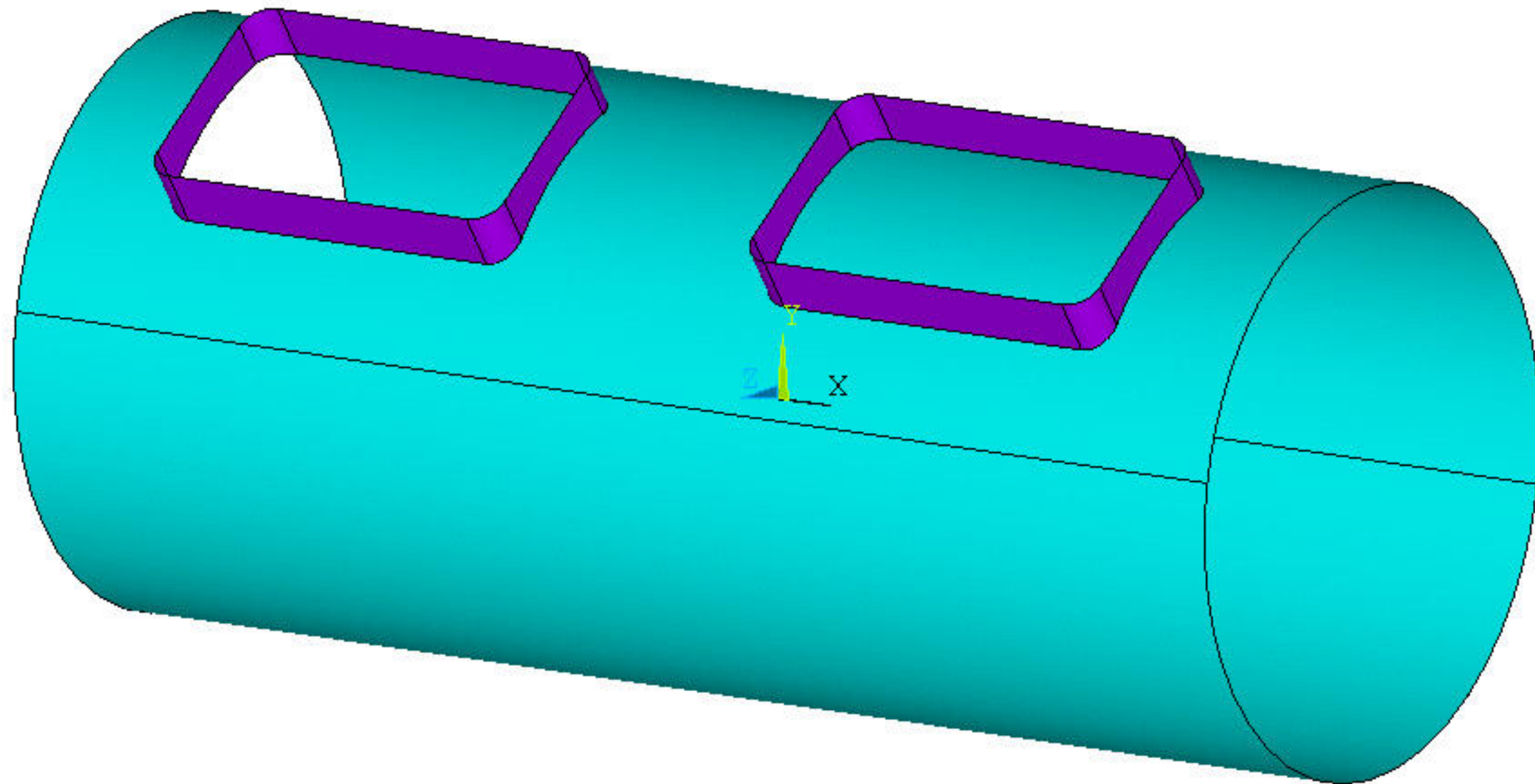
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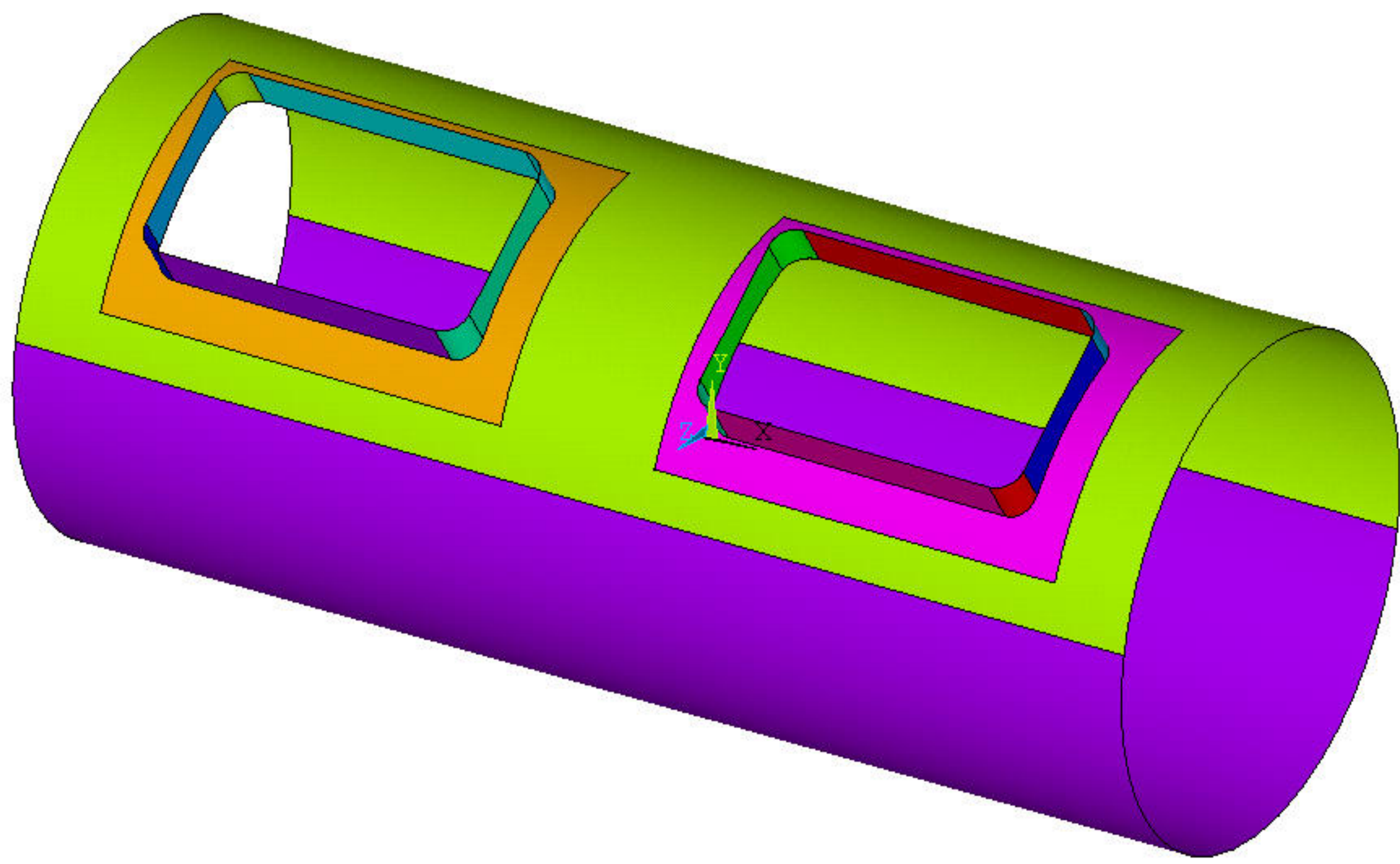
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AREAS

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AREAS
AREA NUM



1

AREAS

AREA NUM

