Deflection of the CC Cryostat Head Under Vacuum Loading

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Introduction

Following the installation of modules, cables and other equipment into the D0 central cryostat (CC cryostat) the small clearance between the cryostat head and internal equipment caused concern that the head would make contact with the equipment when the cryostat was put under vacuum for leak checking. This finite element analysis was requested by George Mulholland to determine the amount of deflection in the head due to vacuum loads.

Cryostat Geometry

The geometry for the finite element model was taken from Drwg. #3740.220-ME-222256.

Finite Element Model

An axisymmetric finite element model was generated using ANSYS STIF42 axisymmetric solid elements. This model is shown in Fig. 1. Symmetry boundary conditions were applied at the midplane, and a uniform pressure of 15 psi was applied to all external surfaces.

Results

The model was checked by calculating hoop stresses in the inner and outer shells at the midplane from thin shell theory and comparing to the ANSYS stresses. Agreement was within 2%. A plot of the distorted cryostat is shown in Fig. 2.

Four locations on the head were of specific interest for deflections. Table I summarizes the deflection results at these locations.

Table I

Summary of Displacements on Cryostat Head

Location	Radius (in)	Radial Deflection	Axial Deflection
A	36	-.007	-.005
B	52	-.003	-.054
C	71	-.002	-.055
D	92	-.018	~0

Note: Negative deflection is toward axis for radial deflection or toward midplane for axial deflection.

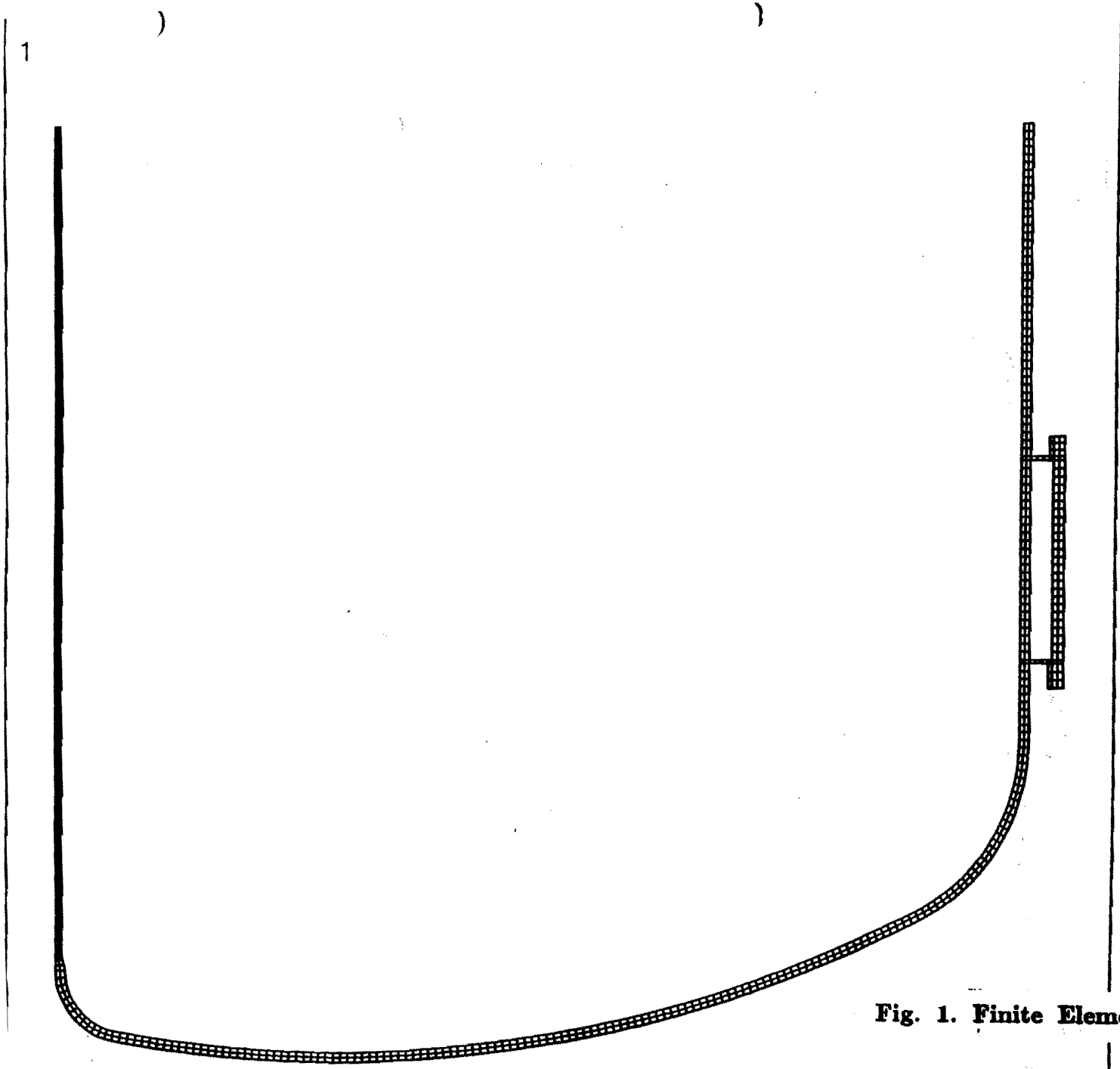

Fig. 1. Finite Element Model of CC Cryostat

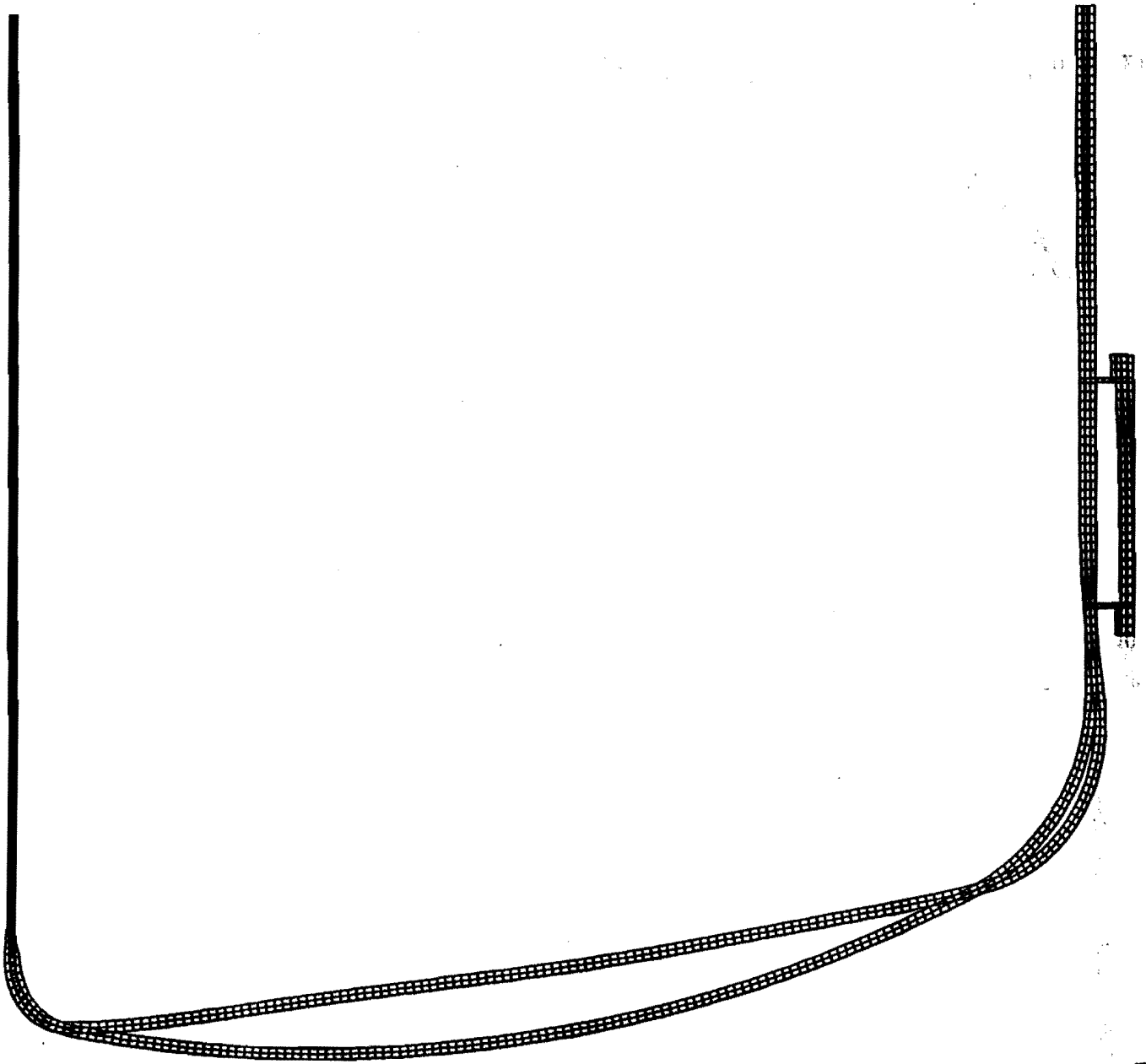

Fig. 2. Deflected Shape of CC Cryostat Under Vacuum Loading