WIYN Project

Wisconsin **Indiana** **Yale** **NOAO**

MEMORANDUM

TO: For the record
FROM: D. Blanco
SUBJECT: Structure of the Instrument Adapter (IAS) guide box
DATE: April 23, 1993

This memo summarizes some analysis done on the structure of the IAS. The design has proceeded to the point where the shape of the box and the bolt circle for attaching it to the rotator are well defined. Indeed some pieces (the rotator flange) are already built.

An FEA model of the intended structure was built to determine its flexure characteristics under the load of the heaviest specified instrument, and to determine optimal attachment points for mounting the instrument to the IAS box. The model is shown in figure one attached. The structure has evolved into an eight sided polygon divided into two levels layer cake fashion. The floor which divides the forward from the aft sections is not meant to act in a structural fashion so was not included in the model.

Structural integrity in this design relies almost solely on the four corner brackets, while the forward and aft plates (as well as the central dividing floor) hang from these brackets. The floors do provide shear stiffness, however they are simply not thick enough to support major loads applied out of the plane of the plates.

Loads were applied to this model simulating a 1320 lb (600 kg) instrument with its center of gravity cantilevered 16.75" (42.5 cm) beyond the back of the box. At first an FEA model of a dummy instrument was added to the box model, however since this adds some structural integrity due to the instrument, the dummy was replaced with reaction loads at four mounting points. In this way the flexure was calculated with a pessimistic assumption that the instrument itself does not contribute at all to the structural integrity of the box.

Gravity loading was applied to the box in two orientations clocked 45° about the rotator axis. Figure 2 and 3 show the deflected box shape under gravity applied along the box Y axis, and figure 4 shows the topography of the back plate under this loading. Similarly, figures 5, 6 and 7 show the distorted box shape under gravity with the box clocked to 45°. Loads were applied

WODC 03-13-01

consistant with instrument attachment placed points at the vertices of the four corner brackets.

As a result of the applied load the back plate both sags laterally and rotates. The magnitude of the deflections (referenced to the center of the back plate) were:

Case 1: Instrument attached to corner brackets

Case	Sag (μm)	Tilt (arcseconds)
Y Gravity	-6.9	0.343

Case 2: IAS clocked 45°

X-Y Gravity	-6.8	0.353

This structural system does not work by truss action hence we can expect the flexure to vary with the rotation angle, however the difference is rather small and can be neglected.

Next instrument loads were applied in a very poor structural location simulating attaching the instrument at four points midway between the four corner brackets. As expected, this gave very poor performance. The attached figures 8, 9 and 10 show the distorted shape of the structure. Gravity was applied along the Y axis with the following results (in microns and arcseconds):

Case 3: Instrument attached to back plate

Case	Sag	Tilt
Y Gravity	-6.9	525.038

In this last loading case the back plate was warped out of plane by 0.035" (0.88 mm), however the resulting stresses were still acceptably safe at about 32% of yield.

The conclusion to be made is obvious; instruments should be attached to the corner brackets of the box.

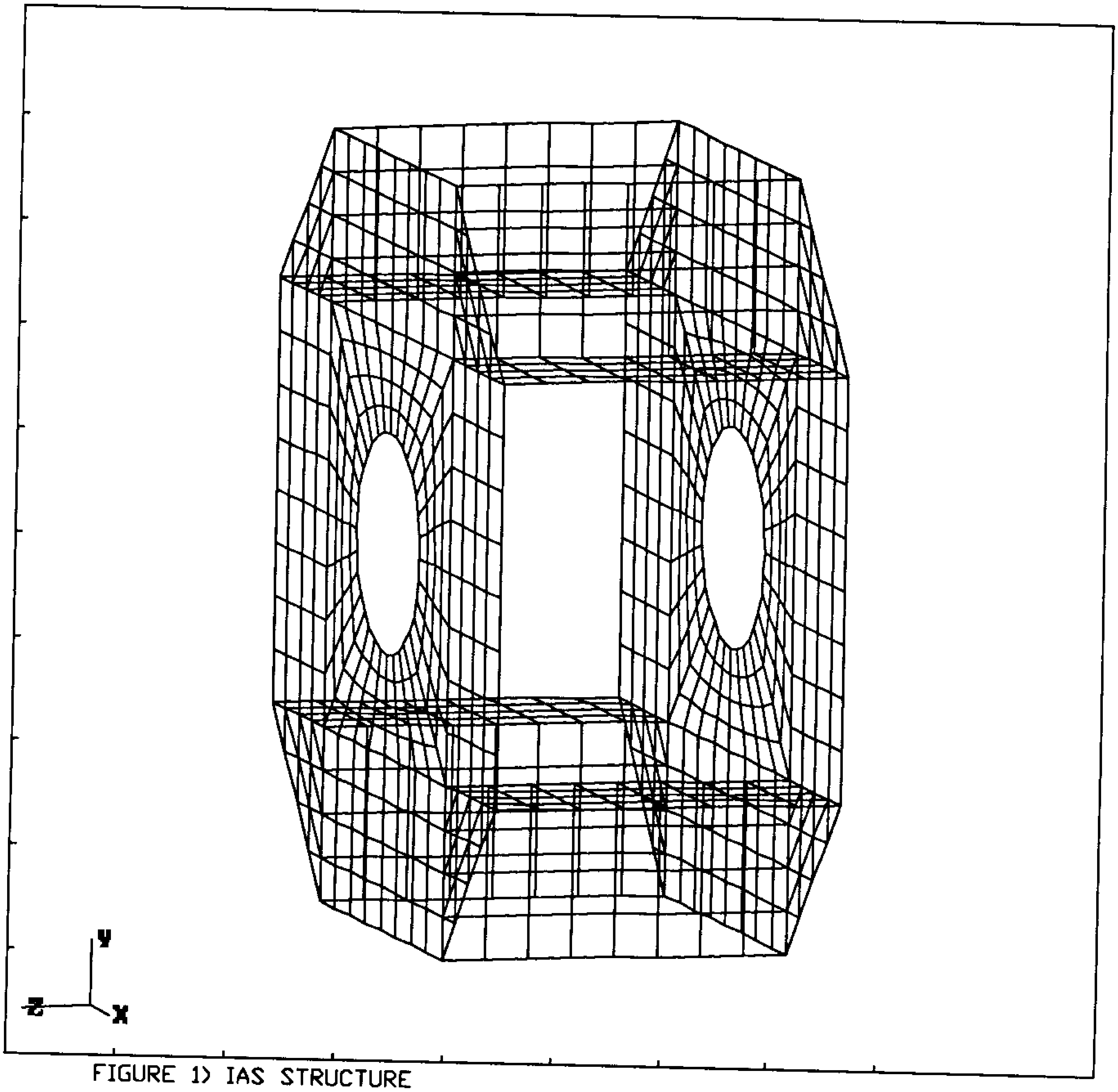

FIGURE 1) IAS STRUCTURE

CASE 1) GRAVITY ACTING ALONG THE Y AXIS

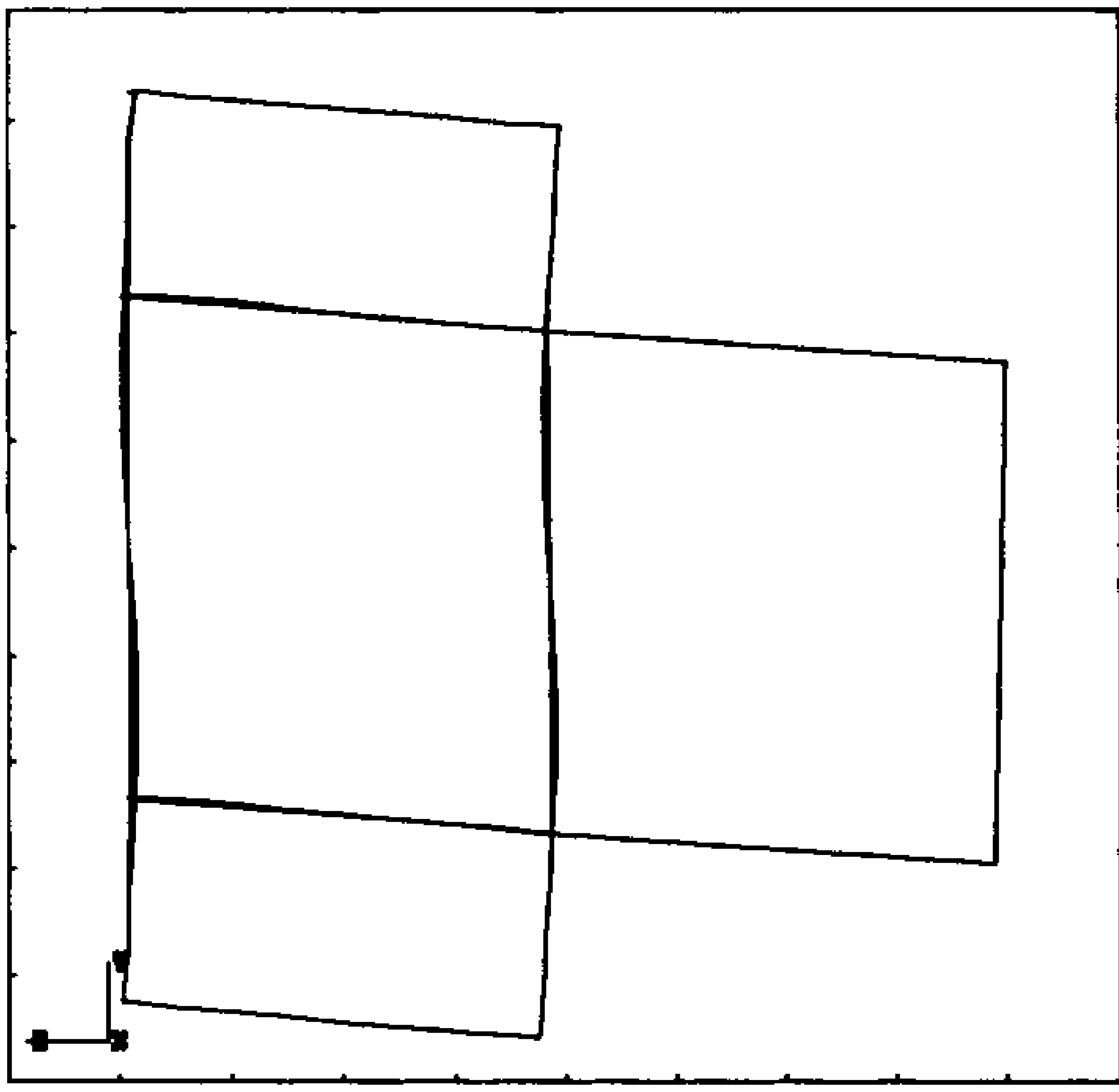

FIGURE 2)

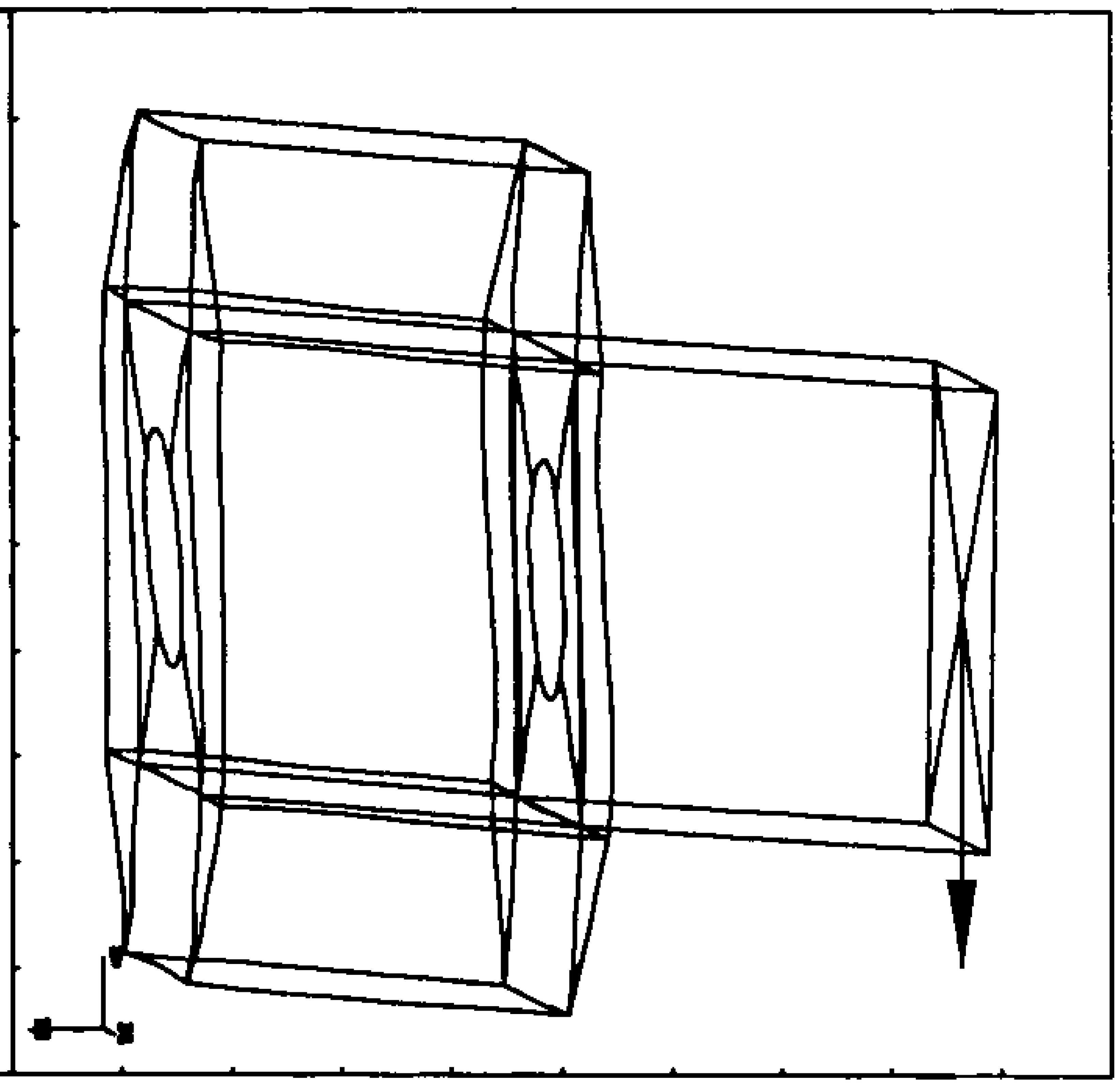

FIGURE 3)

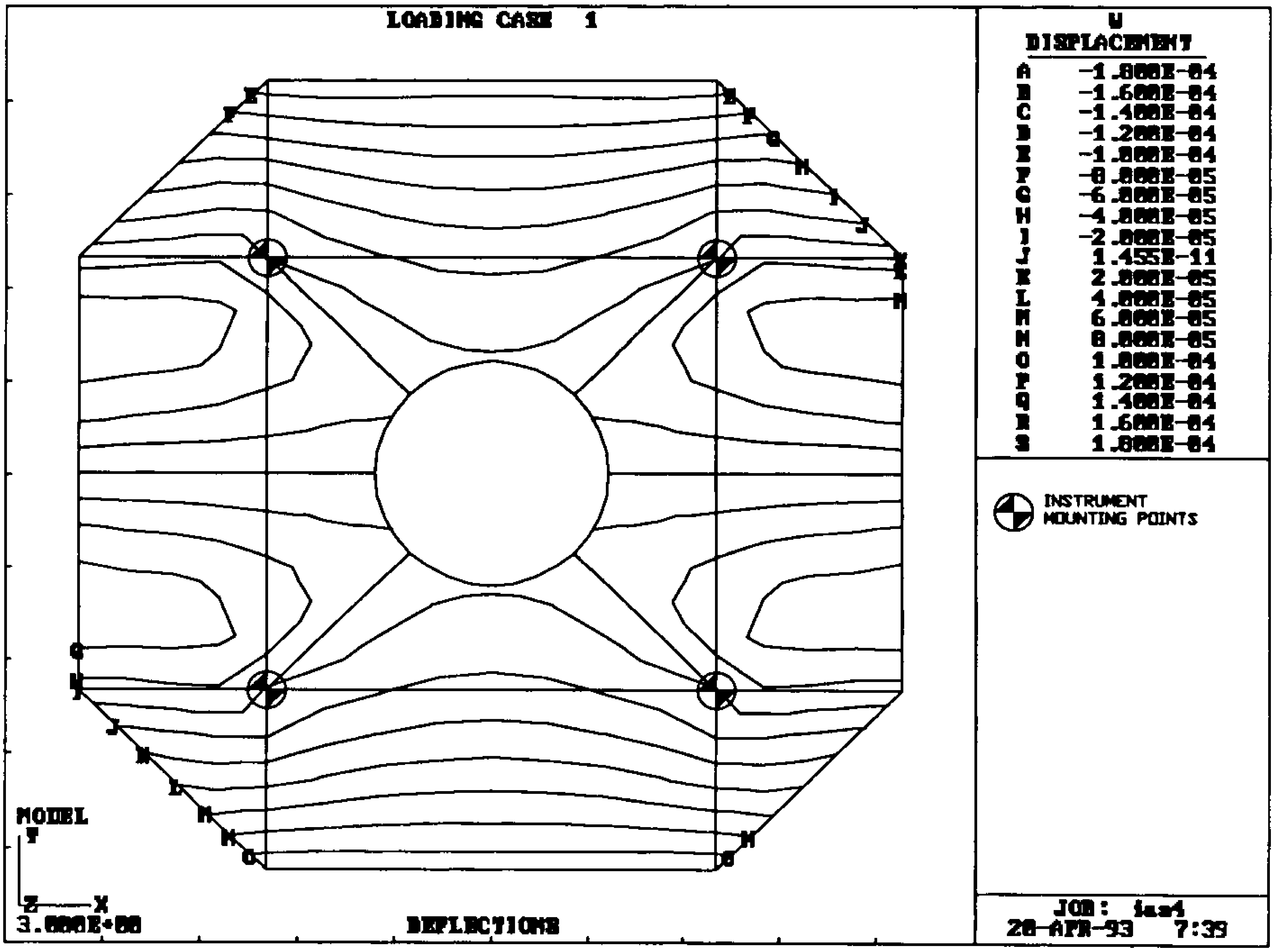

FIGURE 4)

CASE 2) GRAVITY LOAD WITH IAS CLOCKED 45°

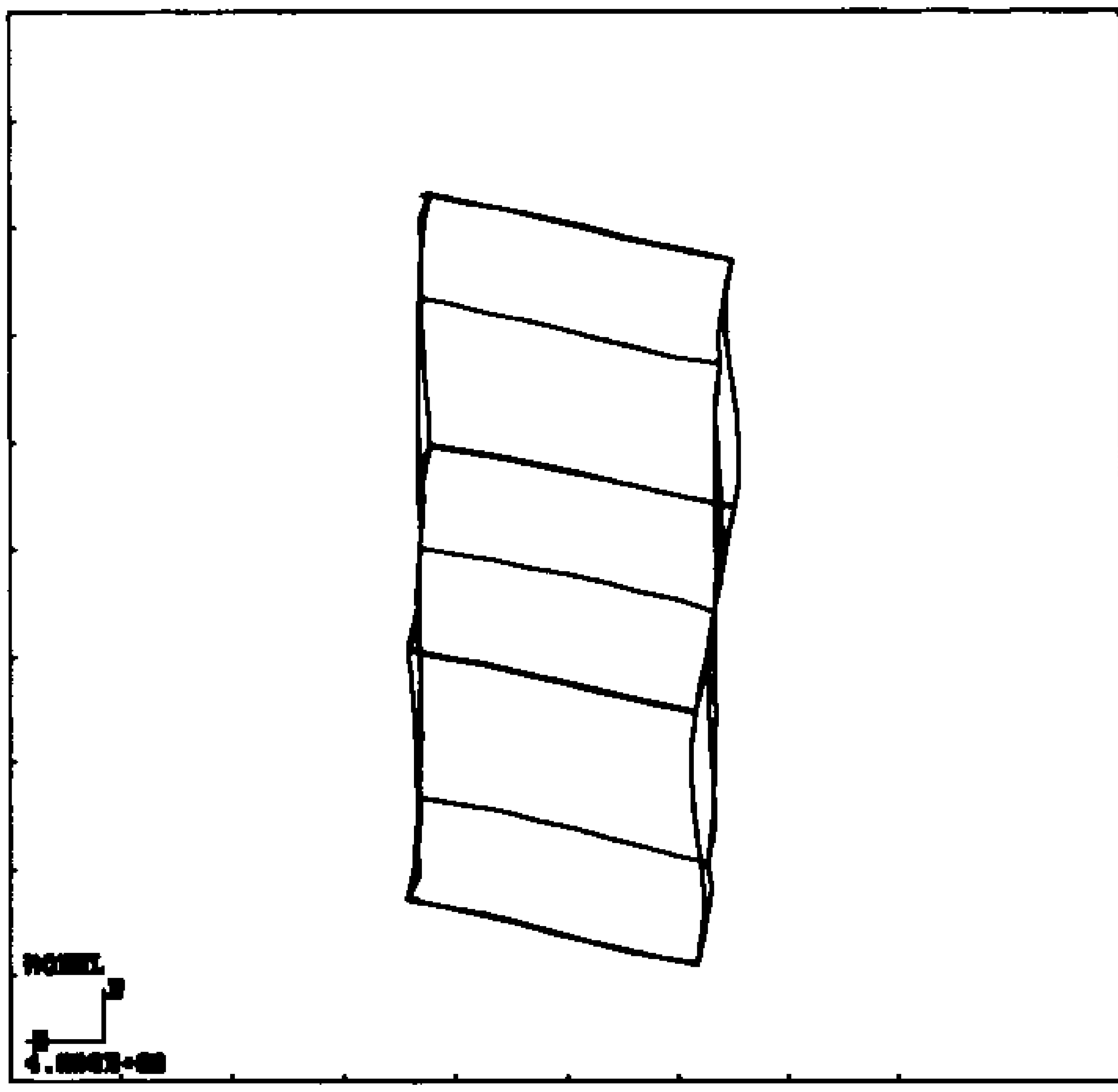

FIGURE 5)

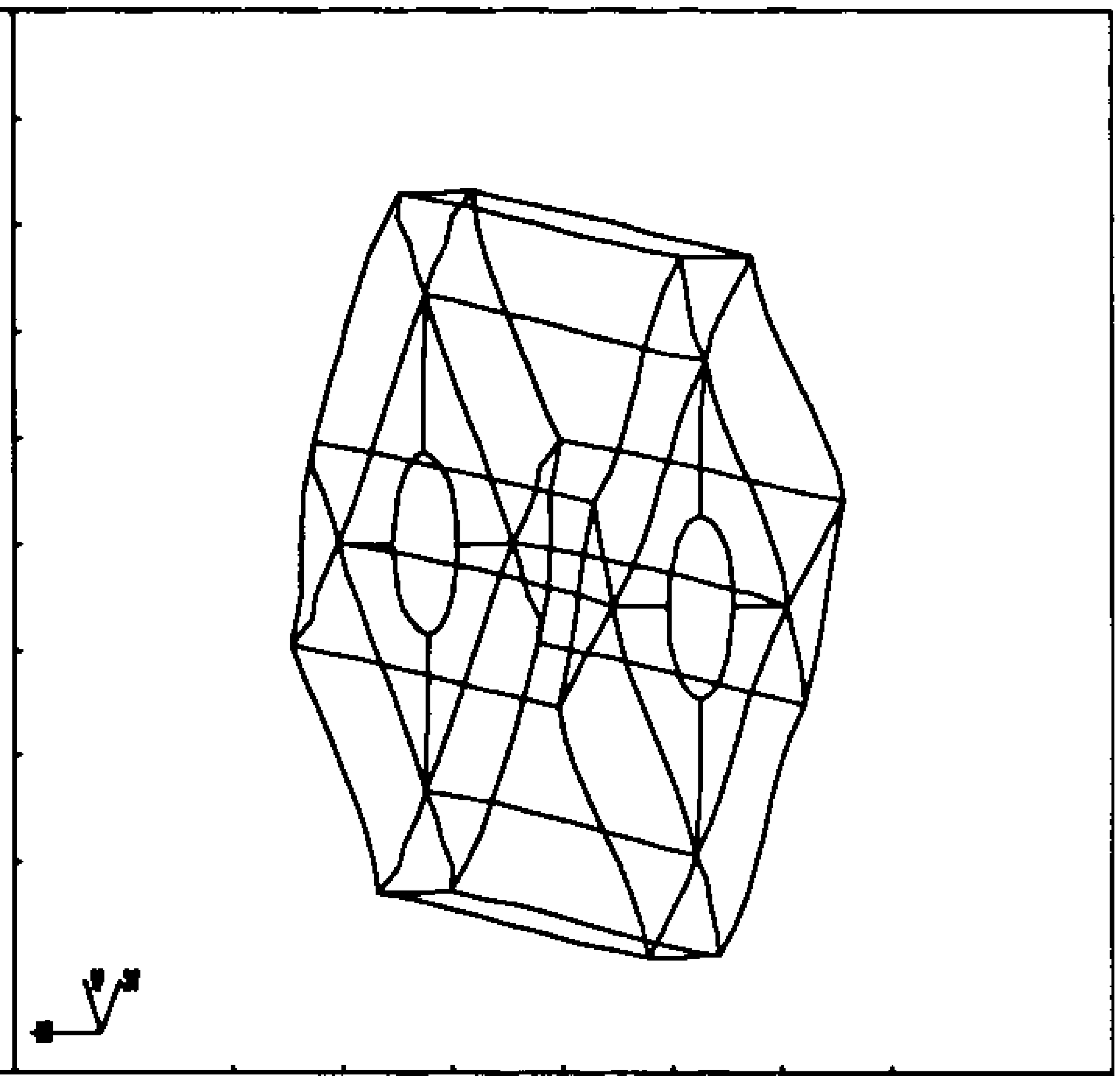

FIGURE 6)

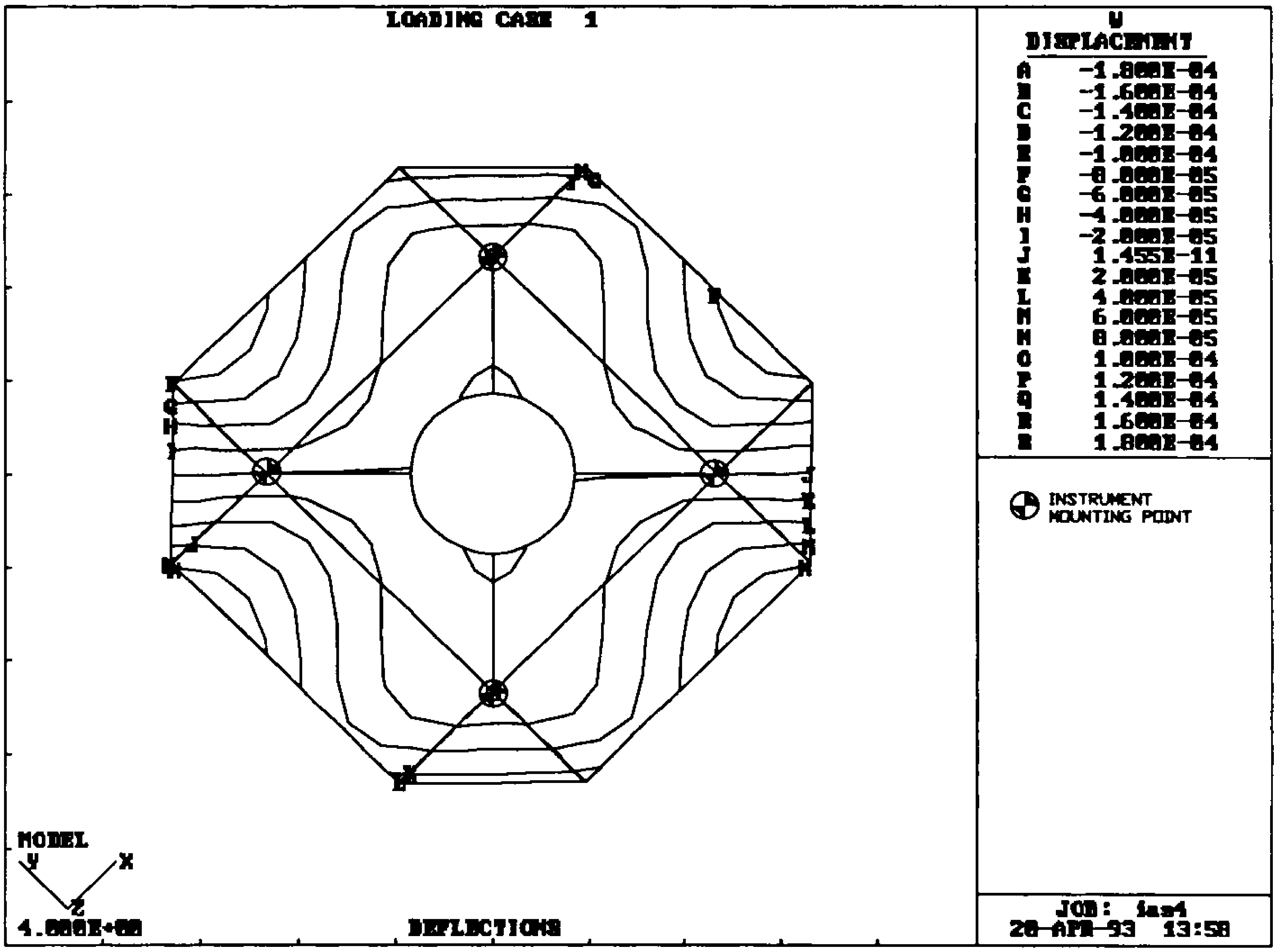

FIGURE 7)

CASE 3) IMPROPER INSTRUMENT MOUNTING POINTS

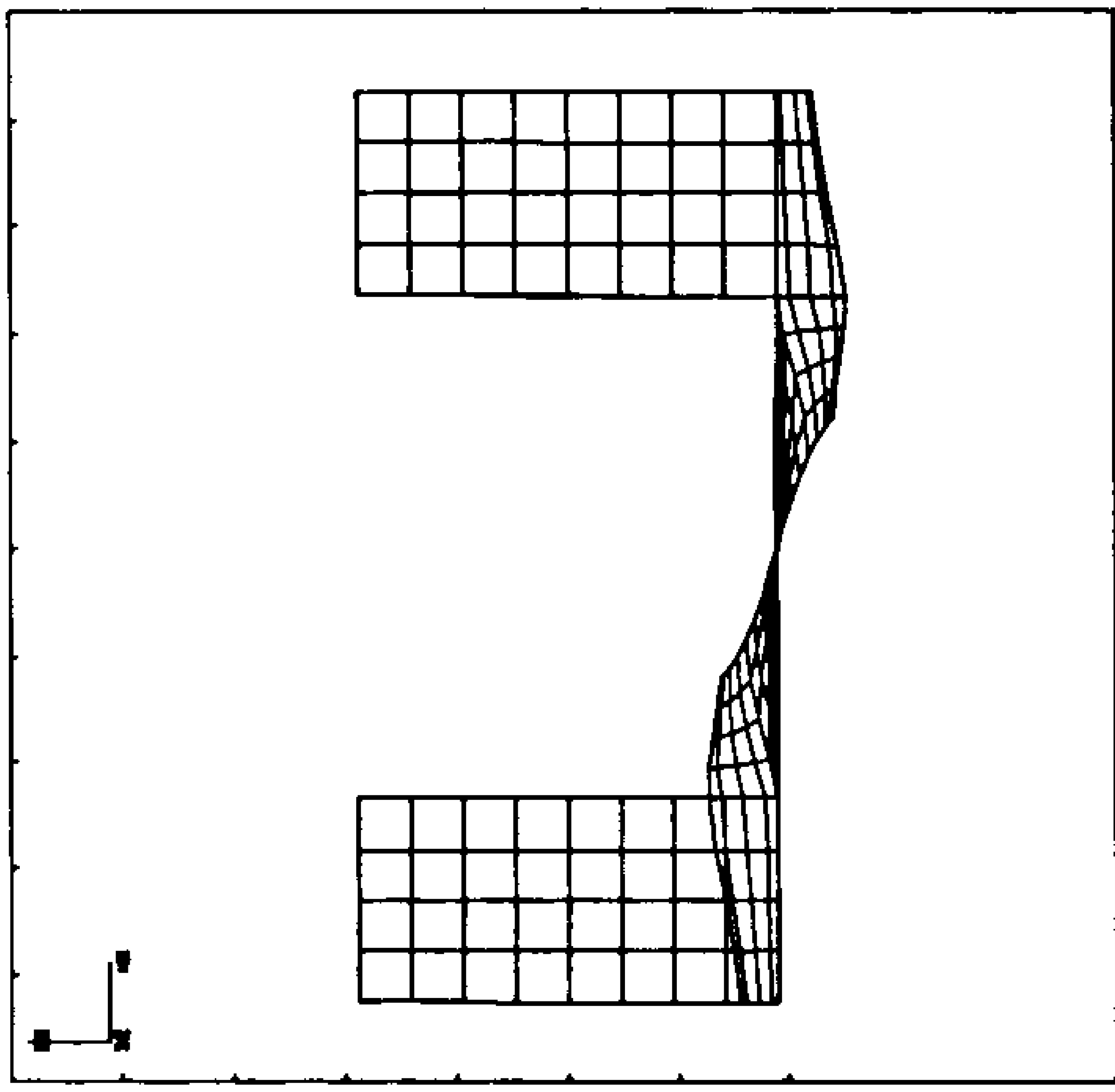

FIGURE 8)

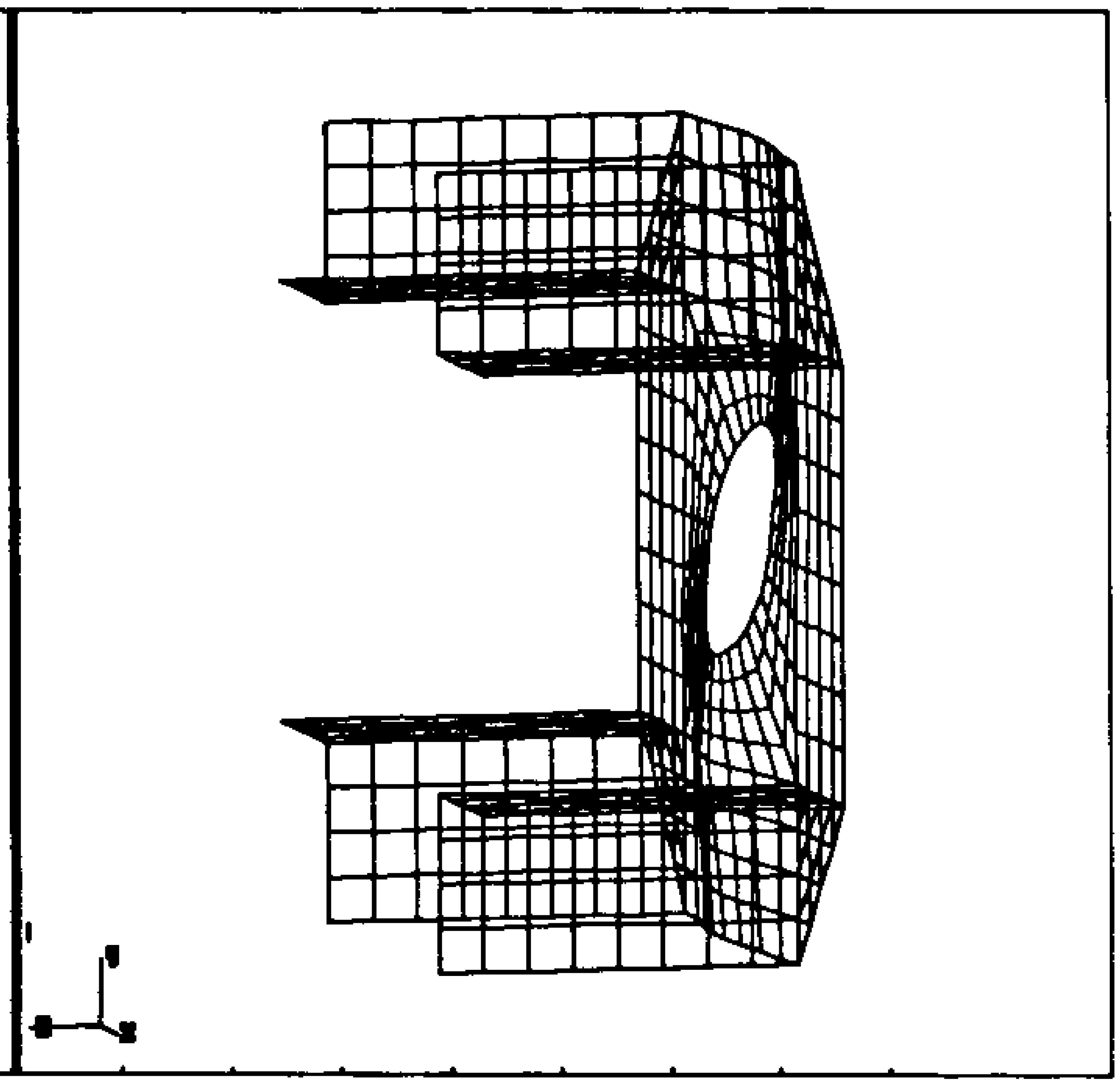

FIGURE 9)

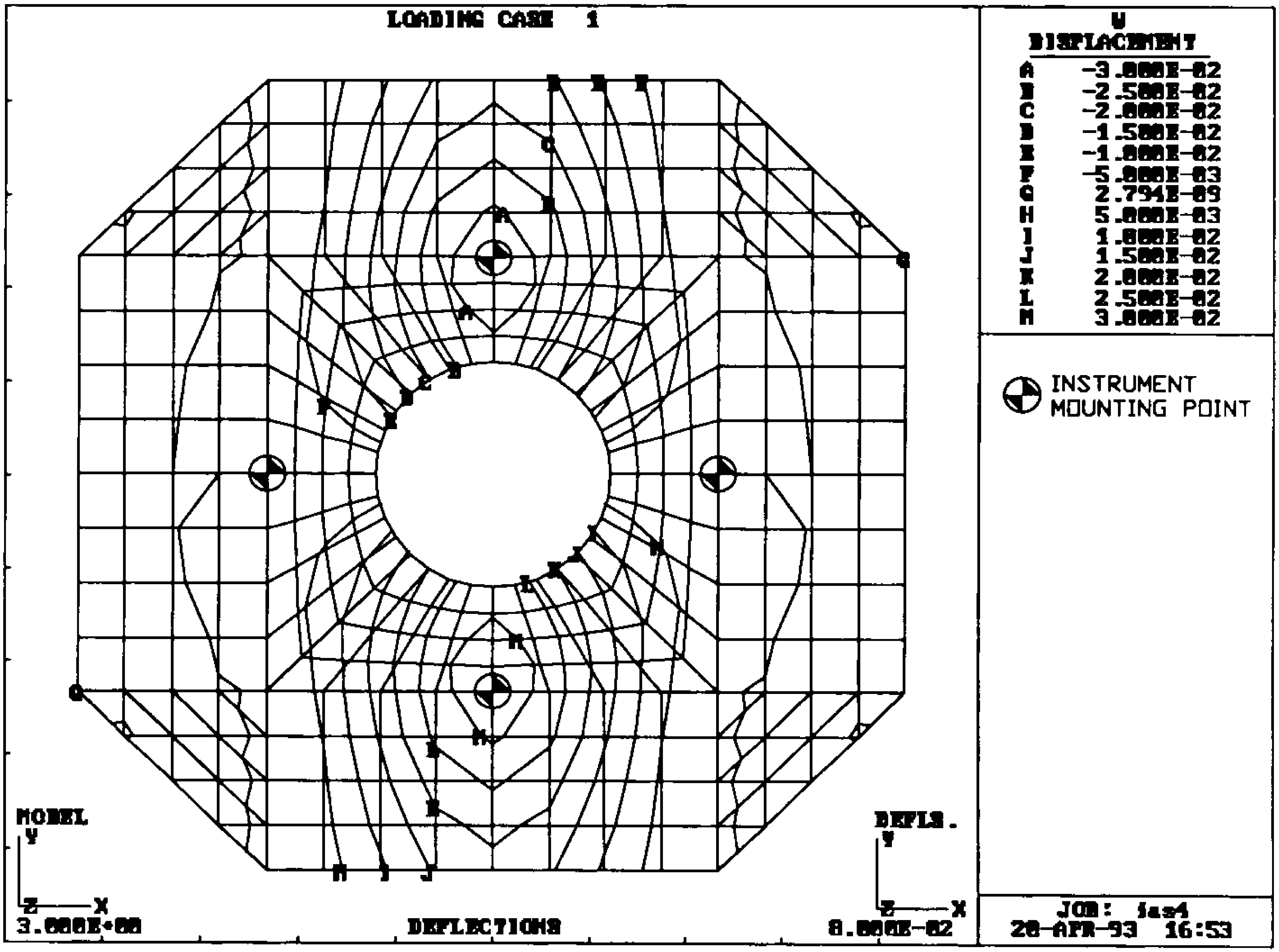

FIGURE 10)