CHARA TECHNICAL REPORT

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Stress in the CHARA Primary Mirror Due to Lifting from the Central Hole

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1. INTRODUCTION

Using the model previously developed for analyzing supports for the CHARA primary mirror, a finite-element calculation was made to estimate the stress condition likely to occur if the mirror is lifted by a device acting at the central hole.

In the model, Points 3 and 4 are located at the inner rim and were chosen to represent an extreme case since the actual support will probably act at points further out from the central hole. Points 3 and 4 were restrained in the z-direction to simulate the effects of a lifting device while gravity acted in the z-direction downward.

The calculations show that maximum stress occurs at the element containing Point 4 (Element 39) and that stress in the element containing point 3 (Element 27) is almost as great. This is as expected. The calculated maximum stress is about 60 psi, well below critical stress levels for glass materials. Hence, lifting the mirror from the central hole should be safe assuming normal precautions are taken to avoid high contact stresses at the points where the lifting device contacts the glass.

Results extracted from the calculations for stress are given in the tables below. A contour plot of tensile stesses at the front mirror surface is shown in Figure 1.

TABLE 1.   Loading Case 1: Extreme Stress Values

Von Mises:	
Minimum Stress =	7.2301E−03% at element 1547
Maximum Stress =	7.4896E−01% at element 39
Tresca:	
Minimum Stress =	7.7850E−03% at element 1547
Maximum Stress =	8.6463E−01% at element 39

[1] Center for High Angular Resolution Astronomy, Georgia State University, Atlanta GA 30303-3083
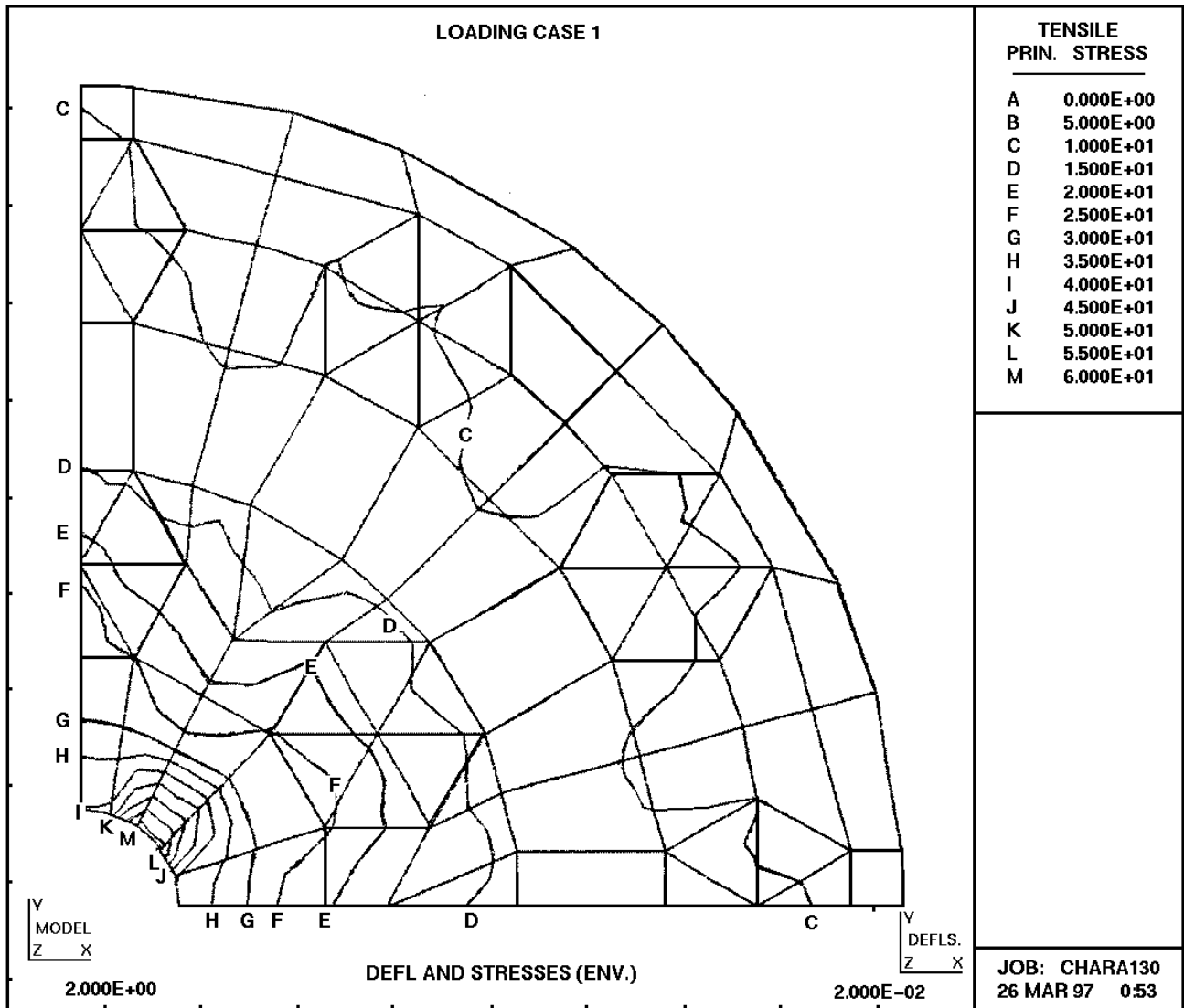Tel: (404) 651-2932, FAX: (404) 651-1389, Anonymous ftp: chara.gsu.edu, WWW: http://www.chara.gsu.edu

FIGURE 1. Tensile stesses at the front mirror surface.

TABLE 2.   Element Information at Restraint Points in Model

Elem No.	Sys No.	Type	Mat No.	Mat Ang	THS No.	Connectivity				
27	1347	SLD8	1		0	349	3	872	279	923
						449	1301	933		
39	1328	SLD8	1		0	351	4	874	280	929
						455	1303	939		

TABLE 3.   Stress at Elements Containing Restraint Points. Principal Stresses – Envelope

Ele No.	Str Pt.	Pos.	Stress	Direction Cosines		
27	1	S11	6.023E+01	7.385E−01	−4.229E−01	−5.252E−01
		S22	3.828E+01	2.237E−01	−5.811E−01	7.825E−01
		S33	−4.629E−01	−6.361E−01	−6.954E−01	−3.345E−01
		T_{max}	3.035E+01			
39	1	S11	6.249E+01	5.137E−01	−6.438E−01	−5.672E−01
		S22	3.239E+01	−4.686E−02	−6.811E−01	7.307E−01
		S33	6.098E−02	8.567E−01	3.488E−01	3.801E−01
		T_{max}	3.121E+01			