MULTIPLE MIRROR TELESCOPE OBSERVATORY

Smithsonian Astrophysical Observatory *and* Steward Observatory, University of Arizona

Reply to: MMT Observatory
University of Arizona
Tucson, Arizona 85721
(602) 621-1558

MMT Conversion Internal Technical Memorandum #91-1

Support and Thermal Analysis of the F/9 Secondary

Dan Blanco

October 23, 1990

Report on F/9 Secondary Study

Lester Cohen and Jim Carnevale

April 18, 1991

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To: MMT Conversion Committee
From: Dan Blanco
Date: October 23, 1990
Re: Support and thermal analysis of the f/9 secondary

Summary

An FEA model of the proposed Hextek secondary was used to examine several mounts and loading conditions. A vacuum system to suspend the mirror by air flotation will give the best axial support. Lateral support can be applied to a single point at the back plate with either three axial hardpoints or three axial whiffle trees.

Introduction

This memo records some finite element analyses of a 40" diameter lightweight mirror blank of Schott Tempax borosilicate glass made by the gas fusion technique. The proposed mirror blank will consist of 1/2" thick front and back plates and a honeycomb structure of 1/4" thick ribs. Overall, the blank will be 6" thick for an aspect ratio of 6.67. This blank will be slumped to provide a convex surface of 110" curvature suitable for generating and optical polishing. The construction is shown in Figure 1.

One purpose of these analyses was to determine whether to purchase a blank with a central mounting boss at the mirror CG. This would be an 8" diameter, 1/2" thick plate fused into a plane between the front and back plates at the CG plane of the final slumped blank (shown in Figure 1). Several groups have proposed mounting lightweight mirrors similar to this one with a single CG point mounting boss for lateral support, three axial defining points, and axial support provided by drawing a vacuum on the back of the mirror. Since the entire blank weighs about 150 lbs and has 1256 square inches of frontal area, it requires only about 0.12 psi vacuum to suspend the mirror at zenith pointing.

The effect of a vacuum support is to dimple the top plate at the center of each cell, similar to quilting caused during polishing by the pressure of the lap. Unfortunately this model is too coarse to predict the optical performance of the mirror under this kind of loading, but a hand calculation based on the 1/2" thick faceplate and 2.56" cell spacing indicates the quilting under 0.12 psi should constitute only about 1.0 nm rms wavefront error.

The Model

Rich Wortley of Hextek Corporation sent me an Autocad file containing a drawing of the proposed blank. Starting with this I converted the drawing into a CAD neutral file—basically an ASCII list of the endpoints of all the lines in the original drawing. This file had to be sorted to eliminate duplicate end points and to arrange the nodes into a pattern with a logical numbering sequence. The resulting pattern of 185 nodes is shown in Figure 2.