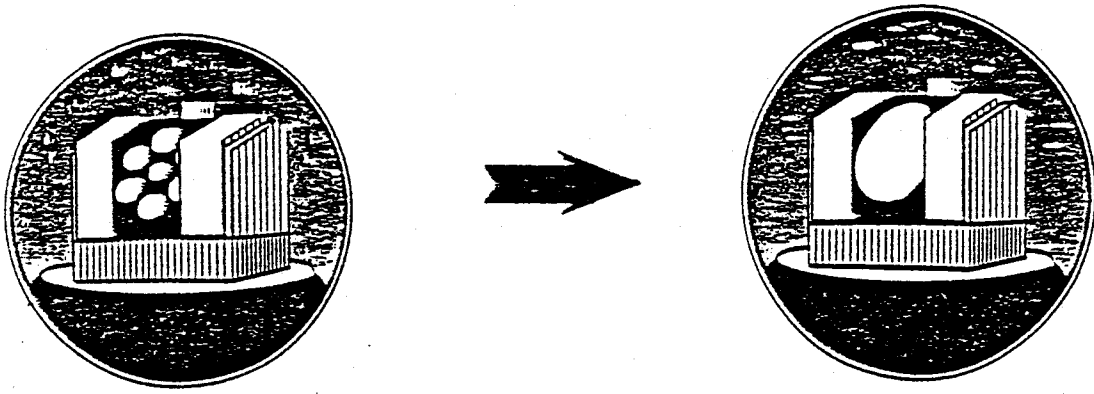


6.5 METER TELESCOPE



MMT Conversion Technical Memorandum #92-3

Fatigue Limits of a 2.2m Stressed Lap Baseplate
on the MMT and Columbus Mirrors

S.C. West & W.B. Davison

February 14, 1992

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1.0 Abstract

This report briefly investigates the fatigue strengths of aluminum alloys relative to the expected alternating stress encountered during polishing, and estimates the statistical likelihood of baseplate failure. The stresses are calculated using the GIFTS finite element program. The stress model is independent of the method used to bend the plate because the deflections are input directly onto the nodes of the model. Both the central and azimuthal variation of the peripheral stresses are evaluated. A subsequent refinement of the model will be required in order to include localized stresses due to the actuators or the effects of weight relieving the plate. Finally we will recommend which alloys will be appropriate for a 2m+ baseplate and what conditions should be followed during manufacturing. The results show that a 7075-T6 baseplate is expected to survive at least 5-10 mirrors.

2.0 Lap Geometry

The calculations are for a 2.2m x 4i thick lap baseplate moving on the Columbus 8.4m f/1.14 and MMT 6.5m f/1.25 mirrors. A 2.2m diameter lap was chosen because it is the largest piece of 7075-T6 x 4i aluminum that can be made at the foundries (a 2.5m 4i or 6i thick piece of 6061-T6 can be purchased, but the fatigue strength of 6061 is half that of 7075).

Plate deflections are calculated with a modified version of B. Martin's `zdcalc()` which is altered to include (not subtract) the preload deflections¹. In this way, the absolute plate stresses are calculated in GIFTS directly. The preload radius is estimated to be 120m giving 5.4mm of edge sag. This is twice the expected deflection of the lap from the reference shape for either mirror. In order to minimize the plate stress, one would like to adjust

1. The preload is the curve of the lap when it is centered over the vertex of the mirror. All other lap shapes are defined relative to this reference. The reference shape has power because at all other locations on the mirror, the lap has less curvature.