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THE COMPENSATING TEST SYSTEM OF HIGH ORDER ASPHERIC PLATE

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I. THE COMPENSATING SYSTEM DESIGN

In this paper, four compensating test systems for two kinds of high order aspheric plates are proposed. One kind of aspheric plates is used for field corrector of a 1m R-C system with $1.5^d eg$ field of view (FOV), this corrector consists of two high order aspheric plastes (P1, P2) and one field lens (L). Another is the 1.5m correction plate of a achromatic Schmidt telescope with FOV of $2W = 6^d eg$, the achromatic Schmidt correction plates consists of two aspheric plates (AP1, AP2) One surface (M_a) of plate AP1 is the spheric with small curvature, the other (M_b) is the aspheric. As for plate AP2, the two surfaces ($M_c M_d$) are the aspheric, surface M_c is cemented with M_b , the surface M_d is regarded as a spheric surface during testing surface M_c . Finally, the surface M_c can be tested with telescope system.

The fifth order spheric aberration is applied to solving the initial structure of compensator. The initial structure of the compensator is in correspondence with the optimal result very well.

The general form of the aspherci surface is

$$Z = \frac{c_0 y^2}{1+\sqrt{1-c_0^2(1-e^2)y^2}} + a_1 y^2 + a_2 y^4 + a_3 y^6 + a_4 y^8 + \cdots \quad (1)$$

In this equation, c_0 is the vertex curvature, e is ellipticity, $a_i (i = 1, 2 \cdots)$ are the aspheric coefficients.

(a) The Testing Systems for Plate P1 and P2

The structures of optical testing systems for P1 and P2 are displayed in table 2 and table 3. The peak to valley value of residual errors of the tested surfaces are $\Delta W_1 = \lambda/102$ and $\Delta W_2 = \lambda/218$. ($\lambda = 0.5893 \mu m$. The follows are all the same).

(b) The Testing Systems for Achromatic Schmidt Plate AP1 and AP2

The structures of optical testing systems for AP1 and AP2 are displayed in table 5 and table 6. The residual errors of the tested surfaces are $\Delta W_4 = \lambda/112$.

II. ERRORS ANALYSIS

In the process of making compensating lenses, there are deviations between the actual values and the ideal values (e.g. the error of curvature, interval and index tec.), but this deviation can be compensated through adjusting the distances from point light source to compensating lens and from compensating lens to the tested element, therefore it is very important to measure the actual values of optical elements and mechanical elements carefully when the cimpensator is finished.

Table 1. The Parameters of Tested Surfaces of Plate P1 and P2 ($c_0 = 0, e^2 = 0$)

	P1	P2
a_1	-2.067×10^{-5}	9.205×10^{-6}
a_2	-5.185×10^{-10}	2.338×10^{-9}
a_3	2.701×10^{-15}	-1.101×10^{-15}
a_4	-8.865×10^{-20}	3.689×10^{-19}

Table 2. The Optimum Structure of Testing System for Plate P1 ($l_1 = -700$)

radius	d spacing	material	aperture
128.948	10	K9	Φ101
216.021	26.5		
-190.592	10	K9	Φ112
260.108	279		
infinity	5	K9	Φ248
aspheric	100		
-613.977		mirror	Φ288.2

Table 3. The Optimum Results of Testing System for Plate P2 ($l_1 = -381$)

radius	spacing	material	aperture
infinity	15	K9	Φ 101
-131.527	267.27		
94.453	6	K9	Φ 53.82
449.433	679.4		
infinity	5	K9	Φ 228.3
aspheric	83.03		
-613.977		mirror	Φ 257.87

Remarks:
1. "l_1" is the distance from point light source. to the first surface of compensating lens.
2. "Aspheric" is the tested surface.

Table 4. The Parameters of Tested Surfaces of Plate AP1 and AP2 ($e^2 = 0, a_1 = 0$)

	AP1	AP2
c_0	1.1088×10^{-5}	-1.1088×10^{-5}
l_2	-2.7908×10^{-12}	-7.2103×10^{-20}
l_3	2.7908×10^{-12}	7.2103×10^{-20}

Table 5. The Optimum Structure of Testing System for Plate AP1 ($l_1 = -810$)

radius	spacing	material	aperture
-251.9873	18 UBK7	Φ 184.5	
1747.185	20		
231.228	20 UBK7	Φ 213.2	
223.022	40		
-1245.468	22	UBK7	Φ 223.8
-320.386	180		
infinity	2970	mirror	540 × 380
-7500	-7500	mirror	Φ 1495
aspheric	-20	LLF6	Φ 1502
170022.6	-100		
infinity		mirror	Φ 1502

Table 6. The Optimum Structure of Testing System for Plate AP2 ($l_1 = -560$)

radius	spacing	material	aperture
infinity	15	UBK7	Φ 140.0
-206.7682	25		
infinity	15	UBK7	Φ 133.1
-448.5713	10		
556.1331	15	UBK7	Φ 128.0
infinity	800		
infinity	3232	mirror	354 × 250
-7500	-7500	mirror	Φ 1496
aspheric	-30	UBK7	Φ 1502
-275661	-100		
infinity		mirror	Φ 1502

The decentring and tilting errors of the lenses can not be adjusted cimpletely, so we must control the toerance range of lenses' decentring and tilting as small as possible during making and assembly compensating lenses. After calculation the four testing systems are feasible.

REFERENCES

Yi Mei-liang, 1982, Astronomy Journal (China), 23, 398

Su Ding-qiang, Optical Instruments Technique (China), 1984, 4