CHAPTER V

RESULTS

In this chapter the stress concentration factor of a specified slit is experimentally obtained as shown in Table 5-1 and on the graphs in Fig. 5-1 to Fig. 5-6.

Table 5-1 : Stress Concentration Factors (K_F) of Slits

Specimen no.	β degree	c/r	K_F
1	30	8	4.25
2	45	8	4.48
3	60	8	4.75
4	75	8	5.10
5	90	8	5.25
6	30	12	4.70
7	45	12	5.02
8	60	12	5.50
9	75	12	6.00
10	90	12	6.18
11	30	16	5.15
12	45	16	5.55
13	60	16	6.20

Table 5-1 : (continued)

Specimen no.	β degree	c/r	K_F
14	75	16	6.80
15	90	16	7.10
16	30	20	5.55
17	45	20	6.05
18	60	20	6.85
19	75	20	7.60
20	90	20	7.95
21	30	24	5.95
22	45	24	6.55
23	60	24	7.45
24	75	24	8.25
25	90	24	8.65
26	30	16	5.08
27	45	16	5.57
28	60	16	6.49
29	75	16	7.14
30	90	16	7.45
31	45	16	5.52
32	60	16	6.43
33	75	16	7.05
34	90	16	7.48

In Fig. 5-1 the variations of stress concentration factors are plotted against the ratio of c/r while the angle of inclination β is kept constant. The series of curves at β equal to 30°, 45°, 60°, 75° and 90° are obtained.

Consider the curve of β equal to 45° and refer to chapter III, eq. (33) gives an expression for stress concentration factor which is given by

$$K_F = k_1 + k_2 \cos 2\beta$$

$$K_F = k_1 \quad \text{at} \quad \beta = 45^\circ$$

k_1 is a function of c/r and can be determined by the experimental curve of stress concentration factor at β equal to 45°. By trial and error and comparing to those of eq. (32), the expression for k_1 is defined by

$$k_1 = \frac{2\left(\frac{c}{r}\right) + 12}{\sqrt{3\left(\frac{c}{r}\right) + 16}} \qquad (40)$$

The comparison of experimental stress concentration factors and those values which are calculated by eq. (40) is shown in Table 5-2.

Table 5-2 : Comparison of Experimental and Calculated Stress Concentration Factor at β equal to 45°

c/r	Stress Concentration Factors	
	Experimental	Calculated, eq. (40)
8	4.48	4.43
12	5.02	4.99
16	5.55	5.50
20	6.05	5.96
24	6.55	6.40

Fig. 5-2 shows the variations of the stress concentration factors with the angle of inclination β while the ratio of c/r is kept constant. This gives a set of curves at c/r equal to 8, 12, 16, 20 and 24. From the graph in Fig. 5-1 and Fig. 5-2, the expression for k_2 will be approximately given by

$$k_2 = -\frac{1}{12}\left(\frac{c}{r}\right) \tag{41}$$

Therefore, the expression for the stress concentration factor of a parallel - side slit is expressed by

$$K_F = \frac{2\left(\frac{c}{r}\right) + 12}{\sqrt{3\left(\frac{c}{r}\right) + 16}} - \frac{1}{12}\left(\frac{c}{r}\right)\cos 2\beta \tag{42}$$

However, this equation gives the values of calculated stress concentration factor slightly different from those values obtained by the experiment. These difference in stress concentration factors are compared below in Table 5-3.

Table 5-3 : Comparison of Experimental and Calculated Stress Concentration Factors at Different β

c/r	Stress Concentration Factors									
	$\beta = 30°$		$\beta = 45°$		$\beta = 60°$		$\beta = 75°$		$\beta = 90°$	
	Exptl.	Eq. (42)	Exptl.	Eq. (42)	Exptl.	Eq. (42)	Exptl.	Eq. (42)	Exptl.	Eq. (42)
8	4.25	4.09	4.48	4.43	4.75	4.76	5.10	5.00	5.25	5.09
12	4.70	4.49	5.02	4.99	5.50	5.49	6.00	5.86	6.18	5.99
16	5.15	4.83	5.55	5.50	6.20	6.17	6.80	6.65	7.10	6.88
20	5.55	5.13	6.05	5.96	6.85	6.80	7.60	7.41	7.95	7.63
24	5.95	5.40	6.55	6.40	7.45	7.40	8.25	8.13	8.65	8.40

Column "Exptl." means stress concentration factors obtained from the experiment whereas the column "Eq. (42)" means stress concentration factors calculated by eq. (42).

In Fig. 5-3 the stress concentration factors of the slits of type I and type II are plotted against the angle of inclination β at the ratio of c/r equal to 16.

Three slits having the sizes indicated as follow:

(a) the parallel - side slit with semi - circular ends, type I, with semi - focal length = 12.0 mm, radius of curvature of its ends = 0.75 mm, and its width = 1.5 mm.

(b) the parallel - side slit with semi - circular ends, type I, with semi - focal length = 8.0 mm, radius of curvature of its ends = 0.5 mm, and its width = 1.0 mm.

(c) the narrow slit with circular ends, type II, with semi - focal length = 12.0 mm, radius of curvature of its ends = 0.75 mm, and its width = 0.35 mm.

Their experiment values of stress concentration factors are compared as shown in Table 5-4.

Table 5-4 : Comparison of Stress Concentration Factors of Slits (a), (b), and (c) at c/r equal to 16.

	Experimental Stress Concentration Factors				
	β = 30°	β = 45°	β = 60°	β = 75°	β = 90°
Slit (a)	5.08	5.57	6.49	7.14	7.45
Slit (b)	5.15	5.55	6.20	6.80	7.10
Slit (c)	-	5.52	6.43	7.05	7.48

Fig. 5-4 shows the comparison of the experimental stress concentration factors and those values which are calculated by eq. (32); the equation of stress concentration factor at the ends of an elliptic hole having the same radius of curvature and the same focal length.

In Fig. 5-5, the stress concentration factors of a parallel - side slit with semi - circular ends are plotted against the ratio of c/r when its axis is perpendicular to the direction of the external uniformly distributed load. This figure is aimed to compare this curve to the curve of previous studies as shown. The works previously studied are:

- the curve as shown in Fig. 1-1 which is presented by Cox.
- the result of stress concentration factor of the rectangular hole considered where $a' = r$ as shown in Fig. 1-2.
- the stress concentration factor of a transverse elliptic hole, which is defined by eq. (29). This curve shown in Fig. 3-2.

The graph shown in Fig. 5-6 are the stress concentration factor curves compared between the result from the experiment and the result calculated by eq. (42). The last picture in Fig. 5-7 is the drawing representing the location of the point where maximum stress occurs at the edge of a specified slit. This point is observed in the polariscope and shown in the picture of isochromatic patterns in Fig. A 8 to Fig. A 41. The Fig. A 8 to Fig. A 41 are also the pictures of stress distribution shown in terms of isochromatic lines.

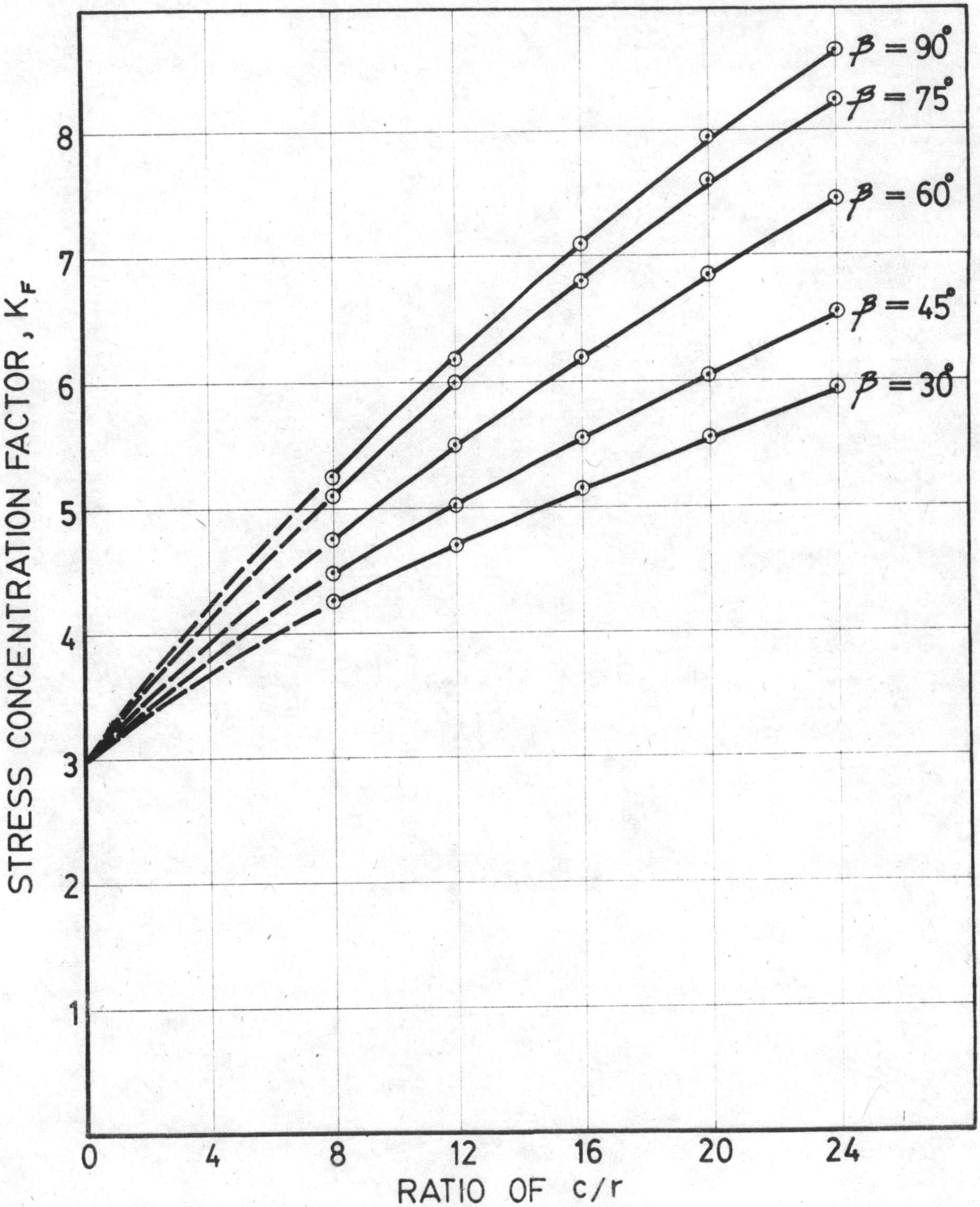

FIG. 5–1 STRESS CONCENTRATION FACTOR OF A PARALLEL-SIDE SLIT PLOTTED AGAINST c/r AT CONSTANT ANGLE OF INCLINATION β

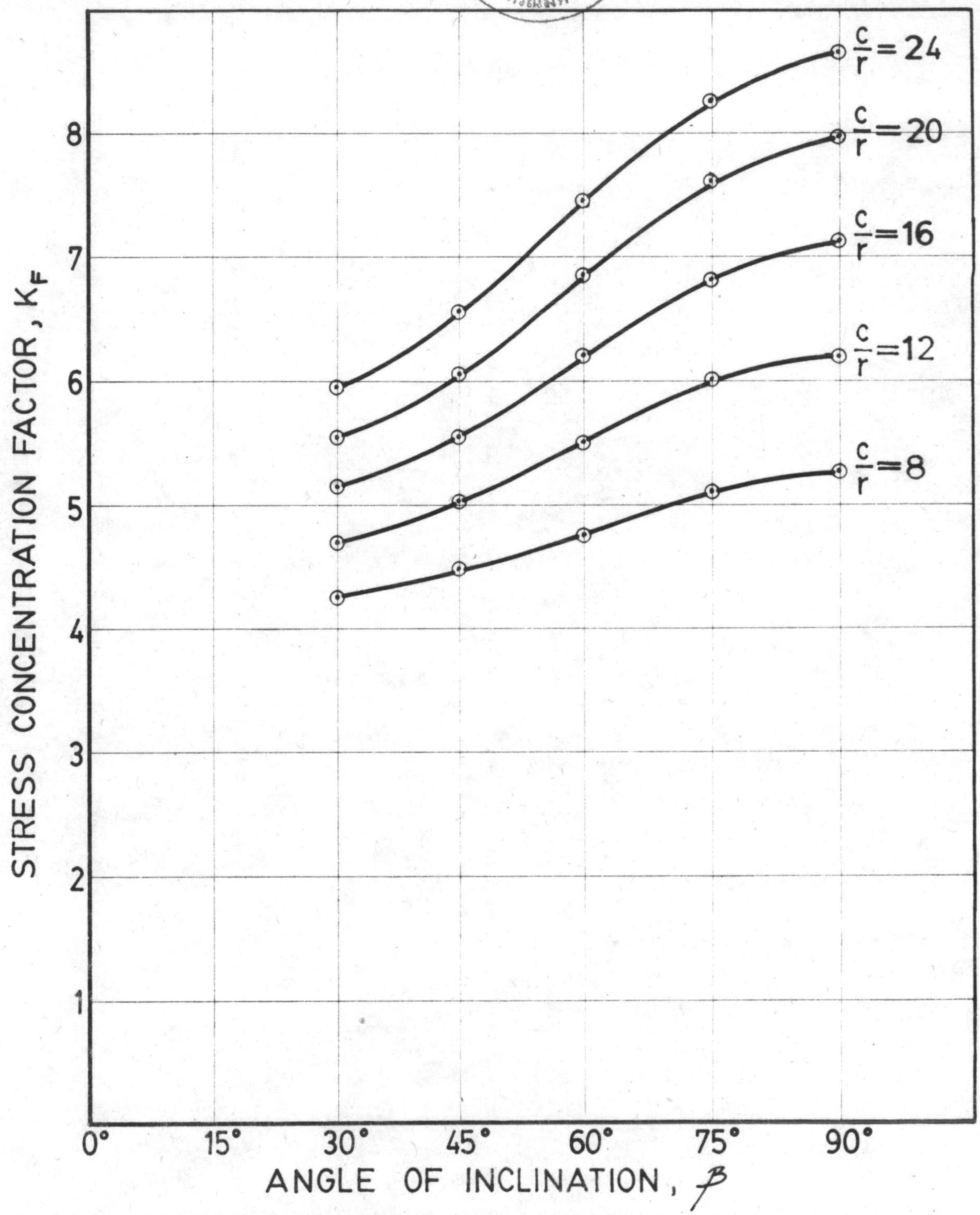

FIG. 5–2 STRESS CONCENTRATION FACTOR OF A PARALLEL–SIDE SLIT PLOTTED AGAINST ANGLE OF INCLINATION β AT CONSTANT c/r

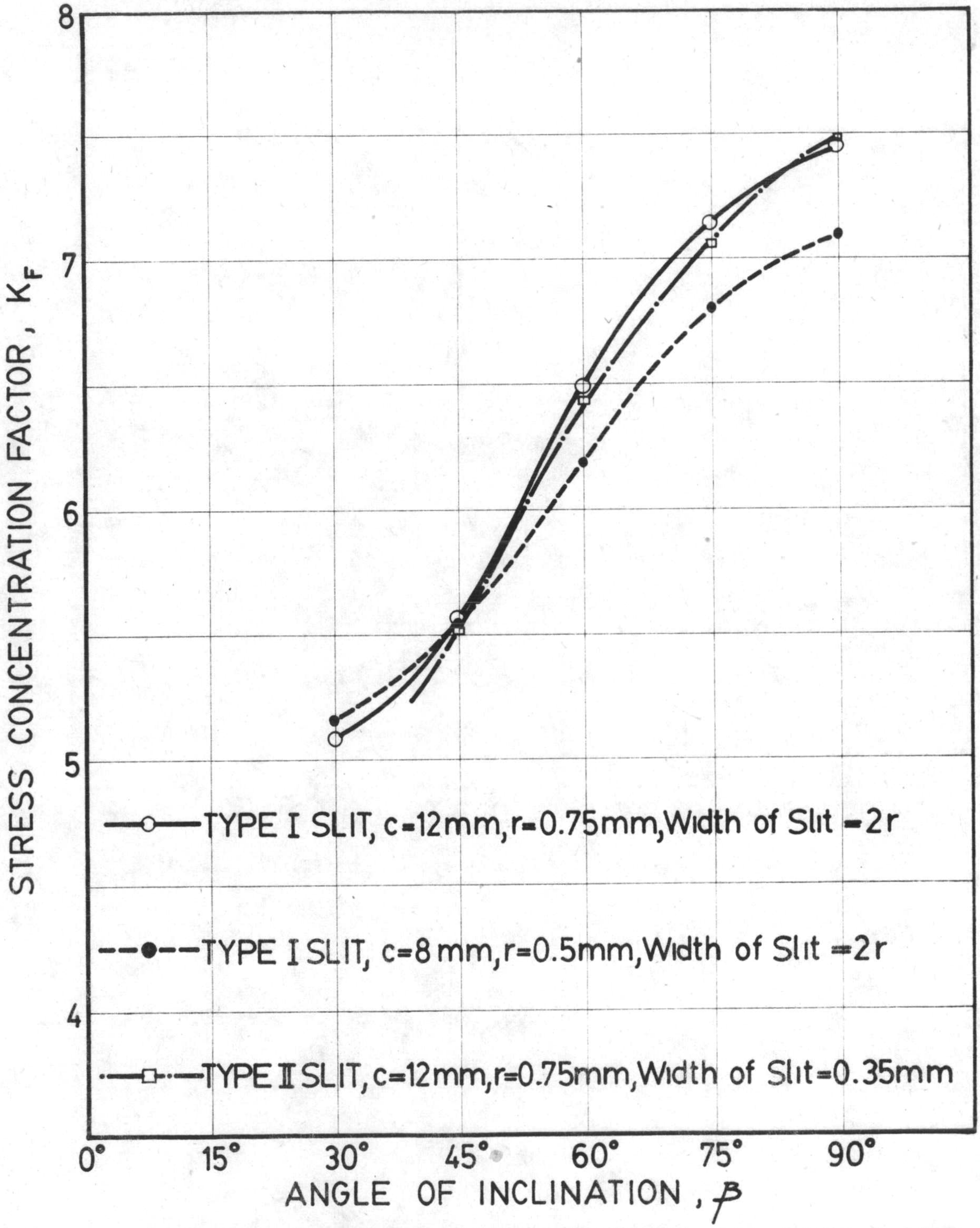

FIG. 5–3 STRESS CONCENTRATION FACTORS OF TYPE I AND TYPE II SLITS PLOTTED AGAINST ANGLE OF INCLINATION AT $\frac{c}{r} = 16$

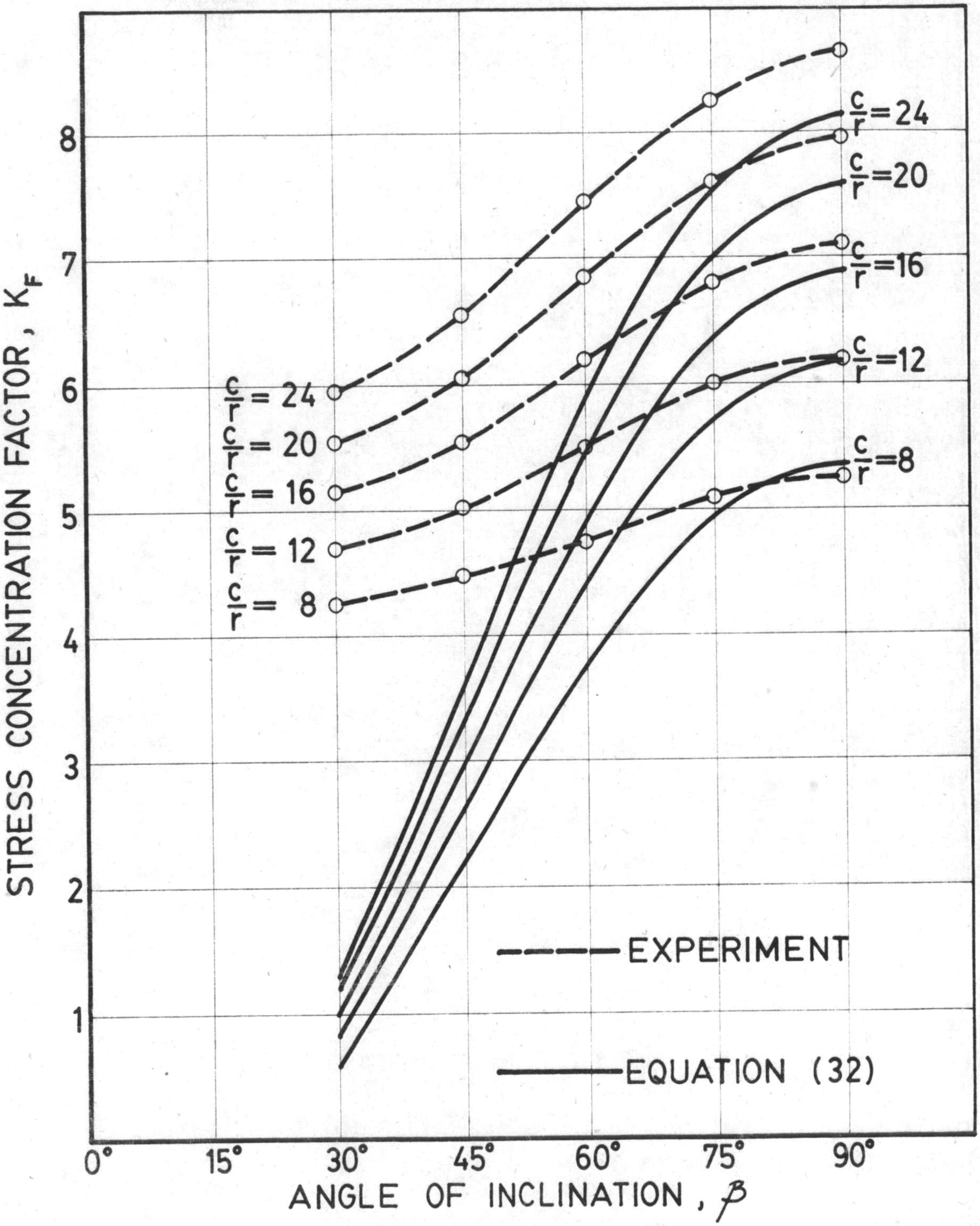

FIG. 5–4 STRESS CONCENTRATION FACTOR PLOTTED AGAINST ANGLE OF INCLINATION AT CONSTANT c/r

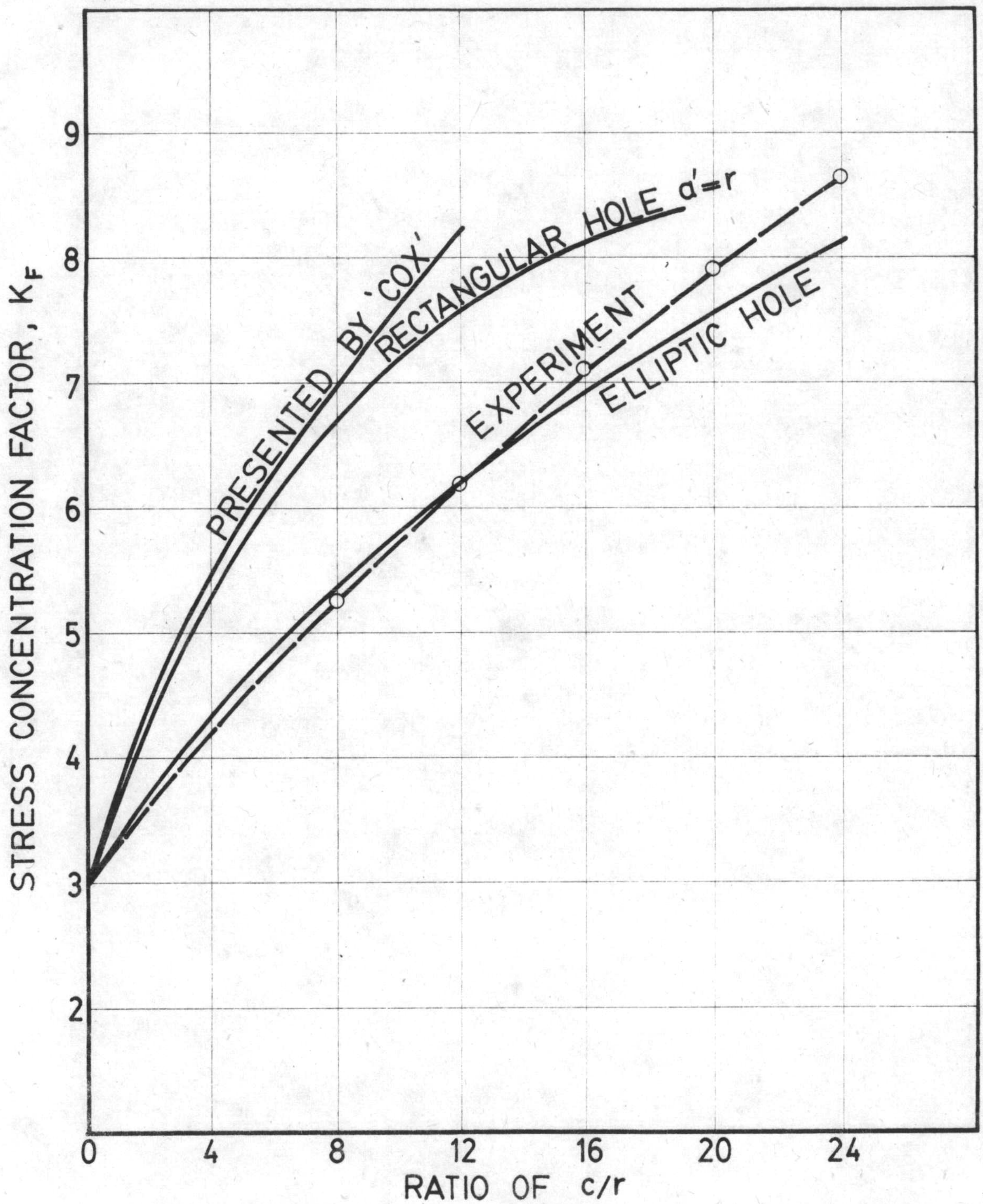

FIG. 5—5 COMPARISON BETWEEN THE RESULT OF PREVIOUS STUDIES AND THE RESULT FROM THE EXPERIMENT AT ANGLE OF INCLINATION $\beta = 90^\circ$

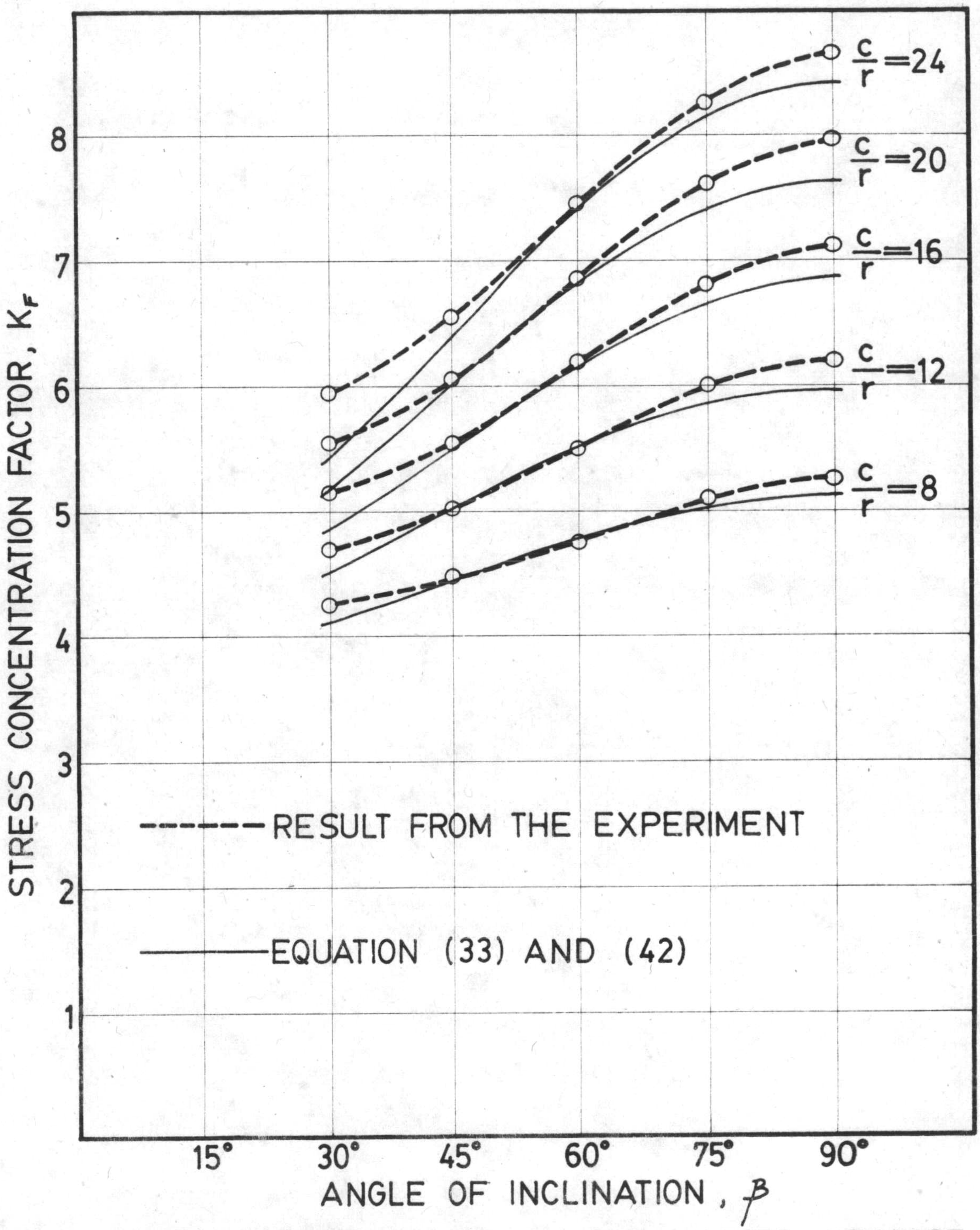

FIG. 5–6 STRESS CONCENTRATION FACTOR PLOTTED AGAINST ANGLE OF INCLINATION AT CONSTANT c/r

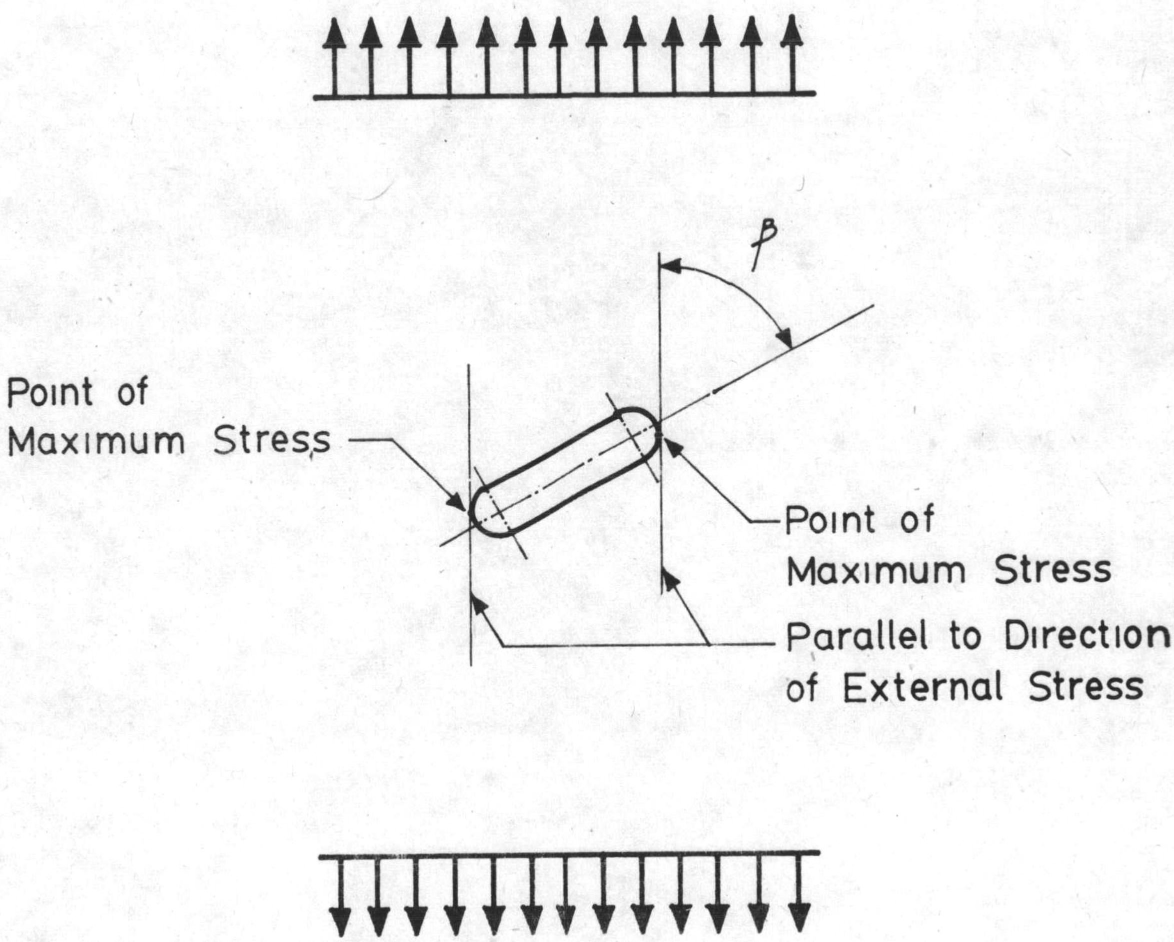

FIG. 5-7 SHOW POINT OF MAXIMUM STRESS