APPENDIX-B

STRESSES IN ELLIPTICAL SECTION

APPENDIX-B Contains the derivation of the equation for the length of the major axis of an elliptical section in the te rm of shear span "a" and effective depth "d" of the beams.

Figures (B-1) and (B-2) as well as Table no. B-1 and B-2 are given in this appendix are taken from (12) keeping original notations of the references.

Refering to the Fig.B, the equation of the line AB and CD which are tengential to the ellipse. (127)

$$\frac{X^2}{A_0^2} + \frac{Y^2}{B_0^2} = 1 \qquad \text{...... (B.1)}$$

may easily obtained as

$$Y = \frac{d}{a} + \frac{d}{2a} \cdot \sqrt{a^2 + d^2} \qquad \text{.....(B.2)}$$

and $$Y = \frac{d}{a} - \frac{d}{2a} \cdot \sqrt{a^2 + d^2} \qquad \text{..... (B.3)}$$

respectively.

It is well known that the lines

$$Y = mx \pm \sqrt{A_0^2 \cdot m^2 + B_0^2} \qquad \text{.....(B.4)}$$

are always tengent to the ellipse given by (B.1). Hence comparing Eq. (B.4) with Eqns.(B.3) and (B.2) one gets

$$\frac{d^2}{4a^2}(a^2 + d^2) = A_0^2\left(\frac{d^2}{a^2}\right) + B_0^2 \qquad \text{.....(B.5)}$$

Substituting the value of B_0 from the relationship

$$B_0^2 = A_0^2(1 - e^2) \qquad \text{..... (B.6)}$$

Into Eq.(B.5), yields

$$A_0^2 = \frac{\frac{d^2}{4 \cdot a^2}(a^2 + d^2)}{\left[\left(\frac{d}{a}\right)^2 + (1 - e^2)\right]} \qquad \text{...... (B.7)}$$

By taking the value of e close to one, it can be notice from the above expression that the ellipse tends to degenerate into an e lliptical strip, while the value of e close to zero tends the ellipse very near to a circle. Hence for moderate ellipses, assuming the value of e to be 0.5, takes the form

$$2A_0 = d\sqrt{\frac{\left(1+\frac{a^2}{d^2}\right)}{1+0.75\left(\frac{a^2}{d^2}\right)}} \qquad \text{..... (B.8)}$$

TABLE - B1

COMPARISON OF PRINCIPAL STRESSES AT THE ORIGINS OF ELLIPTICAL DISCS SUBJECTED TO POINT LOADS

Width/height ratio a/b	Tensile stress			Compressive stress		
	Numerical*	Photoelastic*	Present calculations	Numerical*	Photoelastic*	Present calculations
0.50	0.34	0.36	0.345	2.26	2.26	2.247
0.6667	0.51	0.54	0.51	1.95	1.95	2.00
0.75	---	---	0.574	---	---	1.934
0.90	---	---	0.626	---	---	1.913
1.00	0.64	---	0.632	1.89	---	1.912
1.10	---	---	0.627	---	---	1.911
1.25	---	---	0.608	---	---	1.907
1.50	0.58	---	0.574	1.89	---	1.894
1.75	---	---	0.549	---	---	1.881
2.00	0.53	---	0.532	1.87	---	1.872
3.00	---	---	0.502	---	---	1.854
4.00	---	---	0.490	---	---	1.848
	0.49	---	---	1.82	---	---

TABLE - B2

LOCATION AND MAGNITUDE OF VARIOUS LEVELS OF TENSILE STRESS ON THE Y AXIS OF ELLIPTICAL DISCS

Width/height a/b	Maximum tensile stress		95 per cent of maximum tensile stress		90 per cent of maximum tensile stress	
	Magnitude	Location	Magnitude	Location	Magnitude	Location
0.50	0.726	1.000	0.690	0.980	0.654	0.959
0.75	0.381	1.000	0.362	0.900	0.343	0.788
0.90	0.326	1.000	*	---	*	---
1.00	0.318		*	---	*	---
1.10	0.323	1.000	*	---	*	---
1.25	0.341	1.000	0.324	0.738	0.307	0.250
1.50	0.375	1.000	0.356	0.894	0.338	0.769
1.75	0.402	1.000	0.381	0.925	0.361	0.844
2.00	0.420	1.000	0.399	0.938	0.378	0.869
3.00	0.453	1.000	0.430	0.953	0.408	0.903
4.00	0.464	1.000	0.441	0.958	0.418	0.913

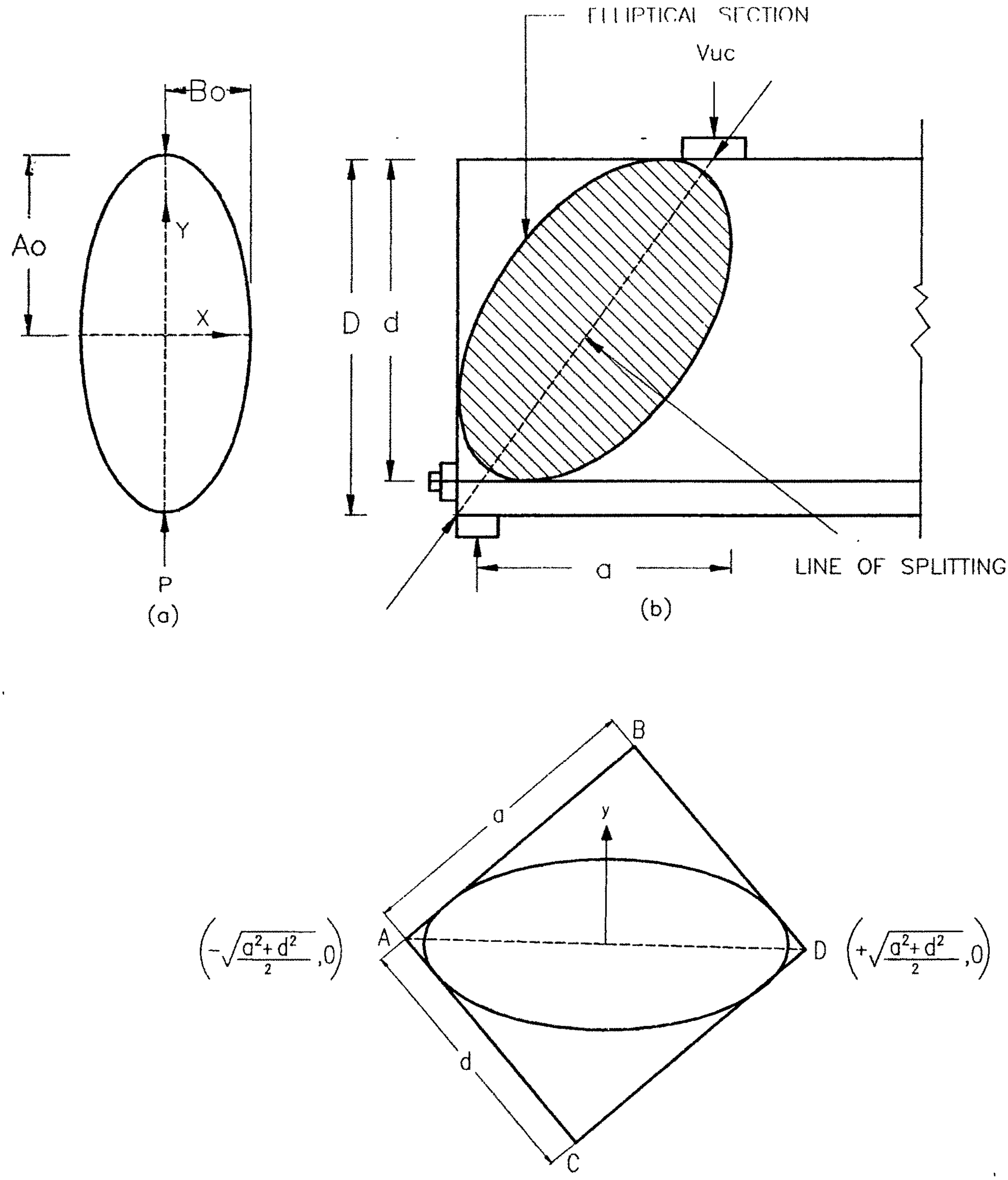

Fig. B ELLIPTICAL DISCS SUBJECTED TO COMPRESSIVE POINT LOAD

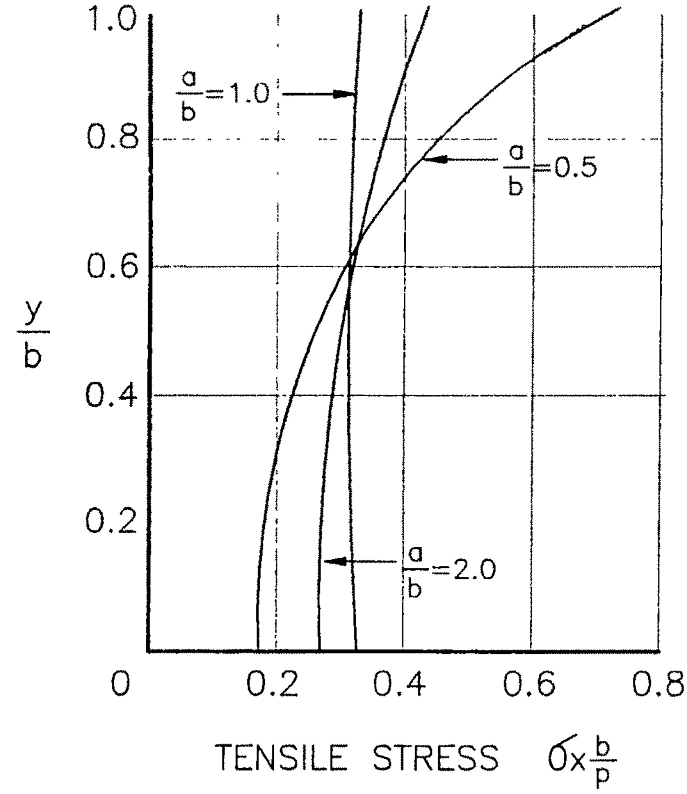

Fig. B1 (a) TENSILE STRESS DISTRIBUTION OF THE 'y' AXIS IN THREE ELLIPTICAL DISCS SUBJECTED TO DIAMETRICALLY OPPOSED COMPRESSIVE POINT LOADS.

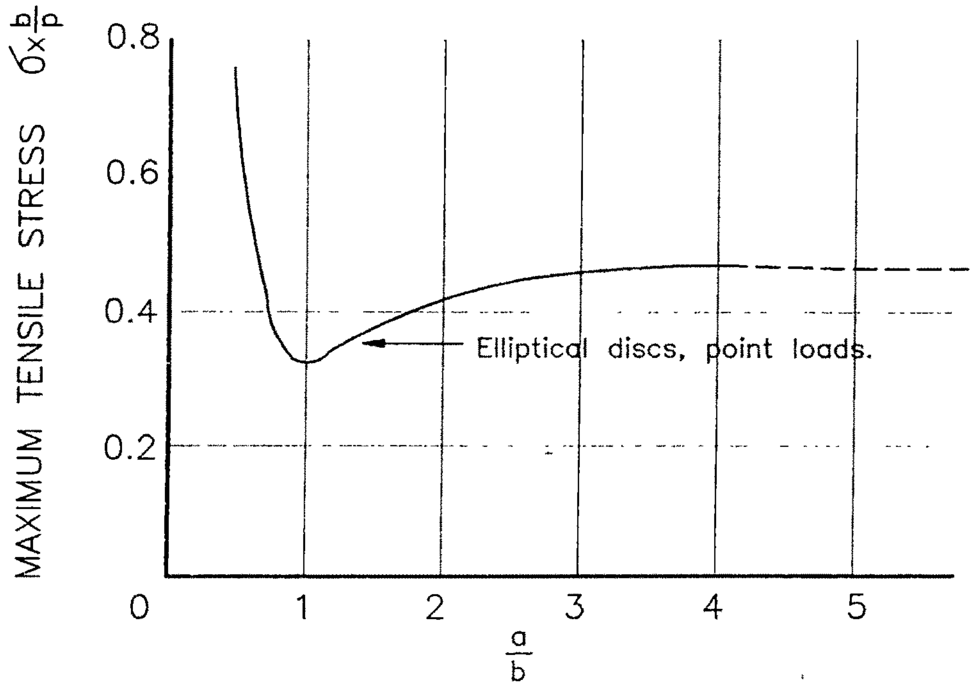

Fig. B1 (b) PARAMETRIC ANALAYSIS OF MAXIMUM TENSILE STRESS ON THE 'y' AXIS OF COMPRESSION MEMBERS.