APPENDIX A

Assuming that the loss of electrons takes place at one location. This implies that both $\beta_x$ and $\beta_z$ have maxima at this point, which is rarely the case for example, it can occur in weak focusing storage rings. Then we may substitute the following $x$ and $z$ in equation 2.9

$$x=\sqrt{\beta_x \beta_{xm}} \theta_m \cos \phi$$

$$z=\sqrt{\beta_z \beta_{zm}} \theta_m \sin \phi$$

A.1

we get

$$F_j = \frac{1}{2\pi} \int_{0}^{2\pi} \frac{d\phi}{\theta_m^2(\phi)} = \int_{0}^{2\pi} \beta_x(s_0) \beta_{xm} \cos^2 \phi + \beta_z(s_0) \beta_{zm} \sin^2 \phi \frac{d\phi}{x^2 + z^2}$$

A.2

At the location of electron loss, $x^2 + z^2 = \rho^2$ and $(\rho \cos \phi, \rho \sin \phi)$ are arbitrary coordinates of $P$. The coordinate $P(\rho \cos \phi, \rho \sin \phi)$ lies on ellipse $\frac{x^2}{a^2} + \frac{z^2}{b^2} = 1$, so using

$$\frac{1}{\rho^2} = \frac{\cos^2 \phi}{a^2} + \frac{\sin^2 \phi}{b^2}$$

in equation 2.3 we get

$$F_j = \frac{1}{2\pi} \int_{0}^{2\pi} \left[ \beta_x(s_0) \beta_{xm} \cos^2 \phi + \beta_z(s_0) \beta_{zm} \sin^2 \phi \right] \left[ \frac{\cos^2 \phi}{a^2} + \frac{\sin^2 \phi}{b^2} \right] d\phi$$

A.3

After integration, we get similar relation 2.24

$$F_j = \pi \left[ \frac{\beta_x(s_0) \beta_{xm}}{a^2} + \frac{\beta_z(s_0) \beta_{zm}}{b^2} \right]$$

A.4

Taking average $\beta$ in ring, we get average shape factor $F$ as

$$F = \pi \left[ \frac{\langle \beta_x \rangle \beta_{xm}}{a^2} + \frac{\langle \beta_z \rangle \beta_{zm}}{b^2} \right]$$

In deriving this equation, we have assumed that the loss takes place at one location where both $\beta_x$ and $\beta_z$ are maximum. This relation is not applicable to the modern storage rings in which the maxima of $\beta_x$ and $\beta_z$ occurs at different places.