4. $\underline{R}_u(u,v) = \langle 3\cos(v),\ 3\sin(v),\ 4 \rangle$

$\underline{R}_v(u,v) = \langle -3u\sin(v),\ 3u\cos(v),\ 0 \rangle$

$$\underline{R}_u \times \underline{R}_v = \begin{vmatrix} \underline{i} & \underline{j} & \underline{k} \\ 3\cos(v) & 3\sin(v) & 4 \\ -3u\sin(v) & 3u\cos(v) & 0 \end{vmatrix}$$

$$= \underline{i}\,(0 - 12u\cos(v)) - \underline{j}\,(0 + 12u\sin(v)) + \underline{k}\,(9u\cos^2(v) + 9u\sin^2(v))$$

$$= \langle -12u\cos(v),\ -12u\sin(v),\ 9u \rangle$$

$$\therefore \|\underline{R}_u \times \underline{R}_v\| = \sqrt{144u^2\cos^2(v) + 144u^2\sin^2(v) + 81u^2}$$

$$= \sqrt{225u^2} = 15u$$

$$S = \int_0^{2\pi}\int_0^2 15u\,du\,dv$$

$$= \int_0^{2\pi} \left[\frac{15}{2}u^2\right]_{u=0}^{u=2} dv$$

$$= \int_0^{2\pi} 30\,dv$$

$$= [30v]_0^{2\pi}$$

$$\boxed{= 60\pi}$$