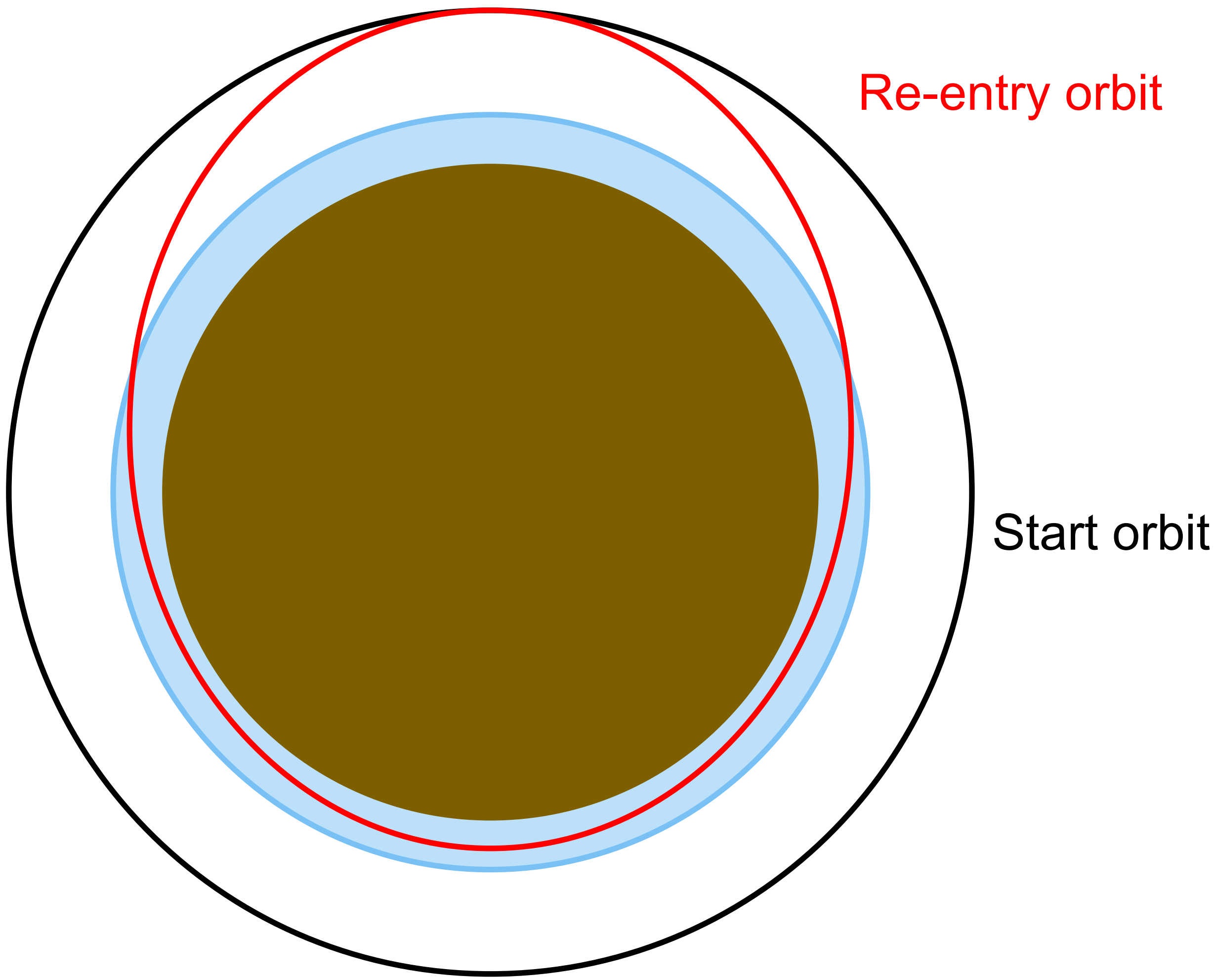
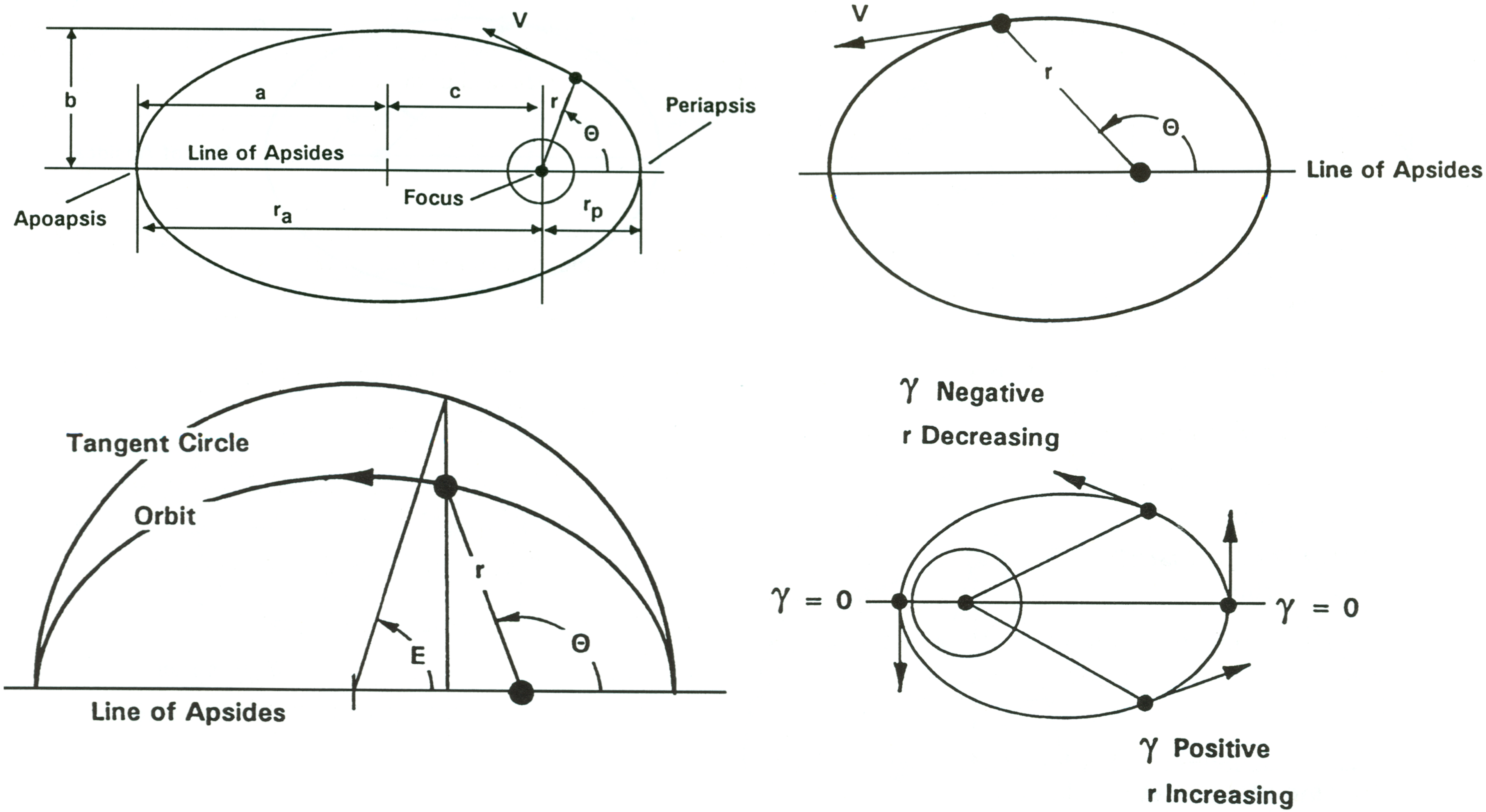
Shape of the re-entry trajectory



Elliptical orbit definition



Calculation of orbit parameters

Eccentricity e

$$e = \frac{c}{a} \qquad (2.19) \qquad e = \frac{r_a}{a} - 1$$

$$e = \frac{(r_a - r_p)}{(r_a + r_p)} \qquad (2.20) \qquad e = 1 - \frac{r_p}{a}$$

$$e = \frac{r_2 - r_1}{r_1 \cos\theta_1 - r_2 \cos\theta_2}$$

Flight path angle γ

$$\tan\gamma = \frac{e \sin\theta}{1 + e\cos\theta}$$

Mean motion n

$$n = \sqrt{\mu/a^3}$$

Period P

$$P = 2\pi/n$$

$$P = 2\pi\sqrt{a^3/\mu}$$

Radius (general) r

$$r = \frac{a(1-e^2)}{1 + e\cos\theta}$$

$$r = \frac{r_p(1+e)}{1 + e\cos\theta}$$

Radius of apoapsis r_a

$$r_a = a(1+e)$$

$$r_a = 2a - r_p$$

$$r_a = r_p\frac{(1+e)}{(1-e)}$$

Calculation of trajectory data at re-entry point

- Define r_p of the re-entry ellipse (typically between r_0+60 km and r_0+120 km)
- Calculate semimajor axis a and numeric eccentricity e from r_p and r_a

  (r_a of the entry ellipse is the radius of the start orbit)
- Calculate the true anomaly θ of re-entry point from the re-entry altitude $r_{atm}=r_0+H_{atm}$
- Calculate the flight path angle γ at the re-entry point from e and θ
- Calculate the velocity V at the re-entry point from r_{atm} and Gravity parameter μ