Section 3.2 Earth Properties (references 3.9.2, 3.9.3)

Std Earth gravitational acceleration, g_o = 9.8066 m/s^2 = 32.174 ft/s^2
mass = 5.9722×10^{24} *kg* = 13.22×10^{24} *lb*
rotation rate, $\omega = 7.292115 \times 10^{-5}$ *rad/sec*
average density = 5.522 g/cm^3 = 344.7 lb/ft^3
radius average, R_{avg} = 6,367,444 *m* = 3956.538 *st. miles* = 20,890,522 *ft*
radius at the equator (R_e) is 6,378,137 *m* (±2)
radius at the poles R_p = 6,356,752 [*m*]
radius as a function of latitude, ϕ (assumes perfect ellipsoid):

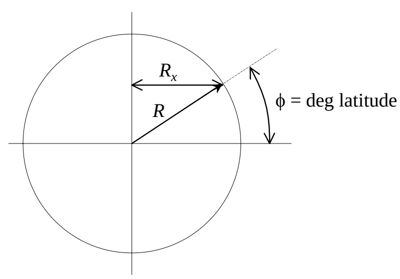
$$R = \left[\left(\frac{\cos\phi}{R_e} \right)^2 + \left(\frac{\sin\phi}{R_p} \right)^2 \right]^{-\frac{1}{2}}$$

Centrifugal Relief from Gravity

The earth's "normal" gravity field includes both the Newtonian Law and a correction for the centrifugal force caused by the earth's rotation. The centrifugal relief correction is

$$\Delta CR = -\frac{V^2}{R_x} = -\frac{(R_x\omega)^2}{R_x} = R_x\omega^2$$

where ω is the earth's rotation rate and R_x is the perpendicular distance from the earth's axis to the surface and can be calculated as $R_x = R \cos\phi$ (see figure below).



For any centrifugal relief calculations associated with aircraft performance, it is sufficiently exact (g ±0.00004 m/s^2) to use the average earth radius. An aircraft flying eastward contributes to centrifugal relief while a west-bound aircraft diminishes it.