θ

$\vec{r}$

$\vec{F}$

M

F_p

F_{py}

F_{px}

mg

T

T_y

T_x

ref. pt.

$T_2 = Mg$

Static:

$$|F_{px}| = |T_x| \checkmark$$

$$\left|\frac{L}{2}mg\right| = |L F_{py}|$$

$$|F_{py}| = \blacksquare \left|\frac{mg}{2}\right| \checkmark$$

$$T_x = T_y \frac{1}{\tan\theta} \checkmark$$

$$|T_y| = \frac{mg}{2} + Mg \checkmark$$

String has tension
T

E string – 340 Hz

L = 0.65 m

Solid cylinder diameter D
$\approx$ 0.01 in
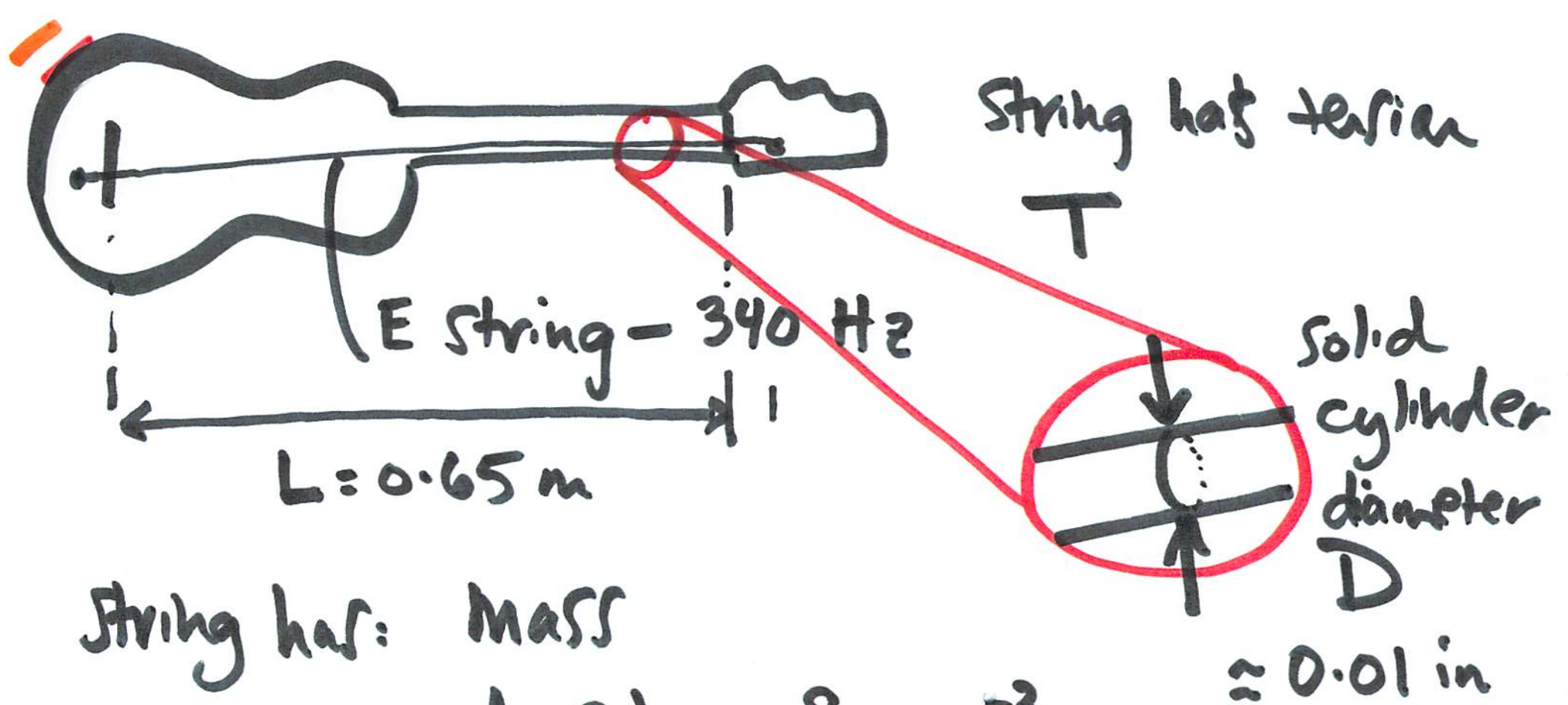
String has:
Mass density – 8 g cm^{-3}

bulk ~~Young's~~ modulus – 200 GPa

frequency: $f = 340$ Hz $= 340$ s^{-1}

Tension: $T = ?$ N $= ?$ kg m s^{-2}

length $L = 0.65$ m

mass $m = \rho L \cdot \frac{\pi}{4} D^2 = 8000$ kg m^{-3} $\times 0.65$ m $\times \frac{3}{4} \times D^2$

$\underbrace{\phantom{\rho L \cdot \frac{\pi}{4} D^2}}_{V}$

$D = 0.01$ m $= 0.0254$ cm

$= 2.5 \times 10^{-4}$ m

$m = 8 \times 0.65 \times \frac{3}{4} \times 2.5 \times 2.5 \times 10^3 \times 10^{-4} \times 10^{-4}$ kg

$= 25 \times 10^{-5}$ kg $= 2.5 \times 10^{-4}$ kg $= 0.25$ g

$2\pi \sqrt{\dfrac{T}{mL}} = f$ $\qquad T = \dfrac{f^2}{4\pi^2} \cdot mL$

$$T = \frac{(340 \text{ Hz})^2}{40} \cdot 2.5 \times 10^{-4} \text{ kg} \cdot 0.65 \text{ m}$$

$$= \frac{3.4 \times 3.4}{40} \times 100 \times 100 \times 2.5 \times 0.65 \times 10^{-4}$$

$$= \frac{1}{4} \times 2.5 \times 0.65 = 0.5 \text{ N} \, !$$

"Stress" is proportional to "Strain"

Hooke's law $\vec{F} = -k\vec{x}$

Force per area
(Tension per X-sectional area)

dimensionless distortion
(stretching)