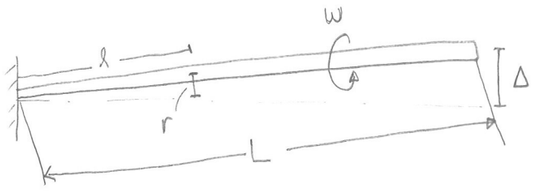

total mass = M Mass per length = m

1. $F = m\,a$ (force = mass x accel.)

2. $a = r\omega^2$

3. $\therefore F = M r \omega^2$

4. Assuming straight shaft.

$r = \frac{\Delta}{L} \times l$ (radius @ given distance)

5. $\therefore F = m.\left(\frac{\Delta l}{L}\right).\omega^2$

6. $\Sigma F = \int_0^L \left(m.\frac{\Delta l}{L}.\omega^2\right) dl$

Removing Constants:

7. $\Sigma F = m.\omega^2.\frac{\Delta}{L}\int_0^L l\, dl$

8. $\Sigma F = m.\omega^2.\frac{\Delta}{L}\left(\frac{l^2}{2}\right)$

9. $\Sigma F = \frac{m.\omega^2.\Delta.l^2}{2L}$

UNITS (S.I.)

10. $F = \frac{kg.}{1} \times \left(\frac{rad}{s}\right)^2 \times \frac{m}{1} \times \left(\frac{m}{1}\right)^2 \times \frac{1}{m}$

11. $= \frac{kg.\ rad^2.\ m.m^2}{s^2.\ m^2}$

12. $= \frac{kg.m^3}{s^2.m^2}$

13. $= \frac{kg.m^2}{s^2}$

14. $= N.m$ (TORQUE)

15. Divide by shaft length, L

$F = \frac{N.m}{m}$

$= N$

16. Divide by shaft length, L

17. $F = \frac{N}{m}$

Giving Equivilent U.D.L

18. Applying to line (9).

$F = \frac{m.\omega^2.\Delta.l^2}{2L} \times \frac{1}{L^2}$

19. $F = \left(\frac{m.\omega^2.\Delta.l^2}{2L^3}\right) N/m$

20. Applying cantilever & UDL deflection equation:

$\delta_{MAX} = \frac{WL^4}{8EI}$

where W = line (19). E = Young's Modulus I = Moment of Inertia.

21. $\delta_{max} = \frac{\left(\frac{m.\omega^2.\Delta.l^2}{2L^3}\right) \times L^4}{8.E.I}$