

NOTES ON MODE SHAPES AND BENDING GAIN UNITS IN NASTRAN

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The bending gain BG is calculate as

$$BG = \frac{\Phi_{\text{pivot}} \phi_{\text{comp}}}{\omega^2}$$

where

- Φ_{pivot} = RSS of Y and Z mode shape coefficients at engine pivot point (translational)
- ϕ_{comp} = RSS of Y and Z rotation mode shape coefficients at GCA center of computation (rotational)

The rotational mode dimension is $\left[\frac{\text{rad}}{\text{inch} \times \text{sqrt}(\text{mass})} \right]$

The translational mode dimension is $\left[\frac{1}{\text{sqrt}(\text{mass})} \right]$

The mass unit is (12 x slugs).

The rotational mode dimension is $\left[\frac{\text{rad}}{\text{inch} \times \text{sqrt}(12 \times \text{slugs})} \right]$

The translational mode dimension is $\left[\frac{1}{\text{sqrt}(12 \times \text{slugs})} \right]$

Note that

$$\omega^2 = \frac{K}{M}$$

where

K is the stiffness in lbf/ft

M is the mass in slugs

The term ω^2 thus has units of $\frac{\text{lbf / ft}}{\text{slugs}}$

The bending gains units for the term

$$\text{BG} = \frac{\phi_{\text{pivot}} \phi_{\text{comp}}}{\omega^2}$$

are

$$\left[\frac{\text{rad}}{\text{inch} \times \sqrt{12 \times \text{slugs}}} \right] \left[\frac{1}{\sqrt{12 \times \text{slugs}}} \right] \left[\frac{\text{slugs} \cdot \text{ft}}{\text{lbf}} \right]$$

$$= \left[\frac{\text{rad}}{12 \text{ inch slugs}} \right] \left[\frac{\text{slugs} \cdot \text{ft}}{\text{lbf}} \right]$$

$$= \left[\frac{\text{rad}}{\text{lbf}} \right]$$