Normal Modes and Effective Modal Mass

English units

Mass entered in lbm, converted to consistent units: $m = W/386$ [lbf sec^2/in]

Stiffness k [lbf/in], length [in], force [lbf], acceleration [in/sec^2]

$1\,G = 386$ in/sec^2

Metric units

Mass m [kg], stiffness k [N/m], length [m], force [N]

$1\,G = 9.81$ m/sec^2

Eigenproblem

$[K]\{\phi\} = \omega^2[M]\{\phi\}$, $f_n = \omega/(2\pi)$, $\{\phi\}^T[M]\{\phi\} = 1$

Solved with $[M] = [L][L]^T$: $[L]^{-1}[K][L]^{-T}\{y\} = \omega^2\{y\}$, $\{\phi\} = [L]^{-T}\{y\}$

Participation and effective modal mass

$\Gamma_i = \{\phi_i\}^T[M]\{r\}$, $m_{eff,i} = \Gamma_i^2$, $\sum_i m_{eff,i} = \{r\}^T[M]\{r\}$

Percent: $100\,m_{eff,i}/(\{r\}^T[M]\{r\})$; English: m_{eff} [lbm] $= 386\,\Gamma^2$