Consider the response of an oscillator to finite ramp displacement of final offset $D$ reached in time $t_R$. This corresponds to the following acceleration forcing function:

$$u_g = (D/t_R)\delta(t) - (D/t_R)\delta(t - t_R).$$

From eq. B.55 in Kramer, the oscillator response is:

$$u_{osc} = (D/t_R)(1/\omega_d)[\exp(-\xi\omega_0 t) \sin(\omega_d t) H(t) - \exp(-\xi\omega_0(t - t_R)) \sin(\omega_d(t - t_R)) H(t - t_R)]$$

where $H(t)$ is the Heaviside function, $\xi$ is the fractional damping, $\omega_0 = 2\pi/T_{osc}$, and $\omega_d = \omega_0 \sqrt{(1 - \xi^2)}$. The task is to find the maximum over time of $u_{osc}$, as a function of $T_{osc}$ for a given damping (call that $RD$). What is of particular interest is the value of $T_{osc}$ for which $RD$ approaches $D$. It might help to write things in a normalized form:

$$u_{osc}/D = \frac{\eta}{2\pi \sqrt{(1 - \xi^2)}}[\exp(-2\pi\xi\epsilon/\eta) \sin(2\pi \sqrt{(1 - \xi^2)}\epsilon/\eta) H(\epsilon)$$

$$- \exp(-2\pi\xi(\epsilon - 1)/\eta) \sin(2\pi \sqrt{(1 - \xi^2)}(\epsilon - 1)/\eta) H(\epsilon - 1)]$$

where $\eta = T_{osc}/t_R$ and $\epsilon = t/t_R$. Now $RD$ is defined as the maximum of the absolute value of $u_{osc}/D$, sweeping over all times $\epsilon$, and what is wanted is a plot of $RD$ vs $\eta$. Does $RD$ approach unity for $\eta$ near unity or for much larger $\eta$ (as found for some of the Chi-Chi response spectra, such as TCU084, TCU089)?

It is, of course, possible to take analytical derivatives of the oscillator response and set those to zero, but I balk at the algebra. Probably faster is to program the function in Fortran or Matlab and to find the necessary quantities.