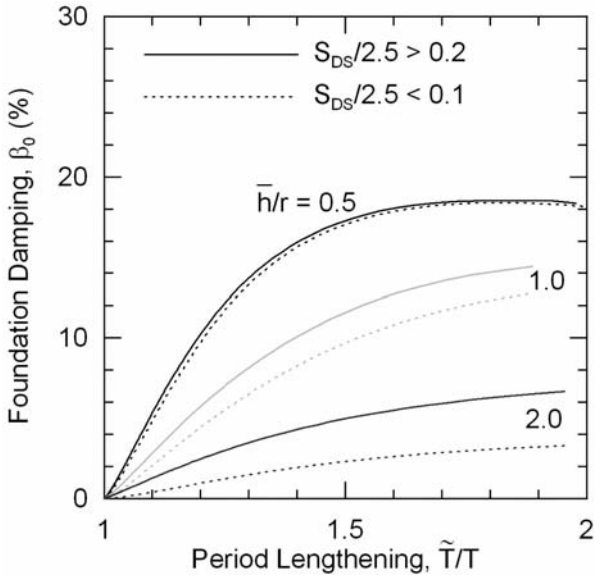

FIGURE 19.2-1 Foundation Damping Factor

where

L_o = the overall length of the side of the foundation in the direction being analyzed

r_a and r_m = characteristic foundation lengths defined in Eqs. 19.2-7 and 19.2-8, respectively

For intermediate values of $\frac{\bar{h}}{L_0}$, the value of r shall be determined by linear interpolation.

EXCEPTION: For structures supported on point-bearing piles and in all other cases where the foundation soil consists of a soft stratum of reasonably uniform properties underlain by a much stiffer, rock-like deposit with an abrupt increase in stiffness, the factor β_o in Eq. 19.2-9 shall be replaced by β_o' if $\frac{4D_s}{v_s\tilde{T}} < 1$ where D_s is the total depth of the stratum. β_o' shall be determined as follows:

$$\beta_o' = \left(\frac{4D_s}{v_s\tilde{T}}\right)^2 \beta_o \qquad (19.2\text{-}12)$$

The value of $\tilde{\beta}$ computed from Eq. 19.2-9, both with or without the adjustment represented by Eq. 19.2-12, shall in no case be taken as less than $\tilde{\beta} = 0.05$ or greater than $\tilde{\beta} = 0.20$.

19.2.2 Vertical Distribution of Seismic Forces

The distribution over the height of the structure of the reduced total seismic force ($\tilde{V}$) shall be considered to be the same as for the structure without interaction.

19.2.3 Other Effects

The modified story shears, overturning moments, and torsional effects about a vertical axis shall be determined as for structures without interaction using the reduced lateral forces.

The modified deflections ($\tilde{\delta}$) shall be determined as follows:

$$\tilde{\delta}_x = \frac{\tilde{V}}{V}\left[\frac{M_o h_x}{K_\theta} + \delta_x\right] \qquad (19.2\text{-}13)$$

where

M_o = the overturning moment at the base using the unmodified seismic forces and not including the reduction permitted in the design of the foundation

h_x = the height above the base to the level under consideration

δ_x = the deflections of the fixed-base structure as determined in Section 12.8.6 using the unmodified seismic forces

The modified story drifts and P-delta effects shall be evaluated in accordance with the provisions of Sections 12.8.6 and 12.8.7 using the modified story shears and deflections determined in this section.

19.3 MODAL ANALYSIS PROCEDURE

The following provisions are supplementary to those presented in Section 12.9.

19.3.1 Modal Base Shears

To account for the effects of soil–structure interaction, the base shear corresponding to the fundamental mode of vibration (V_1) shall be reduced to

$$\tilde{V}_1 = V_1 - \Delta V_1 \qquad (19.3\text{-}1)$$

The reduction (ΔV_1) shall be computed in accordance with Eq. 19.2-2 with $\bar{W}$ taken as equal to the effective seismic weight of the fundamental period of vibration, $\bar{W}$, and C_s computed in accordance with Eq. 12.8-1, except that S_{DS} shall be replaced by design spectral response acceleration of the design response spectra at the fundamental period of the fixed-base structure (T_1).

The period $\tilde{T}$ shall be determined from Eq. 19.2-3 or from Eq. 19.2-5 where applicable, taking $T = T_1$, evaluating $\bar{k}$ from Eq. 19.2-4 with $\bar{W} = \bar{W}_1$, and computing $\bar{h}$ as follows: