(b) Elastic Displacement Spectra: Although many codes still do not define design displacement spectra, they are becoming more common [see, e.g. X2, X3, X4, X8]. Ideally these should be developed separately, though using the same data, from acceleration spectra. However, most code-based design displacement spectra are generated from the acceleration spectra assuming that the peak response is governed by the equations of steady-state sinusoidal response. Thus the relationship between displacement and acceleration can be expressed as

$$\Delta_{(T)} = \frac{T^2}{4\pi^2} S_{(T)} g$$

(2.2)

where \( g \) is the acceleration due to gravity, and \( S_{(T)} \) is expressed as a multiply of \( g \) as in Fig.2.5(a). Equation (2.2) has been used to generate the elastic displacement spectra of

Fig.2.5 Design Elastic Acceleration and Displacement Spectra

Fig.2.5(b) from the acceleration spectra of Fig.2.5(a). Some characteristics are immediately obvious:

- The displacement spectra are essentially linear with period up to the period \( T_C \). For obvious reasons this is termed the corner period. The non-linearity at low periods, corresponding to \( T < T_B \), will be found to have little relevance to most displacement-based designs, as will become apparent in later chapters of this text.

- The general shape agrees reasonably well with the response spectra generated from specific accelerograms in Fig.2.4. The peak displacements are also compatible with the more intense accelerograms of Fig.2.4(b) and (c) considering differences in PGA.

- The displacement spectrum corresponding to a minimum design acceleration as shown in Fig.2.5(a) has completely unrealistic displacement demands for long period structures. This curve, again shown by the dash-dot line in Fig.2.5(b) has only been shown up to a period of 5 seconds. At 10 seconds the response displacement would be 6.2 m (20ft). This illustrates the illogical nature of some design codes that specify minimum design acceleration levels, and require displacement demand to be determined from Eq.(2.2).
Ejemplo de conversión del espectro de diseño a un espectro de desplazamiento

Aplicando la fórmula

\[ D = A_0 g \frac{T^2}{4\pi^2} \]

<table>
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<th>Ts (s)</th>
<th>Espectro diseño</th>
<th>D (cm)</th>
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<td>0.00</td>
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<td>0.917</td>
<td>0.51</td>
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Referencia: