

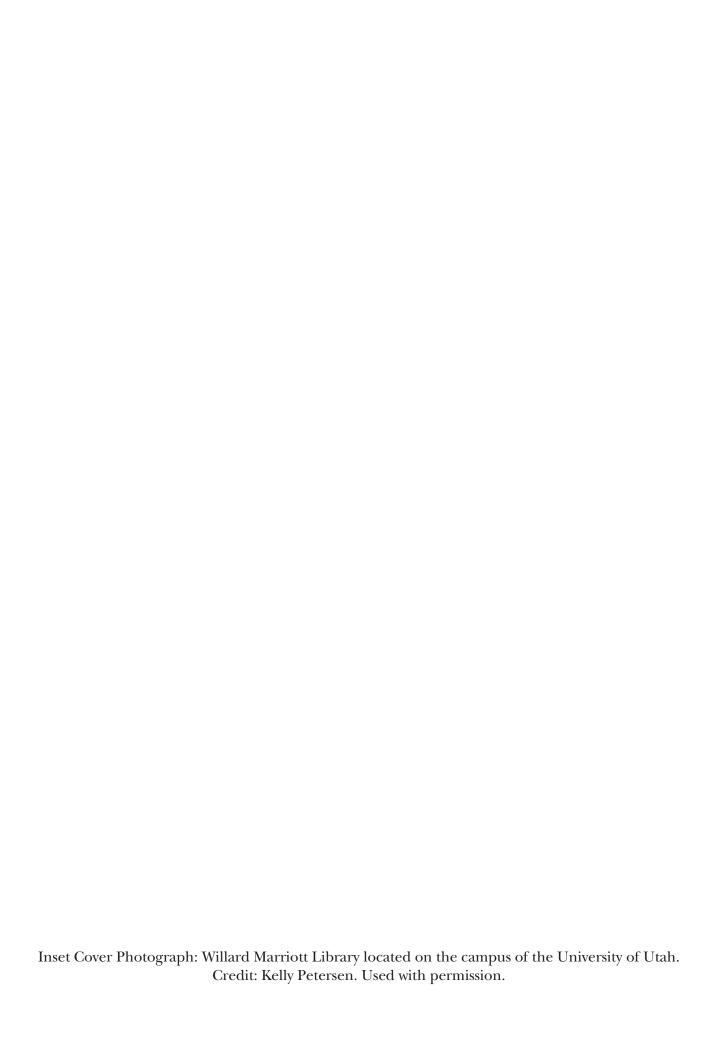
# 2015 NEHRP Recommended Seismic Provisions: Design Examples

Flow Charts

FEMA P-1051B / September 2016







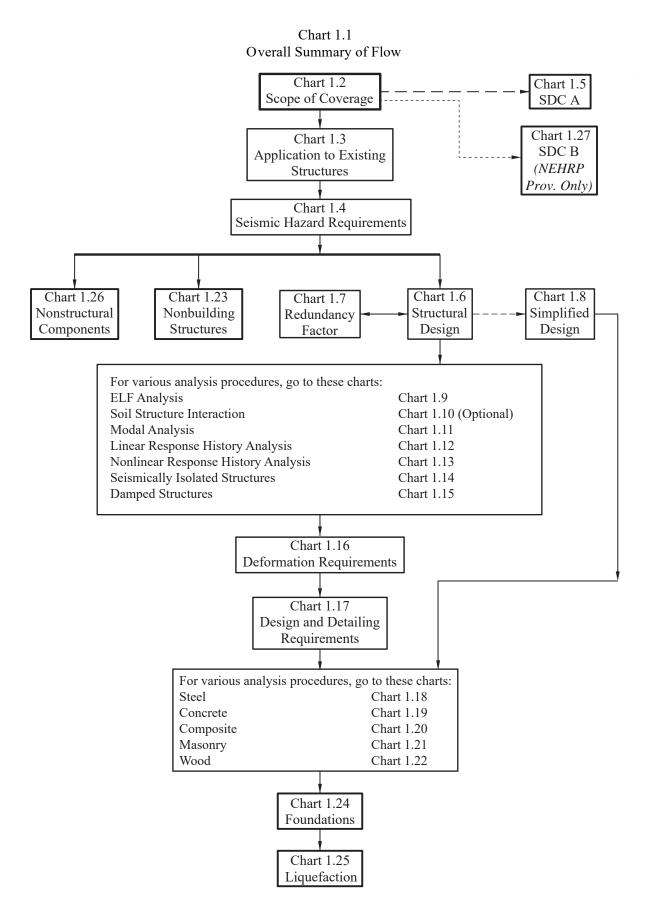


Chart 1.2 Scope of Coverage

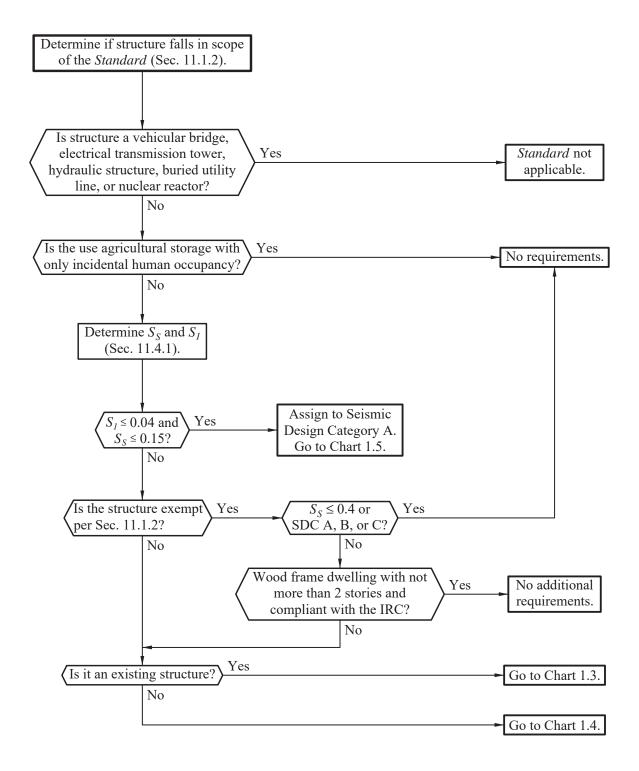
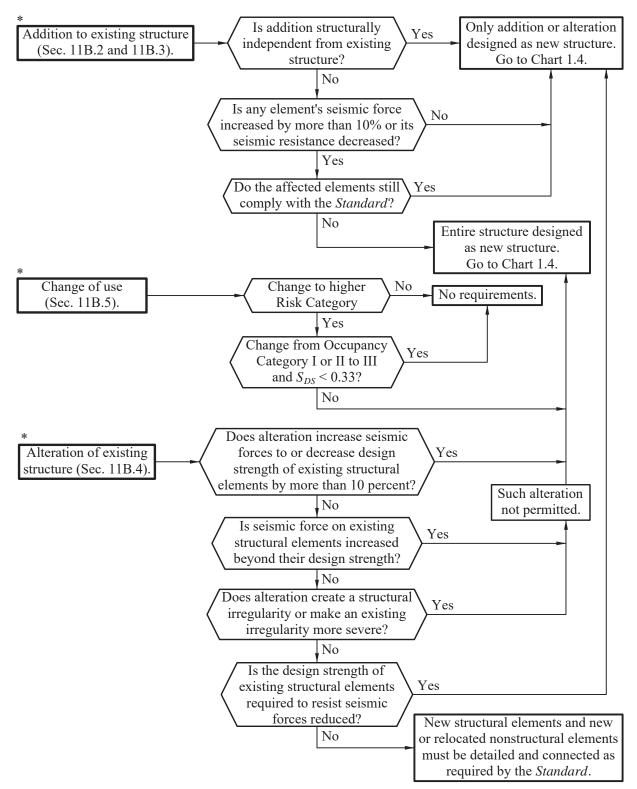


Chart 1.3
Application to Existing Structures



<sup>\*</sup> The *Standard* applies to existing structures only in the cases of additions to, changes of use in, and alterations of such structures.

Chart 1.4
Seismic Hazard Requirements and Seismic Design Category

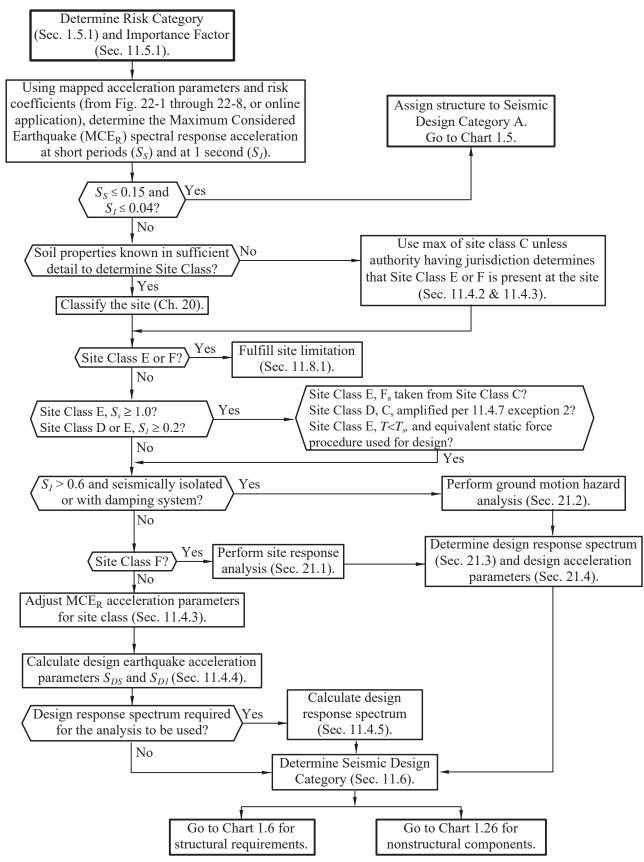


Chart 1.5 Seismic Design Category A

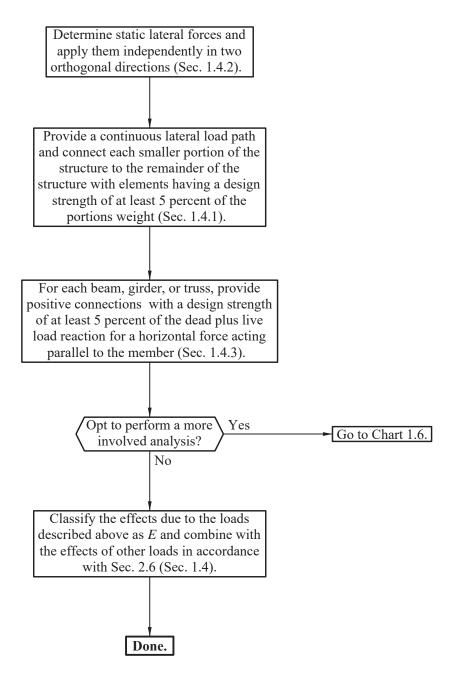


Chart 1.6 Structural Design

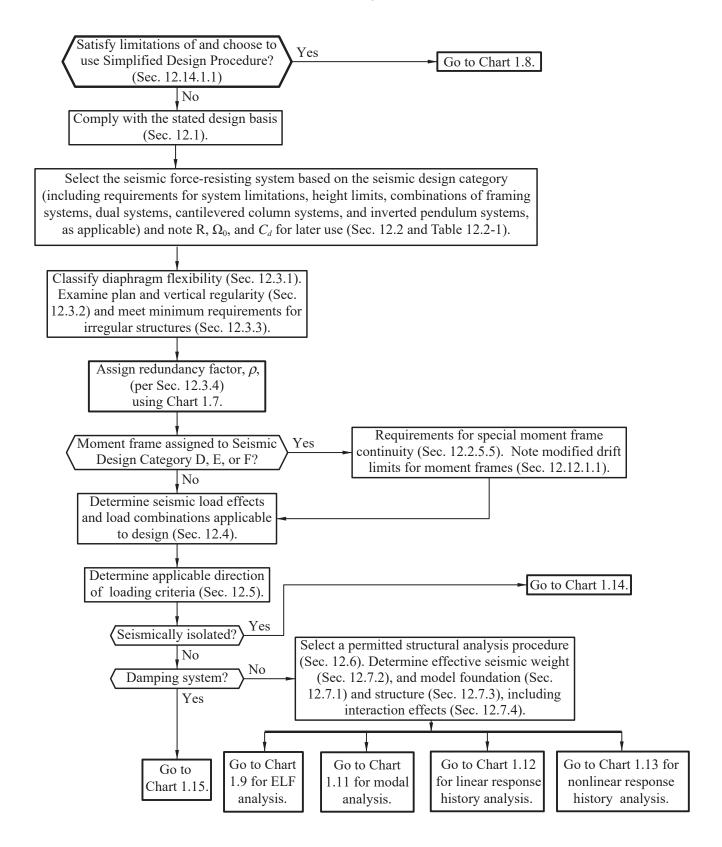
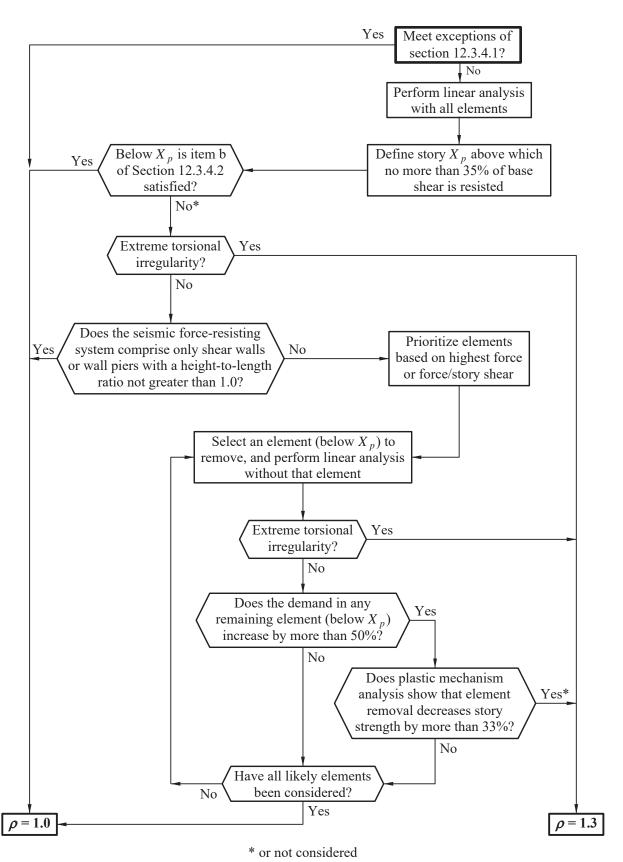


Chart 1.7 Redundancy Factor



# Chart 1.8 Simplified Design Procedure

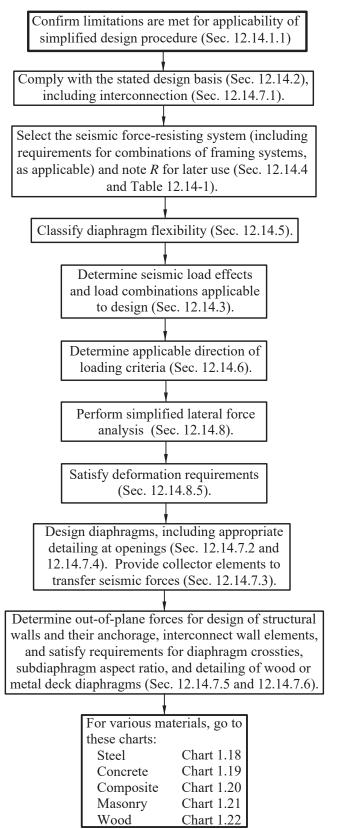


Chart 1.9 Equivalent Lateral Force (ELF) Analysis

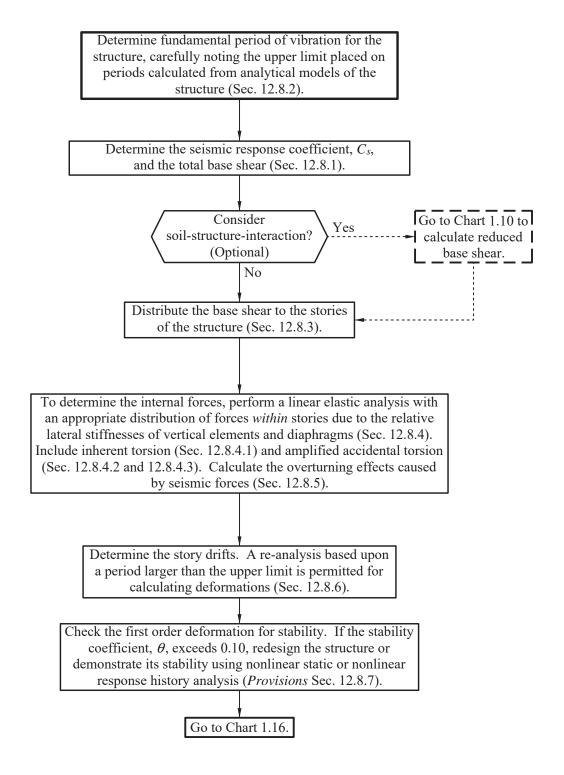
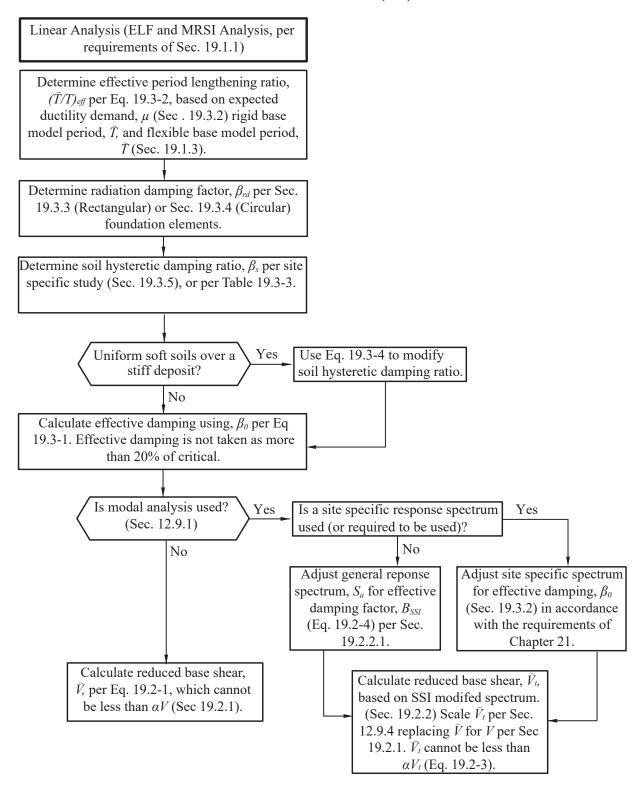


Chart 1.10 Soil-Structure Interaction (SSI)



### Chart 1.11 Modal Response Spectrum Analysis

Use linear elastic analysis to determine periods and mode shapes, including enough modes to obtain 100 percent mass participation. Modes with periods less than 0.05 seconds may be represented in a single rigid body mode having a period of 0.05 seconds. **OR** Determine periods and mode shapes, including enough modes to obtain at least 90 percent mass participation in each orthogonal horizontal direction of response considered. (Sec. 12.9.1.1). Consider Go to Chart 1.10 to Yes soil-structure-interaction? calculate reduced (Optional) base shear. No Determine story forces, individual member forces, displacements, and drifts in each mode (Sec. 12.9.1.2) and combine modal quantities using either the SRSS or the CQC technique\* (Sec. 12.9.1.3). Where the base shear is less than 100 percent of that computed using Sec. 12.8 with  $T \le C_u T_a$ , amplify design forces by V/Vt (Sec. 12.9.1.4.1). Where the base shear is less than 100 percent of that computed using Sec. 12.8 with  $C_s$ determined using Eq. 12.8-6, amplify drifts by  $C_s^*$  W/Vt (Sec. 12.9.1.4.2). To determine the internal forces, perform a linear elastic analysis. Include inherent and accidental torsions. Amplify torsions that are not in the dynamic model (Sec. 12.9.1.5). Check the first order deformation for stability (Sec. 12.9.1.6). If the stability coefficient,  $\theta$ , exceeds 0.10, redesign the structure or demonstrate its stability using nonlinear static or nonlinear response history analysis (Sec. 12.8.7). Go to Chart 1.16.

<sup>\*</sup>As indicated in the text, use of the CQC technique is required where closely spaced periods in the translational and torsional modes will result in cross-correlation of the modes.

Chart 1.12 Linear Response History Analysis

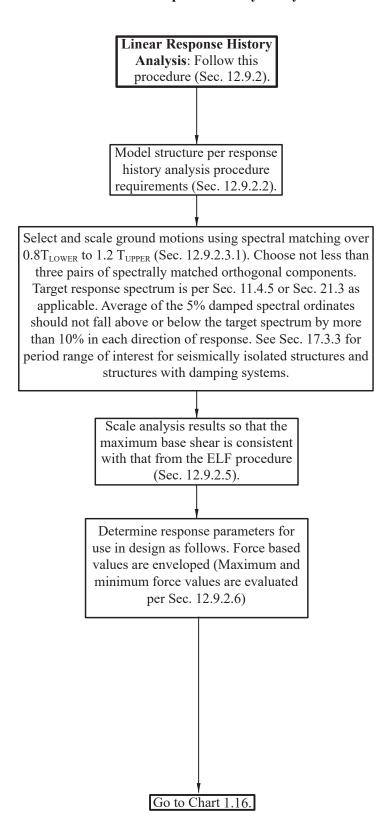


Chart 1.13 Nonlinear Response History Analysis

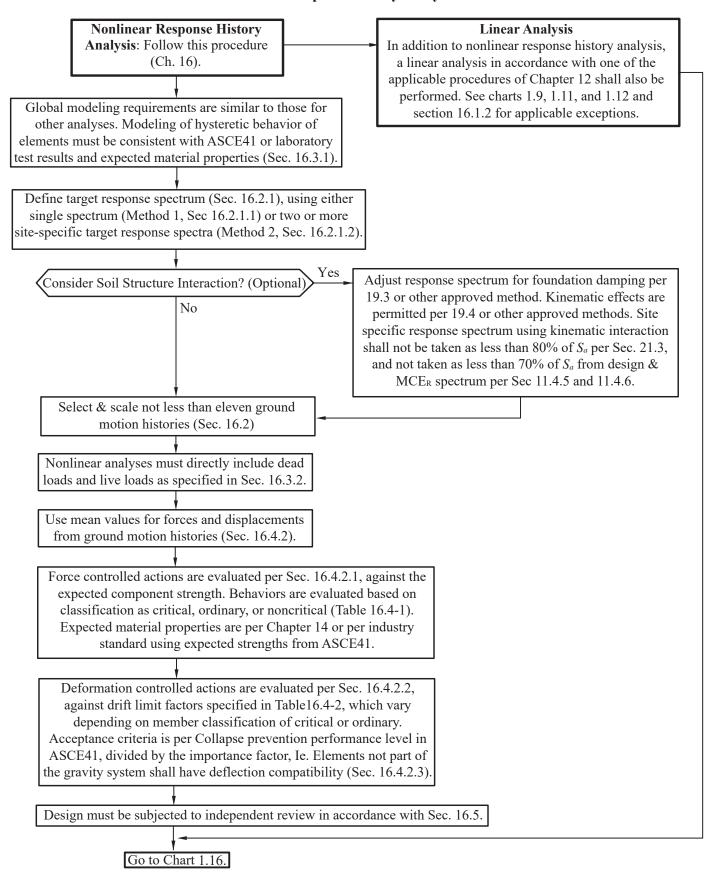


Chart 1.14 Seismically Isolated Structures

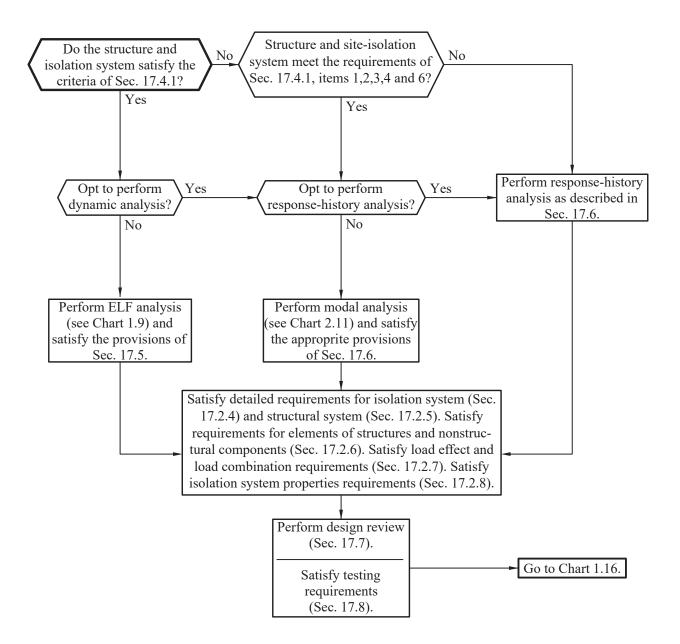
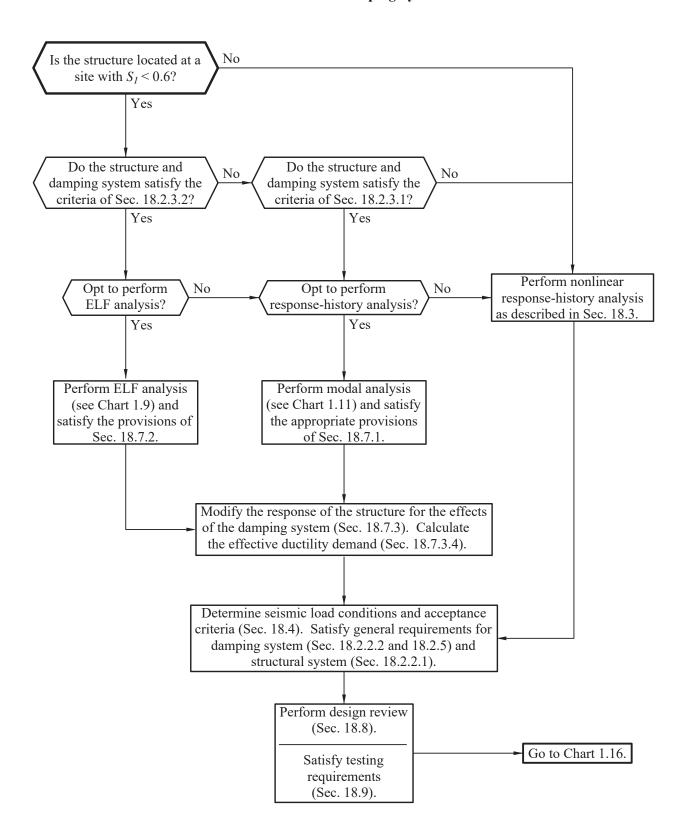
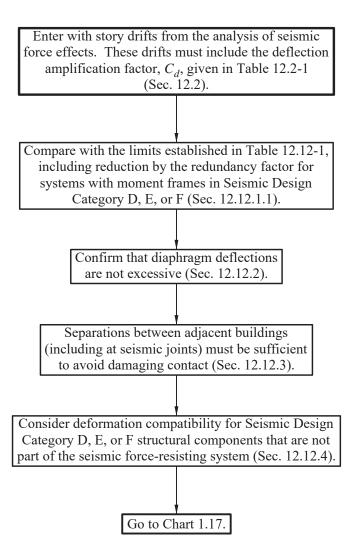


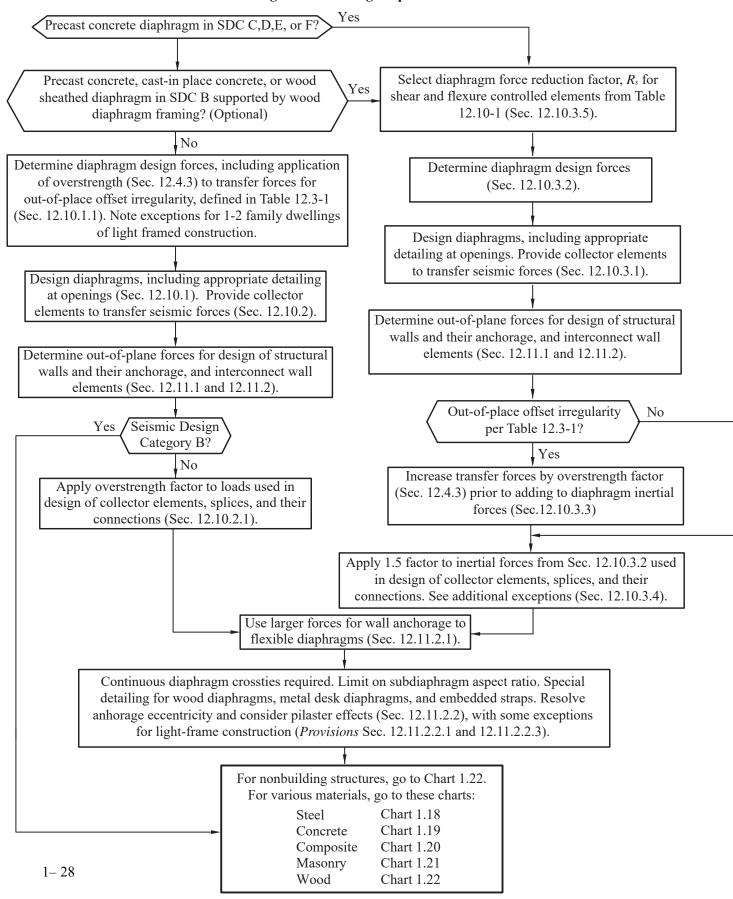
Chart 1.15
Structures with Damping Systems



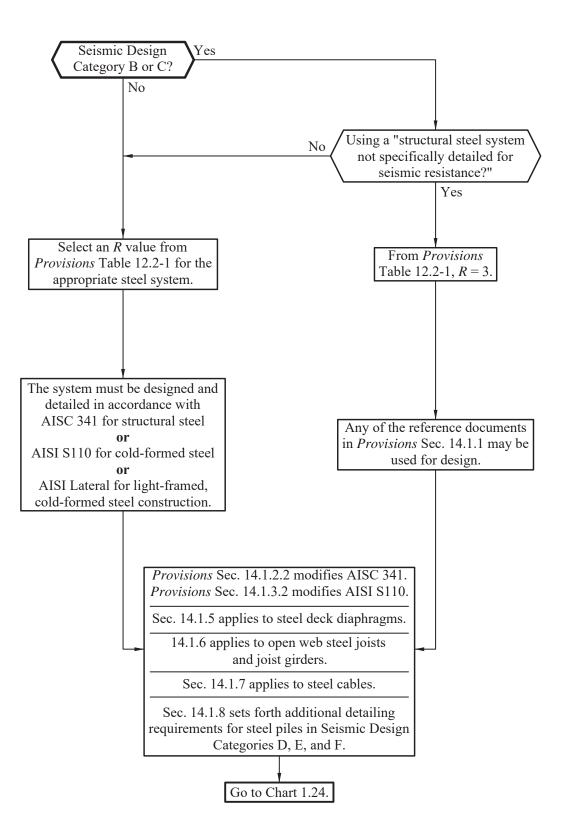
# Chart 1.16 Deformation Requirements



# Chart 1.17 Design and Detailing Requirements



### Chart 1.18 Steel Structures

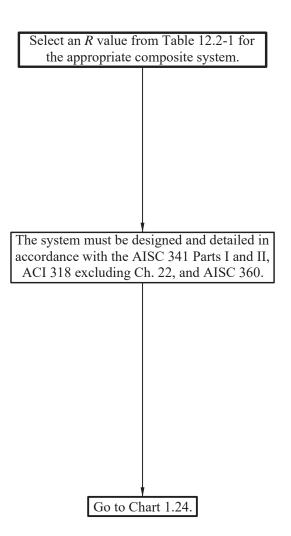


# **Chart 1.19 Concrete Structures**

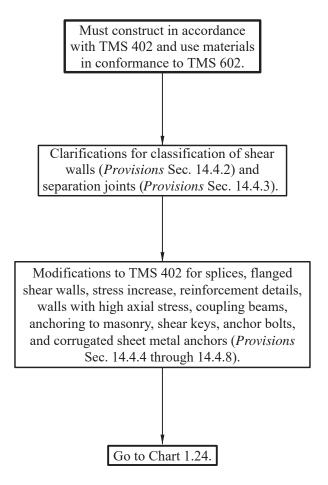
Modifications to ACI 318 to add definitions and requirements for detailed plain concrete structural walls, ordinary precast structural walls, precast concrete diaphragms, and wall piers. Additional requirements for intermediate precast structural walls. Revision of requirements for ties at anchor bolts and for size limits on anchors. (Provisions Sec. 14.2.2) Requirements for concrete piles in Seismic Design Category C, D, E, or F (Provisions Sec. 14.2.3). Requirements for precast concrete diaphragms in Seismic Design Category C, D, E, or F (Provisions Sec. 14.2.4).

Go to Chart 1.24.

# Chart 1.20 Composite Steel and Concrete Structures



## Chart 1.21 Masonry Structures



# Chart 1.22 Wood Structures

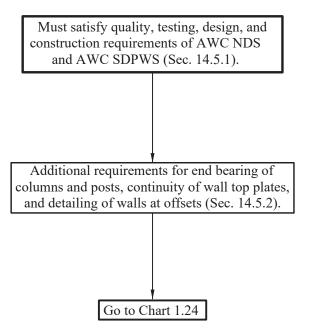


Chart 1.23 Non-building Structures

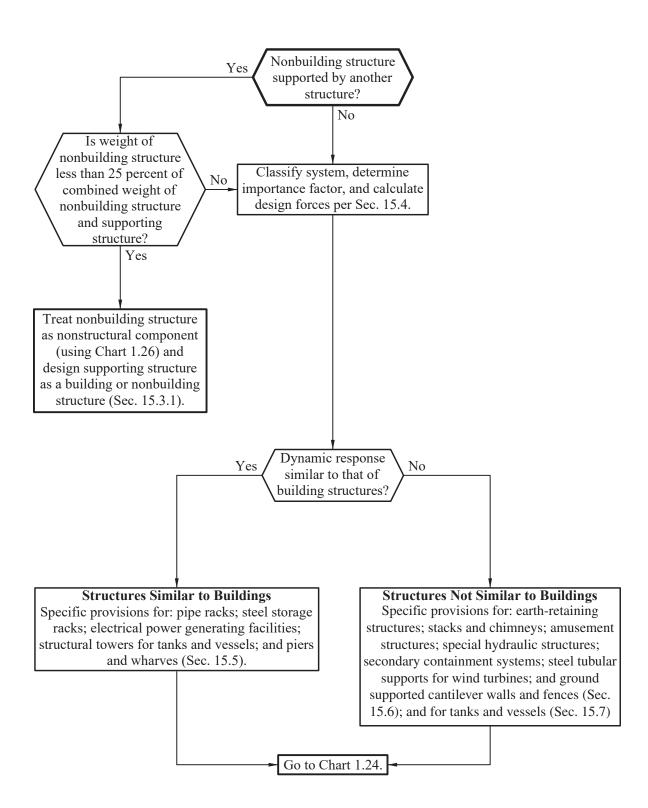
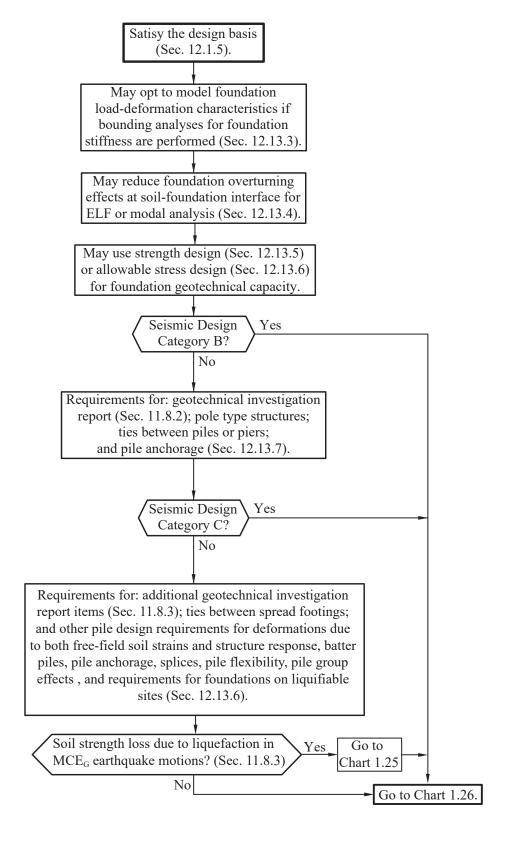


Chart 1.24 Foundations



# Chart 1.25 Liquifiable Soils

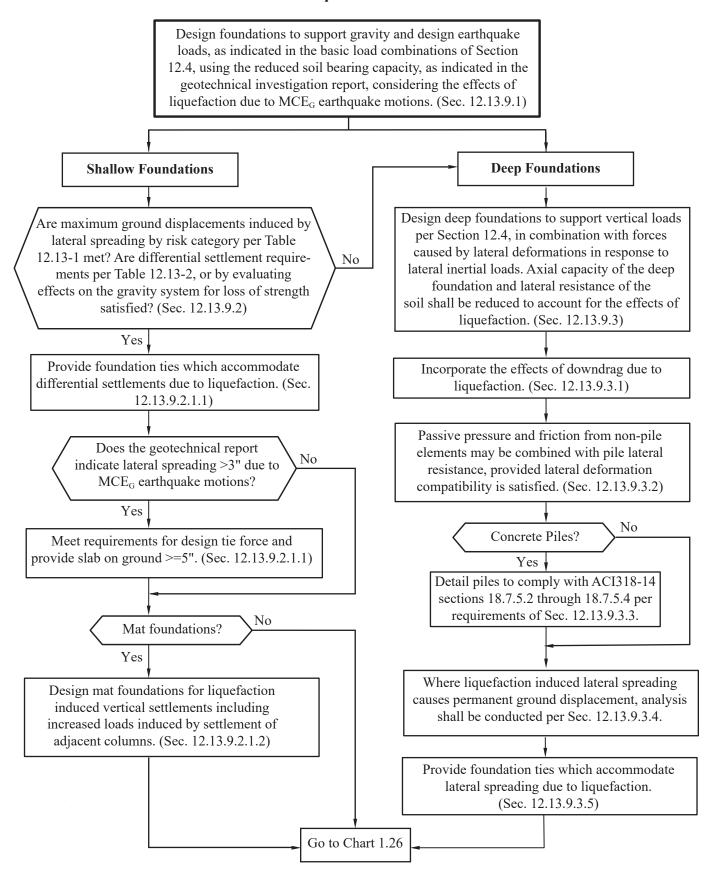
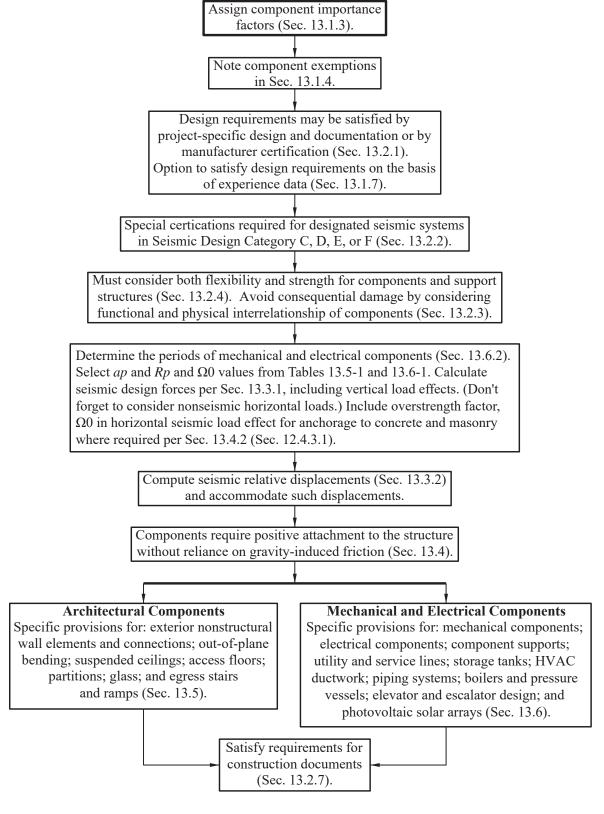


Chart 1.26 Nonstructural Components



## Chart 1.27 SDC B (NEHRP Provisions Only)

