CODE

A.5—Load factors and combinations

A.5.1 Load combinations for nonlinear response history analysis shall conform to the requirements of the general building code.

COMMENTARY

RA.5—Load factors and combinations

RA.5.1 Load combinations for response history analysis used in conjunction with this Appendix are intended to be similar to those of Chapter 16 of ASCE/SEI 7-16, TBI (2017), or LATBSDC (2017).

For nonlinear response history analysis, the principles of linear superposition do not apply. Therefore, it would be incorrect to conduct separate analyses considering various loads and then combine the load effects. Instead, it is necessary to conduct an analysis for each factored load combination and take the design value as the envelope of the analysis results. For any nonlinear analysis including earthquake effects, gravity loads are to be applied to the model first and then the ground shaking simulations are applied in the presence of the gravity loads.

There is a low probability that maximum considered earthquake shaking and factored design gravity load combinations of the general building code will occur simultaneously. A more representative load combination is the occurrence of expected, realistic gravity loading combined with maximum considered earthquake shaking.

One load combination is typically considered for analysis, which includes expected dead load concurrent with expected live load and Maximum Considered Earthquake shaking. Chapter 16 of ASCE/SEI 7-16 requires consideration of a second load combination without live load. It should be noted that this case will seldom govern the design of a tall building.

Accidental torsion is not commonly considered in cases where linear analysis indicates that torsional irregularities are negligible.

Load combinations used in the nonlinear analysis may differ from load combinations used to evaluate force-controlled actions (refer to A.11).

A.6—Modeling and analysis

A.6.1 Models for analysis shall be three-dimensional and shall conform to the requirements of the general building code.

A.6.2 Modeling of member nonlinear behavior, including effective stiffness, expected strength, expected deformation capacity, and hysteresis under force or deformation reversals, shall be substantiated by applicable physical test data and shall not be extrapolated beyond the limits of testing.

A.6.3 Degradation in member strength or stiffness shall be included in the numerical models unless it can be demonstrated that the demand is not sufficiently large to produce these effects. If degradation in component strength is included in the numerical model, the model formulation shall be such

RA.6—Modeling and analysis

RA.6.2 Multiple element formulations and material models are appropriate for use in inelastic dynamic analysis of concrete structures. ASCE/SEI 41, ACI 374.3R, ACI 369.1M, and NIST GCR 17-917-46 provide guidance on modeling and defining model parameters. Selecting model parameters at the mean value of experimental data, as is recommended by the aforementioned documents, avoids skewing analysis results and produces a more reliable evaluation of concrete building response.

RA.6.3 The model mesh size selected should allow determination of the structural responses in sufficient detail and with sufficient accuracy. Some systems will exhibit mesh-dependent response, with a reduction in mesh size resulting in reduced deformation capacity and more rapid strength

A Nonlinear