Appendix A

DIFFERENCES BETWEEN THE 1997 AND THE 2000 EDITIONS OF THE *NEHRP RECOMMENDED PROVISIONS*

EDITORIAL AND ORGANIZATIONAL CHANGES

For the 2000 *Provisions*, an editorial change has been made to the format used to cite reference documents. In the past, reference documents generally were listed at the beginning of a chapter and identified as Ref. X-1, Ref. X-2, etc., with the "X" being the chapter number. The references then were cited in the chapter using the "Ref. X-1" format. In the 2000 *Provisions*, the reference documents continue to be listed at the beginning of a chapter with an indication of the edition to be used but are presented with an abbreviated designation that is used to cite the reference in the text of the chapter (e.g., ACI 318).

2000 CHAPTER 1, GENERAL PROVISIONS

In the 1997 *Provisions*, one-and two-story wood frame dwellings were exempted from the seismic requirements if the design spectral response acceleration at short periods was less than 0.4g. For the 2000 *Provisions*, these dwellings are exempted from all *Provisions* requirements if they are in Seismic Design Categories A, B, or C. They also are exempted from the remaining requirements in the *Provisions* if they are designed and constructed in accordance with the conventional light frame construction requirements in Sec. 12.5.

In Sec.1.2.4, alterations that increase the *seismic force* in any existing structural element by more then 5 percent or decrease the design strength of any existing structural element to resist seismic forces by more than 5 percent are not permitted unless the entire seismic-force-resisting system is determined to conform to the *Provisions* for a new structure. All alterations are required to conform to the *Provisions* for a new structure. Excepted from these requirements are alterations to existing structural elements or additions of new structural elements that are not required by the *Provisions* but are initiated to increase the strength or stiffness of the seismic-force-resisting system of an existing structure provided an engineering analysis meeting several specifically stated requirements is submitted.

2000 CHAPTER 2, GLOSSARY AND NOTATIONS

Additions and deletions have been made to reflect changes made in the text of the *Provisions*.

2000 CHAPTER 3, QUALITY ASSURANCE

For the 2000 *Provisions*, several inspection-related changes have been made. One is a requirement for periodic inspection of shear walls with structural wood and the second requires periodic special inspection of architectural components (glass). The special inspection requirements also have been modified to exempt nonbearing metal stud and gypsum board partitions from periodic special inspection; however, interior and exterior veneers are now covered with exceptions pertaining to lightweight partitions.

Sec. 3.6, Reporting and Compliance Procedures, also has been modified to more clearly state who is to receive reports.

2000 CHAPTER 4, GROUND MOTION

The only substantive changes made for the 2000 *Provisions* relate to the exception in Sec. 4.1.2.1 indicating that, under certain conditions, no site-specific evaluation is required for structures having a fundamental period of less than 0.5 second. This is further clarified in exceptions presented in the footnotes to Tables 4.1.2.4a and 4.1.2b.

2000 CHAPTER 5, STRUCTURAL DESIGN CRITERIA

For the 2000 *Provisions*, the requirements regulating the types of analysis that may be used in determining design seismic forces and drifts have been reformatted so that they all appear in a single table. In addition, two new analysis methods – linear time history analysis and nonlinear time history analysis – are introduced into the text of Chapter 5 and a third analysis method – nonlinear static analysis (pushover analysis) – is introduced as an appendix.

The approximate period formulae used to obtain T_a has been revised to reflect the expanded data base of the measured period of buildings obtained from strong ground motion recordings.

Equation 5.2.1-3 for determining the equivalent lateral force base shear also has been revised to change the equation's dependence on S_{D1} to dependence on S_{DS}. This was done to maintain consistency with parallel provisions in the 2000 *International Building Code*, 1997 *Uniform Building Code*, and ASCE 7-98. The requirements also were modified to clarify that the base shear need not be limited by Eq. 5.2.1-3 when used to evaluate drift. This was the intent when Eq. 5.2.1-3 was originally introduced in the 1997 *Provisions* but was not properly specified.

A change has been made to clarify that collectors in certain irregular buildings need not be designed for 125 percent of the forces otherwise required if other provisions require design of these elements for the special load combinations of Sec. 5.2.7.1.

Another change clarifies that when calculating the redundancy coefficient, ρ, for structures of light frame construction, the quantity $10/l_w$ need not be taken as having a value greater than 1. This was the original intent of the requirement when it was introduced in the 1997 *Provisions* but was not adequately presented in the text.

2000 CHAPTER 6, ARCHITECTURAL, MECHANICAL, AND ELECTRICAL COMPONENTS

For the 2000 *Provisions*, it was determined that additional conservatism was needed and a number of the component modification factor values in Tables 6.2.2 and 6.3.2 have been modified.

Simplified formulae are provided for use with the equivalent lateral force procedure of Sec. 5.4 and exceptions concerning mechanical and electrical components in Seismic Design Categories D, E, and F are clarified.

The relationship between the component transfer of forces and the basic design of the structure also has been clarified so that the design engineer must take into account the forces on the structure generated by the components fixed to the structure.

One of the most significant changes for the 2000 edition of the *Provisions* is the addition of a new section on glass in glazed curtain walls, glazed storefronts, and glazed partitions. The *Provisions* text provides basic requirements concerning drift limits and the *Commentary* contains a detailed study and review of research performed on racking tests.

Commentary Sec. 6.1.6 has been revised to ensure that the user understands what is required concerning chemical anchors.

2000 CHAPTER 7, FOUNDATION DESIGN REQUIREMENTS

Several changes to the sections on soil-structure interaction (SSI) have been made for the 2000 *Provisions*. Recent studies dictated that these changes be made because they significantly affect the period lengthening and foundation damping for a given structure and, hence, a change in base shear.

Both Sec. 7.4 and 7.5 have been modified either to meet the requirements of ACI 318-99 or to highlight exceptions to ACI 318-99.

The steel pile cap tensile force requirement has been adjusted with an exception, and width-thickness ratios have been added to ensure that the formation of plastic hinges in the piles will result without premature local buckling and fracture.

The *Commentary* has been expanded to provide additional guidance on the subject of seismic earth pressures on retaining walls including the addition of more formulations for estimating the seismic earth pressure for dry (nonsubmerged) backfills behind yielding and nonyielding retaining walls. The approach of designing yielding walls based on tolerable displacements also is discussed and key references are provided. Soil-structure interaction implications for seismic earth pressures on nonyielding retaining walls also are discussed and references given for detailed analysis methods. Further, the effects of backfill submergence on seismic earth pressures are discussed and key references cited.

2000 CHAPTER 8, STEEL STRUCTURE DESIGN REQUIREMENTS

The most significant change for the 2000 *Provisions* is the reference to AISC Seismic including Supplement No. 2. Completion of the 2000 *Provisions* update was deliberately delayed so that the results of the SAC Joint Venture program could be integrated via reference to this document. However, some modifications to AISC Seismic are included to, among other things, modify the Charpy V-notch toughness at two temperatures in order to ensure adequate toughness over the range of expected use and to reflect the SAC results indicating that, in reducing seismic hazards in moment resisting steel frames, the shape and size of the weld access hole are critical to the performance moment connections with direct welds of beam flanges to columns. The access hole configuration provided in the 2000 *Provisions* was developed to minimize strain concentrations and has been successfully tested. It is anticipated that this configuration will be adopted into later editions of the AISC specifications.

2000 CHAPTER 9, CONCRETE STRUCTURE DESIGN REQUIREMENTS

The primary modifications for the 2000 *Provisions* reflect the changes made in the 1999 edition of the ACI 318 reference document.

The seismic strength design load combination of the *International Building Code* (adopted from ASCE 7-95) in which the gravity and earthquake effects are counteractive – the load combination that governs the seismic design of reinforced concrete columns and shear walls – is essentially identical to the corresponding design load combination of ACI 318. Thus, there is no basis for the use of ϕ factors with this load combination and this requirement has been eliminated.

ACI 318-99 has revised its terminology for moment frames to be consistent with the *Provisions*; therefore, the provisions describing types of moment frames have been eliminated and references to these requirements have been deleted as well.

A new section on anchoring to concrete is included to reflect work done by ACI on the design of anchoring with cast-in-place headed bolts, J- and L- bolts headed studs, hooked bolts, and post-installed mechanical anchors. Although these requirements are not included in ACI-318-99 because the anchor prequalification standard, ACI 355.2, was not completed in time, the inclusion of comprehensive anchoring design methods in the 2000 *Provisions* was deemed important and it is anticipated that these requirements will eventually be included in ACI 318.

The requirements concerning foundations, gravity columns, and transverse reinforcement have all been modified to comply with ACI 318-99.

Finally, there has been a major expansion of the requirements found in Sec.9.1.1. Recent advances in understanding of the seismic behavior of precast/prestressed concrete frame and wall structures resulting from various research programs and the codification of test procedures have made possible the elimination of 1997 *Provisions* appendix and the inclusion in the 2000 *Provisions* of precast/prestressed concrete requirements based entirely on amendments to ACI 318-99. These are now sequentially listed to conform with Chapter 21 of ACI 318-99.

A new appendix to the *Provisions* and *Commentary* presenting requirements for untopped diaphragms is included.

2000 CHAPTER 10, STEEL AND CONCRETE STRUCTURE DESIGN REQUIREMENTS

The only change for the 2000 *Provisions* is the updating of the reference list to reflect the most current documents.

2000 CHAPTER 11, MASONRY STRUCTURE DESIGN REQUIREMENTS

The 2000 *Provisions* reflects several editorial changes. The scope section now requires that masonry walls be designed as shear walls with one exception. New requirements regarding reinforcing bars are included: lab splices are detailed to reflect new research that eliminates the confusion between splices found in masonry versus concrete, more rational and reliable design requirements for large and small reinforcement diameters are presented, the requirement for 135 degree hooks have been eliminated in masonry construction, and the requirement for end bearing splices has been eliminated since they are seldom used.

The translation from stress design to strength design found in the 1997 *Provisions* for plain (unreinforced) masonry members was not correct and modifications have been made. In addition, the 1997 Appendix to Chapter 11 has been eliminated to achieve parity with other material chapters that base their design on strength versus stress design.

A limitation on the width of the stress block in out-of-plane and in-plane bending has been included. Welded splices are specified to use ASTM A706 reinforcement to ensure the proper chemistry in the weld (i.e., the amount of carbon, sulfur, phosphorus, and other elements must be controlled).

The requirements for mechanical connections have been modified to reflect in fact that their specified yield strength is usually higher than the 125 percent specified in the 1997 *Provision*s. Consequently, the 125 percent requirement has been eliminated and Type 1 or 2 mechanical splices are required.

2000 CHAPTER 12, WOOD STRUCTURE DESIGN REQUIREMENTS

A major change for the 2000 *Provisions* is the elimination in Tables 12.4.3-2a and 12.4.3-2b of the 10 percent reduction of design values imposed on shear walls in the 1997 *Provisions*. This essentially brings these values back to the levels found in the 1994 *Provisions*. These tables also feature changes regarding minimum penetration of nailing. Earlier, thinner side panel members required the same penetration as thicker members, but testing has shown that less penetration is necessary for the conventional siding thickness used in construction. The footnote regarding the specific gravity adjustment factor also now requires that it not be greater than 1.0.

The definition of diaphragm has been changed to include sloping roofs; therefore, they now are considered to be diaphragms rather than shear walls and the requirement for edge blocking is eliminated.

A major reformatting of Sec. 12.3 and 12.4 clarifies the requirements for engineered wood construction and diaphragms and shear walls. Once this was completed, it permitted additional changes to be incorporated to improve clarity.

Another major change is the inclusion of new requirements for perforated shear walls. The perforated shear wall design presented in the 2000 *Provisions* is a recently developed empirical method that recognizes the strength and stiffness provided to framed walls by sheathing above and below wall openings. The Chapter 12 *Commentary* provides background on development and verification.

2000 CHAPTER 13, SEISMICALLY ISOLATED STRUCTURES DESIGN REQUIREMENTS

Sec. 13.2.3 has been revised for the 2000 *Provisions* to correct an oversight concerning the importance factor, which is intended to reduce ductility demand for conventional structures but does not apply in the case of seismically isolated structures that are designed to remain "essentially elastic."

Sec. 13.4.4.1 has been revised to reflect that Site Class E is now covered by the seismic maps and appropriate changes are included in the *Commentary* as well. Sec. 13.6.2.3 has been revised to provide additional wording to clarify the intent of the *Provisions*. Further, Sec.13.9.2.1 has been revised to allow the prototype bearings used for testing to be used in the construction of the structure if the registered design professional will permit their use; this may have a significant impact on smaller projects where the number of test isolators represents a significant number of the total to be used.

The most significant change is the replacement of the brief 1997 Appendix to Chapter 13 with an extensive appendix with a complete set of design provisions for structures with damping systems. Since this information contains design criteria, analysis methods, and testing recommendations that have limited history of use, considerable information on this evolving technology is included to guide the building professional.

2000 CHAPTER 14, NONBUILDING STRUCTURE DESIGN REQUIREMENTS

Since Chapter 14 is intended to provide a bridge from the basic seismic design methodologies contained in the *Provisions* to nonbuilding structure design practices, the reference documents have been updated.

Given the evolving nature of Chapter 14, the 2000 *Provisions* requirements for tanks and vessels have been moved from the Appendix to Chapter 14 into the chapter itself as a result of changes in voluntary standards and other research.

Sections on electrical transmission, substation, and distribution structures that were included in the 1997 *Provisions* text have been moved to the appendix since these lifelines systems generally do not fall under the jurisdiction of the code official. Other sections on telecommunication towers and buried structures also have been moved to the appendix because additional time is needed by the respective industries to evaluate the requirements presented. The *Commentary* sections on buried structures, pipe racks, earth retaining structures, and steel storage racks have been expanded as has the *Provisions* section on steel storage racks.

The importance factors and Seismic Use Group classifications in Chapter 14 have been revised to be consistent with *Provisions* Sec. 1.3; consequently, there are similar changes in the *Commentary* where the four examples in Table 14.2.1.2 have been modified to clarify the use of these factors.

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1.2.5 Alternate Materials and Alternate Means and Methods of Construction
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1.3.2 Seismic Use Group II
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3.4.5 Mechanical and Electrical Equipment
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CABO Code
NFoPA T903
PS20
ANSI/AITC A190.1
ASTM D5055-95A
PS 1
PS 2
ANSI 05.1
ANSI A208.1
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Appendix B

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