2020 NEHRP PROVISIONS SEISMIC PERFORMANCE OBJECTIVES

R. Pekelnicky

ABSTRACT

The 2020 NEHRP Provisions Update Committee has tasked a team with reviewing and better defining the seismic performance objectives for buildings and other structures designed to the provisions. This talk summarizes the qualitative performance objectives of previous editions of the Provisions and the current quantitative safety performance objectives. Following that is a discussion of the updated qualitative and quantitative performance objectives as they related to both safety in the Maximum Considered Earthquake and function protection in the design earthquake and other earthquakes. Additionally, there is discussion about potential revisions to seismic design categories.

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EXTENDED ABSTRACT

The 2020 NEHRP Provisions Update Committee has tasked a team with reviewing and better defining the seismic performance objectives for buildings and other structures designed to the provisions. This talk summarizes the qualitative performance objectives of previous editions of the Provisions and the current quantitative safety performance objectives. Following that is a discussion of the updated qualitative and quantitative performance objectives as they related to both safety in the Maximum Considered Earthquake and function protection in the design earthquake and other earthquakes. Additionally, there is discussion about potential revisions to seismic design categories.

The 2009 Provisions introduced the concept of ordinary structures (Risk Category I & II) being designed to have a 10% probability of collapse under the risk targeted maximum considered earthquake (MCE\textsubscript{R}) shaking intensity. That number was based on work carried out in the FEMA P-695 project, which examined the collapse potential of architype buildings designed to the Provisions. Collapse reliabilities was also proposed for Risk Category III and IV structures of 5% and 2.5% given MCE\textsubscript{R} shaking intensity. This effectively creates a performance objective of resisting collapse in the MCE\textsubscript{R} shaking intensity. However, there is no specific performance objective provided for the design earthquake (DE).

The 2016 edition of ASCE 7 introduced a requirement that buildings and other structures designated as Risk Category IV and their nonstructural systems should be designed to allow resumption of function of the facility following the design environmental hazard. For earthquakes, that is implied to be the DE. There are a number of additional requirements placed upon Risk Category IV structures that are intended to prevent loss of function following the DE. They are increased design forces, significantly reduced maximum story drift limits, and requirements for certified nonstructural components and systems. This presentation discusses the implications of those requirements, whether they provide the intended function protection, and if so, at what reliability.

In the Provisions, seismic design requirements are dependent upon the level of seismicity of the project site. The Provisions have six different categories, based on ground shaking intensity. The lowest category, A, does not require any consideration of earthquake forces in the building design. The next two categories, B and C, require consideration of earthquake forces with no or only a few design requirements, such as prohibiting certain structural systems or requiring special detailing.

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The highest three categories, D, E, and F, require special seismic systems and begin to prohibit various types of structural irregularities. Additionally, nonstructural design requirements begin to be applicable in C, but are not fully required until D and higher. A review of earthquake damage from recent earthquakes correlated with shaking intensity indicates that six categories may not be required and the Provisions intent could be achieved with fewer. This presentation will summarize that study and discuss options for reducing to two or three categories.