DESIGN AND ANALYSIS

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D1 Systems, $R$-factors

- Simplification of ASCE 7 Table 12.2-1, with ordinary, intermediate, and special systems having the same $R$-values irrespective of material
- Need for minimum detailing levels for moderate and high SDCs
- Need for height limits
D1 Systems, $R$-factors

- Life safety in the 10/50 earthquake to
- Collapse prevention in the 2/50 earthquake to
- 10% probability of total or partial collapse, given the occurrence of $MCE_R$

$R$-values (and probably seismic design coefficients) need to be reexamined

NIST GCR 12-917-20


NEHRP
FEMA
Building Seismic Safety Council
A council of the National Institute of Building Sciences
SDC Based on 1-sec Period Response Acceleration – ASCE 7-16

<table>
<thead>
<tr>
<th>Values of $S_{D1}$</th>
<th>RISK CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I or II</td>
</tr>
<tr>
<td>$S_{D1} &lt; 0.067$</td>
<td>A</td>
</tr>
<tr>
<td>$0.067 \leq S_{D1} &lt; 0.133$</td>
<td>B</td>
</tr>
<tr>
<td>$0.133 \leq S_{D1} &lt; 0.20$</td>
<td>C</td>
</tr>
<tr>
<td>$0.20 \leq S_{D1}$</td>
<td>$D^a$</td>
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</tbody>
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<tr>
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<td>I or II</td>
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<tr>
<td>$S_1 \geq 0.75g$</td>
<td>E</td>
</tr>
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</table>
D2 Seismic Design Categories

- Continued need for SDCs?
- Reassessment of the cut-offs between various SDCs. (IRC has split SDC D into several SDCs).
- Possible consolidation of SDCs
D3 Structural Irregularity

• Research is currently underway to investigate system irregularity provisions (ATC 123).
• The research results should be reviewed and incorporated into Provisions as appropriate.
D4 Short-Period Buildings

- Analytical studies show collapse probability of short-period buildings often exceeding 10% in MCE\textsubscript{R}.
- Observations in recent earthquakes do not support this finding.
- Research is underway to resolve the paradox (ATC 116).
- Research results should be reviewed and incorporated into the Provisions as appropriate.
D5 Acceptance Criteria Reconciliation

- ASCE 7-16 Chapter 16 acceptance criteria for force-controlled and deformation-controlled components and its consideration of unacceptable response are inconsistent with those of ASCE 41-13.
- Consistency would be most desirable. At the very least, commentary should be provided where consistency is lacking.
D6 Diaphragm Design

• To use the alternate diaphragm design force level beyond the limited systems currently listed, the development of a methodology for determination of reduction factor $R_s$ is required.
• This will entail development of testing and analysis procedures across construction materials as well as material-specific implementation of such procedures.
D7 Transfer and Inertial Forces in Diaphragms

One approach to analyzing the combination of transfer and inertial forces ...

Alternative approaches also available.
D8 Modal Response Spectrum Analysis

Several issues identified, including:

- Reduction by $R$ only in the first mode (assuming higher modes are elastic)
- Application of accidental torsion to MRSA
- Considering elimination of MRSA in view of the inclusion of Linear Response History Analysis in the 2015 NEHRP Provisions.
D9 Rigid Wall Flexible Diaphragm Buildings

- FEMA P-1026, *Seismic Design of Rigid Wall-Flexible Diaphragm Buildings: An Alternative Procedure*
- Methodology applicable only to very simple building configurations
- Expand applicability
D10 Seismic Design Categories

- For $S_{DS} < 0.167g$ and Risk Category IV, SDC A should change to B?
- For $S_{D1} < 0.067g$ and Risk Category IV, SDC A should change to B?
D11 Full System Modeling

Including all of the following features:
1. Three dimensional analysis
2. Semi-rigid diaphragms
3. P-Delta effects
4. Orthogonal load effects
5. Dynamic effects [using MRS or LRH in lieu of ELF]
6. Accidental torsion and torsional amplification
7. Location for evaluating deformations
8. Inclusion of structural components that are not part of the lateral force-resisting system