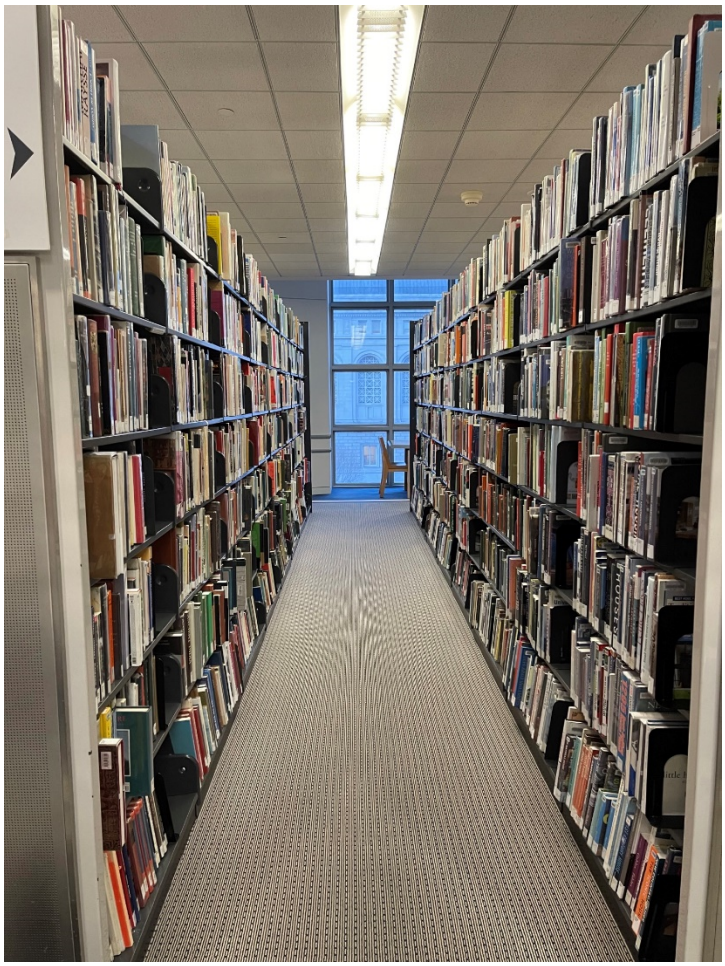

A Step Forward

Recommendations for Improving Seismic Code Development, Content, and Education

FEMA P-2191 / April 2022

FEMA

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A Step Forward: Recommendations for Improving Seismic Code Development, Content, and Education

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Foreword

The 2018 National Earthquake Hazards Reduction Program (NEHRP) Reauthorization Act (PL 115-307) requires the Federal Emergency Management Agency (FEMA) to support preparation, maintenance, and wide dissemination of related information on building codes, standards, and practices for new and existing buildings, and support model building codes that are cost effective and affordable to promote better practices within the design and construction industry and reduce losses from earthquakes. To fulfill this requirement, FEMA has collaborated with other NEHRP agencies, national code and standard organizations, construction material industries, and public and private partners to develop code resources, support code and standard consensus processes, and provide trainings and dissemination of new changes to the national seismic standard and code.

U.S. seismic codes and standards consist of comprehensive technical provisions and guidelines and continue to change as new knowledge and technologies emerge. To ensure seismic codes and standards meet the NEHRP expectations and the earthquake community's needs, FEMA and the Building Seismic Safety Council (BSSC) of National Institute of Building Sciences formed a Project Task Group to reach out and obtain broad feedback from practitioners, stakeholders, and relevant professionals. This report compiles the results of the surveys and interviews conducted by the BSSC Project Task Group on the current seismic code development process, code content and ease of use, and education regarding code changes. The report also includes recommendations and suggested areas of improvement.

FEMA is thankful to the BSSC, the chair and members of the Project Task Group, and the participants of the surveys and interviews conducted by the Project Task Group for the extensive opinions and invaluable recommendations collected and compiled in this report. It is encouraging that the recommendations related to the *NEHRP Provisions* will be considered by the 2026 NEHRP Provisions Update Committee for improving the development of the code resource and communication with engineering practitioners. Hopefully, this report will be helpful to code and standard organizations for related future improvement.

Federal Emergency Management Agency

Preface

The *NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (*NEHRP Provisions*) have played key roles in the development of seismic codes and standards in the United States. It has made it possible to develop nationally applicable seismic regulations with broad support, and it reduces the nation's seismic risk as new construction incorporates features of the *NEHRP Provisions.* The Building Seismic Safety Council (BSSC), and in large, the National Institute of Building Sciences (NIBS), are proud to be part this effort and thankful to NEHRP agencies (FEMA, NIST, USGS, and NSF), our industry partners, and most importantly, hundreds of national experts for their dedicated support and significant contributions.

As the BSSC completed the 2020 *NEHRP Provisions*, 10th edition, the Federal Emergency Management Agency (FEMA) engaged the BSSC to take a broader look at the U.S. seismic codes and standards development and understand what has worked, what has not, and what we need to improve. The project has focused on three topic areas: improving the standard and code development process, making the standards and codes easier to use, and improved communication with the engineering community and the public.

We are thankful to the FEMA leadership and FEMA Project Officer, Mai Tong, for their vision of initiating and leading this effort.

The BSSC is grateful to the Project Task Group, including Bret Lizundia (Chair), Susan Dowty, Julie Furr, Emily Guglielmo, Jim Harris, Sandra Hyde, Ron LaPlante, and Sharyl Rabinovici for their expertise, dedicated support, and generous contributions. They made the project possible.

We are also fortunate and grateful for the support from our Provisions Update Committee members, representatives from our partner organizations, and industry participants. They generously gave their time and expertise to answer questionnaires and participate in interviews, which led to many of the important findings and recommendations.

From the start, it is BSSC's mission to enhance public safety by providing a national forum that fosters coordination of and improvements in seismic planning, design, construction, and regulation in the building community. We look forward to continuing to work with our partner organizations to implement many of the recommendations suggested in the report!

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Notice

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Executive Summary

The *NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* serves as the starting point for updates to U.S. seismic code provisions. The recommendations are reviewed, codified, and incorporated into standards language in the ASCE/SEI 7 standard *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. ASCE/SEI 7 is referenced by the International Building Code (IBC), and the IBC in turn is used as the model code for the building codes adopted by state and local jurisdictions in the U.S. FEMA contracts with the National Institute of Building Sciences and its Building Seismic Safety Council (BSSC) to prepare the *NEHRP Provisions*. The technical provisions and updates are developed by the Provisions Update Committee (PUC) of the BSSC.

At the end of the 2020 *NEHRP Provisions* cycle, the PUC prepared a set of recommendations on issues to be addressed moving forward. A key recommendation was to study ways to improve the seismic code development process to better serve the engineering community. In 2021, FEMA engaged BSSC to convene a carefully selected Task Group made up of a diverse set of knowledgeable seismic code specialists and advisors to carry out the effort. This report documents the study findings, conclusions, and recommendations.

Report Purpose: The purpose of this report is to (1) identify ways to improve U.S. seismic code and standard development for new buildings, (2) identify areas where improved content and ease of use would be beneficial, and (3) identify how to better disseminate seismic code updates and to provide education about the code to practicing engineers and building officials.

Target Audience: There are three target audiences for this report: (1) BSSC and PUC leadership to provide near term advice in planning for their upcoming 2026 *NEHRP Provisions* cycle that runs from 2022-2026, (2) ASCE 7 Seismic Subcommittee leadership to provide advice in planning for the upcoming ASCE/SEI 7-28 update cycle that runs from 2022-2028, and (3) NEHRP agencies (FEMA, NIST, USGS, and NSF) and other relevant stakeholders such as the International Code Council (ICC) and material standard organizations to provide broader advice on seismic code development, content, and education.

Study Methodology: The Task Group selected the following four-phase approach:

- *Phase 1: Task Group brainstorming and discussion about issues and possible solutions.*
- *Phase 2: Online surveying of targeted building code users and other stakeholders.* A User Survey targeted practicing civil, structural, and geotechnical engineers, and code officials who are the direct users of the building code. A Stakeholder Survey was developed for a broader group of other stakeholders like building owners and developers, contractors, construction industry representatives, material trade organization representatives, plans examiners, owners, structural and geotechnical engineering professors and researchers, manufacturers of products subject to seismic requirements, government officials, and earthquake program specialists. There were 56

respondents to the User Survey and 33 respondents to the Stakeholder Survey. The survey results provided information on code use, satisfaction and effectiveness of seismic codes and standards for the intended protections, and geographical variation of opinions by code users and stakeholders. See Chapter 3 for details.

- *Phase 3: Focused interviewing of PUC members and other experienced code developers in small groups.* Pairs of Task Group members interviewed small groups of two to four interviewees for 90 minutes, using a set of questions developed from survey input on ways to improve seismic code development, content and ease of use, and dissemination and education. A total of 27 individuals were interviewed, including nearly all of the 2016-2020 PUC members.

- *Phase 4: Synthesizing and evaluating findings, conclusions, and recommendations by the Task Group.* A summary of recommendations is given below. See Chapter 6 for details. Recommendations are organized into the major categories of code development, content, and education, and into high and medium priorities.

Priority	ID	Recommendation
Improve Code Development		
High	D1	Increase seismic code developer diversity
	D2	Conduct pre-cycle regional workshops
	D3	Require paid worked examples for proposed code changes
Improve Code Content and Ease of Use		
High	C1	Address functional recovery and enhanced resilience in model code framework
	C2	Make low and moderate seismic provisions more usable
Medium	C3	Develop more usable performance-based procedures for design
	C4	Develop construction quality assurance *NEHRP Provisions* Part 3 resource paper
	C5	Improve seismic code provisions for foundation design
Improve Dissemination and Education on Code and Code Changes		
High	E1	Develop coordinated strategy for improving understanding of seismic codes
	E2	Develop interactive online platform for seismic code provisions
Medium	E3	Expand commentaries
	E4	Develop more design guides
	E5	Outreach to geotechnical engineers
	E6	Publicize upcoming code changes and input opportunities
	E7	Develop more webinars, archived and available on demand
Monitoring and Encouraging Progress		
High	M1	Track progress of recommendations

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Chapter 1: Introduction

1.1 Background

Seismic code development in the U.S. is a complex process that involves many individuals and organizations. Most of the people are volunteers, who generously give their time and expertise to help improve code provisions so that buildings are safer, and designs are more efficient. The process involves several key organizations and documents. First, the Federal Emergency Management Agency (FEMA) contracts with the National Institute of Building Sciences (NIBS) and its Building Seismic Safety Council (BSSC) to prepare the *NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (identified here as the *NEHRP Seismic Provisions*). The technical provisions and updates are developed by the Provisions Update Committee (PUC) of the BSSC. Then, the BSSC works with the American Society of Civil Engineers (ASCE) Seismic Subcommittee to review, codify, and incorporate the *NEHRP Seismic Provisions* into standards language incorporated in ASCE/SEI 7 standard *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. Next, ASCE/SEI 7 is referenced by the International Building Code (IBC). Finally, the IBC in turn is used as the model code for the building codes adopted by state and local jurisdictions in the U.S. Figure 1-1 illustrates highlights of how seismic building code regulations are developed.

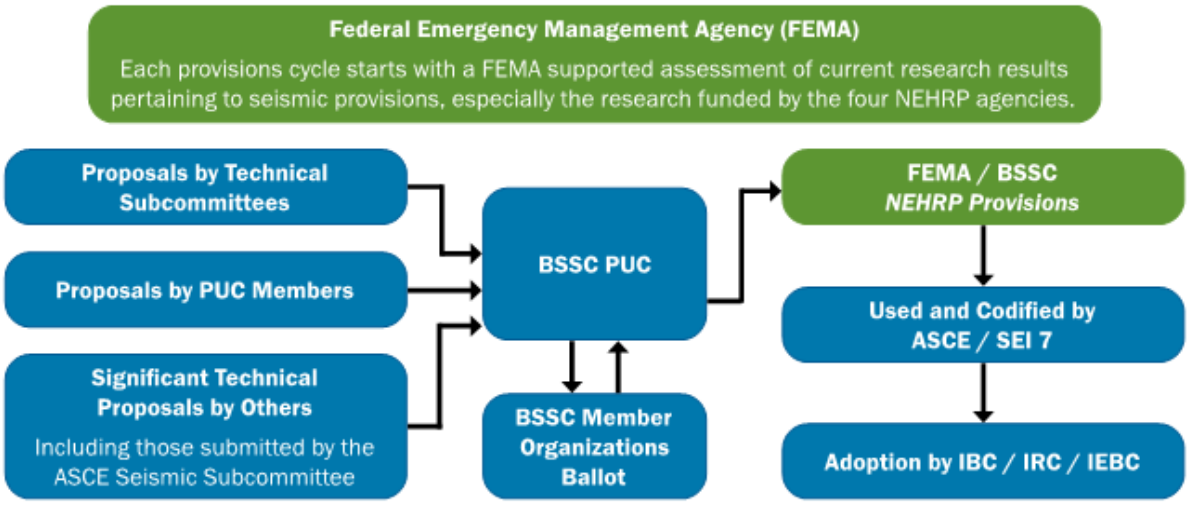

Figure 1-1. Flow Chart Illustrating How Seismic Building Code Regulations Are Developed (from FEMA, 2021b)

The *NEHRP Provisions*, ASCE/SEI 7, and the IBC follow an interlinked cycle of development and publication. The 2020 *NEHRP Provisions* (FEMA, 2020a) was published at the end of a 2016-2020 cycle. ASCE/SEI 7-22 (ASCE, 2021) was published in December 2021. It is anticipated that ASCE/SEI 7-22 will be adopted by the 2024 IBC. The *NEHRP Provisions* and ASCE/SEI 7 reference material standards for seismic provisions specific to individual materials, such as steel (AISC 341) or

concrete (ACI 318). Material standard updates are also generally coordinated with the *NEHRP Provisions* and ASCE/SEI 7 development cycle.

At the end of the 2020 *NEHRP Provisions* cycle, the PUC prepared the *NEHRP Future Provisions and Research Needs Identified During the Development of the 2020 NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (BSSC, 2020) to help identify issues that need to be resolved in the future. In the section entitled "Overarching Issues," the first recommendation is the following:

> *Outreach and engagement of wider involvement in the code development process. Knowledgeable, experienced practicing professionals have been commenting with increasing frequency over the last few years that the code development process and its outcomes are not serving the community well. This goes beyond the traditional request for the code to be simpler and something that is not obviously broken should not be changed. The Provisions Update Committee (PUC), the Building Seismic Safety Council (BSSC), and the Federal Emergency Management Agency (FEMA) need to think more deeply about how to improve engagement and education so that the code development process targets what the wider community really wants and needs.*

After discussions between PUC members, BSSC, and FEMA about this issue and potential next steps, FEMA engaged BSSC to consider the issue in more detail, better define the scope of study, and develop recommendations. BSSC convened a carefully selected Task Group made up of a diverse set of knowledgeable seismic code specialists and advisors to carry out the effort. The 2021-2026 cycle for the 2026 *NEHRP Provisions* will begin soon. This timing provides an excellent opportunity to be able to implement the Task Group's recommendations at the start of the cycle.

1.2 Purpose of the Report

While the general public expects seismic codes and standards to provide sufficient regulation for building design and construction to meet the required level of seismic performance, there are many areas where seismic codes and standards can be improved. This report helps to capture the opinions and recommendations of seismic code and standard developers, users, and other stakeholders. The purpose of this report is to:

- Identify ways to improve U.S. seismic code and standard development.
- Identify areas where improved content and ease of use would be beneficial.
- Identify how to better disseminate seismic code updates and to provide education about the code to practicing engineers and building officials.

1.3 Scope of the Report

The scope of the study includes the following:

- Surveying seismic code users and related construction industry professionals.
- Interviewing experienced seismic code development participants.
- Synthesizing findings from surveys, interviews, and committee discussions into recommendations for key stakeholders.

1.4 Target Audience for the Report

There are three target audiences for this report:

- BSSC and Provisions Update Committee leadership to provide near term advice in planning for their upcoming 2026 NEHRP Provisions cycle that runs from 2021-2026.
- ASCE 7 Seismic Subcommittee leadership to provide advice in planning for the upcoming ASCE/SEI 7-28 code cycle that runs from 2022-2028.
- NEHRP agencies (FEMA, NIST, USGS, and NSF) to provide broader advice on seismic code development, dissemination, and education.

It is anticipated that other organizations involved in seismic code development, such as the International Code Council, state engineering groups, publishers, and educators will also find the report of value in setting priorities and planning their efforts for the future.

1.5 What is Covered (and Not Covered)

The report addresses seismic code development, code content and ease of use, and dissemination and education as summarized below.

Seismic Code Development: This report focuses on **seismic** code development for **new** buildings. The broader development of the overall building code is outside the scope, as are standards and code development for existing buildings. Pertinent current documents and standards are the following. A new development cycle is about to begin for the *NEHRP Provisions* and for ASCE/SEI 7.

- *NEHRP Recommended Seismic* Provisions for New Buildings and Other Structures, including Part 1 Provisions, Part 2 Commentary, and Part 3 Resource Papers, FEMA P-2082-1 and FEMA P-2082-2, September 2020 (FEMA, 2020a and FEMA, 2020b). See Figure 1-2.
- The seismic provisions in ASCE/SEI 7-22, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (ASCE, 2021).

In addition, the scope of the project study did not include the International Building Code or the International Residential Code.

Seismic Code Content and Ease of Use: Although specific technical content is discussed in the report, it was not the primary focus of the study. General areas of need and interest from stakeholder surveys and interviews are mentioned, but the specific details are the purview of code development committees and are outside the report scope.

Dissemination and Education on Seismic Codes and Code Changes: The report also provides recommendations on how code changes are disseminated to users and how to better educate them on the rationale and use of the provisions. Pertinent documents of interest include the following. It is likely that they will be updated in the new development cycle for the *NEHRP Provisions*.

- 2015 *NEHRP Recommended Seismic Provisions Design Examples,* FEMA P-1051, July 2016 (FEMA, 2016).
- 2020 *NEHRP Recommended Seismic Provisions: Design Examples, Training Materials, and Design Flow Charts*, *Volume I: Design Example*s, FEMA P-2192-V1 (FEMA, 2021a). See Figure 1-2.

Figure 1-2. 2020 *NEHRP Provisions* (FEMA, 2020a) and 2020 *NEHRP Provisions Design Examples* (FEMA, 2021a)

1.6 Organization of the Report

The remainder of the report is organized as follows.

- **Chapter 2, Study Methodology**, discusses the study investigation alternatives that were considered and the details of the selected methodology.
- **Chapter 3, Survey Approach and Findings**, summarizes the surveys that were conducted and synthesizes the findings from respondents.
- **Chapter 4, Interview Approach and Findings**, summarizes the interviews that were conducted and synthesizes key findings from the discussions.
- **Chapter 5, Synthesis and Evaluation of Potential Recommendations**, synthesizes and evaluates potential recommendations from the surveys, interviews, and committee participant input, and it includes general conclusions.
- **Chapter 6, Recommendations**, provides a summary and detailed discussion of recommendations that have been developed for improving code development, improving code content and ease of use, and improving dissemination and education about codes and content. The recommendations are categorized into high and medium priorities and identify what organizations would be involved and whether funding is needed.

A reference section, glossary, and a list of project participants are provided at the end of the report, together with appendices that provide additional information on the surveys.

Chapter 2: Study Methodology

2.1 Information Gathering Options Considered

To gain greater insight and a more complete view of issues and opinions for the study, the Task Group decided to reach out and obtain advice from practicing engineers and code officials, other stakeholders, and members of the PUC for the 2016-2020 cycle.

Various options were considered for gaining information. They included:

- *Surveys through industry group mailing lists vs. surveys targeted to specific individuals:* Using the mailing list of an industry group, such as ATC, EERI, SEAOC, NCSEA, to distribute a survey was discussed. This would yield a large number of names and responses, even if the percentage of responses was small. However, it would require the organization's permission and the list would not necessarily target the specific groups of interest. Instead, a smaller, more focused list of individuals in the target demographic set was preferred and where the survey could be somewhat more detailed, the size of the survey group and responses would permit more detailed analysis of results.

- *Single survey or multiple surveys developed for different groups:* The Task Group debated whether to use a single survey or to develop different surveys for different types of groups. Some questions of interest apply to everyone; others are more specific. For example, questions about codes specifics and the extent of use are better tailored to those who use codes more frequently in practice. It was decided that multiple surveys were more appropriate.

- *Multiple choice or open-ended survey questions:* Asking multiple choice questions reduces the time needed for the respondent and reduces the complexity of information processing. However, it does not give the interviewee an opportunity to share their concerns and interests, or the rationale behind them. A combination of multiple-choice and open-ended questions was preferred.

- *Interviews of representative stakeholders:* Surveys only permit a one-way flow of information with the respondent answering a question. Even when open-ended questions are asked in the survey, there is no ability to discuss the issue. One possibility was to select a subgroup of representative stakeholders and interview them. They could be a subset of the survey respondents, perhaps from those who identified an interest in being interviewed.

- *Interviews of PUC members:* Since a key focus of the study is aimed at providing recommendations to the PUC leadership, interviewing PUC members was a high priority with the Task Group. The PUC members are typically very experienced engineers who are also very involved in code development and education. Since many of the past PUC members will likely continue on in the next cycle, gaining PUC insights and interest in recommended improvements is essential.

- *Invited workshop:* Many applied research projects or information gathering projects include an invited workshop to bring a group together to discuss draft findings and conclusions and to test out the viability and desirability of draft recommendations. Due to this study being performed entirely during the Covid pandemic, a workshop would need to be done online as a conference call. The Task Group decided that interviews with the PUC members would be able to serve somewhat like breakout groups in an invited workshop if the interviews were conducted in small groups.

- *Internal workshop of Task Group and BSSC/FEMA:* To synthesize and evaluate potential recommendations from the surveys and interviews, an "internal workshop" of the Task Group members was considered. Due to this study being performed during the Covid pandemic, this idea evolved into a set of key conference calls of the Task Group and BSSC/FEMA representatives.

2.2 Selected Approach

After considering the above options, the Task Group decided on the following four-phase approach:

- Phase 1: Task Group brainstorming and discussion about issues and possible solutions.

- Phase 2: Online surveying of targeted building code users and other stakeholders.

- Phase 3: Focused interviewing of PUC members and other experienced code developers in small groups.

- Phase 4: Synthesizing and evaluating findings, conclusions, and recommendations by the Task Group into this report.

The selected approach permitted information collection from a reasonably diverse group of professionals from different occupations and different parts of the country through the surveys, including some quantitative information. The surveys results helped generate focused topics of discussion with the interviewees. Figure 2-1 shows a graphic of the four phases. Table 2-1 summarizes key study design variables of the approach.

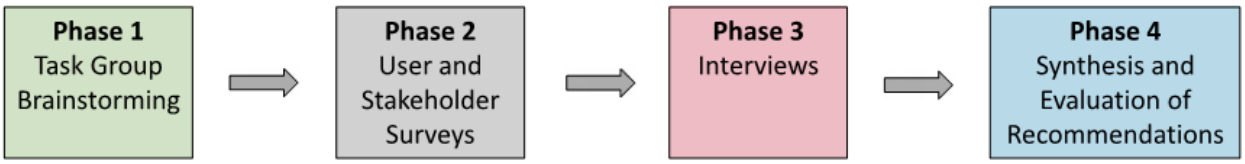

Figure 2-1. Project Study Phases

Table 2-1: Study Design Data Collection Summary: Narrowly Targeted Recruitment/Tailored Data Collection Approach

	Group 1: Direct Code Users	Group 2: Other Stakeholders	Group 3: PUC Experts
Target Participants	Practicing engineers (SE, PE, GE) and code officials. Mix of past involvement in code development process.	Key external groups such as structural and geotechnical engineering professors, hazard scientists, contractors, owners, vendors, and material trade groups,	Persons with direct current expertise in PUC/BSSC committees, plus select researchers that have gone through the PUC process and ATC/FEMA/NIST/PEER reps.
Recruitment Strategy	1-to-1 solicitation of known persons identified by committee and informal cooperation w/prof associations/MOs as needed.	1-to-1 solicitation of known persons identified by committee and informal cooperation w/prof associations/MOs as needed.	1-to-1 solicitation of known persons identified by committee.
Data Collection Format/Length	~20-30 min online survey tailored to participant knowledge set.	~15 min online survey of broad "impression" questions.	90 min small group interviews
Question Emphasis	Moderate complexity, closed and a few open ended, feedback on broad reform ideas, solicit broad suggestions.	Low to moderate complexity, closed and a few open ended, assess understanding of broad concepts, detect major issues or ideas inner circle people wouldn't necessarily see, solicit suggestions.	High topic sophistication, open ended + discussion, feedback on specific reform ideas, solicit specific suggestions.
Expected Participant Count/Response Rate	Mid tens (qualitative summary, comparisons)/~50%	Mid tens (qualitative comparisons)/~25%	5-10 / 90%+
Timeframe (excluding analysis)	6-8 weeks	6-8 weeks	4-6 weeks
Sequence/ Relationship Among Groups	• Survey designed to inform interactions with Group 3.	• Results used to inform interactions with Group 3.	• Take the place of "interview" phase. • Discuss results from Groups 1 and 2.

2.3 Surveys

During the surveying phase, two unique groups were surveyed with separate surveys specifically tailored for each group.

- *User Survey:* The first survey was targeted to practicing civil, structural, and geotechnical engineers, and code officials who are the direct users of the building code.

- *Stakeholder Survey:* The second survey was developed for a broader group of other stakeholders like building owners and developers, contractors, construction industry representatives, material trade organization representatives, plans examiners, owners, structural and geotechnical engineering professors and researchers, manufacturers of products subject to seismic requirements, government officials, and earthquake program specialists.

Survey questions were developed by the Task Group and distributed by the BSSC to the targeted individuals. The user survey was longer and more detailed; the stakeholder survey was shorter and broader. Results were processed by Task Group members. The surveys are in Appendix B, and details about the survey process and findings are in Chapter 3.

2.4 Interviews

Results from the user and stakeholder surveys were used by the Task Group to develop topics, questions, and possible recommendations for the interviews. Interviews were held with key participants in the PUC and ASCE 7 Seismic Subcommittee and other individuals with experience in the PUC process such as the BSSC Board of Directors, leading researchers, and ATC/FEMA/NIST representatives. Two options were considered for the interviews:

- Option A: One on one interviews.

- Option B: Focus group of two to four interviewees.

Both to limit the effort, but also to generate more discussion, Option B was chosen. The interviewees were divided into groups of typically three individuals, although there were some groups with two and some with four interviewees. They were interviewed by two Task Group members about a set of questions and potential recommendations which were distributed in advance. The questions and potential recommendations and details about the interview process and findings are in Chapter 4.

2.5 Synthesis and Evaluation of Recommendations

Task Group members collated findings from the interview questions, looking for recommendations that were considered to be a high priority by PUC members, survey respondents, and Task Group members. As results were synthesized and discussed, some options were combined, and other new ideas and issues were identified. Recommendations were organized into “high priority” and “medium priority.” Organizations that would be involved in implementing the recommendations were

identified, as well as whether funding is needed. Conclusions from the synthesis and evaluation process are described in Chapter 5, and final recommendations are given in Chapter 6.

Chapter 3: Survey Approach and Findings

3.1 Overview

The project Task Group designed and implemented two online surveys in April 2021 to obtain input from professionals who use or whose work is affected by U.S. seismic codes. Members of the Task Group then used the responses to refine their understanding of perceived issues and to develop a robust set of ideas for improvement initiatives that were then tested and elaborated on in the interviews and report writing. The surveys are shown in Appendix B.

As shown in Figure 3-1, 89 people from a variety of professions and regions of the U.S. participated in the surveys, giving the Task Group valuable information about the range of opinions and ideas about U.S. seismic code development, code use and content, and education.

User Survey

- ☐ Practicing Structural and Civil Engineers (38)
- ☐ Code Officials (18)

Total Participants: 56

Stakeholder Survey

- ☐ Structural Engineering Professor / Researcher (11)
- ☐ Code Agency Employee (5)
- ☐ Material Trade Organization Representatives (5)
- ☐ Government (3)
- ☐ Vendor / Manufacturer (3)
- ☐ Contractor / Construction Industry (2)
- ☐ Plans Examiners(2)
- ☐ Non-Profit Leader (1)
- ☐ Building Owner / Developer (1)
- ☐ Fire Engineer (1)

Total Participants: 33

Figure 3-1. Participation by Profession in the User and Stakeholder Surveys

3.2 Survey Approach and Implementation

The Task Group implemented two separate, but similar, surveys based on the idea that the types, topics, and wording of questions that would make sense to each respective group would differ. One survey targeted persons with direct experience with U.S. seismic codes such as practicing engineers (SE, CE, GE) and code officials. These are hereafter referred to as the Users.

The second survey version targeted a broader group of persons directly or indirectly affected by seismic codes, hereafter referred to as the Stakeholders. These individuals included engineering researchers and academics, trade organization and government representatives, owners, vendors, construction industry leaders, and others.

3.2.1 Targeted Audiences and Recruitment

The Task Group elected to send each survey to a sample pool of professionals classified as either a User or Stakeholder. Task Group members brainstormed potential contacts representing different targeted regions of the U.S. (West, Central/Mountain, and East) and professions, and asked for advice from colleagues and initial contacts about other people who should be invited. One goal was to reach a range of professionals who interact with U.S. seismic codes with varying purposes, frequency, and background knowledge. Another objective was to reach professionals who use U.S. seismic codes for projects in places of low, medium, and high seismicity.

A balanced target audience was critical. The Task Group wanted to survey individuals with sufficient knowledge of U.S. seismic codes and code development, yet find voices and perspectives which are not traditionally heard in the current code development process. Collecting broader input was a central goal.

The Task Group considered fielding a broad based survey with open recruitment facilitated by partnering with professional associations, but settled on deliberate, narrower recruitment as more in alignment with project resources and timeline. The selected strategy offered a reasonable chance of capturing diverse representation and variation relative to implementation cost, control, and difficulty.

The resulting sample sizes were modest: 89 in total, including 56 Users and 33 Stakeholders. Convenient sample selection strongly influenced who the surveys reached; any interpretation of the responses should keep this in mind. While efforts were made to reach earlier career professionals, such as by contacting the EERI Young Professionals Committee, 80% of responding Users described themselves as having 15 years or more of experience, as did 91% of responding Stakeholders. Fewer members of the Task Group hail from the Central/Mountain and East regions, and those regions contain more areas of lower seismicity. Both these factors affected how many invitees were identified and responded from those states, with highest representation from the West. User respondents varied in their location of practice from the West (37 or 66%), Central/Mountain (14 or 25%), and East (5 or 9%).

Table 3-1: Distribution of User and Stakeholder Survey Participants by Region

Region	User Survey	Stakeholder Survey	Totals
West	37 (66%)	8 (24%)	**45 (56%)**
Central/Mountain	14 (25%)	10 (30%)	**24 (27%)**
East	5 (9%)	15 (45%)	**20 (22%)**
Totals	**56 (63%)**	**33 (37%)**	**89 (100%)**

Following an email invitation letter with two reminders sent over a three-week period in April 2021, voluntary participants answered a mix of multiple choice and open ended questions via an online JotForm platform. Overall, 89 of the total invited participants responded, including 60% of recruited Users (56/93) and 47% of recruited Stakeholders (33/70). Survey samples of this size are useful for indications of variation and ranges of beliefs and idea generation, but not for statistical inference or hypothesis testing.

3.2.2 Survey Question Topics

There were 54 questions on the User Survey and 29 questions on the Stakeholder Survey. Both surveys emphasized multiple choice questions (primarily on five-point categorical scales) to allow computation of counts and percents and reveal variation in degrees of feeling. The 11 open-ended questions in the User survey and the six open-ended questions in the Stakeholder survey offered participants chances to either comment further or make suggestions. Three multiple choice questions overlapped between the two surveys, allowing for some comparison of answers across groups. Open-ended questions were optional; therefore, only a subset of participants answered any particular question.

Question lists for both surveys were organized by the three overall study themes: Code Content and Ease of Use, Code Development, and Code Dissemination and Education. However, the surveys varied in their terminology and depth of implied experience and understanding of U.S. seismic codes, as detailed in the following sections.

3.2.3 Open-Ended Questions

The open-ended questions on both surveys, though voluntary, were important because they gave respondents a chance to follow up on why they have a certain opinion and to offer specific suggestions on what should or could be done differently. One catch all question at the end allowed

respondents to offer any more thoughts that they had not had a chance yet to convey. About one quarter of respondents overall chose to answer some open-ended questions, so these findings are anecdotal and not representative of the sample as a whole, but they were still very helpful in the Task Group's thought process and deliberations.

Figure 3-2 lists the unique open-ended questions in the User Survey; Figure 3-3 shows the unique open-ended questions in the Stakeholder only; and Figure 3-4 lists open-ended questions that appeared in both surveys.

- "Please describe any ***other seismic code information resources*** you use."
- "Please share any other thoughts you have about the ***content and usability of current U.S. seismic codes and provisions*** (including your own concerns or issues you may hear frequently about from clients or colleagues)."
- "How can we ***reach and involve more practicing engineers*** in the process of developing and updating U.S. seismic codes and standards?"
- "How can U.S. seismic code and resource development organizations (like BSSC, FEMA, ASCE and ICC) ***involve a more diverse group of professionals*** in the seismic code development process, including years of experience, geographic location, gender, and race/ethnicity?"
- "How can organizations involved in developing U.S. seismic codes and resources ***better nurture and facilitate innovation*** in the code development process?"
- "Please share any other ***concerns or suggestions*** you haven't had a chance to say yet about the *seismic code development process* in the U.S."
- "Please tell us any ideas you have for **making the *NEHRP Seismic Provisions: Design Examples* document more effective**."
- How well do current methods of learning and working with U.S. seismic codes ***meet the needs of people in your profession or the types of projects you work on***? If they aren't, why are U.S. seismic codes not meeting your needs?

Figure 3-2. Open-Ended Questions Asked in the User Survey

- *"Please share any ideas for how to **encourage innovation and use of new concepts and technologies** in U.S. seismic codes and standards from your perspective."*
- *In your opinion, **are earthquake safety or performance issues currently well-addressed** in U.S. seismic codes and standards? If not, please tell us what earthquake issues are not well-addressed by current U.S. seismic codes.*
- *When U.S. seismic codes and standards are changed, do you feel the **changes and the rationale behind them are generally well-explained**? What could help better explain U.S. seismic codes and standard changes?*

Figure 3-3. Open-Ended Questions Asked in the Stakeholder Survey

- "How well do you think current U.S. seismic codes and standards meet the needs of all regions of the United States?"
- "How else could U.S. seismic code and resources development organizations better reach you and others in your profession to explain about seismic design and evolving technologies, recommendations, and practices?"
- Please take this space to offer any remaining thoughts you have that would help improve the reach, understanding, and use of seismic codes in the U.S."

Figure 3-4. Open-Ended Questions Asked in the User and Stakeholder Surveys

3.2.4 Data Analysis

Task Group members analyzed responses using both Jotform Reports and Excel pivot tables, crosstabulating responses by profession and region within each survey separately, and then by region and survey group for the subset of questions asked on both surveys.

Each Task Group member also read and summarized a subset of the open-ended questions; then the group reviewed and consolidated the summaries. This qualitative analysis focused on what the answers suggested about the beliefs of surveyed Users and Stakeholders about the content, development, and communication of U.S. seismic codes and how they can be improved.

Finally, the Task Group collectively used the direct findings and discussions about the concerns and opportunities expressed in the surveys to formulate questions to be asked of the interviewees in the Phase 3 interviews.

3.3 Topics and Findings for User Survey

3.3.1 User Survey Questions

The User Survey first asked respondents about their profession, the state in which they primarily practice, their career stage, past level of involvement in code development processes, and the level of support, if any, they have received from their employer(s) to participate in code development work.

Next, the survey sought to document the degree to which User respondents rely on a range of U.S. seismic code information sources, to enable the Task Group to explore whether use patterns differed by profession or region. The Task Group was especially interested in use of *NEHRP Seismic Provisions* and *Design Examples,* key publications of NIBS BSSC. Figure 3-5 shows an example question about seismic code information sources.

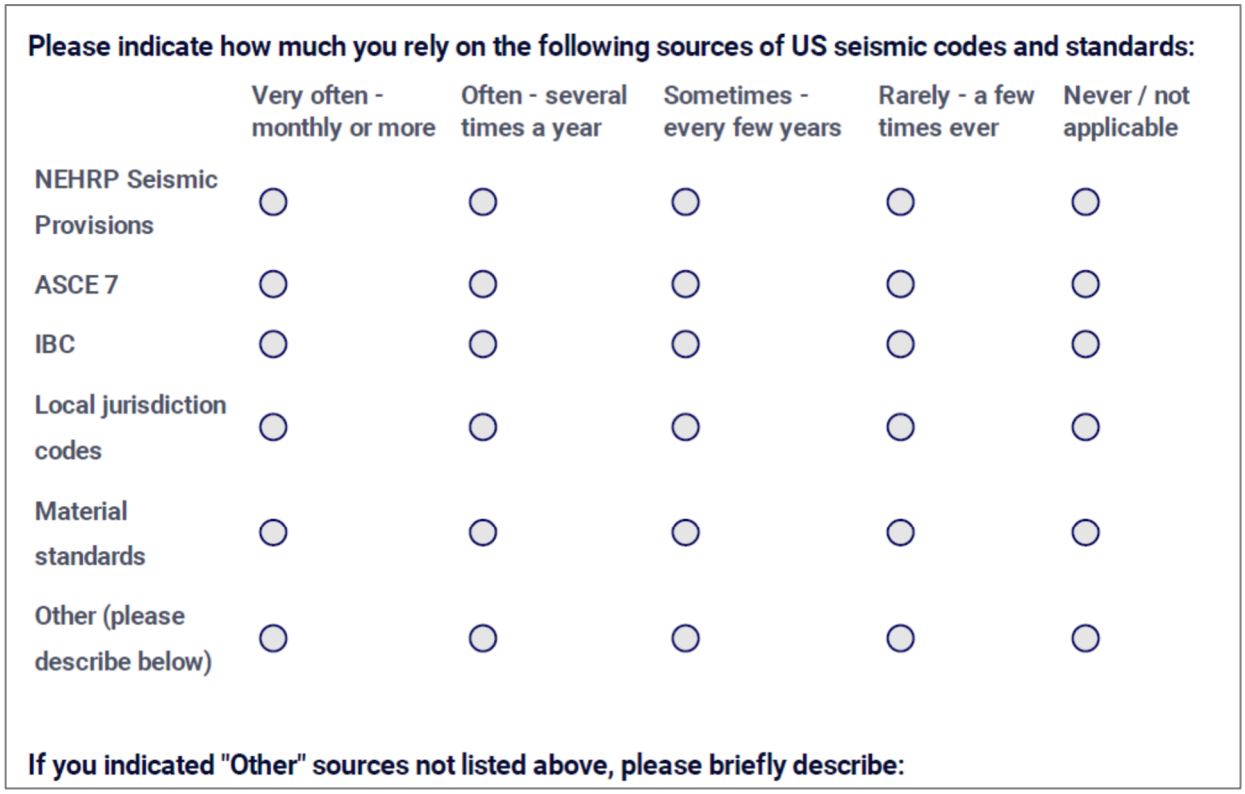

Figure 3-5. An Example Question Block Asked on Both the User and Stakeholder Surveys About the Use of Different U.S. Seismic Code Information Sources

Several questions solicited opinions about qualities of U.S. seismic code content, such as whether regional needs are met, are code goals clear, are codes effective, are they appropriately stringent, are safety issues well-addressed, and any perceived deficiencies.

The User Survey also asked for opinions about the code development process: is there adequate stakeholder review, should the process be sped up or slowed down, and are changes well-explained?

User questions about code dissemination and education asked how well current methods of communicating about codes meet the needs of all regions of the U.S. and of the respondent's own profession. Along the way, several open-ended questions allowed respondents to give reasons for their answers and offer suggestions on ways to increase involvement, understanding, and educational outreach.

3.3.2 User Survey Findings: Code Use

The 56 total responses to the User Survey included 38 practicing engineers and 18 code officials employed at a range of jurisdictional levels (e.g., local, state, and federal). Seventy percent of User respondents reported previous involvement in code development, making this an experienced group with U.S. seismic codes. This level of code participation was consistent across all regions. Respondents from the West cited more frequent use of the largest range of sources, suggesting participants from the West may represent a set of more seismic code-engaged Users.

User respondents' answers suggested reliance on a wide range of seismic code information sources, with some notable regional differences in how many codes are used and which sources are used most frequently.

- ASCE/SEI 7 use was very high and the highest used source overall, with 91% of User respondents saying they use it *Often* or *Very Often* in their work.
- However, User respondents *Very Often* indicated that use of ASCE/SEI 7 tapered from a nearly universal 97% in the West, to 86% in Central/Mountain, and 60% in the East.
- A large majority of respondents (80% overall) described using the International Building Code (IBC) *Often* or *Very Often*.
- Sixty percent of East respondents said they *Rarely* or *Never* use local codes, compared to 28% in Central/Mountain and just 3% in the West.

User respondents from the East in particular reported less frequent use of code resource documents such as the *NEHRP Provisions*, *NEHRP Design Examples*, and material standards.

- For instance, less than half of Eastern respondents (40%) reported using *NEHRP Seismic Provisions Sometimes*, *Often*, or *Very Often*, compared to 92% in the West and 93% in the Central/Mountain regions.
- The Central/Mountain region had the highest fraction of respondents who reported using *NEHRP Design Examples Sometimes*, *Often*, or *Very Often* at 78%, followed by 70% in the West, and 60% in the East.

Figure 3-6 summarizes code resource use by region.

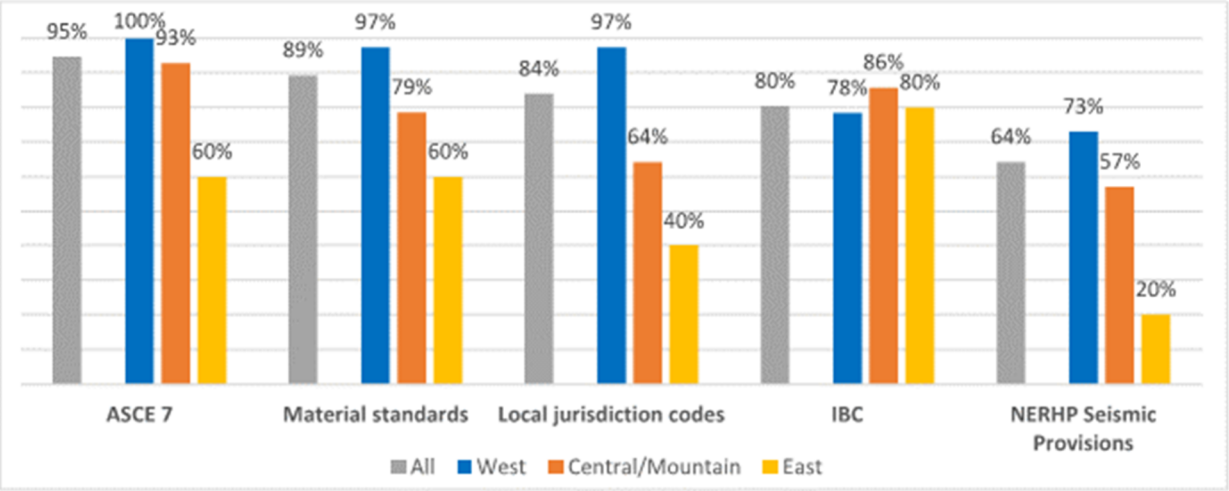

Figure 3-6. Percent of User Respondents by Region Answering That They Use the Code Information Source *Often* or *Very Often*

3.3.3 User Survey Findings: Code Content

Responses showed broad support for the statement that U.S. seismic codes are useful to their work, as 75% of User respondents answered *Agree,* a level consistent in all three regions. Only two persons in Central/Mountain *Disagreed*, while 22% were neutral.

Overall, 72% of User respondents *Agreed* or *Strongly Agreed* that U.S. seismic provisions are understandable and adequately explained. But again, survey results suggested some regional differences in opinion. For instance, 100% in the East either *Agreed* or *Strongly Agreed* that U.S. seismic provisions are understandable and adequately explained—distinctly higher than the 71% saying so in the Central/Mountain and 68% in the West.

Opinions appeared diverse regarding whether U.S. seismic provisions are too prescriptive and constraining. The most common response was *Neither Agree Nor Disagree*, but 34% answered Strongly Disagree or Disagree (implying satisfaction with current code usability) and 27% answered *Agree* or Strongly *Agree* (implying dissatisfaction). The largest range of opinions on this question were in the West.

There was no widespread agreement that current codes are too complicated and technically challenging to use. A minority of respondents *Agreed* or *Strongly Agreed* with that statement, ranging from 30% in the West to 21% in Central/Mountain to 40% in the East. This is somewhat inconsistent in that 100% of Users in the East indicated that they *Agreed* or *Strongly Agreed* that U.S. seismic provisions are understandable and adequately explained.

Figure 3-7 summarizes User Survey results related to code content and ease of use.

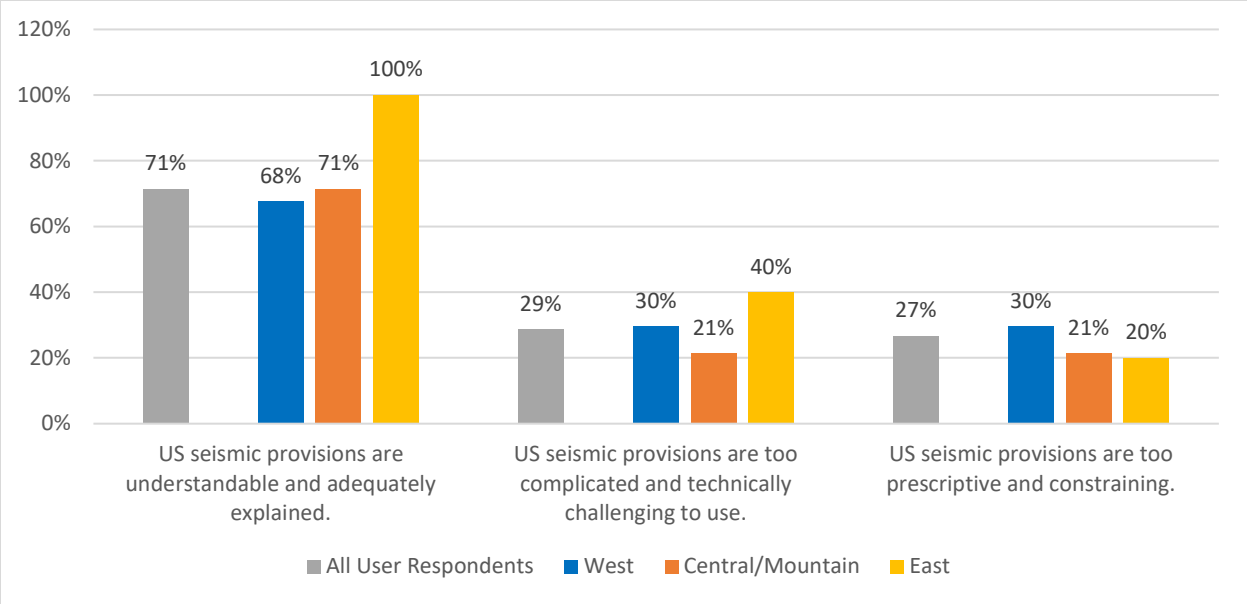

Figure 3-7. Percent of User Respondents by Region Answering *Agree* or *Strongly Agree* on Statements About U.S. Seismic Code Content

The Task Group noted in general that responses in the West seemed more varied and less positive than opinions in the Central/Mountain and East. Somewhat in contrast, User responses when asked directly, indicate general agreement that U.S. seismic codes meet needs well across all regions, with 75% answering 4 or 5 on a five-point scale as shown in Figure 3-8, with 5 indicating needs were met *Very Well*.

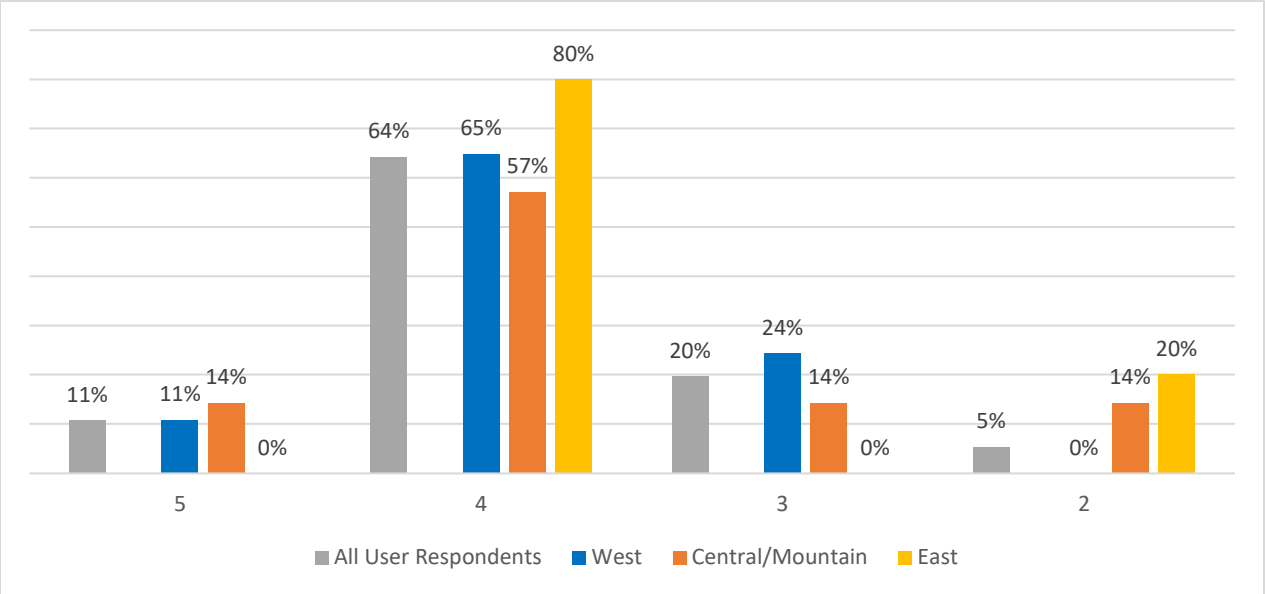

Figure 3-8. Users Responses as a Percent by Region as to How Well U.S. Seismic Codes and Standards Meet the Needs of All Regions (5 = *Very Well*, 1 = *Not at All*)

The User Survey had one detailed question asking respondents to choose up to four top topics they would like to see better addressed in future U.S. seismic code updates. Determining seismic demand including site specific procedures, foundation design provisions, and combinations of systems were the most frequently chosen topics, each selected by at least 30% of respondents. See Figure 3-9.

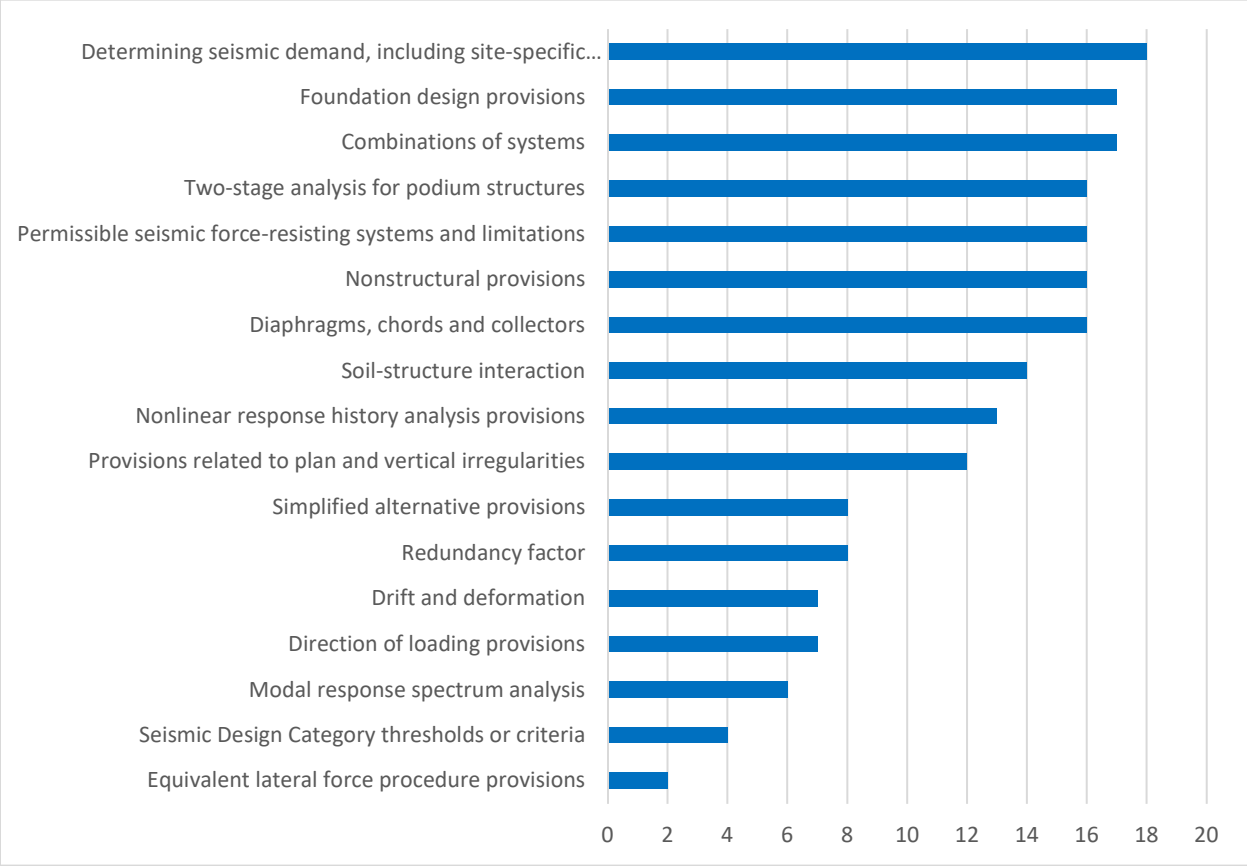

Figure 3-9. Number of User Respondents That Chose Code Element Among Top Four Most in Need of Improvement or Clarification

3.3.4 User Survey Findings: Code Development

Responses overall showed favorable opinions, but not strongly so, about the importance, justification, level of detail, adequacy of stakeholder review, and speed and frequency of updates to U.S. seismic codes.

- Seventy-five percent of respondents said they *Agree* that code updates are useful and important to their work. Only two, from the Central/Mountain region, said they *Disagree*.
- There was broad support for the statement that changes to U.S. seismic codes are well-justified, with overall agreement at 77%. Agreement was consistently high in all three regions, although slightly lower at 64% in Central/Mountain and highest at 100% in the East.

- Sixty-one percent of respondents *Agreed* that code updates are *About Right* in level of detail.
- There was a wider range of opinions across regions on whether updates to U.S. seismic codes receive adequate review by all stakeholders. Agreement on this statement was lowest at 49% in the West, then 60% in the East, and highest at 71% in Central/Mountain.
- Responses showed a mix of opinions, but a majority did not feel the pace of code changes should be changed. Only 18% said they would prefer changes be more frequent or sped up, while 29% said they would prefer changes be less frequent or slowed down.

Generally, the differences were not substantial across the two User professional groups for most questions. However, code officials tended to be more positive about codes and code updates than practicing engineers.

3.3.5 User Survey Findings: Code Dissemination and Education

Respondents reported using a wide variety of ways they get information about seismic codes. The three sources with highest reported use were consultation with peers or other design team members, online codes, standards, or provisions information, hard copy code documents including commentary, and internet searches. Also highly used, if somewhat less frequently, were design guides or white papers and occasional professional education or trainings. Design standards and material trade group help desks or documentation and text books and notes from college were not used as frequently but still at significant levels, with 50% and 19% of respondents, respectively, saying they use these resources a few times a year or more.

When asked about a list of potential ways to improve communication about codes, respondents were positive about many of the suggestions. As shown in Figure 3-10, among the most promising measures, ranked here by percent of respondents answering *Somewhat* or *Very Useful*, were: additional design guides (80%), creation of an interactive online platform where seismic provisions are linked to associated commentary and design example (76%), and providing more training webinars (70%). Other suggestions with slightly lower but still strong support included creating a FAQ forum with timely responses from experts (61%), reducing the cost of educational resources (52%), having more in-person trainings (46%), and increasing outreach to students (44%). Making U.S. seismic codes available on smartphones and increasing use of social media were the lowest supported measures. An example of a commonly used seismic design guide is the SEAOC Structural/Seismic Design Manual (see Figure 3-11).

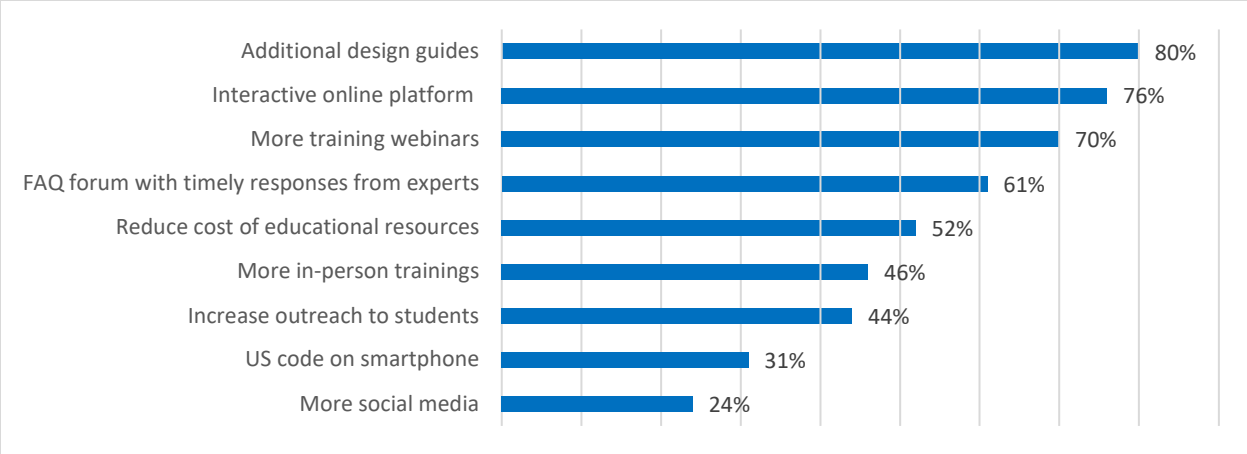

Figure 3-10. Percent of Users Responding That Increasing Use of the Communication or Education Measure Would be *Somewhat* or *Very Useful*

Figure 3-11. The 2018 *IBC SEAOC Structural/Seismic Design Manual* (SEAOC, 2020a-d, images courtesy of SEAOC)

What kind of educational materials and programs did Code Users recommend?

Additional design guides, creation of an interactive online code information platform, and more virtual training opportunities such as webinars were the highest recommended communication measures to expand in the User Survey.

3.4 Topics and Findings for Stakeholder Survey

3.4.1 Stakeholder Survey Questions

The first five questions of Stakeholder Survey mirrored the User Survey by asking about each respondent's profession, the state in which they primarily work, career stage, and their use of the various U.S. seismic code information sources.

The next set of questions asked Stakeholders their opinions about U.S. seismic codes, focusing on perceptions of the intentions and outcomes of codes (rather than how it feels to use them, which was more the focus with Users). Specifically, the survey asked Stakeholders: are the goals of U.S. seismic codes clear, are they effective at meeting those goals, and is there adequate room to exceed those goals for those who want higher performance? Figure 3-12 shows the multiple choice answers available for that question.

Please indicate how much you agree with the following statements about the purpose and importance of US seismic codes and standards:

	Disagree	Neither Agree Nor Disagree	Agree	Does Not Apply
The goals of US seismic codes and standards to prevent collapse and protect lives in major earthquakes are clear to the public.	○	○	○	○
US seismic codes and standards are effective in preventing collapse and protecting lives in major quakes.	○	○	○	○
US codes and standards provide opportunity to choose enhanced performance goals for improved post-earthquake re-occupancy and functional recovery time.	○	○	○	○

Figure 3-12. Example Questions About Code Goals on the Stakeholder Survey

Additional questions asked for respondent opinions about how U.S. seismic codes are developed and updated over time, how well the needs of different regions and professions are met, and how education efforts could be improved and reach more people.

3.4.2 Stakeholder Survey Findings: Code Use

The 33 respondents to the Stakeholder Survey hailed from a wide mix of professions. The largest professional group represented was structural engineering professors and researchers (10/33 or 30%), followed by employees at local building departments or independent plans examiners (7/33 or 21%) and material trade organization representatives (4/33 or 12%). Given the large number of professions included and low numbers in each category, it was not possible to investigate variations in opinions based on profession. Furthermore, variation in answers was generally highest in the three profession categories with the largest response counts. This suggests a diversity of opinion exists within professions that this survey's sample size was not large enough to characterize—a question for future study.

This was not an inexperienced Stakeholder group at working with U.S. seismic codes. Sevety-nine percent of respondents said they used U.S. seismic codes *Very Often* in the their work. ASCE/SEI 7 use was highest, roughly followed by the *NEHRP Provisions* and IBC use, then local codes and material standards. This survey group was not asked about use of *NEHRP Design Examples*.

While experience working with codes was nearly universal, there was slightly lower use levels in the Central/Mountain and East and less range in the number of code information sources used as compared to the West. *NEHRP Provision* use was universal and highest in the West (*Often* or *Very Often* = 100%), followed by the Central/Mountain region (70%) and the lowest in the East (34%). Differences in level of use may be due to who was invited to take the survey--for instance, the survey may have reached an overall more experienced group of respondents in the West.

3.4.3 Stakeholder Survey Findings: Code Content

A majority of, but by no means all, Stakeholder respondents answered positively about the clarity of purpose and effectiveness of U.S. seismic codes, how stringent they are, and their adequacy for pursuing higher building performance, but only half of respondents felt code goals are clear to the public. See Figure 3-13.

- Agreement was 86% or higher in all regions that codes are effective in preventing collapse and protecting lives.
- Overall, a large majority of Stakeholder respondents felt codes are *About Right* in terms of stringency (76%), and meet regional needs (67%).
- Still a majority but closer to one half felt earthquake safety and performance issues are well-addressed (60%), opportunities are well-provided to pursue enhanced performance (55%). Structural engineering professor or researchers were the most likely profession category to *Disagree*.

- About half of respondents answered that the purpose and intent of the codes to prevent collapse and protect lives is clear to the public (52%).

Sixty-seven percent of Stakeholder respondents felt codes meet the needs of all U.S. regions.

- Contrary to the Task Group's initial thinking, there were not strong differences in opinion by region on this question: 70% in Central/Mountain, 76% in the West, and 60% in the East said codes met regional needs *Well* or *Very Well.*

Distinct differences in opinion across regions were evident for a subset of questions, with a clear pattern of greater pessimism and disagreement in the West. This may be because there have been more damaging, relatively recent earthquake events in the West.

- For example, agreement that code purposes and goals are clear was highest in the Central/Mountain at 70%, followed by 53% in the East and 25% in the West.

- The percent answering that code stringency was *About Right* was highest and nearly universally chosen in the Central/Mountain at 90% and East at 87%, but by only 38% in the West.

- Eighty-eight percent of West respondents said they *Disagree* with the statement that codes offer adequate opportunities to choose enhanced performance goals.

- As to whether safety is well-addressed, 90% in the Central/Mountain region and 67% in the East said *Yes*. In contrast, 75% in the West answered *No*.

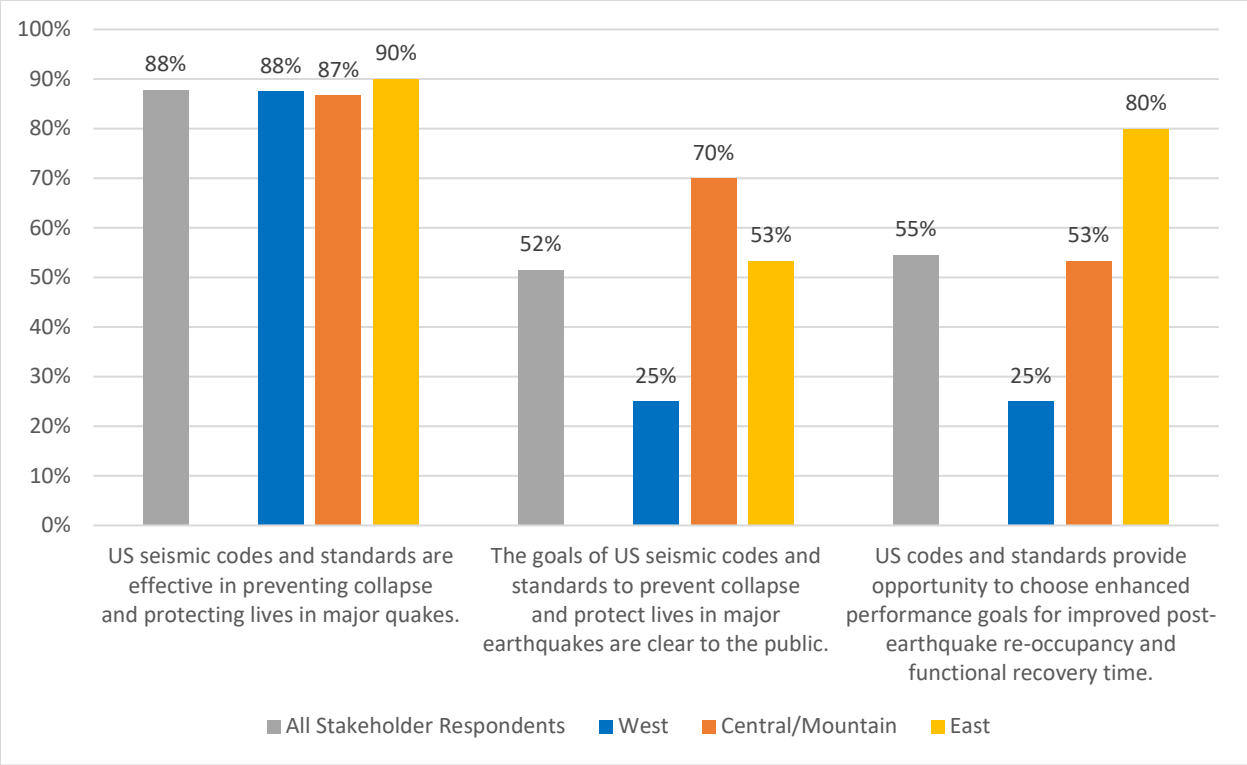

Figure 3-13. Percent of Stakeholders Answering *Agree* on Statements About U.S. Seismic Code Content

3.4.4 Stakeholder Survey Findings: Code Development

A majority of Stakeholders responded positively to the questions about the processes of U.S. seismic code development and updating. The overall sense was the system is not broken, but everyone agrees it could be and would like it to be better.

- In aggregate, a solid majority of respondents (about two thirds) *Agreed* that code updates happen at about the right pace.
- A lower fraction—slightly above half—expressed that code updates receive adequate review by all Stakeholders (55%) and that code changes and the rationales behind them are well-explained (52%).

Stakeholder opinions about code development varied by region, with more dissatisfaction in the West.

- West respondents showed more skepticism about whether there was adequate review by all Stakeholders, with only 13% choosing *Agree*.

- Regarding whether rationales for code changes are well-explained, 70% of Central/Mountain respondents said *Yes*, while only 25% said *Yes* in the West. Opinion on this in the East was more neutral and mixed.

Stakeholders showed more interest in changing the pace of code updates compared to the User survey findings, but with different directions of interest across regions.

- There was more interest in speeding up code change processes among West respondents. Central/Mountain (80%) and East (93%) respondents generally were neutral or *Disagreed* as to whether code changes should happen faster, while 38% of West respondents said *Agree*.

- Respondents in the East (47%) said *Agree* that code changes should happen more slowly or less often, while a large majority in the West (88%) *Disagreed* and 90% of Central/Mountain were either neutral or *Disagreed*.

3.4.5 Stakeholder Survey Findings: Code Dissemination and Education

A majority of Stakeholders responded positively to the questions asked about communication of U.S. seismic codes for their profession and region. Continuing the trend seen elsewhere, Stakeholder opinions about code communication differred by region and were less favorable in the West and East.

- About two thirds (65%) of Stakeholder respondents felt current communications meet their profession's needs, with 88% in the Central/Mountain region answering *Well* or *Very Well*, compared to 57% in the West and 50% in the East, where opinions were lowest.

- About half of respondents (49%) felt current communications meet the needs of all U.S. regions *Well* or *Very Well*. However, the range across regions was large, with 75% of Central/Mountain respondents answering this way, compared to 50% in the West. Answers to this question were more varied in the East, and the lowest fraction of the three regions answering *Well* or *Very Well* (24%). No one in the West answered *Very Well*.

3.5 Cross-Group Comparisons and Findings from Questions Included on Both Surveys

The two surveys included several identical questions to allow for comparison of opinions between User and Stakeholder respondents. These overlapping questions included basic participant descriptors about their level of experience and their level of use of different code information, and some multiple choice and open-ended opinions about code content, development, and communication.

3.5.1 Code Information Source Use by Survey Group

The Task Group expected to see slightly lower frequencies of use of U.S. seismic code and standards in the Stakeholder group compared to the User group, which was the case.

- ASCE/SEI 7 was the most used resource in both survey groups.
- Users reported higher use of *NEHRP Provisions* compared to Stakeholders.
- Stakeholders reported slightly less use of ASCE/SEI 7 and IBC than Users, and much lower use of local codes and material standards.

Both surveys asked respondents to list any other code information resources they use other than NEHRP Provisions, ASCE/SEI 7, IBC, local codes, material standards.

3.5.2 Opinions about U.S. Seismic Code Content, Development, and Communication by Survey Group

- Overall, there were not many sharp differences in opinion between Users and Stakeholders in response to the code content and development questions. Stakeholders showed slightly more range in opinions about whether code development process meets their region's needs, with twice as many Stakeholders answering *Very Well* (21%) compared to Users (11%) but also twice as many Stakeholders than Users saying *Not Very Well*.
- Taken together, results offered no clear direction on preference for changing the pace of the code updating process for either Stakeholders or Users. If anything, Stakeholders showed slightly more inclination that code updates should be sped up or happen more frequently. Perhaps surprisingly, the variation in opinions was nearly identical across survey groups as to whether there is adequate opportunity to review code changes.
- Regarding how well U.S. seismic codes meet regional needs of all regions of the U.S., fewer Stakeholders (66%) answered 4 or 5 (on a five-point scale) compared to 75% of surveyed Users.

3.6 Survey Conclusions and High Level Take-Aways

The survey phase of this study reached out to both Users and Stakeholders of U.S. seismic codes to get a read on current opinions about ways to improve code development, use, and education. Although the number and diversity of participants reached were limited, the goal of systematically collecting information beyond word of mouth was achieved. The survey findings served as an important check on the assumptions and influenced the thinking and directions considered by the Task Group. In the future, these vetted survey instruments can serve as a templates for larger or longitudinal studies, which is advisable for tracking changes in opinion over time and evaluating progress resulting from any reforms. Together, these surveys produced a wealth of data, only a select portion of which could be shown in this report, given the scope of the effort and the Task Group's desire to emphasize resulting recommendations. The survey data could be investigated in

future studies. In addition, the open-ended survey responses sometimes provided suggestions on ways to improve codes and code development that were outside of the scope of this report with its focus on seismic codes and new buildings.

The surveys also helped the Task Group to generate and categorize actionable recommendations—both explicitly made and those inspired by survey responses given—and to develop lists of needs, concerns, themes, and suggestions of interest.

Regarding code development, emerging themes included: increasing diversity in who participates in the code development process overall, expanding the review process to include more and a wider range of stakeholders, improving quality assurance and vetting usability on new provisions, and reducing barriers to innovation or implementing new provisions. Participation naturally centered around reducing barriers and being more proactive in recruitment and apprenticeship. With greater participation comes greater ability to address specific, divergent, and emerging needs.

Why increase participation in U.S. seismic code development processes?

Through answers to open-ended questions, survey respondents expressed a collective belief that greater participation in code development processes would enhance the code's ability to address specific, divergent, and emerging needs.

For code use and content, emerging themes included the need to better address functional recovery and enhanced resilience, finding ways to simplify use of the code, consideration of the impact of different types of seismicity (especially in non-California locations) on codes (such as long duration subduction zone events), and identifying and focusing update efforts on high priority sections for improvement in provisions and commentaries.

Regarding education and dissemination, emerging themes included optimism for expanding existing methods and implementing new approaches for communicating code content and changes to engineers and a desire for wider, centralized, and more consistent education about seismic codes to other stakeholders.

Criteria for generation of actionable recommendations for Phases 3 and 4 consideration included that the recommendation could realistically be implemented and had strong potential to make a difference. A promising idea did not have to be recommended by many people in order to be considered. Additionally, there needed to be some sense of who would be responsible or need to be involved in order to implement the recommendation, and how much funding or additional resources would be required.

Chapter 4: Interview Approach and Findings

4.1 Overview

Results from the User and Stakeholder Surveys were used and combined with the Task Group's own deliberations to develop potential recommendations and questions for the interviews. Interviews were held with key participants in the PUC and ASCE Seismic Subcommittee and others with experience in the PUC process such as leading researchers, and ATC/FEMA/NIST representatives. Interviewees were divided into focus groups of typically three individuals, and they were interviewed by two Task Group members about a set of possible potential recommendations and questions which were distributed in advance.

4.2 Interview Process

All of the PUC members from the 2016-2020 cycle were invited plus a group of others with significant involvement in the code development process. Nearly all accepted. Table 4-1 shows the list of interviewers and interviewees. The majority of those interviewed are practicing structural engineers. An effort was made to vary the focus groups so that geotechnical professionals, ATC/FEMA/NIST, and non-practicing engineers were not concentrated.

Table 4-1: Interview Groups

Interviewers	*Interviewees and Primary Discussion Topic*			
Emily Guglielmo and Ron LaPlante	*Group 1* David Bonneville David Bonowitz *Use/Content*	*Group 2* Jennifer Goupil Ron Hamburger Nicolas Luco *Development*	*Group 3* Jim Malley Bonnie Manley Steve McCabe *Communication*	
Julie Furr and Jim Harris	*Group 4* Kelly Cobeen Anindya Dutta Robert Hanson William Holmes *Use/Content*	*Group 5* Philip Line Jonathan Stewart *Communication*	*Group 6* Kevin Moore Robert Pekelnicky Sanaz Rezaeian *Development*	
Bret Lizundia and either Sandra Hyde or Susan Dowty	*Group 7* SK Ghosh Gyimah Kasali John Gillengerten *Communication*	*Group 8* CB Crouse John Hooper *Development*	*Group 9* Rafael Sabelli Jon Heinz *Use/Content*	*Group 10* Dan Dolan Greg Soules Matt Speicher *Development*

Questions and recommendations for the interviews were distributed in advance for the interviewees to review. Interviews were conducted by in an online meeting. Each interview was 90 minutes long.

For each focus group, one of the three main topic categories were assigned as the primary discussion point for the first 60 minutes. The remaining 30 minutes was intended to focus on the interviewees' highest priority items from the remaining two topic areas. The interviewers took notes on screen during the interview. In all interviews, the discussion was completed for the primary topic and there was some discussion of the other two topics. Interviewees were encouraged to provide comments on the remaining two topics and send them in after the interview. Many did. Separately, JQ Yuan, BSSC Executive Director, interviewed the BSSC Board of Directors (JoAnn Browning, Jim Cagley, Charlie Carter, Anne Ellis, Roberto Leon, and Kent Yu,) using the same question and potential recommendation spreadsheet, and their comments were incorporated into the Task Group's considerations.

4.3 Interview Questions

Interview questions were developed by the Task Group based on topics with reasonable high levels of support from the User and Stakeholder Surveys and Task Group interest. They were typically phrased in the form of potential recommendations that could be implemented. Excel spreadsheets were distributed to each interviewee in advance of the interview. They included three worksheets, one for each topic category. On each worksheet, potential recommendations were listed in rows, plus the following four columns for recommendation.

- Support for recommendation (*High*, *Medium*, *Low*).
- Who should be responsible?
- Funding needed?
- Comments (including what is needed to implement the recommendation).

The goal was to obtain interviewee input for each of these issues for each potential recommendation.

Table 4-2 shows the potential recommendations for the topic category of improving code development, and a tabulation of the number of votes with *High* support for the recommendation. In the summaries of the interviews, sometimes individual interviewee preferences were listed; other times, just a general group preference was given. If any interviewee listed the potential recommendation as *High*, a *High* vote was tabulated. If more than one interviewee listed *High*, only one *High* vote was tabulated. Table 4-3 covers potential recommendations for improving ease of use and code content. Table 4-4 covers improving dissemination and education on codes and code changes.

Table 4-2: Interview Recommendations/Questions on Improving Code Development

Potential Recommendations	*High* Votes
1. *Increase diversity in code developers:*	
a. Compensate practicing engineers to participate for their time (beyond travel expenses).	0
b. Replace some in-person meetings with virtual meetings (to reduce loss of billable time due to travel)	5
c. Solicit new participants, instead of the same select few people.	8
d. Include practicing engineers from smaller firms.	1
e. Target involving younger engineers. Fund young engineers to shadow the chairs.	6
f. Put target role models in issue team chairs and highlight their involvement.	4
g. Empower non-California engineers to participate/lead in code committees and to include low/moderate seismicity discussion topics in code development.	2
h. Start with students to spur further interest. Develop curriculum for a class on codes. Have a code competition for students (like bridge, canoe, and EERI seismic events).	1
i. Other?	
2. *Expand review by more and a wider range of stakeholders:*	
a. Convene pre-cycle regional workshops to identify and prioritize issues to address.	4
b. Earlier outreach through workshops, virtual meetings, email, or web portal on in-progress topics.	2
c. Other?	
3. *Improve quality assurance on new provisions:*	
a. Require worked examples for new provisions done by practicing engineers through a paid process.	8
b. Require worked examples for new provisions by volunteers, perhaps in coordination with NCSEA.	4
c. Other?	
4. *Reduce time to implement innovation or new provisions:*	
a. Publish changes on NIBS website as soon as approved or use supplement concept like ASCE/SEI 7.	2
b. Improve coordination between stakeholders (research/PUC/ASCE/material standards/ICC/state codes).	2
c. Do we need to vet at four levels (PUC, ASCE, IBC, state codes)?	2
d. Create a PUC subcommittee that is always in-session to vet/promote new systems.	3
e. Increase role of Part 3 in NEHRP Provisions.	3
f. Other?	
5. *Do you have other recommendations we have not discussed?*	

Table 4-3: Interview Recommendations/Questions on Improving Code Content and Ease of Use

Potential Recommendations	*High* Votes
1. *Address functional recovery and enhanced resilience:*	
a. Develop requirements for performance objectives beyond life safety, such as functional recovery. This could include prescriptive ways for the engineer of regular buildings to achieve enhanced post-earthquake performance and occupancy.	8
b. Develop a coordinated strategy on functional recovery and the code between ASCE, BSSC, ICC, and others.	8
c. Others?	
2. *Find ways to simplify the code:*	
a. Make provisions simpler in general, and/or focus on detailing.	2
b. Create simplified procedures, such as R=1 for low/moderate seismic regions.	3
c. Discuss ways for how the code can provide better prescriptive and performance-based procedures.	3
3. *Explore impact of different types of seismicity (especially in non-California locations) on codes (such as long duration subduction zone events).*	3
4. *High priority sections for improvement in provisions and commentary from User Survey:*	
a. Combinations of systems.	2
b. Foundation provisions.	3
c. Permitted systems and limitations.	1
d. Two-stage analysis.	1
e. Diaphragms/chords/collectors.	1
f. Nonstructural provisions.	2
g. Soil-structure interaction (SSI).	2
h. Nonlinear response history analysis (NRHA).	0
i. Plan/vertical irregularities.	0
j. Other?	
5. *Develop a Part 3 paper on quality assurance to cover, at a high level, the state of the practice, expectations that code writers have for the level of quality assurance during fabrication and construction, with recommendations for others (ASCE, material standards, ICC, etc.)*	2
6. *For nonstructural components and nonbuilding structures, review best practice guidelines from major utilities on the West Coast.*	2
7. *Do you have other recommendations we have not discussed?*	

Table 4-4: Interview Recommendations/Questions on Improving Dissemination and Education on Codes and Code Content

Potential Recommendations	*High* Votes
1. *Expansion of existing methods or new approaches for engineers:*	
a. Disseminate potential code changes before and during deliberations.	2
b. Create a FAQ code platform like the AISC Solution Center, with timely responses from experts.	3
c. Use social media.	2
d. Create interactive online platform where seismic provisions are linked to associated commentary and examples, similar to ACI 318-Plus.	3
e. Create more detailed commentaries.	4
f. More design guides (such as cladding design, NRHA).	4
g. More (free) training webinars.	4
h. Provide a tips document on frequently missed provisions.	3
i. Other?	
2. *Education for other stakeholders:*	
a. Create classes or videos for non-engineers on seismic code landscape and issues.	0
b. Develop a training materials unit on seismic provisions specifically designed for code officials and promote the training unit as a means to meet the continuing education requirements for building official certifications.	2
c. Develop a workshop and publication for the public on what the code provides, including direct/indirect damage, and post-earthquake occupancy, repairability, and recovery.	2
d. Other?	
3. *Thinking bigger and collaborating:*	
a. Develop a broad coalition of public and private partners to apply best available communication methods and tools towards a nationwide effort to change public understanding of codes and their value to help advance the adoption and enforcement of codes and spur innovation throughout the country.	3
b. Develop a coordinating body between ASME and ASCE/PUC on nonstructural components and nonbuilding structures.	2
c. Other?	
4. *Do you have other recommendations we have not discussed?*	

4.4 Interview Findings

The interview documentation included filling out spreadsheets with all the comments for each focus group. With 10 groups, and one worksheet for each topic, this yields 30 spreadsheets of information. This information was mined by the Task Group for high priority recommendations. There is too much information to include in the report in its entirety, but a few findings are summarized here, including:

- List of additional potential recommendations proposed by interviewees.
- Examples of information collected for two example recommendations.

4.4.1 Other Potential Recommendations Proposed by Interviewees

The interview questions include several open-ended opportunities for interviewees to suggest other potential recommendations. Ideas proposed are listed here by topic category.

- Improving Code Development
    - State/local jurisdictions could become early adopters for issues of interest and short-circuit the IBC development process.
    - Expand review by more and a wider range of stakeholders by conducting surveys. Surveys are good ways to uncover concepts and ideas. A wider audience can be reached, including those who are too busy to attend a workshop. Surveys can be very targeted, and they can also promote open answers.
    - Member organizations are not as involved as is desirable. Improve that dialog.
    - Find ways to collaborate with global/international code development colleagues.
- Improving Code Content and Ease of Use
    - To identify topics for funded projects, improving the NEHRP process of identifying research needs and future issues could help. The current process seems to result in a laundry list rather than a consensus vision. Figure 4-1 shows a testing experiment on the UC San Diego shake table. What is the best use of this resource?
    - Look at ground motion response values for additional damping ratios. There has been work done for the prediction equations.
    - Develop an optional code like the 1997 UBC, which would be applicable to the vast majority of buildings. We do not necessarily have to go back to zones, but we need to get rid of risk-targeted ground motion, multi-period spectra, and so forth. We need to bring seismic design back to an understandable level. It is in imminent danger of becoming a black box.

  - Investigate reliability. We have three different reliability bases: (1) LRFD for gravity, (2) wind, (3) seismic. Can we pick one approach, such as risk on a yearly basis. It would be desirable to have some way to compare seismic and wind (as well as tornado and hurricane) reliability, and thus some way to determine what is the relative risk between natural disasters for a given location. The design process needs to be able to compare risks, what can happen, and answer why the comparison is important. When a structure has multiple pieces, and reliability is dependent on those multiple pieces, then the reliability should be harmonized. We need to know what the reliability of the entire system is likely to be. Where are the weakest points?

  - Develop an industry group that can conduct FEMA P695 (FEMA, 2009) analyses for nonbuilding structures. A FEMA P695 type of project for nonbuilding structures would be highly beneficial to show acceptability of current *R*-values.

- Improving Dissemination and Education on Codes and Code Changes

  - Need to coordinate between PUC, NEHRP, and ASCE on dissemination and education. Do not make plans for dissemination and education in a vacuum. The PUC and BSSC could emphasize the big picture; ASCE and others could expand in more detail. Specific information should be provided on where the practitioner goes for help in understanding the changes.

  - Create a better method of publishing "what is new in this document." Sidebars are sometimes used but not uniformly. There could be multiple versions: one for the designer with details about changes and reasons, and one for the stakeholder with a high-level summary and expectations.

  - There needs to be an advocate for seismic codes at the state legislature level, similar to the California Seismic Safety Commission. In some states, lacking any seismic safety advocate, industry groups are able to minimize seismic provisions on the basis of increased construction costs.

  - In the *NEHRP Provisions* and ASCE/SEI 7 provide a redline version of the code, like the American Wood Council does for wood during their ANSI approval public comment period, that shows the compiled effect of all the changes in a cycle.

  - Require continuing education for design professionals.

Figure 4-1. Shake Table Testing of a Four-Story Reinforced Concrete Building (Jacobs School of Engineering/University of California San Diego from https://www.flickr.com/photos/jsoe/21512310022/in/album-72157637612765485/)

4.4.2 Example Findings

To show the type and extent of comments given by interviewees, two examples are provided here, one for a recommendation with a high degree of support and one for a recommendation with a low degree of support.

4.4.2.1 POTENTIAL RECOMMENDATION: INCREASE DIVERSITY IN CODE DEVELOPMENT: SOLICIT NEW PARTICIPANTS, INSTEAD OF THE SAME SELECT FEW PEOPLE.

Degree of support from interviewees: High.

Interviewee comments

- High priority to engage more new people.
- It will be important that the new people are capable to work at the level needed at NEHRP PUC, needs to be the right person.

- Bringing in new younger engineers to be the secretary does not help them become more engaged.
- It takes a few years for a new person to become engaged.
- Important to have fresh thought and opportunity. On other hand, it is valuable to have some participants have a long history with the process (for example, the AISC ASD load combinations).
- It is important to "build a bench."
- Give new engineers real work/skin in the game to build confidence.
- New people can help with documenting the past more.
- ASCE Seismic Subcommittee is strategic in looking at technical gaps and finding individuals with knowledge of those issues.
- All ASCE members are guaranteed associate member status on an ASCE committee. This is a good system to allow anyone to participate. Voting members are selected from past cycle active associate members.
- Make a stronger outreach to member organizations; issue teams have been a good example.
- Better to add more people rather than replace some on the PUC.
- A reduction in number of meetings would allow expansion of number of people.
- Add new members gradually; roll them in with experienced people.
- There are very few people who can do this. Requires experience and familiarity with provisions and the rationale behind them.
- Put new people on issue teams first.
- We need new, younger participants. There is a huge history though. Don't want to lose that. Perhaps grow it temporarily to "train" new group.
- Do not lose 10 old members and bring in 10 new members. Better to bring in on the order of three new members.
- Soliciting new members is always necessary to do, but they need to have the necessary expertise.
- Has BSSC actually ever done an open solicitation?
- If you bring in new people, do not replace the old. Bring in only a small group and change out a small number. Need to preserve the history.

- It is sensitive if you have to ask someone to drop off.
- Need to keep core group and/or change out members in very small groups over time.
- It would be good to have new participants on the issue teams/subcommittees, but this is less critical on the PUC. The continuity on the PUC is important for understanding how/why provisions have evolved and whether new proposals are needed. New voices provide valuable input, but they should not be wholesale replacement of existing members.
- Issue teams are fairly diverse, but the PUC is less so. However, it would be beneficial to identify people that are going to engage well and in a meaningful manner. Identify who you want to be involved, and then identify specific barriers to those people and groups.
- Institutional knowledge/memory is important. It may be good to limit terms. Need to explore an organizational construct to accommodate new/different voices. The PUC tends to be static, and some changes may be good.

Summary: This potential recommendation was selected as one of the Task Group's high priority recommendations. It is discussed in more detail in Chapter 6. See Section 4.5 for some information on PUC characteristics which are related to this recommendation.

4.4.2.2 POTENTIAL RECOMMENDATION/ASSOCIATED QUESTION: REDUCE TIME TO IMPLEMENT INNOVATION OR NEW PROVISIONS. DO WE NEED TO VET PROPOSAL AT FOUR LEVELS (PUC, ASCE, IBC, STATE CODES)?

Degree of support from interviewees: Low (for changing the current four level system).

Interviewee comments

- Do not see a way out of it. Necessary to keep the four levels.
- There is too much overlap between PUC and ASCE/SEI 7. Have PUC be more forward-looking and focus less on formalities; rethink the division of "labor" between the two organizations.
- The organizations play different roles, so there is not as much overlap as first appears. The PUC is a forward-looking group that develops concepts for different aspects of seismic design. ASCE/SEI 7 takes some of these concepts and works them into regulatory language, using a broader group of individuals. IBC does not really vet the technical provisions of ASCE/SEI 7, since the many of the voting members lack technical expertise in seismic design. However, they introduce politics into the process. They should just incorporate the national standard by default, but they will not likely surrender their current prerogatives. Most states do not perform detailed technical reviews of ASCE 7 either.
- The question is not clear to me. What ASCE 7 does is vetting. But IBC seldom vets any more. And state codes almost never do. What they do at times is inject extra-technical considerations, which are not unimportant and need to be treated with respect

- Would like to change the timing on IBC better. Prefer PUC to finish heavier items a bit sooner. Need to coordinate PUC, ASCE/SEI 7, and IBC timing a bit, particularly between ASCE and IBC.
- This is an interesting question. There is a lot of redundant work, but each level has their own purpose. Not sure how BSSC could effect that change.
- There is a different process for new systems, such as the ICC-ES approach with acceptance criteria. State code is beyond our reach.
- This will greatly extend the cycle. Having common members between PUC and ASCE 7 Seismic Subcommittee goes a long way to vet the provisions.
- There is a general sentiment that PUC should spend time tackling fewer but bigger topics that ASCE would be overwhelmed attempting to take on and doing the underlying work required to inform those topics.
- The PUC may be better served to focus more on developing papers that can inform ASCE decisions, rather than focusing on getting provisions into ASCE. It is redundant to require everything to go through both the PUC and ASCE, using essentially the same vetting process in both groups, with overlapping committee members.
- The current process works well. FEMA pays organizations to help develop/refine code provisions. The practice of engineering is changing, though, with proprietary products, such as isolators, dampers, post-tensioned seismic force-resisting systems being used for functional recovery.
- We need to be thoughtful about the PUC to ASCE/SEI 7 handoff, including what activities ought to occur at which level, minimizing overlap, funding issues (volunteer vs. paid), and respect for each organization.
- Decide at the beginning of the cycle which topics should go straight to ASCE/SEI 7 and which should stay with the PUC at the start.
- Do not change the process simply because we can.
- Keep the focus on the big picture at the PUC. Smaller incremental changes should stay with ASCE/SEI 7.
- Changes should be aimed at getting consistent results.
- The PUC reaches out to member organizations too late. By the time the member organizations respond (if they do), decisions have already been made, and it is difficult or impossible to backtrack.

Summary: This recommendation did not receive a high degree of support from the PUC, nor was it highlighted in User or Stakeholder Surveys. As a result, the Task Group chose not to make it one of their recommendations.

4.5 Recent Provisions Update Committee Member Characteristics

Increasing the diversity of code developers has a high degree of support from User and Stakeholder Surveys as well as from the interviewees (see Section 4.4.2.1, for example). The PUC is a key code resource development committee. PUC members are carefully selected primarily for their technical seismic engineering expertise and knowledge of U.S. seismic code and standard development process. There are specialists in steel, concrete, and wood and in other materials or seismic force-resisting systems; specialists in nonstructural components and nonbuilding structures; and experts in ground motions. All have significant experience in code development committees, and most routinely give presentations at conferences on technical issues.

Given the recurring theme of a desire for more diversity in participation in code development processes, the Task Group decided it was important in this report to offer some information and reflections about the characteristics of the 2016-2020 PUC for several measures of diversity, such as gender, geographical location, age, and profession. This was not a systematic aspect of the study; any errors or omissions are unintended and deserve attention in future tracking of diversity in code development participation. It is not possible to increase diversity without developing strategies for measuring it and future understanding why and how it matters.

Figures 4-2 to 4-7 provide a summary. There were 23 voting members, including the chair. There were seven other non-voting members that were part of the committee, for a total of 30 members. The non-voting members are FEMA, NIST, and USGS representatives and NIBS/BSSC staff members. Judgement by the report authors was used for quantifying some characteristics. For example, geographical location was associated with where the individual has been located for the majority of their career. Many individuals could be assigned to multiple professions, but the primary profession was used. For example, professors often also provide consulting services in addition to teaching and research. Age, race, and gender were not explicitly asked of PUC members, due to privacy, but based on judgment of the report authors, the assumptions are considered reasonably accurate.

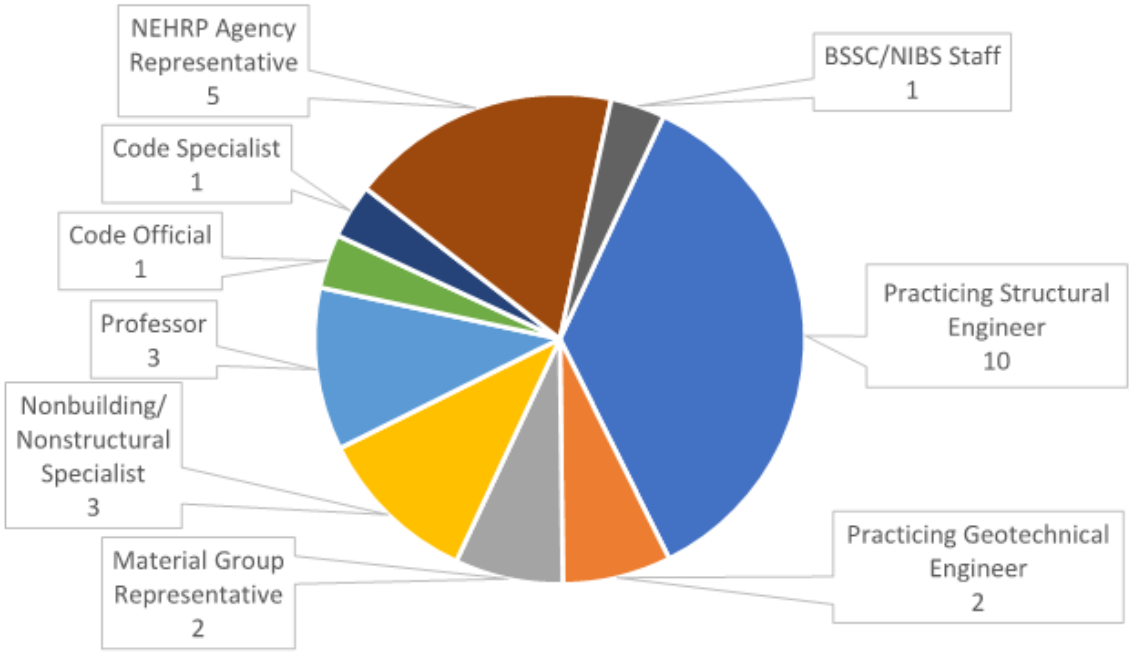

Figure 4-2. 2016-2020 Count of PUC Member Professions

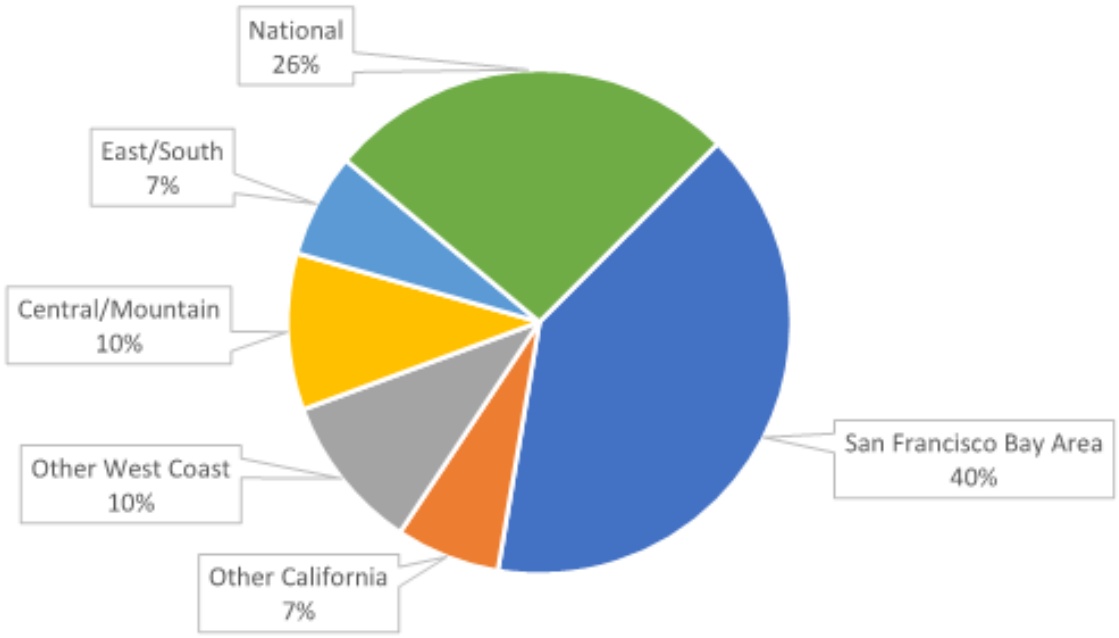

Figure 4-3. 2016-2020 PUC Member Geographical Location

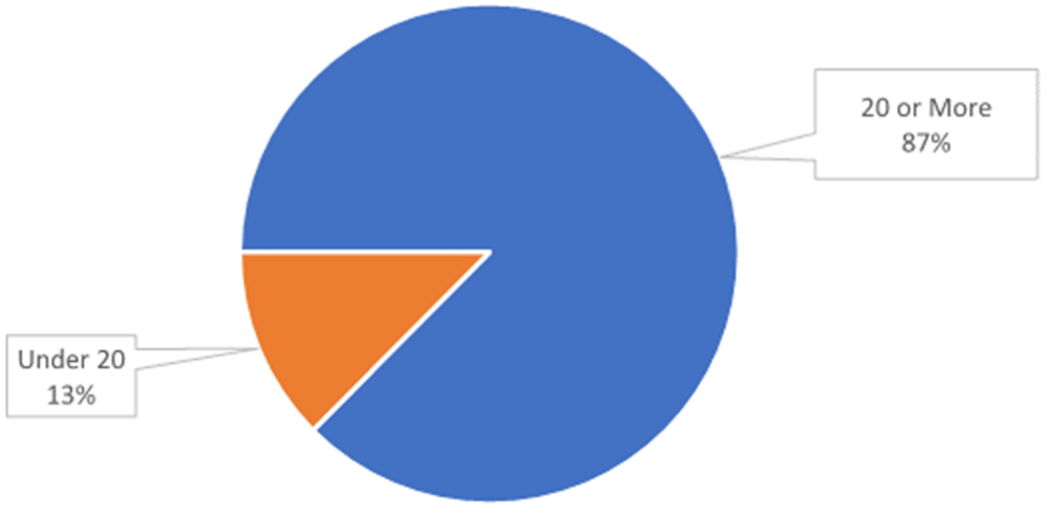

Figure 4-4. 2016-2020 PUC Member Practicing Engineer and Nonbuilding/Nonstructural Specialist Number of Employees at Firm

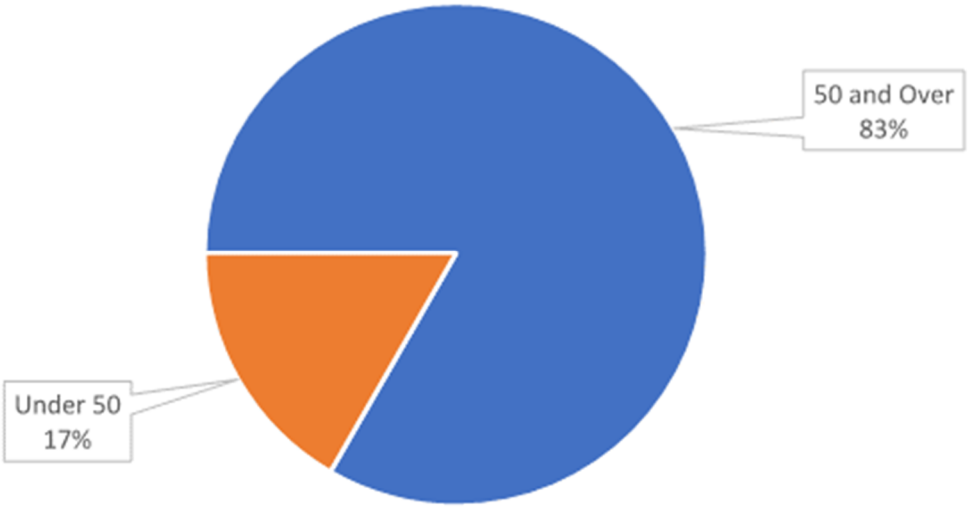

Figure 4-5. 2016-2020 PUC Member Age at Start of Cycle (Estimated)

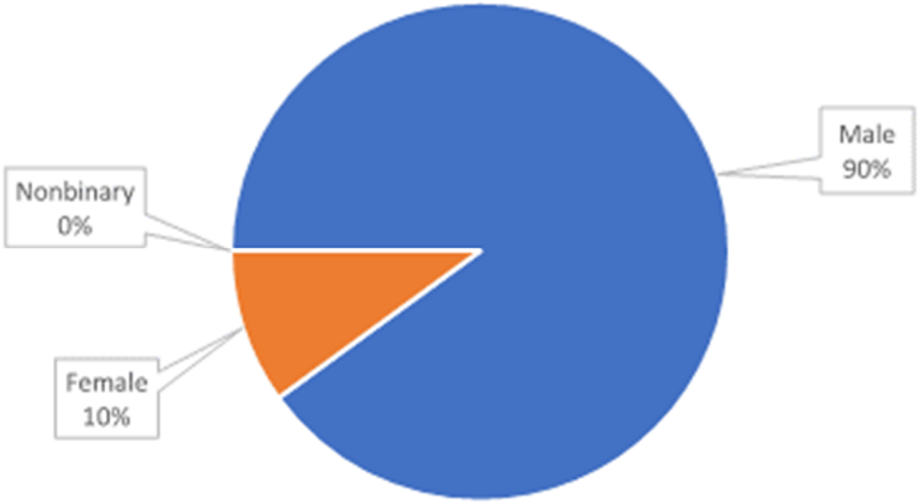

Figure 4-6. 2016-2020 PUC Member Gender (Assumed)

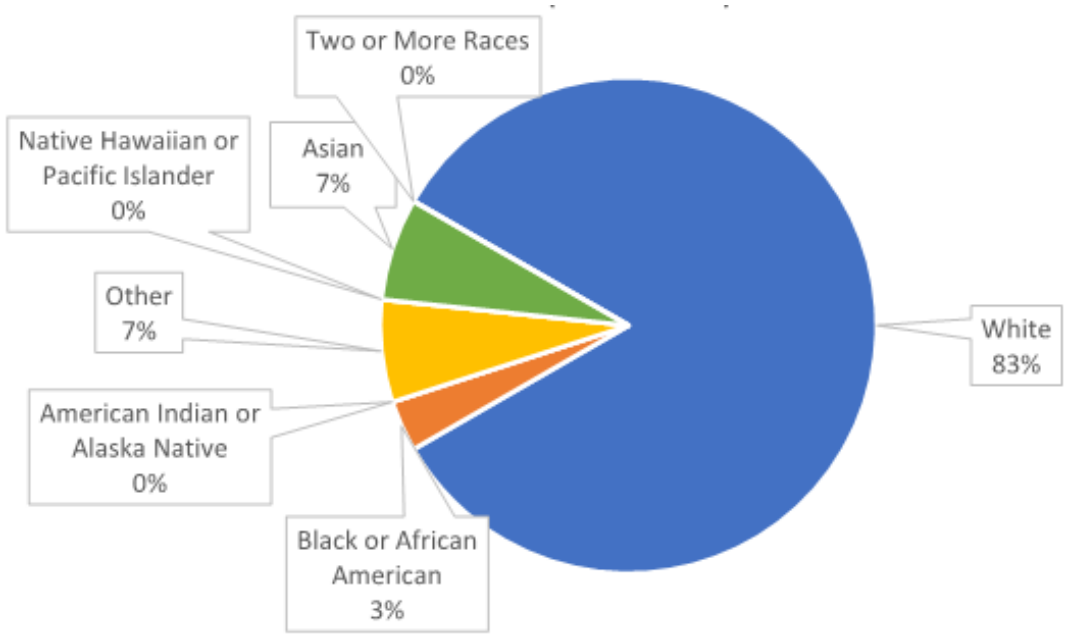

Figure 4-7. 2016-2020 PUC Member Race (Assumed)

Per US Census Bureau (2021), the 2020 U.S. Census used the following racial categories. The same categories were used in the 2010 U.S. Census.

- White
- Black or African American
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Other Pacific Islander
- Some Other Race
- Two or More Races

Table 4-5 compares the assumed PUC racial characteristics with the overall U.S. population in the 2010 census. Results on race and ethnic categories from the 2020 U.S. Census are not yet available.

Table 4-5: 2016-2020 PUC Member Racial Diversity vs. U.S. Population in 2010 U.S. Census

Race	PUC Member (%)	U.S. Population (%)
White	83	72.4
Black or African American	3	12.6
American Indian or Alaska Native	0	0.9
Asian	7	4.8
Native Hawaiian or Other Pacific Islander	0	0.2
Some Other Race	7	6.2
Two or More Races	0	2.9
Totals	**100**	**100**

The 2020 census used two ethnic categories: (1) Hispanic or Latino or (2) Not Hispanic or Latino. The same categories were used in the 2010 U.S. Census. The 2010 census found that 16.3% of the U.S. population identified as Hispanic or Latino (US Census Bureau, 2011). Per the US Office of Management and Budget, "Hispanic or Latino" is defined by as refers to a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race" (US Census Bureau, 2011). There were likely very few, if any, Hispanic or Latino members in the 2016-2020 PUC.

Opportunities for Increased Diversity Among PUC and Issue Team Members

What the summary shows is that there is certainly an opportunity for greater diversity in the PUC. In the 2016-2020 cycle, forty percent of members were from the San Francisco Bay Area. Of the practicing structural and geotechnical engineers, approximately only 13% work for firms with less than 20 employees. Only 17% of PUC members were under 50 years old. Only 10% of members were women. Racial and ethnic diversity is somewhat inconsistent with the larger U.S. population.

Chapter 5: Synthesis and Evaluation of Potential Recommendations

5.1 Process Used

After the interviews were completed, the Task Group synthesized comments from different interview groups and began to evaluate and develop conclusions, recommendations, and priorities. The following process was used.

- Each Task Group member was assigned one of the three topic areas (code development, content and ease of use, or dissemination and education) and asked to identify their top three initial recommendations. There were two Task Group members for each topic area. Task Group pairs by topic area were intentionally varied from the pairs that conducted interviews.
- For each initial recommendation, Task Group members determined the number of "High" support votes from all the interview summaries and then identified the organization that could be responsible, whether funding is needed, whether it is a near-term or long-term recommendation, whether it is it easier or harder to implement, and what issues should be considered in the implementation.
- Task Group members did not necessarily pick the initial recommendations with the largest number of High Priority votes in the interview, if the Task Group member believed the recommendation to be desirable or if there was substantial support based on the survey results.
- Task Group initial recommendations were then combined within each topic area to eliminate redundant recommendations.
- Task Group members then identified their three highest priority interim recommendations across all topic areas, not just the topic area they synthesized. There was significant consensus among the group about the highest priority interim recommendations.
- Finally, during Task Group discussions, interim recommendations were refined into final recommendations, and final recommendations were split into high priority and medium priority recommendations. Task Group members were assigned responsibility for the write up of different recommendations. These are given in Chapter 6.

5.2 Task Group Initial Recommendations

Tables 5-1, 5-2, and 5-3 summarize the initial recommendations from each of the three topic areas (code development, code content and ease of use, and dissemination and education) from each Task Group member, including the recommendation and the issues raised about it during surveys and interviews. Task Group members are listed anonymously as Members A, B, C, etc. They are

similar, but not always identical to the potential recommendations discussed during the interviews. After discussion and ranking by Task Group members, recommendations were assigned a High Priority (shaded in light green) or a Medium Priority (shaded in grey). Recommendations not shaded are similar to other recommendations, so they were not carried forward. Due to space limitations, Tables 5-1, 5-2, and 5-3 do not list the responsible organization, whether funding is needed, or if it is a near-term or long-term recommendation. This information is provided in Chapter 6.

5.3 Conclusions

Chapter 3 provides findings from the surveys; Chapter 4 provides findings from the interviews. This information and the synthesis by the Task Group in developing recommendations yielded several high-level conclusions. These can be summarized as follows.

1. Wholesale changes in both the codes or how they are developed are not strongly desired, but there are many ideas proposed for improvement and a substantial number of desirable recommendations. It is an evolution that is desired, not a revolution.
2. There is support for targeted improvement from FEMA, NIBS, and BSSC and a desire to implement changes in the upcoming *NEHRP Provisions* and ASCE/SEI 7 code development cycle. The time is right to make changes.
3. The three categories of improving code development, improving code content or ease of use, and improving dissemination and education on the code and code changes serve as a useful organizing framework.
4. Some recommendations are relatively easy to implement and have a narrow range of what organization or group would need to be involved. Others are much more involved, and they would require a larger collection of stakeholders and participants. Both types of recommendations are expected to provide worthwhile benefits to engineers and to society as a whole.
5. Developing a process at the PUC and ASCE level for tracking changes and improvements in the code development process and other recommendations of this study and promoting them is strongly encouraged.

Table 5-1: Task Group Initial Recommendations on Improving Code Development

Initial Recommendations	Issues	Priority
Task Group Member A		
1. *Increase diversity in code developers with the following approaches*		High
a. Replace some in-person meetings with virtual meetings (to reduce loss of billable time due to travel).	In-person should be at the beginning to help members get to know one another. Virtual sessions should be four hours maximum and limited to a small number of meetings. Virtual works better with smaller groups, such as subcommittees.	
b. Solicit some new participants for the PUC and issue teams.	Rotate a small number of new members (one-three) in as older ones rotate off. Be very careful. Newer members should start on issue teams to gain experience. Rationale: Will have more points of view. The size of the PUC has shrunk over time, so natural turnover did not happen. Perhaps just make it bigger. A succession pipeline is important. This is a fundamental moment now where diversity and inclusion are increasingly valued by our society.	
c. Target involving younger engineers, both on issue teams, and possibly in special roles on the PUC.	Younger members can start on issue teams as vice chairs or in a special role to the PUC (secretary, historian, balloteer). Could be a partially funded role.	
d. Put target role models in issue team chairs and highlight their involvement.	Expand beyond San Francisco Bay Area older engineers to more fully represent users and researchers. The proposed targets must be highly qualified. Be more intentional, particularly to target highly qualified women.	
2. *Convene pre-cycle regional workshops to identify and prioritize issues to address.*	This will help make sure proposal ideas are desired by users. Need to get ideas on what is not working or needs clarification. Leave time for discussion. Process needs to be well thought out so loud voices do not dominate discussions. Make sure this happens early enough.	High
3. *Require worked examples for proposed new provisions using paid practicing engineers*	The *NEHRP Provisions Design Examples* are valuable, but they are created after the cycle. Vetting is needed during the cycle. Time during the process is limited; there would need an expedited process and a pre-approved list of individuals. It would get done faster with paid engineers, than with volunteers. The change proposal wording and how it gets interpreted are important parts of the example testing.	High

Table 5-1: Task Group Initial Recommendations on Improving Code Development (continued)

Initial Recommendations	Issues	Priority
Task Group Member B		
1. *Increase diversity in code developers with the following approaches*		NA
a. Replace some in-person meetings with virtual meetings (to reduce loss of billable time due to travel). **Similar to Task Group Member A Recommendation 1a.**	Virtual works well with known group and smaller sizes. Voting should be thoughtful (vetted, allow for meaningful input) if being done through web meetings. Important to have in-person meetings to kick off new groups and cycles. Virtual can be good for work by subcommittees and issue teams.	
b. Solicit some new participants for the PUC and issue teams. **Similar to Task Group Member A Recommendation 1b.**	New ideas and fresh perspectives are important, but balance value of having some members with long history with process. Consider what would be an appropriate turnover cycle-to-cycle, say 15%?	
c. Target involving younger engineers. Look for specific tasks for them to do (PUC Secretary, IT participant). **Similar to Task Group Member Recommendation 1c.**	Younger members can start on issue teams as vice chairs or in a special role to the PUC (secretary, historian, balloteer). Should be a partially funded role.	
2. *Convene pre-cycle regional workshops to identify and prioritize issues to address.* **Similar to Task Group Member A Recommendation 2**	Allows stakeholders to have more input to provisions, rather than just voting after developed. Workshops need to be vetted to ensure they are viable mechanisms for feedback. Options: Virtual? Survey? Facilitated? Topic-focused?	NA
3. Require worked examples for new provisions using paid practicing engineers. **Similar to Task Group Member A-3.**	Use ASCE/SEI 7 wind as example: all new provisions/ larger changes require a worked problem to be submitted with proposal. By making it a paid position, quality and timeliness could be better controlled.	NA

Table 5-2: Task Group Initial Recommendations on Improving Code Content and Ease of Use

Initial Recommendations	Issues	Priority
Task Group Member C		
1. Address functional recovery and enhanced resilience:		
a. Develop requirements for performance objectives beyond life safety, such as functional recovery. **Task Group Member C Recommendation 1c selected in lieu of this.**	The PUC needs to take a lead role in establishing an industry standard process. Other organizations are already working on this, but that should inform, not dissuade, the PUC from deliberately moving forward. The general focus on the building code basis needs to shift from life-safety to recovery time. A significant segment of non-engineers already believes current building codes provide better than life-safety performance which is not true. Research needs to be performed to avoid imposing code requirements without really knowing what performance they will result in or how much they will cost. What "functional" means is highly building specific. This needs to be a deliberate, thoughtful effort and not just "rammed" into the code to get something done. Explore different standard levels (different docs?) as opposed to the current one size fits all minimum. That would allow policy makers to select which to apply to specific applications. It is important that provisions clearly delineate which provisions are life-safety and which are additional functional recovery to avoid a disincentive for code adoptions in the central and southeast areas of the U.S.	NA
b. Develop a coordinated strategy between ASCE, BSSC, ICC, and others. **Task Group Member C Recommendation 1c selected in lieu of this.**	The PUC should not work in a box but make a concerted effort to coordinate efforts between organizations. This will involve all other disciplines, not just structural. Planning and coordination would need to come from the federal level. This is more than a typical code activity since broad consensus will be required. Research will need to be performed to develop a methodology; different occupancies will have different needs.	NA
c. Pilot study to identify next steps. **This recommendation was added during Task Group discussions.**	Pick a building type and system, bring wider group of contributors together, and try to develop technical provisions. This would be a pilot study to identify next steps. Focus on a new building that is not Risk Category IV. The study could include couple of different seismic hazard levels and performance levels. Impeding factors and relevant multi-hazard should be included.	High

Table 5-2: Task Group Initial Recommendations on Improving Code Content and Ease of Use (continued)

Initial Recommendations	Issues	Priority
2. *Find ways to simplify the code:*		
a. Make provisions simpler in general, and/or focus on detailing.	There is support for the idea of a separate chapter and simplified procedures for low seismic hazard. A separate committee/subcommittee specifically tasked with low seismic hazard was seen as a good idea. Consistency would need to be deliberately maintained between performance objectives, so they do not diverge between low and high seismic. Explore whether complaints are truly a request for simplification or clarity of delivery. More representation is needed from low-seismic areas. Current committees are predominantly composed of persons from high-seismic, high-impact regions, and thus the issues and modifications are dominated by that need without always considering impacts to low seismic areas.	High
b. Develop ways to make performance-based design for new buildings more accessible to more practicing engineers. Also develop clearer performance-based design provisions.	Performance-based procedures need to become mainstream. ATC-138 should be reviewed by a PUC issue team. Performance and prescriptive are not mutually exclusive. Movement to write a code in a performance perspective raises concern.	Medium
3. *Develop a Part 3 paper on quality assurance to cover, at a high level, the state of the practice, expectations that code writers have for the level of quality assurance during fabrication and construction, with recommendations for others (ASCE, material standards, ICC, etc.)*	Limited comments were provided for rationale and issues, but there was high support for this.	Medium
4. *Develop list of high priority sections for improvement in provisions and commentary from User Survey*. Combine with Task Group Member A Recommendation 2.	Responses to this were varied, from the issue was in the user implementation (nonissue) to someone definitely needs to address problems (major issue). Recommend these be broken out into a separate topic list that can be provided to the PUC for consideration. The list should be ordered in priority and with survey questions and comments provided for context.	NA

Table 5-2: Task Group Initial Recommendations on Improving Code Content and Ease of Use (continued)

Initial Recommendations	Issues	Priority
Task Group Member D		
1. *Address functional recovery and enhanced resilience*		
a. Develop requirements for performance objectives beyond life safety, such as functional recovery. **Task Group Member C Recommendation 1c selected in lieu of this.**	Research is needed to define functional recovery and ensure it is consistent with what society needs and leads to resiliency. Need to develop a knowledge base to establish functional recovery objectives and strategies.	NA
b. Develop a coordinated strategy on functional recovery across all disciplines (MEP, architectural, lifelines) and code development groups (ASCE, BSSC, ICC). **Task Group Member C Recommendation 1c selected in lieu of this.**	This effort would be led by NIST and BSSC PUC to bring order to the process and development of a national standard. Broad consensus building is needed. Codification path needs to be developed.	NA
2. *Improve usability of seismic provisions in low seismic reasons.* **Similar to Task Group Member C Recommendation 2**	Develop work group or subcommittee specifically tasked to improve the usability of the low seismic provisions. This could include reorganizing or relocating the low seismic provisions.	NA
3. *Improve provisions for foundation design.*	Two efforts are needed: (1) Coordinated effort with ICC, ASCE, ACI, and SEI/G-I standards committee to consolidate the current conflicting foundation provisions into a standard, (2) BSSC to develop foundation design provisions to be consistent with building design provisions (e.g., drop allowable stress design, overturning/rocking, capacity-based design). Building yielding mechanism can be very different if the foundation modeled. The ATC-140 project on ASCE/SEI 41 foundation chapter rewrite may provide direction.	Medium

Table 5-3: Task Group Initial Recommendations for Improving Dissemination and Education on Codes and Code Content

Initial Recommendations	Issues	Priority
Task Group Member E		
1. *Create more detailed commentaries. Include the reason why the provision is there. Find the balance between repeat of provision and an overly detailed academic treatise. This target reader should include building officials.*	Focus on ASCE chapters that do not have alternative documents. The ground motion discussion is too voluminous; the code commentary can synthesize it. It would be nice if information for all codes/standards were freely available. Can the ASCE/SEI 7 standard be made available for free (look at ICC for free view online and AWC for free download).	Medium
2. *Develop more design guides (such as cladding design, NRHA). FEMA P-58-7,* Building the Performance You Need, A Guide to State-of-the Art Tools for Seismic Design and Assessment *is an example.*	Need overall strategy for getting the word out about changes to standards, codes, and practices. Design guides are great with comprehensive, specific topics, but sometimes too detailed. Social media offers snippets of small pieces. Designers are looking for an answer to a specific question and have to wade through an example to find that answer. Need to be kept up to date with latest changes.	Medium
3. *Outreach to geotechnical engineers*	Outreach to geotechnical engineers to include journal articles, trade magazines, webinars, and continuing education courses. Too many are unaware of significant changes, and there have been many in ground motions in both the ASCE/SEI 7-16 and the forthcoming ASCE/SEI 7-22.	Medium
4. *Education on upcoming changes during development of ASCE/SEI 7 next edition.*	Need overall strategy for getting the word out about changes to standards, codes, and practices. Use conference presentations and panel discussions during development of changes. Use trade magazine articles to highlight final changes, webinars to explain impact and use, and journal articles to provide the technical detail and rationale behind the changes. AWC publishes a redline version that shows the compiled effect of all the changes in a cycle. This would be nice for BSSC to do with the *NEHRP Provisions* and ASCE to do with ASCE/SEI 7.	Medium

Table 5-3: Task Group Initial Recommendations for Improving Dissemination and Education on Codes and Code Content (cont.)

Initial Recommendations	Issues	Priority
5. *Develop a broad coalition of public and private partners to apply best available communication methods and tools towards a nationwide effort to change public understanding of codes and their value to help advance the adoption and enforcement of codes and spur innovation throughout the country.* ***This is combined with Task Group Member F Recommendation 1.***	Communication specialists can be effective in conveying messages, but they need to understand the issues sufficiently. In the information technology world, they have technical manual specialists. Look in ATC-58-2 for the piece on benefits of seismic design to stakeholders. Need to recognize that the U.S. is not like Japan where whole country is high seismic. Even California does not remember the last earthquake. Need to be sensitive to different needs around the country, including low and moderate seismic regions.	NA
Task Group Member F		
1. Develop an overall coordinated strategy for dissemination to structural engineers, to other engineers and architects, to other stakeholders, including the public, before, during, and after development of new provisions.	To improve the current situation, this needs to include key Federal agencies (NIST, FEMA, USGS) and a great many of the member organizations of BSSC, several of which (e.g., ASCE, ACI, AISC, AISI, AWC, TMS) will need to make commitments to follow through on the strategy	High
2. Develop an interactive, online platform where seismic provisions are linked to commentaries, design examples, background articles, including archival journals, similar to ACI 318 +. Reach out to other potential partners, rather than developing all new.	This is clearly focused on reaching seismic design practitioners. It should not mean that existing efforts such as design examples, commentaries, etc., are discontinued, nor that efforts to reach other groups be discontinued. The links are likely in the commentary to the provisions.	High
3. Develop more webinars, archived and available on demand	Issues to consider include linkage from FAQ platforms and interactive commentaries, cost, formal continuing education credits, etc. This could include specific technical webinars as well as broader overviews.	Medium

The distillation of recommendations is summarized in Figure 5-1. There were 47 potential recommendations discussed in the original interviews between the three topic categories. Task Group members then whittled this down to 24 initial nonredundant recommendations. After discussions, this led to 16 final recommendations, including eight high priority and seven medium priority recommendations. These are discussed in detail in Chapter 6. The high priority recommendations include one to monitor the progress of implementing recommendations. It is not shown above, but it is discussed in Chapter 6.

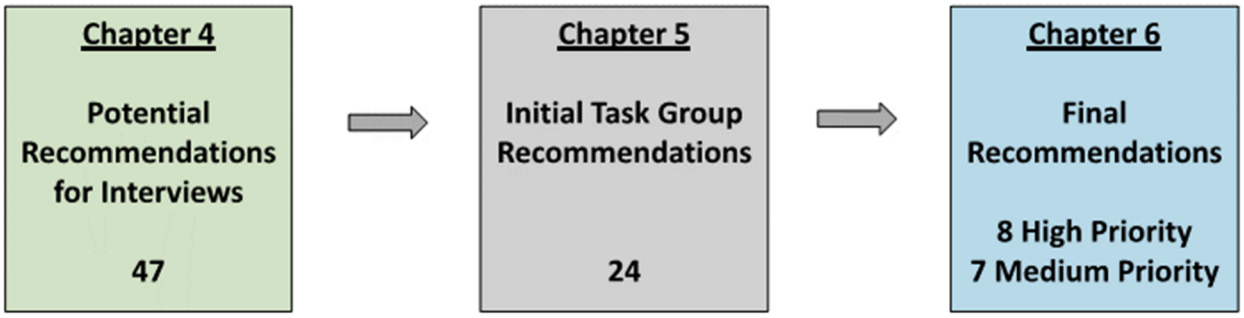

Figure 5-1. Progression of Recommendations

Chapter 6: Recommendations

6.1 Summary of Recommendations

Based on Task Group discussions, User and Stakeholder Surveys, interviews with PUC members, and the conclusions summarized in Chapter 5, the Task Group developed a set of recommendations. They are organized into three categories:

- Improving code development
- Improving code content and ease of use
- Improving dissemination and education on code and code changes.

Recommendations are further divided into eight with high priority and seven with medium priority. The high and medium priority assignments were made by the Task Group, based on the survey findings and interviews. Table 6-1 provides a summary. Organizations with potential capability/responsibility for implementing the recommendation are also listed.

Each recommendation is then discussed in more detail in Sections 6.2, 6.3, 6.4, and 6.5. The discussions are organized in a framework that includes the following items:

- *Objective:* The goal of the recommendation.
- *Recommendation summary:* A short summary, typically one sentence, of the recommendation.
- *Rationale/benefits:* The rationale for why the recommendation was made and the benefits it could provide.
- *Who has capacity/responsibility for the recommendation:* Who would be interested and able to perform the work and who would be able to serve as a partner or provide support? Note that organizations listed here are primarily focused on code or code resource development through their main past and current efforts. Other organizations may be able to address the recommendation as well.
- *Is funding required?* This notes whether funding is required or desired to be more likely for the recommendation to be implemented. Establishing an actual cost is beyond the scope of this report.

Table 6-1: Summary of Recommendations

Priority	ID	Recommendation	Capability/ Responsibility	Funding Needed?	Near-term?
Improve Code Development					
High	D1	Increase seismic code developer diversity	PUC, BSSC, ASCE	No	No
	D2	Conduct pre-cycle regional workshops	PUC, BSSC, ASCE	Yes	Yes
	D3	Require paid worked examples for proposed code changes	PUC, BSSC, NEHRP agencies, industry	Yes	Yes
Improve Code Content and Ease of Use					
High	C1	Address functional recovery and enhanced resilience in model code framework	PUC, BSSC, NEHRP agencies, EERI, ICC, ASCE, ATC	Yes	No
	C2	Make low and moderate seismic provisions more usable	PUC, ASCE, ICC	Yes	No
Medium	C3	Develop more usable performance-based procedures for design	PUC, ASCE, NEHRP agencies, material groups, ATC	Yes	No
	C4	Develop construction quality assurance *NEHRP Provisions* Part 3 resource paper	PUC	No	Yes
	C5	Improve seismic code provisions for foundation design	PUC, ASCE, material groups	Yes	No
Improve Dissemination and Education on Code and Code Changes					
High	E1	Develop coordinated strategy for improving understanding of seismic codes	BSSC, NEHRP agencies, material groups, ICC, ASCE	Yes	Yes
	E2	Develop interactive online platform for seismic code provisions	BSSC, ASCE, SEAs, material groups	Yes	No
Medium	E3	Expand commentaries	PUC, ASCE	Yes	Yes
	E4	Develop more design guides	PUC, ASCE, SEAs, material groups	Yes	No
	E5	Outreach to geotechnical engineers	PUC, BSSC, ASCE	Yes	Yes
	E6	Publicize upcoming code changes and input opportunities	BSSC, ASCE, ICC, material groups	Yes	Yes
	E7	Develop more webinars, archived and available on demand	BSSC, ASCE, material groups	Yes	Yes
Monitoring and Encouraging Progress					
High	M1	Track progress of recommendations	BSSC, ASCE	No	Yes

- *Near-term or long-term:* This is a qualitative judgment as to how long it will take to implement the recommendations. Recommendations that can be initiated in 2022 and completed as part of the 2026 *NEHRP Provisions* and ASCE/SEI 7-28 cycles are typically placed in the near-term category; recommendations that would go beyond this effort are typically placed in the long-term category.

- *Issues of concern and strategies to address them*: This is provided for high priority recommendations to help expand the discussion, highlight areas where there are challenges, and propose how those challenges could be addressed.

- *Related recommendations:* Identifies other recommendations that cover similar goals or are related in other ways. In some ways, all of the recommendations to improve code content and ease of use and the education and information dissemination recommendations are related, in that the real objective cannot be achieved purely by writing more clear code provisions. The typical practicing engineer will need real assistance through educational efforts. Education requires two-way communication. The code and standard developers can help to educate practitioners on the purpose, background, technical benefit, and restrictions of a new code provision. In return, they also need to listen to the potential challenges that practitioners face, including misinterpretation, judgment, applicability, and conflict with other requirements.

It is instructive to summarize the recommendations in Table 6-1 in various ways to highlight distinctive aspects such as the recommendations cost, degree of collaboration required and anticipated time frame. Figures 6-1 and 6-2 provide one approach where Figure 6-1 shows near-term recommendations, and Figure 6-2 shows long-term recommendations. In each figure, the recommendations are placed within a framework with a vertical and horizontal axis. The horizontal axis represents the nexus of control or the extent of organizations with responsibility and capacity. When the only group involved is the PUC, the recommendation is located near the origin; as more organizations and groups are involved, the recommendation is located farther from the origin. The vertical axis represents the level of funding needed in an approximate, relative way. Estimates of a budget were outside the scope of this study. When funding is not needed or negligible, the recommendation is located near the origin; as funding needs increase, the recommendation is located farther from the origin. The Task Group viewed the recommendations nearer to the origin as relatively easier to implement. However, some recommendations farther from the origin are listed as high priorities, given their importance and the magnitude of perceived benefits.

These recommendations are offered as a menu of highly promising potential new initiatives and changes of practice that speak to consequential concerns or untapped opportunities. There is no assertion that all of them should or could be attempted, but the Task Group was careful to put forth recommendations that from their collective perspective were both feasible and compelling. The Task Group put effort into shaping each idea enough so that a reader could understand the intention and benefit from some of the richness of thought about it that resulted from the surveys, interviews, and Task Group deliberations and considerations as to what it might look like. But, these are not fully developed proposals. It is expected that the ideas embodied in these recommendations would

require further refinement and evolution. Where details are given, consider them illustrative of the kind of details that would need to be developed further.

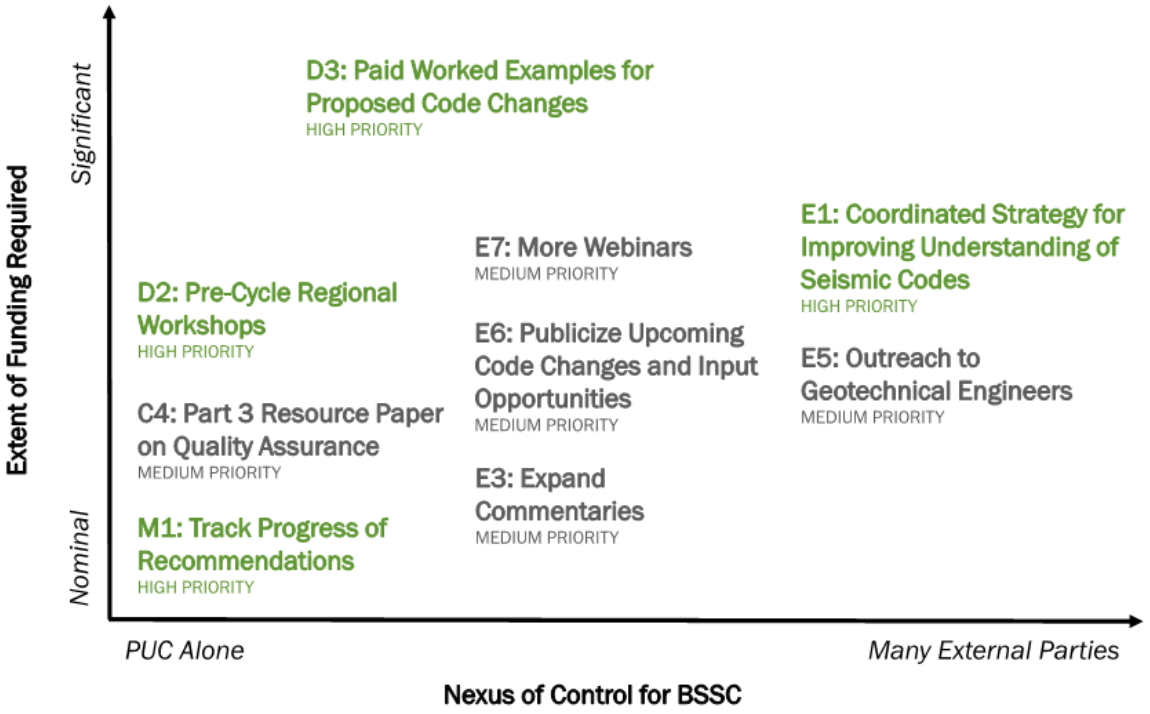

Figure 6-1. Near-term Recommendations: Nexus of Control vs. Extent of Funding Required

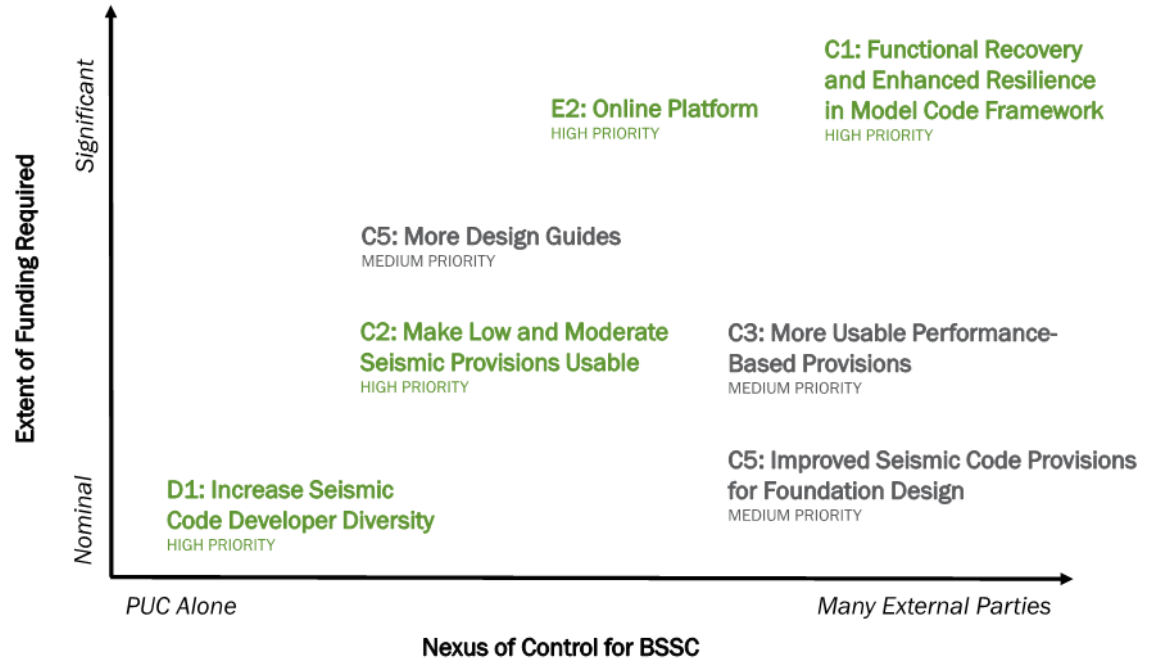

Figure 6-2. Long-term Recommendations: Nexus of Control vs. Extent of Funding Required

6.2 Recommendations for Improving Code Development

6.2.1 High Priority

6.2.1.1 RECOMMENDATION D1 - INCREASE DIVERSITY IN CODE DEVELOPERS

Objective: Expand committee perspectives through inclusion of participants with more widely varying backgrounds and experience.

Synopsis: Section 4.5 described characteristics of the 2016-2020 PUC members and showed that by several measures, the committee is not that diverse. Four recommendations were identified as a means to increase the diversity of the participants in the code development process. Each recommendation is summarized below with relevant information. Recommendations D1A, D1B, and D1C provide approaches to achieving Recommendation D1D and the overall Recommendation D1 goal of increased diversity.

Recommendation Summary D1A - Increase the use of virtual meetings in combination with a limited number of in-person meetings throughout the year to reduce barriers to participation.

Rationale/Benefits: The 2020-2021 use of virtual meetings in lieu of in-person attendance was a national experiment that generated new opportunities to increase diversity in many facets of society, including code development. Anecdotal reports indicate meeting participation increased with new faces and more frequent attendance from established committee members. This increase can be attributed to the reduction in barriers such as time out of the office to travel, travel expenses, and limited financial resources. With the financial demands minimized, meeting locations were no longer a deterrent, and volunteers from across the nation were able to participate. With the travel time demands minimized, volunteers were able to devote more time to actual code development activities with less time away from their office responsibilities. In-person meetings should not be fully eliminated since they provide a valuable opportunity to connect with committee members that cannot be replicated with virtual meetings. Virtual meetings, however, provide an equally valuable opportunity to reach interested persons that are not currently participating simply due to the logistical barriers involved with in-person attendance. A combination of in-person and virtual meetings will provide the best of both worlds and greatly expand the pool of volunteers.

Who Has Capacity/Responsibility for the Recommendation? The PUC and issue teams would determine the best combination of virtual and in-person meetings. A similar process could be used by the ASCE and ICC code committees.

Is Funding Required? Yes, if organizations do not already have virtual platforms in place.

Issues of Concern and Strategies to Address Them: This would be an easy effort that would need to consider the following:

- *Balanced Goals:* Increase diversity while still efficiently completing the work required for the code development process.
- *Experience:* Inclusion of new members should be integrated with, as opposed to replacing, the vast experience and knowledge of established committee members.
- *Volunteer Purpose:* New and established volunteers should be vetted to confirm their desires and long-term intentions related to continued participation on the committee.
- *Timing:* This could be immediately implemented with minimal effort.
- *Ratio:* The ratio of virtual to in-person meetings should consider the group work necessary based on the topics to be considered. This ratio will vary between the main PUC and issue teams. Ratio goals could be established by BSSC, but should be guidelines, not requirements.
- *Technical Oversight:* The host organization would need a dedicated person to facilitate and troubleshoot virtual meeting logistics. Balloting in a virtual setting is much more challenging than in-person. Additional technology may be required to be more effective.

Recommendation Summary D1B - Target younger engineers for involvement on PUC issue teams, ASCE 7 seismic task committees, and specially defined roles within the PUC.

Rationale/Benefits: Younger engineers bring enthusiasm and new ideas but may have less practical experience and technical knowledge on how committees function. In addition, they may lack the historical perspective of what led to past decisions and direction. Despite that lack, they represent the future of the committee membership and should be encouraged to participate where they can. Younger engineers that show interest in the code development process are ideally suited to smaller roles, such as PUC issue teams or ASCE 7 seismic task committees, where they can work alongside experienced members. This allows younger engineers to focus on more manageable goals/topics while gaining insight into the committee code process.

Who Has Capacity/Responsibility for the Recommendation? The BSSC, PUC, ASCE 7 Seismic Subcommittee, and current members.

Is Funding Required? Possibly.

Issues of Concern and Strategies to Address Them: Implementing this recommendation would be a moderate effort that would need to consider the items already identified in D1A.

Recommendation Summary D1C - Assign target role models as issue team chairs and highlight their involvement.

Rationale/Benefits: Increasing diversity of leadership sometimes takes an intentional effort, including seating a more diverse leadership group. Considering diversity as a metric when seating PUC issue team chairs or ASCE 7 seismic task committee chairs is a way to actively promote a more

diverse PUC and ASCE 7 Seismic Subcommittee. Public engagement is often a learned behavior that is developed over years of experience. As such, although new and younger members bring intelligence and enthusiasm, they may not begin with the confidence to speak up if faced with the full experience and surety of the PUC membership. Target role models with similar backgrounds will have greater insight to provide a support system to new and younger members. Role models will serve as a sounding board that can provide guidance on how to function within the committee structure and encouragement to develop the confidence needed to thrive in the committee code development environment.

Who Has Capacity/Responsibility for the Recommendation? The BSSC, PUC, ASCE 7 Seismic Subcommittee, and current members.

Is Funding Required? No.

Issues of Concern and Strategies to Address Them: This would be a moderate effort that would need to consider the following:

- *Role Models:* Role models should be paired with new/younger members based on similarities and a willingness to serve as a mentor.
- *Positions:* Role models serving as issue team chairs would remain responsible for effective function of the issue team and should be qualified to address the designated topics.
- *Marketing:* A variety of role models and their function on the PUC and/or issue teams should be promoted in outreach efforts, to dispel the myth that the committees only accept "old, white guys."
- *Volunteer Purpose:* While mentoring the new/younger members, role models would also be in a position to vet that member for long-term intentions and capability to continue participation on the committee.

Recommendation Summary D1D - Broaden outreach for recruitment to the PUC and the ASCE 7 Seismic Subcommittee.

Rationale/Benefits: New PUC members are critical for continuity and to maintain a relevant knowledge base within the PUC and ASCE 7 Seismic Subcommittee. Established members bring extensive code development knowledge and experience to the PUC and ASCE 7 Seismic Subcommittee. New members bring new ideas and perspectives and form the backbone of the future PUC membership. Outreach should include current member circles but should also look beyond those circles to ensure decisions are not made within a bubble of expertise that ignores other relevant considerations. Each member, new and established, will bring their own experiences and professional challenges to the table that should represent a wide variety to prevent narrowing of the PUC's collective knowledge base through inclusion.

Who Has Capacity/Responsibility for the Recommendation? The BSSC, PUC, incoming PUC Chair, and ASCE 7 Subcommittee.

Is Funding Required? No.

Issues of Concern and Strategies to Address Them: For the PUC, this would be a moderate effort that would need to consider the following. Similar issues could apply to the ASCE 7 Seismic Subcommittee and its seismic task committees.

- *PUC Approach:* The ratio of new members should be kept small to avoid purging the PUC of experience and knowledge. A specific suggestion was provided to rotate approximately 1-3 new members in as established members rotate off each cycle
- *Experience:* Pending the new member's experience with code development committees and the PUC process, initial placement on issue teams (ITs) may be appropriate prior to being moved onto the full PUC. Participating on an IT is a good opportunity to train incoming PUC members on topics, process.
- *Experience:* Inclusion of new members should be integrated with, as opposed to replacing, the vast experience and knowledge of established committee members.
- *Volunteer Purpose:* New and established volunteers should be vetted to confirm their desires and long-term intentions related to continued participation on the committee.
- *Timing:* This will be an on-going effort that will require individual and collective effort from the BSSC, PUC, and members.
- *Mentoring:* assign designated mentors from among established members as a go-to source for new members to collaborate with on technical and logistical questions. Utilize recording secretaries (or other similarly designated roles) for PUC and ITs to help train and mentor future PUC members.

Related Recommendations: None.

6.2.1.2 RECOMMENDATION D2 - CONDUCT PRE-CYCLE REGIONAL WORKSHOPS

Objective: Improve the effectiveness of new code provisions.

Recommendation Summary: Host a series of regional workshops prior to a code cycle to identify focus areas for the PUC.

Rationale/Benefits: Regional workshops would allow for more diverse input from a broad base of practicing engineers on what provisions (or commentary) need improvement and incorporation. This

helps ensure that the changes in the seismic codes are desired by users (practicing engineers, code officials). In addition to identifying issues for study, these regional workshops could be leveraged to assess and prioritize existing PUC focus areas. These workshops must be early in the code-cycle (or between code cycles) to allow sufficient time for Issue Teams and proponents to be developed, necessary study completed, and recommendation code change proposals developed. Pre-workshop surveys could be utilized to prepare attendees and generate advanced topics/consensus.

Who Has Capacity/Responsibility for the Recommendation? BSSC, supported by the PUC, should host these regional workshops. BSSC can also partner with ASCE, as some focus areas may be better developed by ASCE than by PUC.

Is Funding Required? If workshops are held virtually, cost could be negligible. If workshops are in-person, funding will be required.

Issues of Concern and Strategies to Address Them: Incorporating workshops into an already complicated and condensed PUC cycle has several areas of concern that would need to be addressed. They include:

- *Timing:* The workshops must be held early enough in the cycle to allow for incorporation of feedback. If longer term issues are identified, it is possible some efforts may span across multiple cycles/PUCs. For the upcoming cycle, it is important to realize that ASCE/SEI 7-22 will not be used very much until 2024 at the earliest, 2025 in California, and even later in many places. For example, ASCE/SEI 7-22 is intended to be adopted into the 2024 International Building Code, which will be used as the underlying provisions for the 2025 California Building Code, which will not be required for use until January 1, 2026. For workshops in the next few years, then, users are going to be asked to comment on what needs to be changed in something they have not used. This means that preparation for the workshop needs to include education about what changes happened from ASCE/SEI 7-16 to ASCE/SEI 7-22.

- *Scope:* It will be critical to outline the intended outcomes of the workshops in advance. A strong facilitator will be required to allow for equal participation from all attendees and allow for discussion amongst the group. Workshop proceedings or summaries should be produced to document what was covered and key recommendations and next steps.

- *Attendees:* Determining attendees for workshops will be critical to ensuring meaningful, actionable feedback is attained. There must be a balance of understanding/practicality and new ideas. Geographic diversity of workshops should be considered. Target locations could include west coast (CA), high seismic (not CA), high seismic (not west coast), medium/low seismic. Identifying regional leaders to help organize the workshops can be helpful.

- *Risks:* It is possible that ideas generated in the workshops are not implementable. Expectations must be managed, and unreasonable commitments should be avoided.

Near-term or Long-term: Regional workshops can be initiated reasonably easily in the near term, and it should be part of the upcoming 2026 *NEHRP Provisions* and ASCE/SEI 7-28 cycles. This could become a standard approach used as the start of each cycle.

Related Recommendation: *Recommendation E6 - Improve Stakeholder Understanding*. Pre-cycle workshops can be used as a tool to better improve stakeholder understanding of seismic code provisions.

6.2.1.3 RECOMMENDATION D3 - REQUIRE PAID WORKED EXAMPLES FOR PROPOSED CODE CHANGES

Objective: Improve the effectiveness of new code provisions.

Recommendation Summary: Require that worked examples be prepared by practicing engineers through a paid process to evaluate proposed provisions.

Rationale/Benefits: Testing proposed provisions through worked example problems has been shown repeatedly to help confirm whether the provision actually achieves its goal, to help refine the language of the provision to reduce ambiguity, and to identify and mitigate unintended consequences. These worked examples should serve as supporting material attached to the code change proposal. The level of effort can be significant, and it is unrealistic to expect volunteers to prepare such worked examples. A paid process is necessary and considered to be worth the cost.

Who Has Capacity/Responsibility for the Recommendation? The PUC should establish the threshold criteria where worked examples are required for the *NEHRP Provisions*. A similar process could be used by ASCE for code change provisions at the ASCE/SEI 7 level. Alternatively, sample problems developed through the PUC process could be leveraged when balloting code change provisions within ASCE.

Is Funding Required? Yes.

Issues of Concern and Strategies to Address Them: This would be a significant effort, and there are several issues of concern that would need to be addressed. They include:

- *Timing:* The example would need to be developed during the code cycle, and there is limited time available during this process. Note that they are different from and proceed preparation of examples in design guide documents developed after the *NEHRP Provisions*, such as the *NEHRP Provisions Design Examples*, of which the most recent example is FEMA P-2192-V1 (FEMA, 2021a). Having a list of pre-qualified engineers available, including identified areas of expertise, and under contract would be prudent.

- *Scope:* Defining the scope of the example is necessary. This will depend on the proposed provision. A draft guide on scope could be developed using some past code change proposals

for insights, and then it could evolve as it is tested with proposed code changes that come through. The example should include free-body diagrams and a step by step organization, as used by design guides like the *NEHRP Provisions Design Example*s (see Figure 6-3).

- *Technical Oversight:* The engineer for the example would require guidance on development of the example and documenting issues that arise and associated recommendations for improvement. This support could be provided by the code change proposal proponent.

- *Conflict of Interest*: It may be desirable for the paid engineer not to be on the PUC or an issue team that helped review/develop the proposal to avoid the perception of a conflict. In addition, having a fresh review on the proposed provisions is preferred to ensure no unintentional oversight by an invested proponent.

- *Independence:* It is preferred that the engineer testing the provision through the worked example represent a typical and possibly less experienced engineer.

- *Proponent's Responsibility:* In the recent past, an expectation for a major proposal such as the introduction of a new seismic force-resisting system has been that the proponent is responsible for conducting a thorough analytical justification, such as through use of the FEMA P695 process, which effectively requires a form of a case study. This paid worked example recommendation does not change that expectation but would instead focus on the more practical test of designing a new system following the proposed provisions. It is preferred that the proponent do this as well, and that the paid worked example provision recommendation be reserved other types of code change proposals.

Near-term or Long-term: Developing the criteria and process, identifying funding sources, and getting engineers in place to do the worked examples for certain new provisions would take some time, but this is considered a potentially near-term activity. It should be implemented as part of the upcoming 2026 *NEHRP Provisions* and ASCE/SEI 7-28 cycles. It is anticipated it could grow in precision, scope, and scale over time.

Related Recommendation: Recommendation E4 – Develop More Design Guides is similar, but that recommendation focuses on developing design guides which would include worked examples *after* the proposal has been adopted and educating code users about it. Recommendation D3 focuses on worked examples during the code development process. It is possible that some examples generated during the code development process might be leveraged as starting points for expanded design guides for practicing engineers.

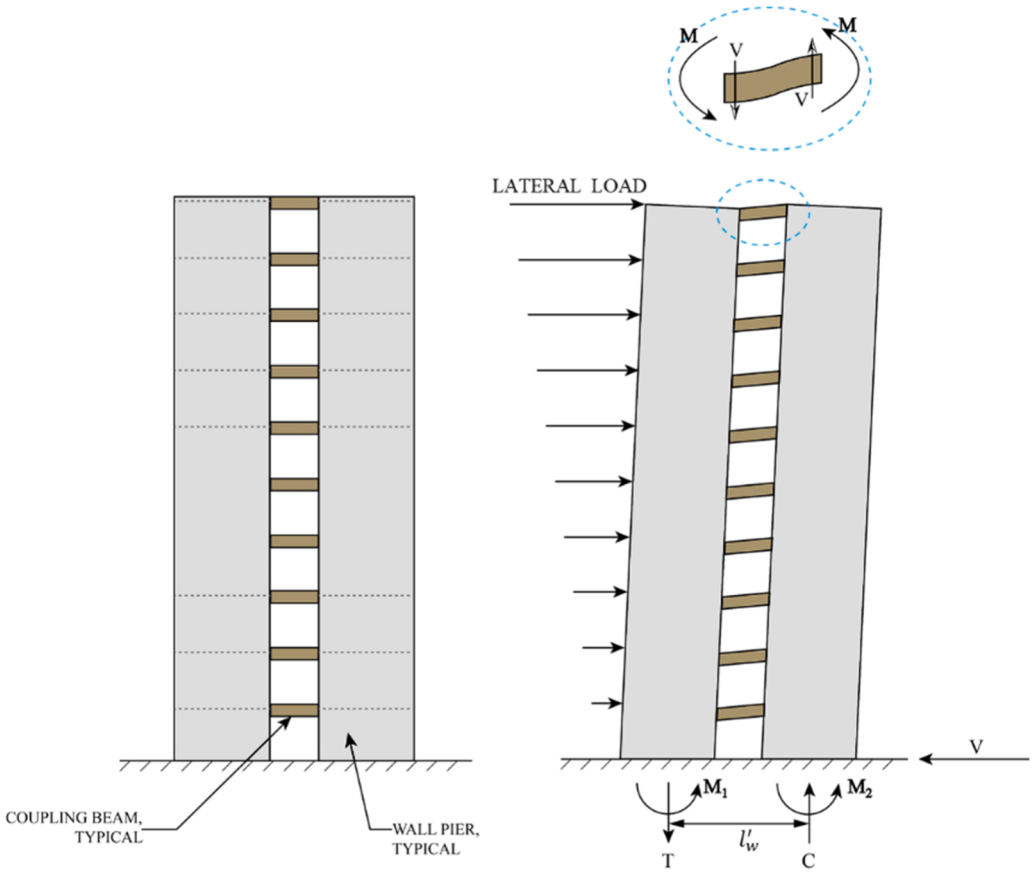

Figure 6-3. Example Free-Body Diagram for a Coupled Concrete Shear Wall System (from Figure 4-1 in FEMA, 2021a)

6.2.2 Medium Priority

There are no medium priority recommendations for improving code development.

6.3 Recommendations for Improving Code Content and Ease of Use

6.3.1 High Priority

6.3.1.1 RECOMMENDATION C1 - ADDRESS FUNCTIONAL RECOVERY AND ENHANCED RESILIENCE IN MODEL CODE FRAMEWORK

Objective: Comprehensively assess and develop functional recovery and enhanced resilience model code frameworks for use by design professionals and society as a whole.

Immediate Recommendation for a Pilot Project

Recommendation Summary: Form a coalition to complete a pilot project that will explore and develop a template on how to:

- Define functional recovery and enhanced resilience requirements
- Define limitations in current technical knowledge and expected system performance
- Incorporate functional recovery and enhance resilience requirements within a national model code framework

Rationale/Benefits: Functional recovery and enhanced resilience are two critical concepts of the near future that have yet to be fully defined and developed. Between climate change, expanding populations, and the increasing cost to rebuild following a disaster, it is becoming ever more important that preemptive action be taken by professional communities to assist with minimizing future consequences. Although there is broad agreement that these concepts should be incorporated into a national model code framework, there is little consensus and no blueprint on the actual goals, process, and pitfalls involved in such an effort.

This immediate recommendation envisions a broad coalition of organizations coming together to work through a real-life example of a typical building development while incorporating functional recovery and/or enhanced resilience requirements. The express purpose of this pilot project will be to identify pitfalls, challenges, and differences in understanding between represented groups and to produce a preliminary blueprint on the process and challenges. The coalition should be composed of engineers from all disciplines (structural, MEP, fire protection, etc.), architects, code writers, material groups, and code officials to ensure information comes from a broad spectrum of perspectives and interpretations. Finally, the fundamental and limited nature of a pilot project will serve as a trial run to identify and quantify technical requirements and language, while removing the inherent pressures and conflicts that come with adopting actionable code language. Note that this recommendation is similar to *Recommendation 1 - Develop a Framework for Post-Earthquake Reoccupancy and Functional Recovery Objectives* and *Recommendation 2 - Design New Buildings to Meet Recovery-Based Objectives* in *FEMA-NIST (2021).*

Who Has Capacity/Responsibility for the Recommendation? A coalition of BSSC, ASCE, ICC, ATC, material groups and broad stakeholders would provide technical support and capacity for developing the pilot project. Following completion of the pilot project, NIST and/or FEMA would take the lead on expanding the project recommendations to facilitate development of actionable code language.

Is Funding Required? Yes.

Issues of Concern and Strategies to Address Them: The pilot project would be a challenging effort that will require coordination and cooperation on a multi-organizational level.

- *Project Setup:* The coalition would define the typical building characteristics for use in the pilot project: building type, structural system, size and number of stories, and occupancy type. The focus would be on a new building, not on retrofitting an existing building. Risk Category II is recommended, since Risk Category III and IV already have higher design requirements.

- *Final Deliverable:* Produce a reference document that organizes discipline specific guidelines as a way to move forward and identifies lessons learned and issues that still require additional investigation/research.

- *Applicability to Model Codes:* The pilot project should consider ways to provide provisions that fit within the desired national model code framework, while also recognizing the economical and practical limitations that AHJs may face in the execution. To that end, the pilot project should explore the pros/cons and varied perspectives between simply incorporating the new requirements within the current life safety model codes vs developing additional separate standards that complement but do not replace the current model codes.

- *Delegated Decisions:* The coalition would be responsible for identifying performance target requirements for each discipline, an approach to achieve those requirements, and what information/research/investigation is required to provide a technical basis for the resulting designs.

- *Research:* It is the intention that this project would identify needed technical research and what group/organization would be best situated to pursue the information. The coalition would not actually perform the technical research at this stage.

- *Definitions and Perspectives:* The coalition would be tasked with clearly defining what functional recovery and enhanced resilience mean, with full consideration and discussion given to the understanding that each has a different inherent meaning and intent depending on the discipline to which is being applied (for example, structural design vs. fire protection).

- *Multidisciplinary:* The resulting guidelines will consider how seismic hazards impact different disciplines and how non-seismic hazard requirements may conflict with seismic considerations. Coalition members will work together to understand how discipline specific requirements impact each other and what that means for the overall goal of achieving functional recovery and/or enhanced resilience (i.e., a requirement in one discipline may reduce performance for another discipline). For example, providing greater fire protection resilience might require a more robust and thicker set of members in a steel structure while enhancing seismic ductility might require a less robust, but more flexible structure.

- *Critical Concepts:* "Functional recovery" and "enhanced resilience," while related, are two distinct concepts. The pilot project will seek to define each concept and identify similarities and differences. This information will be used to outline the processes necessary to achieve these goals, and where those processes may diverge.

Near-term or Long-term: The effort to initiate and implement the immediate recommendation is substantial and is not considered to be a near-term recommendation.

Future Recommendations

Upon completion of the pilot project and reference document, the next step will be to initiate research into the technical requirements and expected performance that were identified as lacking. Simultaneously, the framework for a new standard should be outlined, and less technically dependent provisions could be developed and adopted as the beginning of a national model code. As research and testing progress, this model code can be expanded and additional provisions incorporated once the technical basis and understanding is in place and understood.

Because this is a multi-organizational and multi-discipline undertaking, NIST and/or FEMA are uniquely situated to provide leadership and resources to facilitate the development of both the technical research and the model code layout. ICC and ASCE provide a platform for public outreach on concepts and proposals and an established mechanism to publish the model codes once they are ready for use. With a thoughtful and deliberate path forward and the cooperation of all organizations, uniform and consistent guidance and technical information necessary to achieve functional recovery and enhanced resilience performances can be developed for broad adoption and implementation across jurisdictions.

6.3.2.2 RECOMMENDATION C2 - MAKE LOW AND MODERATE SEISMIC PROVISIONS MORE USABLE

Objective: Improve usability of low and moderate seismic provisions.

Recommendation Summary: Make provisions simpler in general, and/or focus on clarity of delivery.

Rationale/Benefits: Seismic provisions need to be more easily used by practitioners in the low and moderate seismic regions. There is currently a perception that seismic provisions for areas of Seismic Design Categories (SDC) B and C are difficult to navigate and complicated. Some survey respondents and interviewees supported the idea of a separate chapter and simplified procedures for low and moderate seismic hazard. Repeatedly, the desire for a separate committee or subcommittee specifically tasked with low seismic hazard requirements was expressed. If such a chapter is created, consistency must be deliberately maintained in performance objectives between low, moderate, and high seismic areas.

Who Has Capacity/Responsibility for the Recommendation? The PUC would need to broaden committee membership to include more people from areas designing structures assigned to SDC B and SDC C to facilitate a balanced level of focus on the low and moderate seismic region provisions. PUC or ASCE committee members can develop seminars, design guides, and other educational tools.

Is Funding Required? Yes.

Issues of Concern and Strategies to Address Them: Implementing this recommendation would be a significant effort, and there are several issues of concern that would need to be addressed. They include:

- An outstanding question remains of whether low and moderate seismic concerns are a request for simplification or greater clarity. Perhaps the solution to addressing the concerns is a focus on education.
- More representation is needed from low- and moderate-seismic regions on the PUC and within ASCE/SEI 7 seismic committees. Current committees are predominantly composed of people from high-seismic regions; thus, the issues and modifications addressed in these committees may lack consideration of potential impacts to low- and moderate-seismic regions even though these regions represent the largest segment of the population affected by seismic requirements.
- The PUC committee, or a subcommittee, will need to review current provisions and make recommendations for simplifying use and/or broadening targeted education for low and moderate seismic regions. It is worth noting that a low seismic chapter was written during the ASCE/SEI 7-16 development cycle, passed the ASCE 7 Seismic Subcommittee, but was not passed at the ASCE 7 Main Committee level. The concerns of the Main Committee would need to be considered. A stand-alone report, FEMA P-1091, *Recommended Simplified Provisions for Seismic Design Category B Buildings* (FEMA, 2017), was developed for voluntary use by local building departments and practitioners in SDC B regions.
- PUC or ASCE committee members can develop seminars, design guides, and other educational tools to assist engineers and building departments in understanding the expected minimum design and detailing requirements for low and moderate seismic regions. Material industry organizations are likely to help with educational products for their specific material.

Near-term or Long-term: Development of refined low and moderate seismic code provisions is considered to be a long-term effort.

Related Recommendations: None.

6.3.2 Medium Priority

6.3.2.1 RECOMMENDATION C3 - DEVELOP MORE USABLE PERFORMANCE-BASED PROCEDURES FOR DESIGN

Objective: Improve the effectiveness of performance-based seismic code provisions for new buildings.

Recommendation Summary: Improve the clarity and usability of performance-based design procedures in order to facilitate and encourage more widespread use of such procedures for new

buildings by practicing engineers. Currently, performance-based design is not widely adopted outside of a relatively small group of firms practicing primarily on the West Coast.

Rationale/Benefits: A strong ground motion is the most demanding structural loading that ordinary buildings and structures are expected to survive. The accepted response involves some damage, and prediction of performance is inherently complex. A suite of design procedures exists in codes and guidelines, ranging from simplistic and prescriptive to sophisticated and demanding. Most buildings are designed with procedures based on an idealization that treats the dynamic response as an equivalent static load with a very rough approximation to account for nonlinear response. The majority of the remainder are designed with a linear elastic dynamic procedure that used the same rough approximation to account for inelastic response. The use of procedures that include explicit recognition of inelastic response to real ground motions provides improved understanding of the performance and allows the design to refined to improve performance, and in many instances to improve the economy of the construction. With public expectations for functional recovery rising, the need for improved design procedures is becoming more pressing.

Who Has Capacity/Responsibility for the Recommendation? PUC can recommend improvements to the nonlinear response history analysis methods in ASCE/SEI 7; however, coordination is required among committees for other standards and guides, including ASCE 41, ACI 318, ACI 369, and ACI 562, AISC 341, PEER Tall Buildings Initiative, and Los Angeles Tall Buildings Structural Design Council. ATC can help coordinate this overall effort.

Is Funding Required? Yes, to develop a coordinated long-term plan.

Issues of Concern and Strategies to Address Them:

- *Duplication of effort:* The ATC-138 project, funded by FEMA, has a closely related objective to develop methodologies and potential code provision strategies for functional recovery, and it should be reviewed by an Issue Team within the PUC.

- *Starting point:* Performance-based design procedures are more mature for the rehabilitation of existing buildings than they are for new buildings, and development of acceptance criteria for new buildings by extrapolation from the criteria for existing buildings may be inadequate.

- *Expanding beyond a niche area:* A problem the industry faces with nonlinear procedures is that only a small select group of firms knows how to properly perform these analyses, and they are typically peer reviewed. The solution is not simple. There are no current requirements to have this knowledge to pass the structural engineering exam. There are no clear prescriptive new building design nonlinear requirements that are intended for widespread consumption for the average practicing structural engineer. Creative thinking is needed to propose steps to bridge these gaps.

- *Outreach to owners:* The vast majority of developers and building owners see no value is paying for more engineering effort without a clear financial benefit (less construction cost, lower

insurance premium, etc.). Until that bridge is formed, or unless the code mandates performance-based procedures, performance-based design methods will have limited use.

Near-term or Long-term: While some improvements to procedures are likely to be possible in the near term, it is anticipated that this will be a substantial effort that occurs over the long-term.

Related Recommendations: A number of recommendations are related to development of more usable performance-based design provisions. These include *Recommendation E1 – Develop a Coordinated Strategy for Improving Understanding of Seismic Codes*, *Recommendation E4 – Develop More Design Guides*, and *Recommendation E7 – Develop More Webinars, Archived and Available on Demand*. The typical practicing engineer will need real assistance to make performance-based design a methodology that is practical for average projects and fees.

6.3.2.2 RECOMMENDATION C4 - DEVELOP CONSTRUCTION QUALITY ASSURANCE *NEHRP PROVISIONS* PART 3 RESOURCE PAPER

Objective: Improve the clarity and effectiveness of construction quality assurance provisions related to seismic provisions.

Recommendation Summary: Develop a *NEHRP Provisions* Part 3 resource paper on seismic construction quality assurance to cover, at a high level, the state of the practice on quality assurance, expectations that code writers have for the level of quality assurance during fabrication and construction, and recommendations for building code and material standard writers.

Rationale/Benefits: The *NEHRP Provisions* establish the performance intent for seismic design provisions. They provide technical criteria for design. Reconnaissance reports following major earthquakes routinely point to poor construction quality as a common source of damage and unmet performance expectations, yet quality assurance requirements on how to make sure that the engineer's design is implemented properly during construction are increasingly being delegated to material standards. The Part 3 paper would help to define the level of appropriate expectations, areas where additional focus is warranted, and show examples of potential recommendations for improvement. It could address special inspection and testing during fabrication and erection, as well as structural observation requirements. The final implementation of quality assurance provisions would remain in the IBC and the material standards.

Who Has Capacity/Responsibility for the Recommendation? Preparation of the Part 3 paper would be the responsibility of a PUC issue team in the upcoming cycle. Select material standards groups and/or code official groups could be asked to provide peer review.

Is Funding Required? No.

Near-term or Long-term: This could be accomplished in the upcoming 2026 *NEHRP Provisions* cycle; it is a near-term recommendation.

Related Recommendations: None.

6.3.2.3 RECOMMENDATION C5 - IMPROVE SEISMIC CODE PROVISIONS FOR FOUNDATION DESIGN

Objective: Improve the coordination of seismic code provisions and the design methodology for foundation design.

Recommendation Summary: There are two distinct recommendations: 1) create a coordinated effort between ICC, ASCE/SEI, ASCE/GI, and ACI standards committees to create consistent seismic foundation provisions, and 2) develop seismic provisions for foundations that are consistent with the building design provisions and the intended performance mechanism of the building.

Rationale/Benefits: FEMA P-2091 (FEMA, 2020) is a recent design guide for soil-structure interaction (SSI), and it contains some recommendations for related code change revisions. However, it was focused on SSI. More broadly, the foundation design provisions in the various standards are not fully coordinated and have conflicting requirements. For example, the IBC foundation detailing provisions do not align with ACI 318 detailing provisions. There is an effort by ASCE to create a foundations standard that will require coordinated effort to align and consolidate the provisions from ICC, ASCE, and ACI into this new standard.

The foundation analysis and design are typically decoupled from the building analysis, often in separate models with no consideration of the interaction between the two other than load transfer. The provisions do not consider the impact on the structure or nonstructural components when a rocking or yielding mechanism occurs locally at the foundation supporting individual vertical seismic force-resisting system elements or globally at the foundations supporting most or all the vertical seismic force-resisting system elements. These mechanisms in the foundation may result in torsional building responses, lateral drift, and vertical displacements that may far exceed the results of the fixed based building model assumptions. The excess drift or deformations may result in conditions that exceed code limits for torsion or deformation compatibility for both structural and nonstructural components. There is a need to develop seismic foundation provisions that are consistent with the building modeling and design assumptions.

Who Has Capacity/Responsibility for the Recommendation? The coordinated effort on consolidating the seismic foundation design provisions would be the responsibility of the SEI/GI standards committee to bring ICC, ASCE, and ACI together. The development of seismic foundation provisions that are consistent with the building design would be developed by the PUC and its issue teams and can rely on past research and standards development, such as the ATC-140 project which has recently produced a significant rewrite of the foundation chapter of ASCE/SEI 41. Issues identified in the ATC-140 effort that might apply to new buildings include (1) more refined and separate acceptance criteria for foundations that experience only axial demands vs. those that experience both axial and flexural demands, (2) when SSI should be required or not required, and (3) a general

harmonization of requirements for existing buildings in ASCE/SEI 41 and for new buildings in ASCE/SEI 7.

Is Funding Required? Yes.

Near-term or Long-term: This effort is considered to be a substantial one given the scope and extent of required coordination; it is assigned to the long-term category.

Related Recommendations: None.

6.4 Recommendations for Improving Dissemination and Education on Code and Code Changes

6.4.1 High Priority

6.4.1.1 RECOMMENDATION E1 - DEVELOP COORDINATED STRATEGY FOR IMPROVING UNDERSTANDING OF SEISMIC CODES

Objective: Improve stakeholder understanding.

Immediate Recommendation

Recommendation Summary: Develop an overall coordinated strategy among code and standard organizations and stakeholders, including BSSC member organizations, and federal, state, and local governments, for dissemination to structural engineers, to other engineers and architects, and to other stakeholders, including the public, before, during, and after development of new provisions. Articles in trade publications and technical journals, presentations at conferences, webinars, help desks, extended commentaries linked to appropriate references, up-to-date collections of design examples, inspection checklists are but a few of the useful techniques. A workshop of the appropriate stakeholders is a vehicle to prepare a plan to optimize resources for efficient and effective communications to all audiences.

Rationale/Benefits: Seismic codes are complex, and continuing education enhances proper implementation by the many technical disciplines and trades involved in proper execution. Public outreach leads to improved acceptance and adoption of the most up-to-date provisions. Advancement in both areas will improve public safety as well as community, regional, and national resilience. Figure 6-4 shows a cross-laminated timber building under construction. This is a relatively new structural system, and seismic code provisions have recently been developed and need to be disseminated to practitioners. The wood material industry has been providing education about CLT seismic design provisions. New seismic force-resisting systems are typically promoted by

the relevant material industry due to commercial interests. But for other types of seismic code provisions, there is often no material industry group that can take on such responsibility.

Who Has Capacity/Responsibility for the Recommendation? The BSSC was created to be a national forum for the discussion and resolution of issues around seismic safety of buildings. The mission of NEHRP program as a whole is strongly aligned with this recommendation, and the NEHRP agencies already do provide substantial support for this recommendation, as well as coordinating among themselves.

Is Funding Required? Yes. Funding is needed to conduct a workshop to include broad stakeholders and other interested parties.

Issues of Concern and Strategies to Address Them: This would be a significant effort, and there are several issues of concern that would need to be addressed. They include:

- *Cooperation:* There is no intent that the recommendation would mandate action by any entity. The objective is to have a plan with voluntary cooperation, where organizations make commitments that fit their own missions.

- *Scope:* It is entirely likely that a coordinated plan will identify activities for which there are no currently active participants. Thus, the plan may define new needs for supporting the goal of the recommendation. Education that is currently offered will also be identified so duplication of effort is reduced and collaboration in development and distribution of content is enhanced.

- *Timing/Pandemic:* The planning of the workshop can proceed with virtual meetings, but this type of workshop is much more effective if conducted in person; thus, planning needs to account for the continuing pandemic.

Near-term or Long-term: It is anticipated that the workshop can be convened, and the strategy can be developed in the upcoming 2026 *NEHRP Provisions* and ASCE/SEI 7-28 cycles, so the recommendation is assigned to the near-term category.

Future Recommendation

Moving forward, a future recommendation is the development of a broad coalition of public and private partners to apply best available communication methods and tools towards a nationwide effort to change public understanding of codes and their value to help advance the adoption and enforcement codes and spur innovation throughout the country. The formation of such a coalition, or at least a plan for its formation, should be one of the objectives of this workshop.

Figure 6-4. Cross-Laminated Timber Building Under Construction (Photo Credit, Sandra Hyde)

6.4.1.2 RECOMMENDATION E2 - DEVELOP INTERACTIVE ONLINE PLATFORM FOR SEISMIC CODE PROVISIONS

Objective: Improve the effectiveness and centralize digital codes, design examples, and resources.

Recommendation Summary: Develop an interactive online platform of the ASCE/SEI 7 seismic code provisions with on-demand links, pop-ups, and side bar content of commentary, design examples, and other resource documents tied to each code section.

Rationale/Benefits: Since the inception of building codes, they have been published and disseminated in paper form until recently. There is a transition in the profession, especially among the new generation of engineers, to work in a digital environment where paper codes are being replaced by digital versions. Furthermore, with the move to hybrid work models where engineers work in the office and at home, there can be the need for immediate reference to codes in two locations. This requires either two paper copies, bringing code books back and forth between office

and home, or one digital copy of the code. The shortcoming of the current digital versions of the code is that they are simply digital replicas of the paper code. While this transition is useful, it does not consider all the efficiencies and capabilities that can be made by rethinking the digital office the practicing engineer works in. Rather than replicating a code into a digital paper, envision a platform in a web page format where for each code section there is interactive content including the code commentary, worked examples illustrating how to apply that section, on-demand embedded video directly addressing this section, frequently asked questions, and links to references or research to further understand the rationale and applicability of that code section. This would serve as a hub of the content associated to each seismic code provision.

Who Has Capacity/Responsibility for the Recommendation? BSSC would develop the online platform with licensing agreements with ASCE for code provisions and other organizations (e.g. NCSEA, SEAOC) to embed worked examples, video presentations, and other content. Several other organizations can also provide and support a platform. It is recommended that a centralized platform be established.

Is Funding Required? Yes.

Issues of Concern and Strategies to Address Them: This would be a significant effort, and there are several issues of concern that would need to be addressed. They include:

- *Funding:* This is a substantial financial effort to develop and deploy the web platform and to continually maintain and update it. This requires contracting with web developers, technical experts to develop and review content, entering into financial agreements with organizations to use licensed or copyright content.
- *Licensing and Copyright Materials:* If developed by an entity other that ASCE, there will be licensing and copyright agreements to use the code content.
- *Technical Oversight:* Technical oversight is necessary to ensure the content is accurate and represents the intent of the code provisions.
- *Maintenance:* This effort of disseminating the code on a web-based platform does not end after the web platform is deployed as it will require constant maintenance as code provisions change each adoption cycle.
- *Coordination with Others:* ICC has an interactive, online platform that provides access to codes, standards, commentaries with interactive features and advanced tools to search faster, share notes, collaborate, and keep up-to-date. A screen shot is shown in Figure 6-5. Some material standards groups have developed similar tools. Coordination with these efforts would be important to not duplicate efforts.

Near-term or Long-term: Development of the platform is a substantial effort and is assigned to the long-term category.

Related Recommendations: None.

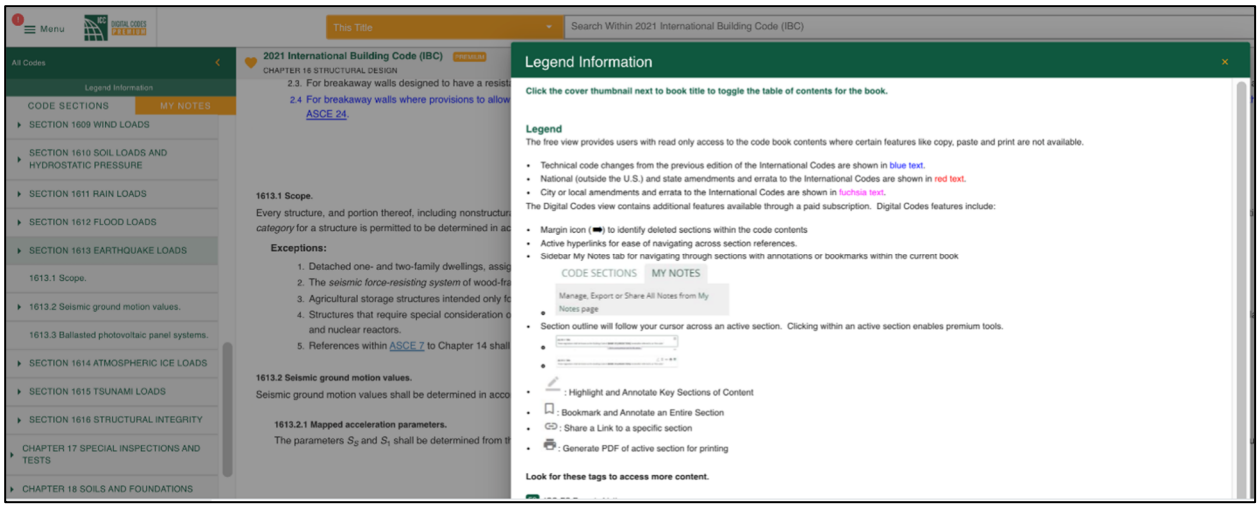

Figure 6-5. Example Online Code Platform from an ICC Digital Codes Screenshot (Image Credit Susan Dowty)

6.4.2 Medium Priority

6.4.2.1 RECOMMENDATION E3 - EXPAND COMMENTARIES

Objective: Improve user understanding of selected seismic code provisions and their rationale.

Recommendation: Create more detailed commentaries for selected seismic code provisions.

Rationale/Benefits: Commentaries can aid code users in understanding key seismic code provisions and why they are required. While there are many examples of thoughtful commentaries in the *NEHRP Provisions* and in ASCE/SEI 7, such as the commentary for Chapter 13, *Seismic Design Requirements for Nonstructural Components*, there are many provisions that lack meaningful or even any commentary. The goal of this recommendation is to identify select provisions where enhanced commentary would be helpful and develop the additional commentary language. The target audience includes both practitioners and code officials. The goal is to find the balance in between overly brief commentary that essentially just restates the provision and overly detailed commentaries that read like academic papers or design examples. Expanding code commentaries was identified as a high priority by many interviewees.

Who Has Capacity/Responsibility for the Recommendation? The PUC would identify code provisions where expanded commentary would be desirable and assign writing responsibility to appropriate PUC issue teams. The effort could be shared with the ASCE/SEI 7 code committees as well.

Is Funding Required? Funding would be helpful, as improving commentaries has always been a goal, but there is limited volunteer resources and time, and this usually falls to a lower priority than reviewing code provisions.

Issues of Concern and Strategies to Address Them

- *Comprehensive Approach:* This effort should not only be limited to select sections, but there is a need to go through the entire commentary for all seismic chapters and parse out the outdated content. For example, often commentary is added to justify why a code change was made in a particular code cycle, and that same commentary lives on for several subsequent code cycles, where it should have been removed or cleaned up.

- *Criteria for What to Put in Commentary:* There is a need for clear framework of what should and should not be in commentary. This should be one of the primary objectives of this recommendation. There is currently little consistency on what level of detail is acceptable—over the top, too little, unnecessary, etc.—for the commentary when new code change proposals are submitted. They are often an afterthought.

Near-term or Long-term: Selected expanded code commentaries could be developed for the 2026 NEHRP Provisions and ASCE/SEI 7-28 cycles, so this is assigned to the near-term category. It is expanded that the effort would continue in the future.

Related Recommendations: There are several related recommendations. *Recommendation E2 – Develop Interactive Online Platform for Seismic Code Provisions* would electronically link seismic provisions, commentaries, design examples, and journal articles. *Recommendation E4 – Develop More Design Guides* would develop design guides and case studies for specific topics. Such design guides would go farther in depth than the expanded commentaries.

6.4.2.2 RECOMMENDATION E4 - DEVELOP MORE DESIGN GUIDES

Objective: Improve practitioner understanding of specific design topics.

Recommendation Summary: Develop more design guides (such as cladding design, nonlinear response history analysis, finite element analysis methods, performance-based design) that provide practicing engineers with a tool to interpret and implement code provisions. Design guides must be maintained as code changes are made. Develop a central repository of existing design guides to increase exposure and usage of these tools.

Rationale/Benefits: Designers often struggle to implement a code provision or utilize a new technique (NRHA, PBD) as the code/commentary provide requirements but not the implementation steps. Design guides (previously developed or new) are powerful tools to educate engineers and ensure better, more uniform implementation of the seismic codes. Straightforward answers to

common questions should be incorporated into the design guides. Social media can be leveraged to answer key questions or advertise existence of guides on various topics. Figure 6-6 shows examples of a recent design guides addressing (1) how to implement soil-structure interaction code provisions (FEMA P-2091, FEMA, 2020c) and (2) rigid wall—flexible diaphragm buildings (FEMA P-1026, FEMA 2021c).

Who Has Capacity/Responsibility for the Recommendation? Design guides could be developed independently or jointly by a variety of groups (BSSC, ASCE, NCSEA, SEAOC, ATC). It's unreasonable to expect PUC members to develop design guides concurrent with a code cycle. Design guide authorship could be used as an opportunity to engage future PUC members or as a transition for retiring PUC members as a post committee effort.

Is Funding Required? Yes, with funding, developing design guides will be done more quickly and more completely.

Issues of Concern and Strategies to Address Them

- *Filling the Gaps:* We need design guides to fill in the gaps. There is a need for design guides to tackle the more complex issues and challenges and to go deeper than a basic building. Design guides can use actual buildings with complex issues, rather than simplified rectangular boxes, such as a performing arts center with torsion, offset diaphragms, multiple lateral systems, non-orthogonal systems, offsets, etc.

- *Code Intent:* Design guides often take a code-based approach to designing buildings rather than a rational building analysis considering the intended performance and building mechanisms implied in the code and then checking for code minimum compliance at the conclusion. What is lost with some engineers is they have no idea what the actual yielding mechanism is and how to ensure it happens. Design guides should approach the design as meeting the intended goal of the code, and then to providing a check to ensure the design complies with the provisions.

Near-term or Long-term: Development of design guides is anticipated to be a substantial effort, and it is assigned to the long-term category.

Related Recommendations: None.

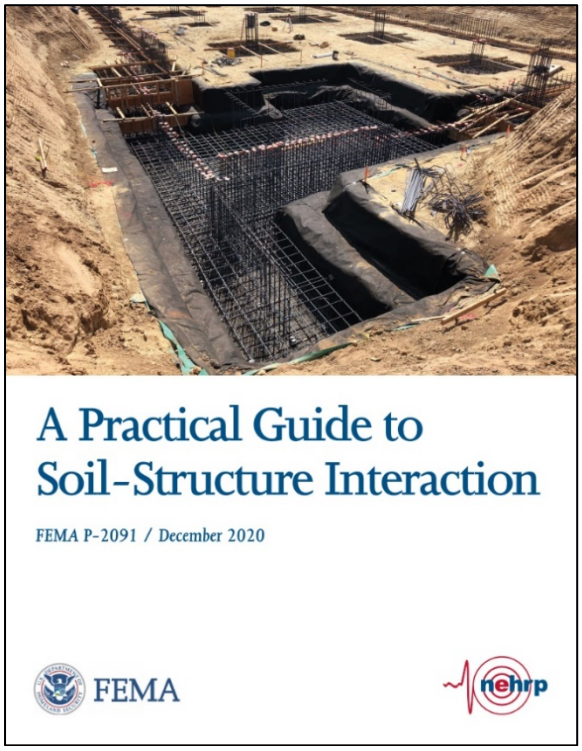

Figure 6-6. Example Design Guides: FEMA P-2091 (FEMA, 2020c) and FEMA P-1026 (FEMA, 2021c)

6.4.2.3 RECOMMENDATION E5 - OUTREACH TO GEOTECHNICAL ENGINEERS

Objective: Improve the outreach to geotechnical engineers for continuing education related to the seismic provisions.

Recommendation Summary: Targeted outreach to geotechnical engineers and geologists about changes to the seismic provisions related to ground motions and seismic induced settlement provisions.

Rationale/Benefits: The *NEHRP Provisions* and ASCE/SEI 7 have made significant changes to the seismic provisions related to developing of the response spectra and seismic induced settlement provisions in recent code cycles, such as an expansion of soil classes, transition to multi-period spectra, and further development and expansion of the seismic induced settlement provisions.

Who Has Capacity/Responsibility for the Recommendation? A coordinated outreach campaign by BSSC, ASCE, and USGS to host webinars, submit papers to technical journals, and present at various conferences that have a geotechnical and geology emphasis.

Is Funding Required? Yes.

Near-term or Long-term: This is an education effort to share information on what has taken place; it can be accomplished in the near term.

Related Recommendations: None.

6.4.2.4 RECOMMENDATION E6 - PUBLICIZE UPCOMING CODE CHANGES AND INPUT OPPORTUNITIES

Objective: Publicize upcoming changes as they are developed and approved.

Recommendation: Publicize and provide education on upcoming changes throughout the development of the next ASCE/SEI 7 edition.

Rationale/Benefits: The design and enforcement communities need an overall strategy for getting the word out to them about changes occurring in updated standards, codes, and common material practices. These often occur at code hearing meetings like those shown in Figure 6-7 which do not reach the vast majority of practitioners. They need to be made aware of schedules and the opportunity to comment. Use of conference presentations and panel discussions can be made throughout the PUC and ASCE/SEI 7 development cycles to get the word out about the changes, process, and important dates. This will increase the utility of public comment periods when people have had time to consider the direction of upcoming or proposed changes. Increased use of trade magazine articles to highlight final changes, webinars to explain potential impact and use, and journal articles to provide technical detail and rationale behind the changes are all possible without further funding. The International Code Council (ICC) publishes a redline version or revision history of their standards and codes that shows the compiled effects of all the changes in a given cycle. This may also be possible for ASCE, the Seismic Code Support Committee at ATC and other material groups to do.

Who Has Capacity/Responsibility for the Recommendation? BSSC, ASCE, and the Seismic Code Support Committee at ATC.

Is Funding Required? Not for publication; possibly for education.

Near-term or Long-term: This dissemination effort should occur as part of the upcoming 2026 *NEHRP Provisions* and ASCE/SEI 7-28 cycles; it is thus assigned to the near-term category.

Related Recommendations: Both *Recommendation E7 - Develop More Webinars, Archived and Available on Demand* and *Recommendation E1 – Develop Coordinated Strategy for Improving Understanding of Codes* are related to Recommendation E6.

Figure 6-7. Code Hearing in 2018 for the International Building Code (Photo Credit, Susan Dowty)

6.4.2.5 RECOMMENDATION E7 - DEVELOP MORE WEBINARS, ARCHIVED AND AVAILABLE ON DEMAND

Objective: Bring awareness to the provisions development process and understanding of the provisions.

Recommendation: Offer live and recorded webinars on ASCE/SEI 7 code changes and provisions.

Rationale/Benefits: To help increase knowledge of current and future seismic provisions, additional recorded webinars are needed that discuss both changes and how to achieve the requirements of the provisions of ASCE/SEI 7. In addition, technical webinars focusing on specific, infrequently used provisions as well as broader overviews are needed. Beyond webinars, there was a desire from both survey respondents as well as PUC members to consider a method to link FAQ platforms and interactive commentaries to webinars or other sources of information on seismic design.

Who Has Capacity/Responsibility for the Recommendation? ASCE, BSSC, material organizations, ICC.

Is Funding Required? Yes.

Issues of Concern and Strategies to Address Them: The amount of resources and the cost to set up and maintain a new platform dedicated to providing a webinar library of content on ASCE/SEI 7 provisions with continuing education units would need to be determined. Funding through the NEHRP agencies could be explored.

Near-term or Long-term: With funding, this effort could occur as part of the upcoming 2026 *NEHRP Provisions* and ASCE/SEI 7-28 code cycles; it is thus assigned to the near-term category.

Related Recommendation: *Recommendation E6 - Publicize Upcoming Code Changes*.

6.5 Recommendation for Monitoring and Encouraging Progress

6.5.1 High Priority

6.5.1.1 RECOMMENDATION M1: TRACK PROGRESS OF IMPLEMENTING RECOMMENDATIONS

Objective: Monitoring progress of implementation of recommendations spurs accountability and completion. It is a standard management tool.

Recommendation Summary: A standing agenda item at PUC meetings should be to discuss the progress of implementation of recommendations for improving code development, code content, and code communication.

Rationale/Benefits: The PUC typically meets quarterly for two-day meetings. Meetings typically focus on the status of proposal development. This standing agenda item will force a broader view for discussing the processes surrounding improving code development, code content, and code communication, and whether changes are proceeding as anticipated or if readjustment is needed. Forcing discussion motivates those assigned to the task.

Who Has Capacity/Responsibility for the Recommendation? The PUC and the BSSC Executive Director would manage the agenda item and assign presentation responsibilities for each meeting.

Is Funding Required? No.

Near-term or Long-term: This is strongly recommended to be part of the upcoming 2026 *NEHRP Provisions* cycle, so the recommendation is assigned to the near-term category. ASCE/SEI 7 code committees could implement the same approach for similar tasks.

Related Recommendation: None.

Additional Recommendation: It is also recommended that the User and Stakeholder Surveys and the interviews be conducted again to help track how well changes are being perceived. Partnering with states and professional organizations in order to reach a wider, more representative sample of survey participants would be advantageous too.

The surveys produced a wealth of data, only a select portion of which could be shown in this report, given the scope of the effort and the Task Group's desire to emphasize resulting recommendations. The survey data could be investigated in more detail for comparison with results in future longitudinal studies. In addition, the open-ended survey responses sometimes provided suggestions on ways to improve codes and code development that were outside of the scope of this report with its focus on seismic codes and new buildings.

6.5.2 Medium Priority

There are no medium priority recommendations for monitoring and encouraging progress.

6.6 Taking the Step Forward

Chapter 6 describes a set of recommendations that the Task Force believes can make a substantial difference in improving code development, improving code content and ease of use, and in improving dissemination and education about codes and code changes. Some are easy to implement with no funding and only PUC involvement; some require other stakeholders; and some require funding to realistically implement.

With the start of the 2026 *NEHRP Provisions* and ASCE/SEI 7-28 cycles about to begin, now is the time to take the step forward to begin addressing these recommendations.

Appendix A: Abbreviations

ANSI	American National Standards Institute
ATC	Applied Technology Council
ASCE	American Society of Civil Engineers
BSSC	Building Seismic Safety Council
CE	Civil Engineer
EERI	Earthquake Engineering Research Institute
FEMA	Federal Emergency Management Agency
GE	Geotechnical Engineer
IBC	International Building Code
ICC	International Code Council
IRC	International Residential Code
IT	Issue Team (of the Provisions Update Committee)
NCSEA	National Council of Structural Engineers Associations
NEHRP	National Earthquake Hazards Reduction Program
NIBS	National Institute of Building Sciences
NIST	National Institute of Standards and Technology
NSF	National Science Foundation
PE	Professional Engineer
PUC	Provisions Update Committee
R	Response Modification Factor
SDC	Seismic Design Category
SEAOC	Structural Engineers Association of California

SE	Structural Engineer
SEI	Structural Engineering Institute
SSC	Seismic Subcommittee of ASCE
UBC	Uniform Building Code
USGS	U.S. Geological Survey

Appendix B: Survey Instruments

B.1 Overview

Two survey instruments were developed for this study. The first was for code users and is replicated in Section B.2. The second was for other stakeholders and is replicated in Section B.3. States were placed into three geographical regions: West, Central/Mountain, and East. Section B.4 shows which states are in which region.

B.2 U.S. Seismic Code Improvement Survey for Users

Thank you for taking the time to help the National Institute of Building Sciences (NIBS)

Building Seismic Safety Council (BSSC) collect input from a variety of stakeholderson ways to improve United States seismic codes and standards.

The goal of this voluntary survey is to get input from a broad group of people who areaffected, directly or indirectly, by US seismic codes and standards. Responses from you and over 100 other participants will be used by advisors to BSSC and FEMA to develop a publicly available report. The report will contain recommendations on how tomake US seismic codes and standards easier to use, how to improve the development of those codes and standards, and how the engineering community can be better educated on changes.

You were recommended and specially invited to participate so the perspectives of people in your profession will be represented. Depending on your answers, this surveyshould take about 15 to 20 minutes. We ask that you kindly submit your response before April 30, 2021.

Thanks again for your contribution to this effort!

For your reference about the survey author, context, and focus:

The BSSC is charged by the Federal Emergency Management Agency (FEMA) to identify and recommend steps to advance the state of the art of earthquake-resistant design in the US. The BSSC prepares the NEHRP Recommended Seismic Provisions forNew Buildings and Other Structures (identified here as the "NEHRP Seismic Provisions"). The BSSC works with the American Society of Civil Engineers (ASCE) Seismic Subcommittee to transfer the NEHRP Seismic Provisions into the

standards language incorporated in ASCE/SEI 7 standard Minimum Design Loads and Associated Criteria for Buildings and Other Structures. ASCE 7 is referenced by the International Building Code (IBC). The IBC in turn is used as the model code for the building codes adopted by state and local jurisdictions in the US.

This survey focuses on the NEHRP Seismic Provisions, the seismic provisions in ASCE 7 and the IBC, and seismic design for new buildings. The following are outside the scope of the survey: non-seismic code provisions, the seismic provisions in the International Residential Code (IRC), and codes and standards for existing buildings such as the International Existing Building Code (IEBC) and ASCE/SEI 41 Seismic Evaluationand Retrofit of Existing Buildings.

For questions about this survey, contact Jiqiu (JQ) Yuan, Executive Director, NIBSMulti-Hazard Mitigation and Building Seismic Safety Council, (202) 787-3240, jyuan@nibs.org, www.nibs.org.

Before we begin, please confirm your name and email. This information will not be shared outside this study.

Name:

First Name:

Last Name:

Email:

example@example.com

Click Here to Begin

All fields marked with * are required and must be filled.

First, please tell us a bit about your professional background.

- Please choose the answer that best describes your profession: *

  ○ Practicing Civil / Structural Engineer ○ Practicing Geotechnical Engineer / Geologist ○ Building Official / Plan Review Engineer - City or County ○ Building Official / Plan Review Engineer - State ○ Building Official / Plan Review Engineer - Federal Other ○

- In what state or US Territory do you primarily practice? * [ ]

- Which of the following best describes your career stage? *

  ○ Early career (1-5 years) ○ Mid-career (6-15 years) ○ Advanced career (>15 years) ○ Retired

- Please indicate the extent to which you have used NEHRP Seismic Provisions in your work: *

  ○ Very often - monthly or more ○ Often - several times a year ○ Sometimes - every few years ○ Rarely - a few times ever ○ Never / not applicable

- Have you personally ever been involved in the seismic code adoption process (e.g., writing, review, or research)? *

  ○ Yes ○ No

- Which of the following if any does your firm or organization do to support your involvement in code committee work? (select all that apply) *

  ☐ Compensates me for all or a portion of my time ☐ Covers travel expenses ☐ No support ☐ Not applicable / don't know ☐ Other: _____

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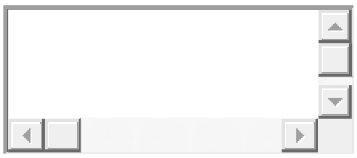
All fields marked with * are required and must be filled.

This section asks what you think about the CONTENT AND USABILITY of USseismic codes and standards for different users and US locations.

- Please indicate how much you rely on the following sources of US seismic codesand standards: *

	Very often - monthly or more	Often - several times a year	Sometimes - every few years	Rarely - a few times ever	Never / not applicable
NEHRP Seismic Provisions	○	○	○	○	○
ASCE 7	○	○	○	○	○
IBC	○	○	○	○	○
Local jurisdiction codes	○	○	○	○	○
Material standards	○	○	○	○	○
Other (please describe below)	○	○	○	○	○

- If you indicated "Other" sources not listed above, please briefly describe:



- Please indicate how much you agree with the following statements about potential concerns or obstacles with using US seismic codes and standards: *

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree	Not Applicable
US seismic provisions are understandable and adequately explained.	○	○	○	○	○	○
US seismic provisions are too prescriptive and constraining.	○	○	○	○	○	○
US seismic provisions are too complicated and technically challenging to use.	○	○	○	○	○	○

- In your opinion, which areas of US seismic codes and standards are most in need improvement or clarification? Please choose your TOP FOUR priority areas: *

  - Determining seismic demand, including site-specific procedures
  - Seismic Design Category thresholds or criteria
  - Permissible seismic force-resisting systems and limitations
  - Combinations of systems
  - Two-stage analysis for podium structures
  - Direction of loading provisions
  - Provisions related to plan and vertical irregularities
  - Redundancy factor
  - Equivalent lateral force procedure provisions
  - Modal response spectrum analysis
  - Diaphragms, chords and collectors
  - Drift and deformation
  - Foundation design provisions
  - Simplified alternative provisions
  - Nonstructural provisions
  - Soil-structure interaction
  - Nonlinear response history analysis provisions
  - Don't know / not applicable
  - Other:

- How well do you think current US seismic codes and standards meet the needsof all regions of the United States? *

  Not at all ○ ○ ○ ○ ◉ Very well

- Please share any other thoughts you have about the CONTENT AND USABILITYof current US seismic codes and provisions (including your own concerns or issues you may hear frequently about from clients or colleagues):

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All fields marked with * are required and must be filled.

This section asks what you think about how US seismic codes andstandards are DEVELOPED AND UPDATED over time.

- Please indicate your level of agreement with the following statements about howUS seismic codes and standards are developed and updated over time: *

	Disagree	Neither Agree Nor Disagree	Agree	Don't Know
Updates address topics that are useful and important to my work.	○	○	○	○
Updates are well-justified by science and research.	○	○	○	○
Updates receive adequate review by all important stakeholders.	○	○	○	○
Updates address issues that are important to reducing seismic risk.	○	○	○	○
Updates should happen faster or more frequently, for instance to promote innovation.	○	○	○	○
Updates should happen more slowly or less frequently, for instance so more meaningful user feedback can be incorporated.	○	○	○	○

- When changes are made to US seismic codes and standards, do you find themin general to be too detailed, about right, or not detailed enough? *

○ Too detailed ○ About right ○ Not detailed enough ○ Undecided / NA

- How can we reach and involve more practicing engineers in the process of developing and updating US seismic codes and standards?

- How can US seismic code and resource development organizations (like BSSC, FEMA, ASCE and ICC) involve a more diverse group of professionals in the seismic code development process, including years of experience, geographic location, gender, and race/ethnicity?

- How can organizations involved in developing US seismic codes and resources better nurture and facilitate innovation in the code development process?

- Please share any other concerns or suggestions you haven't had a chance to sayyet about the seismic code DEVELOPMENT PROCESS in the US:

Back Next

All fields marked with * are required and must be filled.

Questions in this final section relate to improving COMMUNICATION AND USE of US seismic codes and provisions.

- Please indicate the extent to which you have used NEHRP RecommendedSeismic Provisions: Design Examples: *

○ Very often - monthly or more ○ Often - several times a year
○ Sometimes -every few years ○ Rarely - a few times ever
○ Never / not applicable

- Please indicate how much you personally rely on the following sources ofinformation about US seismic codes and standards: *

	Very often - monthly or more	Often - several times a year	Sometimes - every few years	Rarely - a few times ever	Never / not applicable
Consultation with peers or other design team members	○	○	○	○	○
Online codes, standards, or provisions	○	○	○	○	○
Hard copy code documents including commentary	○	○	○	○	○
Design guides or white papers	○	○	○	○	○
Professional education trainings, webinars, etc.	○	○	○	○	○
Textbooks or notes from college	○	○	○	○	○
Design standard or material trade group help desk or solution center	○	○	○	○	○
Internet search	○	○	○	○	○

- How well do current methods of learning and working with US seismic codes (such as those mentioned in the previous question) meet the needs of people inyour profession or the types of projects you work on? *

Not at all ○ ○ ○ ○ ◉ Very well

- How useful do you think the following steps might be for better communicating about US seismic codes and standards for you and others in your profession: *

	Not at all Useful	Somewhat Useful	Very Useful	Don't Know
Use more social media	○	○	○	○
More training webinars	○	○	○	○
More in-person trainings, in more locations and different regions	○	○	○	○
Increase outreach to university students	○	○	○	○
Reduce the cost of educational resources	○	○	○	○
FAQ forum with timely responses from experts	○	○	○	○
Additional guides, resources, and example problems	○	○	○	○
Develop smartphone or tablet-based US seismic codes and standards app	○	○	○	○
Create an interactive online platform where seismic provisions are linked to associated commentary and design examples	○	○	○	○

- How else could US seismic code and resources development organizations betterreach you and others in your profession to explain about seismic design and evolving technologies, recommendations, and practices?

- Please take this space to offer any remaining thoughts you have that would help improve the reach, understanding, and use of seismic codes in the US:

Back	Submit

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B.3 U.S. Seismic Code Improvement Survey for Stakeholders

Thank you for taking the time to help the National Institute of Building Sciences (NIBS) Building Seismic Safety Council (BSSC) collect input from a variety of stakeholders on waysto improve United States seismic codes and standards.

The goal of this voluntary survey is to get input from a broad group of people who are affected, directly or indirectly, by US seismic codes and standards. Responses from you and over 100 other participants will be used by advisors to BSSC and FEMA to develop a publicly available report. The report will contain recommendations on how to make US seismic codes and standards easier to use, how to improve the development of those codesand standards, and how the engineering community can be better educated on changes.

You were recommended and specially invited to participate so the perspectives of peoplein your profession will be represented. Depending on your answers, this survey should take about 15 to 20 minutes. We ask that you kindly submit your response before April 30, 2021.

Thanks again for your contribution to this effort!

For your reference about the survey author, context, and focus:

The BSSC is charged by the Federal Emergency Management Agency (FEMA) to identify and recommend steps to advance the state of the art of earthquake-resistant design in the US. TheBSSC prepares the NEHRP Recommended Seismic Provisions for New Buildings and Other Structures (identified here as the "NEHRP Seismic Provisions"). The BSSC works with the American Society of Civil Engineers (ASCE) Seismic Subcommittee to transfer the NEHRP Seismic Provisions into the standards language incorporated in ASCE/SEI 7standard Minimum Design Loads and Associated Criteria for Buildings and Other Structures.ASCE 7 is referenced by the International Building Code (IBC). The IBC in turn is used as the model code for the building codes adopted by state and local jurisdictions in the US.

This survey focuses on the NEHRP Seismic Provisions, the seismic provisions in ASCE 7 andthe IBC, and seismic design for new buildings. The following are outside the scope of the survey: non-seismic code provisions, the seismic provisions in the International Residential Code (IRC), and codes and

standards for existing buildings such as the International ExistingBuilding Code (IEBC) and ASCE/SEI 41 Seismic Evaluation and Retrofit of Existing Buildings.

For questions about this survey, contact Jiqiu (JQ) Yuan, Executive Director, NIBS Multi-Hazard Mitigation and Building Seismic Safety Council, (202) 787-3240, jyuan@nibs.org, www.nibs.org.

Before we begin, please confirm your name and email. This information will not be sharedoutside this study.

Name:

First Name:

Last Name:

Email:

example@example.com

Click Here to Begin

All fields marked with * are required and must be filled.

First, please tell us a bit about your professional background.

- Please choose the answer that best describes your profession: *

○ Building Owner / Developer ○ Code Agency Employee ○ Contractor / Construction Industry ○ Material Trade Organization Representative
○ PlansExaminer ○ Structural Engineering Professor or Researcher
○ Vendor / Manufacturer ○ Other: _____

- In what state or US Territory do you primarily work? *

[▼]

(options include all states plus American Samoa, DC, Guam, Puerto Rico, US Virgin Islands)

- Which of the following best describes your career stage? *

○ Early career (1-5 years) ○ Mid-career (6-15 years)

○ Advanced career (>15years) ○ Retired

- How often do US seismic codes and standards (such as ASCE 7 or IBC) play a role inyour work? *

○ Very often - monthly or more ○ Often - several times a year
○ Sometimes -every few years ○ Rarely - a few times ever
○ Never / not applicable

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All fields marked with * are required and must be filled.

This section asks about your GENERAL IMPRESSIONS about US seismic codes and standards, and their RELEVANCE to people in your professionand where you work.

- Please indicate how much you rely on the following sources of informationabout US seismic codes and standards: *

	Very often - monthly or more	Often - several times a year	Sometimes - every few years	Rarely - a few times ever	Never / not applicable
NEHRP Seismic Provisions	○	○	○	○	○
ASCE 7	○	○	○	○	○
IBC	○	○	○	○	○
Local jurisdiction codes	○	○	○	○	○
Material standards	○	○	○	○	○
Other (please describe below)	○	○	○	○	○

- If you stated "Other" above, please describe briefly:

- Please indicate how much you agree with the following statements about thepurpose and importance of US seismic codes and standards: *

	Disagree	Neither Agree Nor Disagree	Agree	Does Not Apply
The goals of US seismic codes and standards to prevent collapse and protect lives in major earthquakes are clear to the public.	○	○	○	○
US seismic codes and standards are effective in preventing collapse and protecting lives in major quakes.	○	○	○	○
US codes and standards provide opportunity to choose enhanced performance goals for improved post-earthquake re-occupancy and functional recovery time.	○	○	○	○

- How well do you think current US seismic codes and standards meet the needs ofall regions of the United States? *

Not at all ○ ○ ○ ○ ◉ Very well

- Which answer best reflects your overall opinion about how stringent US seismic codes and standards are? *

○ Not stringent enough - seismic performance expectations should be raised
○ About right- seismic performance expectations reasonably balance cost and benefits ○ Too stringent - seismic performance expectations are too high and notreasonable

- In your opinion, are earthquake safety or performance issues currently well-addressed in US seismic codes and standards? *

○Yes ○ No ○ Not applicable / don't know

- If you answered NO, please tell us what earthquake issues are not well-addressedby current US seismic codes:

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This section asks what you think about how US seismic codes andstandards are DEVELOPED AND UPDATED over time.

- Please indicate your level of agreement with the following statements about howUS seismic codes and standards are developed and updated over time:

	Disagree	Neither Agree Nor Disagree	Agree	Don't Know
Updates receive adequate review by all important stakeholders.	○	○	○	○
Updates should happen faster or more frequently, for instance to promote innovation.	○	○	○	○
Updates should happen more slowly or less frequently, for instance so more meaningful user feedback can be incorporated.	○	○	○	○

- When US seismic codes and standards are changed, do you feel the changes and therationale behind them are generally well-explained? *

○ Yes ○ No ○ Not applicable / don't know

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This last section asks what you think about how COMMUNICATION about US seismic codes is handled and could be improved.

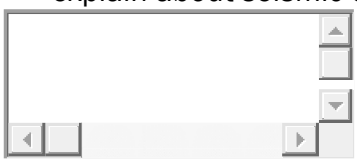
- How well do current methods of communicating about US seismic codes andstandards meet the needs of people in your region? *

Not at all ○ ○ ○ ○ ◉ Very well

- How well do current methods of communicating about US seismic codes and standards meet the needs of people in your profession or types of projects youwork on? *

Not at all ○ ○ ○ ○ ◉ Very well

- How can US seismic code and resource development organizations (such as NIBS,FEMA, ASCE, or ICC) better reach you and others in your profession to explain about seismic design and code changes?



- Please share any ideas for how to encourage innovation and use of new conceptsand new technologies in US seismic codes and standards from your perspective:

- Finally, please use this space to share anything you haven't had a chance to say yet that might help improve the reach, understanding, and use of seismic codes and standards in the US:

Back Submit

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B.4 List of States Assigned to Regions

West	Central/Mountain	East
AK	AL	CT
AZ	AR	DE
CA	CO	DC
HI	ID	FL
OR	IL	GA
WA	IA	IN
AS	KS	KY
GU	LA	ME
--	MN	MD
--	MS	MA
--	MO	MI
--	MT	NE
--	NV	NH
--	NM	NJ
--	ND	NY
--	OK	NC
--	SD	OH
--	TN	PA
--	TX	RI
--	UT	SC
--	WI	VT
--	WY	VA
--	--	WV
--	--	PR
--	--	VI

References

ASCE (2017a). *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, ASCE/SEI 7-16, Structural Engineering Institute of American Society of Civil Engineers, Reston, Virginia.

ASCE (2017b). *Seismic Evaluation and Retrofit of Existing Buildings*, ASCE/SEI 41-17, Structural Engineering Institute of American Society of Civil Engineers, Reston, Virginia.

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