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FEDERAL EMERGENCY MANAGEMENT AGENCY
BUILDING SEISMIC SAFETY COUNCIL / PROVISIONS UPDATE COMMITTEE

FUNCTIONAL RECOVERY PLANNING COMMITTEE REPORT

FUNCTIONAL RECOVERY TASK COMMITTEE RECOMMENDED SCOPE, ORGANIZATION AND DELIVERABLES

August, 2023

BSSC

Federal Emergency Management Agency
Building Seismic Safety Council
Provisions Update Committee
Functional Recovery Planning Committee Report

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Foreword

In the wake of the devastating earthquakes in Turkey and Syria in February 2023, we are reminded of the importance of our work to provide safe buildings and our mission to serve the public interest by advancing building science and technology to improve the built environment.

The *NEHRP Recommended Seismic Provisions for New Buildings and Other Structures (NEHRP Provisions)* have played a foundational role in the development of seismic codes and standards in the United States for almost four decades. They have made it possible to bring together research and practicing engineers, codes and standards officials, and earth science experts to advance our design practices effectively and efficiently, develop nationally applicable seismic regulations with broad support of the industry stakeholders, and reduce the nation's seismic risk through state-of-the-art building codes. The Building Seismic Safety Council (BSSC) and National Institute of Building Sciences (NIBS) are proud to be a part of this effort and thankful to the NEHRP agencies (Federal Emergency Management Agency, National Institute of Standards and Technology, United States Geological Survey, and National Science Foundation), our industry partners, and most importantly, hundreds of national experts for their dedicated support and significant contributions.

Within the framework of developing the 2026 NEHRP Provisions, this report begins to answer part of a very large and difficult task, assigned by our sponsor, Federal Emergency Management Agency, and in large part the U.S. Congress and public. The questions being asked include:

- How can we reduce the risks of life and property from future earthquakes and increase the resilience of communities in the United States?
- How can we address the increasing threat of natural disasters?

The BSSC is grateful to the many individuals for their expertise and generous contributions, much of which has been through volunteer effort. Your dedication has made and will continue to make a lasting impact on the nation's built environment.

We look forward to continuing this important work to save lives, reduce property damage, and improve community resilience through collaboration by integrating science into the built environment.

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National Institute of Building Sciences

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Executive Summary

The National Earthquake Hazards Reduction Program (NEHRP) Reauthorization Act of 2018 (P.L. 115-307) included notable amendments to the law authorizing and governing NEHRP that introduced the concept of community resilience and brought a focus on improving post-earthquake recovery to the NEHRP purpose, program activities, and program agency responsibilities (42 U.S.C. 7701 et seq.). In particular, "Section 3. Purpose" of the Earthquake Hazards Reduction Act (42 U.S.C. 7702) was amended to read:

> *It is the purpose of the Congress in this chapter to reduce the risks of life and property from future earthquakes and increase the resilience of communities in the United States through the establishment and maintenance of an effective earthquake hazards reduction program.*

The four NEHRP agencies – National Institute of Standard and Technology (NIST), Federal Emergency Management Agency (FEMA), National Science Foundation (NSF) and U.S. Geological Survey (USGS) – share the responsibility for the NEHRP mission. FEMA's responsibilities for NEHRP include implementing research results and new knowledge to support development and advancement of national standards and model building codes and to reduce impacts of future earthquakes on at-risk communities. FEMA has currently contracted with the Building Seismic Safety Council (BSSC) of National Institute of Building Sciences (NIBS) to develop and update a key resource: *NEHRP Recommended Seismic Provisions for New Buildings and Other Structures (NEHRP Provisions)*. The *NEHRP Provisions* are used as the primary technical resource for the seismic design provisions of the professional consensus design standard setting minimum criteria for new buildings and structures: *ASCE/SEI 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures (*ASCE 7*)*. In most jurisdictions across the United States, design and construction of most new buildings must comply with a locally-adopted version of the *International Building Code* (IBC), which typically includes ASCE 7 as a reference standard. While the federal government does not control the process or the final content of ASCE 7 or the IBC, the NEHRP agencies play an important role in providing technical material to be considered and encouraging adoption of provisions that would reduce future losses.

The 2018 NEHRP Reauthorization Act also specifically charged NIST and FEMA to convene a committee of experts to develop a report to Congress on options for improving the post-earthquake recovery time of the built environment. In January 2021, FEMA P-2090 / NIST SP-1254 *Recommended Options for Improving the Built Environment for Post-Earthquake Reoccupancy and Functional Recovery Time* (FEMA-NIST report) was published and contains a set of options in the form of recommendations, tasks, and alternatives. The report makes many fundamental contributions toward advancing the concept of functional recovery performance objectives, including how functional recovery performance of individual buildings or lifeline systems can serve to support community resilience goals not expected to be met by current codes and standards focused primarily on minimum life safety performance. The report makes the following key definition:

> *Functional recovery is a post-earthquake performance state in which a building or lifeline infrastructure system is maintained, or restored, to safely and adequately support the basic intended functions associated with the pre-earthquake use or occupancy of a building, or the pre-earthquake service level of a lifeline infrastructure system.*

The FEMA-NIST report is a landmark resource as it reflects the thoughts of the leading national experts on the earthquake performance of buildings and the earthquake preparedness of our communities. It is the result of broad interest, engagement, and support from the earthquake engineering industry and has received significantly positive review and feedback. The report looks forward toward the next generation of seismic design as a way to support the vitality, stability, and growth of our communities in areas of seismic risk. It is something that should be read by policymakers, community advocates, building code officials, codes and standards development organizations, and others in the earthquake engineering industry.

The report makes seven recommendations that consider ways to achieve improved post-earthquake recovery through development of a functional recovery framework; design and construction of new buildings; retrofit of existing buildings; design and retrofit of lifeline infrastructure systems; pre-disaster planning; education and outreach; and access to financial resources. The report also provides four specific actions that the federal government can take: support technical development; incentivize action; lead by example; and mount an education campaign.

The development of the *NEHRP Provisions* can serve to advance portions of two of those recommendations: limited to a functional recovery framework for the design of new buildings. However, no additional funding has been provided to the NEHRP agencies, within the 2018 Reauthorization or otherwise, to develop and advance concepts related to functional recovery. Therefore, any work done to consider functional recovery performance objectives and design criteria for new buildings within the development of the *NEHRP Provisions* will be almost exclusively a volunteer effort.

Clearly, additional resources from the federal government as well as engagement from many industry stakeholder groups will be needed to ultimately advance all seven recommendations.

In early 2022, FEMA and BSSC began the process of developing the *2026 NEHRP Provisions* and established the Provisions Update Committee (PUC). The PUC is supported by Issue Teams (ITs) that address specific aspects of seismic design methodology and construction to ensure that lessons learned from building performance during earthquakes, as well as new research to improve earthquake resistance, are reflected in state-of-the-art seismic requirements. Given recent efforts within the NEHRP agencies, as well as other notable efforts within the earthquake community, to advance the concepts of increased community resilience and improved post-earthquake functional recovery time within model building codes and structural design standards, FEMA requested that BSSC's formation of the PUC include a commitment to establish a specific Functional Recovery Task Committee in addition to other Issue Teams.

Improving post-earthquake reoccupancy and functional recovery time has recently received broad interest and support among community resilience advocates, earthquake risk mitigation professionals, building design practitioners, code and standard developers, and building owners. In order to make early progress and set clear goals for the *2026 NEHRP Provisions* update cycle, a Functional Recovery Planning Committee was formed to help define the scope, organizational structure, operational processes, focused areas of study, and expected deliverables of the Functional Recovery Task Committee in advance of it being formed. This report summarizes the recommendations of the Functional Recovery Planning Committee regarding the scope of the Functional Recovery Task Committee under the PUC for the development of the *2026 NEHRP Provisions*.

The Planning Committee participants were selected to gain a depth of expertise in the subject matter and a breadth of experience across the industry, including practicing engineers, researchers, architects, owners, planners, business continuity experts, public policy advocates, those active in development of applicable codes and standards, and liaisons to other related federal activities or agencies including BSSC, NIBS, PUC, FEMA, NIST, and USGS.

The Functional Recovery Planning Committee considered the 2018 NEHRP Reauthorization Act and the following four resources as primary sources of information and motivation regarding the consideration of functional recovery performance objectives within the context of the *NEHRP Provisions* as a source document for model building codes and design standards:

- FEMA P-2090 / NIST SP-1254 *Recommended Options for Improving the Built Environment for Post-Earthquake Reoccupancy and Functional Recovery Time* (2021)
- "Resource Paper 1 Resilience-Based Design and the NEHRP Provisions" from *2020 NEHRP Recommended Seismic Provisions, Volume II: Part 3 Resource Papers* (FEMA P-2082-2)
- "Recommendation C1 – Address Functional Recovery and Enhanced Resilience in Model Code Framework" from *A Step Forward: Recommendations for Improving Seismic Code Development, Content, and Education* (FEMA P-2191)
- Applied Technology Council (ATC) Project 138 (ATC-138), which is developing a methodology to assess seismic performance of buildings in terms of probable post-earthquake functional recovery time.

In addition to these primary sources of information and motivation, the Planning Committee considered many other relevant publications, presentations, and information resulting from efforts of FEMA, NIST, and USGS at the federal level as well as similar efforts by other industry stakeholders including, but not limited to, the following (listed in alphabetical order): the American Society of Civil Engineers / Structural Engineering Institute (ASCE/SEI), the Applied Technology Council (ATC), the Earthquake Engineering Research Institute (EERI), the International Code Council (ICC), the National Council of Structural Engineers

Associations (NCSEA), the State of California (various agencies and legislative activities), and the Structural Engineers Association of California (SEAOC).

The overarching recommendations of the Functional Recovery Planning Committee are summarized as follows:

- Establish a Functional Recovery Task Committee (TC) with sufficient breadth of perspectives and expertise in the subject matter to explore design criteria and related provisions for improving functional recovery in new building design.
- Develop recommended proposals for provisions and other resources regarding functional recovery to be included in the *2026 NEHRP Provisions*.
- Utilize Functional Recovery Topic Subcommittees (TS), at least the five described below, to consider and address the relevant issues and formulate proposals for review by the Task Committee regarding the following topics:
  - TS #1: Key terms and concepts related to functional recovery
  - TS #2: Functional Recovery Categories and performance metrics
  - TS #3: Functional recovery time targets for occupancies/services
  - TS #4: Prescriptive provisions for each Functional Recovery Category
  - TS #5: Hazard level(s) applicable for functional recovery objectives

Anticipated deliverables from the Functional Recovery Task Committee include:

- Parts 1 & 2 – Provisions & Commentary
  - Proposed new, stand-alone Chapter or Appendix for *2026 NEHRP Provisions* that addresses "Design for Functional Recovery"
- Part 3 – Resources
  - Potential resource paper(s) with additional content or commentary regarding the concepts included in the proposals for Parts 1 and 2
  - Potential resource paper(s) with proposed revisions to content within the ASCE 7 standard and the International Building Code (IBC) to address "Design for Functional Recovery"

1. Background and Introduction to functional recovery Planning Committee

2018 NEHRP Reauthorization and FEMA P-2090/NIST SP-1254

The National Earthquake Hazards Reduction Program (NEHRP) Reauthorization Act of 2018 (P.L. 115-307) included notable amendments to the law authorizing and governing NEHRP that introduced the concept of community resilience and brought a focus on improving post-earthquake recovery to the NEHRP purpose, program activities, and program agency responsibilities (42 U.S.C. 7701 et seq.). In particular, "Section 3. Purpose" of the Earthquake Hazards Reduction Act (42 U.S.C. 7702) was amended to read:

> *It is the purpose of the Congress in this chapter to reduce the risks of life and property from future earthquakes and increase the resilience of communities in the United States through the establishment and maintenance of an effective earthquake hazards reduction program.*

The inclusion of increased community resilience as part of the stated purpose of NEHRP added the authority and responsibility to consider means to improve post-earthquake recovery through various Program objectives and activities, including support for development, publication, and promotion of building codes and other planning, design, and construction standards.

The 2018 NEHRP Reauthorization Act also specifically charged the National Institute of Standards and Technology (NIST) and the Federal Emergency Management Agency (FEMA) to convene a committee of experts to develop a report to Congress on options for improving the post-earthquake recovery time of the built environment. In January 2021, FEMA P-2090 / NIST SP-1254 *Recommended Options for Improving the Built Environment for Post-Earthquake Reoccupancy and Functional Recovery Time* (FEMA-NIST report) was published and contains a set of options in the form of recommendations, tasks, and alternatives. The report makes many fundamental contributions toward advancing the concept of functional recovery performance objectives, including the following key statement and important definitions:

> *To support resilience goals at the community level, there is a need to establish a link between the design, construction, and retrofit of individual buildings and lifeline infrastructure systems, and community resilience, as measured by time to recovery of function; but this link is currently missing. The concepts of reoccupancy and functional recovery have been introduced to serve as this link, defined as follows:*
>
> *Reoccupancy is a post-earthquake performance state in which a building is maintained, or restored, to allow safe re-entry for the purposes of providing shelter or protecting building contents.*
>
> *Functional recovery is a post-earthquake performance state in which a building or lifeline infrastructure system is maintained, or restored, to safely and adequately support the basic intended functions associated with the pre-earthquake use or occupancy of a building, or the pre-earthquake service level of a lifeline infrastructure system.*

Of the seven recommendations provided in the FEMA-NIST report, the following are the most applicable to new buildings within the scope of the *NEHRP Provisions*:

> Recommendation 1: Develop a Framework for Post-Earthquake Reoccupancy and Functional Recovery Objectives. A framework for reoccupancy and functional recovery is needed to provide a national consensus on policies and technical criteria necessary to define what services must be in place and the design requirements needed for a building or lifeline infrastructure system to be occupiable or functionally recoverable within a specified timeframe after an earthquake.
>
> Recommendation 2: Design New Buildings to Meet Recovery-Based Objectives. Because current building codes do not specifically address recovery-based objectives and resulting designs will yield inconsistent performance results, new buildings should be designed for specific recovery-based objectives that will support reliable reoccupancy and acceptable functional recovery times following a major earthquake.

However, no additional funding has been provided to the NEHRP agencies to develop and advance concepts related to functional recovery. Therefore, any consideration of functional recovery performance objectives and design criteria for new buildings within the development of the *2026 NEHRP Provisions* will be almost exclusively a volunteer effort.

2020 NEHRP Provisions Resource Paper 1

As part of the development of the 2020 NEHRP Provisions, the Building Seismic Safety Council (BSSC) of the National Institute of Building Sciences (NIBS) published *Volume I: Part 1 Provisions, Part 2 Commentary* (FEMA P-2082-1) and also published *Volume II: Part 3 Resource Papers* (FEMA P-2082-2). "Resource Paper 1 Resilience-Based Design and the NEHRP Provisions" explored ways that building codes and standards, including future versions of the NEHRP Provisions, could support the new federal policies focused on increasing community resilience to earthquakes by providing design criteria that would yield improved post-earthquake recovery time for new buildings and other structures.

FEMA P-2191 *"A Step Forward"*

Following the development of the *2020 NEHRP Provisions*, FEMA and BSSC embarked on an effort to understand stakeholder perspectives on the seismic code development process, code content, and ease of use. In 2022, *A Step Forward: Recommendations for Improving Seismic Code Development, Content, and Education* (FEMA P-2191) was published and contained recommendations and suggested areas of improvement to ensure that seismic provisions in model codes are consistent with the purpose and goals of NEHRP, meet the needs of industry stakeholders, and satisfy expectations of the general public. In the report, a high priority was assigned to "Recommendation C1 – Address Functional Recovery and Enhanced Resilience in Model Code Framework" which envisioned a coalition-based pilot project that would explore how to incorporate functional recovery concepts, objectives, and requirements in the national model code framework.

2026 NEHRP Provisions

In early 2022, FEMA and BSSC began the process of developing the *2026 NEHRP Provisions* and established the Provisions Update Committee (PUC). The PUC is supported by Issue Teams (ITs) that address specific aspects of seismic design methodology and construction to ensure that lessons learned from building performance during earthquakes, as well as new research to improve earthquake resistance, are reflected in state-of-the-art seismic requirements. Given recent efforts within the NEHRP agencies, as well as other notable efforts within the earthquake community, to advance the concepts of increased community resilience and improved post-earthquake functional recovery time within model building codes and structural design standards, the formation of the PUC included a commitment to form a specific Functional Recovery Task Committee in addition to other Issue Teams normally used to consider, explore, and advance specific topics.

In order to make early progress and set clear goals, FEMA/BSSC formed a Functional Recovery Planning Committee to help define the scope, organizational structure, operational processes, focused areas of study, and expected deliverables of the Functional Recovery Task Committee. This report summarizes the recommendations of the Functional Recovery Planning Committee regarding the scope of the Functional Recovery Task Committee under the PUC for the development of the *2026 NEHRP Provisions*.

The Planning Committee was comprised of 15 members who were selected to gain a depth of expertise in the subject matter and a breadth of experience across the industry, including practicing engineers, researchers, architects, owners, planners, business continuity experts, public policy advocates, and those active in development of applicable codes and standards. In addition to these members, the Planning Committee received input from other subject-specific contributors and liaisons to other related federal activities or agencies, including PUC, NIBS, BSSC, FEMA, NIST, and the U.S. Geological Survey (USGS). The list of Planning Committee participants is included in Appendix A.

In its discussions, the Functional Recovery Planning Committee considered the 2018 NEHRP Reauthorization Act and the three efforts highlighted above as primary sources of information and motivation regarding the consideration of functional recovery performance objectives within the context of model building codes. Another primary source of information considered by the Planning Committee was the ongoing FEMA-funded ATC-138 Support of Performance Based Seismic Design, which is under the project management of the Applied Technology Council (ATC). The ATC-138 project has developed, and is refining, a methodology to assess seismic performance of buildings in terms of probable post-earthquake functional recovery time, based on specific characteristics of the building, including occupancy type, structural and nonstructural systems, and site conditions. In addition to these primary sources of information and motivation, the Planning Committee considered many other relevant publications, presentations, and information resulting from efforts of FEMA, NIST, and USGS at the federal level as well as similar efforts by other industry stakeholders including, but not limited to, the following (listed in alphabetical order): the American Society of Civil Engineers / Structural Engineering Institute (ASCE/SEI), the Applied Technology Council (ATC), the Earthquake Engineering Research Institute (EERI), the State of

California (various agencies and legislative activities), and the Structural Engineers Association of California (SEAOC). A more extensive, but not exhaustive, list of relevant resources is contained in Appendix B.

The Planning Committee found the recommendations of the FEMA-NIST report extremely valuable and found that Recommendation 1 and Recommendation 2 could serve to significantly guide the development of the scope and goals for the Task Committee related to new buildings. In the report, Recommendation 1: Develop a Framework for Post-Earthquake Reoccupancy and Functional Recovery Objectives, includes three primary tasks:

- Task 1.1: Develop a Policy for Recovery-Based Objectives
- Task 1.2: Develop Design Criteria for Achieving Recovery-Based Objectives
- Task 1.3: Determine Appropriate Hazard Level(s) for Recovery-Based Objectives

The FEMA-NIST report describes two primary activities needed under Task 1.1 in order to establish fundamental policies that the Planning Committee found relevant to developing the *2026 NEHRP Provisions*:

- identification of basic intended building functions, including key concepts and terms
- identification of the timeframe for which these functions are needed during recovery

The Planning Committee envisioned that these activities may need to be separated into multiple, but collaborative, efforts in order to obtain the appropriate subject-matter expertise.

Under Task 1.1, the report also introduces the concept of "functional recovery categories" as a potential way to identify and group building occupancies according to the target functional recovery time for the basic intended functions associated with that category of occupancies. The concept of functional recovery categories is further described and explored in Appendix B of the FEMA-NIST report, and the conceptual functional recovery category table from the report is reprinted below. The Planning Committee discussed the importance of exploring the use of functional recovery categories within the *NEHRP Provisions*.

Task 1.2 specifically involves developing the design criteria that would be used to meet the target functional recovery time. Development of the design criteria should leverage the ATC-138 project's methodology to assess functional recovery time by testing how different design parameters affect functional recovery time and then establishing appropriate values to use for design. This development effort should also be informed by the *2020 NEHRP Provisions* Resource Paper 1 which presented conceptual design considerations for various structural and nonstructural parameters depending on target functional recovery time. The table from the paper is reprinted below. Development of functional recovery design criteria is a key task, if not the fundamental objective, within the scope for the Functional Recovery Task Committee as envisioned by the Planning Committee.

The FEMA-NIST report's discussion for Task 1.3 includes a recognition that the selection of hazard level(s) would be informed by a cost-benefit understanding of the desired functional recovery times, the desired level of confidence, and the scale at which the benefit is being measured (individual, community, or larger). The discussion also acknowledges that while a single hazard level is convenient for design purposes, a singular design hazard level might need to consider and provide acceptable performance at multiple hazard levels (for example, reasonable functional recovery times for a medium or large earthquake that may not occur very often, but also quick functional recovery for a smaller but frequent earthquake). The Planning Committee recognized the need for specific expert discussions within the Task Committee regarding selection of hazard level(s).

In the report, Recommendation 2: Design New Buildings to Meet Recovery-Based Objectives included the following three alternatives:

- Alternative 2-1: Mandate the Design of New Buildings to Meet Recovery-Based Objectives Using Future National Model Code Provisions
- Alternative 2-2: Mandate the Design of New Buildings to Meet Recovery-Based Objectives Using Interim Provisions
- Alternative 2-3: Encourage the Voluntary Design of New Buildings to Meet Recovery-Based Objectives

While the Planning Committee did not find the need and capacity for the Task Committee to explicitly explore each of these alternatives simultaneously, the Planning Committee found that the discussion of these alternatives within the report did contain strategies that should be considered by the Task Committee in the development of the anticipated deliverables. For example, the Planning Committee discussed the value in writing proposals in mandatory language, while also considering whether the language would be proposed for inclusion in the main body of the *Provisions* or as an appendix that might only be applicable if certain conditions triggered implementation, including possible optional adoption by a given jurisdiction. The Planning Committee discussions also included suggestions that the Task Committee consider a possible simplified proposal that might serve as initial or interim provisions if a comprehensive proposal might not be completed in time for the consideration during this development cycle. In addition, since NEHRP Provisions are resources for development of industry codes and standards, the Task Committee should collaborate with the ASCE 7 Seismic Subcommittee and other relevant building code and standard development organizations to seek broad input for proposals and incorporation of the resulting provisions.

Finally, the Planning Committee considered that the pilot project program envisioned by Recommendation C1 of *A Step Forward* would be important, if possible and resources allow, for the Task Committee to implement to ensure that any provisions being proposed were tested for consistent and appropriate implementation prior to final adoption.

The full recommendations from the Planning Committee regarding the organization of the Task Committee, the scope of each Topic Subcommittee, and the expected deliverables are included in Sections 3 and 4 below.

The Planning Committee recognizes that functional recovery is an important part of community resilience and it requires a broad community support and engineering development effort. Although the entire recommendations in the FEMA-NIST report are beyond the 2018 NEHRP Reauthorization Act and the capacity of a Functional Recovery Task Committee to accomplish, it is worthy and hopeful that Functional Recovery design for new buildings can be explored and advanced by volunteered experts of a Functional Recovery Task Committee under the PUC.

Table 1. Conceptual Functional Recovery Categories (from FEMA-NIST report Table B-1)

Table B-1 Conceptual Functional recovery Categories for a Design Hazard Level

Functional Recovery Category	Target Functional Recovery Time	Recovery Phase and Associated Functions and Services [(1)]	Examples of Buildings and Lifeline Infrastructure Systems
Functional Recovery Category A (FRC-A)	Hours (or less)	Near-Term (Nearly Immediate) and Emergency Response – rescue, safety, security, and event stabilization	Emergency and first-responder facilities (e.g., hospitals, fire and police stations), designated shelters, emergency operations centers, and lifeline infrastructure systems supporting emergency response (e.g., power, communication, critical transportation)
Functional Recovery Category B (FRC-B)	Days to Weeks	Short-Term – shelter, governance, daily necessities, and care for vulnerable populations	Single- and multi-family residential, local government, schools, outpatient medical facilities, nursing homes, critical retail (e.g., food distribution, pharmacy, home improvement), ad lifeline infrastructure systems supporting short-term activities

Functional Recovery Category	Target Functional Recovery Time	Recovery Phase and Associated Functions and Services (1)	Examples of Buildings and Lifeline Infrastructure Systems
Functional Recovery Category C (FRC-C)	Weeks to Months	Immediate-Term – restoration of neighborhood activities and economic vitality	Critical business enterprises, possibly exceeding a certain size threshold, and lifeline infrastructure system services supporting immediate-term activities
Functional Recovery Category D (FRC-D)	Months to Yeats	Long-Term – cultural, quality of life, and leisure activities	Buildings not assigned to other categories, possibly including less critical business enterprises, less-critical retail, entertainment, leisure, and cultural facilities, and lifeline infrastructure system services supporting long-term activities

Note 1: Recovery phases refer to the FEMA National Disaster Recovery Framework, Second Edition (FEMA, 2016)

Table 2. Conceptual Functional Recovery Design Considerations (from *2020 NEHRP Provisions* Resource Paper 1 Table 1)

Table 1 Hypothetical prescriptive design requirements for a range of functional recovery times

Functional Recovery Design Requirement	**Target Functional recovery Time, T_{target}**			
	1 Hour	1 Day	1 Week	1 Month
Structural				
Limits on lateral system selection	Required	Required	Required	–
Limits on drift	Required	Required	Required	–
Factor on required strength	Required	Required	–	–
Etc.	…	…	…	…
Nonstructural				
Increased bracing scope	Required	Required	Required	–
Reliability factors on design strength	Required	Required	–	–
Ruggedness certification	Required	Required	–	–
Etc.	…	…	…	…
Recovery-critical contents				
To be determined by user groups	Required	Required	…	…
Etc.	…	…	…	…
Utility service				
Electricity backup	Required	Required	Required	–
Potable water backup	Required	Required	Required	Required
Wastewater alternative	Required	–	–	–
Telecommunications	Required	–	–	–
Etc.	…	…	…	…
Reoccupancy and recovery planning				
Repair services on retainer	Moot	Required	Required	–
Pre-determined safety evaluation	Moot	Required	–	–
Business continuity plan	Required	Required	–	–
Pre-defined permit application	Moot	Required	Required	–
Etc.	…	…	…	…

2. Recommendations for Functional Recovery Task Committee and Topic Subcommittees

2.1. Functional Recovery Task Committee (FR TC)

With the understanding that the scope of the *2026 NEHRP Provisions* is focused on new buildings, the Functional Recovery Planning Committee (FR PC) recommended the deliverables, organization, and topic areas discussed below for the Functional Recovery Task Committee (FR TC). At the same time, the FR PC recognized that functional recovery of new buildings cannot be fully accomplished without a comprehensive and holistic approach that considers the dependencies of a new building on the performance of other buildings as well as critical lifeline infrastructure. While the FR TC has scope limited to design of new buildings, it will be important for the FR TC to be aware of and collaborate with the broader effort for developing and implementing functional recovery concepts for existing buildings and lifeline infrastructure. The concept of establishing and implementing objectives for improved post-earthquake functional recovery of new buildings happens at the scale of an individual building but must be informed by dependencies and performance across the built environment. Ultimately, the goal is certainly for an individual building to provide acceptable functional recovery performance that supports improved resilience at the community scale. To serve this goal, the FR TC will not only consider the resources to be developed and their intended use by design practitioners and by standard and code developers but will also inform NEHRP and relevant stakeholders about best practices as well needs to advance resilience through functional recovery research and technologies.

The FR TC will need to consist of members providing sufficient expertise to consider the relationship between the functional recovery performance of an individual new building relative to, and distinct from, resilience at the community scale. FEMA and BSSC encouraged the PUC to select members for the FR TC with a depth of expertise in the subject matter and a breadth of experience across the industry stakeholder groups, including practicing engineers, researchers, architects, owners, planners, business continuity experts, public policy advocates, those active in development of applicable codes and standards. The FR TC membership should also include liaisons to other related federal activities or agencies including BSSC, NIBS, PUC, FEMA, NIST, and USGS and members involved in the efforts of industry organizations that are actively engaged in developing and promoting concepts related to functional recovery, including, but not limited to, ASCE/SEI, ATC, EERI, NCSEA, ICC, SEAOC, and various agencies within state governments actively working to mitigate seismic risk (such as California, Oregon, Washington, Utah, and others). The work of the FR TC will be based on volunteer efforts of these subject matter experts (SMEs) and will be focused on developing technical proposals and other resources regarding functional recovery for the *2026 NEHRP Provisions* that will also serve as source material for proposals for possible adoption and use in model codes and standards for new buildings such as ASCE 7.

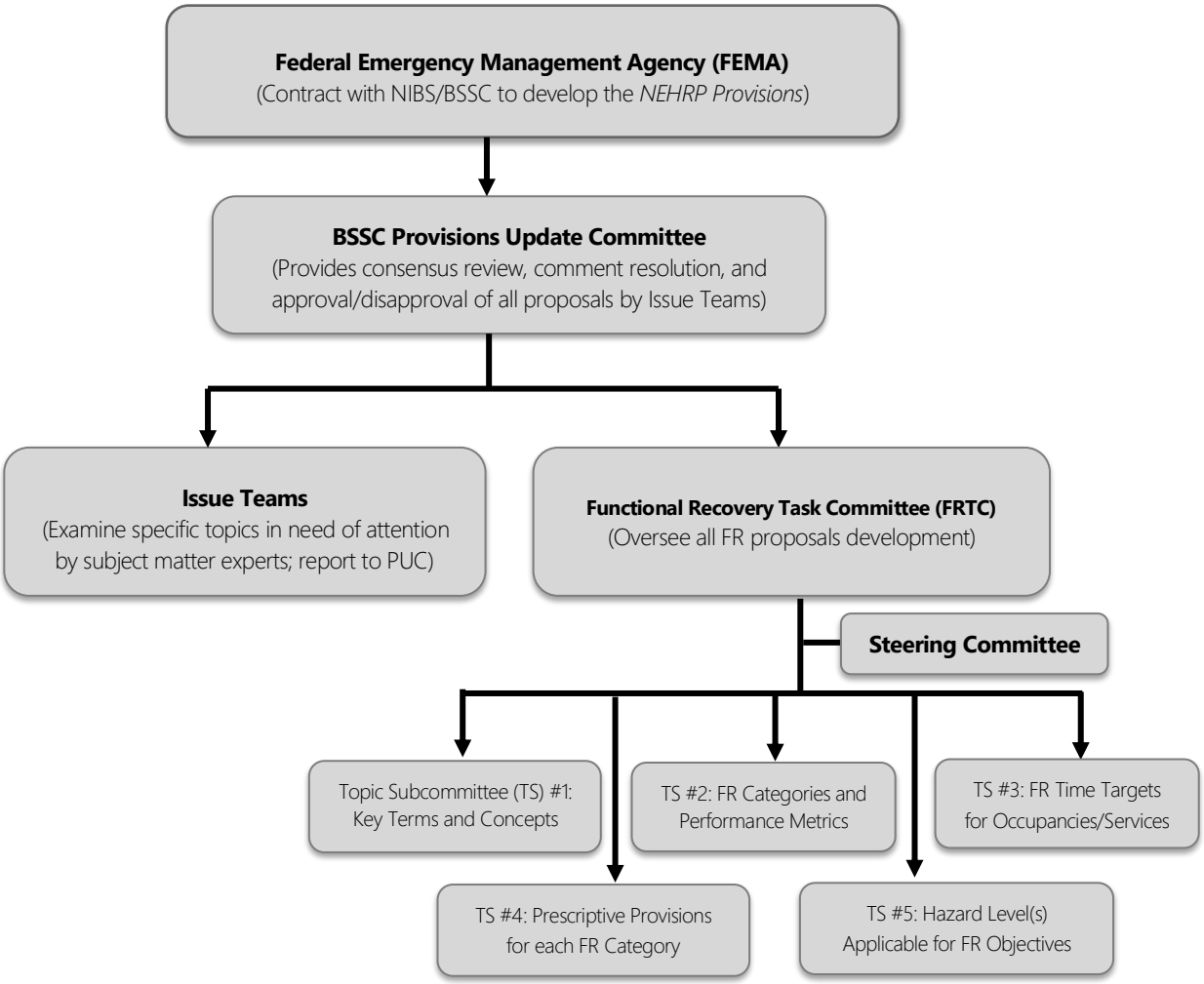
Expected deliverables from the Functional Recovery Task Committee include:

- Parts 1 & 2 – Provisions & Commentary
  - Proposed new, stand-alone Chapter or Appendix for *2026 NEHRP Provisions* that addresses "Design for Functional Recovery" and would be suitable to be submitted for consideration during next development cycle for ASCE 7, which could ultimately be adopted by reference into a future version of the International Building Code.
- Part 3 – Resources
  - Potential resource paper(s) with additional content, context, commentary, or perspective regarding the concepts included in the proposals for Parts 1 and 2
  - Potential resource paper(s) with proposed revisions to content within the ASCE 7 standard and the International Building Code (IBC) and/or a proposed new Appendix for IBC to address "Design for Functional Recovery", either as a complementary resource to the Parts 1 and 2 proposals or as a complete stand-alone resource that is not dependent on the Parts 1 and 2 proposals.

Final content of the proposals, and intended location for placement within the *2026 NEHRP Provisions*, will depend on the consensus of the PUC regarding the technical and policy deliberations of the FR TC and its subcommittees. The determination will consider the appropriate technical design provisions needed for functional recovery as well as the aspects of targeted or limited implementation to all or only selected buildings and whether the conditions of implementation are mandatory or voluntary. All proposals will be subject to the PUC/BSSC consensus review and approval process.

2.2. Functional Recovery Topic Subcommittees

The Functional Recovery Task Committee will oversee subcommittees established to study particular topic areas, including at least the five topic subcommittees (TS) described below, which will each develop proposals and other resources relevant to the given topic area and its contribution functional recovery. The FR TC will evaluate and vote on subcommittee proposals and submit them for PUC approval and acceptance to the *2026 NEHRP Provisions*. The FR TC and its subcommittees will monitor and engage with other relevant functional recovery research projects and development efforts, seeking to evaluate and translate available data and research results to applicable provisions and other resources for consideration of improved functional recovery of new buildings within the scope of the *2026 NEHRP Provisions*. A Steering Committee will provide support to subcommittee leadership, will assist with coordinating activities of the subcommittees, and will facilitate collaboration among the subcommittees. The Steering Committee will consist of the chair and vice-chair of the FR TC, the chair and vice-chair of each TS, a liaison from the PUC, a liaison from the ATC-138 project team, the PUC Chair, the BSSC project manager and the FEMA project officer.



2.2.1. TS#1: Key terms and concepts related to functional recovery

This Topic Subcommittee will begin with the definition of Functional Recovery provided in FEMA P-2090 / NIST SP-1254 and will continue to define key terms and concepts in order to develop and implement functional recovery provisions for the design of new buildings and other structures. This effort will also leverage work currently being conducted under the ATC-138 project to identify requirements and pre-requisites for achieving re-occupancy and for achieving functional recovery, including consideration of what is considered basic intended function for various building occupancy types; what amount of damage is acceptable to still occupy or be able to reoccupy a building and to maintain or restore basic intended function; and when and what types of temporary repairs and other alternatives may be appropriate in order to achieve functional recovery more quickly.

The subcommittee will work to define key terms, such as:

- "Functional Recovery"

  - As a performance state: relative to the condition of a building and the amount of damage that has to be repaired in order to safely and adequately support its basic intended function
  - As a performance objective, including a target metric (such as time, probability, or risk) as a measure of how quickly or how likely the functional recovery performance state will be achieved, and for what hazard level(s)
- "Reoccupancy" as a performance state and as a performance objective, similar to discussion above
- "Basic Intended Function" referring to something that is considered the minimum or critical function related to a given occupancy, which will likely not include functions considered to be amenities or conveniences; thus, basic function is less than full function
- "Impeding Factors" referring to those leading factors that must be addressed after the earthquake damage has occurred, but prior to starting the repair work, such as inspection, design, permitting, financing, contractor mobilization, material procurement, etc.
- "Externalities" referring to items outside the building footprint, and often outside the control of the building designer or building owner, that would affect the time needed to achieve reoccupancy and/or functional recovery, such as basic utilities (water, power, etc.), transportation access, limited access due to damage to nearby buildings, etc.

The subcommittee will also work to describe key concepts and related criteria:

- What structural and nonstructural systems or services are needed for "basic intended function" to be provided for various occupancies/services?
- What damage is allowed or must be repaired prior to reoccupancy and/or achieving functional recovery performance state?
- What temporary fixes are allowed in order to shorten time to reoccupy and/or achieve functional recovery performance state?
- What type and/or level of damage triggers impeding factors?
- How are the effects of impeding factors considered when calculating reoccupancy and functional recovery times as well as when setting targets for reoccupancy and functional recovery times?
- What occupancy/habitability requirements might be able to be temporarily modified post-disaster to allow quicker reoccupancy yet given a "less than perfect" building or "less than normal" conditions? How do these possible modified occupancy/habitability requirements affect functional recovery requirements?
- How do externalities (such as availability of utility services accessed or provided beyond the building footprint) affect functional recovery? For structures that need a higher reliability or confidence level

of meeting certain reoccupancy or functional recovery times, should requirements for back-ups systems with capability of providing service for a limited amount of time be included?

In completing these tasks, the subcommittee is expected to leverage work already completed by other groups that has been documented in available publications, including the FEMA-NIST report, FEMA P-2055, RP-1 from Part 3 of *2020 NEHRP Provisions*, the ATC-138 project, a paper in the 2020 SEAOC Convention Proceedings by Buckalew and Lang, and other publications. Significant interaction, and some iteration, is expected to be necessary between all subcommittees as TS #1 develops defines the terms, describes these concepts, and establishes related criteria.

2.2.2. TS #2: Functional Recovery Categories and performance metrics

This Topic Subcommittee will further explore the concept and use of Functional Recovery Categories discussed in FEMA P-2090 / NIST SP-1254 as a tool for identifying groups of occupancies or services with similar functional recovery time objectives for the purpose of implementing appropriate design provisions. This effort will specifically focus on developing a proposal for an appropriate number of categories and an appropriate range of performance metrics for each category. While the conceptual table in the FEMA-NIST report (repeated as Table 1 above) provides an illustration and possible framework for the idea of functional recovery categories, TS #2 will need to take the idea and further develop it, meaning any number of differences should be expected between the initial idea from the FEMA-NIST report and the final proposal for the *2026 NEHRP Provisions*. The performance metrics could consider multiple parameters that define performance. For example, one metric might be the type and amount of damage that can be allowed relative to a certain targeted functional recovery time. While TS #2 will propose the number of categories and associated performance metrics, the assignment of certain occupancies/services to those categories will be the focus of TS #3 based on understanding the implication of the performance metric on a particular occupancy or service. The results from the ATC-138 project will inform this work in terms of providing an understanding of the level of accuracy and precision that is available in the current methodology for determining expected functional recovery time of a particular building (thus, also relating to the scope of TS #4 regarding development of design provisions to meet functional recovery objectives for each category).

The subcommittee will consider, and propose answers to, relevant questions such as:

- How many functional recovery categories can be reasonably used?
- What performance metrics and relationships should be established for each specific functional recovery category?
- What level of precisions should be used for the performance metrics given the range of results from available functional recovery time calculation methods and the high degree of uncertainly of results once impeding factors have been triggered?

- How should performance metrics account for what is in the control of the building designer and/or building owner while acknowledging the significant influence on (and uncertainly added to) the results once impeding factors are triggered and from externalities?
- Whether to establish performance metrics and targets representing what engineering techniques can realistically quantify and provide or what communities actually need, even if aspirational given current capabilities? In other words, for the development of "first generation" design provisions and performance objectives, is improved functional recovery time relative to current results sufficient even if such improvements do not reach longer-term goals for specific functional recovery time?

In completing these tasks, the subcommittee is expected to leverage work already completed by other groups that has been documented in available publications, including the FEMA-NIST report, FEMA P-2055, RP-1 from Part 3 of *2020 NEHRP Provisions*, the ATC-138 project, the NIST CRPG, efforts by SPUR, current NIST projects, and other publications. Collaboration and some iteration are expected to be needed between TS #2, TS #3, and TS #4 regarding these concepts.

2.2.3. TS #3: Functional recovery time targets for occupancies/services

This Topic Subcommittee will be focused on exploring and assigning the functional recovery time objectives based on types of occupancies and services. This effort will build from the public workshops held for the FEMA P-2090 / NIST SP-1254 report development, including the additional detailed results reported in NIST SP-1269, and will leverage additional work conducted by NIST and others on the topic of acceptable functional recovery times. Understanding that these topics are less about the engineering side of performance and more about the impacts of performance on the basic needs and services within a community, the members of TS #3 will need to have expertise in a breadth of topics like community planning, economics, business continuity, emergency management, and other social sciences. This subcommittee will assign occupancies and services to the functional recovery categories developed by TS #2 based on the target functional recovery time assigned to each category and when a community needs that occupancy or service to be available after an earthquake. TS #3 is also expected to collaborate with TS #1 and TS #2 on other metrics and terms being used to describe performance, particularly for the way those metrics and terms will be communicated to the general public so that they can understand the performance that should be expected from buildings designed for functional recovery performance. This subcommittee will also provide input to TS #2 as it develops definitions of key terms and concepts, particularly regarding basic intended functions of various occupancy types, and the related design provisions developed by TS #4 that considers the impact of component behavior on being able to provide basic intended function. Another important role for TS #3 is to discuss whether the target functional recovery time would be consistent or might vary depending on the different hazard levels being considered by TS #5.

The subcommittee will consider, and propose answers to, relevant questions such as:

- What functional recovery time is needed for various occupancies and services, based on when a community would need that occupancy or service to be available (or how long the community can reasonably accommodate that occupancy or service being unavailable)?
- Does the functional recovery time needed for various occupancies and services vary dependent on hazard level or is it consistent regardless of hazard level?
  - For example, would a particular occupancy or service need to have the same functional recovery time for a very large, but rare, catastrophic earthquake (for which a long functional recovery time might be acceptable given the scale and probability of the event happening) that it needs to have for a small, frequent earthquake (for which quick reoccupancy and functional recovery times might be expected to be reasonably short)?
  - Or, is the functional recovery time consistent for some occupancies because the service being provided is always needed (or not needed) to be available within a certain time (whether short or long) after any size earthquake?
- How does the uncertainly of the methodology to calculate functional recovery time, including effects of impeding factors and externalities, affect the determination of appropriate functional recovery time targets for various occupancies and services?
  - How is the selection of target functional recovery time affected by impact on the community if a building does not meet the target?
  - How acceptable is it to exceed the target functional recovery time?
- What common minimum target functional recovery times can be established that should be consistent across most communities based on basic human needs?
  - What guidance can be developed for how these common minimums could be modified by a jurisdiction to meet the unique recovery needs and priorities of that jurisdiction?
  - How do the new functional recovery performance objectives get communicated to improve understanding of what performance should be expected and preparedness to respond and recovery given that performance?
  - From the perspective of achieving improved community resilience, can functional recovery design provisions be developed over time that start with "first generation" provisions which provide improved functional recovery time compared to current safety-based provisions and involve longer-term efforts to develop future versions of the provisions that achieve specific functional recovery times needed (not just provide better than what we get currently)?

In completing these tasks, the subcommittee is expected to leverage work already completed by other groups that has been documented in available publications, including the FEMA-NIST report, FEMA P-2055, NIST SP-1269, the ATC-138 project, the NIST CRPG, efforts by SPUR, current NIST projects, and other

publications. Significant interaction and some iteration are expected to be necessary between all subcommittees as TS #3 develops target functional recovery times for various occupancies and services.

2.2.4. TS#4: Prescriptive provisions for each Functional Recovery Category

This Topic Subcommittee will work to develop design provisions for new buildings to meet the functional recovery time objective assigned to each functional recovery category and will therefore be in close coordination with TS #2 and TS #3 in particular. This effort will use the functional recovery time methodology developed by the ATC-138 project to quantify functional recovery time expectations for various buildings designed to current code provisions and then explore ways to revise those provisions, when/if needed, to improve functional recovery time for certain buildings to meet the intended objectives. This group will also consider design approaches already implemented voluntarily by certain designers, owners, and jurisdictions, as well as strategies identified in other work including FEMA P-2090 / NIST SP-1254, current NIST projects, and the "Resilience-based Design" Resource Paper from the *2020 NEHRP Provisions*. TS #4 will also work closely with TS #5 regarding setting performance objectives relative to hazard level, as discussed in more detail below.

The subcommittee will consider, and propose answers to, relevant questions such as:

- What do current safety-based design provisions (e.g., current ASCE 7 and IBC provisions) provide in terms of functional recovery time?
- Are the results from real building designs (with reasonable levels of overstrength, redundancy, etc.) similar to results from academic studies?
- Can use of better Risk Category criteria (i.e., Risk Category IV instead of Risk Category II) provide improved and acceptable functional recovery time even if not meeting specific, aspirational target functional recovery time?
- What new criteria should be used to improve functional recovery time or to meet specific functional recovery time targets?
  - While RP-1 from Part 3 of *2020 NEHRP Provisions* contained a table with some hypothetical design requirement concepts related to functional recovery time (repeated as Table 2 above), that table was simply intending to provide an illustration of the concepts and some preliminary considerations. TS #4 will need to take the idea and further develop it particularly given the development of the ATC-138 methodology. A number of differences should be expected between the hypothetical ideas and targets presented in the RP-1 table and the final proposal for the *2026 NEHRP Provisions*.
- How does uncertainty of impeding factors influence results?
- How should appropriate reliability or confidence parameters be established?
  - What should the confidence level be?

  - Is the same confidence level appropriate for all buildings or do some buildings warrant higher confidence?
  - For example, when using the ATC-138 methodology to calculate expected functional recovery time based on certain set of design criteria, should mean or median results be used or should a higher degree of confidence be used for some or all buildings (e.g., 90th percentile results)?
- When high reliability or confidence is desired for a certain building or occupancy type, what provisions can be developed regarding the need for back-up lifeline systems to address the uncertainty associated with factors beyond the control of the building designer or building owner?
  - Serviceability of lifeline systems is critical to support basic intended functions of a building, particularly when a short functional recovery time is needed such that unplanned alternative sources may not be readily available. While consideration of reliability of lifelines is beyond the scope of the *2026 NEHRP Provisions* and the FR TC, TS #4 may consider developing requirements for back-up lifeline systems for buildings that warrant a high degree of confidence that utility services will be available, even if through stand-by back-up systems for a short amount of time to allow for alternative sources to be established until regular delivery is resumed.
- Can recommendations or provisions for better quality assurance and quality control programs (construction inspection, plan reviews, etc.) be developed and implemented that can quantifiably improve functional recovery time?
- What recommendations or provisions might be developed regarding the use of innovative structural and nonstructural systems that provide cost-effective damage reduction and therefore improve functional recovery time?
- What recommendations or provisions might be developed regarding how pre-earthquake recovery planning and/or post-earthquake alternative solutions can improve functional recovery time?

In completing these tasks, the subcommittee is expected to leverage work already completed by other groups that has been documented in available publications, including the FEMA-NIST report, the ATC-138 project, RP-1 from Part 3 of *2020 NEHRP Provisions*, current NIST projects, and other publications. Significant interaction and some iteration are expected to be necessary between all subcommittees as TS #4 develops design provisions for each Functional Recovery Category.

2.2.5. TS #5: Hazard level(s) applicable for functional recovery objectives

This Topic Subcommittee will explore the hazard level(s) applicable for functional recovery performance objectives. The FEMA P-2090 / NIST SP-1254 report includes a discussion about hazard level for functional recovery and mentioned three options: a uniform-hazard approach (possibly considering single or multiple hazard levels and possible different performance targets for each per Table B-2 from that report), a risk-based approach similar to the approach used for safety-based objectives in current codes, or a

scenario-based approach for regions with well-defined risk on a known fault. These options were explored further during FEMA's Functional Recovery Workshop in August 2022. The participants in the workshop were interested in exploring a risk-based approach for functional recovery, with the understanding that a singular design hazard could be used and that additional discussion may be needed to understand what functional recovery times are provided at certain hazard levels by a risk-based approach. On these topics, TS #5 will need to work closely with TS #3 and TS #4. The collaboration with TS #3 will be focused on understanding whether a risk-based approach needs to explicitly address risk associated with meeting or exceeding specific functional recovery time targets at different hazard levels, or whether a risk-based approach could instead address risk of meeting or exceeding a functional recovery time target over the life of the building given the probabilities of being subjected to different earthquake ground motion intensities, whether or not that still, but implicitly, provides specific functional recovery times at different hazard levels. Once the risk-based performance targets are understood, TS #5 will likely be iterating with TS #4 regarding the selection of a singular design ground motion parameter that will result in an acceptable level of risk when used in combination with other design criteria being established by TS #4.

The subcommittee will consider, and propose answers to, relevant questions such as:

- Should functional recovery performance objectives be established using a risk-based approach or using an approach based on hazard level?
  - A risk-based performance objective would generally be written in the form of: some X probability (low?) of exceeding target functional recovery time of Y days (averaged acceptable functional recovery time, not necessarily hazard-specific) across Z years (e.g., 50 years)
  - A performance objective would generally be written in the form of: T number of days for a H hazard level
- If using an approach based on hazard level, at what hazard level(s) should functional recovery time targets be established and do those targets vary with hazard level?
  - Should functional recovery performance objectives be established as Tn days for Hn hazard level?
  - How many 'n' number of target times and hazard levels are appropriate?
  - This will be informed by work being done by TS #3.
- If using a risk-based approach, how is the acceptable level of risk (probability of exceedance) established? And consistent with current seismic performance criteria in ASCE 7?
- If using a risk-based approach, do specific hazard-level functional recovery time targets need to be explicitly satisfied or is it acceptable to consider these only implicitly or generally?
- Regardless of whether the performance objective is risk-based or based on hazard level, what ground motion parameter(s) should be used in the design criteria in order to meet the stated performance objective(s)?

  - The goal is to be able to provide a singular ground motion parameter for design so that the engineering calculation procedures mimic current safety-based procedures, even if design parameters have different numerical value and/or if acceptance criteria have different limits.
  - This will be informed by work being done by TS #4.
- How does cost-benefit analysis affect risk-basis and/or hazard levels used for functional recovery performance objectives?

In completing these tasks, the subcommittee is expected to leverage work already completed by other groups that has been documented in available publications, including the FEMA-NIST report, the ATC-138 project, current NIST projects, USGS expertise, and other publications. Significant collaboration, and some degree of iteration, is expected to be needed between TS #5, TS #4, and TS #3 regarding these concepts.

3. Recommendations for Deliverables to PUC

Based on the conversations of the Functional Recovery Planning Committee, the Functional Recovery Task Committee is charged with developing technical proposals and other resources regarding functional recovery for the *2026 NEHRP Provisions* that will also serve as source material for proposals for possible adoption and use in model codes and standards for new buildings such as ASCE 7 and IBC. The intent is for functional recovery provisions to be in a stand-alone format for ease of adoption and implementation, to be written such that compliance with current life-safety provisions is maintained, and to only supplement current provisions when better functional recovery time is needed compared to what those life-safety provisions would yield. Final content of the proposals, and intended location for placement within the *2026 NEHRP Provisions*, will depend on the technical and policy deliberations of the FR TC and its subcommittees and the progress that can be made in the available time. The goal is for the FR TC to be able to develop as much as possible in a timeframe that allows for proposals to be submitted in time for consideration in the next development cycles of ASCE 7 and IBC, even if those deadlines are beyond the control of the PUC. The FR TC intends to consider appropriate technical design provisions needed for functional recovery as well as the aspects of targeted or limited implementation to all or only selected buildings, even if some decisions about whether the conditions of implementation are mandatory or voluntary may be left to the PUC or other codes and standards development groups. A detailed description of the current scope of deliverables is provided below.

Parts 1 & 2 – Provisions & Commentary (mainly for TS #1, #4, & #5, partly for TS #2 & #3)

- Proposed new, stand-alone Chapter or Appendix for the *2026 NEHRP Provisions* that addresses "Design for Functional Recovery" and would be suitable to be submitted for consideration during next development cycle for ASCE 7, which could ultimately be adopted by reference into a future version of the International Building Code.
  - Includes definitions of key terms, possibly as additions or revisions to definitions in ASCE 7 Chapter 11
  - Includes a functional recovery category table appropriate for use within the context of ASCE 7
  - Addresses design criteria in a stand-alone set of provisions that possibly revises, or replaces, otherwise applicable sections of ASCE 7 (particularly ASCE 7 Chapters 11, 12, & 13), for example:
    - "Modify Section 11.4.4 Design Spectral Acceleration Parameters as follows:"
    - "Replace Table 12.12-1 Allowable Story Drift with the following table:"
    - "Modify Section 13.1.3 Component Importance Factor as follows:"
  - Addresses potential QA/QC criteria, possibly as revisions to / replacement of otherwise applicable sections of ASCE 7, particularly ASCE 7 Chapters 11, 12, 13, & 14), for example
    - "Modify Section 11.1.5 Quality Assurance as follows:"

- "Modify Section 13.2.3 Special Certification Requirements for Designated Seismic Systems as follows:"

- Addresses potential coordination with other provisions, possibly as revisions to ASCE 7 Chapter 1 (and others), for example:
  - Table 1.5-1 Risk Category of Buildings and Other Structures… (and potential new Functional Recovery Category table)
  - Table 1.5-2 Importance Factors
  - Other provisions related to reliability, serviceability, functionality, etc.

Part 3 – Resources (mainly for TS #2 & #3, but available to any TS to provide additional material to support Part 1 and 2 proposals or to address topics not covered in Parts 1 and 2)

- Potential resource paper(s) with proposed revisions to content within the International Building Code (IBC) and/or a proposed new Appendix for IBC to address "Design for Functional Recovery", either as a complementary resource to the Parts 1 and 2 proposals or as a complete stand-alone resource that is not dependent on the Parts 1 and 2 proposals.
  - Potential new Functional Recovery Categories and/or revisions to IBC Risk Categories, presented in "alternative" provisions (but written in mandatory code language), for example:
    - Revisions to IBC Table 1604.5 "Risk Category of Buildings and Other Structures" and/or addition of New Functional Recovery Category Table
  - Potential revisions to other sections of IBC Chapter 16 and Chapter 17
  - Potential stand-alone appendix that includes the proposed provisions from Part 1 and 2 for ease of inclusion within the IBC (whether for mandatory or voluntary adoption by a jurisdiction)
- Potential resource paper(s) with additional content, context, commentary, or perspective regarding the concepts included in the proposals for Parts 1 and 2 or additional topics

The development of the NEHRP Provisions is limited to consideration of functional recovery for the design of new buildings. No additional funding has been provided to the NEHRP agencies, within the 2018 Reauthorization or otherwise, to develop and advance concepts related to functional recovery. Therefore, any work done to consider functional recovery performance objectives and design criteria for new buildings within the development of the NEHRP Provisions will be almost exclusively a volunteer effort. Clearly, additional resources from the federal government as well as engagement from many industry stakeholder groups will be needed to ultimately improve community resilience through functional recovery concepts that are advanced to consider other hazards in addition to earthquakes, appropriate performance objectives and retrofit strategies for existing construction, and consideration of lifeline infrastructure systems in addition to buildings.

Appendix A: Functional Recovery Planning Committee Participants

MEMBERS	RELEVANT CONNECTIONS
Ryan Kersting, Buehler and FRPC Chair	PUC, FEMA/NIST Report, SEAOC, NCSEA, ATC
Abbie Liel, Univ. of Colorado Boulder	PUC, ATC 138, NIST
Bob Pekelnicky, Degenkolb Engineers	PUC, ASCE 7, ASCE 41, SPUR, NIST CRPG
Bret Lizundia, Rutherford+Chekene	PUC, FEMA P-2191, FEMA P-2055, UCSF & UCB Seismic Review Panels, Enhanced Design Experience,
Curt Haselton, CSU-Chico / HBRG	FEMA P-58, ATC 138, SP3, SEAOC Resilience
David Bonowitz, DBSE	2020 NEHRP Resource Paper, FEMA-NIST Report, EERI, SPUR, EQFR Roundtable
Emily Guglielmo, Martin/Martin	PUC, FEMA P-2191, ASCE 7, SEAOC, NCSEA
Greg Soules, CB&I Storage Solutions	PUC, ASCE 7, Lifelines Infrastructure, Nonbuilding Structures
Jeff Soulages, Intel	FEMA-NIST Report, OSSPAC
Jon Heintz, Applied Technology Council	PUC, ATC 138/150/152, FEMA-NIST Report
Kevin Moore, Simpson Gumpertz & Heger	NCSEA Resilience, ASCE 7, SEAOC
Laurie Johnson, LJ Consulting & CEA	EERI, formerly ACEHR, FEMA P-2055, HayWired, CEA, SPUR, ATC 150/152, Urban planning for FR
Lucy Arendt, SNC College of Business	FEMA-NIST Report, ATC 150, EERI, ACEHR

MEMBERS	RELEVANT CONNECTIONS
	Social/financial decision-making for FR
Ron Hamburger, Simpson Gumpertz & Heger	FEMA-NIST Report, FEMA P-58, ATC 138, ASCE 7 PBD project experience with enhanced goals
Steve Winkel, Preview Group	AIA, FEMA SCSC, VA Tornado, CA BSC Fire, life-safety, accessibility code consultant
LIAISONS	**REPRESENTING / RELEVANT CONNECTIONS**
John Hooper, MKA and PUC Chair	PUC, ASCE 7
Jiqiu (JQ) Yuan, NIBS and BSSC Ex. Dir.	NIBS, BSSC, Multi-hazard Mitigation Council
Mai (Mike) Tong, FEMA Project Officer	FEMA, NEHRP
Christina Aronson, FEMA	FEMA, NEHRP
Bob Hanson, FEMA Advisor	FEMA, NEHRP
Mike Mahoney, FEMA (retired)	FEMA, NEHRP, FEMA-NIST Report
Charlie Carter, AISC	AISC, BSSC Board
Kent Yu, SEFT Consulting	BSSC Board, ASCE Infrastructure Resilience, Oregon Resilience Plan, NIST CRPG, FEMA-NIST Report
Steve McCabe, NIST	NIST NEHRP Office, FEMA-NIST Report
Siamak Sattar, NIST	NIST Earthquake Eng. Group, FEMA-NIST Report

MEMBERS	RELEVANT CONNECTIONS
Therese McAllister, NIST	NIST Community Resilience Group
Nico Luco, USGS	USGS National Seismic Hazard Model Team
Sanaz Rezaeian, USGS	USGS National Seismic Hazard Model Team
Andrew Makdisi, USGS	USGS National Seismic Hazard Model Team

Appendix B. Relevant Functional Recovery Resources

ATC 58-7: Proceedings of FEMA-sponsored workshop on functional recovery (2022)
https://www.atcouncil.org/docman/atc-publications/327-atc-58-7-fr-workshop-report-2022-2/file

ATC-138-3, Seismic Performance Assessment of Buildings, Volume 8 – Methodology for Assessment of Functional Recovery Time, Preliminary Report (September 2021)
http://femap58.atcouncil.org/documents/fema-p-58/34-atc-138-3-volume-8-methodology-for-assessment-of-functional-recovery-time/file

EERI White Paper: Functional Recovery: A Conceptual Framework with Policy Options
https://www.eeri.org/images/archived/wp-content/uploads/EERI-Functional-Recovery-Conceptual-Framework-White-Paper-201912.pdf (December 2019)

FEMA E-74: "Reducing the Risks of Nonstructural Earthquake Damage – A Practical Guide" (ATC-69 project)
https://fema.gov/sites/default/files/2020-07/fema_earthquakes_reducing-the-risks-of-nonstructural-damage-a-practical-guide-fema-e-74.pdf

FEMA P-58: Seismic Performance Assessment of Buildings Volumes 1-7
https://femap58.atcouncil.org/reports

FEMA P-1019: "Emergency Power Systems for Critical Facilities: A Best Practices Approach to Improving Reliability"
https://www.wbdg.org/ffc/dhs/criteria/femap1019

FEMA P-2055: "Post-disaster Building Safety Evaluation Guidance: Report on the Current State of Practice, including Recommendations Related to Structural and Nonstructural Safety and Habitability"
https://www.fema.gov/sites/default/files/2020-07/fema_p-2055_post-disaster_buildingsafety_evaluation_2019.pdf (November 2019)

FEMA P-2082-2 RP1: "NEHRP Recommended Seismic Provisions for New Buildings and Other Structures, Volume II: Part 3 Resource Papers, Resource Paper 1 – Resilience-based Design and the NEHRP Provisions"
https://www.fema.gov/sites/default/files/2020-10/fema_2020-nehrp-provisions_part-3.pdf

FEMA P-2090 / NIST SP-1254: "Recommended Options for Improving the Built Environment for Post-Earthquake Reoccupancy and Functional Recovery Time"
https://www.fema.gov/sites/default/files/documents/fema_p-2090_nist_sp-1254_functional-recovery_01-01-2021.pdf (January 2021)

FEMA P-2191: "A Step Forward: Recommendations for Improving Seismic Code Development, Content, and Education" https://www.fema.gov/sites/default/files/documents/fema_p-2191-a-step-forward.pdf (April 2022)

ICC Seismic Functional Recovery Resource "Library"
https://www.iccsafe.org/advocacy/seismic-functional-recovery-resources/

NIST Community Resilience Planning Guide
https://www.nist.gov/community-resilience/planning-guide
https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1190v1.pdf (May 2016)
https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1190v2.pdf (May 2016)

NIST GCR 14-917-33: Earthquake-Resilient Lifelines: NEHRP Research, Development and Implementation Roadmap (ATC-126 project) https://www.nehrp.gov/pdf/nistgcr14-917-33.pdf

NIST GCR 17-917-44: Seismic Analysis, Design, and Installation of Nonstructural Components and Systems – Background and Recommendations for Future Work (ATC-120 project)
https://nvlpubs.nist.gov/nistpubs/gcr/2017/NIST.GCR.17-917-44.pdf

NIST GCR 18-917-43 Recommendations for Improved Seismic Performance of Nonstructural Components (ATC-120 project) https://nvlpubs.nist.gov/nistpubs/gcr/2018/NIST.GCR.18-917-43.pdf

NIST Special Publication SP-1224: "Research Needs to Support Immediate Occupancy Building Performance Objective Following Natural Hazard Events"
https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1224.pdf

NIST Special Publication SP-1269: "NIST-FEMA Post-Earthquake Functional Recovery Workshop Report"
https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1269.pdf (July 2021)

Appendix C. Functional Recovery Planning Committee Presentation to PUC on May 4, 2022

2026 Provisions Update Committee

Functional Recovery Planning Committee Report

May 4, 2022

Ryan Kersting, S.E., Buehler
PUC FR Planning Committee Chair

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PUC FR Planning Committee Report

- Introduce PUC to Functional Recovery
- Overview of Relevant Functional Recovery Work
- Potential Scope of Work and Deliverables for Functional Recovery Task Committee (TC) and Topic Subcommittees (TS)
- Discussion

PUC FR Planning Committee Report

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PUC FR Planning Committee Report

Functional Recovery –

- What is it?
- Why does it matter to PUC?

PUC FR Planning Committee Report

Functional Recovery – What is it?

- Definitions from FEMA-NIST Special Publication:

Functional recovery **is a post-earthquake performance state in which a building or lifeline infrastructure system is maintained, or restored, to safely and adequately support the basic intended functions associated with the pre-earthquake use or occupancy of a building, or the pre-earthquake service level of a lifeline infrastructure system.**

A *functional recovery objective* is functional recovery achieved within an acceptable time following a specified earthquake, where the acceptable time might differ for various building uses and occupancies, or lifeline services.

PUC FR Planning Committee Report

Functional Recovery – What is it?

- Definitions from FEMA-NIST Special Publication:

Functional recovery **is a post-earthquake performance state in which a building or lifeline infrastructure system is maintained, or restored, to safely and adequately support the basic intended functions associated with the pre-earthquake use or occupancy of a building, or the pre-earthquake service level of a lifeline infrastructure system.**

Basic intended functions are less than full pre-earthquake functionality, but more than what would be considered the minimum sufficient for reoccupancy of buildings, or for temporary provision of lifeline services. In simpler terms, functional recovery for a building means it is ready to support most of its pre-earthquake uses in addition to reoccupancy, and for a lifeline infrastructure system means it is ready to provide near-normal basic services, although the system may not be as reliable or resistant to service interruptions.

PUC FR Planning Committee Report

Functional Recovery – What is it?

- Definitions from FEMA-NIST Special Publication:

Functional recovery **is a post-earthquake performance state in which a building or lifeline infrastructure system is maintained, or restored, to safely and adequately support the basic intended functions associated with the pre-earthquake use or occupancy of a building, or the pre-earthquake service level of a lifeline infrastructure system.**

Full recovery is restoration to the pre-earthquake safety and functionality of the building.

Functionality is a measure of how well a building or lifeline infrastructure system operates, delivers its required services, or meets its intended purpose.

PUC FR Planning Committee Report

Functional Recovery – What is it?

- Functional Recovery **≠≠≠≠** Full Recovery

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Functional Recovery – What is it?

- Definition of Functionality from ASCE 7-22 Chap 1:

> **1.3.3 Functionality** Structural systems and members and connections thereof assigned to Risk Category IV shall be designed with reasonable probability to have adequate structural strength and stiffness to limit deflections, lateral drift, or other deformations such that their behavior would not prevent function of the facility immediately following any of the design-level environmental hazard events specified in this standard. Designated nonstructural systems and their attachment to the structure shall be designed with sufficient strength and stiffness such that their behavior would not prevent function immediately following any of the design-level environmental hazard events specified in this standard. Components of designated nonstructural systems shall be designed, qualified, or otherwise protected such

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Functional Recovery – What is it?

- Functional Recovery ~~≠≠≠≠~~ ASCE 7 “Functionality”

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Functional Recovery –

- What is it?
- Why does it matter to PUC?

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Functional Recovery – Why does it matter to PUC?

- 2015 NEHRP Resource Paper
- 2020 NEHRP Resource Paper
- 2018 NEHRP Reauthorization
- FEMA Contract with BSSC for 2026 PUC Cycle

PUC FR Planning Committee Report

Functional Recovery –

- What is it?
- Why does it matter to PUC?

PUC FR Planning Committee Report

- Introduce PUC to Functional Recovery
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- Discussion

PUC FR Planning Committee Report

Overview of Relevant Functional Recovery Work

- 2020 NEHRP Provisions Resource Paper: "Resilience-Based Design and the NEHRP Provisions"
- NIST/FEMA Special Publication FEMA P-2090 / NIST SP-1254: "Recommended Options for Improving… Post-Earthquake… Functional Recovery Time"
- FEMA P-2191: "A Step Forward"

2020 NEHRP Provisions Resource Paper: "Resilience-Based Design and the NEHRP Provisions"

Relevant Concepts & Recommendations

Presentation for PUC Functional Recovery Planning Committee

2020 NEHRP Resource Paper

1.1. Federal policy now calls for increasing earthquake resilience at the community scale and identifies building codes and standards as tools for doing so.

1.2. Key Concepts

A functional recovery standard is necessary for resilience-based earthquake design. Resilience relies on the timely recovery of the built environment. Building codes and standards can therefore serve a resilience goal by providing design criteria based on functional recovery time.

2020 NEHRP Resource Paper

2. A framework for NEHRP Provisions for resilience-based design

The NEHRP Provisions can support resilience-based design by providing source material for a functional recovery standard. Specific design strategies and criteria would be required for different functional recovery times, much in the same way that the current Provisions set specific criteria for different seismic design categories. While many questions remain to be answered through research, the current Provisions suggest a set of requirements that might be used in the short term.

2020 NEHRP Resource Paper

Figure 2. Hypothetical prescriptive design requirements for a range of functional recovery times

Functional Recovery Design Requirement	Target Functional Recovery Time, T_{target}			
	1 Hour	1 Day	1 Week	1 Month
Structural				
Limits on lateral system selection	Required	Required	Required	–
Limits on drift	Required	Required	Required	–
Factor on required strength	Required	Required	–	–
etc.	...	...	...	...
Nonstructural				
Increased bracing scope	Required	Required	Required	–
Reliability factors on design strength	Required	Required	–	–
Ruggedness certification	Required	Required	–	–
etc.	...	...	...	...
Recovery-critical contents				
To be determined by user groups	Required	Required	...	...
etc.	...	...	...	...

Functional Recovery Design Requirement	Target Functional Recovery Time, T_{target}			
	1 Hour	1 Day	1 Week	1 Month
Utility service				
Electricity backup	Required	Required	Required	–
Potable water backup	Required	Required	Required	Required
Wastewater alternative	Required	–	–	–
Telecommunications	Required	–	–	–
etc.	...	...	...	...
Reoccupancy and recovery planning				
Repair services on retainer	Moot	Required	Required	–
Pre-determined safety evaluation protocol	Moot	Required	–	–
Business continuity plan	Required	Required	–	–
Pre-defined permit application	Moot	Required	Required	–
etc.	...	...	...	...

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2020 NEHRP Provisions Resource Paper: "Resilience-Based Design and the NEHRP Provisions"

Relevant Concepts & Recommendations

Presentation for PUC Functional Recovery Planning Committee

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FEMA-NIST Functional Recovery Report (FEMA P-2090 / NIST SP-1254)

Relevant Concepts & Recommendations

Presentation for PUC Functional Recovery Planning Committee

Ryan Kersting, S.E., Buehler
FEMA-NIST Project Team: SEAOC Rep and PTP Chair

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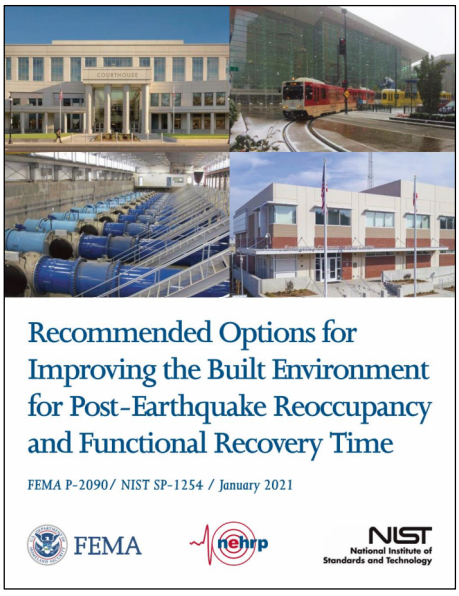
FEMA-NIST FR Report | Schedule & Milestones



- FEMA P-2090 / NIST SP-1254

- Committee Formed 6/2019
- Stakeholder Workshops 2/2020
- Review Panel Complete 3/2020
- Committee Complete 5/2020
- Published 1/2021

- https://www.fema.gov/sites/default/files/documents/fema_p-2090_nist_sp-1254_functional-recovery_01-01-2021.pdf

FEMA-NIST FR Report | Definitions

Functional recovery **is a post-earthquake performance state in which a building or lifeline infrastructure system is maintained, or restored, to safely and adequately support the basic intended functions associated with the pre-earthquake use or occupancy of a building, or the pre-earthquake service level of a lifeline infrastructure system.**

A *functional recovery objective* is functional recovery achieved within an acceptable time following a specified earthquake, where the acceptable time might differ for various building uses and occupancies, or lifeline services.

Reoccupancy is a post-earthquake performance state in which a building is maintained, or restored, to allow safe re-entry for the purposes of providing shelter or protecting building contents.

A *reoccupancy objective* is reoccupancy achieved within an acceptable time following a specified earthquake, where the acceptable time might differ for various building uses and occupancies.

FEMA-NIST FR Report | Recommendations

#1: Develop a Framework for Post-Earthquake Reoccupancy and Functional Recovery Objectives

#2: Design New Buildings to Meet Recovery-Based Objectives

#3: Retrofit Existing Buildings to Meet Recovery-Based Objectives

#4: Design, Upgrade, and Maintain Lifeline Infrastructure Systems to Meet Recovery-Based Objectives

#5: Develop and Implement Pre-Disaster Recovery Planning Focused on Recovery-Based Objectives

#6: Provide Education and Outreach to Enhance Awareness and Understanding of Earthquake Risk and Recovery-Based Objectives

#7: Facilitate Access to Financial Resources Needed to Achieve Recovery-Based Objectives

FEMA-NIST FR Report | Recommendations

#1: Develop a Framework for Post-Earthquake Reoccupancy and Functional Recovery Objectives

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FEMA-NIST FR Report | Recommendations

#1: Develop a Framework for Post-Earthquake Reoccupancy and Functional Recovery Objectives

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#6: Provide Education and Outreach to Enhance Awareness and Understanding of Earthquake Risk and Recovery-Based Objectives

#7: Facilitate Access to Financial Resources Needed to Achieve Recovery-Based Objectives

FEMA-NIST FR Report | Recommendation #1

#1: Develop a Framework for Post-Earthquake Reoccupancy and Functional Recovery Objectives

Tasks

- Develop a policy for recovery-based objectives
  - Target recovery times for key functions / services
  - May vary for new and existing buildings / systems
- Develop design criteria for recovery-based objectives
  - Separate but parallel for buildings and lifelines
- Determine appropriate hazard level(s)

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FEMA-NIST FR Report | Recommendation #1

#1: Develop a Framework for Post-Earthquake Reoccupancy and Functional Recovery Objectives

- What recovery time is needed for what functions and services to meet community resilience goals?
  - Target recovery time is related to when those functions and services are needed in the overall community recovery spectrum

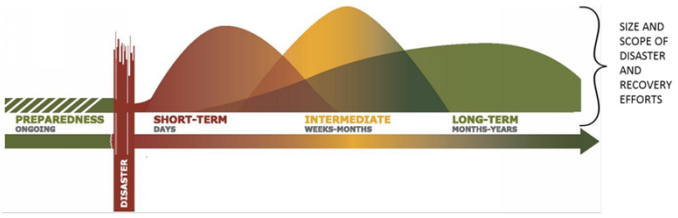

Figure 4-1: National Disaster Recovery Framework (NDRF) recovery continuum [FEMA 2011]

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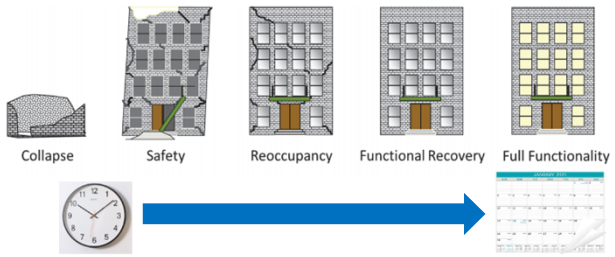
FEMA-NIST FR Report | Recommendation #1

#1: Develop a Framework for Post-Earthquake Reoccupancy and Functional Recovery Objectives

- What recovery time is needed for what functions and services to meet community resilience goals?
  - Not all functions and services need quick recovery, but what are essential or critical to recovery for today's communities?



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FEMA-NIST FR Report | Recommendation #1

#1: Develop a Framework for Post-Earthquake Reoccupancy and Functional Recovery Objectives

- What design criteria will achieve desired recovery times?
  - Start with simple approach as comprehensive solutions are developed and refined
  - Use of risk category criteria as interim approach
  - Ultimately envision prescriptive design parameters deemed to meet desired recovery times
    - Recovery-based importance factor, system coefficients and factors (Table 12.2-1), drift limits, structural and nonstructural detailing requirements, utilities, etc.
  - Transition to use of Functional Recovery Categories

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FEMA-NIST FR Report | Recommendation #1

#1: Develop a Framework for Post-Earthquake Reoccupancy and Functional Recovery Objectives

Table B-1 Conceptual Functional Recovery Categories for a Design Hazard Level

Functional Recovery Category	Target Functional Recovery Time	Recovery Phase and Associated Functions and Services (1)	Examples of Buildings and Lifeline Infrastructure Systems
Functional Recovery Category A (FRC-A)	Hours (or Less)	Near-Term (Nearly Immediate) and Emergency Response – rescue, safety, security, and event stabilization	Emergency and first-responder facilities (e.g., hospitals, fire and police stations), designated shelters, emergency operations centers, and lifeline infrastructure systems supporting emergency response (e.g., power, communication, critical transportation)
Functional Recovery Category B (FRC-B)	Days to Weeks	Short-Term – shelter, governance, daily necessities, and care for vulnerable populations	Single- and multi-family residential, local government, schools, outpatient medical facilities, nursing homes, critical retail (e.g., food distribution, pharmacy, home improvement), and lifeline infrastructure systems supporting short-term activities
Functional Recovery Category C (FRC-C)	Weeks to Months	Intermediate-Term – restoration of neighborhood activities and economic vitality	Critical business enterprises, possibly exceeding a certain size threshold, and lifeline infrastructure system services supporting intermediate-term activities
Functional Recovery Category D (FRC-D)	Months to Years	Long-Term – cultural, quality of life, and leisure activities	Buildings not assigned to other categories, possibly including less critical business enterprises, less-critical retail, entertainment, leisure, and cultural facilities, and lifeline infrastructure system services supporting long-term activities

Note 1: Recovery phases refer to the FEMA National Disaster Recovery Framework, Second Edition (FEMA, 2016)

FEMA-NIST FR Report | Recommendation #1

#1: Develop a Framework for Post-Earthquake Reoccupancy and Functional Recovery Objectives

- What hazard level(s) should be used for recovery-based objectives?
  - Risk-based?
  - Scenario-based?
  - National, regional, local or individual perspective?

FEMA-NIST FR Report | Recommendation #1

#1: Develop a Framework for Post-Earthquake Reoccupancy and Functional Recovery Objectives

- What recovery times should be targeted for different hazard levels (return periods)?

Table B-2 Possible Functional Recovery Times for Different Earthquake Hazard Levels

Functional Recovery Category	Earthquake Hazard Level (Frequency of Occurrence)		
	Frequent (return period of 50-100 years)	Design (return period of 300-700 years)	Maximum Considered (return period of 1,000-3,000 years)
Functional Recovery Category A (FRC-A)	Hours (or less)	Hours (or less)	Days to Weeks
Functional Recovery Category B (FRC-B)	Hours to Days	Days to Weeks	Weeks to Months
Functional Recovery Category C (FRC-C)	Days to Weeks	Weeks to Months	Months to Years
Functional Recovery Category D (FRC-D)	Weeks to Months	Months to Years	Years

FEMA-NIST FR Report | Recommendation #2

#2: Design New Buildings to Meet Recovery-Based Objectives

Alternatives

- Mandate the design of new buildings to meet recovery-based objectives using future national model codes
- Mandate the design of new buildings to meet recovery-based objectives using interim provisions
  - Use of Risk Category IV to achieve quicker recovery for a broader class of buildings
- Encourage the voluntary design of new buildings to meet recovery-based objectives
  - Federal and/or SLTT programs can lead by example and/or provide incentives

FEMA-NIST FR Report | The Path Forward

- **Coordinated action across all recommendations**

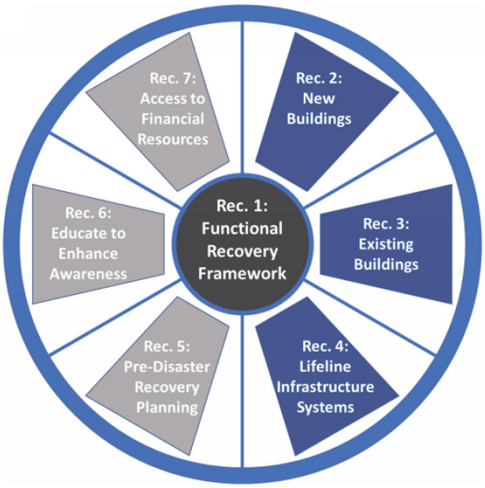

Figure 7-1 Interactions among the recommendations.

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FEMA-NIST Functional Recovery Report (FEMA P-2090 / NIST SP-1254)

Key Concepts & Recommendations

Presentation for PUC Functional Recovery Planning Committee

Ryan Kersting, S.E., Buehler
FEMA-NIST Project Team: SEAOC Rep and PTP Chair

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FEMA P-2191:
"A Step Forward: Recommendations for Improving Seismic Code Development, Content, and Education"

Relevant Concepts & Recommendations

Presentation for PUC Functional Recovery Planning Committee

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FEMA P-2191 "A Step Forward" | FR Topics

Priority	ID	Recommendation	Responsibility	Funding Needed?	Near-term?
Improve Code Content and Ease of Use					
High	C1	Address functional recovery and enhanced resilience in model code framework	PUC, BSSC, NEHRP agencies	Yes	No
	C2	Make low and moderate seismic provisions more usable	PUC, ASCE	Yes	No
Medium	C3	Develop more usable performance-based procedures for design	PUC, ASCE, Material groups	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

FEMA P-2191 “A Step Forward” | FR Topics

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

FEMA P-2191 “A Step Forward” | FR Topics

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

FEMA P-2191 “A Step Forward” | FR Topics

Who Has Capacity/Responsibility for the Recommendation?

- BSSC would lead the pilot project and organize the coalition.
- 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.

FEMA P-2191 “A Step Forward” | FR Topics

Applicability to Model Codes:

- 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.
- 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.

FEMA P-2191 “A Step Forward” | FR Topics

Suggestions:

- Don’t reinvent the wheel, particularly with terminology.
- Decide how far we should go (if at all) beyond building code (structural and nonstructural) design provisions.
- Take on-going research and translate into the building code.
- Develop meaningful, practical technical provisions judged to meet functional recovery objectives.

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FEMA P-2191: “A Step Forward: Recommendations for Improving Seismic Code Development, Content, and Education”

Relevant Concepts & Recommendations

Presentation for PUC Functional Recovery Planning Committee

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Relevant Functional Recovery Work Current/Ongoing

- FEMA / ATC 138 FR Project
- NIST FR projects
- EQ FR Roundtable
- ICC RC IV Code Change Proposals
- ICC Performance Code re-write

PUC FR Planning Committee Report

Additional Functional Recovery Resources

- 2020 NEHRP Provisions Resource Paper: "Resilience-Based Design and the NEHRP Provisions" https://www.nibs.org/files/pdfs/NIBS_BSSC_NEHRPResilience_Based_Design.pdf (February 2020)
- NIST/FEMA Special Publication FEMA P-2090 / NIST SP-1254: "Recommended Options for Improving the Built Environment for Post-Earthquake Reoccupancy and Functional Recovery Time" https://www.fema.gov/sites/default/files/documents/fema_p-2090_nist_sp-1254_functional-recovery_01-01-2021.pdf (January 2021)
- FEMA P-2191: "A Step Forward: Recommendations for Improving Seismic Code Development, Content, and Education" https://www.fema.gov/sites/default/files/documents/fema_p-2191-a-step-forward.pdf (April 2022)
- EERI White Paper: Functional Recovery: A Conceptual Framework with Policy Options https://www.eeri.org/images/archived/wp-content/uploads/EERI-Functional-Recovery-Conceptual-Framework-White-Paper-201912.pdf (December 2019)
- FEMA P-2055: "Post-disaster Building Safety Evaluation Guidance: Report on the Current State of Practice, including Recommendations Related to Structural and Nonstructural Safety and Habitability" https://www.fema.gov/sites/default/files/2020-07/fema_p-2055_post-disaster_buildingsafety_evaluation_2019.pdf (November 2019)
- NIST Special Publication SP-1269: "NIST-FEMA Post-Earthquake Functional Recovery Workshop Report" https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1269.pdf (July 2021)
- NIST Community Resilience Planning Guide https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1190v1.pdf (May 2016) https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1190v2.pdf (May 2016)
- ICC Seismic Functional Recovery Resource "Library" https://www.iccsafe.org/advocacy/seismic-functional-recovery-resources/
- FEMA E-74
- ATC 120

PUC FR Planning Committee Report

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- Discussion

PUC FR Planning Committee Report

PUC Functional Recovery Plan

Pre-kickoff meeting (prior to May 3, 2022):

- Functional Recovery Planning Committee

Post-kickoff meeting (after May 4, 2022):

- Functional Recovery Task Committee (TC)
  - Topic Subcommittees (TS)

PUC FR Planning Committee Report

Functional Recovery Planning Committee

MEMBERS	RELEVANT CONNECTIONS
Ryan Kersting, Buehler and FRPC Chair	PUC, FEMA/NIST SP, SEAOC, NCSEA, ATC
Abbie Liel, Univ. of Colorado Boulder	PUC, ATC 138, NIST
Bob Pekelnicky, Degenkolb Engineers	PUC, ASCE 7, ASCE 41, SPUR, NIST CRPG
Bret Lizundia, Rutherford+Chekene	PUC, FEMA P-2191, FEMA P-2055, UCSF & UCB Seismic Review Panels, Enhanced Design Experience,
Curt Haselton, CSU-Chico / HBRG	FEMA P-58, ATC 138, SP3, SEAOC Resilience
David Bonowitz, DBSE	2020 NEHRP Resource Paper, FEMA-NIST SP, EERI, SPUR, EQFR Roundtable
Emily Guglielmo, Martin/Martin	PUC, FEMA P-2191, ASCE 7, SEAOC, NCSEA
Greg Soules, CB&I Storage Solutions	PUC, ASCE 7, Lifelines Infrastructure, Nonbuilding Structures
Jeff Soulages, Intel	FEMA/NIST SP, OSSPAC
Jon Heintz, Applied Technology Council	PUC, ATC 138/150/152, FEMA/NIST SP
Kevin Moore, Simpson Gumpertz & Heger	NCSEA Resilience, ASCE 7, SEAOC
Laurie Johnson, LJ Consulting & CEA	EERI, formerly ACEHR, FEMA P-2055, HayWired, CEA, SPUR, ATC 150/152, Urban planning for FR
Lucy Arendt, SNC College of Business	FEMA-NIST SP, ATC 150, EERI, ACEHR Social/financial decision-making for FR
Ron Hamburger, Simpson Gumpertz & Heger	FEMA-NIST SP, FEMA P-58, ATC 138, ASCE 7 PBD project experience with enhanced goals
Steve Winkel, Preview Group	AIA, FEMA SCSC, VA Tornado, CA BSC Fire, life-safety, accessibility code consultant

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PUC FR Planning Committee Report

Functional Recovery Planning Committee

LIAISONS	REPRESENTING / RELEVANT CONNECTIONS
John Hooper, MKA and PUC Chair	PUC, ASCE 7
Jiqiu (JQ) Yuan, NIBS and BSSC Ex. Dir.	NIBS, BSSC Board, Multi-hazard Mitigation Council
Mai (Mike) Tong, FEMA	FEMA
Christina Aronson, FEMA	FEMA
Bob Hansen, FEMA SME	FEMA
Mike Mahoney, FEMA	FEMA
Charlie Carter, AISC and BSSC Chair	AISC, BSSC Board
Kent Yu, SEFT Consulting and BSSC Board	BSSC Board, ASCE Infrastructure Resilience, Oregon Resilience Plan, NIST CRPG, FEMA-NIST SP
Steve McCabe, NIST	NIST NEHRP Office, FEMA-NIST SP
Siamak Sattar, NIST	NIST Earthquake Eng. Group, FEMA-NIST SP
Therese McAllister, NIST	NIST Community Resilience Group
Nico Luco, USGS	USGS National Seismic Hazard Model Team
Sanaz Rezaeian, USGS	USGS National Seismic Hazard Model Team
Andrew Makdisi, USGS	USGS National Seismic Hazard Model Team

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PUC FR Planning Committee Report

Suggested Topic/Deliverable #1

Define Key Terms and Concepts

- Leverage FEMA-NIST SP, 2020 NEHRP Resource Paper, ATC-138 project, and other publications or current work
  - What is "Functional Recovery?" What is "Reoccupancy?"
  - What is (or what is needed for) "basic intended function" for various occupancies/services? ("Basic intended function" implies something less than full function)
  - What damage is allowed (relates to achieving Functional Recovery)?
  - What temporary fixes are allowed (relates to achieving Functional Recovery)?
  - What are the post-disaster occupancy/habitability requirements (given a "less than perfect" building) and how does these affect functional recovery requirements?
  - How does availability of utility services (accessed or provided beyond the building footprint) affect functional recovery?
    (Possible Part 3 paper on lifeline systems?)

PUC FR Planning Committee Report

Suggested Topic/Deliverable #2

Develop functional recovery categories with appropriate ranges and/or precision of recovery time

- Leverage FEMA-NIST SP, 2020 NEHRP Resource Paper, NIST CRPG, SPUR and other publications or current work
  - How many categories?
  - What is recovery time (or range of time) associated with each?
  - How precise should the time (or range of time) be?
  - Establish targets and precision that represent what engineering can provide or what communities need?

PUC FR Planning Committee Report

Suggested Topic/Deliverable #3

Develop target functional recovery times for various occupancies/services

- Leverage FEMA-NIST SP, Current NIST projects, NIST CRPG, SPUR and other publications or current work
  - What time is needed for what occupancies and services?
  - Establish common minimums that can be modified by local/state priorities
  - Does it have to meet target or just be improved?

PUC FR Planning Committee Report

Suggested Topic/Deliverable #4

Develop prescriptive provisions that meet functional recovery category objectives

- Leverage FEMA-NIST SP, ATC-138 project, Current NIST projects, 2020 NEHRP Resource Paper, and other publications or current work to define/address key concepts
  - Study what current design provisions provide in terms of recovery time and test new criteria to meet FR objectives
  - Consider real building designs (reasonable levels of overstrength, redundancy, etc.)
  - Consider use of Risk Category criteria to provide improved functional recovery even if not providing target functional recovery time
  - Can/should also look at recommendations for QA/QC and adaptive solutions
  - What about need for back-up lifeline systems?
  - Pilot study that takes a design from cradle to grave (critical to test the methodology)

PUC FR Planning Committee Report

Suggested Topic/Deliverable #5

Develop hazard level(s) applicable for functional recovery performance objective(s)

- Leverage FEMA-NIST SP, Current NIST projects, USGS expertise, and other publications or current work to define/address key concepts
  - Similar to current design approach that uses a "design level" as a portion of MCE, that is deemed to provide adequate performance at the MCE as well as some smaller, more frequent events? Or, should specific scenarios for specific communities be considered instead?
  - How does cost-benefit analysis affect hazard level(s) for considering functional recovery?

PUC FR Planning Committee Report

Potential format for final deliverables

Part 1/2 – Provisions & Commentary

- New/Proposed Stand-alone Chapter or Appendix for NEHRP Provisions / ASCE 7 that addresses "Design for Functional Recovery"
  - Includes key terms/definitions, possibly as additions/revisions to ASCE 7
  - Includes a functional recovery category table (detail TBD)
  - Addresses design criteria, possibly as revisions to / replacement of otherwise applicable sections of ASCE 7
  - Addresses potential QA/QC criteria, possibly as revisions to / replacement of otherwise applicable sections of ASCE 7 or IBC
  - Address potential coordination with other provisions, possibly as revisions to ASCE 7 Chapter 1 and/or IBC

PUC FR Planning Committee Report

Potential format for final deliverables

Part 3 – Resources

- Potential revisions to IBC language and/or new Appendix for IBC to address "Design for Functional Recovery"
  - Potential new Functional Recovery Categories and/or revisions to Risk Categories, presented in "alternative" provisions (but written in mandatory code language) and/or possibly as "code change proposal" language
  - Potential revisions to IBC Table 1604.5 "Risk Category of Buildings and Other Structures" and/or addition of New Functional Recovery Category Table
  - Potential revisions to other sections of IBC Chapter 16 and Chapter 17
  - Potential stand-alone appendix that mimics the Part 1/2 concepts

PUC FR Planning Committee Report

- Introduce PUC to Functional Recovery
- Overview of Relevant Functional Recovery Work
- Potential Scope of Work and Deliverables for Functional Recovery Task Committee (TC) and Topic Subcommittees (TS)
- Discussion

PUC FR Planning Committee Report

Suggested Topic/Deliverable #1

Define Key Terms and Concepts

Suggested Topic/Deliverable #2

Develop functional recovery categories with appropriate ranges and/or precision of recovery time

Suggested Topic/Deliverable #3

Develop target functional recovery times for various occupancies/services

Suggested Topic/Deliverable #4

Develop prescriptive provisions that meet functional recovery category objectives

Suggested Topic/Deliverable #5

Develop hazard level(s) applicable for functional recovery performance objective(s)

BUEHLER

Appendix D. Functional Recovery Task Committee Presentation to PUC on August 25, 2022

National Institute of BUILDING SCIENCES™

Functional Recovery Task Committee (TC) & Topic Subcommittees (TS)

Report to PUC Meeting - August 25, 2022

Ryan Kersting & Abbie Liel
Functional Recovery TC Chair and Vice Chair

nehrp FEMA Building Seismic Safety Council

Functional Recovery Task Committee (TC)

Scope:

Consider the topic of functional recovery for the design of new buildings and develop appropriate proposals for the 2026 NEHRP Provisions

- Part 1: Provisions & Part 2: Commentary
- Part 3: Resource Papers).

Organization:

- Task Committee (TC)
  - No more than 20 voting members
  - Approximately 25 corresponding members and liaisons
  - TC Chair: Ryan Kersting
  - TC Vice Chair: Abbie Liel
  - TC Secretary (non-voting): Jakub Valigura
- Five Topic Subcommittees (TS) – discussed later

nehrp FEMA Building Seismic Safety Council

Functional Recovery Task Committee (TC)

Intended Deliverable (as presented to PUC in May, 2022):

Part 1/2 – Provisions & Commentary

- New/Proposed Stand-alone Chapter or Appendix for NEHRP Provisions / ASCE 7 that addresses "Design of New Buildings for Functional Recovery"
  - Includes key terms/definitions, as additions/revisions to ASCE 7
  - Includes a functional recovery category table (detail TBD)
  - Addresses design criteria, as additions/revisions to otherwise applicable sections of ASCE 7
  - Addresses potential QA/QC criteria, as additions/revisions to applicable sections of ASCE 7 or IBC
  - Address potential coordination with other provisions, as revisions to ASCE 7 Chapter 1 and/or IBC

Functional Recovery Task Committee (TC)

Intended Deliverable (as presented to PUC in May, 2022):

Part 3 – Resources

- Potential revisions to IBC language and/or new Appendix for IBC to address "Design of New Buildings for Functional Recovery"
  - Potential new Functional Recovery Categories and/or revisions to Risk Categories, presented in "alternative" provisions (but written in mandatory code language),
  - Potential revisions to IBC Table 1604.5 "Risk Category of Buildings and Other Structures" and/or addition of New Functional Recovery Category Table
  - Potential revisions to other sections of IBC Chapter 16 and Chapter 17
  - Potential stand-alone appendix that mimics the Part 1/2 concepts
  - Likely written as (or adaptable to) "code change proposal" language

Functional Recovery Task Committee (TC)

Voting Members:

- Ryan Kersting* (Chair), Buehler
- Abbie Liel* (Vice Chair), Univ. of Colorado
- Bob Pekelnicky* (PUC Liaison), Degenkolb
- Bret Lizundia*, Rutherford+Chekene
- Daniel Zepeda, Degenkolb
- David Bonowitz*, private consulting
- Emily Guglielmo*, Martin/Martin
- Greg Soules*, CB&I Storage Solutions
- Jeff Soulages*, Intel
- Jon Heintz*, Applied Technology Council
- Jon Siu, private consulting
- Kevin Moore*, SGH
- Lucy Arendt*, SNC School of Business
- Phil Caldwell, private advising
- Ron Hamburger*, SGH
- Steve Winkel*, Preview Group
- Mike Mahoney*, FEMA
- Nico Luco*, USGS
- Siamak Sattar*, NIST

* Indicates member of prior Functional Recovery Planning Committee

Functional Recovery Task Committee (TC)

Corresponding Members:

- Anna Lang, Zylient
- Bonnie Manley, AISI
- Carlos Molina-Hutt, Univ. of British Columbia
- Curt Haselton*, CSU-Chico / HBRG
- Don Scott, private consulting
- Dustin Cook, NIST
- Gary Ehrlich, NAHB
- Jakub Valigura (TC Secretary), Arup
- Jennifer Goupil, ASCE/SEI
- Jon Van de Lindt, Colorado St. Univ.
- Jonathan Buckalew, Nabih Youssef & Assoc.
- Julie Furr, Rimkus
- Keith Porter
- Kent Yu*, SEFT Consulting
- Laurie Johnson*, private consulting & CEA
- Nathan Gould, ABS Consulting
- Reid Zimmerman, KPFF
- Ron Larsen, GSA
- SK Ghosh, SKGA
- Susan Dowty, ICC
- Therese (Terri) McAlister*, NIST
- Bob Hanson*, FEMA SME
- Christina Aronson*, FEMA
- Mai Tong*, FEMA
- John Hooper*, MKA and PUC Chair
- Jiqiu (JQ) Yuan*, NIBS and BSSC Ex. Dir.

* Indicates member of prior Functional Recovery Planning Committee

Functional Recovery Task Committee (TC)

Topic Subcommittees:

- TS #1: Define key terms and concepts related to Functional Recovery
  Chair: Jon Heintz Vice Chair: Jonathan Buckalew
- TS #2: Define Functional Recovery Categories with appropriate ranges of time targets
  Chair: Jakub Valigura Vice Chair: Siamak Sattar
- TS #3: Define functional recovery time targets for various occupancies/services
  Chair: Anna Lang Vice Chair: Lucy Arendt
- TS #4: Develop prescriptive provisions that meet functional recovery objectives
  Chair: Reid Zimmerman Vice Chair: Carlos Molina-Hutt
- TS #5: Develop hazard level(s) applicable for functional recovery objectives
  Chair: Dustin Cook Vice Chair: Nico Luco

Functional Recovery Task Committee (TC) – TS #1

TS #1: Define key terms and concepts related to Functional Recovery

Scope:

- This FR Topic Subcommittee will begin with the definition of Functional Recovery provided in FEMA P-2090 / NIST SP-1254 and will continue to define key terms and concepts in order to develop and implement Functional Recovery provisions for the design of buildings and other structures. This effort will also leverage work currently being conducted under the ATC-138 project to identify requirements and pre-requisites for achieving re-occupancy and for achieving functional recovery, including consideration of when temporary repairs and other alternatives may be appropriate.

Functional Recovery Task Committee (TC) – TS #1

TS #1: Define key terms and concepts related to Functional Recovery

Scope:

- Define key terms:
  - "Functional Recovery" (state and performance objective from FEMA/NIST)
  - "Reoccupancy" (state and performance objective from FEMA/NIST)
  - "Functional Recovery Time"
  - "Reoccupancy Time"
  - "Basic Intended Function"
  - "Impeding Factors"
  - "Externalities"

Functional Recovery Task Committee (TC) – TS #1

TS #1: Define key terms and concepts related to Functional Recovery

Scope:

- Describe key concepts:
  - What is "basic intended function" for various occupancies/services?
  - "Basic intended function" implies something less than full function
  - What damage is allowed (relates to achieving RO & FR)?
  - What temporary fixes are allowed (relates to achieving RO & FR)?
  - What damage triggers impeding factors (relates to achieving RO & FR)?
  - Are the effects of impeding factors considered when calculating RO & FR times as well as when setting targets for RO & FR times?
  - What are (modified?) post-disaster occupancy/habitability requirements (given a "less than perfect" building)? How do these affect functional recovery requirements?
  - How does availability of utility services (accessed or provided beyond the building footprint) affect functional recovery?

Functional Recovery Task Committee (TC) – TS #1

TS #1: Define key terms and concepts related to Functional Recovery

Roster:

TS#1 PRIMARY MEMBERS	SECONDARY MEMBERS
Jon Heintz (Chair), ATC	
Jonathan Buckalew (Vice Chair), NYASE	
Curt Haselton, CSU-Chico & HBRG	
David Bonowitz, private consulting	
Don Scott, private consulting	
Jeff Soulages, Intel	
Jon Siu, private consulting	**COLLABORATORS**
Kevin Moore, SGH	Nico Luco (TS#5)
Mike Mahoney, FEMA	Carlos Molina-Hutt (TS#4)
Ron Hamburger, SGH	Lucy Arendt (TS#3)
Steve Winkel, Preview Group	Jakub Valigura (TS#2)
Susan Dowty, ICC	Abbie Liel (TC Vice Chair)
Terri McAlister, NIST	Ryan Kersting (TC Chair)

Functional Recovery Task Committee (TC) – TS #2

TS #2: Define Functional Recovery Categories with appropriate ranges of recovery times

Scope:

- This FR Topic Subcommittee will further explore the concept and use of Functional Recovery Categories discussed in FEMA P-2090 / NIST SP-1254 as a tool for identifying groups of occupancies or services with similar recovery time objectives for the purpose of implementing appropriate design provisions. This effort will specifically focus on developing a proposal for an appropriate number of categories and an appropriate range of functional recovery time targets for each category (but assigning occupancies/services to those categories will be the focus of TS#3). The results from the ATC-138 project will inform this work in terms of providing an understanding of the level of accuracy and precision that is available in the current methodology for determining expected functional recovery time of a particular structure (relating to the scope of TS#4 to develop FR design provisions).

Functional Recovery Task Committee (TC) – TS #2

TS #2: Define Functional Recovery Categories with appropriate ranges of recovery times

Scope:

- Consider and propose:
  - How many categories?
  - What is specific recovery time, range of recovery time, or recovery priority associated with each?
  - How precise should the time or range of time be?
  - Establish targets and precision that represent what engineering can provide or what communities need?

Functional Recovery Task Committee (TC) – TS #2

TS #2: Define Functional Recovery Categories with appropriate ranges of recovery times

Roster:

TS#2 PRIMARY MEMBERS	SECONDARY MEMBERS
Jakub Valigura (Chair), Arup	Aaron Yung, SGH
Siamak Sattar (Vice Chair), NIST	Bret Lizundia, R+C
Curt Haselton, CSU-Chico & HBRG	Don Scott, private consulting
Daniel Zepeda, Degenkolb	Isabella Stahl, MKA
David Bonowitz, private consulting	Jack Wegleitner, Degenkolb
Keith Porter	Ron Larsen, GSA
Kevin Moore, SGH	Susan Dowty, ICC
Tamika Bassman, Arup	Vesna Terzic
Tommy Sidebottom, ZFA	
COLLABORATORS	**COLLABORATORS**
Dustin Cook (TS#5)	Jon Heintz (TS#1)
Carlos Molina-Hutt (TS#4)	Abbie Liel (TC Vice Chair)
Anna Lang (TS#3)	Ryan Kersting (TC Chair)

Functional Recovery Task Committee (TC) – TS #3

TS #3: Develop functional recovery time objectives for various occupancies/services

Scope:

- This FR Topic Subcommittee will work closely with TS#2 and with TS#4 and will be focused exploring and assigning the functional recovery time objectives for various occupancies and services. This effort will build from the public workshops held for the FEMA P-2090 / NIST SP-1254 report development (additional detailed results reported in NIST SP-1269) and will leverage additional work conducted by NIST and others on the topic of acceptable functional recovery times. This subcommittee will assign occupancies and services to the functional recovery categories developed by TS#2 and in consideration of the design provisions developed by TS#4.

Functional Recovery Task Committee (TC) – TS #3

TS #3: Develop functional recovery time objectives for various occupancies/services

Scope:

- Consider and propose:
  - What time is needed for what occupancies and services and at what hazard intensity (or relative to acceptable level and type of damage)? Or how often is it acceptable to exceed that level of recovery?
  - Establish common minimums that can be modified by local/state priorities
  - Does “first generation” objective have to meet aspirational target or would it be acceptable to start with an improved recovery time compared to current?

Functional Recovery Task Committee (TC) – TS #3

TS #3: Develop functional recovery time objectives for various occupancies/services

Roster:

TS#3 PRIMARY MEMBERS	SECONDARY MEMBERS
Anna Lang (Chair)	Diane Gould (or designee), CA DSA
Lucy Arendt (Vice Chair)	Jeff Soulages, Intel
Brian Strong (or alternate)	John Van de Lindt, Colorado St. Univ.
David Bonowitz, private consulting	Katherine "Jo" Johnson, NIST
Jon Siu, private consulting	Keith Porter
Julie Furr, Rimkus	Laura Rendos, MKA
Laurie Johnson, private consulting	Mary Comerio
Meg Ackerson, Arup	Mike Mahoney, FEMA
Siamak Sattar, NIST	Roy Lobo (or designee), CA HCAI
Steve Winkel, Preview Group	Terri McAlister, NIST
COLLABORATORS	
Ryan Kersting (TC Chair)	Jakub Valigura (TS#2)
Abbie Liel (TC Vice Chair)	Reid Zimmerman (TS#4)
Jon Heintz (TS#1)	Nico Luco (TS#5)

Functional Recovery Task Committee (TC) – TS #4

TS #4: Develop prescriptive provisions that meet functional recovery category objectives

Scope:

- This FR Topic Subcommittee will work to develop design provisions for structures to meet the functional recovery time objective assigned to each functional recovery category and will therefore be in close coordination with TS#2 and TS#3. This effort will use the functional recovery time methodology developed by the ATC-138 project to quantify recovery time expectations for various structures designed to current code provisions and then explore ways to revise those provisions, when/if needed, to improve functional recovery time for certain structures to meet the intended objectives. This group will also consider design approaches already implemented voluntarily by certain designers, owners, and jurisdictions, as well as strategies identified in other work including FEMA P-2090 / NIST SP-1254, current NIST projects, and the "Resilience-based Design" Resource Paper from the 2020 NEHRP Provisions.

Functional Recovery Task Committee (TC) – TS #4

TS #4: Develop prescriptive provisions that meet functional recovery category objectives

Scope:

- Consider and propose:
  - What current design provisions provide in terms of recovery time and test new criteria to meet FR objectives
  - Real building designs (reasonable levels of overstrength, redundancy, etc.)
  - Use of Risk Category criteria to provide improved functional recovery even if not providing target functional recovery time
  - Recommendations for QA/QC and adaptive solutions
  - Need for back-up lifeline systems?

Functional Recovery Task Committee (TC) – TS #4

TS #4: Develop prescriptive provisions that meet functional recovery category objectives

Roster:

TS#4 PRIMARY MEMBERS	**SECONDARY MEMBERS**
Reid Zimmerman (Chair), KPFF	Daniel Zepeda, Degenkolb
Carlos Molina-Hutt (Vice Chair), UBC	Emily Guglielmo, Martin/Martin
Bret Lizundia, R+C	Greg Soules, CB&I
Curt Haselton, CSU-Chico / HBRG	Jordan Jarrett, Univ. of Colorado
Ibbi Almufti, Arup	Julie Furr, Rimkus
Roy Lobo, CA HCAI	Meaghan Halligan, ISAT
Tali Feinstein, Exponent	Nathan Gould, ABS
	Sandy Hohener, Degenkolb
COLLABORATORS	Solmaz Jumakuliyeva, eStructure
Dustin Cook (TS#5)	**WORKSHOP MEMBERS**
Anna Lang (TS#3)	John Silva, Hilti
Jakub Valigura (TS#2)	Kevin Brinkman, National Elevator Ind.
Jonathan Buckalew (TS#1)	Phil Caldwell, Schneider Electric (ret.)
Abbie Liel (TC Vice Chair)	Stephen Fisher, Marvin Windows & Doors
Ryan Kersting (TC Chair)	Steve Edgett (or alternate), WECG

Functional Recovery Task Committee (TC) – TS #5

TS#5: Develop hazard level(s) applicable for functional recovery performance objectives

Scope:

- This FR Topic Subcommittee will explore the hazard level(s) applicable for functional recovery performance objectives. Consistent with FEMA P-2090 / NIST SP-1254, this subcommittee will consider targeting improved post-earthquake functional recovery time with use of the current design approach (using seismic effects related to 2/3 MCEr) or whether functional recovery performance should be considered at a different hazard level (whether directly or indirectly).

Functional Recovery Task Committee (TC) – TS #5

TS#5: Develop hazard level(s) applicable for functional recovery performance objectives

Scope:

- Consider and propose:
  - Hazard consideration (ground motion parameters to be used for design) for Functional Recovery performance objectives
    - Risk-targeted, i.e. some X probability (high?) of meeting target functional recovery time or community resilience goal of Y days (reasonably short to intermediate recovery time) across Z years (e.g. 50 years)
    - Or based on a particular uniform hazard (e.g. some % of MCE)
    - Or based on a particular scenario event
  - Basis/scale of consideration: individual building, community, region/nation
  - How does cost-benefit analysis affect hazard level(s) for considering functional recovery?

Functional Recovery Task Committee (TC) – TS #5

TS#5: Develop hazard level(s) applicable for functional recovery performance objectives

Roster:

TS#5 PRIMARY MEMBERS	SECONDARY MEMBERS
Dustin Cook (Chair), NIST	Curt Haselton
Nico Luco (Vice Chair), USGS	Dawn Lehman
Charlie Kircher	Jason Bock
Emily Guglielmo, Martin/Martin	Justin Marshall
Greg Soules, CB&I	Sandra Hyde
Jack Backer, Stanford	Sean McGowan
Phil Caldwell, Schneider Electric (ret.)	Silvia Mazzoni
Ron Hamburger, SGH	Tamika Bassman
Ron Larsen, GSA	Tommy Sidebottom
Yolanda Lin (regional)	Zia Zafir
COLLABORATORS	
Ryan Kersting (TC Chair)	Siamak Sattar (TS#2)
Abbie Liel (TC Vice Chair)	Anna Lang (TS#3)
Jon Heintz (TS#1)	Reid Zimmerman (TS#4)

Functional Recovery Task Committee (TC) – Next Steps

Key Early Deliverables / Decisions:

- Pilot Program / Study and Test-bed Projects
- Outline / Draft of proposed deliverables for Part 1/2 and Part 3
- Impeding factors: include time effects in calculations for functional recovery time?
- Functional recovery time sensitivity study (ATC-138) for FR Category thresholds
- Hazard consideration relative to Functional Recovery Performance Objective
  - Risk-targeted statement of performance objective or uniform hazard considered?
    - X probability (low?) of exceeding target functional recovery time of Y days (still TBD) across Z years (e.g. 50 years)
    - Presentation from Nico

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Functional Recovery Task Committee (TC) & Topic Subcommittees (TS)

Report to PUC Meeting - August 25, 2022

Ryan Kersting & Abbie Liel
Functional Recovery TC Chair and Vice Chair

nehrp FEMA Building Seismic Safety Council