City and County of San Francisco
Department of Building Inspection

London N. Breed, Mayor
Patrick O'Riordan, C.B.O., Director

Date: May 20, 2022

To: Sandra Eng, Executive Director
Civil Service Commission

From: Patrick O' Riordan, C.B.O., Director

Re: Review of PSC 44359-19/20 Modification #1 from the Department of Building Inspection

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The Department of Building Inspection respectfully submits the Personal Service Contract #44359 -19/20, modification #1 for Civil Service Commission review and approval.

PSC 44359 -19/20 modification #1 was submitted in March 2022 to the Civil Service Commission, and withdrawn per the Department's request to make a correction and was resubmitted for the June 6, 2022 Civil Service Commission hearing. The modification seeks an approval amount from $2 million to $9.5 million and extends the duration for a total of nine years.

The increase in funding and duration extension is necessary to continue the current as-needed professional services contracts for Structural Design Review, in accordance with Administrative Bulletin AB-082, of the seismic structural design of new tall buildings using non-prescriptive seismic design procedures, in accordance with Administrative Bulletins AB-083 and AB-111 (attached).

Due to the pandemic, ongoing plan reviews for new tall buildings were delayed for almost 2 years. Under the Controller's Concurrence Process pursuant to the 13th and 35th Supplements to Mayor's Thirteenth Supplement to Mayoral Proclamation Declaring the existence of a local emergency dated February 25, 2020, professional services contracts were extended and the not-to-exceed amounts were also increased. Under the Forty-Seventh Supplement to Mayor Proclamation, contracts will continue to be extended.

Additionally, the modification will also allow the Department to issue as needed professional's services contracts for Structural Design Review of new tall building projects forthcoming.

Lastly, the department plans to issue a Request for Proposal (RFP) to seek responses from respondents demonstrating expertise in one or more of the following: 1) Structural Engineering, 2) Geological Engineering 3) Site-Specific Seismic Hazard Assessment, 4) Earthquake Ground Motion Selection and Scaling from an existing pre-qualified list of consultants/professionals and academic experts. The department will choose contractors, on an as-needed basis for up to five (5) years, to advise the department on the seismic structural design of tall building projects. Projects are short-term and may take a few years to complete.

Notifications: list of the person(s) to be notified in the format described in IV. Commission Report Format -A).

Neville Pereira, P.E., CBO
Deputy Director
Department of Building Inspection
Plan Review Services Division
Neville.pereira@sfgov.org

Richard Tam, S.E.
Building Plans Engineer
Supervisor
Plan Rev Department of Building Inspection
Plan Review Services Division
Richard.tam@sfgov.org

Howard Zee, S.E.
Structural Engineer
Department of Building Inspection
Plan Review Services
Howard.zee@sfgov.org

Sharon Lee
Finance and Administrative Services
Sharon.lee@sfgov.org

PERSONAL SERVICES CONTRACT SUMMARY ("PSC FORM 1")

Department: DEPARTMENT OF BUILDING INSPECTION Dept. Code: DBI

Type of Request:	☐Initial	☑Modification of an existing PSC (PSC # 44359 - 19/20)			
Type of Approval:	☐Expedited	☑Regular	☐Annual	☐Continuing	☐ (Omit Posting)

Type of Service: Professional Services

Funding Source: Operating Budget

PSC Original Approved Amount: $2,000,000 PSC Original Approved Duration: 07/01/20 - 06/30/26 (6 years)

PSC Mod#1 Amount: $7,500,000 PSC Mod#1 Duration: 03/22/22-06/30/29 (3 years 1 day)

PSC Cumulative Amount Proposed: $9,500,000 PSC Cumulative Duration Proposed: 9 years 1 day

1. Description of Work

A. Scope of Work/Services to be Contracted Out:

Department to re-issue a Request for Qualifications (RFQ) to seek responses from Respondents demonstrating expertise in one or more of the following Areas: 1) Structural Design Review; and 2) Geo-technical and Geological Engineering Review. Based on the responses from this RFQ, Department will create a pre-qualified list of consultants/professionals and academic experts from which Department may choose prospective contractors, on an as-needed basis for up to five (5) years of the pre-qualification notification date, to advise the Department in structure design and plan review for privately-sponsored projects. Due to continued development of buildings that require structural and geotechnical review, these specialized services are still needed.

B. Explain why this service is necessary and the consequence of denial:

It is the Department's policy, procedures and safety regulations to monitor the construction of new buildings in San Francisco. The Department continues to review and constantly take steps to strengthen requirements to ensure that buildings are as safely built as contemporary engineering permits. Staff of engineers, inspectors and permitting technician's works closely with the project sponsor and chosen design and engineering team to ensure that submitted plans and subsequent construction meet or exceed the minimum standards of the San Francisco Building Code. Expert Consultants supplement the plan review process. Denial would limit the Department's ability to work directly with experts.

C. Has this service been provided in the past? If so, how? If the service was provided under a previous PSC, attach copy of the most recently approved PSC.

PSC 44359 19-20

D. Will the contract(s) be renewed?

No. As needed services.

E. If this is a request for a new PSC in excess of five years, or if your request is to extend (modify) an existing PSC by another five years, please explain why:
there are forthcoming private sponsored projects that require as needed professional services for structural and geotechnical peer review. Some projects require several years to complete review.

2. **Reason(s) for the Request**

A. Display all that apply

☑ Services required on an as-needed, intermittent, or periodic basis (e.g., peaks in workload).

Explain the qualifying circumstances:
Consultants will be individual structural and geotechncial engineers and academia experts with minimum 15 years experience in Structural Design Reviewer/Practicing Structural Engineer. Services will be on a as needed bases. Structural expert shall have minimum 15 years experience practicing in structural engineering with expertise in structural engineering, earthquake engineering, performance based seismic engineering, and nonlinear response history analysis of building and tall building design; structural peer review; development of structural building codes and guidelines for buildings. Structural Design Reviewer/Academia shall have with minimum 15 years experience researching in structural engineering with expertise in structural engineering, earthquake engineering, performance-based seismic engineering, nonlinear response history analysis of building and tall building design; structural peer review; development of structural building codes and guidelines for buildings. Geotechnical Reviewer expert shall ahve with minimum 15 years experience in geotechnical and geological engineering with expertise in geotechnical or geological engineering, generation of site-specific ground motions of use in linear and nonlinear analyses, performance-based seismic design for tall buildings, site soil classification, foundation recommendation, deep foundation evaluation, earth pressure recommendation,soil structure interaction, building settlements analysis, excavation and ground water monitoring; geotechnical peer review; development geotechnical requirements for building codes and design guidelines of buildings.

B. Reason for the request for modification:
increase funding to extend current contracts for project completion and contracts for new projects requiring peer review

3. **Description of Required Skills/Expertise**

A. Specify required skills and/or expertise: Consultants will be individual consultants (structural engineers and researchers) with minimum 15 years experience in the following areas: A Structural Design Reviewer/Practicing Structural Engineer shall have minimum 15 years experience practicing in structural engineering with expertise in structural engineering, earthquake engineering, performance based seismic engineering, and nonlinear response history analysis of building and tall building design; structural peer review; development of structural building codes and guidelines for buildings. A Structural Design Reviewer/Academia with minimum 15 years experience researching in structural engineering with expertise in structural engineering, earthquake engineering, performance-based seismic engineering, nonlinear response history analysis of building and tall building design; structural peer review; development of structural building codes and guidelines for buildings. A geotechnical Reviewer with minimum 15 years experience in geotechnical and geological engineering with expertise in geotechnical or geological engineering, generation of site-specific ground motions of use in linear and nonlinear analyses, performance-based seismic design for tall buildings, site soil classification, foundation recommendation, deep foundation evaluation, earth pressure recommendation, soil structure interaction, building settlements analysis, excavation and ground water monitoring; geotechnical peer review; development geotechnical requirements for building codes and design guidelines of buildings.

B. Which, if any, civil service class(es) normally perform(s) this work? none

C. Will contractor provide facilities and/or equipment not currently possessed by the City? If so, explain: no

4. <u>If applicable, what efforts has the department made to obtain these services through available resources within the City?</u>

Not Applicable

5. <u>Why Civil Service Employees Cannot Perform the Services to be Contracted Out</u>

A. Explain why civil service classes are not applicable.
There are no civil service classifications that is able to perform this type of specialized work.

B. If there is no civil service class that could perform the work, would it be practical and/or feasible to adopt a new civil service class to perform this work? Explain: No, the contractor will be on an as-needed basis. Also, these skills needed are very specialized.

6. <u>Additional Information</u>

A. Will the contractor directly supervise City and County employee? If so, please include an explanation.
No.

B. Will the contractor train City and County employees and/or is there a transfer of knowledge component that will be included in the contact? If so, please explain what that will entail; if not, explain why not.
No training provided to city employees. This type of review work is highly specialized and requires extensive work experience. Knowledge includes both academic knowledge and extensive hands-on work experience with review of the proposed structural design criteria, assumptions and acceptance criteria; review of structural analysis results and the design details; and engineering calculations and permit structural drawings. Minimum work requirements for a structural or geotechnical engineer is 15 years work experience.

C. Are there legal mandates requiring the use of contractual services?
see attached Board of Supervisors Ordinance 36-18

D. Are there federal or state grant requirements regarding the use of contractual services? If so, please explain and include an excerpt or copy of any such applicable requirement.
No.

E. Has a board or commission determined that contracting is the most effective way to provide this service? If so, please explain and include a copy of the board or commission action.
Board of Supervisors Ordinance 36-18

F. Will the proposed work be completed by a contractor that has a current PSC contract with your department? If so, please explain.
   No.

7. Union Notification: On 03/22/22, the Department notified the following employee organizations of this PSC/RFP request:
all unions were notified

☑ I CERTIFY ON BEHALF OF THE DEPARTMENT THAT THE INFORMATION CONTAINED IN AND ATTACHED TO THIS FORM IS COMPLETE AND ACCURATE:

Name: Sharon Lee Phone: 415-575-6947 Email: sharon.lee@sfgov.org

Address: 1660 Mission Street, 6th Floor,, San Francisco, CA 94103
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FOR DEPARTMENT OF HUMAN RESOURCES USE

PSC# 44359 - 19/20
DHR Analysis/Recommendation: 03/21/2022
Commission Approval Required Other
03/21/2022 DHR Approved for 03/21/2022

Receipt of Union Notification(s)

Choi, Suzanne (HRD)

From: dhr-psccoordinator@sfgov.org on behalf of sharon.lee@sfgov.org
Sent: Tuesday, March 22, 2022 9:56 AM
To: Lee, Sharon (DBI); kennethlomba@gmail.com; snaranjo@cirseiu.org; mdennis@twusf.org; roger marenco; pwilson@twusf.org; cmoyer@nccrc.org; Frigault, Noah (HRC); sfdpoa@icloud.com; Mjayne@iam1414.org; Emanuel, Rachel (DEM); laborers261@gmail.com; Laxamana, Junko (BOS); jennifer.esteen@seiu1021.org; emathurin@cirseiu.org; abush@cirseiu.org; sbabaria@cirseiu.org; anthony@dc16.us; mlobre@sfpoa.org; @sfpoa.org; tracym@sfpoa.org; mleach@ibt856.org; rooferslocal40@gmail.com; sal@local16.org; Criss@sfmea.com; Meyers, Julie (HSA); seichenberger@local39.org; camaguey@sfmea.com (contact); ablood@cirseiu.org; kcartermartinez@cirseiu.org; ecassidy@ifpte21.com; WendyWong26@yahoo.com; wendywong26 @yahoo.com; sarah.wilson@seiu1021.org; kschumacher@ifpte21.org; kpage@ifpte21.org; tjenkins@uapd.com; eerbach@ifpte21.org; tmathews@ifpte21.org; amakayan@ifpte21.org; jb@local16.org; Ricardo.lopez@sfgov.org; Basconcillo, Katherine (PUC); Sandeep.lal@seiu1021.me; pcamarillo_seiu@sbcglobal.net; MRainsford@local39.org; Wendy.Frigillana@seiu1021.org; pscreview@seiu1021.org; pkim@ifpte21.org; agonzalez@iam1414.org; ted.zarzecki@seiu1021.net; leah.berlanga@seiu1021.org; gail@sffdlocal798.org; cityworker@sfcwu.org; davidmkersten@gmail.com; djohnson@opcmialocal300.org; Ramon Hernandez; ablood@cirseiu.org; pkarinen@nccrc.org; tony@dc16.us; stevek@bac3-ca.org; xiumin.li@seiu1021.org; Poon, Sin Yee (HSA); smcgarry@nccrc.org; rmitchell@twusf.org; grojo@local39.org; jduritz@uapd.com; staff@sfmea.com; mike@dc16.us; khughes@ibew6.org; L21PSCReview@ifpte21.org; sfsmsa@gmail.com; bart@dc16.us; david.canham@seiu1021.org; jtanner940@aol.com; oashworth@ibew6.org; L21PSCReview@ifpte21.org; laborers261@gmail.com; local200twu@sbcglobal.net; speedy4864@aol.com; Christina@sfmea.com; ecdemvoter@aol.com; thomas.vitale@seiu1021.org; DHR-PSCCoordinator, DHR (HRD)
Subject: Receipt of Modification Request to PSC # 44359 - 19/20 - MODIFICATIONS

PSC RECEIPT of Modification notification sent to Unions and DHR

The DEPARTMENT OF BUILDING INSPECTION -- DBI has submitted a modification request for a Personal Services Contract (PSC) for $7,500,000 for services for the period March 22, 2022 – June 30, 2029. For all Modification requests, there is a 7-Day noticed to the union(s) prior to DHR Review.

If SEIU is one of the unions that represents the classes you identified in the initial PSC and the cumulative amount of the request is over $100,000, there is a 60 day review period for SEIU

After logging into the system please select link below:

http://apps.sfgov.org/dhrdrupal/node/17918
Email sent to the following addresses: Please check the record to see if you selected a union where a corresponding email in the TO: field isn't present.
Either you selected none or there is no email entered in the system by that particular union

Choi, Suzanne (HRD)

From: dhr-psccoordinator@sfgov.org on behalf of sharon.lee@sfgov.org
Sent: Thursday, February 10, 2022 1:55 PM
To: Lee, Sharon (DBI); kennethlomba@gmail.com; snaranjo@cirseiu.org; mdennis@twusf.org; roger marenco; pwilson@twusf.org; cmoyer@nccrc.org; Frigault, Noah (HRC); sfdpoa@icloud.com; Mjayne@iam1414.org; Emanuel, Rachel (DEM); laborers261@gmail.com; Laxamana, Junko (BOS); jennifer.esteen@seiu1021.org; emathurin@cirseiu.org; abush@cirseiu.org; sbabaria@cirseiu.org; anthony@dc16.us; mlobre@sfpoa.org; @sfpoa.org; tracym@sfpoa.org; mleach@ibt856.org; rooferslocal40@gmail.com; sal@local16.org; Criss@sfmea.com; Meyers, Julie (HSA); seichenberger@local39.org; camaguey@sfmea.com (contact); ablood@cirseiu.org; kcartermartinez@cirseiu.org; ecassidy@ifpte21.com; WendyWong26@yahoo.com; wendywong26 @yahoo.com; sarah.wilson@seiu1021.org; kschumacher@ifpte21.org; kpage@ifpte21.org; tjenkins@uapd.com; eerbach@ifpte21.org; tmathews@ifpte21.org; amakayan@ifpte21.org; jb@local16.org; Ricardo.lopez@sfgov.org; Basconcillo, Katherine (PUC); Sandeep.lal@seiu1021.me; pcamarillo_seiu@sbcglobal.net; MRainsford@local39.org; Wendy.Frigillana@seiu1021.org; pscreview@seiu1021.org; pkim@ifpte21.org; agonzalez@iam1414.org; ted.zarzecki@seiu1021.net; leah.berlanga@seiu1021.org; gail@sffdlocal798.org; cityworker@sfcwu.org; davidmkersten@gmail.com; djohnson@opcmialocal300.org; Ramon Hernandez; ablood@cirseiu.org; pkarinen@nccrc.org; tony@dc16.us; stevek@bac3-ca.org; xiumin.li@seiu1021.org; Poon, Sin Yee (HSA); smcgarry@nccrc.org; rmitchell@twusf.org; grojo@local39.org; jduritz@uapd.com; staff@sfmea.com; mike@dc16.us; khughes@ibew6.org; L21PSCReview@ifpte21.org; sfsmsa@gmail.com; bart@dc16.us; david.canham@seiu1021.org; jtanner940@aol.com; oashworth@ibew6.org; L21PSCReview@ifpte21.org; laborers261@gmail.com; local200twu@sbcglobal.net; speedy4864@aol.com; Christina@sfmea.com; ecdemvoter@aol.com; thomas.vitale@seiu1021.org; DHR-PSCCoordinator, DHR (HRD)
Subject: Receipt of Modification Request to PSC # 44359 - 19/20 - MODIFICATIONS

PSC RECEIPT of Modification notification sent to Unions and DHR

The DEPARTMENT OF BUILDING INSPECTION -- DBI has submitted a modification request for a Personal Services Contract (PSC) for $2,000,000 for services for the period February 3, 2022 – June 30, 2026. For all Modification requests, there is a 7-Day noticed to the union(s) prior to DHR Review.

If SEIU is one of the unions that represents the classes you identified in the initial PSC and the cumulative amount of the request is over $100,000, there is a 60 day review period for SEIU

After logging into the system please select link below:

http://apps.sfgov.org/dhrdrupal/node/17918
Email sent to the following addresses: Please check the record to see if you selected a union where a corresponding email in the TO: field isn't present.
Either you selected none or there is no email entered in the system by that particular union

Additional Attachment(s)

[Building Code -Third Party Expert Fees]

Ordinance amending Building Code, Section 107A, and Table 1A-B of Section 110A, to allow recovery of costs of third party experts and other permit related expenses; and affirming the Planning Department's determination under the California Environmental Quality Act.

NOTE: **Unchanged Code text and uncodified text** are in plain Arial font.
Additions to Codes are in *single-underline italics Times New Roman font*.
Deletions to Codes are in ~~*strikethrough italics Times New Roman font*~~.
Board amendment additions are in double-underlined Arial font.
Board amendment deletions are in ~~strikethrough Arial font~~.
Asterisks (*   *   *   *) indicate the omission of unchanged Code subsections or parts of tables.

Be it ordained by the People of the City and County of San Francisco:

Section 1. Findings.

(a) The Planning Department has determined that the actions contemplated in this ordinance comply with the California Environmental Quality Act (California Public Resources Code Sections 21000 et seq.). Said determination is on file with the Clerk of the Board of Supervisors in File No. 170942 and is incorporated herein by reference. The Board affirms this determination.

(b) On August 16, 2017, the Building Inspection Commission conducted a duly noticed public hearing on the legislative amendments proposed in this Ordinance pursuant to Charter Section D3.750-5.

Section 2. The Building Code is hereby amended by amending Section 107A, to read as follows:

107A.14 Third-Party Experts and Other Permit Related Actions Fee. *Actions requiring third-party experts or other actions not specified above, shall be charged a fee based on actual costs that the Department incurs in administering and processing the action or procedure and shall be charged on a time and materials basis. The Department shall provide the applicant with a written estimate of said costs at the time of application, and the applicant shall pay such fees prior to the time that the application is deemed complete. To the extent that the estimated fees do not cover actual costs, any outstanding amount due shall be a condition of the Department's final decision on the action or procedure. To the extent that the estimated fees exceeded the actual costs, the Department shall refund the excess amount to the applicant within a reasonable period after the Department's final decision on the action or procedure.*

Section 3. The Building Code is hereby amended by amending Table 1A-B of Section 110A, to read as follows:

TABLE 1A-B – OTHER BUILDING PERMIT AND PLAN REVIEW FEES

1. Plan Review Fees Not Covered in Table 1A-A:	Plan Review Hourly Rate - Minimum One Hour
2. Back Check Fee:	Plan Review Hourly Rate - Minimum One Hour
3. Commencement of work not started: a. Building, Plumbing, Mechanical, or Electric Permit Fee:	See SFBC Section 106A.4.4.1 Note: Compliance with additional codes is required. 75% of current fee

b. Plan Review Fee:	100% of current fee
4. Permit Facilitator Fee:	Plan Review Hourly Rate Hourly - Minimum Three Hours See SFBC Section 106A.3.6
5. Pre-application Plan Review Fee:	Plan Review Hourly Rate - Minimum Two Hours Per Employee
6. Reduced Plan Review Fee:	50% of the Plan Review Fee
7. Sign Plan Review Fee:	See Table 1A-A– Building Permit Fees
8. Site Permit Fee:	25% of Plan Review Fee based on Table 1A-A. Minimum fee $500.00
9. Premium Plan Review Fee– Submitted application:	50% of Plan Review Fee plus $1,000.00
10. Premium Plan Review Fee– Over the counter building plan review by appointment:	50% of Plan Review Fee plus $400.00
11. Third-Party Experts and Other Permit Related Actions Fee:	*Actual costs that the Department incurs in administering and processing the action or procedure on a time and materials basis.*
12~~1~~. Other Services:	Hourly Rates per Table 1A-D

Section 4. Effective Date. This ordinance shall become effective 30 days after enactment. Enactment occurs when the Mayor signs the ordinance, the Mayor returns the ordinance unsigned or does not sign the ordinance within ten days of receiving it, or the Board of Supervisors overrides the Mayor's veto of the ordinance.

numbers, punctuation marks, charts, diagrams, or any other constituent parts of the Municipal Code that are explicitly shown in this ordinance as additions, deletions, Board amendment additions, and Board amendment deletions in accordance with the "Note" that appears under the official title of the ordinance.

APPROVED AS TO FORM:
DENNIS J. HERRERA, City Attorney

By: ______________________
ROBB W. KAPLA
Deputy City Attorney

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City and County of San Francisco
Tails
Ordinance

City Hall
1 Dr. Carlton B. Goodlett Place
San Francisco, CA 94102-4689

File Number: 170942 **Date Passed:** February 27, 2018

Ordinance amending Building Code, Section 107A, and Table 1A-B of Section 110A, to allow recovery of costs of third party experts and other permit related expenses; and affirming the Planning Department's determination under the California Environmental Quality Act.

February 05, 2018 Land Use and Transportation Committee - RECOMMENDED

February 13, 2018 Board of Supervisors - PASSED ON FIRST READING

Ayes: 11 - Breed, Cohen, Fewer, Kim, Peskin, Ronen, Safai, Sheehy, Stefani, Tang and Yee

February 27, 2018 Board of Supervisors - FINALLY PASSED

Ayes: 10 - Breed, Cohen, Fewer, Kim, Peskin, Ronen, Safai, Sheehy, Stefani and Yee
Excused: 1 - Tang

File No. 170942

I hereby certify that the foregoing Ordinance was FINALLY PASSED on 2/27/2018 by the Board of Supervisors of the City and County of San Francisco.

Angela Calvillo
Clerk of the Board

Mark E. Farrell
Mayor

3/9/18
Date Approved

ADMINISTRATIVE BULLETIN

NO. AB-082 :

DATE : November 21, 2018
[Supersedes Administrative Bulletin AB-082 originally issued 03/25/2008, revised 12/19/2016]

SUBJECT : Permit Processing and Issuance

TITLE : **Guidelines and Procedures for Structural, Geotechnical, and Seismic Hazard Engineering Design Review**

PURPOSE : The purpose of this Administrative Bulletin is to present guidelines and procedures for Structural, Geotechnical, and Seismic Hazard Engineering Design Review of buildings and other structures. Such Review may be required by the San Francisco Building Code, by another Administrative Bulletin, or at the request of the Director of the Department of Building Inspection (SFDBI).

REFERENCES : 2016 San Francisco Building Code (SFBC)
- Section 101A.2, Purpose
- Section 104A.2, Powers and Duties of Building Official
- Section 104A.2.8, Alternate for materials, design, tests and methods of construction
- Section 105A.6, Structural Advisory Committee
- Chapter 16, Structural Design

ASCE 7-10 *Minimum Design Loads for Buildings and Other Structures*:
- Section 16.2.5 Design Review, Seismic Response History Procedures
- Section 17.7 Design Review, Seismically Isolated Structures
- Section 18.8 Design Review, Structures with Damping Systems

SEAOC, 1999, "Project Design Peer Review" (Chapter 4, October 1995) *Recommended Guidelines for the practice of Structural Engineering in California*, Structural Engineers Association of California, Sacramento, California

DISCUSSION : See Commentary sections throughout this document.

1. SCOPE OF THIS BULLETIN

This bulletin addresses Structural, Geotechnical, and Seismic Hazard Engineering Design Review of buildings and other structures (referred to herein as "Review"). Review may apply to design of new structures, or addition, alteration, or retrofit of existing structures. It may apply to projects designed to the prescriptive provisions of the SFBC or to projects incorporating exceptions to the prescriptive provisions of the SFBC, at the discretion of the Director of the Department of Building Inspection (SFDBI). Review may include one or more of the following disciplines:

1. Structural Engineering
2. Geotechnical Engineering
3. Site-Specific Seismic Hazard Assessment
4. Earthquake Ground Motion Selection and Scaling

> **Commentary**: The term "Structural, Geotechnical, and Seismic Hazard Engineering Design Review" (or "Review") used herein is often referred to as "Peer Review." It encompasses "Design Review" as required by ASCE 7-10 Section 16.2.5 (Seismic Response History Procedures), 17.7 (Seismically Isolated Structures), and 18.8 (Structures with Damping Systems). The Director requires Review when implicated by these Building Code sections, and may require Review in other instances as deemed necessary by the Director.
>
> Reviewers and Review teams are distinct from a Structural Advisory Committee, which is a public body that the Director may convene in accordance with SFBC Section 105A.6 "to advise the Building Official on matters pertaining to the design and construction of buildings with special features or special design procedures."

2. PURPOSE OF REVIEW

If the Director determines that Review is required, the Director shall request one or more Structural, Geotechnical, or Seismic Hazard Reviewers having specialized knowledge and experience to provide their professional opinion on identified aspects of a project. The purpose of the Review is to provide an independent, objective, technical review of those aspects of the project design that are identified in the scope of the Review. For projects that are intended to be fully compliant with the prescriptive provisions of the SFBC, the purpose of the Review also includes advising the Director whether the design aspects in the scope of the Review satisfy the prescriptive requirements of the SFBC. For projects incorporating exceptions to the prescriptive provisions of the SFBC, the purpose of the Review also includes advising the Director whether the design aspects in the scope of the Review satisfy the requirements of SFBC 2016 Section 104.11 ("Alternative materials, design and methods") or other requirements or criteria identified in the scope of the review.

The Review shall not be construed to replace quality assurance measures ordinarily exercised by the Structural or Geotechnical Engineer of Record in the design of a structure or development of geotechnical design recommendations. Responsibility for the design, and the responsibility to demonstrate conformance of the design to the SFBC, resides solely with the Engineer of Record. The responsibility for conducting plan check resides with the Director and any plan check consultants. The responsibility for acceptance of a design and any decisions on the issuance of permits resides solely with the Director.

3. ADMINISTRATION OF REVIEW

Reviewers contract with SFDBI and are responsible to the Director. SFDBI is responsible for the payment of fees and other expenses for the professional services of the Reviewer(s). Reviewers shall provide their professional opinion to the Director and shall sign all written communication to the Director.

> **Commentary:** SFDBI's new process retains the Reviewer's responsibility to the Director and aligns with a number of jurisdictions that contract directly with Reviewers and pass the cost through to the Project Sponsor. Previously, the City of San Francisco procedures for procurement of professional services have not been suited to directly contracting with consulting engineers, and Reviewers instead contracted with the Project Sponsor. The Reviewers nevertheless are responsible to and act under the instructions of the Director.
>
> The Structural Engineers Association *Recommended Guidelines for the Practice of Structural Engineering in California*, 5th Edition (1999) recommends that appropriate language regarding design responsibility be included in the Reviewer's contract:
>
> "Responsibility for the structural design remains with the [Engineer of Record] because the [Reviewer] has no contractual ability to change or prepare contract documents. For this reason, an appropriate indemnification clause should be included in the [Reviewer's] agreement with the client."

Responsibilities of the Chair of a Review Team

On a project for which there is more than one Reviewer, the Director shall designate one of the Reviewers to serve as Chair of the Review Team. The Chair is responsible for leading the Review in his or her own discipline and for coordinating the Review. The Chair does not take responsibility for the professional opinions of Reviewers of other disciplines. Either the Reviewers jointly write a letter or letters expressing the opinions of the Review Team, or the Reviewers in each discipline write separate letters to the Director addressing the findings and review scope for their discipline. Reviewers provide their professional opinion only in their area of expertise.

Distinction between Review reports and Construction Documents

None of the reports or documents from the Reviewer(s) are Construction Documents. Under no circumstances should letters or other documents from the Reviewer(s) be put into the Engineer of Record's project drawings or reproduced in any other way that makes Reviewer documents appear to be part of the Construction Contract Documents. The Engineer of Record is solely responsible for the Construction Contract Documents. Documents from the Reviewer(s) will be retained as part of SFDBI's project files.

4. QUALIFICATIONS AND SELECTION OF REVIEWERS

Each Reviewer shall be selected by the Director based on the Reviewer's qualifications applicable to the project and considering availability relative to the project schedule. The Director may, at his or her discretion, consult with the Project Sponsor, the Engineer of Record, or others before selecting the Reviewer(s), with the final selection of the Reviewer(s) being the sole responsibility of the Director. Reviewers shall disclose to the Director, in writing, any potential conflict of interest related to the project, the desired scope of Review, or the ability of the Reviewer to be independent and objective in the Review.

Each Reviewer providing professional engineering services shall be a Registered Design Professional holding a Professional Engineer (P.E.) license, in accordance with California law. Qualified engineering staff and reviewers not registered as a P.E., including reviewers from academia, can contribute to the review under the responsible charge of a registered P.E.

Additional registration requirements for each Review discipline are specified below. Where suitably qualified, it is acceptable for one Reviewer to fulfill more than one of these roles.

Structural Engineering Design Reviewers

Structural Engineering Design Reviewers shall have experience in structural engineering pertinent to the review scope and type of structure. If applicable to the review scope, they shall have experience in:

- Prescriptive requirements and, where applicable, the "alternative materials, design and methods" provisions of the SFBC
- Performance-based engineering
- Structural design and detailing for seismic performance
- Seismic evaluation and retrofit of existing structures
- Design of structures incorporating the materials, systems, and technologies to be incorporated in the project
- Nonlinear response-history analysis
- Applicable structural engineering research

In addition to having the experience described above, the lead Structural Engineering Design Reviewer shall be registered as a Structural Engineer (S.E.) in California. Additional Structural Engineering Design Reviewers who work as part of the Review team are not required to be registered Structural Engineers.

Geotechnical Engineering Reviewers

Geotechnical Engineering Reviewers shall have experience in geotechnical engineering pertinent to the review scope and type of site and foundation. If applicable to the review scope, they shall have experience in:

- Design of shallow and/or deep foundation systems of the type proposed for the project

- Interpretation of geotechnical and geological investigations
- Soil-foundation-structure interaction under static (gravity) and seismic loading conditions
- Liquefaction, landslides, and other geological site hazards
- Ground improvement
- Static and dynamic earth pressures
- Effects of dewatering on the project site and its vicinity
- Effects of construction-related activities on foundation performance of neighboring structures
- Numerical modeling of geotechnical and seismic hazards, and associated soil- structure interaction issues

In addition to having the experience described above, the lead Geotechnical Engineering Reviewer shall be registered as a Geotechnical Engineer (G.E.) or a Civil Engineer (C.E.) in California. Additional Geotechnical Engineering Reviewers who work as part of the Review team are not required to be registered Geotechnical or Civil Engineers.

Seismic Hazard and Ground Motion Reviewers

Reviewers of seismic hazard and ground motions shall have experience in these fields pertinent to the review scope and the hazard and ground motion approaches being used. If applicable to the review scope, they shall have experience in:

- SFBC requirements related to hazard and ground motions
- Fault sources and characteristics in the San Francisco Bay Area
- Probabilistic and deterministic seismic hazard assessment
- Site effects and site response analysis
- Ground motion prediction equations
- Selection and scaling of motions, and application of motions to a structure
- Applicable research on seismic hazard and ground motion selection and scaling

In addition to having the experience described above, the Reviewer of seismic hazard and ground motions shall be registered as a Professional Engineer in California or shall provide his or her services under the responsible charge of a registered Professional Engineer on the Review team.

5. PROJECTS REQUIRING REVIEW

The Director shall require Review for projects where Review is required by the SFBC. The Director may require Review for other projects at the Director's discretion. Table 1 lists project characteristics commonly considered by the Director in determining whether Review is required. Along with the characteristics in Table 1, the Director's determination of whether a project requires Review, and what Review disciplines are required, may depend on factors such as:

- Size, importance, occupant load, post-earthquake functionality requirements, or risk category of the structure
- Characteristics of the site, foundation system, and adjacent structures
- Irregular or unusual structural configurations
- Pertinent qualifications within SFDBI to conduct an in-house review

Commentary: Project Sponsors are strongly encouraged to contact SFDBI early in the project design process and to request a pre-application meeting with SFDBI and the Engineer of Record to determine Review requirements. The SFDBI AB-028 "Pre-application and Pre-addendum Plan Review Procedures" specifies procedures for requesting and carrying out such a meeting.

Table 1: Project Characteristics considered by the Director in determining whether Review is required

	Review discipline		
	Structural	Geotech-nical	Site-specific Hazard [e]
Projects that require Review			
Projects where Review is required by the SFBC [a, b, c]	√	√	√
Projects that typically require Review			
Projects incorporating exception(s) to prescriptive requirements of the SFBC [c]	√	√	√
Projects incorporating materials, systems, or technologies that are not directly addressed by the SFBC [c]	√	√	√
Buildings with structural height (h_n as defined in ASCE 7) 240 feet or taller, including projects designed to the prescriptive provisions of the SFBC [d]	√	√	√
Projects that may require Review, depending on size, occupant load, importance, and similar considerations [h]			
Addition or alteration of existing structures, where seismic retrofit is required by the SFEBC [f]	√	√	
Projects on Site Class F sites requiring site responses analysis		√	√
Projects on sites with mapped or potential geologic or seismic ground deformation hazards		√	√
Projects on sites with compressible soils below the foundation, having potential for long-term consolidation settlement under gravity loads [g]		√	
Projects using ground improvement or special foundation systems		√	√
Projects with dewatering that lowers groundwater by more than 10 feet, located adjacent to major structures or utilities		√	
Projects with below-grade excavation deeper than 15 feet, located adjacent to major structures or utilities		√	

[a] Ground Motion Review is required whenever response-history analysis is used.

[b] Where Review is required by the SFBC, such review process shall also conform to the specific requirements of the SFBC. The 2016 SFBC references ASCE 7-10, which requires design review in Sections 16.2.5 (Seismic Response History Procedures), 17.7 (Seismically Isolated Structures), and 18.8 (Structures with Damping Systems)

[c] The Director shall determine which Review disciplines are required based on which disciplines relate to the code requirements, code exceptions, or technologies proposed for the project.

[d] All projects of new buildings 240 feet or taller located in the City's softest soils and/or liquefaction zones, as defined by the California Seismic Hazard Zone Map, released by the California Department of Conservation, Division of Mines and Geology, dated November 17, 2000, shall include two Geotechnical Reviewers on the Engineering Design Review Team unless the project will include piles/drilled piers anchored to bedrock. Only one Geotechnical Reviewer is required for a project that will anchor piles/piers to bedrock.

[e] Review of site-specific hazard is not required if the general (rather than site-specific) earthquake response spectrum is used.

[f] See commentary regarding Review of existing structures.

[g] Soils with potential for long-term consolidation settlement typically include normally to lightly overconsolidated clayey soils, such as Bay Mud and Old Bay Clay, though other soils may also exhibit such behavior.

[h] It is intended that most projects in this category would not require Review, except for major structures based on the list of considerations above this table.

Commentary: Review may be appropriate for the seismic evaluation or retrofit design of existing structures when such an evaluation is carried out according to either (a) SFEBC Sections 301.1.4.2.3/301.1.4.1.2, which reference the ASCE 41 standard, or (b) SFEBC Sections 301.1.4.2.1/301.1.4.1.1, which require a lateral strength of 75%/100% of that required for new buildings, sometimes assumed to be taken only in elements with structural detailing conforming to current code requirements. Review issues applicable to existing structures can include:

- Establishing appropriate material properties.
- Properly accounting for strength degradation, including acceptability limits for degrading components.
- Use of materials not covered in building codes, such as fiber-reinforced polymer (FRP).
- For evaluations per SFEBC Sections 301.1.4.2.1/301.1.4.1.1, evaluating the behavior and compatibility of existing elements, including gravity framing.

6. SCOPE OF REVIEW SERVICES

The scope of services for each Reviewer shall be approved by the Director. Each Reviewer shall provide to the Director a written copy of the proposed scope of services for the Reviewer's contract with SFDBI. The proposed scope of services in the contract and any changes proposed to be made thereto shall be approved by the Director. The following describes possible review services for the disciplines addressed in this bulletin.

Services common to all Review disciplines

The scope of services for Review disciplines addressed herein shall include the following:

- Define the scope of the Review.
- Participate in meetings with the Engineer of Record, other Reviewers, and representatives of the Director, either in person or remotely, to discuss and resolve technical issues.
- Review design criteria, methods, and assumptions, and compatibility of the criteria with the project objectives.
- Review, typically by spot-check, analysis results, calculations, and structural drawings. As appropriate, conduct limited independent analyses or calculations as a check of the design.
- Maintain a project Review comment log addressing the material reviewed, including Reviewer comments, the Engineer of Record's responses, and resolution of comments.
- Prepare a letter report that summarizes the findings of the Review and provides the Reviewer's professional opinion whether the aspects of the project in the Reviewer's purview are in conformance with criteria identified in the scope of the Review. Prepare interim letters if required for partial permitting.

At the discretion of the Director, the Review may be restricted to a single aspect, such as seismic design of the structural system, or it may include other aspects of design, such as design for wind resistance, design of special foundation or earth retaining systems, or the structural bracing of important non-structural elements.

The Review may cover design-build or contractor-designed items that affect structural and geotechnical performance relevant to the intended scope of the Review.

Structural Engineering Design Review services

If a Review of Structural Engineering Design is undertaken, the scope of services shall indicate the aspects of design or structural elements (e.g. seismic design, dampers, etc.) that are included in the Review. The scope of services may include review of the following:

- Structural performance goals

- Structural basis of design and overall concept
- Design methodology and acceptance criteria
- Mathematical modeling and simulation, including input assumptions
- Structural calculations
- Interpretation of analysis results
- Design and detailing of members and systems
- Structural Construction Documents, including drawings, specifications, and quality control and inspection provisions

Geotechnical Engineering Review services

If a Review of Geotechnical Engineering is undertaken, the scope of services shall include review of geotechnical engineering methods and assumptions and the geotechnical aspects of foundation design, as well as evaluation of the recommendations regarding geotechnical aspects of construction, which may include load testing and construction monitoring. This may include review of the following:

- Project geotechnical report, including draft versions as appropriate, and the final report
- Geotechnical basis of design
- Plans and drawings for the selected foundation system, including below-grade walls
- Pertinent calculations performed in support of geotechnical or foundation recommendations
- The proposed foundation system and its appropriateness for the structure and ground conditions encountered at the site
- Allowable foundation bearing pressures for gravity, seismic, and other relevant loading conditions
- Predicted foundation settlement, including expected and potential variation, under anticipated gravity and seismic loading conditions
- Design earth pressure, including static and seismic, for below-grade walls
- If used in the design evaluations, load-deflection characteristics of the soil-foundation system
- The assessment of risk for liquefaction, landslide, or other site geologic hazards
- Ground improvement recommendations, including static and seismic performance criteria
- The potential effects of construction activities
- Long-term interaction with foundations of existing adjacent and nearby structures
- The proposed foundation load testing program and load test program results
- The proposed quality control and quality assurance program for ground improvement
- The proposed monitoring program for evaluating performance of shoring, dewatering, adjacent buildings, and nearby improvements

Commentary: Often, design of ground improvement systems (e.g. deep soil mixing) is performed by a design-build contractor. In that case, the design team should provide to the Reviewers design-build contractor's calculations demonstrating that the ground improvement will perform as intended during the design ground motions. The contractor's ground improvement plan – including test section, quality control and quality assurance procedures, and post- improvement verification field measurements – should be reviewed by the Geotechnical Engineering Reviewer.

If design of deep foundations is performed by a specialty deep foundation contractor (e.g. torqued-in pipe piles), foundation performance criteria should be established by the design team, and verification load test results should be reviewed by the Geotechnical Engineering Reviewer.

Site-Specific Seismic Hazard Review services

If a Review of site-specific seismic hazard is undertaken, the scope of services shall include the review of site-specific earthquake spectra, the methods and assumptions used in development of the spectra, and SFBC requirements. This may include the review of:

- Fault sources, and associated magnitude ranges
- Site information and assumed shear wave velocity and other properties
- Application of ground motion prediction equations
- Adjustment for rupture directivity, orientation with respect to the fault, basin effects, maximum direction effects, or other effects
- Site response analysis, including effect of the presence of deep foundations and/or ground improvement on site response.
- Comparison of spectra to code-minimum requirements
- Soil-foundation-structure interaction effects, where included in the seismic hazard analysis

Earthquake Ground Motion Review services

The scope of services shall include the review of the motions to be used in the design, their selection, scaling to response spectra, their duration, and SFBC requirements. This may include review of:

- Fault sources and characteristics
- The method used for scaling or matching and the period range for scaling
- Suitability related to record characteristics such as magnitude, distance, mechanism, $V_{s\,30}$ or other site parameters, scale factor, and the presence and period of pulses
- Orbit plots of the horizontal components of the records
- The location and orientation of how the records are applied to the structure

7. REVIEW PROCESS

Schedule

Reviewers should be engaged as early in the design process as practical. This affords Reviewers and the design team an opportunity to evaluate fundamental design decisions, which could disrupt design development if addressed later in the design phase. Early in the design process, the Engineer(s) of Record, a representative of the Director, and the Reviewer(s) should convene a meeting to establish the scope of the Review, the methods and lines of communication, the timing of Review milestones, and the degree to which the Engineer(s) of Record anticipates the design will be developed for each milestone.

Submittals by the Engineer(s) of Record to the Reviewer(s)

The Engineer(s) of Record shall provide design submittals to the Reviewer(s). Submittals shall be organized and documented in a manner that facilitates review by the Reviewer(s).

Where engineering software is used to perform structural or geotechnical analysis, the Engineer of Record shall identify the version of software used and shall indicate key assumptions and how the analysis is applied to the project. The Engineer of Record shall, as requested, provide copies of data input and output for the Reviewer(s) and shall indicate those aspects of the output that govern the design. Where the software used is not commercially available or commonly used in the industry for the purpose undertaken, the Engineer of Record shall provide verification records indicating that the software is capable of proper solution of analysis of the type performed on the project. If the software is not available to the Reviewer(s) for the evaluation of the input and interpretation of results, the Engineer of Record shall provide such data as the Reviewer(s) deem necessary to perform verification that the work is properly executed.

Comment log

Reviewers shall provide written comments in a timely fashion to the Engineer(s) of Record and to the Director, with requests for response as necessary. The Engineer(s) of Record are responsible for responding to all comments. The Reviewer(s) shall maintain a log that summarizes Reviewer comments, Engineer of Record responses to comments, and resolution of comments. The Reviewer(s) shall make the log available to the Engineer(s) of Record, the Director, and the Project Sponsor as requested.

For projects designed to the prescriptive provisions of the SFBC, the comment log may identify aspects of the project for which performance might be improved by introducing design enhancements exceeding the minimum requirements of the SFBC. It is not required for the design to be modified to comply with these enhancements unless so directed by the Director.

Review findings reports

At the conclusion of the Review, and at other times requested by the Director, the Reviewer(s) shall submit to the Director a written report documenting the scope of the Review, the comment log, and the professional opinions of the Reviewer(s) regarding the design's conformance with the criteria identified in the scope of the Review.

8. DISPUTE RESOLUTION

The Engineer of Record and the Reviewer(s) shall interact in a professional manner. Reviewers shall prepare comments in a respectful manner, shall prepare in writing all requests for response, and shall make reasonable requests of the Engineer of Record for additional evaluations or backup information. The Engineer of Record shall respond clearly and completely to Reviewer comments.

The Engineer of Record and the Reviewer(s) shall attempt to develop a resolution on each issue raised. If the Engineer of Record and the Reviewer(s) are unable to resolve particular comments, the Reviewer(s) shall report the impasse to the Director, and the Director shall give the Engineer of Record and the Reviewer(s) the opportunity to explain their arguments.

The Director, as Building Official, makes all decisions concerning acceptance of a design and issuance of permits. The responsibility of the Reviewer is limited to providing his or her professional opinion to the Director. The Director, should the need arise, may address differences of opinion between the Engineer of Record and the Reviewer(s) in a method the Director deems appropriate. The Director also may engage additional outside consultants to assist in issue resolution.

12/3/18

Daniel Lowrey — Date
Deputy Director
Department of Building Inspection

12/3/18

Tom C. Hui, S.E., C.B.O. — Date
Director
Department of Building Inspection

12/3/18

Gary Ho, S.E. — Date
Manager
Department of Building Inspection

Approved by the Building Inspection Commission on 11/21/2018.

AB-083 Requirements and Guidelines for the Seismic Design of New Tall Buildings using Non-Prescriptive Seismic-Design Procedures

NO. AB-083 :	
DATE :	March 25, 2008 (Updated 01/01/2020 for code references)
SUBJECT :	Permit Processing and Issuance
TITLE :	**Requirements and Guidelines for the Seismic Design of New Tall Buildings using Non-Prescriptive Seismic-Design Procedures**
PURPOSE :	The purpose of this Administrative Bulletin is to present requirements and guidelines for the seismic structural design and submittal documents for building permits for new tall buildings in San Francisco that use non-prescriptive seismic design procedures.
REFERENCES :	2019 San Francisco Building Code, Section 104A.2.8 Alternate materials, design, and methods of construction SEAONC, 2007, *Recommended Administrative Bulletin on the Seismic Design & Review of Tall Buildings Using Non-Prescriptive Procedures* , prepared by Structural Engineers Association of Northern California (SEAONC) AB-083 Tall Buildings Task Group ASCE, 2016, *Minimum Design Loads for Buildings and Other Structures* (ASCE/SEI 7-16, Prepared by the Structural Engineering Institute of the American Society of Civil Engineers 2003 NEHRP Recommended Provisions For New Buildings And Other Structures Part 1: Provisions and Part 2: Commentary (FEMA 450) SEAONC, 1999, *Contractual Provisions to Address the Engineer's Liability when Using Performance-Based Seismic Design*, Structural Engineers Association of Northern California SEAOC, 2001, "Seismology Committee Background and Position Regarding 1997 UBCEq. 30-7 and Drift," Structural Engineers Association of California (http://www.seaoc.org/seismpdfs/UBC/30_7.pdf)
DISCUSSION :	

1. SCOPE

This bulletin presents requirements and guidelines for seismic structural design and submittal documents for building permit for new tall buildings in San Francisco that use non-prescriptive seismic design procedures.

Commentary: It is intended that buildings designed to the requirements and guidelines of this bulletin will have seismic performance at least equivalent to that intended of code-prescriptive seismic designs, consistent with the San Francisco Building Code sections indicated below. To demonstrate that a building design is capable of providing code equivalent seismic performance, a three-step procedure shall be performed as specified in Section 4 of this Administrative Bulletin. Intended code seismic performance can be found in the commentary of FEMA 450.

This bulletin intentionally contains both requirements, which are stated in mandatory language (e.g., "shall") and guidelines, which use non-mandatory language.

This bulletin is not written to cover essential facilities.

For the purposes of this Administrative Bulletin, a non-prescriptive seismic design is one that takes exception to one or more of the prescriptive requirements of the San Francisco Building Code and Chapter 12 of ASCE/SEI 7-16 and the standards referenced therein, by invoking San Francisco Building Code, Section 104A.2.8, which allows alternative materials and methods of construction as approved by the Building Official.

For the purposes of this bulletin, tall buildings are defined as those with h_n greater than 160 feet above average adjacent ground surface.

The height, h_n is defined in the San Francisco Building Code as the height of Level n above the average level of the ground surface adjacent to the structure. Level n is permitted to be taken as the roof of the structure, excluding mechanical penthouses and other projections above the roof whose mass is small compared with the mass of the roof.

Procedures other than those presented herein may be acceptable pursuant to the approval of the Director of the Department of Building Inspection.

Commentary: ASCE/SEI 7-16 Sections that discuss non-prescriptive or "alternative" seismic design procedures are reproduced below:

11.1.4 Alternate Materials and Methods of Construction. Alternate materials and methods of construction to those prescribed in the seismic requirements of this standard shall not be used unless approved by the authority having jurisdiction. Substantiating evidence shall be submitted demonstrating that the proposed alternate, for the purpose intended, will be at least equal in strength, durability, and seismic resistance.

12.1.1 Basic Requirements. …An approved alternative procedure shall not be used to establish the seismic forces and their distribution unless the corresponding internal forces and deformations in the members are determined using a model consistent with the procedure adopted.

San Francisco Building Code sections that discuss non-prescriptive or "alternative" seismic design procedures are reproduced below:

104A.2.8 Alternate materials, design and methods of construction. The provisions of this code are not intended to prevent the use of any material, alternate design or method of construction not specifically prescribed by this code, provided any alternate has been approved and its use authorized by the building official.

The building official may approve any such alternate, provided the building official finds that the proposed design is satisfactory and complies with the provisions of this code and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in suitability, strength, effectiveness, fire resistance, durability, safety and sanitation.

The building official shall require that sufficient evidence or proof be submitted to substantiate any claims that may be made regarding its use. The details of any action granting approval of an alternate shall be recorded and entered in the files of the code enforcement agency.

1604.4 Analysis. Any system or method of construction to be used shall be based on a rational analysis in accordance with well-established principles of mechanics. Such analysis shall result in a system that provides a complete load path capable of transferring all loads and forces from their point of origin to the load-resisting elements.

2. STRUCTURAL DESIGN REVIEW

Structural Design Review shall be in accordance with AB-082. At the conclusion of the review, the Structural Design Reviewer shall provide a written statement that, in their professional opinion, the building elements under their review are equivalent in strength, durability, and seismic resistance of the building to those of a building designed according to the prescriptive provisions of the San Francisco Building Code.

3. SUBMITTAL REQUIREMENTS

Project submittal documents shall be in accordance with the San Francisco Building Code and Department of Building Inspection interpretations, Administrative Bulletins, and policies. In addition, documents relevant to the Structural Design Review shall be submitted by the Engineer of Record to the Director and to the Structural Design Reviewer.

As early as practicable, the Engineer of Record shall submit to the Director an initial Seismic Design Criteria along with a description and initial drawings of the structure. The Seismic Design Criteria shall be consistent with the requirements of this bulletin, and shall be updated to incorporate issues resolved during the Structural Design Review process.

The Seismic Design Criteria shall describe the proposed building and structural system, proposed analysis methodology, and acceptance criteria. The Seismic Design Criteria shall include any proposed exceptions to the prescriptive provisions of the San Francisco Building Code, modeling parameters, material properties, drift limits, element force capacities and deformation capacities. The Seismic Design Criteria shall identify all exceptions to the San Francisco Building Code prescriptive requirements that the Engineer of Record proposes. The Seismic Design Criteria shall be subject to review by the Structural Design Reviewer and approval by the Director. A summary of the Engineer of Record's final Seismic Design Criteria shall be included in the general notes of the structural drawings.

4. SEISMIC DESIGN REQUIREMENTS

The Engineer of Record shall evaluate the structure at the levels of earthquake ground motion as indicated in the subsections below.

If nonlinear response is anticipated under any of the Maximum Considered Earthquake (MCE) ground motions specified in Section 4.3, the Engineer of Record shall apply capacity design principles and design the structure to have a suitable ductile yielding mechanism, or mechanisms, under nonlinear lateral deformation. The code-level analysis shall be used to determine the required strength of the yielding actions. The Engineer of Record shall include in the Seismic Design Criteria all assumptions and factors used in the application of capacity design principles.

Commentary: The purpose of each level of seismic evaluation is as follows:

The code-level evaluation of Section 4.1 is used to identify the exceptions being taken to the prescriptive requirements of the San Francisco Building Code and to define the minimum required strength and stiffness for earthquake resistance. Minimum strength is defined according to San Francisco Building Code minimum base shear equations, with a response modification coefficient *R*, proposed by the Engineer of Record, reviewed by the Structural Design Reviewer, and approved by the Director. Minimum stiffness is defined by requiring the design to meet San Francisco Building Code-specified drift limits, using traditional assumptions for effective stiffness. Providing a non-prescriptive seismic design with minimum strength and stiffness comparable to code-prescriptive designs helps produce seismic performance at least equivalent to the code. Minimizing the number of exceptions to prescriptive requirements also helps achieve this aim.

As indicated in Section 4.2, a service-level evaluation is required by this bulletin to demonstrate acceptable seismic performance for moderate earthquakes.

The MCE-level evaluation of Section 4.3 is intended to verify that the structure has an acceptably low probability of collapse under severe earthquake ground motions. The evaluation uses nonlinear response-history analysis to demonstrate an acceptable mechanism of nonlinear lateral deformation and to determine the maximum forces to be considered for structural elements and actions designed to remain elastic.

4.1 Code-Level Evaluation

The seismic structural design shall be performed in accordance with the prescriptive provisions of the San Francisco Building Code, except for those provisions specifically identified by the Engineer of Record in the Seismic Design Criteria as Code Exceptions.

Commentary: Code exceptions that have typically been taken for non-prescriptive designs of tall buildings in high seismic design categories include exceeding the height limitations of ASCE/SEI 7-16 Table 12.2.1. Other exceptions, including provisions related to R,ρ,Ω_0, limitations on T, and various detailing requirements, may be considered at the discretion of the Director. The Engineer of Record is required to justify all exceptions to prescriptive code provisions. The scope of structural design review shall include all proposed code exceptions.

The lower limit of ASCE/SEI 7-16 Eq. 12.8-5 and 12.8-6 for the calculation of the Seismic Response Coefficient applies to the scaling process of ASCE/SEI 7-16 Section 12.9. The value of R used shall be indicated in the Seismic Design Criteria, and shall not be greater than 8.5.

The Engineer of Record shall demonstrate that the structure meets the story drift ratio limitations of the San Francisco Building Code using a code-level response-spectrum analysis and the following requirements:

a) The design lateral forces used to determine the calculated drift need not include the minimum base shear limitation of ASCE/SEI 7-16 eq. 12.8-5 and 12.8-6.

b) Stiffness properties of non-prestressed concrete elements shall not exceed 0.5 times gross-section properties.

c) Foundation flexibility shall be considered, using recommendations provided by the Geotechnical Engineer of Record that are defined in the Seismic Design Criteria.

d) The analysis shall account for P-delta effects.

Commentary: ASCE/SEI 7-16 requires the consideration of the minimum base shear of Eq. 12.8-5 and 12.8-6 for checking design story drifts relative to allowable story drifts. However, the consensus of SEAONC's AB-083 Task Group for this Administrative Bulletin, approved by the SEAONC Board, is that UBC Formula 30-7 (equivalent to ASCE/SEI 7-16 Eq. 12.8-6) need not be applied to the check of drift limits for tall buildings designed according to this bulletin, because the MCE-level Evaluation of Section 4.3 includes a check of drift for site-specific ground motions. Such ground motions are required to take account of near-fault and directivity effects. The consensus of the task group is that this is an appropriate and more explicit way of addressing the intended purpose of applying Formula 30-7 to the check of drift limits.

Actual concrete stiffness properties may vary significantly from the value of 0.5 times gross-section properties referenced for the code-level check of story drift limits. This assumption is specified to provide a consistent requirement for minimum building stiffness. This requirement is intended to lead to earthquake serviceability performance related to story drift that is at least comparable to that expected of prescriptively-designed tall buildings designed to the San Francisco Building Code.

For the deformation compatibility evaluation of critical non-structural elements, such as exterior curtain wall and cladding systems and egress stairways, the drift ratio demand shall be calculated using the minimum base shear limitations of ASCE/SEI 7-16 Eq. 12.8-5 and 12.8-6. In lieu of this requirement, these critical non-structural elements may be designed for drift ratios at the MCE-level.

4.2 Service-Level Evaluation

A service-level evaluation of the primary structural system is required to demonstrate acceptable, essentially elastic seismic performance at the service-level ground motion.

Commentary: To ensure code-equivalent seismic performance, the Director is requiring a service-level evaluation for new tall buildings utilizing non-prescriptive design procedures.

There are circumstances where there is a reason to believe that the serviceability performance of the design would be worse than that anticipated for a code-prescriptive design. Some of these circumstances have been identified as follows:

a) Where the Engineer of Record has taken any exception to code-prescriptive requirements for non-structural elements (ASCE/SEI 7-16, Chapter 13)

b) Where the stiffness representation of any structural element in the code-level evaluation is significantly less than the effective linear-elastic stiffness described in applicable research

c) For a structure that exhibits disproportionably large drift or accelerations for ground motions less than the San Francisco Building Code Design Basis Ground Motion (not reduced by R).

While this bulletin does not require checking all non-structural elements at the service-level evaluation, it is expected that the building cladding will remain undamaged and that egress from the building will not be impeded when the building is subjected to the service-level ground motion.

For the purposes of this bulletin, the service-level ground motion shall be that having a 43-year mean return period (50% probability of exceedance in 30 years).

Structural models used in the service-level evaluation shall incorporate realistic estimates of stiffness and damping considering the anticipated levels of excitation and damage. The evaluation shall demonstrate that the elements being evaluated exhibit serviceable behavior.

Commentary: While essentially elastic performance is required in the service-level ground motion, it is not the intent of this bulletin to require that a structure remain fully linear and elastic. It is permissible for the analysis to indicate minor yielding of ductile elements of the primary structural system, provided such results do not suggest appreciable permanent deformation in the elements, strength degradation, or significant damage to the elements requiring more than minor repair. It is permissible for the analysis to indicate minor and repairable cracking of concrete elements.

Where numerical analysis is used to demonstrate serviceability, the analysis model should represent element behavior that is reasonably consistent with the expected performance of the elements. In typical cases it may be suitable to use a linear response spectrum analysis, with appropriate stiffness and damping, and with the earthquake demands represented by a linear response spectrum corresponding to the service-level ground motion. Where response history analysis is used, the selection and scaling of ground motion time series should comply with the requirements of ASCE/SEI 7-16, Section 16.2, with the service-level response spectrum used instead of the design basis earthquake response spectrum, and with the design demand represented by the mean of calculated responses for not less than seven appropriately selected and scaled time series.

As expressed by SEAONC [1999], it should be understood "that the current state of knowledge and available technology is such that the design profession's ability to accurately predict the earthquake performance of a specific building is limited and subject to a number of uncertainties." Actual performance may differ from intended performance.

4.3 Maximum Considered Earthquake-Level Evaluation

Ground Motion: The ground motion representation for this evaluation shall be the Maximum Considered Earthquake (MCE) as defined in ASCE/SEI 7-16, Chapter 21.

A suite of not less than seven pairs of appropriate horizontal ground motion time series shall be used in the analyses. The selection and scaling of these ground motion time series shall comply with the requirements of ASCE/SEI 7-16, Chapter 16, with the following modifications:

a) The MCE response spectrum shall be the basis for ground motion time series scaling instead of the design response spectrum.

b) Either amplitude-scaling procedures or spectrum-matching procedures may be used.

c) Where applicable, an appropriate number of the ground motion time series shall include near fault and directivity effects such as velocity pulses producing relatively large spectral ordinates at relatively long periods.

Commentary: The procedures for selecting and scaling ground motion records, as presented here, represent the current state of practice. The procedures are written to retain some flexibility so that engineering judgment can be used to identify the best approach considering the unique characteristics of the site and the building.

Selection and scaling of earthquake ground motion records for design purposes is a subject of much current research. The Engineer of Record may wish to consider alternative approaches recently proposed; however, some of the proposed approaches have not been adequately tested on tall buildings so their adoption should only be considered with caution. Aspects of particular concern include the long vibration period of many tall buildings and the contributions of multiple vibration "modes" to key response quantities.

At near-fault sites, the average fault-normal response spectrum usually is larger than the average fault-parallel response spectrum due to the presence of a rupture directivity pulse in the fault-normal component of the ground motion. It is important to include in the suite of ground motions an appropriate number of motions that include near-fault and directivity effects so that design drift demands are appropriately determined, especially considering that Section 4.1 permits the design to be exempt from applying Equations 12.8-5 and 12.8-6 to drift calculations. If spectral matching is used, individual ground motion components should account for the distinction between fault-normal and fault-parallel hazard.

Mathematical Model: The three-dimensional mathematical analysis model of the structure shall conform to ASCE/SEI 7-16 Section 12.7.3.

The analyses shall consider the interaction of all structural and non-structural elements that materially affect the linear and nonlinear response of the structure to earthquake motions, including elements not designated as part of the lateral-force-resisting system in the code-level analysis (Section 4.1).

Commentary: This requires explicit modeling of those parts of the structural and non-structural systems that affect the dynamic response of the building. In addition, the effect of building response on all materially affected parts of the building must be evaluated.

The stiffness properties of reinforced concrete shall consider the effects of cracking and other phenomena on initial stiffness.

Commentary: In addition to cracking, effective stiffness can be affected by other phenomena. These include bond slip, yield penetration, tension-shift associated with shear cracking, panel zone deformations, and other effects.

The effective initial stiffness of steel elements embedded in concrete shall include the effect of the embedded zone. For steel moment frame systems, the contribution of panel zone (beam-column joint) deformations shall be included.

The Engineer of Record shall identify any structural elements for which demands for any of the response-history runs are within a range for which significant strength degradation could occur, and shall demonstrate that these effects are appropriately considered in the dynamic analysis.

Commentary: For typical situations, element strength degradation of more than 20% of peak strength should be considered significant.

P-Δ effects that include all the building dead load shall be included explicitly in the nonlinear response history analyses.

Documentation submitted for Structural Design Reviewer review shall clearly identify which elements are modeled linearly and which elements are modeled nonlinearly. For elements that are modeled as nonlinear elements, submitted documentation shall include suitable laboratory test results or analyses that justify the hysteretic properties represented in the model.

The properties of elements in the analysis model shall be determined considering earthquake plus expected gravity loads. In the absence of alternative information, gravity load shall be based on the load combination $1.0D + L_{exp}$, where D is the service dead load and L_{exp} is the expected service live load.

Commentary: In typical cases it will be sufficient to take $L_{exp} = 0.2L$, where L is the code-prescribed live load without live load reduction.

The foundation strength and stiffness contribution to the building seismic response shall be represented in the model. The foundation strength and stiffness characterization shall be consistent with the strength and stiffness properties of the soils at the site, considering both strain rate effects and soil deformation magnitude.

Analysis Procedure: Three-dimensional nonlinear response history (NLRH) analyses of the structure shall be performed. Inclusion of accidental torsion is not required. When the ground motion components represent site-specific fault-normal ground motions and fault-parallel ground motions, the components shall be applied to the three-dimensional mathematical analysis model according to the orientation of the fault with respect to the building. When the ground motion components represent random orientations, the components shall be applied to the model at orientation angles that are selected randomly; individual ground motion pairs need not be applied in multiple orientations.

Commentary: Three-dimensional analyses are required to represent the inherent torsional response of the building to earthquake ground shaking. This is done by including in the NLRH model the actual locations and distribution of the building mass, stiffness, and strength. Accidental torsion is not required to be included in the NLRH analyses. (Accidental torsion is required for the code-level analysis of Section 4.1.)

The Engineer of Record shall report how damping effects are included in the NLRH analyses. The equivalent viscous damping level shall not exceed 5%, unless adequately substantiated by the Engineer of Record.

Commentary: The effects of damping in an analysis depend on the type of damping model implemented. Some models may over-damp higher modes or have other undesirable effects.

For each horizontal ground motion pair, the structure shall be evaluated for the following load combination:

$$1.0D + L_{exp} + 1.0E$$

Alternative load combinations, if used, shall be adequately substantiated by the Engineer of Record.

Demands for ductile actions shall be taken not less than the mean value obtained from the NLRH. Demands for low-ductility actions (e.g., axial and shear response of columns and shear response of walls) shall consider the dispersion of the values obtained from the NLRH.

Commentary: In typical cases the demand for low-ductility actions can be defined as the mean plus one standard deviation of the values obtained from the NLRH. Procedures for selecting and scaling ground motions, and for defining the demands for low-ductility actions, should be defined and agreed to early in the review process.

Acceptance Criteria: Calculated force and deformation demands on all elements required to resist lateral and gravity loads shall be checked to ensure they do not exceed element force and deformation capacities. This requirement applies to those elements designated as part of the lateral-force-resisting system in the code-level analysis (Section 4.1), as well as those elements not designated as part of the lateral-force-resisting system in the code-level analysis but deemed to be materially affected.

Commentary: Elements not designated as part of the lateral-force-resisting system in the code-level analysis (gravity systems) may be subjected to substantial deformations and forces, including axial forces accumulated over many stories, as they interact with the primary lateral-force-resisting system. Non-structural elements such as cladding are evaluated according to code requirements. This bulletin does not require checking non-structural elements at the MCE level.

The Engineer of Record shall identify the structural elements or actions that are designed for nonlinear seismic response. All other elements and actions shall be demonstrated by analysis to remain essentially elastic.

Commentary: Essentially elastic response may be assumed for elements when force demands are less than design strengths. Design strengths for non-ductile behaviors (e.g., shear and compression) of these essentially elastic elements are defined as nominal strengths, based on specified material properties, multiplied by strength reduction factors as prescribed in the SFBC. Design strengths for ductile behaviors of these essentially elastic elements are defined as nominal strengths, based on expected material properties, multiplied by ϕ=1.0. Alternative approaches to demonstrating essentially elastic response may be acceptable where appropriately substantiated by the Engineer of Record.

For structural elements or actions that are designed for nonlinear seismic response, the Engineer of Record shall evaluate the adequacy of individual elements and their connections to withstand the deformation demands. Force and deformation capacities shall be based on applicable documents or representative test results, or shall be substantiated by analyses using expected material properties.

The average result, over the NLRH analyses, of peak story drift ratio shall not exceed 0.03 for any story.

All procedures and values shall be included in the Seismic Design Criteria and are subject to review by the Structural Design Reviewer and approval by the Director.

Originally signed by:

Isam Hasenin, P.E., C.B.O.,

Director

Department of Building Inspection

Approved by the Building Inspection Commission on March 19, 2008

Administrative Bulletin

No. AB-111	**:**	
SUBJECT	**:**	Permit Processing and Issuance
DATE	**:**	June 15, 2020
TITLE	**:**	**Guidelines for Preparation of Geotechnical and Earthquake Ground Motion Reports for Foundation Design and Construction of Tall Buildings**

PURPOSE : The purpose of this Administrative Bulletin is to present requirements and guidelines for developing geotechnical site investigations and preparing geotechnical reports for the foundation design and construction of tall buildings.

REFERENCES : 2019 San Francisco Building Code (SFBC)

Administrative Bulletin AB-082: Guidelines and Procedures for Structural, Geotechnical, and Seismic Hazard Engineering Design Review

CCSF (2014) – Guidance for Incorporating Sea Level Rise into Capital Planning In San Francisco: Assessing Vulnerability and Risk to Support Adaptation.

CCSF (1206) – San Francisco Sea Level Rise Action Plan.

NRC (2012) – Sea Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future.

NIST / NEHRP (2012) – Soil-Structure Interaction for Building Structures, GCR 12-917-21.

PEER (2017) – Tall Buildings Initiative, Guidelines for Performance-Based Seismic Design of Tall Buildings, Version 2.01, PEER Report No. 2017/06, May.

Poulos, H.G. 2017 – Tall Building Foundation Design, publishing house CRC Press, ISBN 9781138748033.

Ellen Plane, Kristina Hill, and Christine May “A Rapid Assessment Method to Identify Potential Groundwater Flooding Hotspots as Sea Levels Rise in Coastal Cities,” October 25, 2019

K. Yasuhara; S. Murakami; N. Mimura; H. Komine; and J. Recio, “Influence of global warming on coastal infrastructural instability,” December 2006

Many relevant and useful references are provided in the following document: ATC 119 (2019) – Seismic Safety and Engineering Consulting Services for the Earthquake Safety Implementation Program (ESIP), City and County of San Francisco, 2019.

DISCUSSION :

1. SCOPE OF THIS BULLETIN

This bulletin presents guidelines for developing a geotechnical site-investigation program and preparing geotechnical reports for foundation design and construction of tall buildings in San Francisco. Sections 2 and 3 of this bulletin are requirements and therefore are stated in mandatory language. The remaining sections are guidelines, which use non-mandatory language.

For the purposes of this bulletin, tall buildings are defined as those with h_n (ASCE 7), greater than 240 feet.

The height, h_n, is defined in the San Francisco Building Code (SFBC) as the height of level *n* above the average level of the ground surface adjacent to the structure. Level *n* is permitted to be taken as the roof of the structure, excluding mechanical penthouses and other projections above the roof whose mass is small compared with the mass of the roof.

Early in a project, the Geotechnical Engineer of Record (GEOR) shall develop a geotechnical site-investigation program and geotechnical report document in accordance with this bulletin.

2. GEOTECHNICAL DESIGN REVIEW

The review of geotechnical design shall meet the requirements of AB-082. The geotechnical member(s) of the Engineering Design Review Team (EDRT) shall participate in the Early Site Permit phase of the project to review the GEOR's plan for geotechnical site investigations and the GEOR's geotechnical basis-of-design document. During the subsequent design review, the EDRT will use the guidelines below to review the geotechnical report prepared for foundation design and construction.

At the conclusion of the review, the geotechnical members of the EDRT shall provide a written statement that, in their professional opinion, the geotechnical site-investigation plan and geotechnical reports meet the requirements of the SFBC and this bulletin.

> **Commentary:** The Draft of this bulletin was developed by a volunteer group of experienced geotechnical engineers as an ad-hoc committee of the Structural Engineers Association of Northern California (SEAONC). The draft was requested of SEAONC by SFDBI. Subsequently, the draft of this bulletin was processed (and in some places revised) through subcommittees of the Building Inspection Commission according to the Administrative Bulletin process.

3. SUBMITTAL REQUIREMENTS

Project submittal documents shall be in accordance with the SFBC and Department of Building Inspection (DBI) interpretations, Administrative Bulletins, and policies. In addition, documents relevant to the Geotechnical Design Review shall be submitted by the Engineer of Record to the Director and to the geotechnical members of the EDRT.

4. PROJECT DEFINITION AND DESIGN CRITERIA

In coordination with the project architect and structural engineer, the following information (if available at the time of preparation of the geotechnical report) should be provided: The project description; a site location map; height of the structure; number of stories; number of basement levels; lateral and gravity loads resisting systems; anticipated gravity foundation loads or bearing pressures; applicable codes and design guidelines for seismic design of the building (e.g., PEER TBI 2017 performance-based design of tall buildings); description of the energy dissipation system (if used); and the approach for development of design ground motions.

5. SITE SURFACE CONDITIONS

Description of existing structure(s) on the site should be presented with information related to the foundations (if known); the site's historical and current use; site surface elevation including, the reference datum; and description of adjacent facilities and structures with information related to their foundation system (if known) within the foundation zone of influence. The GEOR should determine the foundation zone of influence based on site's subsurface conditions, foundation type, and building configuration.

> **Commentary:** For a mat foundation bearing on the Colma sand layer, the lateral extent of the zone of influence could be estimated as approximately ½ of distance between the base of the mat and bedrock.

6. REGIONAL AND LOCAL GEOLOGY

This section should include a description of regional and local geology, including fill placement as part of land reclamation, if any. The description of local site geology should provide information about the anticipated engineering soil and rock properties likely to be encountered. Hazard maps and information from the USGS and the State should also be presented including anticipated sea level rise during the design life of the structure (e.g., NRC 2012, CCSF 2014, and CCSF 2016), seismic ground motion, soil liquefaction and lateral spreading, landslides, and tsunami/seiche (for sites near the shoreline).

7. SEISMICITY

A fault map should be provided showing the location of Holocene active faults within a 100 km radius of the site, with the epicenter and magnitude of historical earthquake events shown on the map. A table should be provided containing the pertinent fault information for sources that contribute significantly to the probabilistic seismic hazard analysis (PSHA) performed for a return period of 2,475 years at the key periods of interest to the building design using Uniform California Earthquake Rupture Forecast (UCERF) fault data file.

Commentary: The version of UCERF fault data file that is referenced by the latest California Building Code (CBC)/SFBC and ASCE 7 Standard should be identified and used. In current practice, when performing deterministic seismic hazards analysis (DSHA), maximum fault magnitudes are obtained either from UCERF2 fault data file or mean/mode magnitude from deaggregation of 2,475-year PSHA results.

8. FIELD INVESTIGATION AND LABORATORY TESTING

The subsurface conditions should be explored by drilling borings, and if appropriate, conducting cone penetration test (CPT) soundings. When considering the plan area of the proposed development and the magnitude of building loads, the number of borings and CPTs should be sufficient for characterizing the site's subsurface conditions and physical properties of soils and bedrock encountered.

The quality of samples should be appropriate for the anticipated laboratory strength or compressibility tests conducted to obtain load-deformation characteristics of soil in support of advanced numerical modeling.

Commentary: Integrated field and laboratory tests should be performed as appropriate to support the anticipated methods of analysis, which commonly include standard general limit equilibrium (GLE) methods and 2D or 3D nonlinear seismic soil-structure interaction (SSI) analyses. Historically, the selection of soil properties for static and seismic design of building foundations has been accomplished through parameter correlations with field tests such as the CPT and field vane shear test (FVST). Correlations with the results of field and soil-index tests are useful; however, it is recommended that relationships used in support of tall-building design in San Francisco be checked against local geotechnical data and adjusted, if need be, to provide representative properties of local soils. With the evolution and widespread adoption of performance-based seismic design for tall buildings, advanced numerical analyses incorporating soil-structure interaction (SSI) may be performed. Appropriate SSI analyses require substantial characterization of soil behavior such as strain-dependent shear modulus and material damping curves, and residual shear strength. The use of field test data should be supplemented with laboratory tests that provide soil parameters across the range of deformation anticipated for the project. Strain-dependent soil parameters must also account for the rate effects and the potential for cyclic degradation of soil stiffness and strength. Laboratory tests on soil, such as cyclic direct simple shear and cyclic triaxial, can provide insight into the soil behavior during seismic loading. The integration of suitability extensive field and laboratory test programs improves the reliability of site characterization, thereby reducing uncertainty.

Information and data from existing geotechnical borings and CPTs could be used to supplement new borings as long as existing geotechnical borings and CPTs are located reasonably close to the project site and are drilled in accordance with currently acceptable methods and standards. However, borings drilled only for environmental soil and/or groundwater sampling and testing or for water wells should not be used as a substitute for project-specific geotechnical borings or CPTs.

For sites with depth-to-bedrock of more than 100 feet, at least one boring should extend a minimum of 50 feet below the surface of bedrock; other borings should be as deep as deemed appropriate as determined by the GEOR and reviewed by the geotechnical members of the EDRT, based on the site's subsurface conditions, structural loads, and below-grade structural geometry.

For depth-to-bedrock of less than 100 feet, all borings should extend to the bedrock surface with one boring extending at least 50 feet below bedrock surface.

If used, CPTs should be pushed to refusal using a 20-ton CPT rig, if it is possible to access the site with it. At least one CPT sounding should be near a geotechnical boring for calibration purposes. If site conditions prohibit access for a CPT rig within the site, additional CPTs and/or borings adjacent to the site may be necessary and may be required by the EDRT.

Commentary: Field vane shear tests (FVST) are useful for evaluating the peak and remolded undrained shear strength of soft clay. For evaluation of soil liquefaction potential, lateral spreading, and slope instability adjacent to the site, it is suggested that CPT soundings be performed as much as practical because they provide continuous, reliable measurements that can be correlated to physical soil properties. CPTs are also useful for characterizing denser and stiffer units, such as Old Bay Clay (OBC) and for characterizing groundwater conditions with a pore pressure dissipation test. However, because liquefiable and soft soils are bypassed by using deep foundations or by using ground improvement to provide appropriate bearing support for building foundation, CPT soundings are of limited use under the building footprint because CPTs will most likely encounter refusal within the dense sand layer present at many sites in San Francisco. A sufficient number of borings should be drilled for adequate sampling within the OBC layer. Typically, at least one boring should be drilled or one CPT sounding should be performed in every 5,000 square feet of plot area.

Shear-wave velocity should be measured at least at one location using downhole techniques, seismic CPT, suspension logging, or surface-wave method, as appropriate. The number of tests should reflect the lateral variability of the soil deposits across the site. The shear-wave-velocity measurement should be conducted in such a manner as to allow for accurate determination of variation of shear-wave velocity with depth for computing the Vs30 parameter and for conducting site response analysis (if performed). If downhole logging is used, the shear-wave velocity of bedrock should be measured within the boring that extends at least 50 feet below the surface of bedrock.

To capture the variability in groundwater conditions over time, at least one piezometer should be installed, and piezometric levels should be observed from the time of original geotechnical exploration. In some cases, additional piezometers may be necessary and may be required by the EDRT.

Soil borings should be drilled using rotary wash drilling methods (unless the groundwater table is below the bottom of the boring). Drilling fluid or casing should be used to prevent collapse of borings and bottom instability.

Where compressibility and strength tests are planned in soft clays (e.g., Bay mud - BM), samples should be obtained using a thin-walled tube sampler.

Commentary: Osterberg-type hydraulic fixed-piston sampler with thin-wall tubes of constant inside diameter can provide high-quality samples.

In stiff clays (e.g., OBC) where strength and consolidation tests are planned, Pitcher Barrel sampler or approved equivalent should be used.

Standard penetration tests (SPT) should be performed in cohesionless soils. California modified sampler or Sprague and Henwood (S&H) sampler may be used in the alluvium often found between the bottom of OBC and bedrock and where strength and compressibility tests are not required. Hammer energy measurements should be performed for drive sample system (e.g., SPT and S&H) on at least one boring for the project.

Commentary: Pressuremeter test results have been successfully correlated with large strain modulus of various geological units in the east coast of the United States and overseas.

Rock coring should be used to obtain rock cores within bedrock for borings that extend at least 50 feet into rock. Rock cores should be reviewed and classified by a registered professional geologist. Parameters defining degree of rock weathering, rock strength, rock hardness, and rock mass properties such as the RQD, spacing of discontinuities, conditions of discontinuities, and dip angle should be recorded as directed by the GEOR.

For all soil types, sample intervals should be no greater than 5 feet or at layer interface unless a larger interval is deemed appropriate by the GEOR based on thickness and uniformity of soil layer, data from field vane tests or CPT soundings.

For sandy soils, one or more of the following laboratory tests, as deemed appropriate by GEOR, should be conducted: moisture-density (if S&H sampler is used), moisture test (if SPT sampler is used), fines content (minus sieve No. 200), sieve analysis, and plastic and liquid limits (if silty or clayey sand).

For cohesive soils, one or more of the following tests, as deemed appropriate by the GEOR, should be conducted: (1) unconsolidated or consolidated undrained triaxial tests, or (2) a direct simple shear test. Unconfined compressive strength may be used on representative rock samples but should not be used for cohesive soils.

The GEOR should determine the adequate number of pairs of consolidation and undrained shear strength tests to be performed on undisturbed samples of OBC for evaluation of settlement if a mat foundation is not supported by a deep foundation and is placed above the surface of OBC or if the foundation bears above or within OBC. One pair of consolidation and undrained shear strength tests should be considered for every 30 feet of OBC depth in four representative borings, unless the variability of the site is evaluated through CPTs. The minimum number of pairs should be four. Additional tests would be required if the preconsolidation stress is exceeded.

If OBC is expected to be subjected to vertical effective stresses higher than the preconsolidation pressure, additional tests are also required to measure the secondary consolidation characteristics of the OBC.

Field “index” tests such as the Pocket Penetrometer or Torvane tests may be used on clayey soil samples but should not be considered as a substitute for any laboratory tests described above.

9. SUBSURFACE CONDITIONS

At least two perpendicular cross sections should be provided. A full description of soil layers and geologic units with engineering properties (consistency and consolidation characteristic for clayey soils and potential for soil liquefaction and settlement for sand layers) should be provided.

A design groundwater elevation with consideration of sea level rise during the design life of the structure and seasonal fluctuation of groundwater level (if known) should be presented. The groundwater table expected to be encountered during construction should also be identified.

Commentary: The GEOR should use her/his judgement as to how far inland the influence of sea level rise would impact the groundwater level.

10. FOUNDATION AND GEOTECHNICAL EARTHQUAKE ENGINEERING STUDIES

10.1 Code-Based Site Classification

The Site Class designation should be made following the current edition of the applicable code and standard (e.g., ASCE 7, SFBC). The Site Class definitions should be based on V_{s30} and presence of soft clay or liquefiable soils. According to the code-based Site Class designation, V_{s30} is defined in the free field from the ground surface to the depth of 30 m (100 ft). However, Site Class may be defined below the bottom of the mat foundation (see Section 10.2.2 Ground Motion Characterization Commentary), if deemed appropriate.

10.2 Ground Motion and Seismic Ground Deformation Characterization

The regional seismic hazard assessment and ground-motion characterization should follow the procedures provided in applicable seismic guidelines and code provisions (e.g., PEER TBI 2017, ASCE 7). These procedures include the application of Probabilistic and Deterministic Seismic Hazard Analyses (PSHA, DSHA) incorporating specific seismic source models (e.g., UCERF, USGS NSHMP 2014 or 2018) and ground motion models (GMMs). The GEOR may use updated, widely adopted models in PSHA and DSHA in site-specific analysis. The ground-motion characterization should address pertinent issues such as near-fault effects, basin effects, and dynamic soil response (site effects). Embedment and base averaging effects may be accounted for, as applicable.

The selection and modification of ground motions (acceleration time series) should be consistent with recommendations found in the applicable codes and standards.

The subsequent sections address ground-motion characterization at the surface and at depth.

10.2.1 Ground-Motion Characterization at Surface

- For Site Classes A, B, and C, the ground-motion development may be based on V_{s30} measured from the ground surface using ground motion models (GMMs). The resulting ground-surface acceleration response spectra (MCE_R and DE) should be checked against minimum code requirements.
- For Site Class D determined based on V_{s30} measured from the ground surface, the ground motion may be developed using site response analyses or GMM's, as determined by the GEOR and approved by the geotechnical members of the EDRT. The resulting acceleration response spectra should be checked against the minimum code requirements. Consideration of site response analysis is warranted because of the breadth of the V_{s30} values defining Site Class D soil profiles (i.e., V_{s30} of 600 to 1,200 ft/sec) and the range in anticipated ground-surface motions for the wide variety of soil conditions represented by Site Class D sites.

  Other factors influencing the decision to perform a site response analysis include: (1) depth to material with shear wave velocity equal to or greater than 1,200 ft/s, (2) depth to bedrock defined as the Site Class B/C boundary (2,500 ft/sec), and (3) the trend of site-specific V_s with depth (i.e., the site period).
- For Site Classes E and F, site response analysis using methods suitably calibrated by the GEOR should be performed and the design spectrum calculated at the ground surface should be in conformance with the applicable Building Code requirements. For sites where (1) surficial soil (e.g., liquefiable fill and soft Bay mud) are removed through basement excavation and foundation installation or (2) ground improvement is used to bypass liquefiable or soft soil, the GEOR should evaluate whether the site could be reclassified as site class D with concurrence with the geotechnical members of the EDRT.

  The number and characteristics of ground motions, variation in shear-wave velocity profile, and variation in soil shear modulus reduction and material damping curves used in site response analysis should be adequate to capture the potential variation in surface ground motion in a realistic and defensible manner.

  The following procedure is suggested for consideration by the GEOR:

  After a thorough review of site-specific geotechnical and geophysical data, evaluate the applicability of GMMs (i.e., V_{s30}-based estimation) for approximating the dynamic response of the soil profile.

  If site-specific aspects of the soil profile are not reasonably approximated by the "average, characteristic V_s profile" implied by the GMMs, ground response analysis should be considered. The ground-surface motions developed through ground response analysis should be checked against minimum code requirements.

Ground Motion Characterization Commentary: The level of analysis required for establishing surface, or near-surface, ground motions should reflect site-specific factors such as stratigraphy, geotechnical characteristics and properties of the soils, depth to bedrock, the trend of Vs from the ground surface to competent bedrock, and the amplitude of the bedrock motions (e.g., MCE_R, DE). Methods of analysis can be generalized as consisting of (1) numerical dynamic site response analyses, (2) estimation using current GMMs that include regression terms for V_{s30} (e.g., NGA-West2 GMMs), and (3) simplified, code-based site class designation and site coefficients (F_{pga}, F_a, and F_v), which are required as a check on the ground motions developed using methods 1 or 2. The applicability and suitability of site response analysis and GMMs for the development of design-level ground surface motions should be evaluated prior to adoption on a project-specific basis for all Class D sites.

The potential range of representative ground-surface motions anticipated at Class D sites due to the inherent variability of subsurface conditions and dynamic response of soil profiles falling under this general V_{s30}-based classification in the San Francisco Bay Area necessitates critical evaluation of the procedures applied for developing design ground motions. It is suggested that the GEOR engage the geotechnical members of the EDRT as soon as practical after pertinent site-specific geotechnical and geophysical data have been collected to identify the appropriate method of developing ground-surface motions prior to analysis. The following suggestions are deemed pertinent to local practice and provided for demonstration and guidance.

For sites containing soft-to-medium stiff fine-grained soils (e.g., BM), numerical ground response analysis is preferred and considered the primary method for developing ground-surface motions. This suggestion also applies to sites with lower V_{s30} (600 ft/s to 900 ft/s). In this situation, methods 2 and 3 are performed as checks on the results of the numerical site response analyses.

For stiffer soil profiles with V_{s30} in the upper range of the Site Class D category (900 ft/s to 1,200 ft/s), methods 2 and 3 may be acceptable for characterizing ground motion.

Many sites in the San Francisco Bay Area are underlain by dense sand and stiff clays that contribute to V_{s30} values in the range of 1,000 to 1,200 ft/s. The development of ground motion for these sites may be based on site-specific V_{s30} measured from the ground surface using GMMs.

Ground Response Commentary: Dynamic ground response analyses are routinely performed in practice using equivalent-linear and nonlinear models. The strengths and limitations of both methods of analysis have been addressed in the technical literature, and one of the primary differences in the two approaches is simulation of moderate- to large-strain behavior in cyclic loading. The combination of soft or medium stiff soil (i.e. BM or other marine deposits) and liquefiable sands that are prevalent in San Francisco, and the strength of design-level cyclic loading leads to highly nonlinear soil behavior. Therefore, nonlinear models that have been suitably calibrated are preferred over the equivalent linear model; however, equivalent linear site response analysis results are often used for comparison with nonlinear site response analysis results. Numerous computer programs have been used to perform nonlinear site response analysis on local projects. The GEOR may select the preferred model for the project. It is suggested that the GEOR provide documentation supporting calibration of the proposed model for analysis of similar soil profiles subjected to ground motions that are similar in nature to the design-level motions required for the project. Irrespective of the model used on the project, the results of the dynamic response analysis should be reviewed by the geotechnical members of the EDRT.

The slope of bedrock in the vicinity of the site should be evaluated and the GEOR, with approval from geotechnical members of the EDRT, should determine whether a two-dimensional site response analysis is required.

For sites at which lateral and vertical variability of the soil profile and depth to bedrock is significant enough to result in dual Site Class designations, two-dimensional or three-dimensional site response analysis may be required to develop an appropriate ground motions for design. The required check against code-based ground motions should be provided for both Site Classes, and the proposed design motions presented to the geotechnical members of the EDRT for review.

10.2.2 Site Response and Ground Motion Characterization at Depth of Interest

Time series selected and modified by the GEOR for use in structural dynamic analyses by the structural engineer of record (SEOR) should be representative of the ground motions at the depth of interest for the structural model. The depth of interest is a function of the modeling approach implemented by the SEOR. Primary considerations for the ground motions used in dynamic structural analyses are well presented in numerous documents (e.g., NEHRP 2015, NIST 2011, NIST 2012). In most cases, ground surface motions should not be used in structural models for buildings with multiple basement levels. Therefore, the acceleration response spectrum used as the basis for modification of time series should be developed using either (1) calibrated ground response analysis allowing development of the acceleration response spectrum at the appropriate depth, or (2) validated simplified methods that account for foundation embedment effects. The latter would be required, for example, on projects for which the ground surface motions were developed using GMM's and trends in the motions with depth are not provided.

The design team, with review by the geotechnical members of the EDRT, should determine whether ground response analysis should be performed using ground motions corresponding to MCE_R, DE (or both), and possibly the Serviceability Level earthquake (SLE).

For sites where (1) surficial soils (e.g., liquefiable fill and BM) are removed through basement excavation or foundation installation, or (2) ground improvement is used to bypass liquefiable and soft soil, the GEOR, with concurrence of the geotechnical members of the EDRT, should evaluate whether the site could be reclassified for the sake of ground-motion comparison to code-based requirements based on a representative 30 m (100 ft) time-averaged interval velocity that is computed using site-specific Vs data over a depth range deemed appropriate for configuration of the basement, foundation, or ground treatment.

Ground Motion Characterization Commentary: For a surface foundation, the energy transmitted to the structure is applied through soil in contact with the base of the foundation. For embedded structures, the basement walls may be in contact with liquefiable soil or soft clayey soil over a certain depth and then in contact with competent soil down to the lowest elevation of the basement walls. In this case, the presence of soft or liquefiable soil may be ignored and V_{s30} could be evaluated from the surface of competent soils. The rationale behind this is; while ground motion within soft or liquefiable soil may be higher than ground motion within the competent soils, the energy transmitted to the structure from these layers is relatively small due to their low stiffness (i.e., the product of ground-motion intensity and soil stiffness controls the amount of energy transmitted to the structure from each layer). However, seismic earth pressures should consider the effects of soft soil against basement walls.

10.2.3 Kinematic Soil-Structure Interaction (KSSI)

KSSI analysis may be performed using (1) simplified methods accounting for base averaging and embedment effects (e.g., NIST 2012), or (2) finite element or finite difference kinematic SSI analysis. It should be noted that the provisions of ASCE 7-16 (Chapter 19) provide a maximum allowable reduction of ground motion due to combined (base averaging and embedment) kinematic SSI effects when performing nonlinear response history analyses. Per ASCE 7-16 Section (19.2.3), the site-specific response spectrum modified for kinematic SSI shall not be less than 70% of S_a as determined from the design response spectrum and MCE_R response spectrum motions developed using the code-based approaches. When using the simplified method (Chapter 19, ASCE7-16) for evaluation of ground motion with embedment effects, the V_{s30} computed from the ground surface (as opposed to from the bottom of the basement) should be used. To compute the ground motion reduction due to embedment effects, the average shear wave velocity over the height of the basement should be used.

If finite element or finite difference kinematic SSI analysis is performed (1) the ground motion near the boundary of the model should be similar to those obtained from one dimensional site response analysis, and (2) kinematic ground motion should meet ASCE 7 requirements.

Commentary: If soil conditions at the boundary of the FEM model vary from those at the site, the ground motion calculated at the boundary may be compared with results of one-dimensional finite element or finite difference site response analysis using soil profile at the boundary.

10.2.4 Development of Ground Motion Time Series

If ground acceleration time series are used (i.e., performance-based design approach), seed motions should be selected based on the controlling earthquake scenarios (e.g., magnitude, site-to-source distance, significant duration (D5-75, D5-95), Arias Intensity, peak ground velocity (PGV), and period of pulse for forward-directivity motions), and the V_{s30} at the recording station. The percentage of seed motions that have near-source (directivity) characteristics can be defined from deaggregation of the regional seismic hazard (PSHA) for the 2,475-year average return period and across the structural period range of interest, identification of the primary seismic hazards, and the amplitude of the motions from the predominate seismic sources relative to the uniform hazard (NEHRP 2015, NIST 2011).

If spectral matching of seed motions is performed, care should be exercised not to eliminate or unreasonably elongate the pulse period.

Ground motions with velocity pulse characteristics should be rotated and oriented along fault normal (FN) and fault parallel (FP) directions. Furthermore, the modified motions in FN and FP directions should be rotated again based on the orientation of the building axis relative to the causative fault. Seed motions that do not exhibit near-fault effects (i.e., without the forward-directivity or fling step) may be used in a random orientation.

Commentary: Applying seed motions that do not exhibit near-source effects in a random orientation deviates from ASCE 7 requirements but is judged to be appropriate. However, care should be taken that the mean spectra for each direction of response meets ASCE limits so as to avoid design that do not meet minimum strength criteria in any direction.

It is recommended that orbit plots at structural periods of interest be made before and after spectral matching and before and after rotation of ground motion along the building axis to confirm that the appropriate orientation of ground motion is used in the structural dynamic analysis.

For structures on continuous foundations with plan dimensions of greater than 400 feet, effects of wave passage and incoherency of ground motion on design ground motions should be evaluated and addressed.

10.2.5 Seismic Slope Stability and Soil Liquefaction Hazards

The potential for and consequences of liquefaction or cyclic degradation of soils should be evaluated using current and widely adopted methods of analysis. The evaluation of liquefaction hazard should be based on standard semi-empirical methods.

If potentially liquefiable soil layers are present below the foundation level, the effects of soil liquefaction (strength loss, settlement and down-drag loads acting on deep foundations) and potential for lateral spreading should be evaluated. The GEOR should review published maps and reports regarding potential for soil-liquefaction-induced ground settlement and lateral spreading at the site and in its vicinity.

Commentary: Existing reports include Lawson Report on the 1906 Great San Francisco Earthquake (1908), Harding Lawson Associates, City and County of San Francisco Soil Liquefaction Report (1992), GHD-GTC Port of San Francisco Seawall Stability Report (2016), and Port of San Francisco, Seawall Resiliency Study currently underway.

For sites underlain by BM, the potential for seismically induced slope deformation should be evaluated, and mitigation measures should be identified.

10.3 Settlement Analysis

Settlement calculations should account for various stages and durations of construction (i.e., estimates of the time required for each stage of dewatering and construction should be made). Stages include, but are not limited to, placement of shoring, dewatering, excavation for construction of basement and foundation, termination of dewatering, and long-term recharge of groundwater table. In some cases, and depending on soil permeability, recharging of the groundwater table may not occur until sometime after completion of construction. This delay in groundwater recharge should be accounted for when evaluating the hydrostatic uplift pressure during and after termination of dewatering (i.e., accounting for full and immediate groundwater recharge after termination of dewatering may be unconservative). The geotechnical report should state the estimated long-term groundwater conditions at the site.

10.3.1 Shallow Foundations

Short-term and long-term (consolidation) settlement analysis should be performed using appropriate models as approved by the geotechnical members of the EDRT.

Commentary: For shallow foundations, consolidation analysis may be conducted using computer programs that perform one-dimensional settlement analyses at several locations across the building footprint and within the zone of influence based on a three-dimensional stress distribution.

10.3.2 Deep Foundations

For deep foundations that terminate above bedrock, short-term and long-term (consolidation) settlement analysis should be performed using appropriate models capable of modeling deep foundations as single piles or pile groups, as reviewed by the geotechnical members of the EDRT.

Commentary: Finite-element or finite-difference computer programs, which are capable of modeling single piles or pile groups, should be used to calculate consolidation settlement of structures supported on deep foundations.

10.4 Sea Level Rise

The effects of sea level rise during the design life of structures should be evaluated based on NRC 2012; CCSF 2014; CCSF 2016; Plane et al. 2019; Yasuhara, et al. 2007; and others. Effects considered should include, but are not limited to, the potential for increased flooding and the effect of rising groundwater on increasing hydrostatic pressure, increasing liquefaction potential, saltwater intrusion, and decreasing bearing capacity.

10.5 Static and Seismic Design of Basement Walls

Basement walls should be designed against the more critical of the following conditions: (1) At-rest soil pressure and (2) active soil pressure plus dynamic increment. In addition, effects of surcharge loads (traffic and adjacent building foundation, if not underpinned) should be considered.

When calculating hydrostatic pressure, the design groundwater table with consideration of sea level rise and seasonal fluctuation of groundwater table should be identified and used. If a drainage system is not installed behind the basement walls above the design groundwater table, the basement walls should be waterproofed beginning at the ground surface. In this case, the basement walls should be designed per code requirements and checked for the groundwater table being at the ground surface, but using a load factor of 1.0 as opposed to 1.6 for this check.

Commentary: According to the load combination in current building code, a factor of 1.6 is applied to hydrostatic pressure. The resulting pressure in most cases accounts for effects of sea level rise, fluctuation in groundwater table, or effects of a temporary buildup of water behind the basement walls due to a possible breakage in a water conveying pipe adjacent to the site. Care should be exercised to avoid undue conservatism in design against hydrostatic pressure.

Resistance to lateral loads could be calculated by considering frictional resistance on basement walls and beneath the foundation (if not pile-supported) and passive pressure against the basement walls, pile caps, grade beams, and foundation edge extending below the basement walls. In calculating frictional resistance, the effects of the presence of a waterproofing membrane (if used) on allowable frictional resistance should be accounted for.

A load-deflection curve for passive resistance should be developed by the GEOR and used by the SEOR to account for displacement compatibility within various components contributing to lateral resistance.

For basement walls in contact with slopping ground conditions, the effects of unbalanced soil pressure on basement walls should be considered.

11. Foundation Support

Shallow or deep foundation systems may be appropriate for support of tall buildings depending on the ground conditions, structural loads, and performance criteria. Unless it could be demonstrated through comprehensive geotechnical and structural studies that the computed total and differential settlement will not compromise the safety and functionality of the structure and its components, foundation systems should be designed to meet the following criteria using the best estimate soil properties: (1) the total short-term and long-term computed settlement of the foundation under gravity and seismic loads should not exceed 4 inches, and (2) its differential settlement under gravity and seismic loads should not exceed an angular distortion of 1/500. Nonstructural components such as cladding or partition walls may control the acceptable threshold of differential settlement. The amount of dishing of the site under building load should be communicated to the SEOR in the geotechnical report, so that the appropriate building camber could be provided.

Commentary: The inherent variability of natural soil deposits often causes tilting of the foundation (rigid body rotation), which would add to differential settlement (dishing) caused by the applied structural loads. The magnitude of foundation tilting is directly related to the extent of total settlement. Some tilting can be compensated for during construction; however, some tilting may occur after construction is completed. If settlement of more than 4 inches is calculated, GEOR and SEOR should work together and carefully evaluate the impact of settlement larger than 4 inches on the structural system and nonstructural components. Factors to be considered include the amount of settlement occurring after placement of the mat and before the lowest floor is constructed, the timing of placement of cladding and ability to correct foundation tilting before cladding is installed, and of course, the tolerance of cladding to differential settlement caused by tilting and/or by dishing of the mat foundation.

Settlement analyses are often made using the approximation that the foundation soil deposits are uniform, homogeneous layers. If this simplification is adopted, it is recommended that the GEOR perform analyses to evaluate the sensitivity of the computed settlement on the input soil parameters.

For shallow foundations, the factor of safety against bearing failure (both global failure mechanism and punching shear failure mechanism) should be evaluated. A minimum factor of safety of 2.0 should be maintained under anticipated gravity loads considering the above bearing failure mechanisms.

If ground improvement is used to mitigate the effects of compressible, weak, liquefiable, or other problematic soil conditions, the GEOR should review design calculations by the design-build (DB) contractor to check that the integrity of ground improvement elements is maintained during both static and seismic loading conditions; that is to say, the replacement ratio and geometry of grid pattern should be such that the ground improvement system maintains its integrity under structural gravity loads, seismic loads (base shear and overturning moment applied by the structure), and seismic loads due to vertical propagation of seismic waves.

> **Commentary:** Recent research indicates that individual columns of deep soil mix (DSM) would bend during design-level ground shaking, thereby limiting the effectiveness of DSM columns for prevention of soil liquefaction. In addition to lateral movement, individual unreinforced DSM columns could crack in bending and with excessive repeated loading and extensive cracking, could have the effect of losing the cohesive strength associated with cementation, with a residual strength related to contact through friction only. Unreinforced individual columns of DSM are brittle and could fail to transfer gravity loads to more competent soils at depth.

If deep foundations are used to bypass compressible, soft, or liquefiable soils, the following construction design issues should be addressed:

11.1 Driven Concrete and Steel Piles

The geotechnical report should address axial and lateral pile capacity, driving criteria, noise and vibration effects, corrosion protection, indicator-pile driving program, and pile load testing.

11.2 Augered Cast-in-Place Piles

The geotechnical report should address axial and lateral pile capacity, integrity testing requirements (especially in case of loose to medium dense saturated sandy soils and soft clayey soils) using, for example, cross hole sonic logging, cross hole Gamma-Gamma logging, thermal testing, or a combination of these methods, as appropriate, pile load testing, and requirements for an automated data-acquisition system.

11.3 Drilled Shafts

The geotechnical report should address axial and lateral pile capacity, axial pile load test for drilled shafts with reaction piles or bidirectional load cells, integrity testing using cross-hole sonic logging, cross-hole Gamma-Gamma logging, thermal testing, or a combination of these methods, as appropriate.

End bearing for shafts is normally ignored unless pile capacity can be verified by top-down or by using bidirectional load tests. For end bearing in dense sand or bedrock, the bottom of a shaft should be cleaned out thoroughly and tested using Mini SID (Shaft Identification Device) or similar tools for evaluating proper clean out.

12. Shoring, Dewatering, Excavation and Underpinning

The geotechnical report should address shoring, dewatering, and underpinning. Design of the shoring, dewatering, and underpinning system is usually provided by specialty contractors, with design parameters (soil and groundwater pressure) provided by the GEOR. If shoring is used to support an adjacent building, the design soil pressure should correspond to the at-rest pressure and account for building surcharge. The GEOR and the EDRT should review the contractor’s analysis and design to evaluate that the design has used appropriate soil and groundwater pressures. The GEOR and the EDRT should also review the contractor’s Plan of Action for trigger levels (e.g., Warning Level or Design Limit) of lateral and vertical movement of the shoring and underpinning system before the start of construction.

Because of the potential presence of confined aquifers within or below the BM and OBC, nested piezometers should be installed outside of the excavation for monitoring of drop in groundwater table and water head within various sand layers, as appropriate.

Bottom of excavation should be evaluated for expected conditions for stability. If cohesionless soil is exposed at the bottom of the excavation, the factor of safety against bottom instability should be calculated to check that piping (quick sand condition) is prevented. If cohesive soil is exposed at bottom of excavation, the factor of safety against basal heave should be calculated. Finally, if a cohesionless soil layer at depth is overlain by a layer of cohesive soil at the bottom of excavation, the blowout condition should be carefully analyzed and, if necessary, the cohesionless soil layer should be depressurized to prevent a bottom blowout condition.

13. Instrumentation and Construction Monitoring

The GEOR should provide recommendation for geotechnical instrumentation and construction monitoring at locations where ground conditions, type of loading, or proximity of existing structures could be adversely affected by planned construction.

13.1 Selection of Instrumentation and Monitoring Requirements

The type, location, and requirements for instrumentation should be determined by the GEOR based on the impact of construction related to excavation, shoring, dewatering, foundation installation including noise and vibration, and implementation of ground improvement on groundwater conditions and performance of adjacent structures, roadways, utilities, and other improvements.

The geotechnical report should provide the rationale for selection of instrumentation type and number, installation method, and the frequency of monitoring for each type of instrumentation.

The frequency of monitoring should be defined based on the type of loading and construction activities. Monitoring should be initiated before the construction work starts to obtain ambient or baseline conditions. As appropriate, monitoring rates may be adjusted after initial period of monitoring, if data from instrumentations indicate that the rate of change is diminishing with time.

The instrumentation used for monitoring during construction should be sufficient to meet accuracy and reliability requirements needed for the duration of monitoring.

13.2 Pre-Construction Monitoring

The GEOR should develop a plan for preconstruction monitoring of adjacent buildings and improvements. The GEOR should request that the shoring and dewatering contractor(s) evaluate the effects of lowering of the groundwater on adjacent structures and improvements, and define the allowable drop in groundwater level outside of the excavation. The allowable lowering of the groundwater elevation should account for the duration of the anticipated construction-related change in the groundwater level. The GEOR should request that the dewatering contractor prepare for review and approval a plan of action in case the groundwater table drop below the contractor’s specified limit.

13.3 Reporting

The baseline and data collected during construction from piezometers and inclinometers, and field warnings (see section 9 for discussion on warning level or design limit) should be reported to the design and construction team in a timely manner. If in response to a field warning any changes are made to the original design, the revised design should be presented to the GEOR and the geotechnical members of EDRT for further review.

14. Other Construction Considerations

The geotechnical report should address the following construction considerations:

- The effects of construction on adjacent buildings, notably where ground improvements or new foundations extend below the foundation of the adjacent buildings;
- The potential of loss of ground and displacements due to construction of large-diameter drilled shafts installed deeper than the foundation of an adjacent buildings;
- Impact of installation of deep foundations on previously installed foundations;
- The potential impact of ground-surface heave or vibrations on adjacent structures and improvements;
- The effect of construction on the groundwater level inside and outside of the construction area.

15. Settlement Monitoring Requirements

Prior to completion of all new tall building projects where the building is planned to be supported on a shallow foundation underlain by soil (i.e. the foundation is not bearing directly on bedrock) or on a deep foundation system not gaining axial support within bedrock or not driven to bedrock / bedrock-type material, the project Sponsor shall secure a contract with qualified Monitoring Surveyors and Instrumentation Engineers (MSIEs) to monitor the settlement of the buildings for a period of 10 years after the issuance of CFC/TCO. A notarized legal document, completed by the Project Sponsor and recorded against the property title, with the MSIE's contact details, shall be submitted to DBI prior to issuance of the CFC/TCO and shall be retained with the project's permanent records and readily retrievable within DBI's inspection records on this project.

Settlement monitoring data are to be submitted annually to DBI's Building Inspection Division each year of this 10-year period. Should the settlement monitoring data exceed the project sponsor's geotechnical engineer's estimated time rate of settlement in any annual data reporting period, the project sponsor/owner is required to immediately notify the DBI's Deputy Director for Inspection Services and bring this condition to his/her attention for immediate additional investigation.

Daniel Lowrey Permit Services Deputy Director Department of Building Inspection	6/24/20 Date	Patrick O'Riordan Interim Director Department of Building Inspection	6/24/20 Date
Gary Ho, S.E. Plan Review Services Manager Department of Building Inspection	6/24/20 Date		

Approved by the Building Inspection Commission on 06/17/2020.

PERSONAL SERVICES CONTRACT SUMMARY ("PSC FORM 1")

Department: DEPARTMENT OF BUILDING INSPECTION -- DBI　　Dept. Code: DBI

Type of Request: ☑Initial ☐Modification of an existing PSC (PSC # __________)

Type of Approval: ☐Expedited ☑Regular ☐Annual ☐Continuing ☐ (Omit Posting)

Type of Service: Professional Services

Funding Source: Operating Budget
PSC Amount: $2,000,000　PSC Est. Start Date: 07/01/2020　PSC Est. End Date 06/30/2026

1. Description of Work

A. Scope of Work/Services to be Contracted Out:
Department to re-issue a Request for Qualifications (RFQ) to seek responses from Respondents demonstrating expertise in one or more of the following Areas: 1) Structural Design Review; and 2) Geo-technical and Geological Engineering Review. Based on the responses from this RFQ, Department will create a pre-qualified list of consultants/professionals and academic experts from which Department may choose prospective contractors, on an as-needed basis for up to five (5) years of the pre-qualification notification date, to advise the Department in structure design and plan review for privately-sponsored projects. Due to continued development of buildings that require structural and geotechnical review, these specialized services are still needed.

B. Explain why this service is necessary and the consequence of denial:
It is the Department's policy, procedures and safety regulations to monitor the construction of new buildings in San Francisco. The Department continues to review and constantly take steps to strengthen requirements to ensure that buildings are as safely built as contemporary engineering permits. Staff of engineers, inspectors and permitting technician's works closely with the project sponsor and chosen design and engineering team to ensure that submitted plans and subsequent construction meet or exceed the minimum standards of the San Francisco Building Code. Expert Consultants supplement the plan review process. Denial would limit the Department's ability to work directly with experts.

C. Has this service been provided in the past? If so, how? If the service was provided under a previous PSC, attach copy of the most recently approved PSC.
This service has been provided under PSC 49526 16/17. Pre-qualified list expired and a new list is needed.

D. Will the contract(s) be renewed?
No. As needed services.

E. If this is a request for a new PSC in excess of five years, or if your request is to extend (modify) an existing PSC by another five years, please explain why.
there are forthcoming private sponsored projects that require as needed professional services for structural and geotechnical peer review. Some projects require several years to complete review.

2. **Reason(s) for the Request**

A. Indicate all that apply (be specific and attach any relevant supporting documents):

☑ Services required on an as-needed, intermittent, or periodic basis (e.g., peaks in workload).

B. Explain the qualifying circumstances:

Consultants will be individual structural and geotechncial engineers and academia experts with minimum 15 years experience in Structural Design Reviewer/Practicing Structural Engineer. Services will be on a as needed bases. Structural expert shall have minimum 15 years experience practicing in structural engineering with expertise in structural engineering, earthquake engineering, performance based seismic engineering, and nonlinear response history analysis of building and tall building design; structural peer review; development of structural building codes and guidelines for buildings. Structural Design Reviewer/Academia shall have with minimum 15 years experience researching in structural engineering with expertise in structural engineering, earthquake engineering, performance-based seismic engineering, nonlinear response history analysis of building and tall building design; structural peer review; development of structural building codes and guidelines for buildings. Geotechnical Reviewer expert shall ahve with minimum 15 years experience in geotechnical and geological engineering with expertise in geotechnical or geological engineering, generation of site-specific ground motions of use in linear and nonlinear analyses, performance-based seismic design for tall buildings, site soil classification, foundation recommendation, deep foundation evaluation, earth pressure recommendation,soil structure interaction, building settlements analysis, excavation and ground water monitoring; geotechnical peer review; development geotechnical requirements for building codes and design guidelines of buildings.

3. **Description of Required Skills/Expertise**

A. Specify required skills and/or expertise: Consultants will be individual consultants (structural engineers and researchers) with minimum 15 years experience in the following areas: A Structural Design Reviewer/Practicing Structural Engineer shall have minimum 15 years experience practicing in structural engineering with expertise in structural engineering, earthquake engineering, performance based seismic engineering, and nonlinear response history analysis of building and tall building design; structural peer review; development of structural building codes and guidelines for buildings. A Structural Design Reviewer/Academia with minimum 15 years experience researching in structural engineering with expertise in structural engineering, earthquake engineering, performance-based seismic engineering, nonlinear response history analysis of building and tall building design; structural peer review; development of structural building codes and guidelines for buildings. A geotechnical Reviewer with minimum 15 years experience in geotechnical and geological engineering with expertise in geotechnical or geological engineering, generation of site-specific ground motions of use in linear and nonlinear analyses, performance-based seismic design for tall buildings, site soil classification, foundation recommendation, deep foundation evaluation, earth pressure recommendation, soil structure interaction, building settlements analysis, excavation and ground water monitoring; geotechnical peer review; development geotechnical requirements for building codes and design guidelines of buildings.

B. Which, if any, civil service class(es) normally perform(s) this work? none

C. Will contractor provide facilities and/or equipment not currently possessed by the City? If so, explain: no

4. **<u>If applicable, what efforts has the department made to obtain these services through available resources within the City?</u>**
There are no civil service classifications that is able to perform this type of specialized work.

5. **<u>Why Civil Service Employees Cannot Perform the Services to be Contracted Out</u>**
   A. Explain why civil service classes are not applicable.
      There are no civil service classifications that is able to perform this type of specialized work.

   B. If there is no civil service class that could perform the work, would it be practical and/or feasible to adopt a new civil service class to perform this work? Explain. No, the contractor will be on an as-needed basis. Also, these skills needed are very specialized.

6. **<u>Additional Information</u>**
   A. Will the contractor directly supervise City and County employee? If so, please include an explanation.
      No.

   B. Will the contractor train City and County employees and/or is there a transfer of knowledge component that will be included in the contact? If so, please explain what that will entail; if not, explain why not.
      No. No training provided to city employees. This type of review work is highly specialized and requires extensive work experience. Knowledge includes both academic knowledge and extensive hands-on work experience with review of the proposed structural design criteria, assumptions and acceptance criteria; review of structural analysis results and the design details; and engineering calculations and permit structural drawings. Minimum work requirements for a structural or geotechnical engineer is 15 years work experience.

   C. Are there legal mandates requiring the use of contractual services?
      Yes. see attached Board of Supervisors Ordinance 36-18

   D. Are there federal or state grant requirements regarding the use of contractual services? If so, please explain and include an excerpt or copy of any such applicable requirement.
      No.

   E. Has a board or commission determined that contracting is the most effective way to provide this service? If so, please explain and include a copy of the board or commission action.
      Yes. Board of Supervisors Ordinance 36-18

   F. Will the proposed work be completed by a contractor that has a current PSC contract with your department? If so, please explain.
      No.

7. **<u>Union Notification</u>**: On <u>04/16/2020</u>, the Department notified the following employee organizations of this PSC/RFP request:
   <u>all unions were notified</u>

☑ I CERTIFY ON BEHALF OF THE DEPARTMENT THAT THE INFORMATION CONTAINED IN AND ATTACHED TO THIS FORM IS COMPLETE AND ACCURATE:

Name: Sharon Lee Phone: 415-575-6947 Email: sharon.lee@sfgov.org

Address: 1660 Mission Street, 6th Floor, San Francisco, CA 94103

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FOR DEPARTMENT OF HUMAN RESOURCES USE

PSC# 44359 - 19/20

DHR Analysis/Recommendation: action date: 07/06/2020

Commission Approval Required Approved by Civil Service Commission

07/06/2020 DHR Approved for 07/06/2020