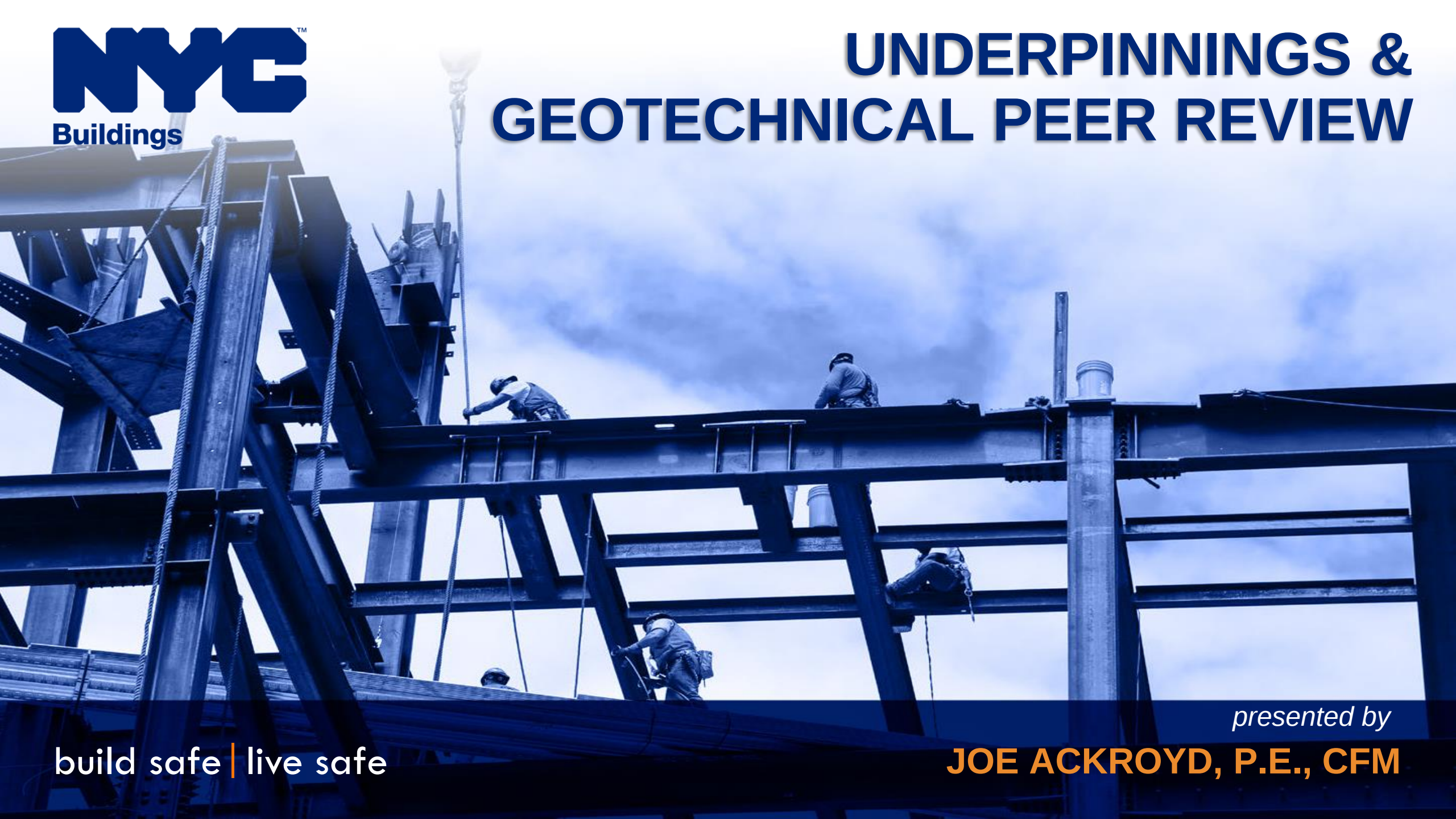
NYC Buildings

UNDERPINNINGS & GEOTECHNICAL PEER REVIEW



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presented by

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PRESENTATION DESCRIPTION

In this presentation, in an effort to protect the health, safety and welfare of building occupants, workers and the public, participants in this course will learn about significant changes in the 2022 Building Code with respect to updated requirements in the geotechnical provisions. Participants will analyze new provisions for soils and foundations including geotechnical peer review. Participants will also examine new design requirements for support of adjacent buildings during excavation including underpinning and alternative methods of support.

AGENDA

- Course Description
- Codes Implementation
- Building Code Chapter 18: Soils and Foundations
- Building Code Chapter 33: Safeguards During Construction or Demolition

2022 CODES IMPLEMENTATION

THE NEW YORK CITY COUNCIL
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File #	Law Number	Type	Status	Committee	Prime Sponsor	Council Member Sponsors	Title
Int 2264-2021	2021/148	Introduction	Enacted	Committee on Housing and Buildings	Robert E. Cornegy, Jr.	4	A Local Law to amend the New York city building code, in relation to cold-formed steel construction
Int 2276-2021	2021/149	Introduction	Enacted	Committee on Housing and Buildings	Francisco P. Moya	3	A Local Law to amend the New York city building code, in relation to construction superintendents
Int 2261-2021	2021/126	Introduction	Enacted	Committee on Housing and Buildings	Robert E. Cornegy, Jr.	4	A Local Law to amend the administrative code of the city of New York, the New York city plumbing code, the New York city building code, the New York city mechanical code and the New York city fuel gas code, in relation to bringing such codes and related provisions of law up to date with the 2015 editions of the international building, mechanical, fuel gas and plumbing codes, with differences that reflect the unique character of the city, clarifying and updating administration and enforcement of such codes and the 1968 code and repealing chapters 2 and 35, appendices K and M, section N102 of

November 7, 2021
Council approval LL 126 of 2021*

Implementation & Training

November 7, 2022
Effective date

*Also amends **LL 14 of 2020** (aka **2022 NYC Plumbing Code**)

2022 NYC BUILDING CODE CHAPTER 18

Soils & Foundations

UPDATES TO CHAPTER 18

- **1803.5.2** Alternative Investigative Methods
- **1803.6** Geotechnical Reports
- **1811.7** Structural Steel Piles
- **1812.3** Drilled, Drilled Displacement. or Augered Uncased Piles
- **1815** Permanent Prestressed Rock and Soil Anchors
- **1817** Underpinning and Alternate Methods of Support of Buildings and Adjacent Property
- **1818** Geotechnical Peer Review

1803.5 SOIL & ROCK SAMPLING

SOURCE: LANGAN

1803.5.2 Alternative investigative methods

- Revised quantity of alternative investigation methods – more for economy of subsurface investigation
- Cone penetrometer testing (CPT) now permitted as an “as of right”
- CPTs may replace borings on a one to one (1:1) basis, but in no case shall there be fewer than half the required standard borings and no less than two standard borings

  NOTE: 2014 Code; 1.5 CPT’s could replace 1 boring
- Will ease need for CCD1s by accepting an already established and recognized technology

1803.5 SOIL & ROCK SAMPLING

1803.5.2 Alternative investigative methods (Shallow Foundation)
Examples (* all borings)

20,000 sq ft Footprint		
	# Borings	# CPT
2014 BC	(*8) 4	6
2020 BC	(*8) 4	4

50,000 sq ft Footprint		
	# Borings	# CPT
2014 BC	(*14) 7	11
2020 BC	(*14) 7	7

100,000 sq ft Footprint		
	# Borings	# CPT
2014 BC	(*24) 12	18
2020 BC	(*24) 12	12

1803.6 GEOTECHNICAL REPORTS

- Previously, geotechnical reports were only required to be submitted to the Department under certain conditions
- With this revision, a geotechnical report shall be prepared and submitted to the Department for all sites with the exception of some 1- and 2-famly homes
- Geotechnical reports are required for 1- and 2-family homes where underpinning or dewatering is required or where the property falls in the special flood hazard area

1803.6 GEOTECHNICAL REPORTS

1803.6.1 Information required in geotechnical reports

- The report shall include the foundation system shown on the drawings submitted to the department
- New requirements
  - Base Flood Elevation
  - Soil stiffness parameters for design of the foundations
  - Foundation type and design criteria: mapped spectral response accelerations (SS and S1); site class; spectral response coefficients (SDS and SD1)
  - Design lateral earth pressures on foundation walls and other retaining walls

1803.6 GEOTECHNICAL REPORTS

1803.6.1 Information required in geotechnical reports

- New requirements *(continued)*
  - Recommendations for the evaluation of adjacent properties potentially impacted by the proposed construction
  - Where dewatering required, recommendations for the maximum permissible drawdown outside the site
  - For permanent prestressed rock and soil anchor reports
  - Soil and rock parameters to be used to determine the safe slope of temporary excavations

1811.7 STRUCTURAL STEEL PILES

SOURCE: LANGAN

1811.7.1.1 Structural steel pipe piles to be welded

- Requirements for high strength steel (Mill Secondary) pipe ordinarily utilized in deep foundation construction
- Provisions for carbon equivalency and sulfur content to aid assurance of welding suitability
- Requirements for welding and high strength pipe consistent with those employed by AASHTO for micropiles

1811.7.1.2 High strength pipe

- Clarity on current market practice and ensures required testing

1811.7 STRUCTURAL STEEL PILES

1811.7.1.2 High Strength Pipe

- High strength pipe meeting the strength requirements of API Specification 5L (X80) and API Specification 5CT (N80) permitted for use as structural steel pipe piles.
- All such pile and casing shall meet the minimum requirements of ASTM A252 Grade 3
- Mill certificates shall be provided. Where not available, a minimum of 2 tests per 1,000 lineal feet of pipe or part thereof shall be performed. Testing procedures shall meet the requirements as set forth in Section 18 of ASTM A252
- Welding shall be in accordance with Section 1811.7.1.1. In addition, where welded splices are used, they shall be complete joint penetration welds. Reinforcing steel shall not be welded to high strength pipe.

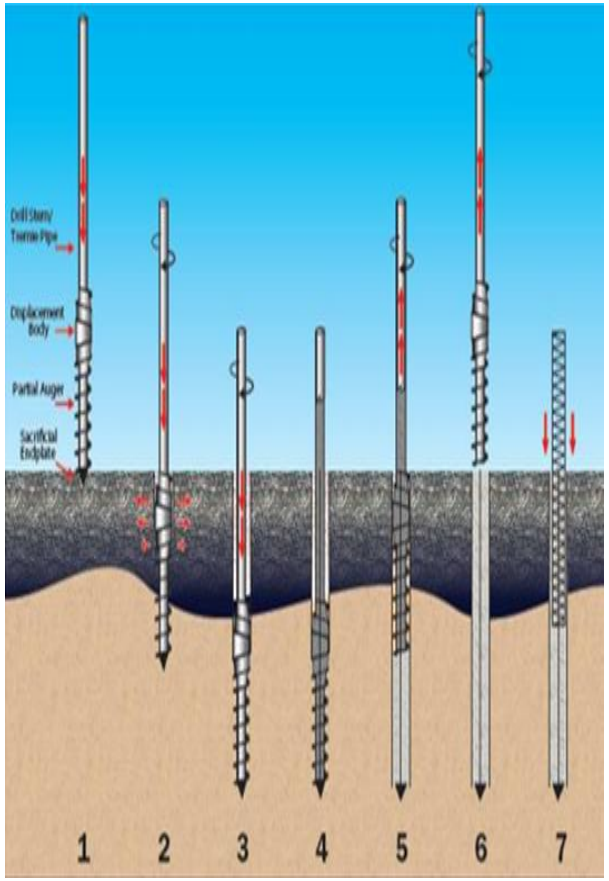
1812 CAST-IN-PLACE CONCRETE PILES

Concrete sampling and testing in accordance with BC Chapter 19

Grout Sampling & Testing

- Samples shall be collected, and testing shall be performed for the lesser of the following conditions:
  - Each element installed
  - Each batch of site-mixed grout, or
  - Each load of ready-mixed grout used
- Compressive strength tests shall be performed using cylinders of < 3 inches
- Grout tested in according with ASTM C39
- Minimum of 6 samples prepared for each test group
- Specific gravity testing shall be performed using the API Recommended Practice 13B-1 or ASTM C138

1812.3 DRILLED, DRILLED DISPLACEMENT, OR AUGERED UNCASED PILES



SOURCE: LANGAN

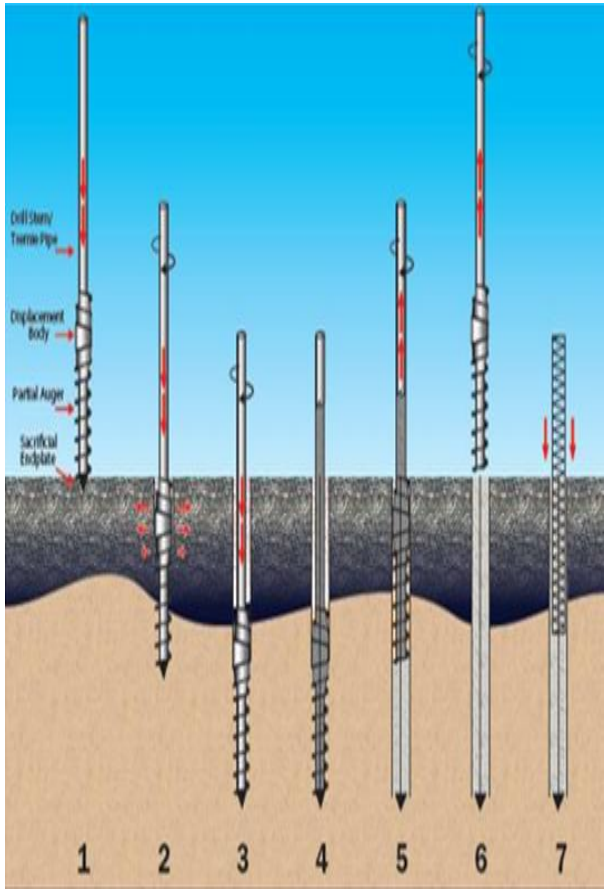
1812.3.2 Dimensions

- Minimum diameter of drilled, drilled displacement piles shall be 8 inches, and for augered uncased piles the minimum diameter shall be 12 inches

1812.3.3 Installation

- Insert steel liner where shafts for drilled pile piles are formed through unstable soils and concrete is placed in an open-drilled hole

1812.3 DRILLED, DRILLED DISPLACEMENT, OR AUGERED UNCASED PILES

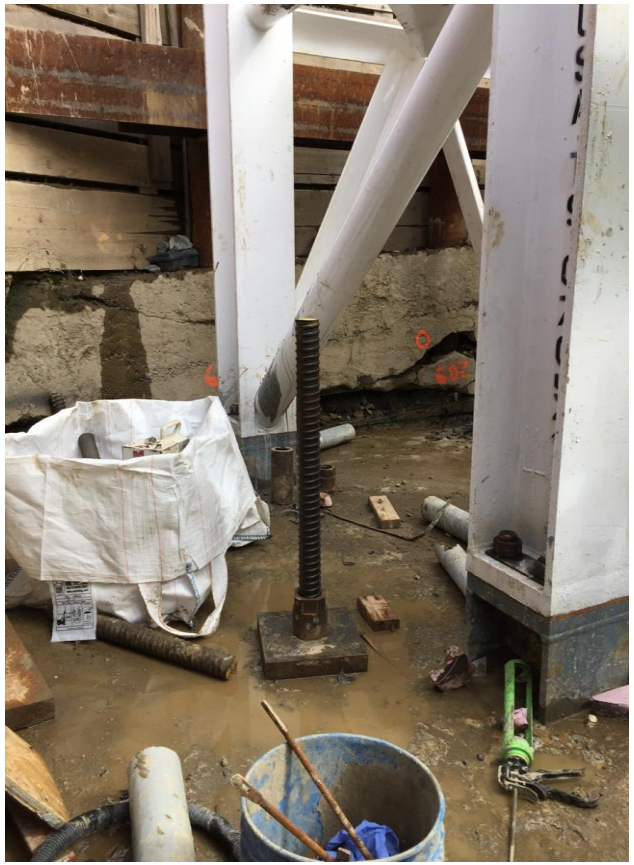


SOURCE: LANGAN

1812.3.3 Installation *(continued)*

- Maintain level of concrete above bottom of liner at sufficient height where steel line is withdrawn during concreting (to offset hydrostatic or lateral soil pressure)
- Where drilled displacement piles used, auger segments shall be installed with both a vertical force and torque such that the soil is displaced laterally. Fill void created with grout or concrete

1815 PERMANENT PRESTRESSED ROCK AND SOIL ANCHORS



SOURCE: LANGAN

- **1815.2** Additional geotechnical investigation and report requirements
- **1815.3** Materials
- **1815.4** Design
- **1815.5** Load Testing
- **1815.6** Installation
- **1815.7** Grout Sampling and Testing
- **1815.8** Special inspection

1815 PERMANENT PRESTRESSED ROCK AND SOIL ANCHORS

1815.2 Additional geotechnical investigation and report requirements

- Suitable anchor types and capacities.
- Suitable center-to-center spacing
- Minimum unbonded and bonded lengths
- The effects of groundwater or voids
- Installation procedures.
- Load test requirements.
- Durability of anchor materials
- Lock-off & lift-off load requirements
- Reductions for group action
- Protection of adjacent structures

1815 PERMANENT PRESTRESSED ROCK AND SOIL ANCHORS

1815.8 Special inspection

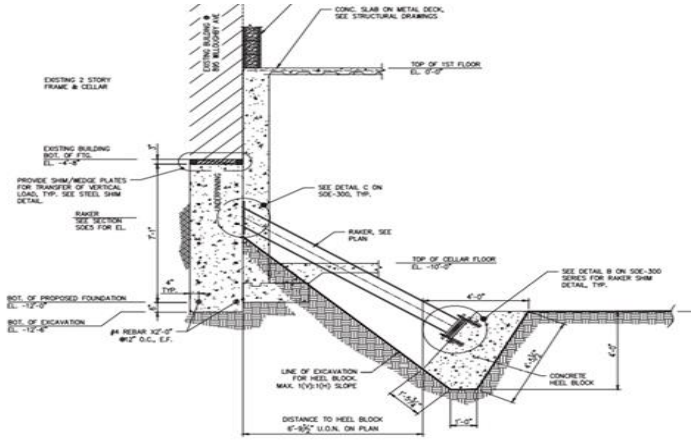
The installation and testing of prestressed rock and soil anchors shall be subject to special inspection in accordance with the requirements of Section 1704.9

1817 UNDERPINNING & ALTERNATE METHODS OF SUPPORT OF BUILDINGS AND ADJACENT PROPERTY

OVERVIEW

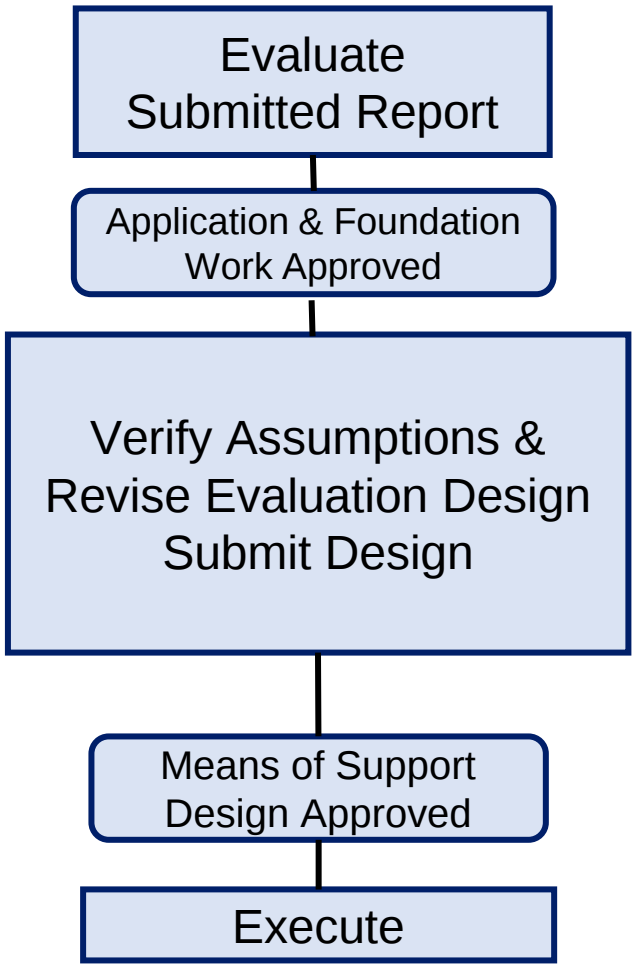
- Where proposed work may create a disturbance, an engineer shall evaluate the need for and methods to maintain the stability and integrity of the building(s), utilities or soil adjacent
- Specific parameters for evaluation and report creation

  GOAL: Ensure sufficient investigation be performed to ensure building and foundation system align with existing condition



SOURCE: LANGAN

OVERVIEW



1817.3.1 Assessment of building and subsurface

EOR Applic. or subconsultant

1817.5 Design requirements

1817.6 Minimum requirements for construction documents

1817.7 Additional requirements for pit-pier underpinning

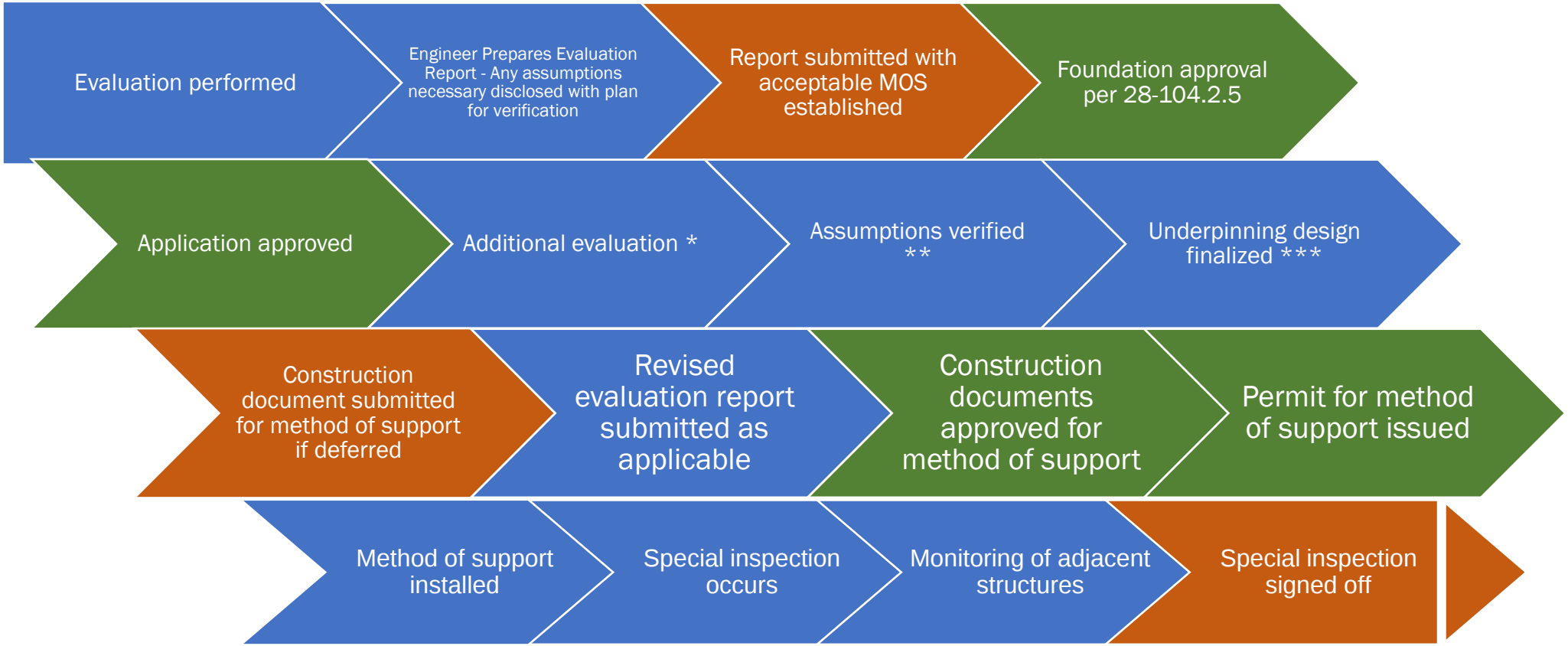
1817.8 Deep foundation elements

EOR Method of Support

1817.9 Monitoring

Special Inspector

TIMELINE



**Additional evaluation may include execution of required load testing where deep foundation elements are proposed as a method of support*
***Where adequate information can be obtained and no assumptions required method or support can be designed and submitted for approval at the time of foundation approval*
****Method of support designer may be the same or different engineer as compared to author of evaluation report*

1817.2 MINIMUM REQUIREMENTS FOR UNDERDEVELOPED ADJACENT PROPERTY

Minimum requirements for construction docs for adjacent empty lots, court yards, front yards, or rear yards:

- Existing grade of the adjacent property
- Plans, cross-sections, and elevations showing:
  - Subsurface conditions
  - Surcharge loading
  - The proposed method of support
  - Sequence of construction
  - Required material properties
- Details and criteria for monitoring
  - Thresholds for movements
  - Dewatering
  - Elevation of the water table
  - Maximum permissible drawdown outside of the project site

1817.3 EVALUATION OF ADJACENT BUILDINGS FOR SUITABLE METHOD OF SUPPORT

SOURCE: LANGAN

- At the time of foundation plan approval, an engineer shall submit an evaluation report assessing the condition of the existing building and the subsurface conditions of the construction site and adjacent property
- The report shall also identify acceptable method(s) of support, including underpinning or alternate methods of support, for the building

1817.3 EVALUATION OF ADJACENT BUILDINGS FOR SUITABLE METHOD OF SUPPORT

1817.3.1 Assessment of the building and the subsurface conditions

- Assessment shall be based on:
  - **Visual observations**
  - **Calculations**
  - **Review of the geotechnical report**
  - **Review of other available documentation**
- An evaluation of the vertical and lateral load path of the building as it relates to the location of the proposed underpinning
- Calculations of the loads at the foundations to be underpinned
- Type and condition of elements to be supported or potentially affected
- A survey of deviations from plumb or horizontal position of the building

1817.3 EVALUATION OF ADJACENT BUILDINGS FOR SUITABLE METHOD OF SUPPORT

1817.3.1 Assessment of the building and the subsurface conditions *(continued)*

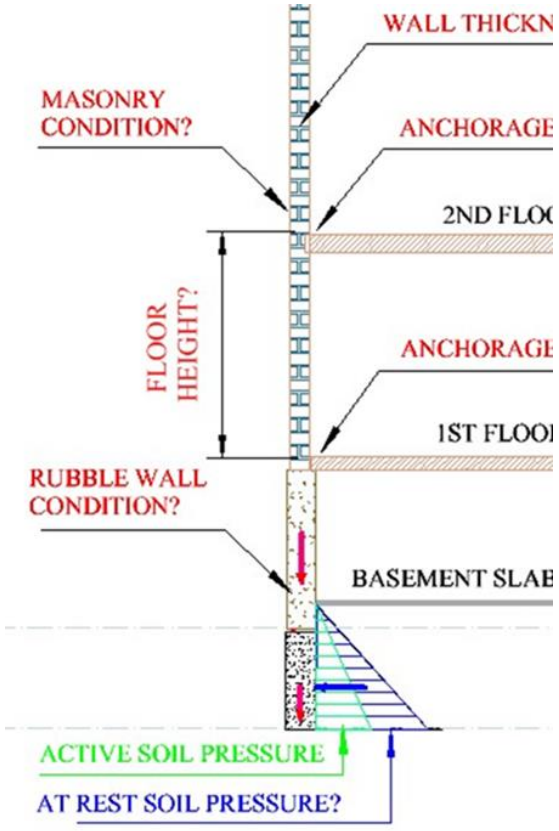
- Identification of conspicuous structural defects
  - **Bowing**
  - **Significant cracking**
  - **Structural degradation**
  - **Unusual slenderness**
- A determination of acceptable thresholds for maximum vertical and lateral movement, maximum permissible vibrations, the required monitoring, the protocols for exceedances, and foundation elements to be supported by the work
- A determination of the type and condition of the foundation elements to be supported or potentially affected by the work

1817.3 EVALUATION OF ADJACENT BUILDINGS FOR SUITABLE METHOD OF SUPPORT

1817.3.1 Assessment of the building and the subsurface conditions *(continued)*

- A test pit at each substantial change in foundation type
  - **A description of the construction materials and condition of the footing**
  - **The bottom elevation of the wall(s) and/or footing(s)**
  - **The classification of the soil or rock the foundation bears upon**
  - **Photographs and sketches of the test pit**
- Allowable bearing pressure for the existing foundation(s)
- Potential reductions to the allowable bearing pressure to the proposed excavation
- The pressures that will be presented on the proposed underpinning or MOS
  - Earth, wind, surcharge

1817.3 EVALUATION OF ADJACENT BUILDINGS FOR SUITABLE METHOD OF SUPPORT



SOURCE: LANGAN

1817.3.1 Assessment of the building and the subsurface conditions *(continued)*

- An analysis of potential effect of the subsurface condition
  - **High water table and need for dewatering**
  - **Loose soils**
  - **Potentially running soils**
  - **Presence of boulders**
- Allowable bearing pressure of the soils supporting the underpinning
- The anticipated settlement during soil and foundation work

1817.3 EVALUATION OF ADJACENT BUILDINGS FOR SUITABLE METHOD OF SUPPORT

1817.3.2 Condition of rubble foundation elements

- Investigate the condition of the rubble foundation

1817.3.3 Additional requirements for unreinforced masonry buildings

- Where the building being supported is of unreinforced masonry construction, the lateral stability of the masonry walls and their ability to resist the loads imposed shall be verified

  EXCEPTION: if not possible to verify the lateral stability, lateral support shall be provided at the floor levels of the adjacent building prior to installation of the underpinning

1817.3 EVALUATION OF ADJACENT BUILDINGS FOR SUITABLE METHOD OF SUPPORT

1817.3.5 Evaluation report

- Specifies the content of the evaluation report to be filed
- Summary of the assessments required to be performed
- Statement of what methods of support are acceptable given the assessed conditions

1817.3.6 Responsibility for the report

- Specifies the party responsible for the evaluation report and the methodology for relying on the work and judgement of additional engineers

1817.5 DESIGN REQUIREMENTS

1817.5.4.1 Loads from the existing building

- Loads and load combinations shall be computed in accordance with BC Chapter 16 or where permitted for loads of Prior Codes for Prior Code buildings

1817.5.4.1.1 Unconfirmed load path

- Where the evaluation is unable to visually confirm the load path from the existing building, pit-pier underpinning where all horizontal loads are transferred directly to a raker or tension anchor bracing system that braces every pit-pier is permissible

  EXCEPTION: Raker bracing or tension anchors need not be installed where the underpinning system, analyzed as a retaining wall that supports the soil and water behind it, has satisfactory bearing pressures and is stable. This exception is not applicable for URM in which access to verify the lateral stability of masonry walls was not performed.

1817.5 DESIGN REQUIREMENTS

1817.5.4.2 Soil and water pressures

- The design shall include at rest soil pressures, water pressures and any surcharge pressures

1817.5.1 New construction

- Materials and design in accordance with this Code

1817.5.2 Incorporation of the evaluation report

- The design shall incorporate the findings of the evaluation. If the evaluation report did not conclusively demonstrate the suitability such method of support shall not be used

1817.5 DESIGN REQUIREMENTS

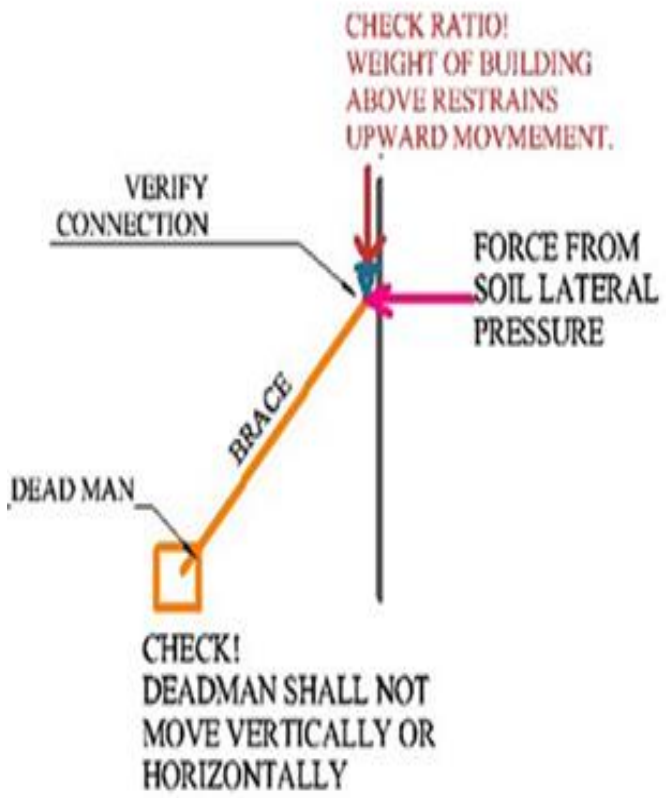
1817.5.3 Deviations from the evaluation report

- The engineer designing the MOS may be an engineer other than the engineer who submitted the evaluation report
- If the engineer designing the MOS does not accept the evaluation report or finds it insufficient, a new evaluation report shall be submitted
- Different MOS other than the evaluation report is proposed for use, an additional evaluation report shall be submitted. (along with the construction documents for the design of the method of support)

1817.5.5 Anticipated deflection

- A calculation shall be performed for the anticipated deflection of the method of support system and its effect on the supported building

1817.5 DESIGN REQUIREMENTS



SOURCE: LANGAN

1817.5.6 Factor of safety

- Methods of support shall provide a minimum factor of safety of 1.5 for sliding and overturning for all loads and all anticipated interim conditions

1817.5.7 Sequence

- The design of the method of support shall account for the means and methods of installation, sequence of operations, and all the load transfers and associated support conditions for all phases of the work

1817.6 MINIMUM REQUIREMENTS FOR CONSTRUCTION DOCUMENTS

- Type of adjacent foundation
- Bearing elevation(s) soil classification
- Top and bottom elevations of deep foundation elements
- Elevations of all floor levels at grade and below
- Plans, cross-sections, and elevations views as necessary
- Details for monitoring

1817.6 MINIMUM REQUIREMENTS FOR CONSTRUCTION DOCUMENTS

- Design of the method of support including bracing
- A step-by-step procedure describing the installation of the support
- The elevation of the water table, need for dewatering, etc.
- References alerting to the evaluation report of the adjacent building
- Plans, sections, and elevation views of all methods of support
- A load table/diagram indicating total gravity and lateral load in underpinning piers or alternate method of support

1817.7 ADDITIONAL REQUIREMENTS FOR PIT-PIER UNDERPINNING

When the method of support selected is pit-pier underpinning, the design shall meet certain minimum criteria:

- After installation, the approach pit shall be back filled
- The site excavation should not expose more than 1/3 of the total height of a pit-pier, unless:
  - A pit-pier bracing system designed by the engineer is installed
  - The calculated capacity of the individual pit-pier to resist lateral loading at a greater depth is identified on the drawings
- Pit-piers shall be preloaded by wedging, use of permanent jacks, etc.

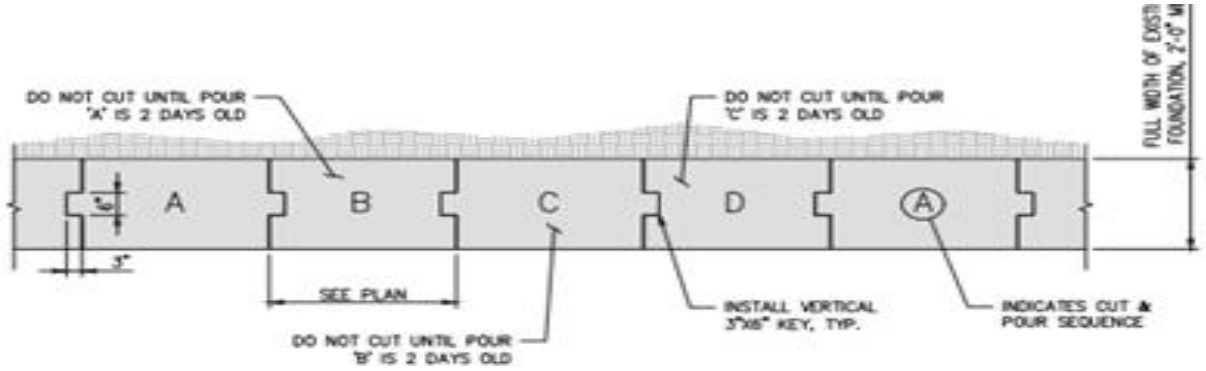
1817.7 ADDITIONAL REQUIREMENTS FOR PIT-PIER UNDERPINNING

- Voids between the bottom of the foundation and the top of the pit-pier shall be filled with dry-pack
- The need for jacking shall be determined by the engineer responsible for the underpinning design
- Width of pit-piers shall not exceed 4 feet
- Shear transfer shall be designed and installed between adjacent pit-piers.
- Bottom of pit-pier elevation shall be a minimum of 1 foot below the bottom of the future adjacent excavation

1817.7 ADDITIONAL REQUIREMENTS FOR PIT-PIER UNDERPINNING

Pit-pier excavation is subject to several requirements:

- Excavation shall be performed using handheld tools
- Clear distance between open pits shall be determined by the evaluation report and shall not be <12 feet
- Lagging boards installed as the excavation proceeds to limit soil loss
- Backpacking of any voids shall be performed at each excavation lift



1817.7 ADDITIONAL REQUIREMENTS FOR PIT-PIER UNDERPINNING

Pit-pier excavation is subject to several requirements: ***(continued)***

- Pit excavation shall not proceed below the water table.
- Where construction requires adjacent pits to be excavated to differing depths, the deeper pit-pier shall be constructed first
- Where multi-tier pit-pier underpinning is utilized, upper piers shall be braced prior to the excavation of the lower pier
- When tension anchors are utilized, must account for effects of vertical and horizontal force components

1817.8 ADDITIONAL REQUIREMENTS FOR DEEP FOUNDATION ELEMENTS USED IN UNDERPINNING

SOURCE: LANGAN

Where the method of support includes deep foundation systems such as pile supported underpinning or tie anchors, several requirements shall be met related to:

- Pile design
- Load testing
- Eccentric pile loads
- Spanning between piles
- Piles used as excavation support elements

1817.9 MONITORING

- Adjacent structures and properties shall be monitored in accordance with a plan prepared by the engineer
  - **Scope of the monitoring program**
  - **Location and type of instruments**
  - **Frequency and duration of readings and reporting**
  - **Maximum allowable time to report readings (timely report)**
  - **Reporting requirements**
  - **Permissible movement and vibration criteria**
- Take into account buildings or property to be monitored and its conditions
- Address exceedances
- Notifying the Commissioner
- Where a building is subject to underpinning, the monitoring plan shall be determined by the engineer

1817.10 SPECIAL INSPECTION

Special inspection for underpinning shall be conducted in accordance with **BC Chapter 17**

- **1704.20.3 Underpinning**
- **1704.20.3.1 New foundations**
  - In addition to the special inspection for structural stability, and new foundation elements installed as part of underpinning operations shall be subject to special inspection as a permanent installation
- **1704.20.6 Inspection program**
- **1704.20.7 Design documents**
- **1704.20.8 Inspection during construction operations**
- **1704.20.9 Records of special inspections**
- **1704.20.10 Special requirements for work in occupied multiple dwellings**

1818 GEOTECHNICAL PEER REVIEW

1818 GEOTECHNICAL PEER REVIEW

1818.2 Where required

- As per BC **Section 1617 Structural Peer Review**
- Structures of Occupancy Category III or IV where the Seismic site is classified as Site Class F
- Performance based foundation design is utilized
- If required by the Commissioner

1818.3 Geotechnical Peer Review Qualifications

- Qualified independent geotechnical engineer who has been retained by or on behalf of the owner

1818.4.1 Scope

- Review the plans and specifications submitted with the permit application for general compliance with the foundation design provisions of this Code

1818 GEOTECHNICAL PEER REVIEW

1818.5 Geotechnical Peer Review Report

- The reviewing engineering shall submit a report stating that the geotechnical design shown on the plans, reports and specifications generally conforms to the requirements of this Code

- Need not be submitted concurrently with the structural peer review report

1818 GEOTECHNICAL PEER REVIEW

1818.6 Responsibility

- The engineer of record for the foundation design shall retain sole responsibility for the geotechnical design
- The geotechnical peer reviewer's report states an opinion regarding the design by the engineer of record for the foundation design
- Geotechnical peer reviewer is not responsible for the accuracy of the subsurface investigation data or the conclusions of the structural peer review reports
- When revisions to design are made, the engineer of record for the foundation design must identify that a new review is required

2022 NYC BUILDING CODE
CHAPTER 33

Safeguards During Construction Or Demolition

3304 SOIL AND FOUNDATION WORK

SOURCE: LANGAN

3304.4.1 Support of excavation

- The sides of all excavations, including rock faces and soil slopes, must be supported by means of sheeting, shoring, bracing, sloping, benching, or other retaining structures or bracing systems required to support the excavation face or foundation work before permanent supports are provided
- Creating a general duty to support excavations in all cases
- The section today only requires protection if the excavation is 5 ft or deeper
- Added prescriptive requirements that are worked into the design requirements and revised to avoid conflict with OSHA requirements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