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DIGITAL CONSTRUCTION SAFETY CONFERENCE

EXCAVATION SAFETY: SUPPORT OF EXCAVATION & UNDERPINNING

PRESENTED BY

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NYC Buildings

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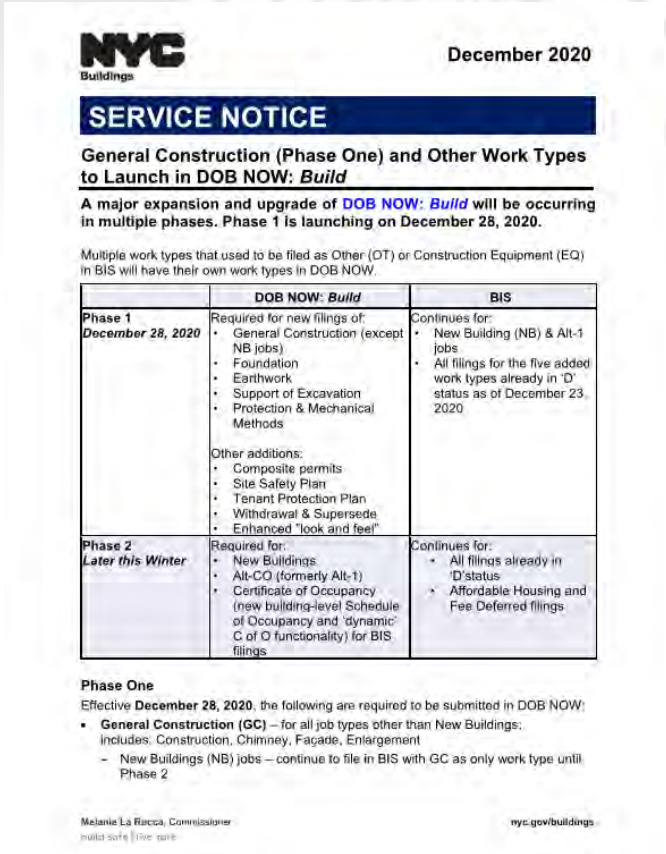
PRESENTATION OVERVIEW

This presentation will provide an overview of the NYC Administrative and Building Code requirements as they relate to Excavation and Underpinning. Examples will be utilized to demonstrate how design and construction errors and omissions impact property as well as public and worker safety. The presentation also reviews proper methods for sequencing and monitoring excavations to assure structural stability during excavation and underpinning operations.

DOB NOW: *Build*

Foundation, Earthwork, and Support of Excavation Filings



NYC Buildings

December 2020

SERVICE NOTICE

General Construction (Phase One) and Other Work Types to Launch in DOB NOW: *Build*

A major expansion and upgrade of DOB NOW: *Build* will be occurring in multiple phases. Phase 1 is launching on December 28, 2020.

Multiple work types that used to be filed as Other (OT) or Construction Equipment (EQ) in BIS will have their own work types in DOB NOW.

	DOB NOW: *Build*	BIS
Phase 1 ***December 28, 2020***	Required for new filings of: • General Construction (except NB jobs) • Foundation • Earthwork • Support of Excavation • Protection & Mechanical Methods Other additions: • Composite permits • Site Safety Plan • Tenant Protection Plan • Withdrawal & Supersede • Enhanced "look and feel"	Continues for: • New Building (NB) & Alt-1 jobs • All filings for the five added work types already in 'D' status as of December 23, 2020
Phase 2 ***Later this Winter***	Required for: • New Buildings • Alt-CO (formerly Alt-1) • Certificate of Occupancy (new building-level Schedule of Occupancy and 'dynamic' C of O functionality) for BIS filings	Continues for: • All filings already in 'D' status • Affordable Housing and Fee Deferred filings

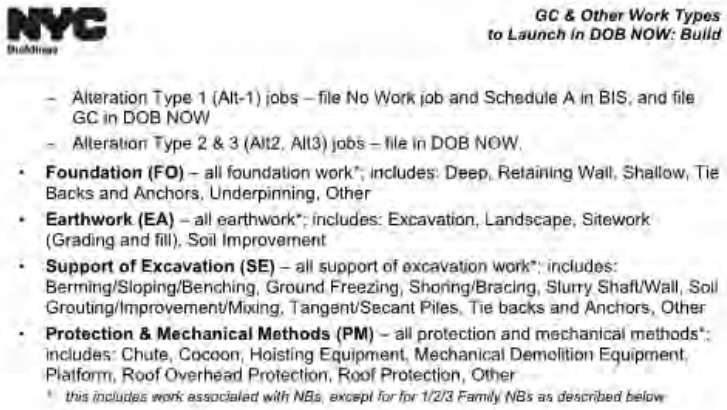
Phase One

Effective **December 28, 2020**, the following are required to be submitted in DOB NOW:

- **General Construction (GC)** – for all job types other than New Buildings; includes: Construction, Chimney, Façade, Enlargement
  - New Buildings (NB) jobs – continue to file in BIS with GC as only work type until Phase 2

Melanie La Rocca, Commissioner

nyc.gov/buildings



NYC Buildings

GC & Other Work Types to Launch in DOB NOW: Build

  - Alteration Type 1 (Alt-1) jobs – file No Work job and Schedule A in BIS, and file GC in DOB NOW
  - Alteration Type 2 & 3 (Alt2, Alt3) jobs – file in DOB NOW.
- **Foundation (FO)** – all foundation work*; includes: Deep, Retaining Wall, Shallow, Tie Backs and Anchors, Underpinning, Other
- **Earthwork (EA)** – all earthwork*; includes: Excavation, Landscape, Sitework (Grading and fill), Soil Improvement
- **Support of Excavation (SE)** – all support of excavation work*; includes: Berming/Sloping/Benching, Ground Freezing, Shoring/Bracing, Slurry Shaft/Wall, Soil Grouting/Improvement/Mixing, Tangent/Secant Piles, Tie backs and Anchors, Other
- **Protection & Mechanical Methods (PM)** – all protection and mechanical methods*; includes: Chute, Cocoon, Hoisting Equipment, Mechanical Demolition Equipment, Platform, Roof Overhead Protection, Roof Protection, Other

* *this includes work associated with NBs, except for for 1/2/3 Family NBs as described below*

As of December 28, 2020 Foundation (FO), Earthwork (EA), Support of Excavation (SE) filings to be done through DOB NOW: Build

https://www1.nyc.gov/site/buildings/business/service-updates.page

IMPORTANCE OF SUPPORT OF EXCAVATION & SOIL WEIGHT

- A single cubic yard of soil weighs approximately **3,000 lbs**.
- A 2021 Honda Accord weighs approximately **3,150 lbs**.

COMMON ERRORS & OMISSIONS

Adjacent Building Structure Not Indicated

Adjacent buildings structure not shown on the plans. Bottom of existing adjacent footings not indicated.

2014 BUILDING CODE: CHAPTER 1 ADMINISTRATION

BC 107 Construction Documents

BC 107.7.1 Foundation Plans

Foundation plans shall show compliance with the requirements of Chapter 18 of this code regarding foundation design and shall show the plan locations, design loads, design elevations of the bottoms, and details as to sizes, reinforcement, and construction of all footings, piers, foundation walls, pile groups, and pile caps. **The levels of footings of adjacent structures shall be indicated or, if the adjacent structures are pile supported, this shall be stated.** Where applicable, the plans shall include underpinning details.

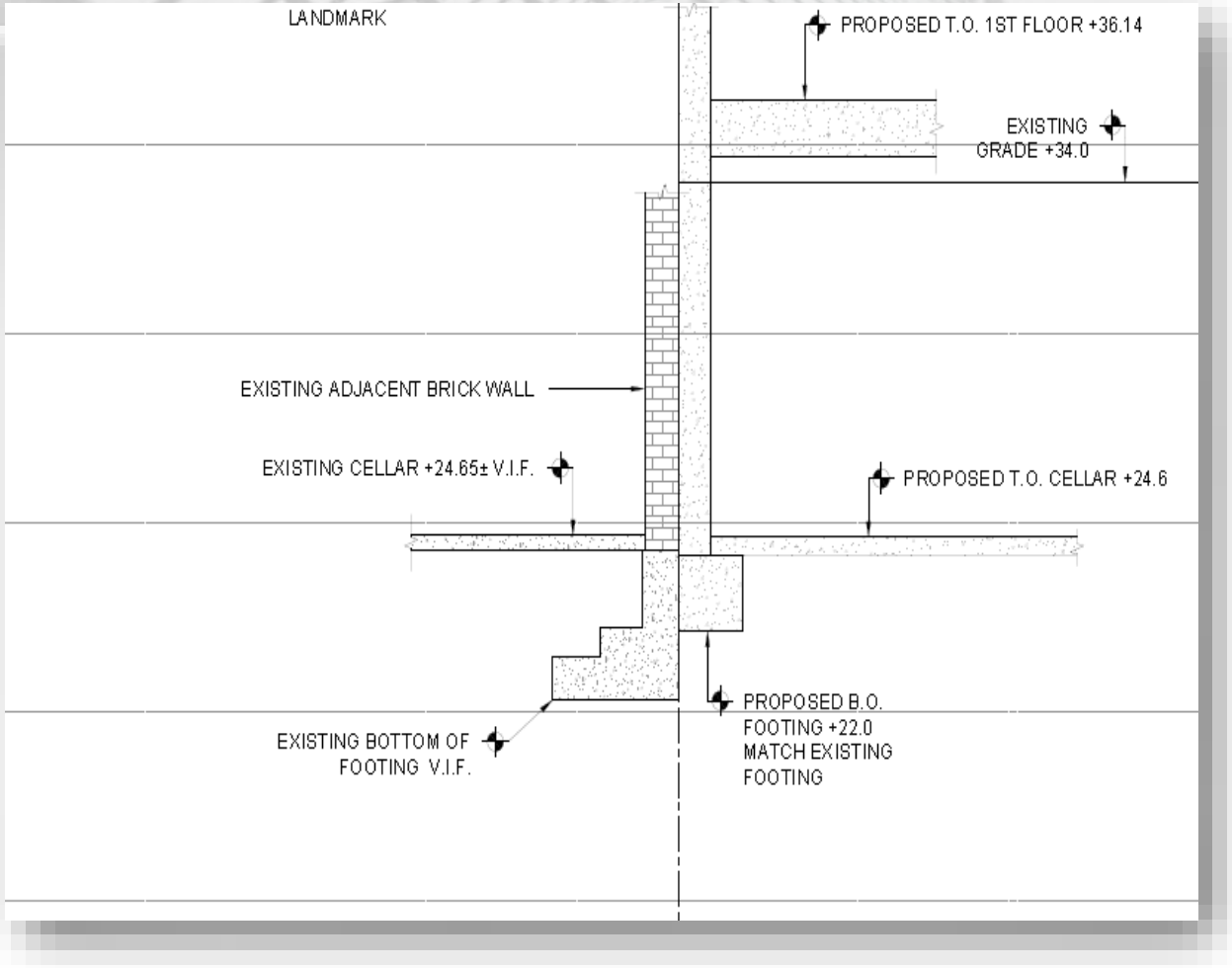
2014 BUILDING CODE: CHAPTER 1 ADMINISTRATION

BC 107 Construction Documents

BC 107.8 Earthwork Plans

For excavation operations, **the plans shall also indicate the levels of footings of all adjacent structures or, if the adjacent structures are pile supported, this shall be stated.** Where applicable, the plans shall also include underpinning details, soil information in accordance with Chapter 18, and a final grading plan representing the lot after all earthwork, excavation or fill operations have been completed.

BOTTOM OF EXISTING FOOTING V.I.F.: NO GOOD



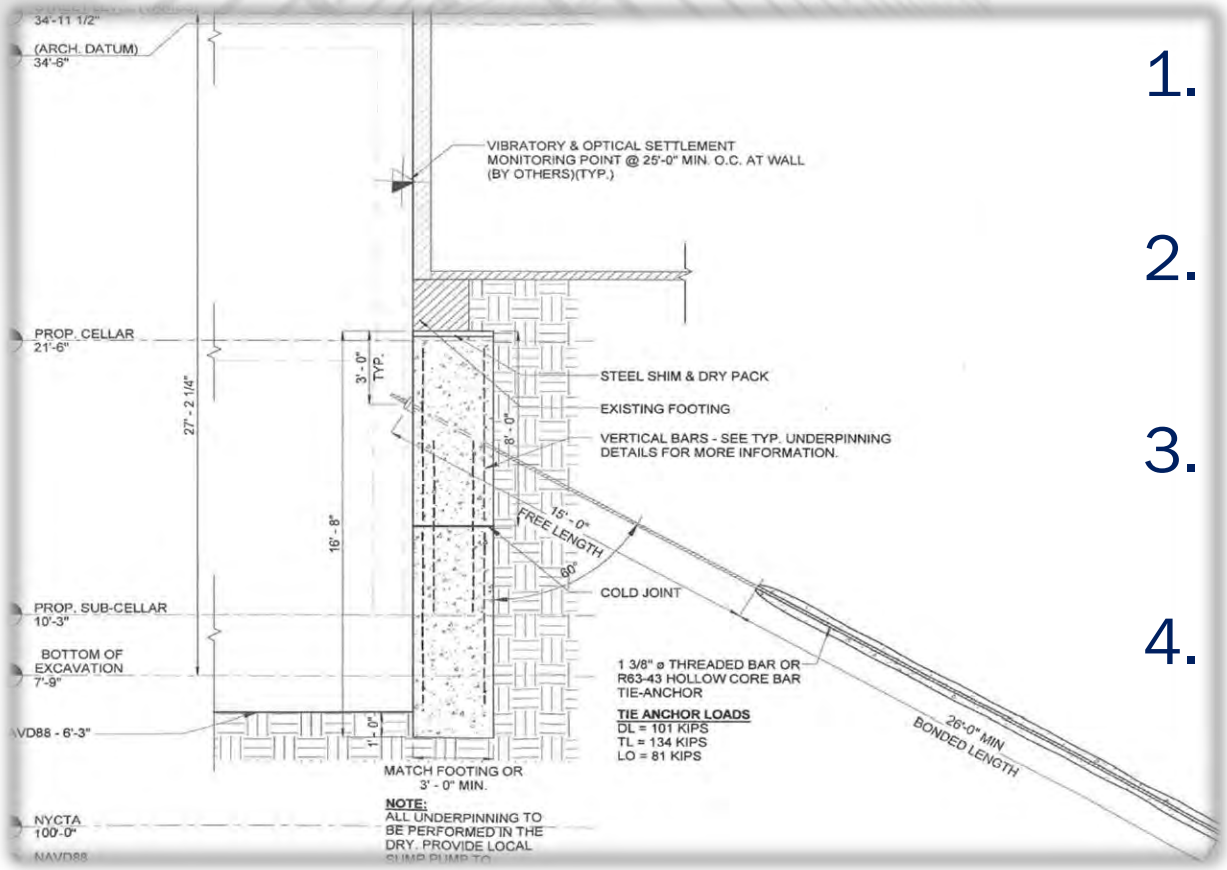
- Bottom of existing adjacent footings **must** be documented prior to filing and permitting with the Department.
- Exploratory work can be performed as per AC 28-105.4.6 Geotechnical Investigations
- Do not address during construction and note V.I.F.

COMMON ERRORS & OMISSIONS

Lateral Loads & Eccentricities Not Accounted for in the Design

Deficient design of SOE systems where the lateral loads and eccentricities are not accounted for in the design.

ECCENTRICITY AND LATERAL LOADS



1. Lateral soil, surcharge, hydrostatic, seismic loads accounted for?
2. Dead load from the structure? Lightweight structure?
3. Eccentrically loaded underpinning. Not centered with footing width above.
4. Vertical component from tieback accounted for in design?

COMMON ERRORS & OMISSIONS

No SOE provided for excavations < 5ft

No SOE provided for excavations less than 5ft., but within 5ft. of adjacent foundation.

2014 BUILDING CODE: CHAPTER 33 SAFEGUARDS

BC 3304 Soil and Foundation Work

3304.2 Support of excavation drawings

The sides of all excavations, including related or resulting embankments, shall be supported as specified on the drawings. Such drawings shall be site specific and shall clearly illustrate all related protection and support of excavation, including but not limited to sloping, stepping, sheeting, shoring, bracing, guardrail systems, and fences as required by Section 3304.4 (protection of sides of excavation), with all dimensions indicated. Such drawings shall also indicate any utilities or public infrastructure impacted by the excavation.

NO SOE: DEPTH LESS THAN 5 FEET

BC 3304 Soil and Foundation Work

3304.2 Support of excavation drawings *(continued)*

Exceptions:

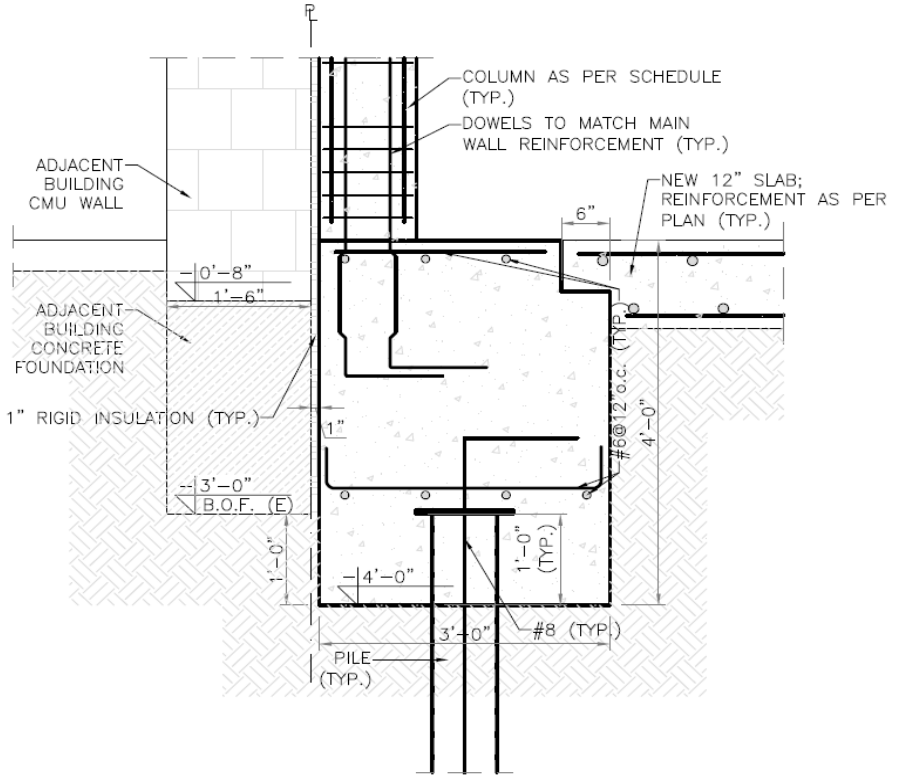
1. Drawings for the support of excavations are not required for an excavation:

    1.1 That occurs 5 feet or less in depth **PROVIDED:**

    1.1.1 The excavation also occurs more than 5ft from all footings and foundations; or

    1.1.2 *Where the excavation occurs within 5ft or less from a footing or foundation, such excavation does not occur below the level of the footing or foundation.*

NO SOE: DEPTH LESS THAN 5 FEET



L ADJACENT BUILDING - CORNER CONDITION
Scale: 3/4" = 1'-0"

- Excavation is occurring adjacent to and below the existing foundation.
- Depth is 4ft.
- Drawings are required and support of excavation must be indicated.

NO SUPPORT OF EXCAVATION OR DRAWINGS

- Support of excavation required due to excavation below the bottom of the adjacent footing
- Support of excavation drawings required as per code

COMMON ERRORS & OMISSIONS

No SOE provided and work contrary to the design documents

No SOE provided in general and work performed contrary to the approved design documents.

SUPPORT OF EXCAVATION: NO SUPPORT

- No support of excavation provided contrary to drawings
- Sloped excavation much steeper than 45 degrees
- Proper support of excavation or sloping is required as per the approved SOE drawings.
- Not acceptable to forgo support even temporarily. Hazard to workers and adjacent property

SUPPORT OF EXCAVATION: NO SUPPORT

- 12ft tall shear cuts with no support of excavation
- Surcharge pressure from construction materials above in addition to soil pressure

UNDERPINNING: NONCONFORMANCE TO DRAWINGS

- Approach and box pit construction?
- Formwork only
- Sequence of work?
- Cantilevered foundation and soil ledge over location
- Hazardous condition for workers and adjacent property

COMMON ERRORS & OMISSIONS

Inadequate Bracing and Displacement of Support of Excavation

Missing or inadequate bracing for underpinning or support of excavation. Excessive vertical and horizontal displacements. Deflection/lateral movement must be considered during design (not only stress).

2014 BUILDING CODE: CHAPTER 18 FOUNDATIONS

BC 1814 Underpinning and Support of Adjacent Property

1814.1.1 Underpinning and Bracing

Underpinning piers, walls, piles and footings shall be designed as permanent structural elements and installed in accordance with provisions of this chapter and Chapter 33 and shall be inspected in accordance with the provisions of Chapter 17. *Underpinning shall be designed and installed in such a manner so as to limit the lateral and vertical displacement of the adjacent structure to permissible values as established in accordance with Section 1814.3 (Monitoring).*

2014 BUILDING CODE: CHAPTER 33 SAFEGUARDS

BC 3309 Protection of Adjoining Property

3309.4 Soil or foundation work affecting adjoining property

Whenever soil or foundation work occurs, regardless of the depth of such, the person who causes such to be made shall, at all times during the course of such work and at his or her own expense, preserve and protect from damage any adjoining structures, including but not limited to footings and foundations…

2014 BUILDING CODE: CHAPTER 33 SAFEGUARDS

BC 3309 Protection of Adjoining Property

3309.4.1 Additional safeguards during construction

The following additional requirements shall apply during excavation:

1. The person causing the excavation shall support the vertical and **lateral** load of the adjoining structure by proper foundations, underpinning, or other equivalent means where the level of the foundations of the adjoining structure is at or above the level of the bottom of the new excavation.

CMU ‘RETAINING WALL’ IN LIEU OF UNDERPINNING

- Cantilevered CMU ‘wall’ built adjacent to the undermined section of wall
- Lateral resistance? Sufficient to limit lateral displacement? **NO**
- Unpermitted work with no design documents
- Not an acceptable method of support of excavation or underpinning alternative

UNDERPINNING: LATERAL SUPPORT

- Steel waler and raker system provided for lateral support of underpinning
- Location of waler installed just below the cold joint of the underpinning and the existing wall footing
- Location of the support significantly reduces shear and moment on the existing structure and underpinning system
- Cold joint is essentially a hinge

LATERAL MOVEMENT OF SUPPORT OF EXCAVATION

- Deflection/ lateral movement of SOE system **not** accounted for in design
- Design only addressed stress
- Excessive lateral movements caused damage to adjacent utilities and property

LATERAL MOVEMENT OF SUPPORT OF EXCAVATION

- Watermain was perpendicular to the SOE system
- Lateral movement of the SOE system imposed additional stress on the existing cast iron connection causing failure

SUPPORT OF EXCAVATION: SOLDIER PILES & LAGGING

- Cantilevered Soldier Piles with no lateral bracing
- Surcharge from Excavator
- Significant Lateral movement observed
- Lagging boards not properly supported

COMMON ERRORS & OMISSIONS

Sequence of Work

The sequence of work is not indicated or not indicated to sufficient detail (generic and not site specific). This must be included in the design documents

2014 BUILDING CODE: CHAPTER 18

BC 1814 Underpinning and Support of Adjacent Property

1814.1 General

Where the protection and/or support of a structure or property adjacent to an excavation is required, an engineer shall prepare a preconstruction report summarizing the condition of the structure or property. The **engineer** shall determine the requirements for underpinning or other protection of the site and structure-specific plans, including details and ***sequence of work*** for submission to the commissioner.

INSUFFICIENT SEQUENCE OF WORK

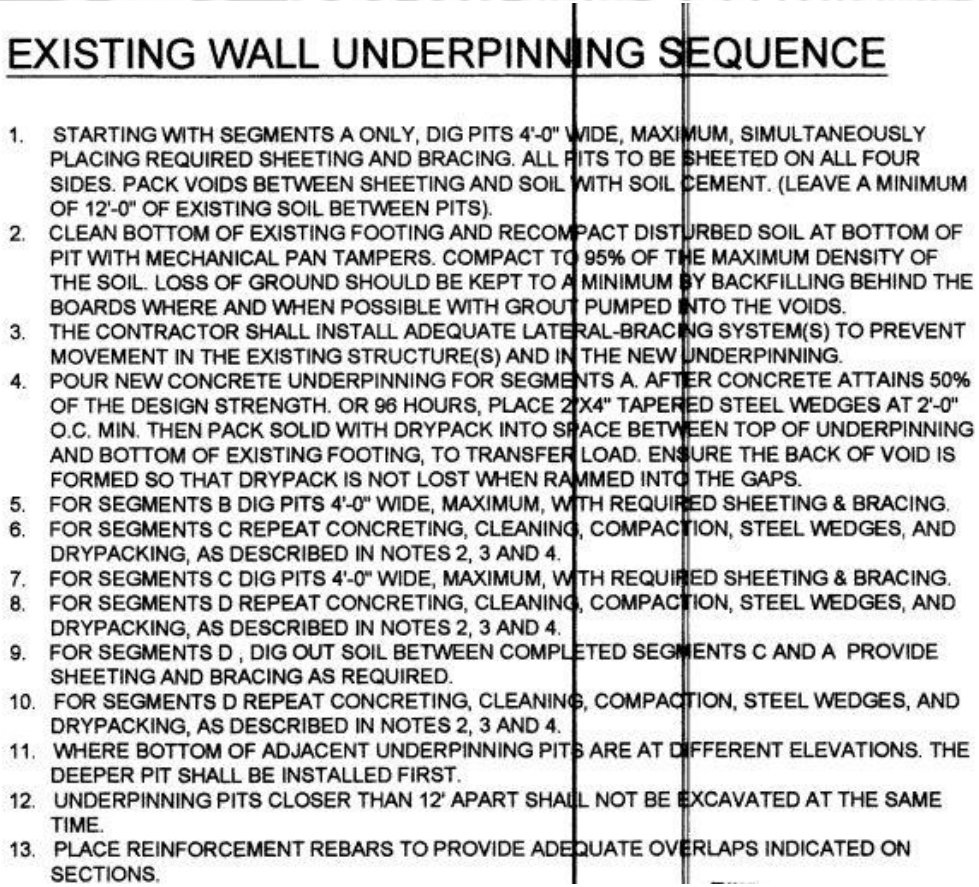
Sequence of Work

Responsibility of the Contractor? Means and Methods of Construction?

NO!

The Sequence of Work must be developed by the engineer based on the design requirements and the existing conditions. This must be site specific.

SEQUENCE OF WORK: UNDERPINNING



EXISTING WALL UNDERPINNING SEQUENCE

1. STARTING WITH SEGMENTS A ONLY, DIG PITS 4'-0" WIDE, MAXIMUM, SIMULTANEOUSLY PLACING REQUIRED SHEETING AND BRACING. ALL PITS TO BE SHEETED ON ALL FOUR SIDES. PACK VOIDS BETWEEN SHEETING AND SOIL WITH SOIL CEMENT. (LEAVE A MINIMUM OF 12'-0" OF EXISTING SOIL BETWEEN PITS).
2. CLEAN BOTTOM OF EXISTING FOOTING AND RECOMPACT DISTURBED SOIL AT BOTTOM OF PIT WITH MECHANICAL PAN TAMPERS. COMPACT TO 95% OF THE MAXIMUM DENSITY OF THE SOIL. LOSS OF GROUND SHOULD BE KEPT TO A MINIMUM BY BACKFILLING BEHIND THE BOARDS WHERE AND WHEN POSSIBLE WITH GROUT PUMPED INTO THE VOIDS.
3. THE CONTRACTOR SHALL INSTALL ADEQUATE LATERAL-BRACING SYSTEM(S) TO PREVENT MOVEMENT IN THE EXISTING STRUCTURE(S) AND IN THE NEW UNDERPINNING.
4. POUR NEW CONCRETE UNDERPINNING FOR SEGMENTS A. AFTER CONCRETE ATTAINS 50% OF THE DESIGN STRENGTH. OR 96 HOURS, PLACE 2"X4" TAPERED STEEL WEDGES AT 2'-0" O.C. MIN. THEN PACK SOLID WITH DRYPACK INTO SPACE BETWEEN TOP OF UNDERPINNING AND BOTTOM OF EXISTING FOOTING, TO TRANSFER LOAD. ENSURE THE BACK OF VOID IS FORMED SO THAT DRYPACK IS NOT LOST WHEN RAMMED INTO THE GAPS.
5. FOR SEGMENTS B DIG PITS 4'-0" WIDE, MAXIMUM, WITH REQUIRED SHEETING & BRACING.
6. FOR SEGMENTS C REPEAT CONCRETING, CLEANING, COMPACTION, STEEL WEDGES, AND DRYPACKING, AS DESCRIBED IN NOTES 2, 3 AND 4.
7. FOR SEGMENTS C DIG PITS 4'-0" WIDE, MAXIMUM, WITH REQUIRED SHEETING & BRACING.
8. FOR SEGMENTS D REPEAT CONCRETING, CLEANING, COMPACTION, STEEL WEDGES, AND DRYPACKING, AS DESCRIBED IN NOTES 2, 3 AND 4.
9. FOR SEGMENTS D , DIG OUT SOIL BETWEEN COMPLETED SEGMENTS C AND A PROVIDE SHEETING AND BRACING AS REQUIRED.
10. FOR SEGMENTS D REPEAT CONCRETING, CLEANING, COMPACTION, STEEL WEDGES, AND DRYPACKING, AS DESCRIBED IN NOTES 2, 3 AND 4.
11. WHERE BOTTOM OF ADJACENT UNDERPINNING PITS ARE AT DIFFERENT ELEVATIONS. THE DEEPER PIT SHALL BE INSTALLED FIRST.
12. UNDERPINNING PITS CLOSER THAN 12' APART SHALL NOT BE EXCAVATED AT THE SAME TIME.
13. PLACE REINFORCEMENT REBARS TO PROVIDE ADEQUATE OVERLAPS INDICATED ON SECTIONS.

- Sequence of work is very general and is not site or structure specific
- Cookie cutter A,B,C,D pins 4 feet wide with 12 foot spacing.
- Note #3 indicates, “The Contractor shall install an adequate lateral bracing system to prevent movement in the existing structure and in the new underpinning.”
- The lateral bracing needs to be designed and documented on approved EOR drawings. This cannot be delegated to the contractor with no approved design.

SUPPORT OF EXCAVATION: NO SUPPORT

- No support of excavation provided
- Example of improper sequence of work for SOE installation
- Full excavation performed and support provided after
- Hazardous condition for workers and adjacent property

SUPPORT OF EXCAVATION: PROPER SEQUENCING

- Soldier pile and lagging construction
- Waler installed and coordinated with the sequence of work not allowing additional excavation until lateral support is installed
- Localized raker and heel block installation next step as per sequence

COMMON ERRORS & OMISSIONS

Monitoring

Insufficient monitoring specified and/or implemented for protection of adjacent buildings and/or landmark structures within 90ft.

2014 BUILDING CODE: CHAPTER 17 SPECIAL INSPECTIONS

BC 1704.20 Structural Stability

1704.20.7.1 Monitoring

The design documents shall include any requirements for monitoring of the subject structure **and/or adjacent structures**, as determined by the registered design professional responsible for the design. The monitoring plan shall be specific to the buildings to be monitored and operations to be undertaken, **and shall specify the scope and frequency of monitoring, acceptable tolerances, and reporting criteria for when tolerances are exceeded**.

2014 BUILDING CODE: CHAPTER 18 SOILS & FOUNDATIONS

BC 1814 Underpinning and Support of Adjacent Property

1814.3 Monitoring

When excavation, foundation construction, or underpinning is required, adjacent structures and properties shall be monitored in accordance with a plan prepared by the engineer. The engineer shall develop the scope of the monitoring program, including location and type of instruments, frequency and duration of readings, and permissible movement and vibration criteria.

2014 BUILDING CODE: CHAPTER 18 SOILS & FOUNDATIONS

BC 1814 Underpinning and Support of Adjacent Property

1814.3 Monitoring *(continued)*

This scope shall take into account the structures or property to be monitored and the conditions thereof. **The monitoring program shall include necessary actions to address exceedances**. These actions shall include notification of the commissioner. Monitoring of historic and landmarked structures shall be subject to special requirements as determined by the department.

2014 BUILDING CODE: CHAPTER 33 SAFEGUARDS

BC 3309 Protection of Adjoining Property

3309.4.4 Monitoring

During the course of excavation work the following shall be monitored in accordance with Section 3309.16:

1. Buildings that are within a distance from the edge of the excavation that is equal to or less than the maximum depth of the excavation.
2. Historic structures that are contiguous to or within a lateral distance of 90 feet from the edge of the lot where an excavation is occurring.

2014 BUILDING CODE: CHAPTER 33 SAFEGUARDS

BC 3309 Protection of Adjoining Property

3309.16 Monitoring plan

Where monitoring is required by Section 3309, such monitoring **shall be in accordance with a monitoring plan developed by a registered design professional** and acceptable to the commissioner. The monitoring plan shall be specific to the structures to be monitored and operations to be undertaken, and **shall specify the scope and frequency of monitoring, acceptable tolerances, and reporting criteria for when tolerances are exceeded**.

COMMON ERRORS & OMISSIONS

Preconstruction Reports

No preconstruction report for determining the existing condition and protection of adjacent buildings.

A preconstruction survey **is not** a preconstruction report.

2014 BUILDING CODE: CHAPTER 18 SOILS & FOUNDATIONS

BC 1814 Underpinning and Support of Adjacent Property

1814.1 General

Where the protection and/or support of a structure or property adjacent to an excavation is required, **an *engineer* shall prepare a preconstruction report *summarizing the condition* of the structure or property.** The engineer shall determine the requirements for underpinning or other protection of the site and structure-specific plans, including details and sequence of work for submission to the commissioner.

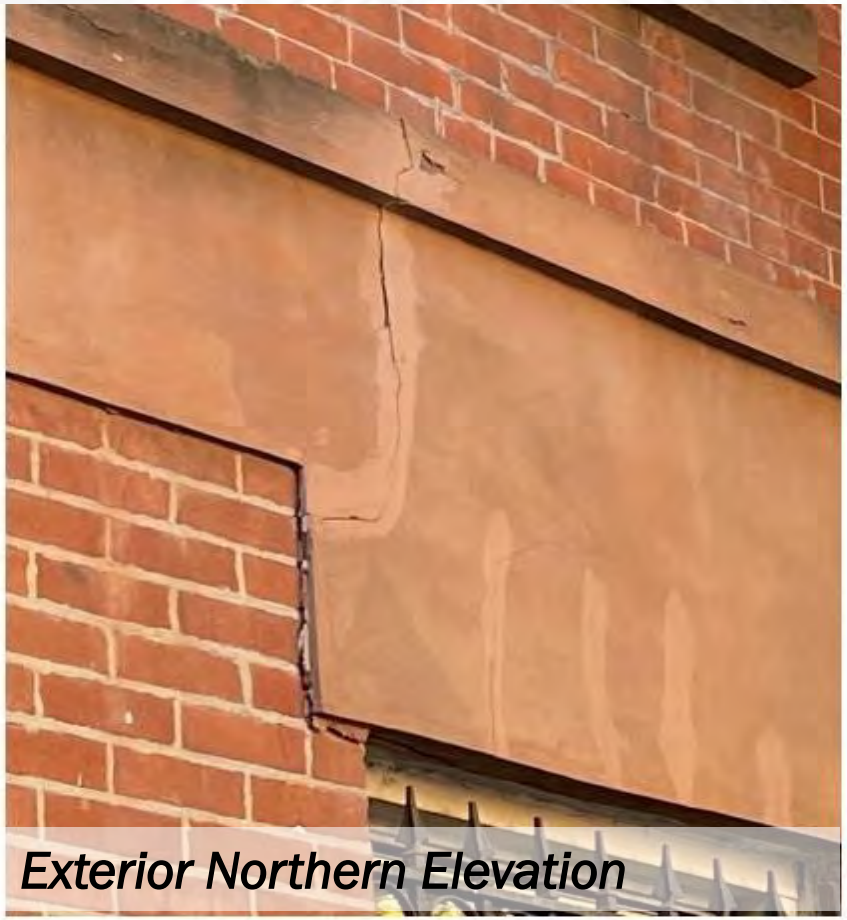
2014 BUILDING CODE: CHAPTER 33 SAFEGUARDS

BC 3309 Protection of Adjoining Property

3309.4.3 Preconstruction survey

No excavation work to a depth of 5 feet to 10 feet within 10 feet of an adjacent building, or an excavation over 10 feet anywhere on the site **shall commence** until the person causing an excavation to be made has *documented* the existing conditions of all adjacent buildings in a preconstruction survey.

PRECONSTRUCTION SURVEY OR REPORT?



Exterior Northern Elevation

- Condition of the adjacent building(s) summarized? Has the building(s) been maintained? Preexisting conditions?
- Building age, foundation and structure type indicated? Sensitivity to excavation/ underpinning operations?
- Summary and recommendations for the protection and support of the existing structure?
- Photo documentation only? (preconstruction survey)

COMMON ERRORS & OMISSIONS

Structural Stability Inspections

Structural stability inspections for adjacent structures not indicated or implemented.

2014 BUILDING CODE: CHAPTER 17 SPECIAL INSPECTIONS

BC 1704.20 Structural Stability

1704.20.1.1 Construction operations influencing adjacent structures.
Where construction operations have the potential to affect structurally the condition or occupancy of the subject structure and/or an adjacent structure, the structural stability of such structures shall be subject to special inspections in accordance with Sections 1704.20.6 through 1704.20.10.

2014 BUILDING CODE: CHAPTER 17 SPECIAL INSPECTIONS

BC 1704.20 Structural Stability

The required special inspection for construction operations that influence adjacent structures does seem to cause confusion. As it notes this special inspection is required for ANY construction operation that affects an adjacent building. This is not limited to existing structures on a project site and is required for construction operations such as excavation and foundation work for a new building. This is a relatively new Code requirement and was introduced in the 2014 Code. Keep this in mind for future projects.

2014 BUILDING CODE: CHAPTER 17 SPECIAL INSPECTIONS

BC 1704.20 Structural Stability

1704.20.2 Excavations

Methods employed to protect the sides of excavations meeting the requirements of Item 1 of Section 3304.4.1 shall be subject to special inspections in accordance with Sections 1704.20.6 through 1704.20.10.

1704.20.3 Underpinning

Underpinning of structures shall be subject to special inspections in accordance with Sections 1704.20.6 through 1704.20.10

COMMON ERRORS & OMISSIONS

Surveying/Locating Adjacent Utilities

Adjacent utilities not surveyed/located and documented prior to start of construction. 811 not called.

2014 BUILDING CODE: CHAPTER 1 ADMINISTRATION

BC 107 Construction Documents

107.8 Earthwork Plans

Where the application is sought solely for or includes earthwork, excavation or fill operations, including but not limited to site decontamination, soil remediation and grading, the applicant shall submit 1) a lot diagram showing the exact location of the lot and dimensions to the nearest corner; and
2) *plans showing the exact location, extent, and depth or height of the proposed earthwork, excavation or fill operation and* ***any existing utilities****, foundations or other infrastructure potentially impacted by the earthwork, excavation or fill operation.*

2014 BUILDING CODE: CHAPTER 33 SAFEGUARDS

BC 3304 Soil and Foundation Work

3304.2 Support of excavation drawings

The sides of all excavations, including related or resulting embankments, shall be supported as specified on the drawings. Such drawings shall be site specific and shall clearly illustrate all related protection and support of excavation, including but not limited to sloping, stepping, sheeting, shoring, bracing, guardrail systems, and fences as required by Section 3304.4 (protection of sides of excavation), with all dimensions indicated. *Such drawings shall also indicate any utilities or public infrastructure impacted by the excavation.*

SOIL & FOUNDATION WORK NOTIFICATION

BC 3304 Soil and Foundation Work

BC 3304.3.1 Notification to the Department

No soil or foundation work within the property line shall commence unless the permit holder, or where there is no permit holder the person causing the soil or foundation work to be made, notifies the department, via phone or electronically, at least 24 hours, but no more than 48 hours prior to the commencement of such work. The notification shall state the date that such soil or foundation work is to commence…

811 CALL BEFORE YOU DIG NOTIFICATION

NYC Buildings

INDUSTRY NOTICE

Earthwork Notification: 811 (Call Before You Dig) One Call Ticket Number Requirement

Beginning May 1, 2017, the Department of Buildings requires Earthwork Contractors to provide the 811 (Call Before You Dig) One Call ticket number when making normal notification of the commencement of earthwork. The required ticket number can be obtained through the 811 One Call phone number or online at www.newyork-811.com.

Notification is not complete unless the 811 ticket number is provided to the Department. Once the Department receives the required ticket number, the information will be recorded in the Department's notification database. All documents related to the notification **must** be kept on-site and available upon request.

*NOTE: The 811 ticket number **must** address **all street frontages** associated with the excavation.*

To complete the Department's Earthwork Notification, please call (212) 393-2550. For questions or additional information, please email EInquiry@buildings.nyc.gov.

As of May 1, 2017 it is required that the **811 Call Before You Dig** ticket number(s) be provided for **ALL** street frontages associated with the excavation

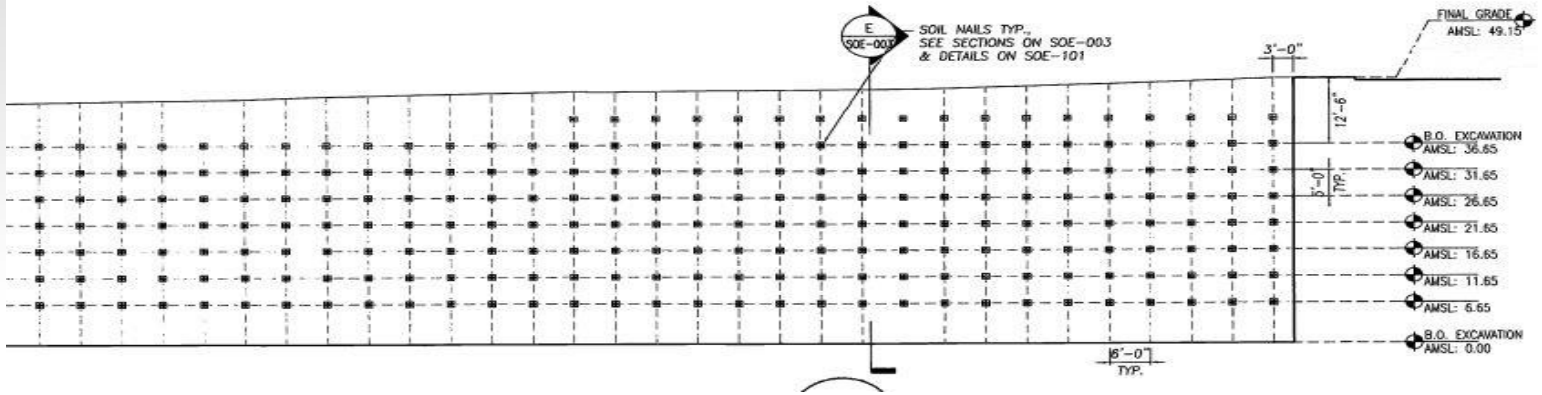
6. How do I submit an Earthwork notification for a BIS job?

An Earthwork notification can only be submitted in DOB NOW for jobs that are created in DOB NOW. Continue to call 212-393-2550 to make Earthwork notifications for BIS jobs.

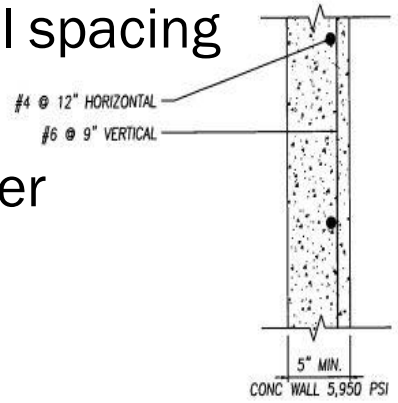
CASE STUDIES

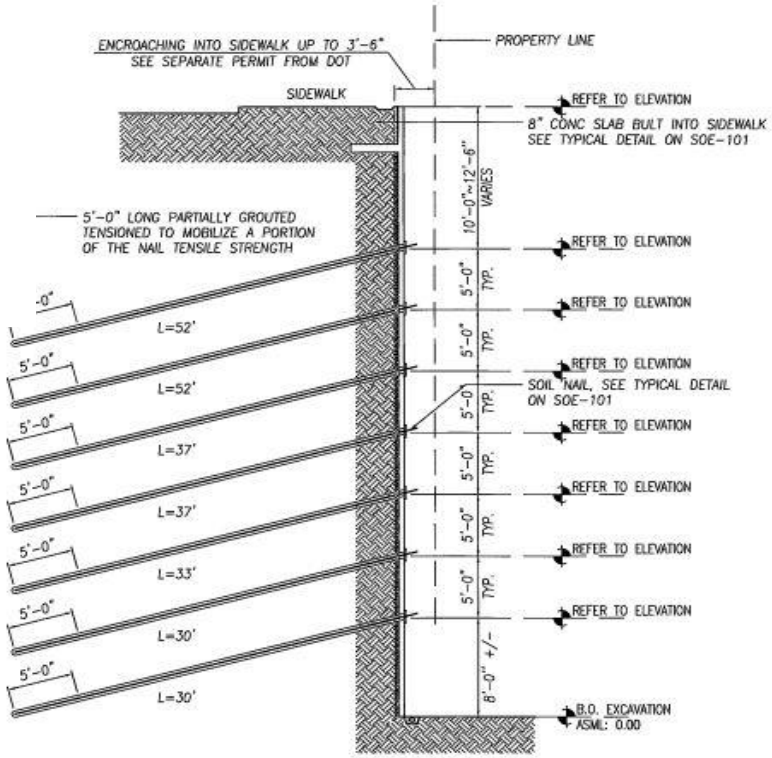
- *SUPPORT OF EXCAVATION (SOIL NAIL WALL)*
- *UNDERPINNING*

SOIL NAIL WALL: SUPPORT OF EXCAVATION – DRAWINGS

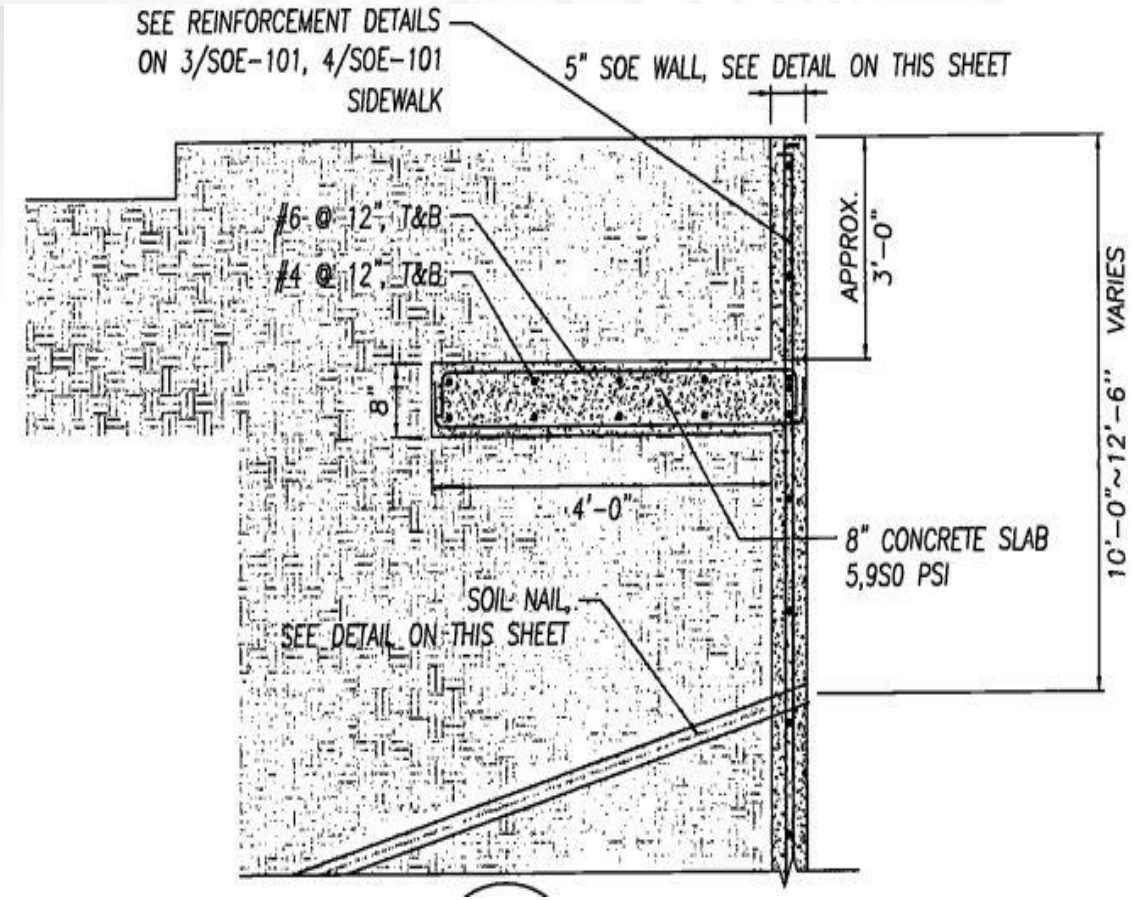


- Soil nails, 5ft vertical spacing, 6ft horizontal spacing
- Depth approximately 50 feet
- 5” thick wall for full height. Concerns at lower elevations?
- Sequence of work not indicated
- All utilities not indicated





SOIL NAIL WALL: SUPPORT OF EXCAVATION



Drawings

- Constructability and installation of the continuous concrete key near the top of the wall?
- Lateral movement resistance?
- First soil anchor 10-12.5 feet below the sidewalk level
- Documents indicated monitoring was not required

SOIL NAIL WALL: SUPPORT OF EXCAVATION

- Site bound by streets on all frontages
- Selection of SOE system based on site specific conditions
- Utilities and infrastructure need to be accounted for at all exposures
- Allowable deformation and lateral movement must be addressed

SOIL NAIL WALL: SUPPORT OF EXCAVATION

- Sequencing of work critical due to deep excavation (i.e. large lateral loads and pressures)
- Anchors must be tested for proper engagement

SOIL NAIL WALL: SUPPORT OF EXCAVATION

- Street adjacent to the excavation site
- Utilities and infrastructure can be visually identified from street level (i.e. manhole, street light, fire hydrant, etc.)

SOIL NAIL WALL: SUPPORT OF EXCAVATION

- The project had a SWO in effect due to observed excessive settlement of the adjacent street and sidewalk
- Berm was in place at the time of the SWO
- A partial wall failure occurred during the SWO
- Workers at the site took video immediately prior to the wall failure
- Note in the still images, no berm in place, lack of soil nails and lateral support as noted

SOIL NAIL WALL: SUPPORT OF EXCAVATION

- A multiple City agency response was required to address the failure
- Multiple utilities were impacted including gas, electric and water.
- A main roadway had to be closed and traffic rerouted
- A portion of the reinforced concrete foundation wall had already been placed adjacent to the collapse zone possibly preventing further collapse
- No injuries or fatalities

SOIL NAIL WALL: SUPPORT OF EXCAVATION

- Close up view of the failure
- Partial installation of the permanent foundation wall can be seen on the left side
- Cores were taken at the base of the foundation wall and were found to be 8” thick. Drawings specified 14”. Lateral movement?

SOIL NAIL WALL: SUPPORT OF EXCAVATION

- Alternate view of the failure
- No grout observed on or around the soil nails near the collapse zone

SOIL NAIL WALL: SUPPORT OF EXCAVATION

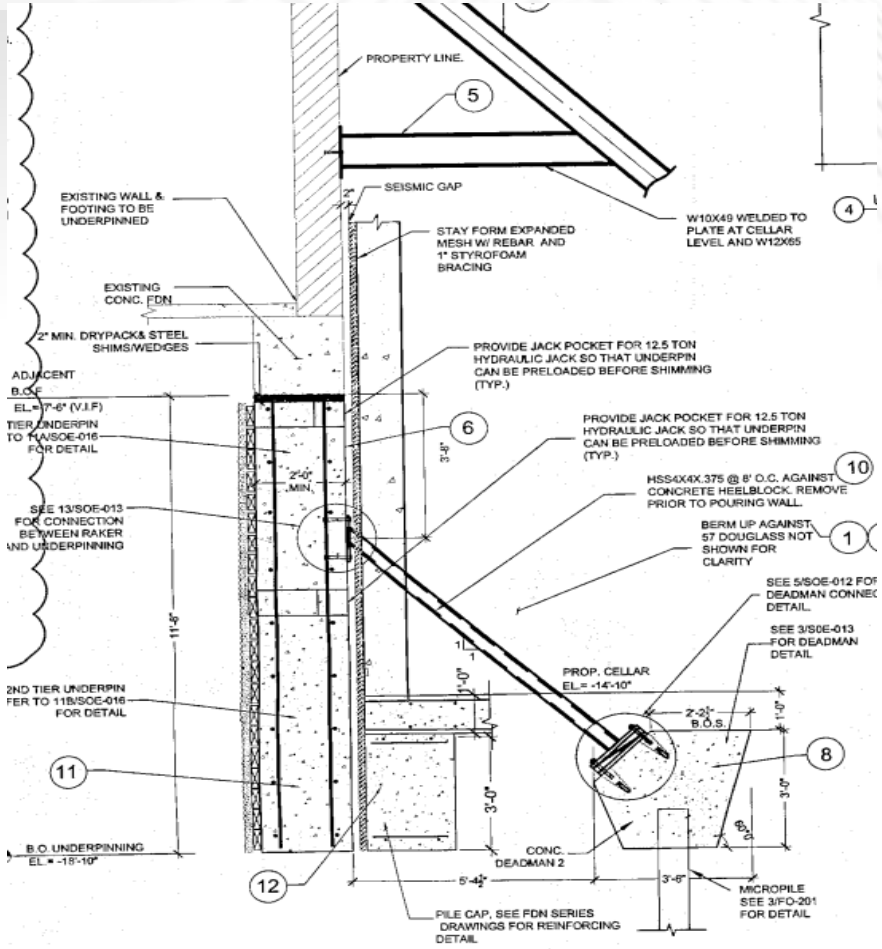
- View from street level
- Note the proximity of the utilities to the SOE system and street level
- Utilities not indicated on the SOE drawings
- Gas main, electrical, water visible

SOIL NAIL WALL: SUPPORT OF EXCAVATION

Summary

- Utilities need to be documented and shown on the design drawings and accounted for in the design
- The Support of Excavation system must be selected based on site specific conditions (I.e. Geotechnical recommendations)
- All applicable lateral pressures and allowable deflection limits must be accounted for in the design
- The Sequence of Work must be clearly indicated
- Support of Excavation work must conform to the approved design drawings
- Testing and Special Inspections to be clearly documented

UNDERPINNING: CASE STUDY



- New Building construction
- Corner lot with two adjacent URM buildings
- Proposed double tier underpinning for new cellar installation
- Unfavorable soil conditions present at the site

UNDERPINNING: CASE STUDY

TR4

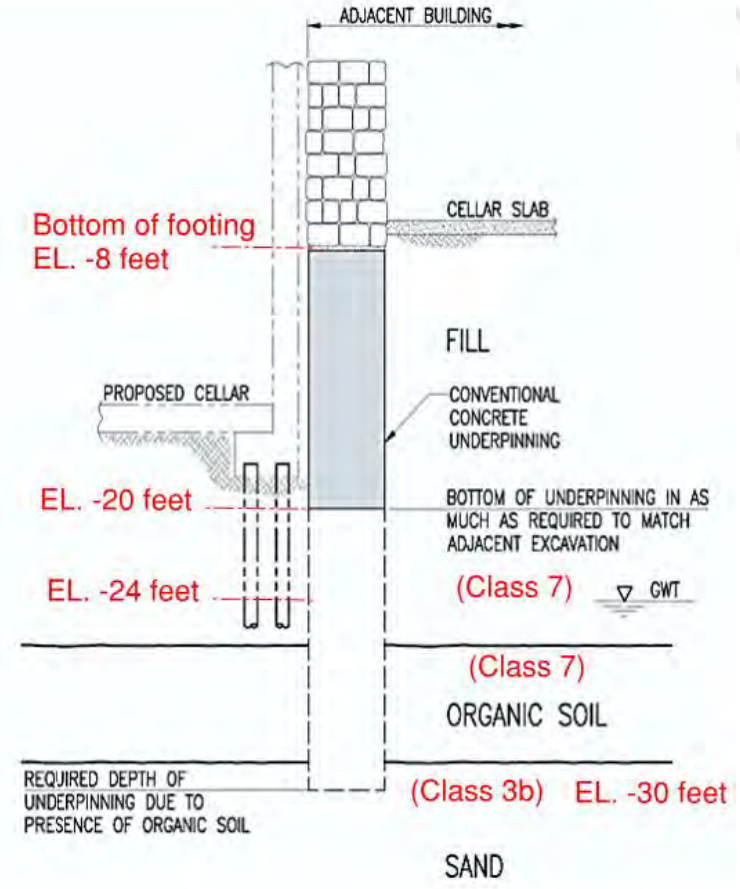
PAGE 2

5 Test Report *Required for all applications.*

Date	Boring/ Test Pit #	Feet Below Curb	Soil Description	Class Number	Remarks
10-30-15	B1	5-7	sand silt gravel brick	7	
		10-12	fine sand little silt	7	clean fill
		15-17	fine sand litle silt	7	clean fill
		20-22	organic silt	7	
		25-27	organic silt	7	groundwater @ 24'
		30-32	fine-medium brown sand tr silt	3b	
		35-37	fine-medium brown sand tr silt	3b	
		40-42	fine-medium brown sand tr silt	3b	
		45-47	fine-medium brown sand tr silt	3b	
		50-52	fine-medium brown sand tr silt	3b	
	B2	5-7	sand silt gravel brick	7	
		10-12	fine sand little silt	7	clean fill
		15-17	fine sand little silt	7	clean fill
		20-21	fine sand little silt	7	clean fill
		21-22	organic silt	7	groundwater @ 24'
		25-26	organic silt	7	

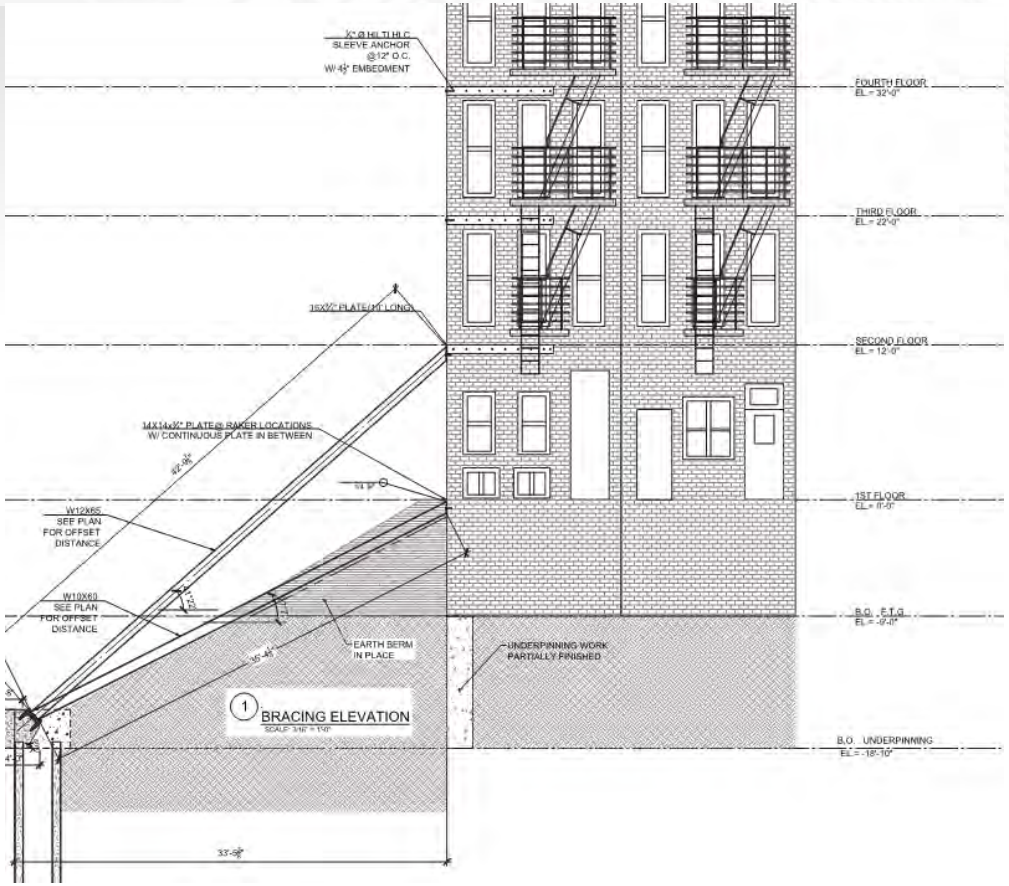
- Soil investigation and boring data provided on TR4
- Bottom of the proposed underpinning approximately 20 feet below grade
- Soil Class at 20 feet is Class 7
- Groundwater observed at 24 feet below grade
- Sand layer not encountered until 30 feet below grade (Class 3b soil)

UNDERPINNING: CASE STUDY



- Due to the extent of the Class 7 soil an additional 10 feet of underpinning would have been required to reach Class 3b soil (22 ft high)
- The water table was encountered 4 feet below the originally proposed underpinning
- Based on the soil investigation alternatives to underpinning should have been considered (i.e. soil improvement, secant wall, etc.)
- Due to the site specific conditions the feasibility of adding a cellar at the NB site should have been discussed by the project team and ownership

UNDERPINNING: CASE STUDY



- Underpinning was performed as per drawings (double-height)
- The adjacent buildings settled and moved laterally. External waler and raker bracing installed **after** movement occurred
- Internal shoring required for stabilization as well
- Buildings had to be vacated due to structural concerns observed

UNDERPINNING: CASE STUDY

- General view of the project site after bracing system installation on both adjacent buildings
- Both buildings were underpinned

UNDERPINNING: CASE STUDY

- General View of the adjacent 3-story URM building with 1-story rear extension
- Upper tier of underpinning can be seen at the bottom of excavation

UNDERPINNING: CASE STUDY

- View of the 1-story rear extension
- Light structure
- Single underpinning pier between 3-story and 1-story structures
- Feasibility of underpinning (including double-height) based on site specific conditions?

UNDERPINNING: CASE STUDY

- Severe bowing of the foundation walls was observed
- Continuous horizontal crack on the exterior face
- Filled in with closed cell spray foam and mortar

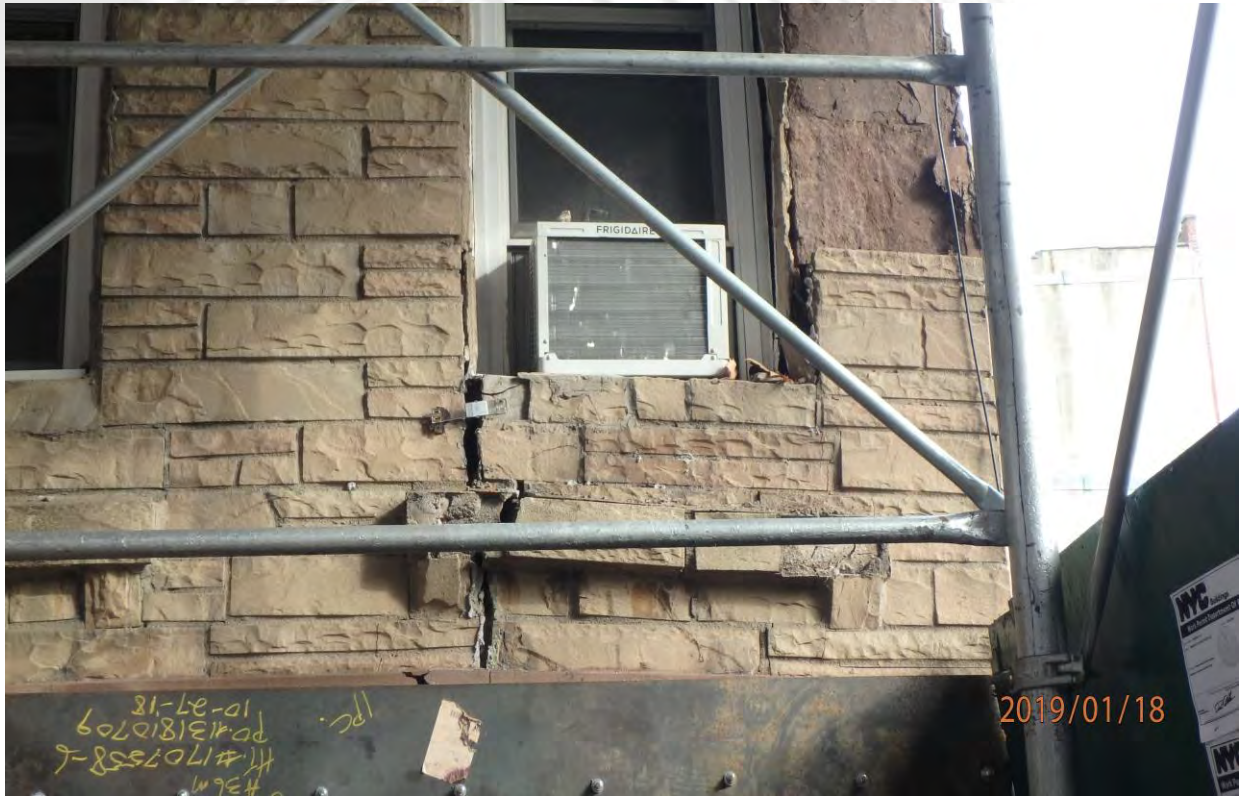
UNDERPINNING: CASE STUDY

- Approximately 2” of localized bowing of the foundation wall. Global movement larger

UNDERPINNING: CASE STUDY

- The existing conditions of the neighboring buildings were not assessed prior to the start of work
- No preconstruction report was provided
- Deteriorated conditions were documented after the incident
- Water infiltration and joist decay were observed
- These conditions were present prior to the start of the excavation work

UNDERPINNING: CASE STUDY



- 3 story unreinforced masonry residential structure
- Significant cracking and damage noted at the front facade first window bay for the full height of the building

UNDERPINNING: CASE STUDY

- Rear façade of 3-story building
- Cracking noted across entire width of building
- Crack pattern suggests significant settlement and lateral movement
- Overstress of masonry walls due to underpinning operations and movement

UNDERPINNING: CASE STUDY SUMMARY

- Site specific geotechnical investigation results are required and must be evaluated with the proposed design.
- The selection of an appropriate SOE/support system based on the site specific conditions (soil type, ground water, building condition, etc.)
- Feasibility of the proposed support system based on the site specific conditions must be evaluated. Alternatives may have to be considered (including unfeasible)

UNDERPINNING: CASE STUDY SUMMARY

(continued)

- Preconstruction report (not a preconstruction survey) including evaluation and documentation of the existing conditions and types of all adjacent existing buildings is required. The condition of the existing structure may not allow for modification (preexisting conditions present)
- Monitoring required at the start of construction as per a site specific plan developed by the RDP/ Engineer and coordinated with the designed system (not reactive)

THANK YOU