
# Concrete and Formwork in New York City

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NYC Buildings

# American Institute of Architects Continuing Education System

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

# Course Description

- Comprehensive review of the latest NYC Building Code requirements for concrete construction and formwork in accordance with the 2014 Building Code Chapters 19 and 33.
- Provide participants with the guidelines on how to work with the Concrete Enforcement Unit on design, construction or special inspection related issues that may arise during the course of design or construction of a project.
- Review of construction related failures, incidents and overall dangerous conditions commonly found by the Concrete Enforcement Unit.
- Review the dangers of formwork failures as it relates to neighboring buildings and the general public.

# Learning Objectives

1. Participants will review and be able to identify the 2014 Building Code requirements for formwork.

2. Participants will review and be able to identify the 2014 Building Code requirements for concrete construction.

3. Participants will review and be able to identify the 2014 Building Code requirements for special inspections of concrete construction.

4. Participants will review and be able to apply the 2014 Building Code Chapter 19 and related safety requirements in Chapter 33 as it relates to formwork and concrete construction.

# Copyright Materials



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# Concrete and Formwork in New York


# Concrete and Formwork in New York

# Investigative Engineering Services

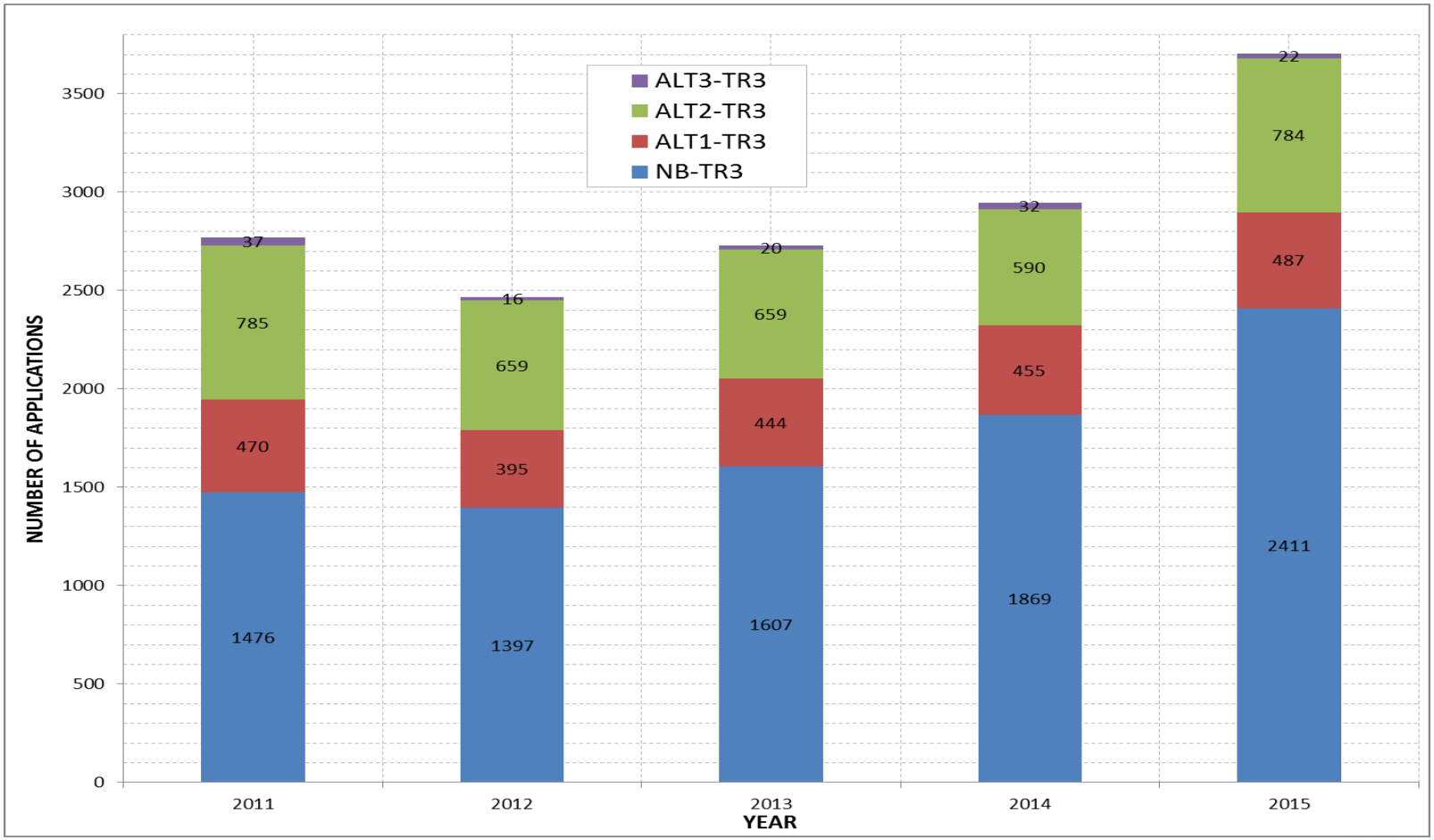
- Forensic Engineering Unit
- Concrete Enforcement Unit
- Facade and Local Law Unit
- Retaining Walls
- Compromised Buildings
- Cooling Towers

# Concrete Enforcement Unit

## Description

- Is a Legislative Unit
- Enforcement in all five boroughs
- Unit comprised of specially trained inspectors, engineers and administrators
- All inspectors and engineers are ACI certified

# Concrete – NYC Filing Statistics



# Concrete Enforcement Unit

## Legislative Responsibilities: *Field Inspections*

- Structural inspections and Site Safety inspections of all buildings nine stories and under
- Structural inspections of all buildings ten stories and up (BEST responsible for site safety of major buildings)
- Parallel Testing – compressive cylinders taken on site and tested at Port Authority Lab. CEU engineers compare test results from PA with testing lab results
- TR-2/TR-3 forms, referrals from industry and other DOB Units (BEST, Excavation/Foundation, Scaffold Safety)

# Concrete Enforcement Unit

**Legislative Responsibilities:** ***Concrete Lab Inspections***

- Random twice annual inspections of all NYC registered concrete testing labs
- Review lab records for equipment calibration
- Witness a compression test
- Inspect that concrete cylinders are stored properly

# Concrete Enforcement Unit

## Legislative Responsibilities: *Engineering Audits*

- **Review of structural and architectural drawings**
  - Engineering Design
    - Lateral systems, building separations, under design structural elements
- **Pre-permit reviews**
  - Special Inspections
    - Incomplete TR-1, TR-2 and TR-3 forms
- **Post-permit reviews**
  - Special Inspections
    - Lack of Special Inspections
  - Concrete operations/construction

# Concrete Enforcement Unit

**Legislative Responsibilities:** *Incident Response*

- Formwork failures
- Concrete Pump/Hose malfunctions
- Concrete truck accidents

# Concrete: Special Inspections

**BC 1704.4 Concrete construction.**

Special Inspections for Concrete Construction is *exempt* in the following cases:

- Nonstructural concrete slabs on grade
- Concrete foundation for lightweight fences and recreational equipment
- Concrete patios, site furnishings, garden walls, driveways, sidewalks and similar construction

# Concrete: Special Inspections

**BC 1704.4 Concrete construction.**

Testing of Concrete Construction at the time fresh concrete is required at all times ***except*** in the following cases:

- Where total concrete placement on a given project is less than 50 cubic yards
- Isolated spread footings of 1 or 2 family buildings three stories or less supported on earth or rock
- Continuous concrete spread footings supporting walls of 1 or 2 family buildings three stories or less supporting on earth or rock

# Formwork: New Design Triggers

BC 3305.3.2.1 Design Drawings. (new design triggers)

*Triggers incorporated into 2014 NYCBC Code*

- For concrete formwork is in a structure classified as a major building; or
- Wherever the slab thicknesses or beam heights equal or exceed 10 inches; or
- Wherever there are concentrated loads exceeding 2000 lbs. imposed on the formwork; or
- Wherever there are loads imposed on existing structures in accordance with Section 3305.3.1.2.1.

# Formwork: Existing Triggers

**BC 3305.3.2.1 Design Drawings.**

*Triggers from 2008 NYCBC Code*

- Wherever the shore or form height exceed 14 feet; or
- Wherever the total vertical load on the forms exceed 150 pounds per square foot; or
- Wherever power buggies are used; or
- Wherever multi-stage shores are used.

*Note: In 2008 NYCBC these design triggers were located in Chapter 19 (Concrete) section 1906.3 Design of Concrete Formwork.*

# Concrete Load on Existing Structures

**BC 3305.3.1.2.1 Use of existing structures to support vertical or lateral loads.**

The use of existing structures to support vertical or lateral loads imposed by concrete construction operations shall *require an evaluation* of the existing structure for the loads imposed *by* a registered *design professional*. The registered design professional shall *prepare design drawings* documenting the *findings of the evaluation, indicate the location of formwork elements, and the interface between the formwork and the existing structure*.

# Formwork: Inspection & Observation

## BC 3305.3.3.1 Inspection.

Formwork, including shores, reshores, braces and other supports, shall be inspected *prior* to placement of reinforcing steel to verify that they conform to the construction documents and formwork design drawings …periodically… *during* the placement of concrete. During and after concreting, the elevations, camber, and *vertical alignment* of formwork systems shall be inspected using tell-tale devices…

## BC 3305.3.3.2 Formwork observation.

In addition to the inspections by the contractor required pursuant to Section 3305.3.3.1, *visual observations* of the formwork for the general conformance with the design intent shall be performed by the *formwork designer* or his designee.

# Construction Concrete Formwork

**BC 3305.3.4.5 Perimeter formwork.**

Horizontal formwork deck panels and beam for formwork within *16 feet* (4877 mm) from the building perimeter shall be positively attached to all formwork support systems at a minimum.

# Reshoring at Forms

**BC 3305.3.6 Reshoring.**

A signed and sealed *reshoring schedule* shall be provided and maintained at the construction site whenever reshoring is employed.

***Exception:***

A separate reshoring schedule is *not required* when the required reshoring information *is covered on the approved construction* documents prepared by the applicant of record.

# Curing and Cold Weather Requirements

**BC1905.11.1** Curing Regular. Concrete (other than high early strength) shall be maintained above 50°F and in a moist condition for at least the first seven days after placement, except when cured in accordance with BC1905.11.3 (Accelerated curing).

**BC1905.12** Cold weather requirements.


# Curing and Cold Weather Requirements

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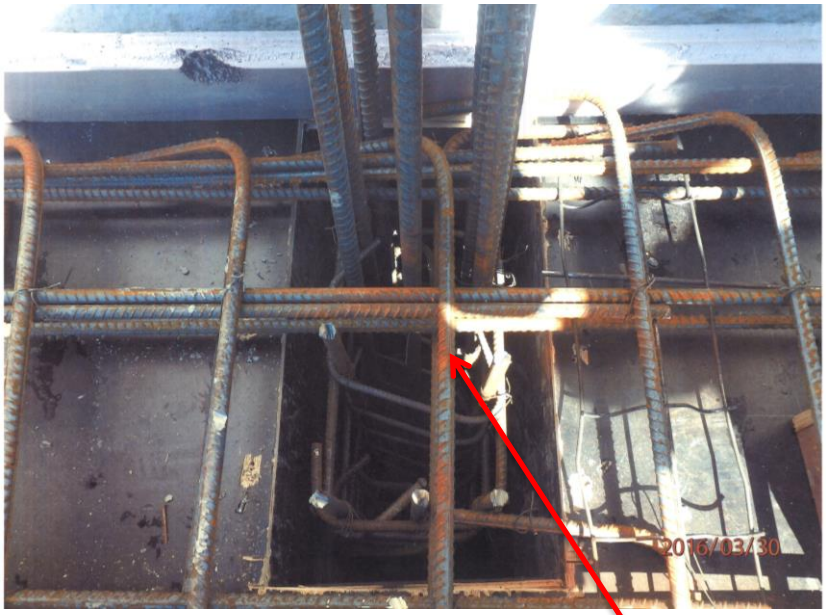
**BC1905.12** Cold weather requirements.

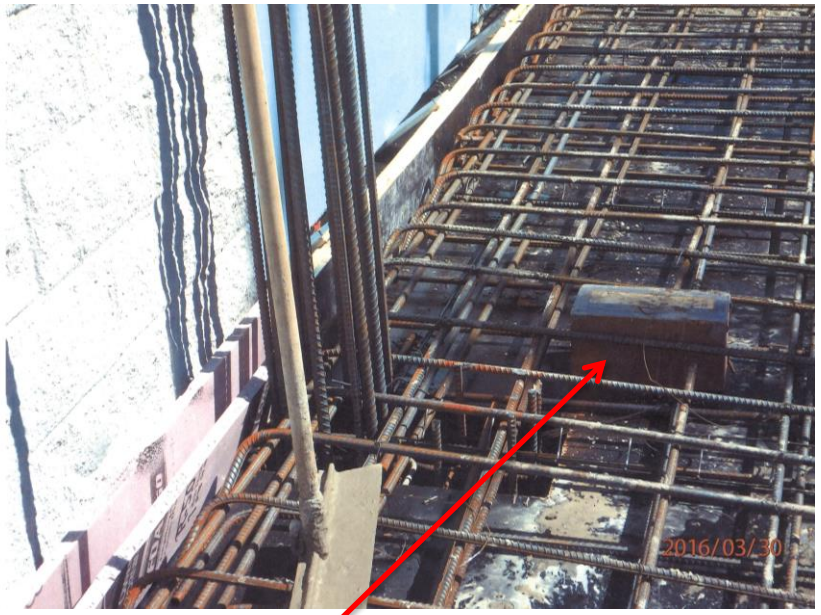

# Spacing Limits for Reinforcement

**BC1907.6** The clear distance between reinforcing bars, bundle bars, tendons and ducts shall comply with ACI 318, Section 7.6.

# Reinforced Concrete (BC1901.2)

**BC1901.2** Structural concrete shall be designed and constructed in accordance with the requirements of this chapter and ACI 318 as amended in Section 1908 of this Code.

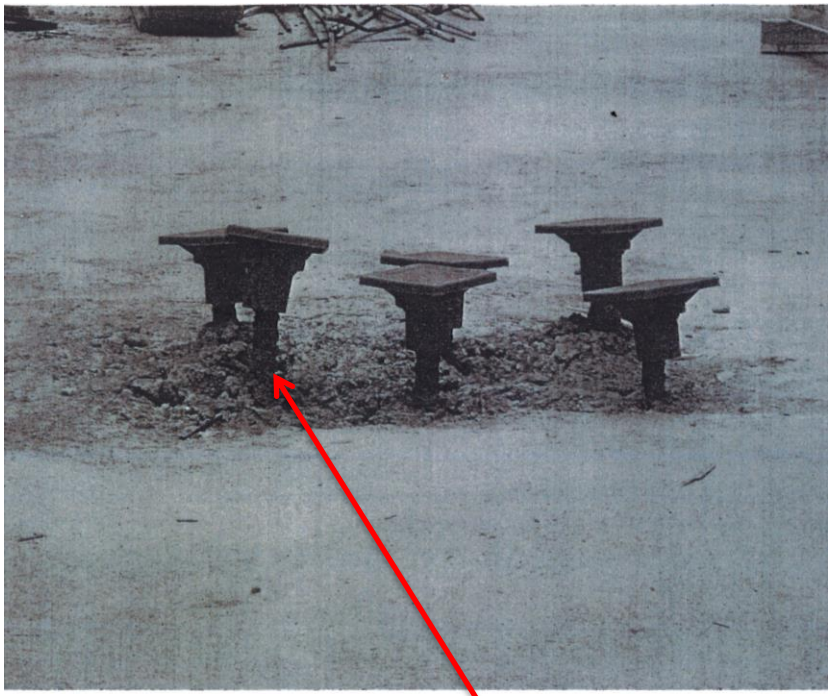


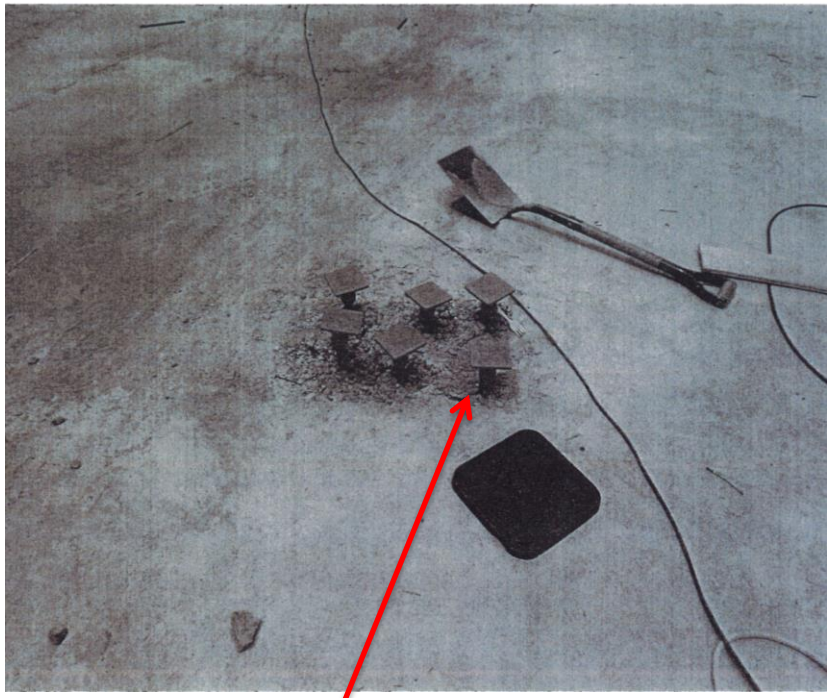




Column rebars undeveloped

# Reinforced Concrete

BC1901.2





Column rebars capped but insufficient splice length

# Compliance with Construction and Submittal Documents

**28-105.12.2** All work shall conform to the approved construction and submittal documents, and any approved amendments thereto. Changes and revisions during the course of construction shall conform to the amendment requirements of this Code.

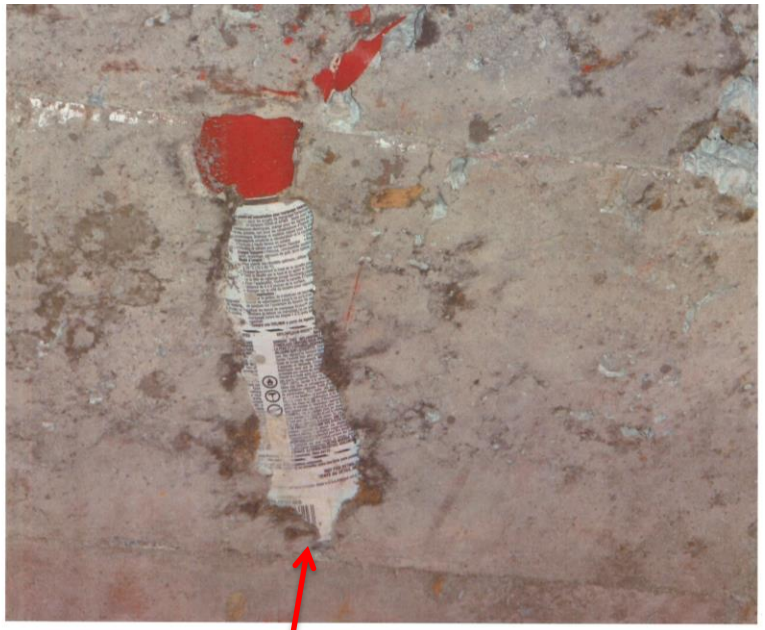
# Perimeter Concrete Formwork (BC3305.3.4)

**BC 3305.3.4.5 Perimeter formwork.** Horizontal formwork deck panels and beam for formwork within *16 feet* (4877 mm) from the building perimeter shall be positively attached to all formwork support systems at a minimum.

# Formwork Inspection

BC 3305.3.3.1 Inspection *A classic one!*


Candy bar wrapper



Paint can

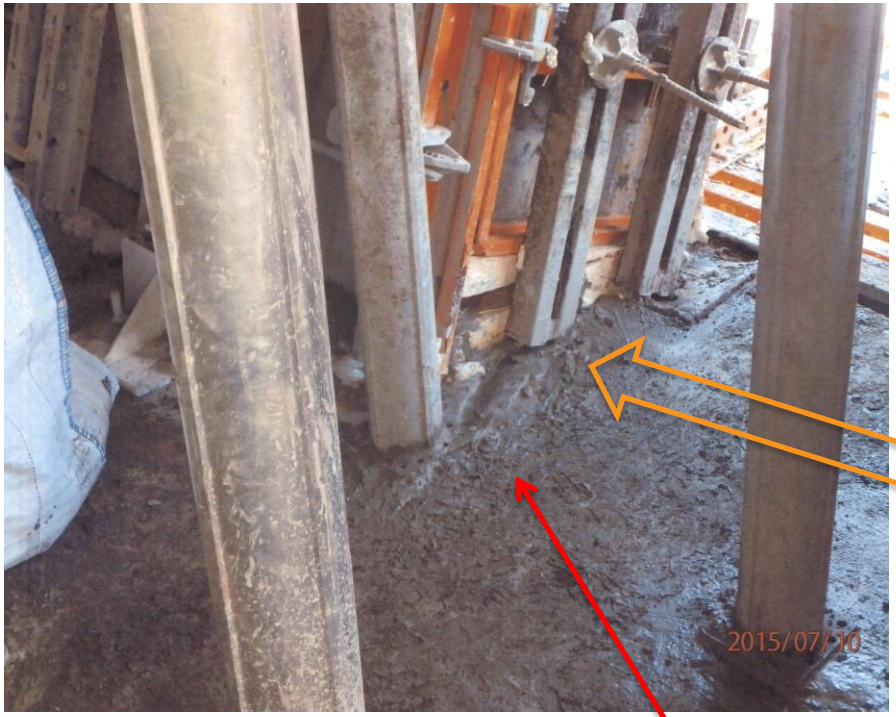
# Formwork Inspection

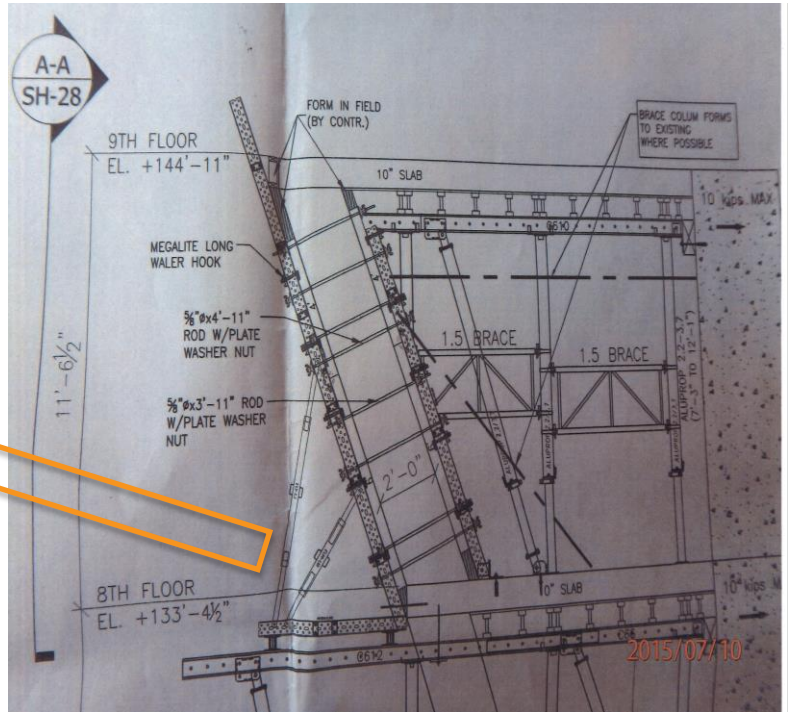
## BC 3305.3.3.1 Inspection

Concrete into adjacent property = collateral damage

# Formwork Inspection

## BC 3305.3.3.1 Inspection




Improper concrete formwork

# Concrete Load on Existing Structures

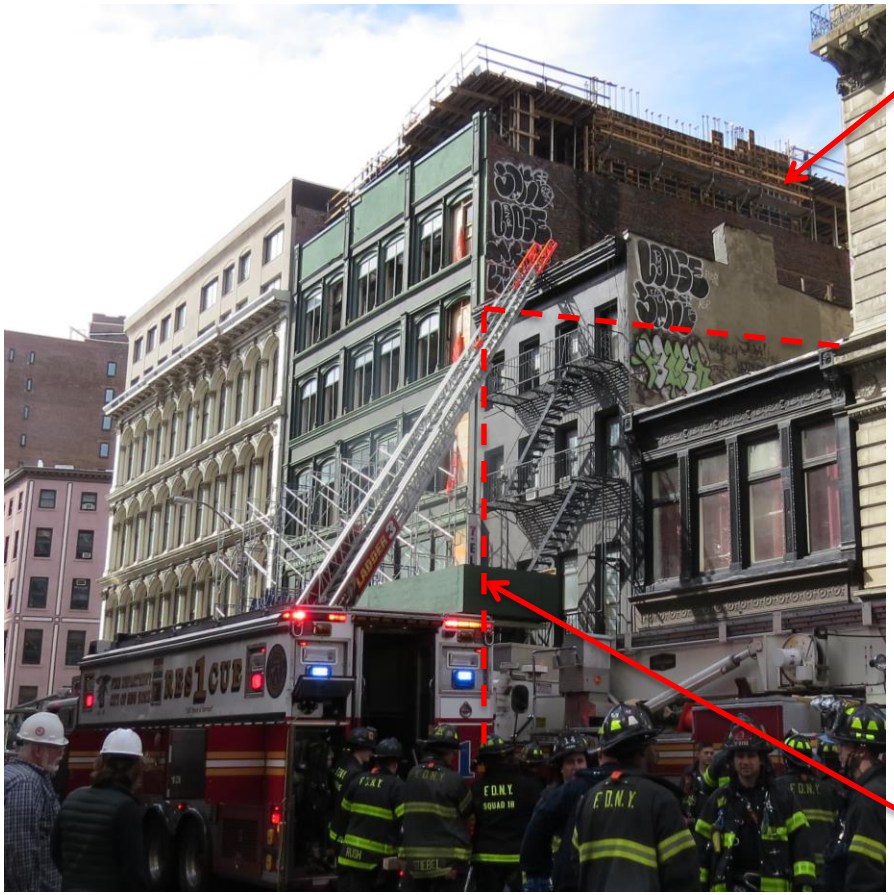
BC 3305.3.1.2.1 Use of existing structures to support vertical or lateral loads

Adjacent building parapet wall partially collapsed under wet concrete lateral load = collateral damage

Single form

# Concrete Load On Existing Structures

BC 3305.3.1.2.1 Use of existing structures to support vertical or lateral loads

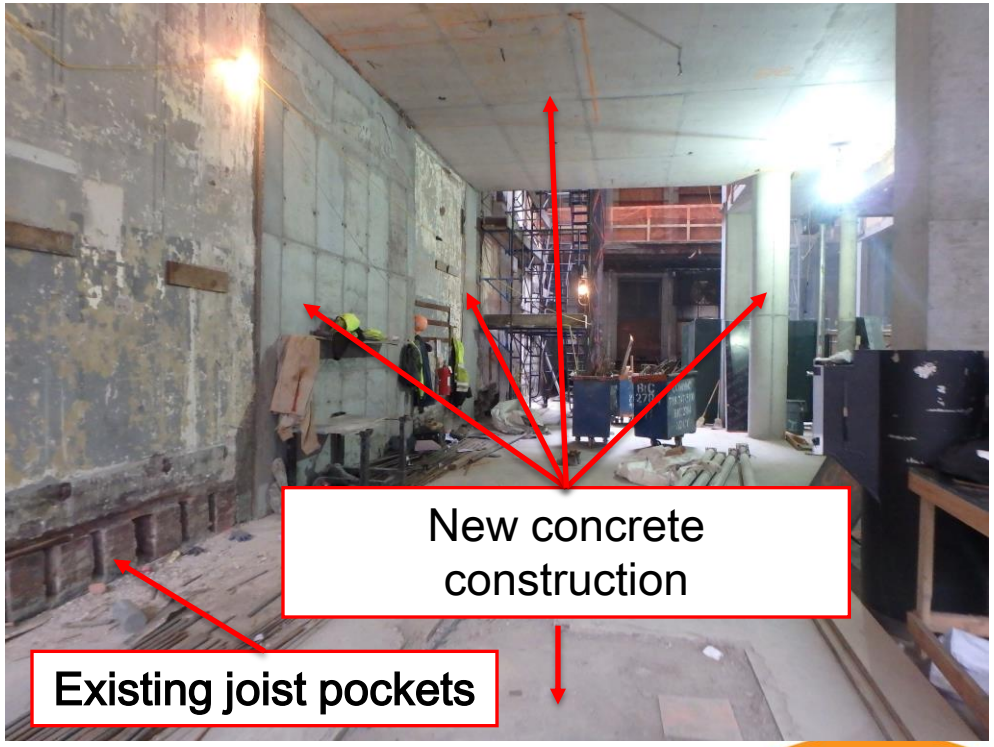


Vertical enlargement: New concrete slabs, columns and walls

Existing party wall affected by lateral load imposed by adjacent building construction

# Concrete Load on Existing Structures

**BC 3305.3.1.2.1** The use of existing structures to support vertical or lateral loads imposed by concrete construction operations shall *require an evaluation* of the existing structure for the loads imposed *by* a registered *design professional*…

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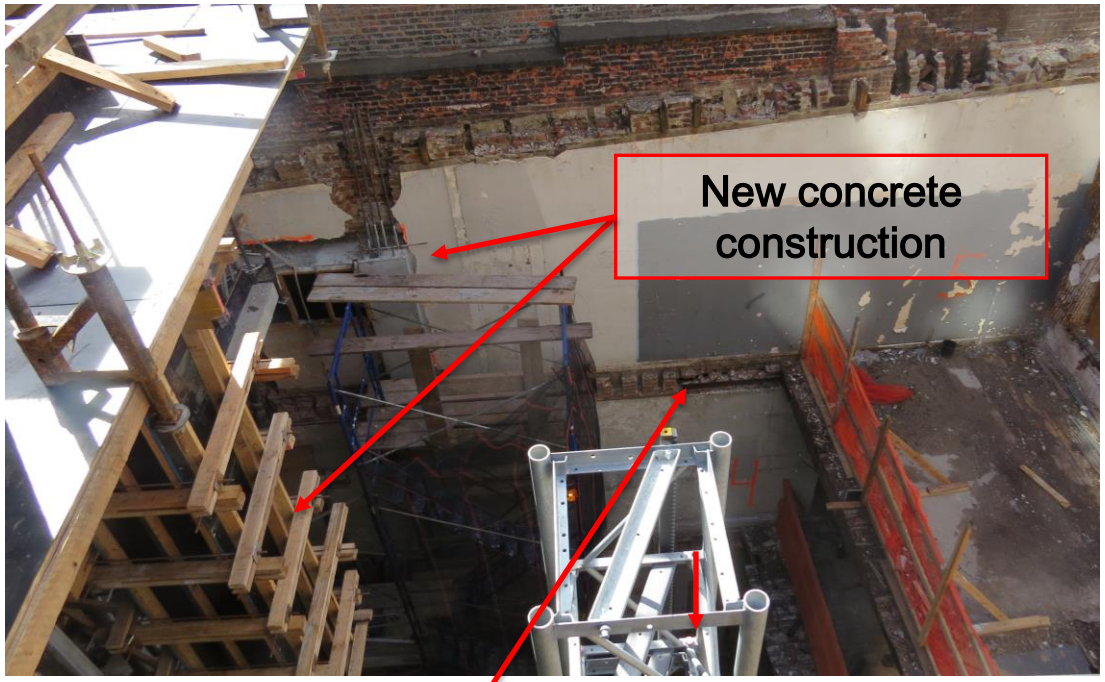


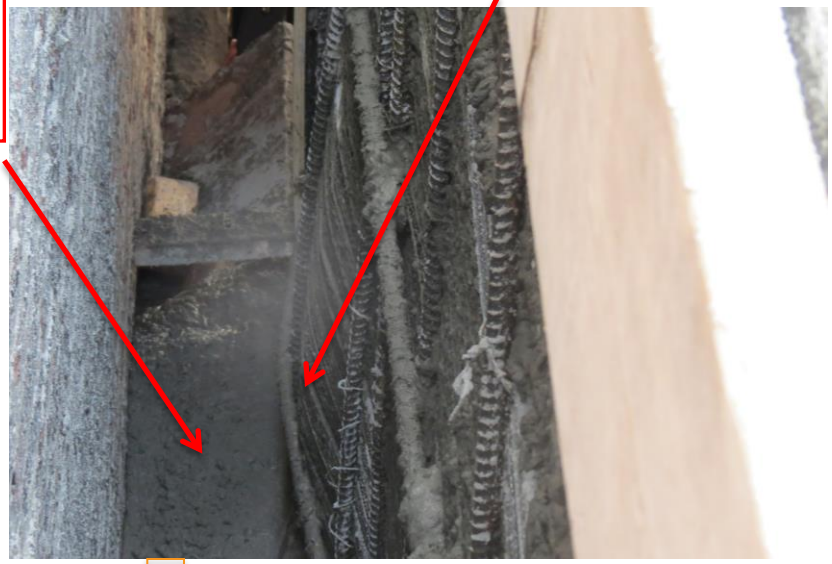
# Formwork Inspection and Observation

**BC 3305.3.3** Formwork…shall be inspected *prior* to placement of reinforcing steel to verify that they conform to the construction documents and form design drawings…periodically…*during* the placement of concrete…

Shear wall
*Stay Form*

Wet concrete against adjacent existing wall

*Stay Form* partially collapsed



# Concrete Load on Existing Structures

BC 3305.3.1.2.1 Use of existing structures to support vertical or lateral loads

Chimney flutes filled with wet concrete

Existing party wall affected by lateral load imposed by adjacent building construction

# Concrete Load on Existing Structures

BC 3305.3.1.2.1 Use of existing structures to support vertical or lateral loads

Upper portion of wall bulging out

# Concrete Load on Existing Structures

**BC 3305.3.1.2.1** The use of existing structures to support vertical or lateral loads imposed by concrete construction operations shall ***require an evaluation*** of the existing structure for the loads imposed ***by*** a registered ***design professional.***

**Major problems**

1. Failure to identify party wall with adjacent building to the north.
2. Removal of floor joist that destabilized this party wall.
3. Failure to evaluate existing structure for loads imposed.
4. Failure to inspect formwork before and during concrete pour.

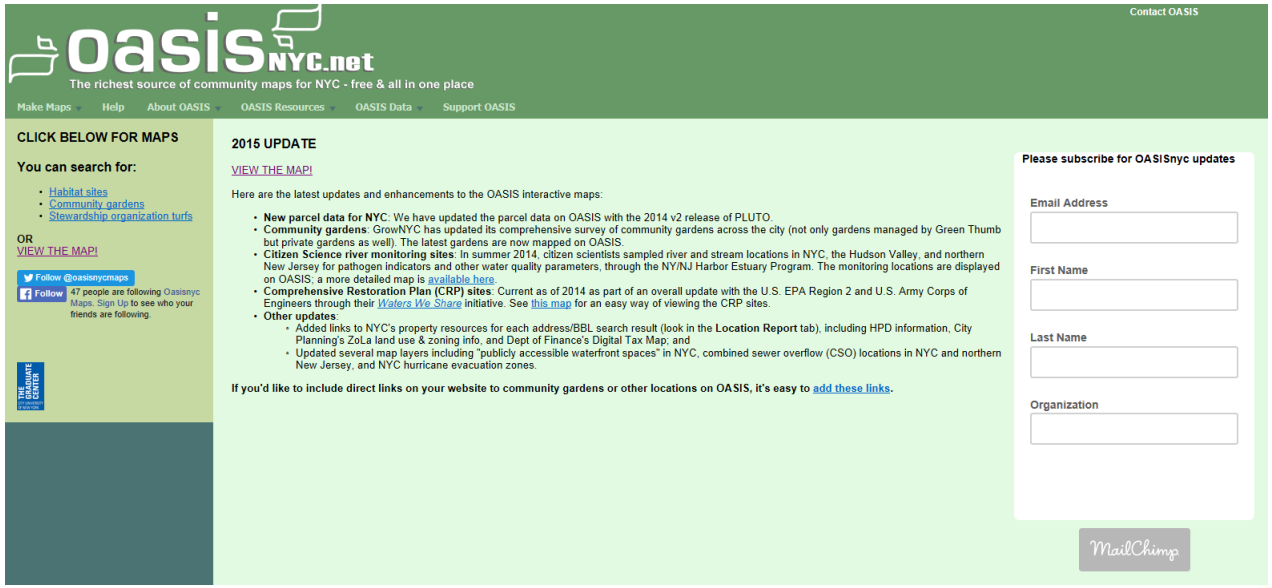
**Main consequences**

1. FULL VACATE OF ADJACENT PROPERTY – collateral damage - 16 people displaced from residence.
2. Regulatory actions at on going construction (SWO, Violations, etc.) - 50 People out of work at construction site.

# Concrete Load on Existing Structures

**BC 3305.3.1.2.1** The use of existing structures to support vertical or lateral loads imposed by concrete construction operations shall ***require an evaluation*** of the existing structure for the loads imposed ***by*** a registered ***design professional***.

Free available resources online: ***Oasis maps*** [http://www.oasisnyc.net/](http://www.oasisnyc.net/)



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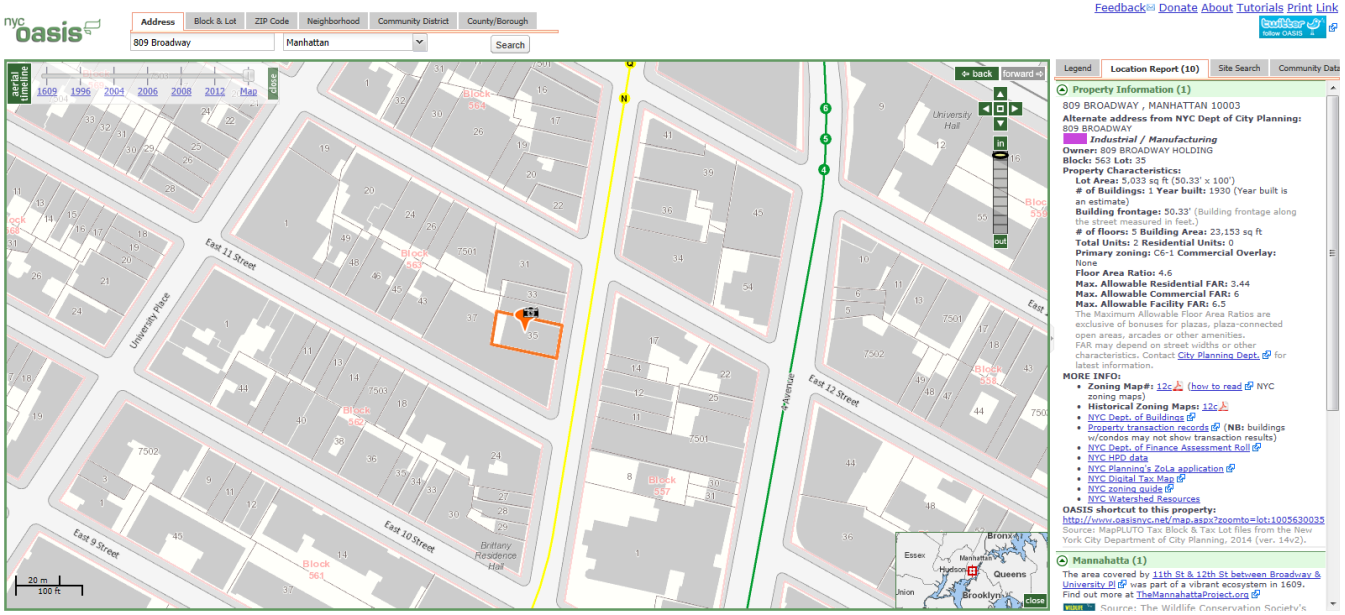

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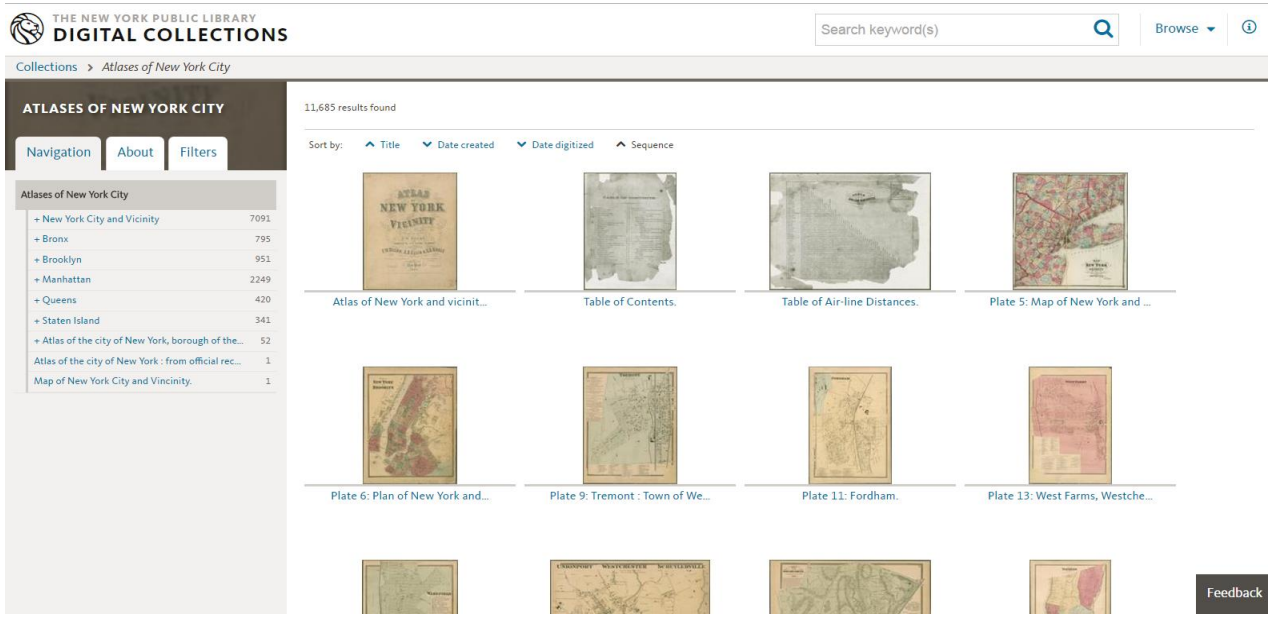
*Free available resources online:* ***New York Public Library***

*http://digitalcollections.nypl.org/collections/atlases-of-new-york-city*



# Concrete Load on Existing Structures

## BC 3305.3.1.2.1

Using NYPL Historic Tax Maps:

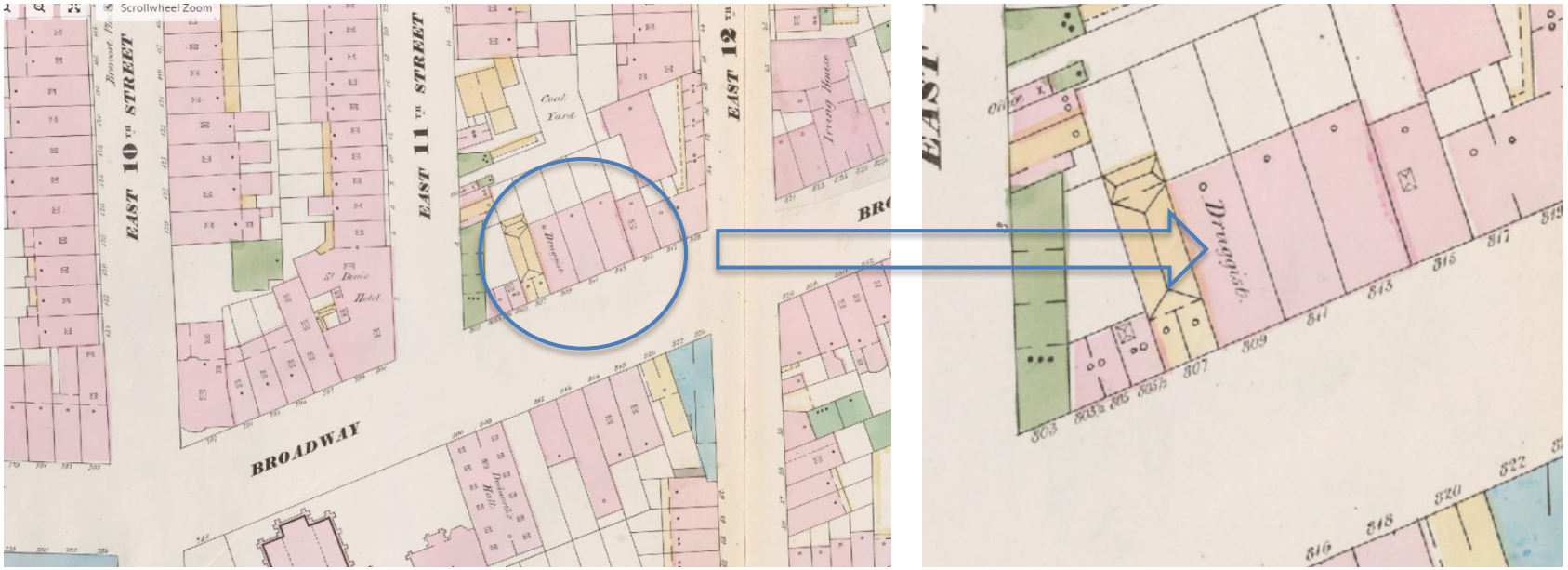
1852

# Concrete Load on Existing Structures

## BC 3305.3.1.2.1

Using NYPL Historic Tax Maps:

1857-1862

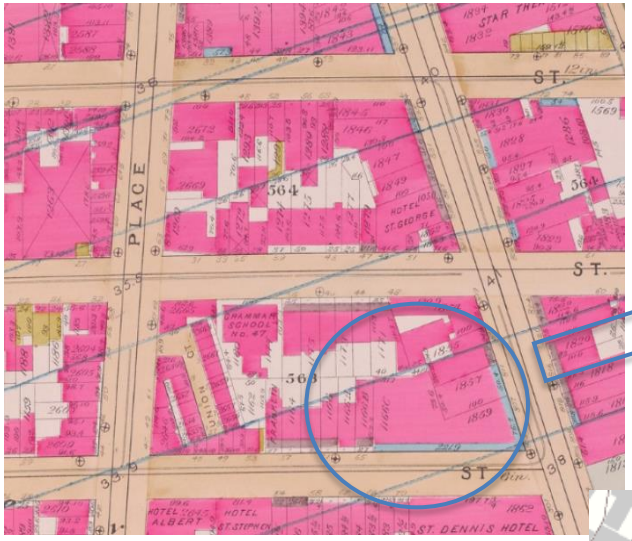


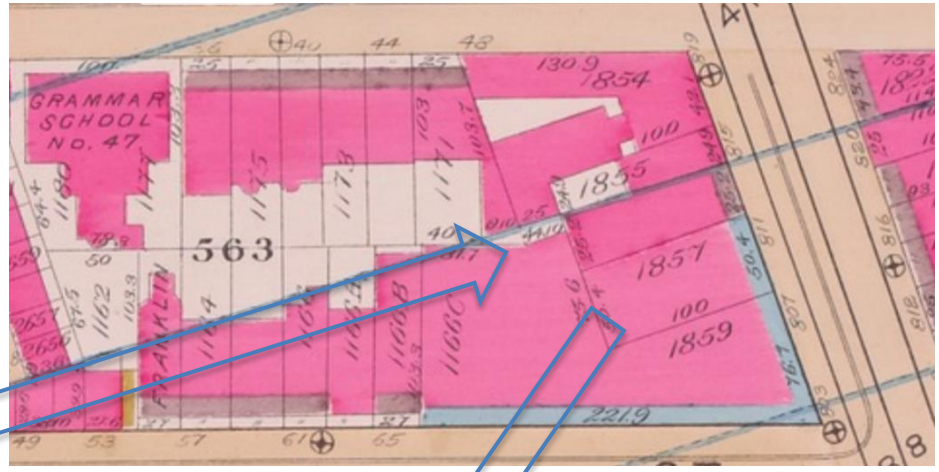
# Concrete Load on Existing Structures

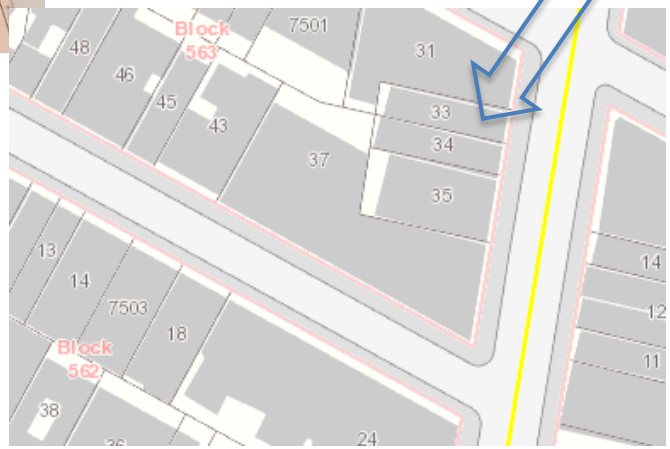
## BC 3305.3.1.2.1

Using NYPL Historic Tax Maps:

1893

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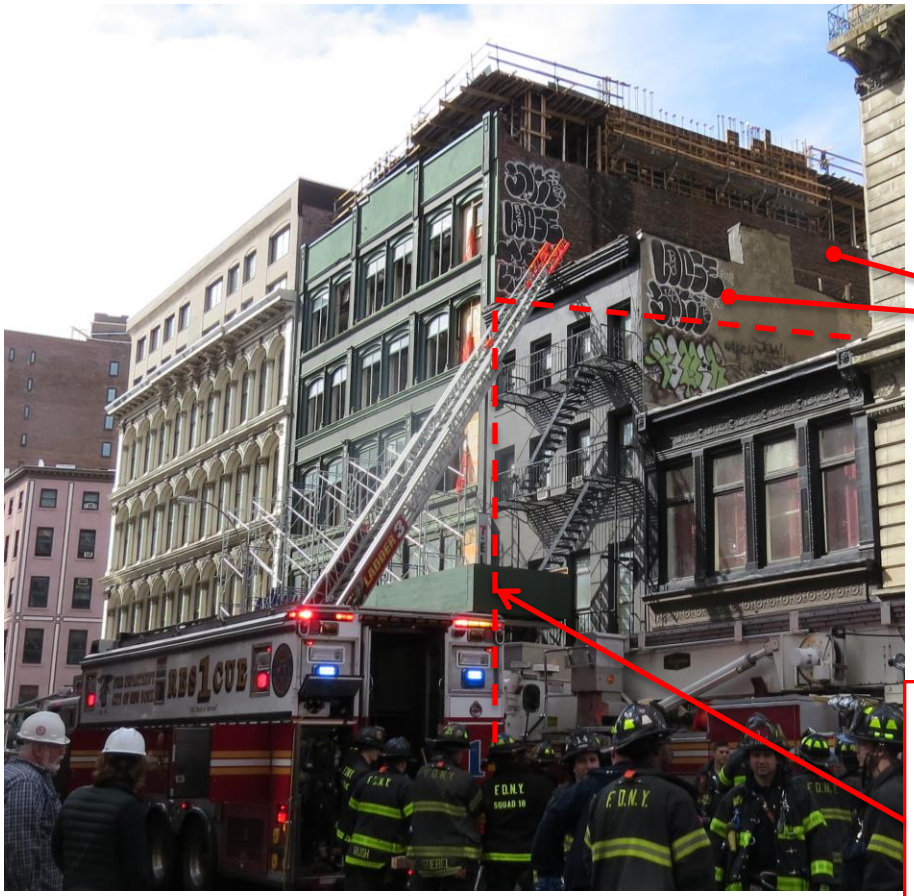
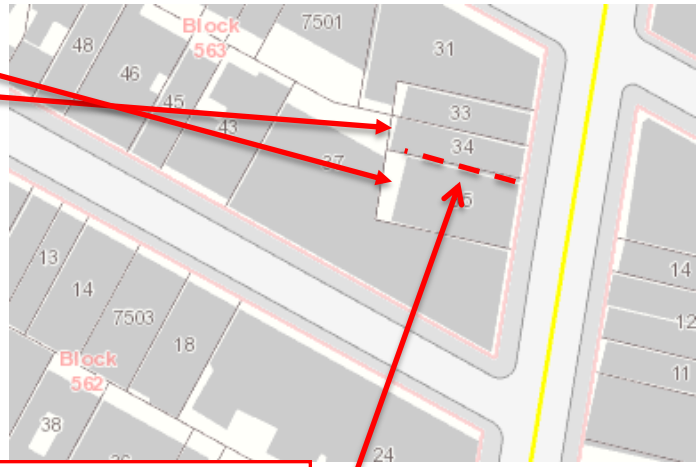
# Concrete Load on Existing Structures

BC 3305.3.1.2.1

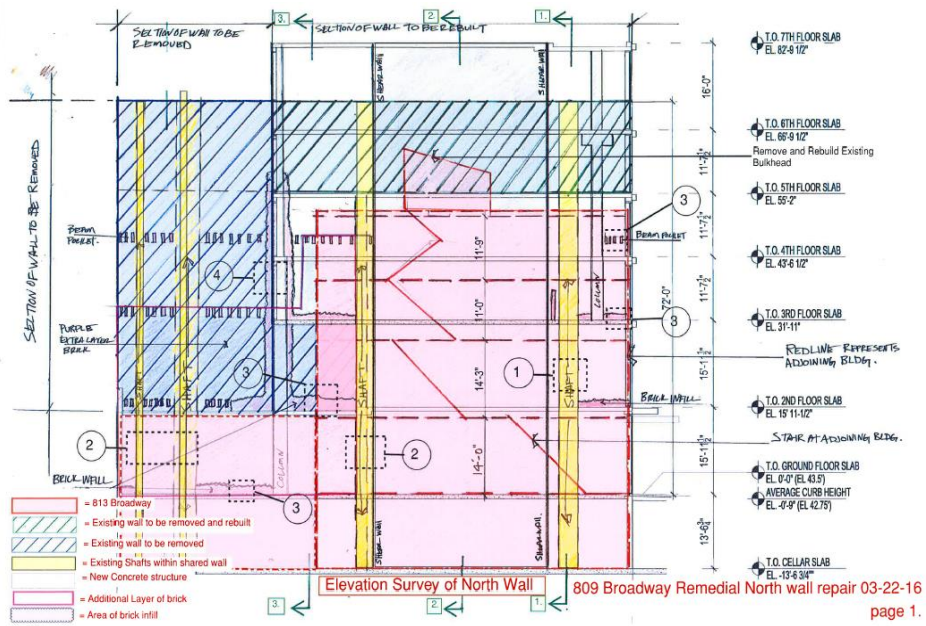





Existing party wall affected by lateral load imposed by adjacent building construction

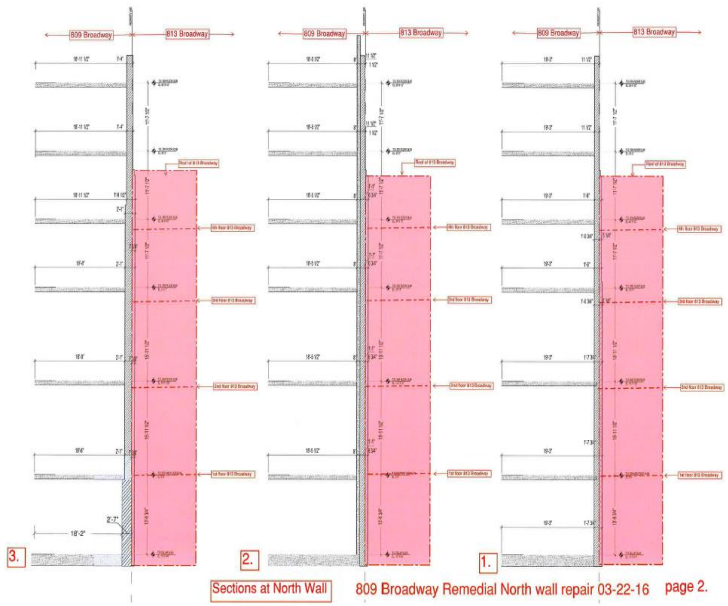
# Concrete Load on Existing Structures

## BC 3305.3.1.2.1




Elevation Survey of North Wall

809 Broadway Remedial North wall repair 03-22-16 page 1.




Sections at North Wall

809 Broadway Remedial North wall repair 03-22-16 page 2.

# Safety Measures and Standards

**BC 3301.2** Contractors, construction managers, and subcontractors engaged construction…operations shall institute and maintain all safety measures required by this chapter and provide all equipment or temporary construction necessary to safeguard the public and property affected by such contractor's operations.

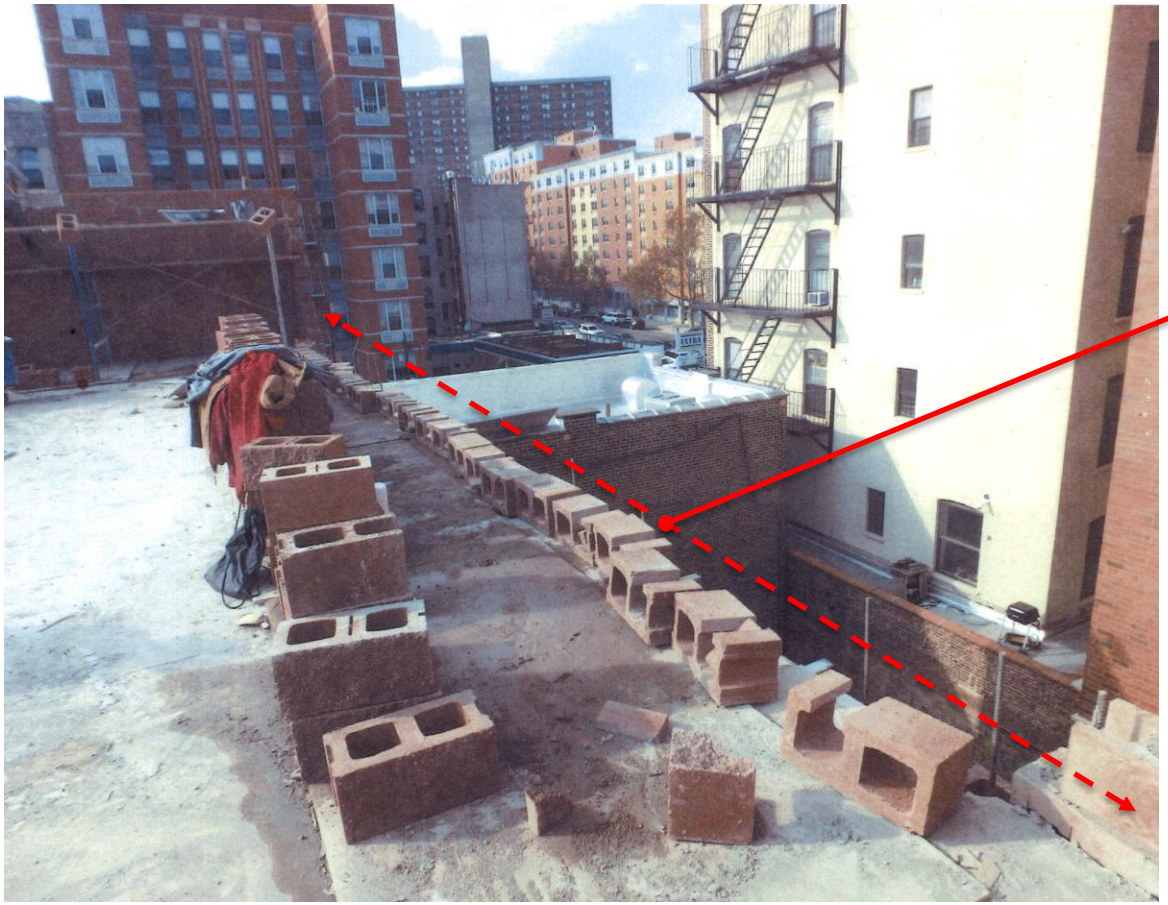

*fake* ladder

# Safety Measures and Standards

BC 3301.2

# Safety Measures and Standards

BC 3301.2



# Safety Measures and Standards

BC 3301.2


Missing safety measurements

# Safety Measures and Standards

BC 3301.2

Concrete pump at the sidewalk, inadequate public protection

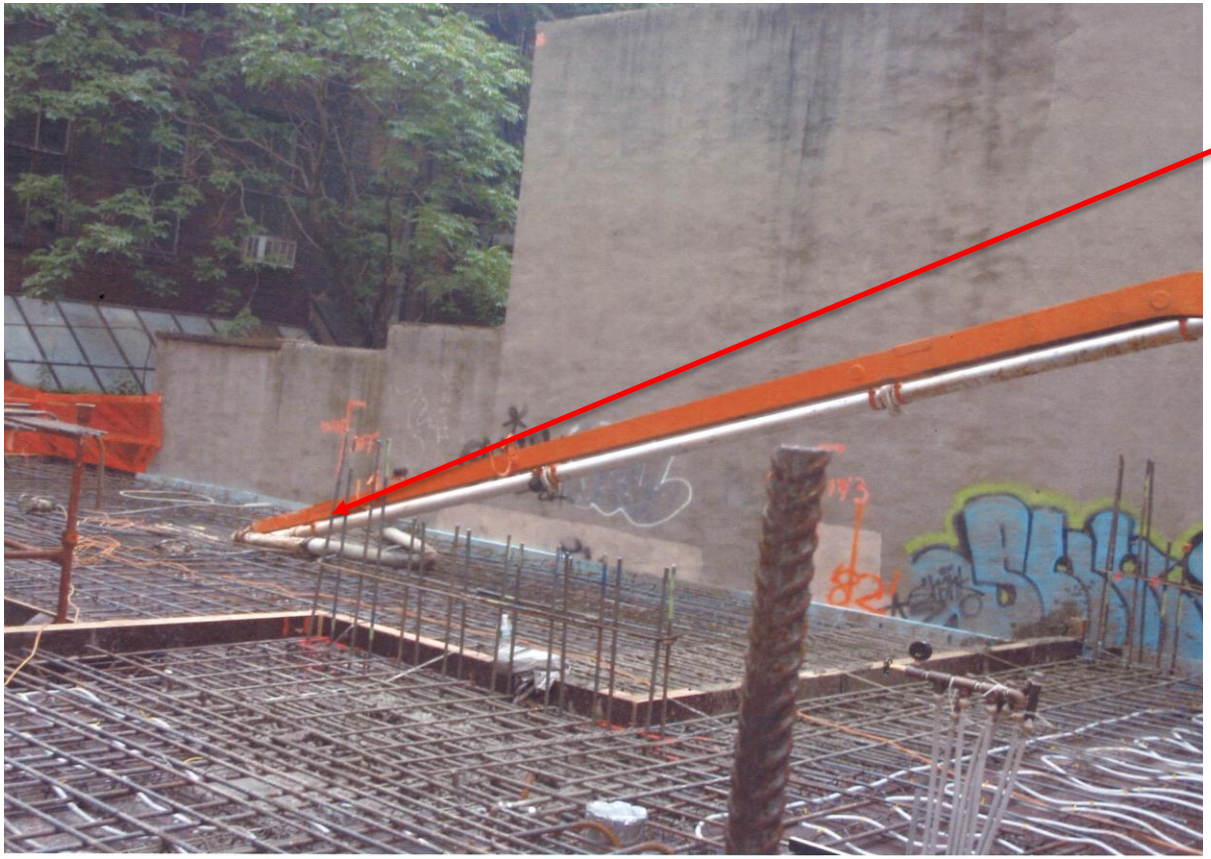
# Safety Measures and Standards

BC 3301.2

Concrete pump flying at the sidewalk, inadequate public protection

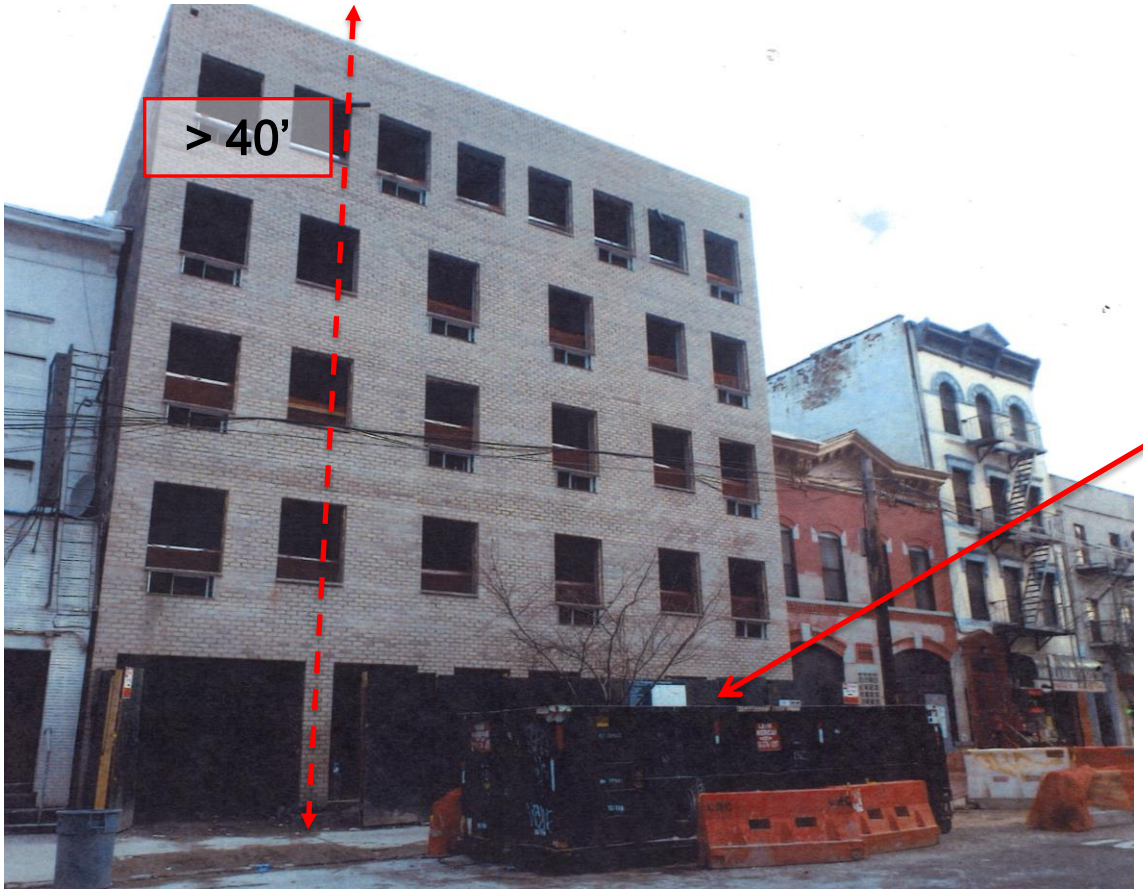
# Safety Measures and Standards

BC 3301.2



# Protection of Pedestrians

**BC 3307.1** Pedestrians shall be protected during construction…activities as required by this section and by the Department of Transportation




Sidewalk shed and construction fence required BC3307.6.2 & BC3307.7

# Accidents & Damage to Adjoining Property

**BC 3301.8** The department shall be notified **immediately** by the **permit holder,** or a duly authorized representative, of an **accident** at a construction …site, **or** of any **damage to adjoining property** caused by the construction…activity at the site.

# Accidents & Damage to Adjoining Property

**BC 3302.1** ACCIDENT: An occurrence **directly caused by construction**…activity or site conditions that **result in** one or more of the following:

1. A **fatality** to a member of the public; or
2. Any type of **injury** to a member of the public; or
3. A **fatality** to a **worke**r; or
4. An **injury** to a **worker** that requires **transport** by emergency medical services or requires **immediate emergency** care at a hospital or offsite medical clinic; or
5. Any complete or partial **structural collapse** or material failure; or
6. Any complete or partial collapse or **failure** of **pedestrian protection**, **scaffolding**, **hoisting** equipment, or **material handling** equipment; or
7. Any **material fall** exterior to the building or structure

*Thank you!*

This concludes the

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**Continuing Education Systems Course.**

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