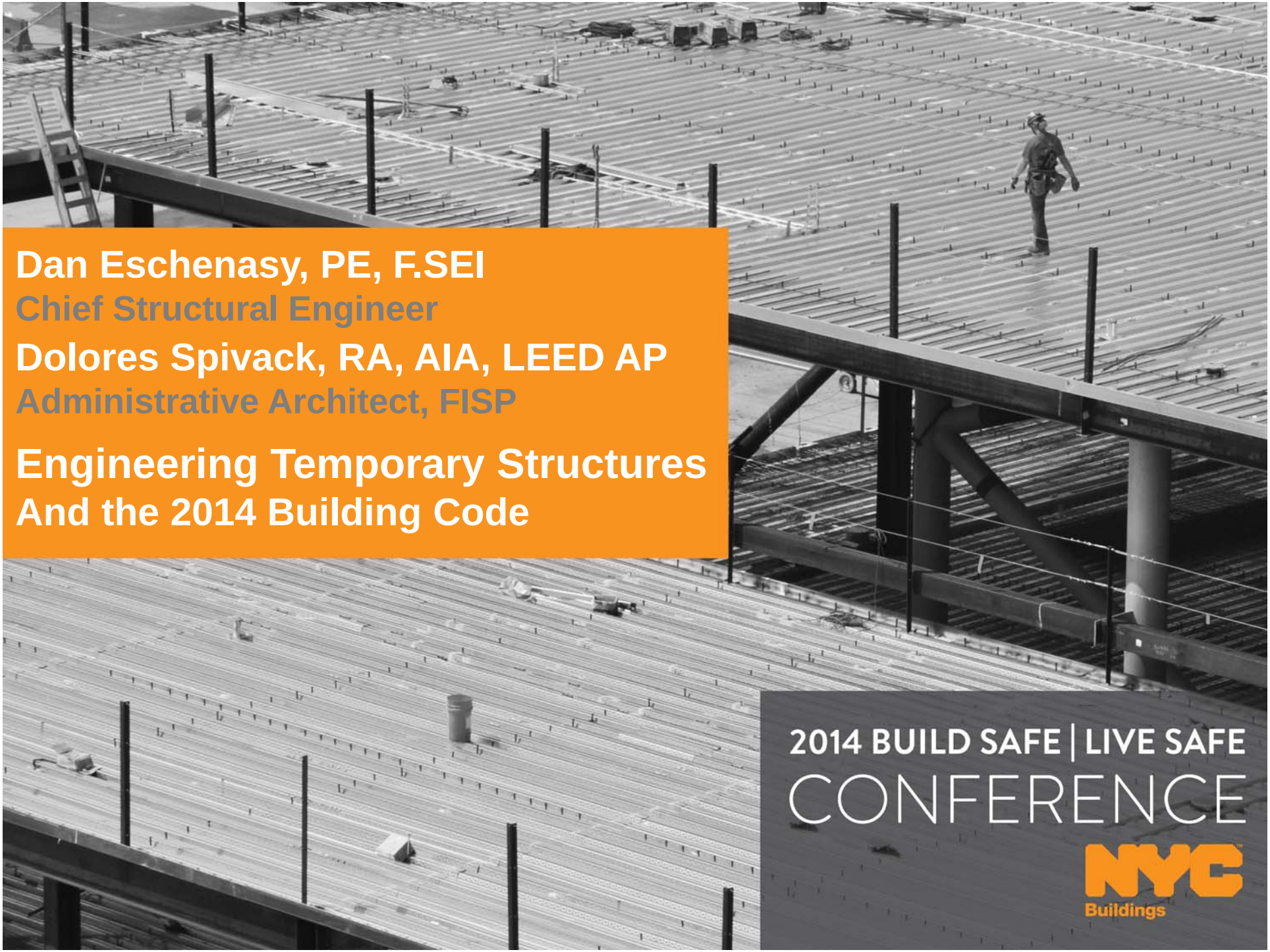
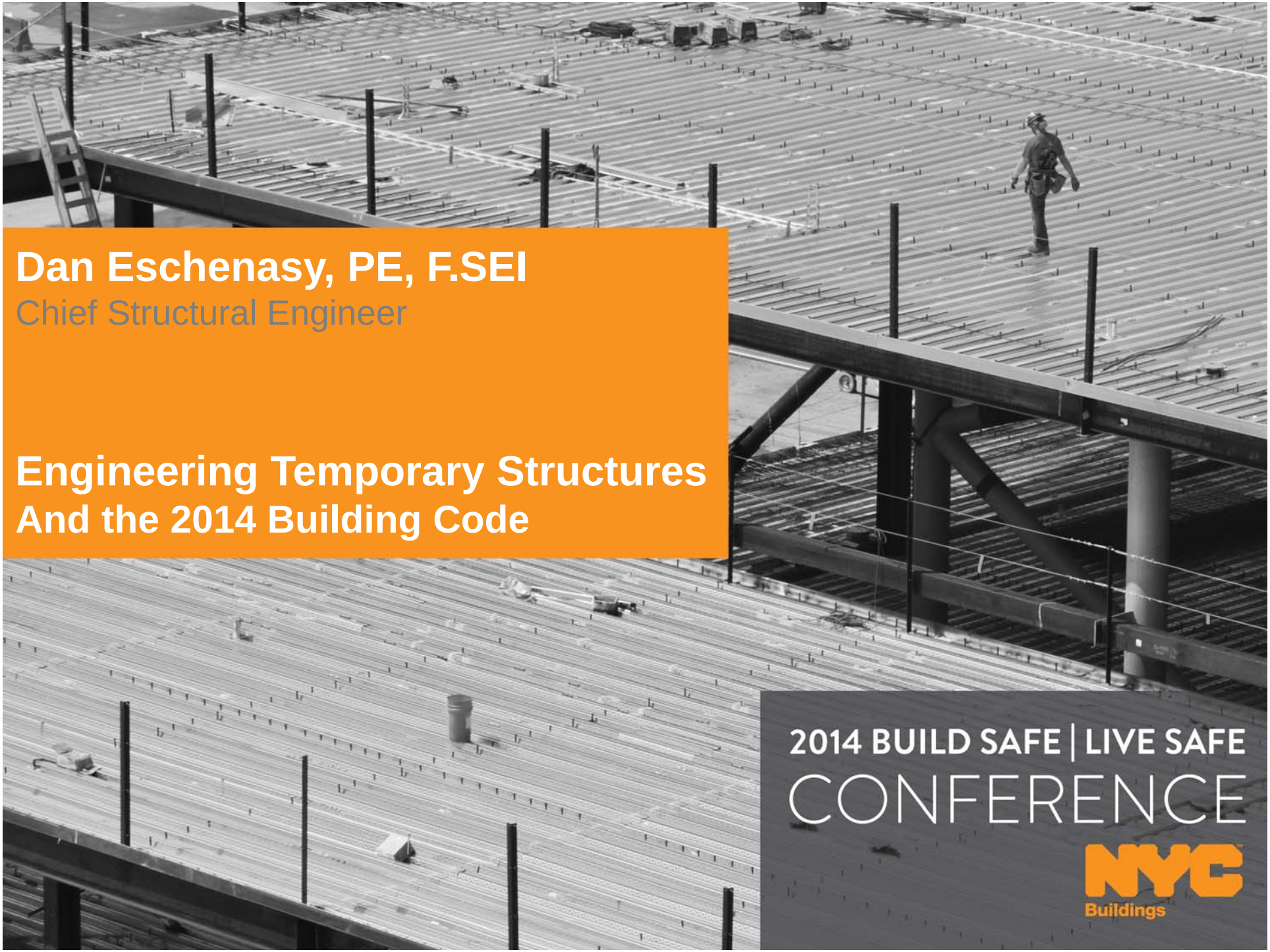


Dan Eschenasy, PE, F.SEI
Chief Structural Engineer
Dolores Spivack, RA, AIA, LEED AP
Administrative Architect, FISP

Engineering Temporary Structures
And the 2014 Building Code

2014 BUILD SAFE | LIVE SAFE
CONFERENCE
NYC Buildings



Dan Eschenasy, PE, F.SEI
Chief Structural Engineer

Engineering Temporary Structures
And the 2014 Building Code

2014 BUILD SAFE | LIVE SAFE
CONFERENCE
NYC Buildings

American Institute of Architects Continuing Education System

The NYC Department of Buildings is a registered provider with The American Institute of Architects Continuing Education Systems (AIA/ CES). Credit earned on completion of this program will be reported to AIA/CES for AIA members. Certificates of Completion for both members and non-AIA members are available upon request.

This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or constructed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

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

Course Description

This course will discuss changes to the 2014 NYC Building Code (BC) that deal with the design of temporary structures for construction leading to an increased level of engineering safety. In addition, the course will review Code changes for the definition of wind loads for temporary structures and specificity of measures required to ensure public and safety.

Learning Objectives

Participants will learn:

1. How to use of BC 2014 Article 1618.2 safe loads in engineering design of temporary structures for construction and will be able to describe how to appropriately apply these requirements.

2. How to identify the conditions in BC 2014 article 1618.3 that require a safety action plan and will be able to describe appropriate safety measures to be incorporated in this action plan.

Learning Objectives Continued

3. Participants will review examples of using provisions of BC 2014 Chapter 16 of wind load design provisions for scaffolds, cranes and shoring and be able to describe how these provisions mitigate construction accidents.

4. Participants will discuss BC 2014 Article 1704.20 requirements for the timely monitoring of safety of existing buildings during construction operations and be able to describe how the indicated procedures ensure safe occupancy of adjoining buildings.

Content

Temporary Installations (D. Eschenasy)

- Definitions
- Loads
- Action Plans
- Additional design provisions

Special Inspection for Structural Stability (D. Eschenasy)

- Inspection Types
- Common Requirements
- Monitoring

Facades Under Construction (D. Spivack)

Temporary Installations for Construction

Scaffolds (3314)

Shoring, Bracing Structures

Tower Cranes (3319)

Sidewalk Sheds (3307.6)

Netting (3308)

Support of Excavation (3304.2)

Cocoons (3308)

Underpinning Bracing

Concrete Formwork (3305.3)

Runback Structures, Hoists (3316, 3317, 3318)

Platforms

1618.1 Temporary Installations Definition

Installations governed by this code shall be defined as temporary when such installations are intended to be taken apart or removed after a limited period following their installation, including, but not limited to, tents, scaffolds, sidewalk sheds, cranes, and run back structures.

1618.1.1 Duration

Such limited period shall **not exceed one year** for temporary installations used in construction operations covered by Chapter 33. … The limited period shall be counted from the date the temporary installation is substantially installed.

1618.1.1.1 Extension of Time Request

Submission of a report from a registered design professional that certifies the following:

1. Such registered design professional performed an inspection within the last 30 days to confirm that the installation complies with the requirements of the approved construction documents for the temporary installation; and

2. The action plan:

   2.1 is still in effect;

   2.2 has been revised to reflect the current conditions of the installation; or

   2.3 is no longer required, as the installation has been retrofitted to comply with the loads for new construction without any reduction, pursuant to Section 1618.2.

1618.2 Loads for Temporary Installations

1618.2 Loads. *Temporary installations shall be designed and constructed to resist the loads required by Chapter 16 of this code for new construction.*

3301.6.3 Capacity. *No structure, temporary construction, or equipment shall be loaded in excess of its capacity as specified by the code, manufacturer, and/or designer. Where there is a discrepancy, the stricter standard shall apply*.

For some specific installations, additional design loads are specified in Chapter 33.

Most Common Load Combinations

1605.2 Combinations for strength design (LRFD)

1605.3 Combinations for allowable stress design

Most common combinations for allowable stress design:

Dead + Horizontal Soil

Dead + Horizontal Soil + Live

Dead + Wind + Live

Dead + 0.7 *Earthquake

0.6* Dead + Wind + Horizontal Soil

Design per Chapter 16

Temporary Structures Risk Category I

Snow Importance Factor	0.8
Seismic Importance Factor	1.0
Wind Use Importance Factor	1.0

1605.1.1 Stability

Regardless of which load combinations are used to design for strength, where overall structure stability (such as stability against overturning, sliding, or buoyancy) is being verified, use of the load combinations specified in Section 1605.2 or 1605.3 shall be permitted.

Where the load combinations specified in Section 1605.2 are used, strength reduction factors applicable to soil resistance shall be provided by a registered design professional. The stability of retaining walls shall be verified in accordance with Section 1806.2.

1605.3.1.1 Stress Increases

Increases in allowable stresses specified in the appropriate material chapter or the referenced standards shall not be used with the load combinations of Section 1605.3.1, except that increases shall be permitted in accordance with Chapter 23 (wood).

Exception

Temporary installations that are accompanied by **an action plan** in accordance with Section 1618.3 shall be permitted to **reduce** the design environmental loads required by Chapter 16:

Seismic

Wind

Seismic Loads

Temporary installations shall be permitted to use 2 percent of the design dead and live load in lieu of the seismic forces required by Section 1614. …

This load shall be distributed in proportion to the design loads, shall be applied in any horizontal direction and need not be combined with other environmental loads.

Wind

The wind design for temporary installations shall be computed as required by Section 1609. The **basic wind speed** used to design the structure shall be permitted to be reduced by applying a factor of **0.8** – provided an adequate action plan is submitted.

Wind Loads

Depend on:

- Location – Exposure
- Height

Direction:

- Horizontal
- Vertical

Wind Design

Wind Speed: 98 mph

Maps of wind exposure

1618.3 Action Plan

All temporary installations reducing the design environmental loads in accordance with Section 1618.2 shall include environmental load mitigation measures as part of an action plan. The action plan measures shall be indicated on the drawings.

1618.3.1 Action Plan Implementation

The action plan shall be such that it may be reliably implemented in one day's notice or less as appropriate for the actions.

1618.3.2 Plan Components

1. Threshold of predicted environmental loads;

2. Method of monitoring environmental loads;

3. Party responsible for monitoring loads and determining implementation of action plan;

4. Party responsible for effectuating the action plan;

5. Evacuation procedures;

1618.3.2 Plan Components Continued

6. Safety zone, standoff distance or standoff perimeter as appropriate. Safety zone, standoff distance or standoff perimeter shall not extend beyond the property line;

7. Any other activities, such as the addition or removal of structural and/or non-structural elements, removal of loads or creating sacrificial elements so that the structure may resist unreduced forces as required for permanent structures;

8. Plan to prevent wind-born debris; and

9. Verification that the design and procedures shall not adversely impact other structures.

3308.3.1 Safety Netting Wind Design

Safety netting systems shall be designed by a registered design professional to meet temporary loads, including but not limited to wind, as prescribed in Chapter 16.

A reduction in the surface area due to the openings in vertical or horizontal net fabric or partially enclosed perimeter panel is permitted provided that the force at design wind speed is derived from manufacturers' test data or other testing or methods acceptable to the commissioner.

Related Changes – Soils

1801.2 Design. Allowable bearing pressures, allowable stresses and design formulas provided in this chapter shall be used with the allowable stress design load combinations specified in Section 1605.3.

DELETED:

1801.2 Design. …

1. For the design of temporary structures, (defined for this chapter as a structure that will be in place 180 days or less) load combinations in Equations 16-8 and4 16-9 can be multiplied by a factor of 0.75.

2. For the design of temporary structures, the Equations 16-10, 16-11 and4 16-12 can be multiplied by a factor of 0.67.

1806.2.2 Temporary Retaining Structures

Structural members for temporary retaining structures may be designed with a 20 percent decrease in the computed bending moment only.

Concrete Formwork – Changes

Provisions moved from Ch. 19 to Ch. 33. reference is made to ACI 318 Section 6.2.

3305.3.1.1 Safe Support of Loads

Formwork, including all related braces, shoring, framing, and auxiliary construction, shall be proportioned, erected, supported, braced, and maintained so that it will safely support all vertical and lateral loads that might be applied until such loads can be supported by the permanent construction.

3305.3.2.1 Design Drawings

Site-specific formwork design drawings prepared by a registered design professional shall be required in the following cases:

1. For concrete formwork in a structure classified as a major building; or
2. Wherever the shore or form height exceeds14 feet; or
3. Wherever the total vertical load on the forms exceeds 150 pounds per square foot (732 kg/m2); or
4. Wherever power buggies are used; or

33305.3.2.1 Design Drawings Continued

5. Wherever multi-stage shores are used; or

6. Wherever the slab thicknesses or beam heights equal or exceed 10 inches; or

7. Wherever there are concentrated loads exceeding 2000 pounds imposed on the formwork; or

8. Wherever there are loads are imposed on existing structures in accordance with Section 3305.3.1.2.1.

3305.3.1.2.1 Use of Existing Structures

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.

3305.3.2.6.1 Approval

When **patented or commercial devices** that are not susceptible to design are used for shoring, bracing, or splicing, they shall be approved by the commissioner.

3305.3.2.4 External Lateral Loads

Braces and shores shall be designed to resist all external lateral loads, including, but not limited to, wind, cable tensions, inclined supports, dumping of concrete, and starting and stopping of equipment.

In no case shall the assumed value of lateral load due to wind, dumping of concrete, and equipment acting in any direction at each floorline be less than 100 plf applied along the edge or 2 percent of total dead load of the floor, whichever is greater.

3305.3.2.4 External Lateral Loads Continued

Except for foundation walls that are poured against a rigid backing, wall forms shall be designed for a minimum lateral load of 10 pounds per square foot (49 kg/m2), and bracing for wall forms shall be designed for a lateral load of at least 100 pounds per linear foot (148.8 kilograms per linear meter) of wall, applied at the top. The lateral load acting on walls greater than 14 feet (4267 mm) high shall be determined by analysis of conditions applicable to the site and building.

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 form design drawings. Such inspections shall be performed by a qualified person designated by the contractor; nothing shall prohibit the concrete safety manager from performing such inspection where so designated. Subsequently, inspections shall be performed by such person 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.

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:

1. The formwork designer;
2. An employee of the formwork designer under his or her direct supervision;
3. A registered design professional retained by the formwork designer; or
4. An employee of such retained registered design professional under the direct supervision of such retained registered design professional.

Special Inspections

Special Inspectors verify:

- Material or system installed
- Installation procedure

Meet design documents:

- Design drawings
- Engineered instructions
- Specified standards

1704.1.1.2 Designer for Construction Operations

Identification of registered design professionals providing design documents for certain construction operations.

The registered design professionals responsible for the production of design, sequence of construction operations or shop drawings for projects that require design pursuant to Chapter 33, shall file documentation of their intent to perform those duties on forms supplied by the department.

1704.20 Special Inspection for Structural Stability

Special Inspection for structural stability shall be required for construction work as specified in this section or elsewhere in this code.

Structural materials and methods of construction utilized in temporary protections shall be subject to special inspection when such materials and methods of construction would be subject to Special Inspection as a permanent installation in accordance with the applicable sections of this chapter, including but not limited to Special Inspection for concrete, welding, and pile driving.

Structural Stability and Integrity

1704.20 Structural Stability

1704.20.1 Structural stability of existing buildings

1704.20.1 Construction operations influencing adjacent structures

1704.20.2 Excavations

1704.20.2.1 Slurry

1704.20.3 Underpinning

1704.20.4 Demolitions

1704.20.5 **Raising and moving of a building**

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 the such structures shall be subject to special inspections in accordance with Sections 1704.20.6 through 1704.20.10.

3309.4.3 Preconstruction Survey

No excavation work to a depth of 5 feet to 10 feet (1524 mm to 3048 mm) within 10 feet (3048 mm) of an adjacent building, or an excavation over 10 feet (3048 mm) 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.

3309.8 Adjoining Walls

When any construction or demolition operation exposes or breaches an adjoining wall, including load-bearing and non-load-bearing walls as well as party walls and non-party walls, the person causing the construction or demolition operation shall, at his or her own expense, perform the following:

1. Maintain the structural integrity of such walls and **adjoining structure**, and have a registered design professional investigate the stability and condition of the wall and **adjoining structure**, and take all necessary steps to protect such wall and **structure.**

1704.20 Common Requirements

1704.20.6 Inspection program – at start

1704.20.7 Design documents

1704.20.8 Inspection during construction

1704.20.9 Record keeping

Work in occupied multiple dwellings

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.**

Specific to the Building

Inspect building:

a. Determine existing condition of the building

b. Determine weak elements

c. Potential of distress due to movement or vibration

Protocol of Actions

The monitoring program shall include necessary actions to address exceedances.

Whom to communicate

Adjust construction operations

Reevaluate construction operations

Instrumentation

Location

Type of instruments

Frequency and duration of readings

Permissible movement and vibration criteria

Assessing Deterioration of Masonry Buildings

Condition Assessment

Building lean

Wall cracks

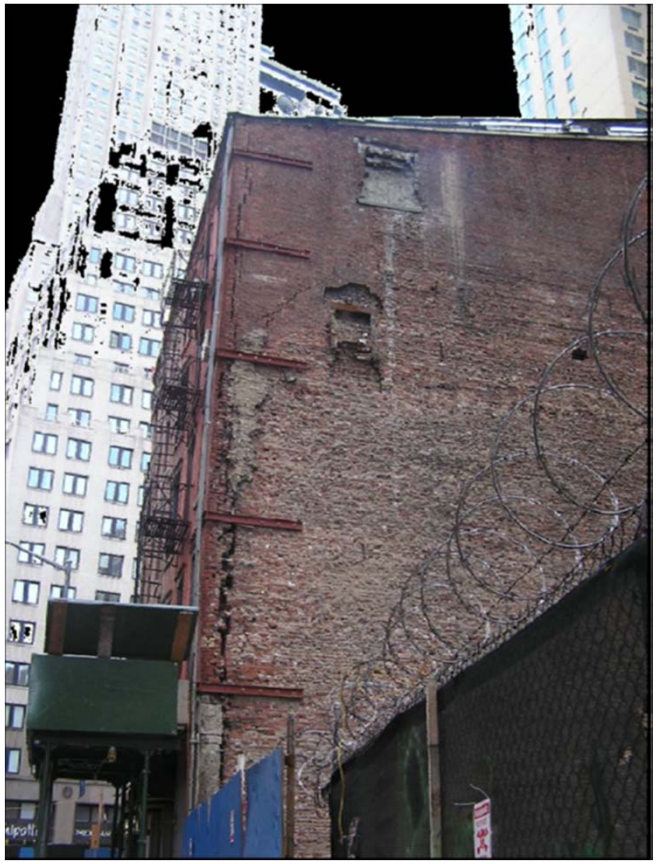
Wood deterioration

Evidence of foundation settlement

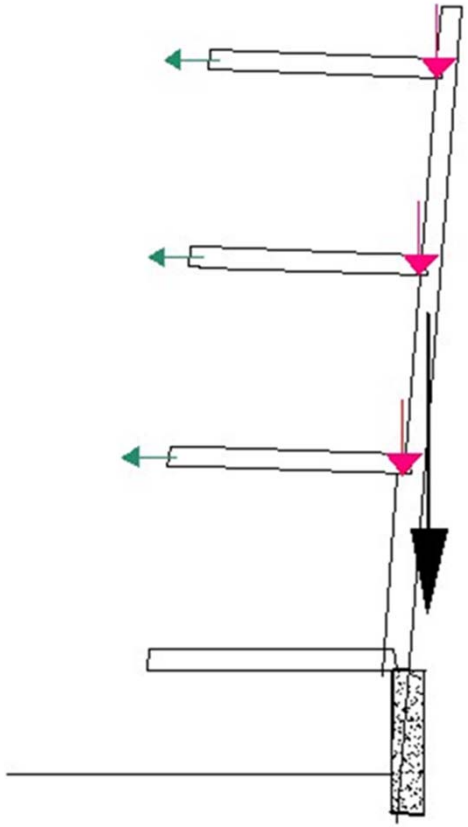
Eroded mortar joints

Most Serious Building Conditions

Crack at Corner



Building Leaning



Elements Influencing Stability and Load Path

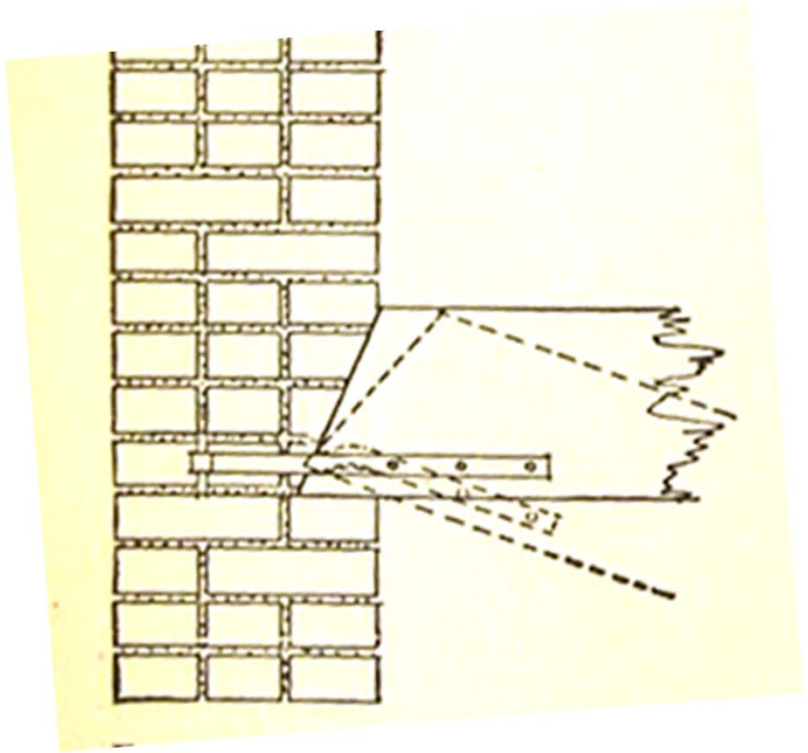
Floor to floor height vs. wall thickness

Floor and joists anchorage to walls

Wall to wall anchorage

Interior walls

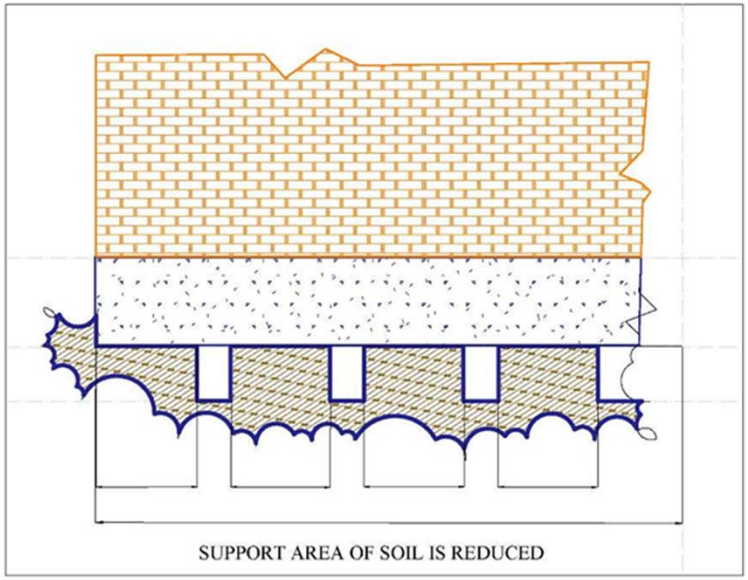
Number of floors



Underpinning

1704.20.3.1 New foundations installed as part of underpinning.

Pin-underpinning is a method of underpinning that is used also as support of excavation – sometimes a temporary function.



1814.1 Underpinning & Support of Adjacent Property

Where the protection and/or support of adjacent structures is required, an engineer shall prepare a preconstruction report summarizing the condition of the structure as determined from examination of the structure, the review of available design documents and, if necessary, the excavation of test pits.

1814.1 Underpinning – General

The engineer shall determine the requirements for underpinning and protection and prepare site-specific plans, details, and sequence of work for submission to the commissioner. Such support may be provided by underpinning, sheeting, and bracing, or by other means acceptable to the commissioner.

1814.1.1 Underpinning and bracing

Underpinning piers, walls, piles and footings shall be designed as permanent structural elements. ….

Underpinning shall be designed and installed in such 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.

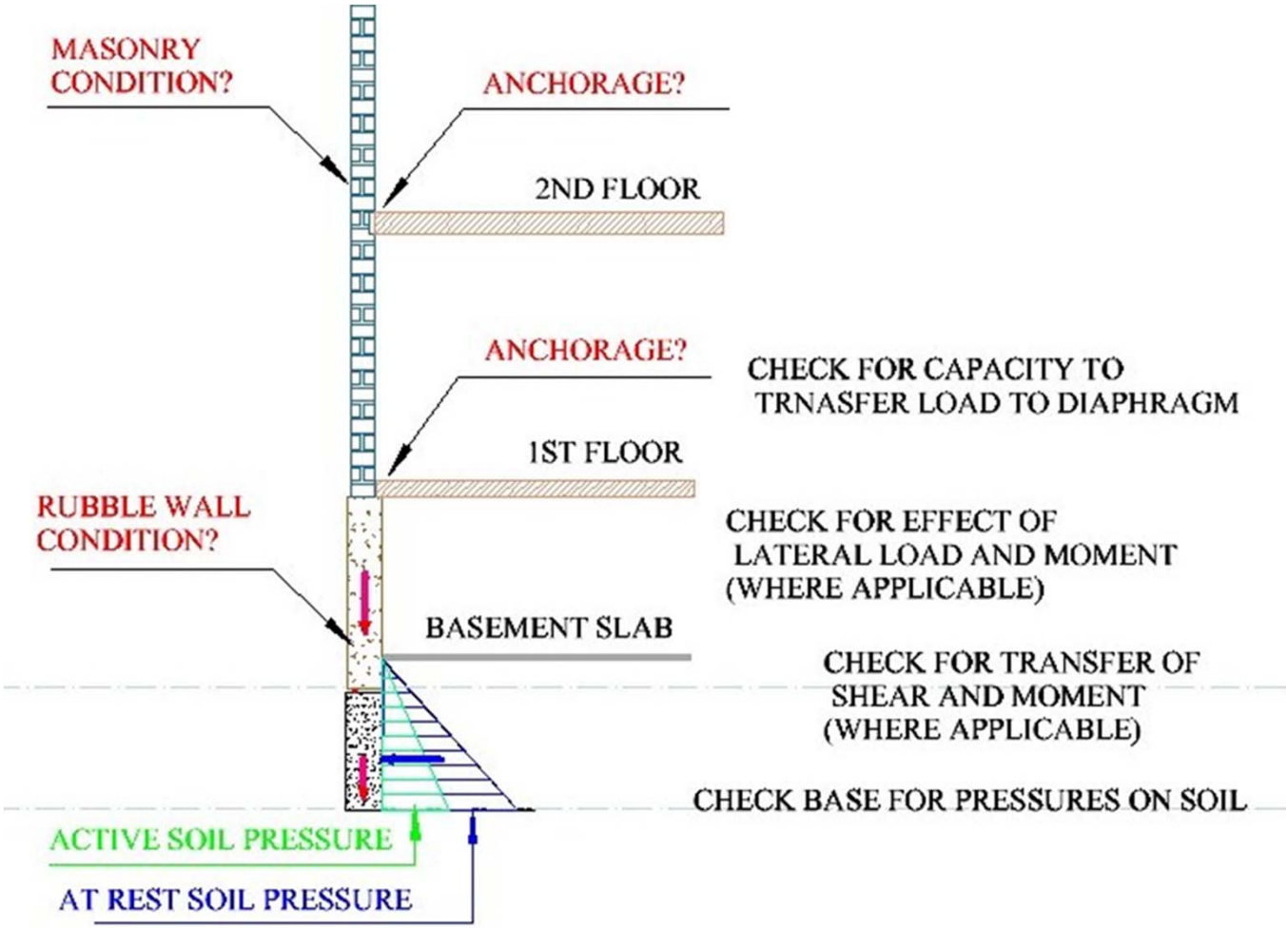
The design shall take in account the effects on foundation and structure produced by the lateral earth pressure exerted on the underpinning.

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.**

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.

Design of PIN-Underpinning

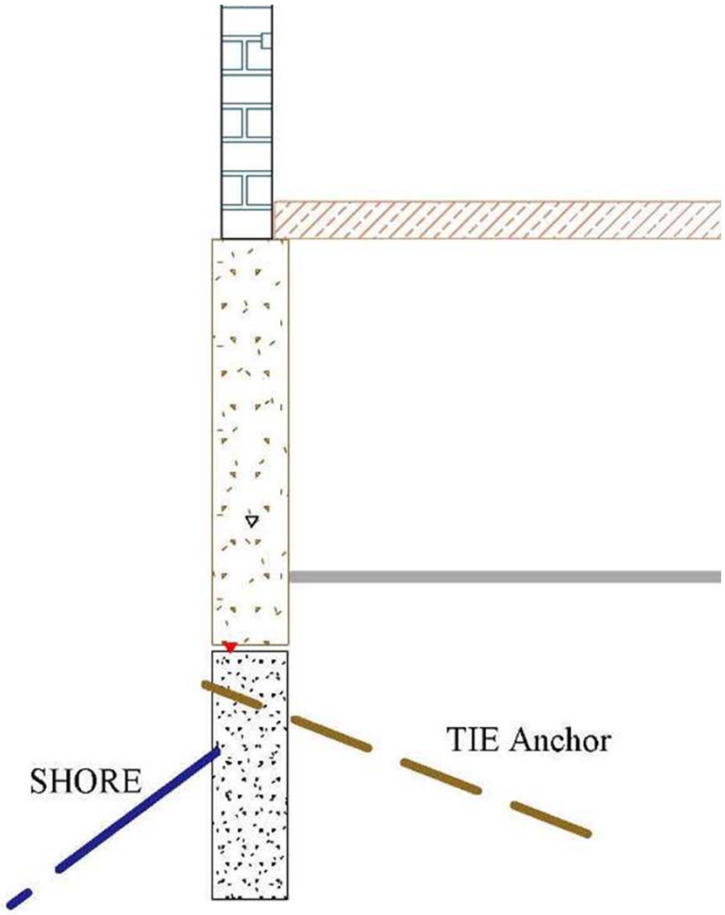


Pin-underpinning – Provide Support

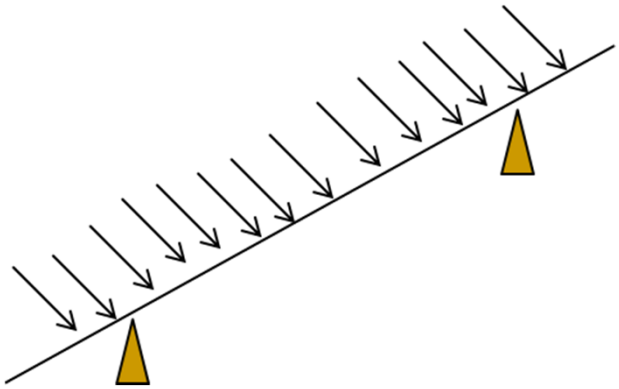
When you cannot ascertain capacity of structure to carry lateral load **provide support**!

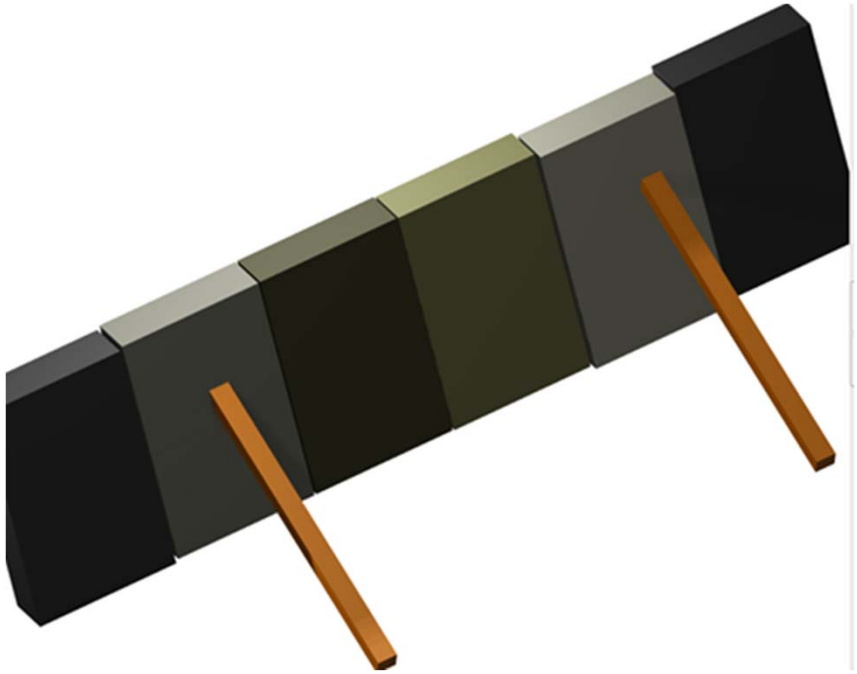
1814.1.1

Lateral support for underpinning, if needed, shall be accounted for during the design of the new construction.



Transfer Lateral Pressure to Support Points





1704.3.4 Special Inspection Cold-Formed Steel

Verify that temporary bracing, shoring, jacks, etc., are installed, and not removed until no longer necessary, in accordance with the approved construction documents and approved erection drawings.

Verify that permanent bracing, web stiffeners, bridging, blocking, wind bracing, etc, are installed in accordance with the approved construction documents and approved erection drawings.

1704.32 Post-installed Anchors

The installation of post-installed mechanical anchors, adhesive anchors, and screw anchors shall comply with Table 1704.32. The Special Inspection shall include the verification of compliance with approved construction documents and

1704.32 Preconstruction Survey

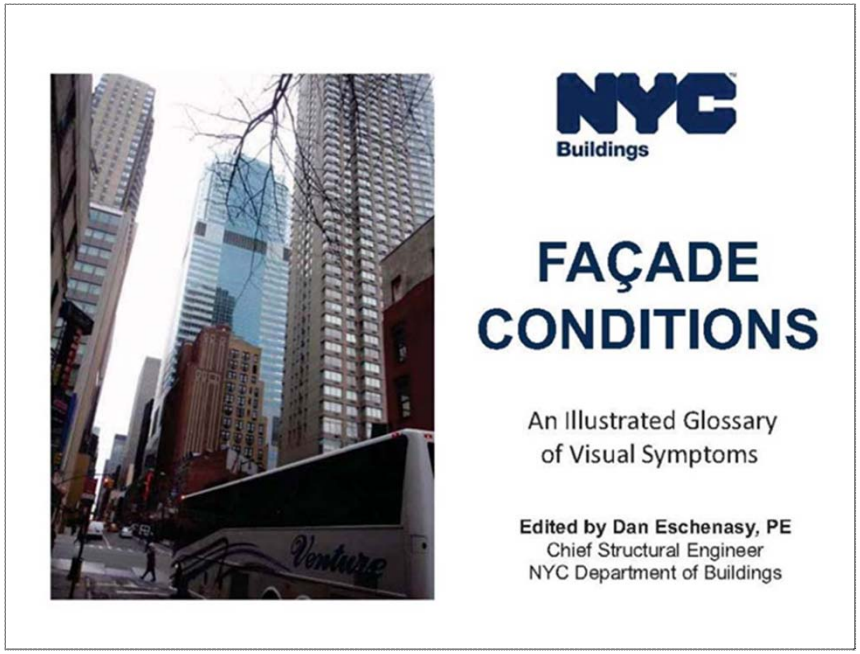
No excavation work to a depth of 5 feet to 10 feet (1524 mm to 3048 mm) within 10 feet (3048 mm) of an adjacent building, or an excavation over 10 feet (3048 mm) anywhere on the site shall commence until the person causing an excavation to be made has documented the existing conditions of all adjacent buildings in a preconstruction survey.

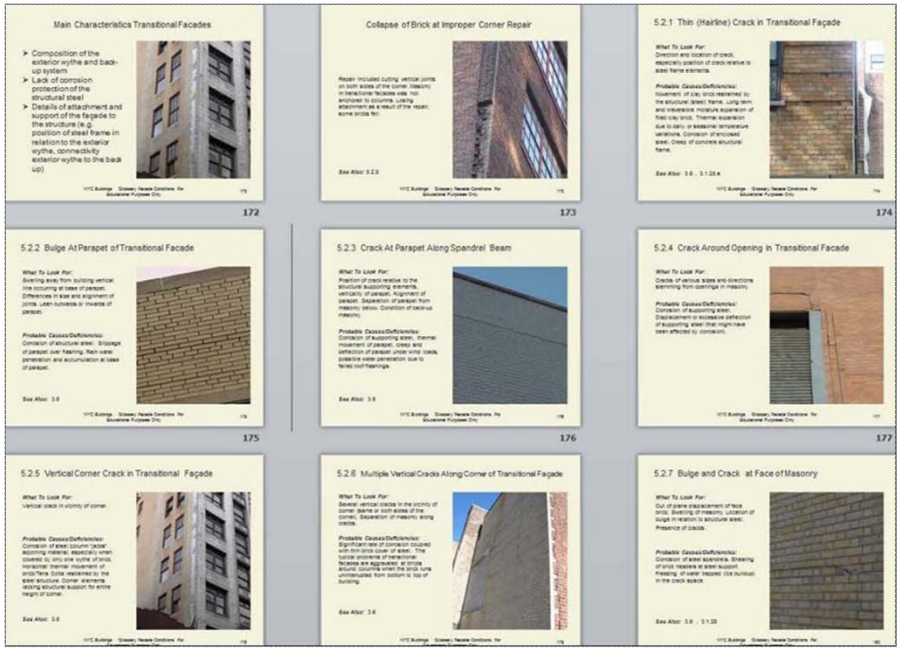
Post-installed Anchors

TABLE 1704.32
REQUIRED VERIFICATION AND INSPECTION OF POST-INSTALLED ANCHORS

VERIFICATION AND INSPECTION	CONTINUOUS	PERIODIC	REFERENCED STANDARD	BC REFERENCE
1. Preparation, placement, type, size and location of anchors, including other details of anchors, installed in hardened concrete, and installed to hardened concrete and to another construction.	—	X	ACI 318: 3.8.6, 8.1.3, 15.8.3, 21.1.8	1912.1, 1908.9
2. Preparation, placement, type, size and location of anchors, including other details of anchors, installed in masonry, and installed to masonry and to another construction.	—	X	Manufacturer's specifications and installation instructions	
3. Preparation, placement, type, size and location of anchors, including other details of anchors, installed in stone, and installed to stone and to another construction.	—	X	Manufacturer's specifications and installation instructions	

Façade Conditions Glossary





Available at nyc.gov/buildings.
See the Façades page under Safety & Enforcement.

Dolores Spivack, RA, AIA, LEED AP
Administrative Architect, FISP

Façades During Construction

2014 BUILD SAFE | LIVE SAFE
CONFERENCE
NYC Buildings

Façades During Construction

§ 28-302
Obligation to maintain safe condition of adjacent properties

1 RCNY §103-04

CHAPTER 100

Subchapter C Maintenance of Buildings

§103-04 Periodic Inspection of Exterior Walls and Appurtenances of Buildings.
(a) *Definitions.*
Acceptable report. A technical examination report filed by a Qualified Exterior Wall Inspector that meets the requirements of the Administrative Code and this rule as determined by the Department.

Façades During Construction

Historic buildings

Adjacent construction monitored

TPPN 10/88

Façades During Construction

Lot-line façade of existing High-rise that is adjacent to the construction site =

fragile condition

What is performance of adjacent building?

Façades During Construction

LL 10/1980

Amended by LL 11/1998

Re-enacted and renumbered by 2008 Code to **§ 28-302**

LL 11, 1 RCNY § 103-04 technically repealed:

Now called the Façade Safety Inspection Program (FISP)

Façades During Construction

FISP helps identify:

When the buildings are not maintained in good order

Risks associated with **Failure to Maintain/ SWARMP** (Safe with a Repair and Maintenance Program)

Façades During Construction

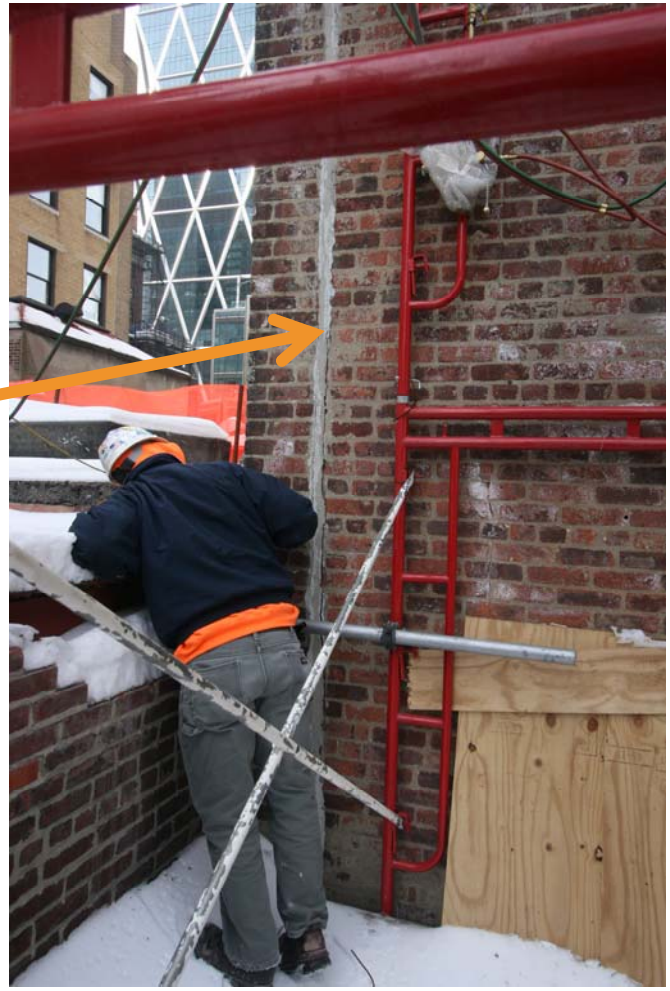
1 RCNY § 103-04 amended May 2013

History

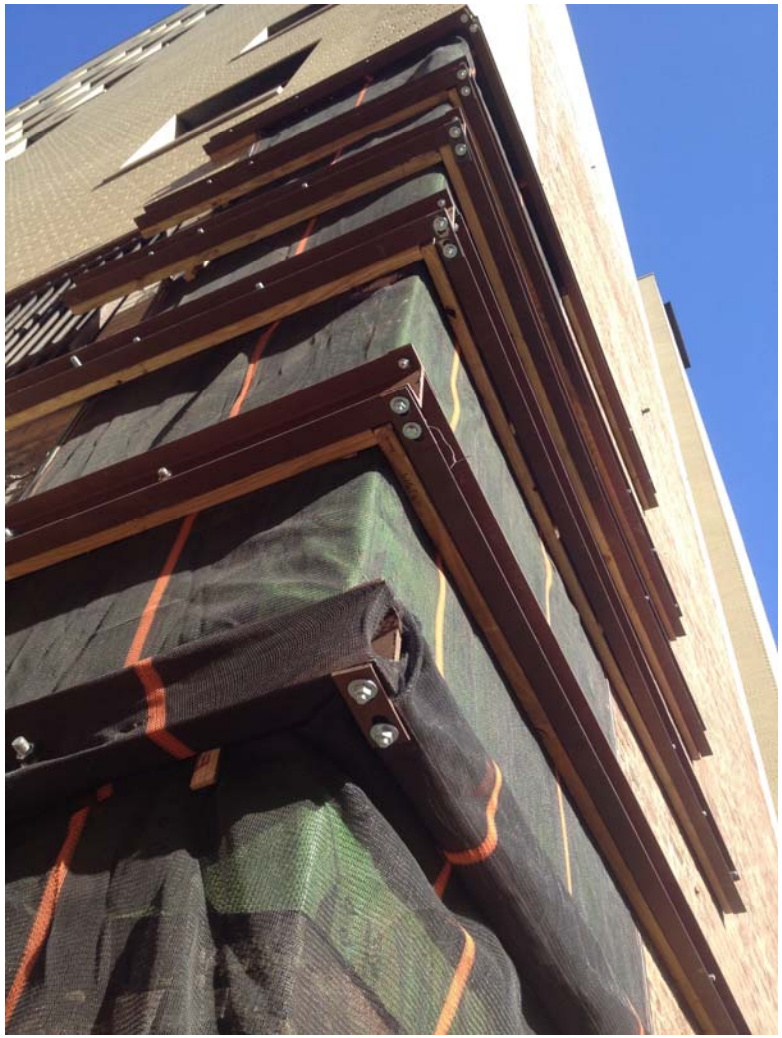
Intent

Façades During Construction

Performance of **adjacent buildings** is often overlooked.



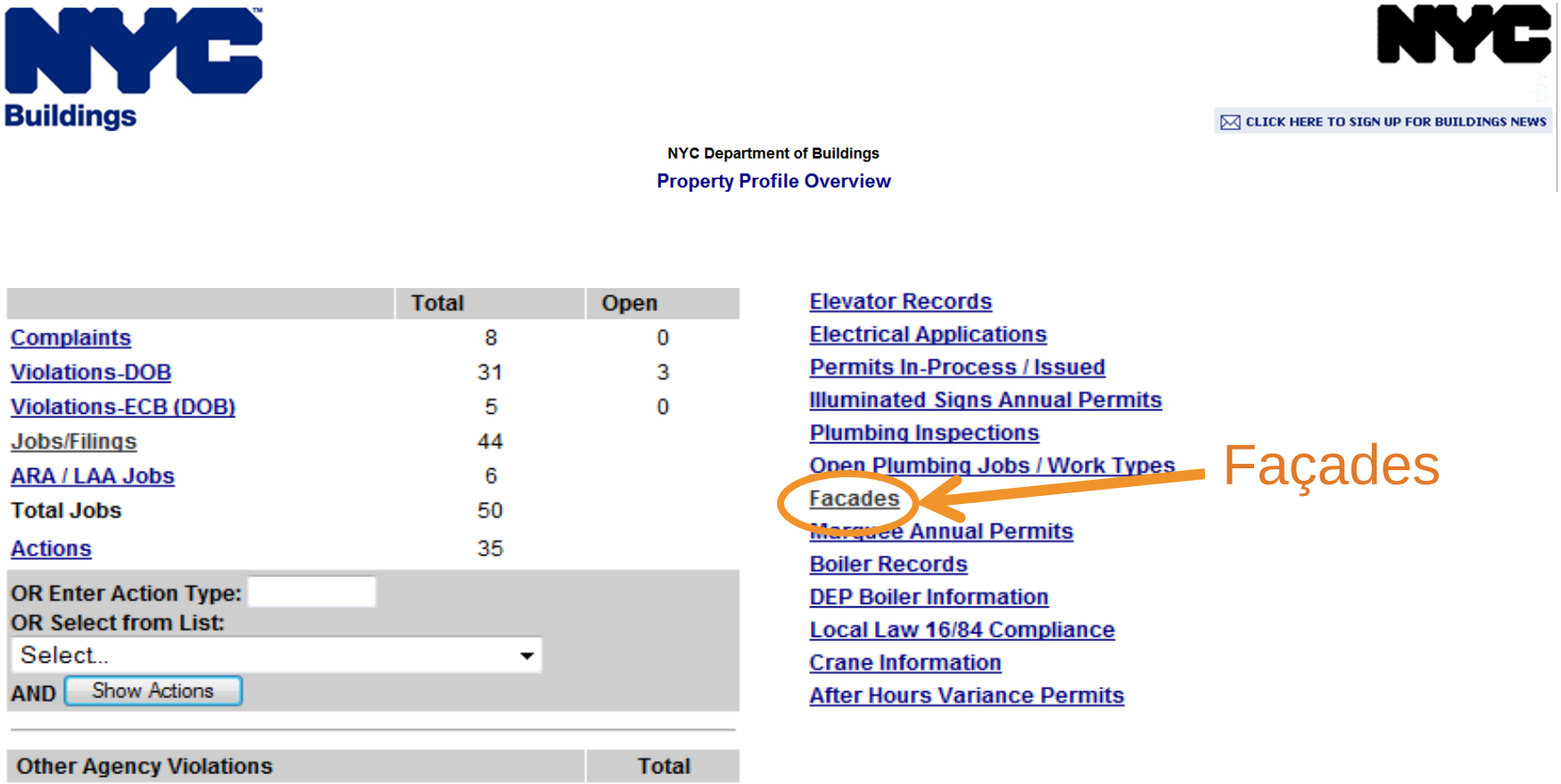
Façades During Construction



Corner stabilized **before** construction on adjacent lot could continue.

Partner with adjacent building

Where to Find Façade Information



Inspections of Façade Installations

For façades under construction:

What is new in the 2014 Building Code?

Inspections of Façade Installations

1704.1.2.4. Reports

4.3 Hazardous conditions. The special inspector shall report conditions noted as hazardous to life, safety or health **that are not immediately corrected** to the immediate attention of the commissioner.

Inspections of Façade Installations

1704.1.2, 4. Reports

4.5. Approval of partially completed work. Approval of partially completed work. Reports of partially completed work shall be accepted when such reports indicate that the inspected work has been completed in accordance with the construction documents and the condition of the remaining work.

1704.10.2 Inspection Program – Walls

1. The supporting structure **for components being inspected** is aligned and within **specified** tolerances **required for components.**

1704.10.2 Inspection Program – Walls

2. **Required** inserts are installed.

1704.10.2 Inspection Program – Walls

3. **Framing** components are **installed and** aligned **as specified**, and without structural defects or weakness.

1704.10.2 Inspection Program – Walls

4. **Anchors** are placed, welded, bolted and finished **as specified**, as applicable.

1704.10.2 Inspection Program – Walls

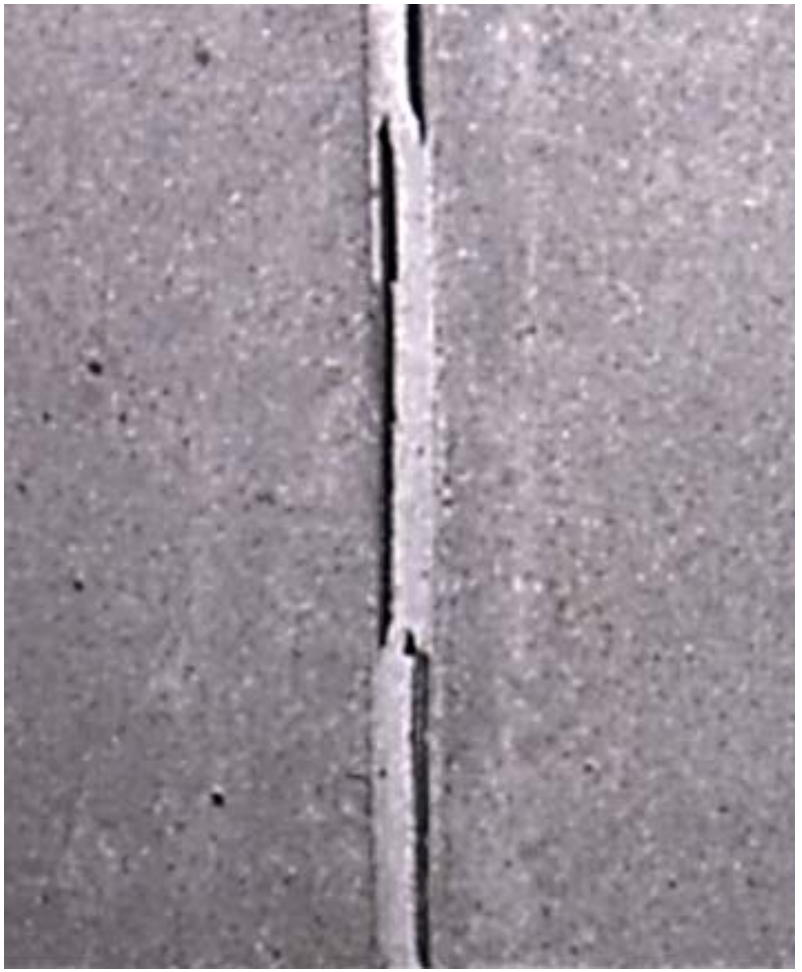
5. **Weeps,** flashings and tubes are **installed as specified** and **functioning.**

1704.10.2 Inspection Program – Walls

6. **Joinery** and end dams are sealed **as specified.**

1704.10.2 Inspection Program – Walls

7. **Sealing** materials with **specified adhesive and movement capabilities are installed.**

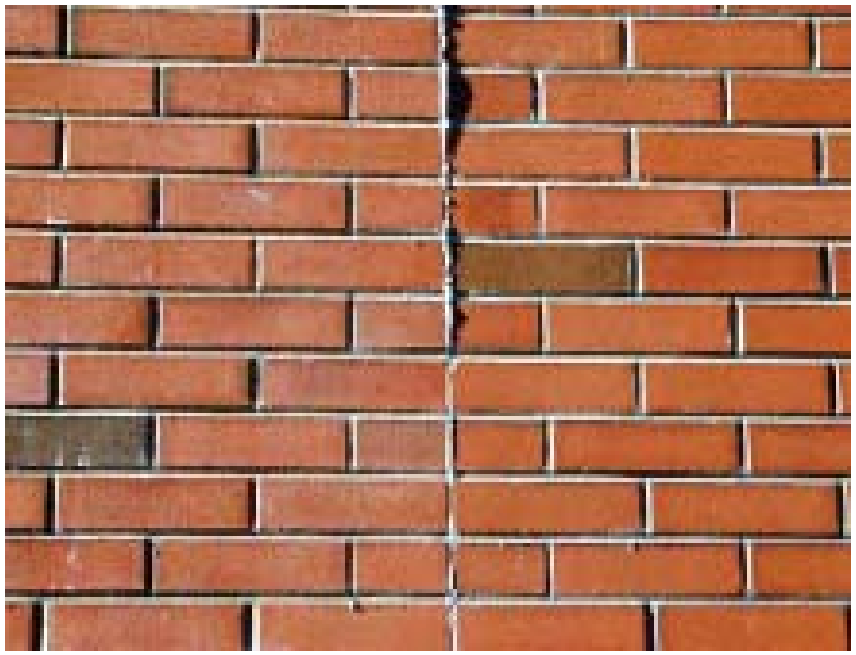


1704.10.2 Inspection Program – Walls

8. Gaskets, tapes, seals, insulation, flashing and other materials that are barriers to air and water movement, vapor drive, and heat loss are installed as specified.

1704.10.2 Inspection Program – Walls

9. **Join filler** materials **accommodate specified** horizontal and vertical movement **are installed** in accordance with the manufacturers' **instructions.**



1704.10.2 Inspection Program – Walls

10. **Any** other observations pertinent to safety of performance of the wall system.

Masonry Façade During Construction

2109.7.4.3 Precautions during erection.

Temporary bracing shall be used wherever necessary to resist loads to which the walls may be subjected during erection. Such bracing shall remain in place as long as may be required for safety.

Questions?

This concludes the American Institute of Architects Continuing Education Systems Course.

AIA Point of Contact:
Allison Ginsburg
AllisonGo@buildings.nyc.gov
212.393.2167