



Changes to the NYC Building Code
Chapter 18 – Soils & Foundations

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OUTLINE

- Site Exploration
- Material Classes
- Bearing Pressures
- Piles
 - Types
 - Load Tests
 - Allowable Stresses



SITE EXPLORATION

Number of Borings

Type	Old Code	New Code
<p>Shallow Foundations</p>	<p>1 boring per 2,500 sf</p>	<ul style="list-style-type: none"> • 2 borings <i>A < 5,000 sf</i>
		<ul style="list-style-type: none"> • 1 add'l boring <i>for ea. 2,500 sf</i> <i>5,000 < A < 20,000 sf</i>
		<ul style="list-style-type: none"> • 1 add'l boring <i>for ea. 5,000 sf</i> <i>A > 20,000 sf</i>
<p>Pile Foundations req. tests</p>	<p>1 boring per 1,600 sf <i>(56% increase)</i></p>	<p>30% increase of shallow</p>

SITE EXPLORATION

Boring Locations

Old Code	New Code
<ul style="list-style-type: none">• 2/3 of borings within loaded area <p><i>and</i></p> <ul style="list-style-type: none">• remaining at < 25 ft from loaded area	<ul style="list-style-type: none">• 1/2 of borings within loaded area <hr/> <ul style="list-style-type: none">• uniformly distributed under the structure <p><i>or</i></p> <ul style="list-style-type: none">• in accordance with load pattern



SITE EXPLORATION

Boring Depths

Old Code	New Code
<ul style="list-style-type: none">• To suitable bearing with min:<ul style="list-style-type: none">- 10 ft into 5-65- 15 ft for < 2 stories- 25 ft for all other cases	<ul style="list-style-type: none">• into bedrock<i>or</i>• to depth where loads are dissipated
<ul style="list-style-type: none">• to depth where vertical stresses < 10% of those by orig. overburden	<ul style="list-style-type: none">• for $p > 1000$ psf min 1 boring / 10,000 sf 100 ft below curb or 5 ft into class 1c material

SITE EXPLORATION

Prior Borings

Old Code	New Code
<ul style="list-style-type: none">• may be used <i>if samples available</i>• replace 50% <i>if samples not available</i> <i>(unless approved by Commissioner)</i>	<ul style="list-style-type: none">• for partial fulfillment <i>subject to approval</i>• add borings <i>for uncertainties</i>



SITE EXPLORATION

Boring Alternatives

Alternative	Old Code	New Code
Test Pits	<ul style="list-style-type: none">• may replace borings on 1-to-1 basis: 4 ft deep 2-story buildings below deepest level	<ul style="list-style-type: none">• may replace borings for 1-, 2-story structures <i>and</i>• may establish top of rock for higher structures



SITE EXPLORATION

Boring Alternatives (*cont'd*)

Alternative	Old Code	New Code
Probing <i>and</i> Geophysical	<ul style="list-style-type: none">• May substitute:<ul style="list-style-type: none">- <i>up to 50% of borings with adequate depth</i>- <i>rock cores at 1/5 such locations</i>• <i>Personnel:</i><ul style="list-style-type: none">- <i>experienced / qualified</i>- <i>acceptable to Commissioner</i>	<ul style="list-style-type: none">• CPT may be used to:<ul style="list-style-type: none">- <i>supplement soil borings</i>- <i>determine properties</i>• Altern. to substitute 2-to-1 borings (upon approval):<ul style="list-style-type: none">- <i>min 2 borings / 10,000 sf</i>- <i>min 100 ft deep or 5 ft in bedrock</i>• Geophysical, vane shear and pressure meters:<ul style="list-style-type: none">- <i><u>only</u> for material properties</i>- <i>not to replace borings</i>

SITE EXPLORATION

Seismic Requirements

- **Seismic Design Category C**

Evaluate potential hazards of:

- Slope instability
- Liquefaction
- Surface rupture

- **Seismic Design Category D**

Same as Category C and:

- Site specific analysis for response spectrum
- Lateral pressures on walls due to earthquake motion
- Evaluate kinematic effects on piles
- Evaluate effects of liquefaction

SOIL CLASSIFICATION / SAMPLING

Both New and Old Codes

- Soil classification follows Unified Soil Classification System

New Code

- Rock / soil classification terms have been revised
- Rock core sampling as per ASTM D 2113:
 - min OD for dbl-tube core barrels is 2 7/8 inches
 - smaller sizes may be used
- Rock classification is determined
 - Recovery
 - RQD values

NEW MATERIAL CLASSES

Bedrock

Description	Old Code	New Code
Hard Sound Rock	1-65	1a
Medium Hard Rock	2-65	1b
Intermediate rock	3-65	1c
Soft Rock	4-65	1d
Hardpan	5-65	Not addressed

NEW MATERIAL CLASSES

Sandy Gravel & Gravel (GW, GP)

Description	Old Code	New Code
Dense	6-65	2a
Medium		2b
Loose		6

Granular Soil (GM, GC, SW, SP, SM, SC)

Description	Old Code	New Code
Dense	6-65 or	3a
Medium		3b
Loose	7-65	6

NEW MATERIAL CLASSES

Clays (SC, CL, CH)

Description	Old Code	New Code
Hard	9-65	4a
Stiff		4b
Medium		4c
Soft		6

Silts, Clayey Silts (ML, MH)

Description	Old Code	New Code
Dense	10-65	5a
Medium		5b
Loose		6

NEW MATERIAL CLASSES

Other

Description	Old Code	New Code
Organic silts, clays and peats	11-65	6
Controlled and uncontrolled fills		7



NEW MATERIAL CLASSES

Remarks

- No material class for:
 - Hardpan
 - Fine sands
- Clays:
 - 4 subclasses vs. 3 in old code



ALLOWABLE BEARING PRESSURE Bedrock

Material	Old Code (tsf)	New Code (tsf)
Hard Sound Rock (1a)	60	60
Medium Hard Rock (1b)	40	40
Intermediate rock (1c)	20	20
Soft Rock (1d)	8	8

ALLOWABLE BEARING PRESSURE

Sandy Gravel & Gravel (GW, GP)

Material	Old Code	New Code	
Dense (2a)	10	10	Interpolate
Medium (2b)	6-10 (interpolate)	6	
Loose (6)	6	Follow Class 6	

Granular Soil (GM, GC, SW, SP, SM, SC)

Material	Old Code	New Code	
Dense (3a)	8-10	6	
Medium (3b)	Interpolate	3	
Loose (6)	4-6	Follow Class 6	

ALLOWABLE BEARING PRESSURE

Clays (SC, CL, CH)

Material	Old Code (tsf)	New Code (tsf)
Hard (4a)	5	5
Stiff (4b)	N/A	3
Medium (4c)	2	2
Soft (4d)	< 1 tsf	<i>based on soil properties</i>

ALLOWABLE BEARING PRESSURE

Silts, Clayey Silts (ML, MH)

Material	Old Code (tsf)	New Code (tsf)
Dense (5a)	3	3
Medium (5b)	1.5	1.5
Soft (5c)	< 1 tsf <i>unless pre-consolidated (< 2 tsf)</i>	based on investigation and soil properties

ALLOWABLE BEARING PRESSURE

Other (Class 6, 7, varved)

Material	Old Code (tsf)	New Code (tsf)
Varved silts	< 2 tsf <i>except desiccated or pre-consolidated</i>	< 2 tsf <i>unless approved by Commissioner</i>
Organic soils Soft clays Loose granular soil	< 1 tsf <i>unless pre-consolidated (< 2 tsf) (not for granular soil)</i>	based on investigation and soil properties

ALLOWABLE BEARING PRESSURE

Controlled Fill

- modified grain size distribution
- max allowable bearing = **3 tsf**
old code allowed bearing from class material (6-65 or 7-65)

Controlled Low-Strength Material

- allowable bearing by test

PILE FOUNDATIONS

Types

Pile Type	Old Code	New Code
Timber	✓	✓
Caissons	✓ <i>in rock >18 inches</i>	✓ <i>in soil or rock > 7 inches</i>
Concrete-filled Pipe	✓	✓
Compacted Concrete	✓	✓
H-Piles	✓	✓
Cast-in-place	✓	✓ <i>(Augered or Drilled)</i>
Composite Piles	✓	✓

PILE FOUNDATIONS

Types

Pile Type	Old Code	New Code
Enlarged-base Piles	✓ <i>included in compacted concrete piles</i>	✓
Micro-Piles Mini-Piles	not addressed	✓ <i>(under caissons)</i>
Jacked Piles	✓	✓
Driven Uncased	✓	✓
Open-end Pipe	✓	✓

PILE LOAD TESTS

Minimum Number

Load Test	Old Code	New Code
min number	<ul style="list-style-type: none"> • Uniform conditions <i>1 per area</i> • <i>2</i> for entire foundation <i>or</i> • <i>1 / 15,000 sf</i> • <i>1 / 10,000 sf</i> to substantiate higher allowable loads 	<ul style="list-style-type: none"> • Uniform conditions <i>1 per area</i> • $A < 5,000$ sf <i>1</i> • $5,000 < A < 30,000$ sf <i>2</i> • Add'l 20,000 sf <i>1 ea</i>

PILE LOAD TESTS

Alternative Methods

- If > 3 load tests are required
(upon approval)
- min 1 alt. test on pile tested by static test
- max 50% of required tests by alt. methods
- number of alt. tests = $2 \times$ replaced static tests

PILE LOAD TESTS

Procedure

- Closer to ASTM 1143
- Hold of final load:
 - *longer than ASTM 1143*
 - *shorter than current code*
 - *modified acceptance criteria*



PILE LOAD TESTS

Procedure

Criteria	Old Code	New Code
Extensometer accuracy	1 / 1000 in	1 / 1000 in
Test Load	2 x working load	2 x working load
Settlement Criteria (presumptive)	rate < 0.001 ft (0.012 in) in 48 hrs	rate < 0.012 in (0.001 ft) in 12 hrs

PILE LOAD TESTS

Procedure

Time		Old Code	New Code
min hold for test load	$P < \text{max}$ per code	48 hrs	12 hrs
	$P > \text{max}$ per code	96 hrs	24 hrs
time for measuring final rebound		24 hrs after load removed	24 hrs after load removed

LATERAL & UPLIFT CAPACITY

- Old Code

No load test procedures provided

- New Code

- Lateral Capacity as per ASTM D 3966

max 1 ton without testing

1/2 load resulting in 1 inch at surface

- Uplift Capacity as per ASTM D 3689

1/2 the ultimate load by test

MAX PILE LOAD

(in tons)

Pile Type	Old Code	New Code																		
Caissons	no max	no max																		
Open-end pipe on rock (class 1a, 1b, 1c)	<table border="1"> <thead> <tr> <th>OD(in)</th> <th>$Q_{max}(t)$</th> </tr> </thead> <tbody> <tr> <td>≥ 18</td> <td>250</td> </tr> <tr> <td>< 18</td> <td>200</td> </tr> </tbody> </table>	OD(in)	$Q_{max}(t)$	≥ 18	250	< 18	200	<table border="1"> <thead> <tr> <th>OD(in)</th> <th>$Q_{max}(t)$</th> </tr> </thead> <tbody> <tr> <td>≥ 18:</td> <td>250</td> </tr> <tr> <td>14 – 18</td> <td>200</td> </tr> <tr> <td>12 – 14</td> <td>150</td> </tr> <tr> <td>10 – 12</td> <td>100</td> </tr> <tr> <td>8 – 10</td> <td>60</td> </tr> </tbody> </table>	OD(in)	$Q_{max}(t)$	≥ 18 :	250	14 – 18	200	12 – 14	150	10 – 12	100	8 – 10	60
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≥ 18 :	250																			
14 – 18	200																			
12 – 14	150																			
10 – 12	100																			
8 – 10	60																			
Closed-end or H	150	150																		

MAX PILE LOAD

(in tons)

Pile Type	Old Code	New Code
Piles on soft rock	100	80
Piles on Soil	60	75
Timber piles on rock	25	25
Timber piles on soil	30	40, with load test 30, no load test

ALLOWABLE STRESSES

Material	Old Code	New Code
Timber	Class A or B of ASTM D 25	ASTM D 25
Concrete	$f_{all} < 0.25 f_c'$	depends on pile type
Rfmt. Steel	$f_{all} < 0.40 f_y$ $f_y \text{ not } > 30,000 \text{ psi}$	
Steel Piles	$f_{all} < 0.35 f_y$ $f_y \leq 36,000 \text{ psi}$	
Caisson Piles Core Sections	$f_{all} < 0.50 f_y \text{ with}$ $f_y \leq 36,000 \text{ psi}$	

ALLOWABLE STRESSES

Pile Type		New Code
Precast non-prestressed	Concrete	$f_{all} = 0.33 f_c'$
	Steel rfmt.	$f_{all} = 0.40 f_y$ f_y not > 30,000 psi (comp.) $f_{all} = 0.50 f_y$ f_y not > 24,000 psi (tens.)
Precast prestressed		$f_c = 0.33 f_c' - 0.27 f_{pc}$
Structural Steel Piles		$f_{all} = 0.35 f_y$ $f_{all} = 0.5 f_y$ if justified

ALLOWABLE STRESSES

Pile Type		New Code
Enlarged Base	Non Perm. Casing	$f_{all} = 0.25 f_c'$
	Perm. Casing	$f_{all} = 0.33 f_c'$
Drilled Uncased	Concrete	$f_{all} = 0.33 f_c'$
	Steel Rfmt.	$f_{all} = 0.34 f_y$ $f_y \text{ not } > 25,000 \text{ psi}$
Augered Cast-in-place uncased	Concrete	$f_{all} = 0.25 f_c'$
	Steel Rfmt.	$f_{all} = 0.34 f_y$ $f_y \text{ not } > 25,000 \text{ psi}$

ALLOWABLE STRESSES

Pile Type		New Code
Driven uncased		$f_{all} = 0.25 f_c'$
Steel Cased		$f_{all} = 0.33 f_c'$ unless shell meets spec. criteria: $f_{all} = 0.40 f_c'$
Concrete filled steel pipes and tube piles		$f_{all} = 0.33 f_c'$ $f_{all} = 0.35 f_y, f_y < 36,000 \text{ psi}$ $f_{all} = 0.5 f_y, \text{ if load tested}$
Caissons	Concrete	$f_{all} = 0.33 f_c'$
	Steel pipe	$f_{all} = 0.35 f_y$
	Steel core	$f_{all} = 0.50 f_y$

NEW TO THE CODE

Waterproofing / Damproofing Requirements

- Floors / walls below grade require waterproofing and damproofing.
- In hydrostatic conditions, waterproofing by membrane or other approved method.
- Damproofing above water level.
- Alternatives for permanent groundwater pumping and foundation drains are provided.

THIS MAY NOT BE PERMITTED BY DEP



NEW TO THE CODE

- Seismic requirements Section 18 include:
 - new liquefaction screening diagram
 - reinforcing for foundation elements



MISSING FROM NEW CODE

- Bond stress between rock and concrete caisson socket
(previously 200 psi)



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Questions P



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