

INTRODUCTION TO MNBC 2020

PART 4 SOIL AND FOUNDATION

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BEI Seminar

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Introduction to speaker

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Seminar information

- ◉ To introduce new provisions in Part 4: Soil and Foundation of MNBC 2020
- ◉ Target audience: Civil engineering professionals
- ◉ Target level: Awareness
- ◉ Content
 - Introduction to MNBC 2020
 - Key points in all sections 1 to 13 of PART 4: soil & Foundation
 - Detailed information for shallow & deep foundation is excluded for further seminars

MNBC 2020

- Published by MoC
- Revision of MNBC 2016
- Part 3 & Part 4 significantly revised
- Part 4: Soil and Foundation was completely revised by referencing relevant versions of IBC

PART 4: SOIL AND FOUNDATION

Content of Part 4: Soil and Foundation

- 4.1 General
- 4.2 Geotechnical Investigation
- 4.3 Excavation, Grading and Fill
- 4.4 Damp-proofing and Waterproofing
- 4.5 Earth Retaining Systems
- 4.6 Allowable Load Bearing Values of Soil
- 4.7 Footings and Foundations
- 4.8 General Requirements for Pier and Pile Foundations
- 4.9 Driven Pile Foundations
- 4.10 Cast-in-place Concrete Pile Foundations
- 4.11 Composite Piles
- 4.12 Pier Foundations
- 4.13 Other Requirements

4.1 General

- 4.1.1 Scope
- 4.1.2 Referenced codes and standards
- 4.1.3 Design
- 4.1.4 Liquefaction
- 4.1.5 Definitions and notations

○ **Scope & general requirements for geotechnical design**

○ **Referenced code**

- **Main reference: IBC 2006**

The other codes and standards referenced in this PART shall be considered part of the requirements of this code to the prescribed extent of each reference. Version of referenced code or standard shall conform to IBC 2006 unless otherwise specified in this PART. Where conflicts occur between requirements of this PART and referenced codes and standards, the requirements of this PART shall apply.

4.2 Geotechnical investigation

- 4.2.1 General
- 4.2.2 Investigations required
- 4.2.3 Soil classification
- 4.2.4 Investigation
- 4.2.5 Soil boring and sampling
- 4.2.6 Reports

- **Classification & investigation of soil shall be made by registered design professional**
- **Building official need not require geotechnical investigation where satisfactory data from adjacent areas is available that demonstrates an investigation is not necessary**

4.2 Geotechnical investigation

⊙ Investigation required for-

- Questionable soil
- Expansive soils
- Ground-water table
- Pile and pier foundations
- Rock strata
- Seismic design category C
- Seismic design category D, E or F

⊙ Requirements for soil classification

- Definition and classification in accordance with ASTM D 2487
- Criteria for expansive soils

4.2 Geotechnical investigation

- ◎ **Requirements for type, testing program, number, location, depth of investigation**
 - **Type & program determined by registered geotechnical **and/or** design professional in compliance with requirements of concerning building authorities**
 - **Location determined by registered geotechnical **and/or** design professional**
 - **Number**
 1. Minimum of 2 borings for every project.
 2. One boring for every 2500 sq-ft (or 250 sq-m) for built-over area $\leq 10,000$ sq-ft (or 1,000 sq-m).
 3. One additional boring for every extra 5,000 sq-ft (or 500 sq-m) for large area projects $>10,000$ sq-ft (or 1,000 sq-m).
 3. Additional borings for irregular soil conditions as required by design professional and/or concerning building authority.

4.2 Geotechnical investigation

- **Sufficient depth to establish adequate information for the significant soil variation**

1. For shallow foundations, minimum depth of boring shall be larger value of 1.5 times lesser dimension of the shallow foundation or 30ft (10 m).
2. For deep foundations, minimum depth of boring shall be as follows:
 $20 S^{0.7}$ (ft.) or $6 S^{0.7}$ (m) where S = number of storeys including basements.
The boring shall not be terminated until soil layer with 3 consecutive SPT values larger than 100 is encountered.
3. For any type of foundation in seismic design purposes (Seismic Design Categories A to F), minimum depth of boring shall be 100 ft. (or 30 m) to enable proper determination of Site Class in the proposed project.
4. In all cases, depth of boring shall be decided by the requirements of design professional and/or building authority to provide adequate information for design purposes. Boreholes should penetrate more than 5 meters into hard stratum with SPT blow counts of 100 or at least 5 times pile diameter beyond the intended founding level for deep foundations.

- ◎ **Requirements for site investigation report**

4.3 Excavation, grading and fill

- 4.3.1 Excavations near footing or foundations
- 4.3.2 Placement of backfill
- 4.3.3 Site grading
- 4.3.4 Grading and filling in flood hazard areas
- 4.3.5 Compacted fill material
- 4.3.6 Controlled low-strength material

- **Excavation shall not affect lateral support of any footing or foundation w/o prior underpinning or protection**
- **Requirements for backfill & site grading**
- **Requirements for flood hazard areas established in section 3.2.5 of MNBC 2020**
- **Requirements for compacted fill materials & CLSM which bears foundations**

4.4 Damp-proofing and waterproofing

- 4.4.1 General
- 4.4.2 Damp proofing
- 4.4.3 Waterproofing
- 4.4.4 Subsoil drainage system

- **Required for walls and floors below grade**
- **Exception for groups other than residential or institutional occupancy**
- **Subsoil drainage system for lowering groundwater table**
- **Hydrostatic pressure is key factor**
 - No hydrostatic pressure → Damp-proofing
 - Hydrostatic pressure → Water proofing

4.5 Earth retaining systems

- 4.5.1 General
- 4.5.2 Temporary earth retaining systems
 - 4.5.2.1 Temporary earth retaining systems intended to be integrated with permanent structure

- ⦿ **Designed for:**
 - **Overturning/Sliding/Excessive foundation pressure/Uplift**
- ⦿ **Safety factor ≥ 1.5 against overturning & sliding**
- ⦿ **Designed by registered design professional**

4.6 Allowable load bearing values of soil

- 4.6.1 General
- 4.6.2 Presumptive load-bearing values
- 4.6.3 Lateral sliding resistance

- **To be applied unless otherwise specified by concerning authorities**
- **Table 4.6.1 in combination with section 3.2 of MNBC 2020**
- **Higher values must be supported by data and approved**
- **Limitations for weak soils**

4.7 Footings and foundations

- 4.7.1 General
- 4.7.2 Depth of footings
- 4.7.3 Footings on or adjacent to slopes
- 4.7.4 Footings
- 4.7.5 Foundation walls
- 4.7.6 Designs employing lateral bearing
- 4.7.7 Design for expansive soils
- 4.7.8 Seismic requirements

○ **Requirements for shallow foundations**

4.8 General requirements for pier and pile foundation

- ④ 4.8.1 General
- ④ 4.8.2 Special types of piles
- ④ 4.8.3 Pile caps
- ④ 4.8.4 Stability
- ④ 4.8.5 Structural integrity
- ④ 4.8.6 Splices
- ④ 4.8.7 Allowable pier or pile loads
- ④ 4.8.8 Lateral support
- ④ 4.8.9 Use of allowable higher pier or pile stresses
- ④ 4.8.10 Piles in subsiding areas
- ④ 4.8.11 Negative skin friction or down drag force
- ④ 4.8.12 Settlement analysis
- ④ 4.8.13 Pre-excavation

④ **General requirements for deep foundations**

4.8 General requirements for pier and pile foundation

- ④ 4.8.14 Installation sequence
- ④ 4.8.15 Use of vibratory drivers
- ④ 4.8.16 Pile drivability
- ④ 4.8.17 Protection of pile materials
- ④ 4.8.18 Use of existing piers or piles
- ④ 4.8.20 Heaved piles
- ④ 4.8.21 Identification
- ④ 4.8.22 Spacing of piles
- ④ 4.8.23 Special inspection
- ④ 4.8.24 Seismic design of piers or piles

④ **General requirements for deep foundations**

4.9 Driven pile foundations

- 4.9.1 Timber piles
- 4.9.2 Precast concrete piles
- 4.9.3 Structural steel piles

🎯 Requirements for DRIVEN PILES

4.10 Cast-in-place concrete pile foundations

- ◉ 4.10.1 General
- ◉ 4.10.2 Enlarged base piles
- ◉ 4.10.3 Drilled or augured uncased piles
- ◉ 4.10.4 Driven uncased pile
- ◉ 4.10.5 Steel-cased piles
- ◉ 4.10.6 Concrete-filled steel pipe and tube piles
- ◉ 4.10.7 Caisson piles
- ◉ 4.10.8 Micro pile

◉ Requirements for CAST-IN-PLACE PILES

4.11 Composite piles

- 4.11.1 General
- 4.11.2 Design
- 4.11.3 Limitation of load
- 4.11.4 Splices
- 4.11.5 Seismic reinforcement

- **Requirements for COMPOSITE PILES**
- **Designed for condition of installation & authority requirements**
- **Load capacity controlled by weakest section**
- **Requirements for splices!**
- **Refers sections 4.10.1.2.1, 4.10.1.2.2 & 4.10.6.4.1 of MNBC 2020 for seismic reinforcement**

4.12 Pier foundation

- 4.12.1 General
- 4.12.2 Lateral dimensions and height
- 4.12.3 Materials
- 4.12.4 Reinforcement
- 4.12.5 Concrete placement
- 4.12.6 Belled bottoms
- 4.12.7 Masonry
- 4.12.8 Concrete
- 4.12.9 Steel shell
- 4.12.10 Dewatering

- **Requirements for PIER FOUNDATION**
- **Section 4.8 also referred**
- **Minimum dimension = 2 ft. (610 mm)**
- **Height $\leq 12 B$**
(B = least horizontal dimension)
- **$f'_c \geq 2500$ psi**
- **Concrete slump limitation!**
- **Refers IBC 2006, ACI 530, ACI 310-08, sections 4.8.6, 4.8.8 & 4.8.17 of MNBC 2020**

4.13 Other requirements

- ④ 4.13.1 Soil improvement
- ④ 4.13.2 Instrumentation and monitoring

④ **Suitable methods**

④ **Determined by registered geotechnical professional**

Review Questions

Please choose TRUE or FALSE for the following statements)

1. Main reference of MNBC 2020 Part 4 is IBC 2006.
2. Minimum number of site investigation points shall be **TWO**.
3. Minimum depth of boring for **shallow foundations** shall be **1.5B or 30 ft. (10 m) which ever is greater**.
4. Minimum depth of boring for **deep foundations** shall be **$20S^{0.7}$ (ft.) or $6S^{0.7}$ (m)** where S is the number of storeys including basements.
5. For seismic design purposes (Seismic Design Categories A to F), **minimum depth of boring shall be 100 ft. (30 m)**.