

Section 9.15. Footings and Foundations

9.15.1. Application

9.15.1.1. General

(See Notes A-9.15.1.1. and A-9.4.4.6. and 9.15.1.1.)

- 1) Except as provided in Articles 9.15.1.2. and 9.15.1.3., this Section applies to
 - a) concrete or unit masonry *foundation* walls and concrete footings not subject to surcharge
 - i) on stable *soils* with an allowable bearing pressure of 75 kPa or greater, and
 - ii) for *buildings* of wood-frame or masonry construction,
 - b) wood-frame *foundation* walls and wood or concrete footings not subject to surcharge
 - i) on stable *soils* with an allowable bearing pressure of 75 kPa or greater, and
 - ii) for *buildings* of wood-frame construction, and
 - c) flat insulating concrete form *foundation* walls and concrete footings not subject to surcharge (see Note A-9.15.1.1.(1)(c) and 9.20.1.1.(1)(b))
 - i) on stable *soils* with an allowable bearing pressure of 75 kPa or greater, and
 - ii) for *buildings* of light-frame or flat insulating concrete form construction that are not more than 2 *storeys* in *building height*, with a maximum floor to floor height of 3 m, and containing only a single *dwelling unit*.
- 2) *Foundations* for applications other than as described in Sentence (1) shall be designed in accordance with Section 9.4.

9.15.1.2. Permafrost

- 1) *Buildings* erected on permafrost shall have *foundations* designed by a *designer* competent in this field in accordance with the appropriate requirements of Part 4.

9.15.1.3. Foundations for Deformation-Resistant Buildings

- 1) Where the superstructure of a detached *building* conforms to the requirements of the deformation resistance test in CSA Z240.2.1, “Structural Requirements for Manufactured Homes,” the *foundation* shall be constructed in conformance with
 - a) the remainder of this Section, or
 - b) CSA Z240.10.1, “Site Preparation, Foundation, and Anchorage of Manufactured Homes.”

9.15.2. General

9.15.2.1. Concrete

- 1) Concrete shall conform to Section 9.3.

9.15.2.2. Unit Masonry Construction

- 1) Concrete block shall conform to CSA A165.1, “Concrete Block Masonry Units,” and shall have a compressive strength over the average net cross-sectional area of the block of not less than 15 MPa.
- 2) Mortar, grout, mortar joints, corbelling and protection for unit masonry shall conform to Section 9.20.
- 3) For concrete block *foundation* walls required to be reinforced,
 - a) mortar shall be Type S, conforming to CSA A179, “Mortar and Grout for Unit Masonry,”
 - b) grout shall be coarse, conforming to CSA A179, “Mortar and Grout for Unit Masonry,” and
 - c) placement of grout shall conform to CSA A371, “Masonry Construction for Buildings.”

9.15.2.3. Pier-Type Foundations

1) Where pier-type *foundations* are used, the piers shall be designed to support the applied loads from the superstructure.

2) Where piers are used as a *foundation* system in a *building* of 1 storey in *building height*, the piers shall be installed to support the principal framing members and shall be spaced not more than 3.5 m apart along the framing, unless the piers and their footings are designed for larger spacings.

3) The height of piers described in Sentence (2) shall not exceed 3 times their least dimension at the base of the pier.

4) Where concrete block is used for piers described in Sentence (2), they shall be laid with cores placed vertically, and where the width of the *building* is 4.3 m or less, placed with their longest dimension at right angles to the longest dimension of the *building*.

9.15.2.4. Wood-Frame Foundations

1) *Foundations* of wood-frame construction shall conform to

- a) CSA S406, “Permanent Wood Foundations for Housing and Small Buildings,” or
- b) Part 4.

(See Note A-9.15.2.4.(1).)

9.15.3. Footings

9.15.3.1. Footings Required

1) Footings shall be provided under walls, pilasters, columns, piers, fireplaces and *chimneys* that bear on *soil* or *rock*, except that footings may be omitted under piers or monolithic concrete walls if the safe *loadbearing* capacity of the *soil* or *rock* is not exceeded.

9.15.3.2. Support of Footings

1) Footings shall rest on undisturbed *soil*, *rock* or compacted granular *fill*.

2) Granular *fill* shall not contain pyritic material in a concentration that will damage the *building* to a degree that would adversely affect its stability or the performance of assemblies. (See also Article 9.4.4.4. and Note A-9.4.4.4.(1).)

9.15.3.3. Application of Footing Width and Area Requirements

1) Except as provided in Sentence 9.15.3.4.(2), the minimum footing width or area requirements provided in Articles 9.15.3.4. to 9.15.3.7. shall apply to footings, where

- a) the footings support
 - i) *foundation* walls of masonry, concrete, or flat insulating concrete form walls,
 - ii) above-ground walls of masonry, flat insulating concrete form walls or light wood-frame construction, and
 - iii) floors and roofs of light wood-frame construction,
- b) the span of supported joists does not exceed 4.9 m, and
- c) the specified *live load* on any floor supported by the footing does not exceed 2.4 kPa (see Table 4.1.5.3.).

2) Except as provided in Sentence 9.15.3.4.(2), where the span of the supported joists exceeds 4.9 m, footings shall be designed in accordance with Section 4.2.

3) Where the specified *live load* exceeds 2.4 kPa, footings shall be designed in accordance with Section 4.2.

9.15.3.4. Basic Footing Widths and Areas

1) Except as provided in Sentences (2) and (3) and in Articles 9.15.3.5. to 9.15.3.7., the minimum footing width or area shall comply with Table 9.15.3.4.

2) Where the supported joist span exceeds 4.9 m in *buildings* with light wood-frame walls, floors and roofs, footing widths shall be determined according to

- a) Section 4.2., or
- b) the following formula

$$W = w \bullet [\Sigma sjs / (storeys \bullet 4.9)]$$

where

W = minimum footing width,

w = minimum width of footings supporting joists not exceeding 4.9 m, as defined by Table 9.15.3.4.,

Σsjs = sum of the supported joist spans on each *storey* whose load is transferred to the footing, and

storeys = number of *storeys* supported by the footing.

(See Note A-9.15.3.4.(2).)

3) Where a *foundation* rests on gravel, sand or silt in which the water table level is less than the width of the footings below the *bearing surface*,

- a) the footing width for walls shall be not less than twice the width required by Sentences (1) and (2), and Articles 9.15.3.5. and 9.15.3.6., and
- b) the footing area for columns shall be not less than twice the area required by Sentences (1) and (2) and Article 9.15.3.7.

Table 9.15.3.4.
Minimum Footing Sizes
Forming Part of Sentence 9.15.3.4.(1)

No. of Floors Supported	Minimum Width of Strip Footings, mm		Minimum Footing Area for Columns Spaced 3 m o.c., ⁽¹⁾ m ²
	Supporting Exterior Walls ⁽²⁾	Supporting Interior Walls ⁽³⁾	
1	250	200	0.4
2	350	350	0.75
3	450	500	1.0

Notes to Table 9.15.3.4.:

- (1) See Sentence 9.15.3.7.(1).
- (2) See Sentence 9.15.3.5.(1).
- (3) See Sentence 9.15.3.6.(1).

9.15.3.5. Adjustments to Footing Widths for Exterior Walls

- 1)** The strip footing widths for exterior walls shown in Table 9.15.3.4. shall be increased by
 - a) 65 mm for each *storey* of masonry veneer over wood-frame construction supported by the *foundation* wall,
 - b) 130 mm for each *storey* of masonry construction supported by the *foundation* wall, and
 - c) 150 mm for each *storey* of flat insulating concrete form wall construction supported by the *foundation* wall.

9.15.3.6. Adjustments to Footing Widths for Interior Walls

- 1)** The minimum strip footing widths for interior *loadbearing* masonry walls shown in Table 9.15.3.4. shall be increased by 100 mm for each *storey* of masonry construction supported by the footing.
- 2)** Footings for interior non-*loadbearing* masonry walls shall be not less than 200 mm wide for walls up to 5.5 m high and the width shall be increased by 100 mm for each additional 2.7 m of height.

9.15.3.7. Adjustments to Footing Area for Columns

- 1)** The footing area for column spacings other than shown in Table 9.15.3.4. shall be adjusted in proportion to the distance between columns.

9.15.3.8. Footing Thickness

- 1) Footing thickness shall be not less than the greater of
 - a) 100 mm, or
 - b) the width of the projection of the footing beyond the supported element.

9.15.3.9. Step Footings

- 1) Where step footings are used,
 - a) the vertical rise between horizontal portions shall not exceed 600 mm, and
 - b) the horizontal distance between risers shall not be less than 600 mm.

9.15.4. Foundation Walls**9.15.4.1. Permanent Form Material**

- 1) Insulating concrete form units shall be manufactured of polystyrene conforming to the performance requirements of CAN/ULC-S701, “Thermal Insulation, Polystyrene, Boards and Pipe Covering,” for Type 2, 3 or 4 polystyrene.

9.15.4.2. Foundation Wall Thickness and Required Lateral Support

- 1) Except as required in Sentence (2), the thickness of *foundation* walls made of unreinforced concrete block or solid concrete and subject to lateral earth pressure shall conform to Table 9.15.4.2.-A for walls not exceeding 3.0 m in unsupported height.
- 2) The thickness of concrete in flat insulating concrete form *foundation* walls shall be not less than the greater of
 - a) 140 mm, or
 - b) the thickness of the concrete in the wall above.
- 3) *Foundation* walls made of flat insulating concrete form units shall be laterally supported at the top and at the bottom.

Table 9.15.4.2.-A
Thickness of Solid Concrete and Unreinforced Concrete Block Foundation Walls
 Forming Part of Sentence 9.15.4.2.(1)

Type of <i>Foundation</i> Wall	Minimum Wall Thickness, mm	Maximum Height of Finished Ground Above <i>Basement</i> Floor or Crawl Space Ground Cover, m			
		Height of <i>Foundation</i> Wall Laterally Unsupported at the Top ⁽¹⁾⁽²⁾	Height of <i>Foundation</i> Wall Laterally Supported at the Top ⁽¹⁾⁽²⁾		
			≤ 3.0 m	≤ 2.5 m	> 2.5 m and ≤ 2.75 m
Solid concrete, 15 MPa min. strength	150	0.8	1.5	1.5	1.4
	200	1.2	2.15	2.15	2.1
	250	1.4	2.3	2.6	2.5
	300	1.5	2.3	2.6	2.85
Solid concrete, 20 MPa min. strength	150	0.8	1.8	1.6	1.6
	200	1.2	2.3	2.3	2.2
	250	1.4	2.3	2.6	2.85
	300	1.5	2.3	2.6	2.85

Table 9.15.4.2.-A (continued)
Thickness of Solid Concrete and Unreinforced Concrete Block Foundation Walls
 Forming Part of Sentence 9.15.4.2.(1)

Type of <i>Foundation</i> Wall	Minimum Wall Thickness, mm	Maximum Height of Finished Ground Above <i>Basement</i> Floor or Crawl Space Ground Cover, m			
		Height of <i>Foundation</i> Wall Laterally Unsupported at the Top ⁽¹⁾⁽²⁾	Height of <i>Foundation</i> Wall Laterally Supported at the Top ⁽¹⁾⁽²⁾		
			≤ 3.0 m	≤ 2.5 m	> 2.5 m and ≤ 2.75 m
Unreinforced concrete block	140	0.6	0.8	—	—
	190	0.9	1.2	(3)	(3)
	240	1.2	1.8	(3)	(3)
	290	1.4	2.2	—	—

Notes to Table 9.15.4.2.-A:

- (1) See Article 9.15.4.3.
 (2) See Article 9.15.4.6.
 (3) See Table 9.15.4.2.-B.

- 4)** The thickness and reinforcing of *foundation* walls made of reinforced concrete block and subject to lateral earth pressure shall conform to Table 9.15.4.2.-B and Sentences (5) to (8), where
- the walls are laterally supported at the top,
 - average stable *soils* are encountered, and
 - wind loads on the exposed portion of the *foundation* are no greater than 0.70 kPa.
- 5)** For concrete block walls required to be reinforced, continuous vertical reinforcement shall
- be provided at wall corners, wall ends, wall intersections, at changes in wall height, at the jambs of all openings and at movement joints,
 - extend from the top of the footing to the top of the *foundation* wall, and
 - where *foundation* walls are laterally supported at the top, have not less than 50 mm embedment into the footing, if the floor slab does not provide lateral support at the wall base.
- 6)** For concrete block walls required to be reinforced, a continuous horizontal bond beam containing not less than one 15M bar shall be installed
- along the top of the wall,
 - at the sill and head of all openings greater than 1.20 m in width, and
 - at structurally connected floors.

Table 9.15.4.2.-B
Reinforced Concrete Block Foundation Walls Laterally Supported at the Top⁽¹⁾
 Forming Part of Sentence 9.15.4.2.(4)

Maximum Height of Finished Ground Above <i>Basement</i> Floor or Crawl Space Ground Cover, m ⁽²⁾	Size and Spacing of Continuous Vertical Reinforcement, M at mm o.c.					
	190 mm Minimum Wall Thickness			240 mm Minimum Wall Thickness		
	<i>Foundation</i> Wall Height			<i>Foundation</i> Wall Height		
	≤ 2.5 m	≤ 2.75 m	≤ 3.0 m	≤ 2.5 m	≤ 2.75 m	≤ 3.0 m
0.8	(3)	(3)	(3)	(3)	(3)	(3)
1	(3)	1-15M at 1 800	1-15M at 1 800	(3)	(3)	(3)
1.2	(3)	1-15M at 1 600	1-15M at 1 600	(3)	1-20M at 2 000	1-20M at 2 000
1.4	1-15M at 1 600	1-15M at 1 600	1-15M at 1 600	(3)	1-20M at 1 800	1-20M at 1 800
1.6	1-15M at 1 400	1-15M at 1 400	1-15M at 1 400	(3)	1-20M at 1 600	1-20M at 1 600
1.8	1-15M at 1 400	1-15M at 1 400	1-15M at 1 200	(3)	1-20M at 1 600	1-20M at 1 600

Table 9.15.4.2.-B (continued)
Reinforced Concrete Block Foundation Walls Laterally Supported at the Top⁽¹⁾
 Forming Part of Sentence 9.15.4.2.(4)

Maximum Height of Finished Ground Above Basement Floor or Crawl Space Ground Cover, m ⁽²⁾	Size and Spacing of Continuous Vertical Reinforcement, M at mm o.c.					
	190 mm Minimum Wall Thickness			240 mm Minimum Wall Thickness		
	Foundation Wall Height			Foundation Wall Height		
	≤ 2.5 m	≤ 2.75 m	≤ 3.0 m	≤ 2.5 m	≤ 2.75 m	≤ 3.0 m
2	1-15M at 1 200	1-15M at 1 000 or 1-20M at 1 200	2-15M at 1 200	1-20M at 1 600	1-20M at 1 600	1-20M at 1 600
2.2	2-15M at 1 200	2-15M at 1 000	2-15M at 1 000	1-20M at 1 400	1-20M at 1 400	1-20M at 1 400
2.4	2-15M at 1 000	2-15M at 1 000	2-15M at 800	1-20M at 1 400	1-20M at 1 400	1-20M at 1 200
2.6	n/a	2-15M at 800 or 1-25M at 1 000	2-15M at 800 or 1-25M at 1 000	n/a	1-20M at 1 000	1-20M at 1 000
2.8	n/a	n/a	1-20M at 600	n/a	n/a	1-20M at 800 or 2-15M at 1 000
3	n/a	n/a	1-20M at 400 or 1-25M at 600	n/a	n/a	2-15M at 800

Notes to Table 9.15.4.2.-B:

- (1) See Article 9.15.4.3.
 (2) See Article 9.15.4.6.
 (3) No reinforcement required.

7) In concrete block walls required to be reinforced, all vertical bar reinforcement shall be installed along the centre line of the wall.

8) In concrete block walls required to be reinforced, ladder- or truss-type lateral reinforcement not less than 3.8 mm in diameter (no. 9 ASWG) shall be installed in the bed joint of every second masonry course.

9.15.4.3. Foundation Walls Considered to be Laterally Supported at the Top

- 1)** Sentences (2) to (4) pertain to lateral support for walls described in Sentence 9.15.4.2.(1).
- 2)** *Foundation* walls shall be considered to be laterally supported at the top if
 - a) such walls support a *solid masonry* superstructure,
 - b) the floor joists are embedded in the top of the *foundation* walls, or
 - c) the floor system is anchored to the top of the *foundation* walls with anchor bolts, in which case the joists may run either parallel or perpendicular to the *foundation* walls.
- 3)** Unless the wall around an opening is reinforced to withstand earth pressure, the portion of the *foundation* wall beneath an opening shall be considered laterally unsupported if
 - a) the opening is more than 1.2 m wide, or
 - b) the total width of the openings in the *foundation* wall constitutes more than 25% of the length of the wall.
- 4)** For the purposes of Sentence (3), the combined width of the openings shall be considered as a single opening if the average width is greater than the width of solid wall between them.
- 5)** Flat insulating concrete form *foundation* walls shall be considered to be laterally supported at the top if the floor joists are installed according to Article 9.20.17.5.

9.15.4.4. Foundation Walls Considered to be Laterally Supported at the Bottom

1) Flat insulating concrete form *foundation* walls shall be considered to be laterally supported at the bottom where the *foundation* wall

- a) supports backfill not more than 1.2 m in height,
- b) is supported at the footing by a shear key and at the top by the ground floor framing, or
- c) is doweled to the footing with not less than 15M bars spaced not more than 1.2 m o.c.

9.15.4.5. Reinforcement for Flat Insulating Concrete Form Foundation Walls

1) Horizontal reinforcement in flat insulating concrete form *foundation* walls shall

- a) consist of
 - i) one 10M bar placed not more than 300 mm from the top of the wall, and
 - ii) 10M bars at 600 mm o.c., and
- b) be located
 - i) in the inside half of the wall section, and
 - ii) with a minimum cover of 30 mm from the inside face of the concrete.

2) Vertical reinforcement in flat insulating concrete form *foundation* walls shall be

- a) provided in accordance with
 - i) Table 9.15.4.5.-A for 140 mm walls,
 - ii) Table 9.15.4.5.-B for 190 mm walls, and
 - iii) Table 9.15.4.5.-C for 240 mm walls,
- b) located in the inside half of the wall section with a minimum cover of 30 mm from the inside face of the concrete wall, and
- c) where interrupted by wall openings, placed not more than 600 mm from each side of the openings.

3) Cold joints in flat insulating concrete form *foundation* walls shall be reinforced with no less than one 15M bar spaced at not more than 600 mm o.c. and embedded 300 mm on both sides of the joint.

4) Reinforcing around openings in flat insulating concrete form *foundation* walls shall comply with Article 9.20.17.3. or 9.20.17.4.

Table 9.15.4.5.-A
Vertical Reinforcement for 140 mm Flat Insulating Concrete Form Foundation Walls
 Forming Part of Sentence 9.15.4.5.(2)

Max. Height of Finished Ground Above Finished Basement Floor, m	Minimum Vertical Reinforcement		
	Maximum Unsupported Basement Wall Height		
	2.44 m	2.75 m	3.0 m
1.35	10M at 400 mm o.c.	10M at 400 mm o.c.	10M at 400 mm o.c.
1.6	10M at 400 mm o.c.	10M at 380 mm o.c.	10M at 380 mm o.c.
2	10M at 380 mm o.c.	10M at 380 mm o.c.	10M at 380 mm o.c.
2.2	10M at 250 mm o.c.	10M at 250 mm o.c.	10M at 250 mm o.c.
2.35	n/a	10M at 250 mm o.c.	10M at 250 mm o.c.
2.6	n/a	10M at 250 mm o.c.	10M at 250 mm o.c.
3	n/a	n/a	15M at 250 mm o.c.

Table 9.15.4.5.-B
Vertical Reinforcement for 190 mm Flat Insulating Concrete Form Foundation Walls
 Forming Part of Sentence 9.15.4.5.(2)

Max. Height of Finished Ground Above Finished Basement Floor, m	Minimum Vertical Reinforcement		
	Maximum Unsupported <i>Basement</i> Wall Height		
	2.44 m	2.75 m	3.0 m
2.2	None required	10M at 400 mm o.c.	10M at 400 mm o.c.
2.35	n/a	10M at 300 mm o.c.	10M at 300 mm o.c.
2.6	n/a	10M at 300 mm o.c.	15M at 400 mm o.c.
3.0	n/a	n/a	15M at 400 mm o.c.

Table 9.15.4.5.-C
Vertical Reinforcement for 240 mm Flat Insulating Concrete Form Foundation Walls
 Forming Part of Sentence 9.15.4.5.(2)

Max. Height of Finished Ground Above Finished <i>Basement</i> Floor, m	Minimum Vertical Reinforcement		
	Maximum Unsupported <i>Basement</i> Wall Height		
	2.44 m	2.75 m	3.0 m
2.2	None required	None required	None required
2.6	n/a	15M at 400 mm o.c.	15M at 400 mm o.c.
3.0	n/a	n/a	15M at 400 mm o.c.

9.15.4.6. Extension above Ground Level

- 1) Exterior *foundation* walls shall extend not less than 150 mm above finished ground level.

9.15.4.7. Reduction in Thickness

- 1) Where the top of a *foundation* wall is reduced in thickness to permit the installation of floor joists, the reduced section shall be not more than 350 mm high and not less than 90 mm thick.
- 2) Where the top of a *foundation* wall is reduced in thickness to permit the installation of a masonry exterior facing, the reduced section shall be
 - a) not less than 90 mm thick, and
 - b) tied to the facing material with metal ties conforming to Sentence 9.20.9.4.(3) spaced not more than
 - i) 200 mm o.c. vertically, and
 - ii) 900 mm o.c. horizontally.
- 3) The space between wall and facing described in Sentence (2) shall be filled with mortar.

9.15.4.8. Corbelling

- 1) Corbelling of masonry *foundation* walls supporting *cavity walls* shall conform to Article 9.20.12.2.

9.15.4.9. Crack Control Joints

- 1) Crack control joints shall be provided in *foundation* walls more than 25 m long at intervals of not more than 15 m.
- 2) Joints required in Sentence (1) shall be designed to resist moisture penetration and shall be keyed to prevent relative displacement of the wall portions adjacent to the joint.

9.15.4.10. Interior Masonry Walls

- 1) Interior masonry *foundation* walls not subject to lateral earth pressure shall conform to Section 9.20.

9.15.5. Support of Joists and Beams on Masonry Foundation Walls

9.15.5.1. Support of Floor Joists

1) Except as permitted in Sentence (2), *foundation* walls of hollow masonry units supporting floor joists shall be capped with

- a) not less than 50 mm of concrete,
- b) *solid masonry units* that are 100% solid and not less than 50 mm high, or
- c) *semi-solid or hollow solid masonry units* that have the top course completely filled with mortar, grout or concrete.

2) Capping required in Sentence (1) need not be provided

- a) in localities where termites are not known to occur,
- b) when the joists are supported on a wood plate not less than 38 mm by 89 mm, and
- c) when the siding overlaps the *foundation* wall not less than 12 mm.

9.15.5.2. Support of Beams

1) Not less than 190 mm depth of *solid masonry* shall be provided beneath beams supported on masonry.

2) Where the beam referred to in Sentence (1) is supported below the top of the *foundation* walls, the ends of such beams shall be protected from the weather.

9.15.5.3. Pilasters

1) Pilasters shall be provided under beams that frame into unit masonry *foundation* walls 140 mm or less in thickness.

2) Pilasters required in Sentence (1) shall be not less than 90 mm by 290 mm and shall be bonded or tied into the wall.

3) The top 200 mm of pilasters required in Sentence (1) shall be *solid masonry* with the cells of hollow or semi-solid units filled with mortar, grout or concrete.

9.15.6. Parging and Finishing of Masonry Foundation Walls

9.15.6.1. Foundation Walls below Ground

1) Concrete block *foundation* walls shall be parged on the exterior face below ground level as required in Section 9.13.

9.15.6.2. Foundation Walls above Ground

1) Exterior surfaces of concrete block *foundation* walls above ground level shall have tooled joints, or shall be parged or otherwise suitably finished.

9.15.6.3. Form Ties

1) All form ties shall be removed at least flush with the concrete surface.