TACOMA ENGINEERS

Design Limitations and Tables for Above and Below Grade Walls

TACOMA ENGINEERS

Design Limitations / Installation Conditions

Introduction

The structural wall reinforcing and lintel design tables contained within Appendix D and E of NUDURA's Installation Manual have been prepared consistent with the design principals and practices that have been applied throughout the North American ICF industry for prescriptive design of insulated concrete form walls. The intent of these specific tables is to enable design and building reviewing professionals to competently determine reinforcement requirements for walls specifically constructed using the NUDURA Integrated Building Technology Insulated Concrete Form System™. For this reason, reinforcement specifications may vary slightly from generic reinforcement configurations that may be specified within the IRC 2000 or 2003 (USA) or the NBCC 2005 (Canada) as the design reflects the specific geometry and reinforcement capabilities that are unique to the NUDURA Wall System .

Design - General

1. These tables apply to residential buildings ONLY that conform to the requirements of the appropriate building codes or design guides that are already recognized within the official American and Canadian product evaluation reports produced for NUDURA Corporation. It is assumed that construction will comply with the appropriate, local building codes, which may include:

- USA: Chapters R404 and R611 of the International Residential Codes (2000 and 2003).
- USA: EB 118: "Prescriptive Requirements for Insulating Concrete Forms in Residential Construction, 2nd Edition" published by the Portland Cement Association
- Canada: Part 9 of the National Building Code of Canada.

TACOMA ENGINEERS

NOTE: If the proposed construction does not meet the design or applicability parameters noted herein, a local design professional shall be retained to prepare the design in accordance with applicable standards.

2. These tables have been designed to resist gravity, wind, and earthquake forces, as stated in accordance with the National Building Code of Canada, along with the design loads and factors that are indicated in Notes 3 & 4 and within the structural tables contained in this appendix.

3. The following maximum UNFACTORED loads were assumed in the design of the structural tables featured in this appendix:

   A) Roof Snow Load (Live) = 84 psf (4.0 kPa)
   B) Main Floor Occupancy Load (Live) = 40 psf (1.9 kPa)
   C) Second Floor Occupancy Load (Live) = 30 psf (1.4 kPa)
   D) Roof and Floor Load (Dead) = 15 psf (0.7 kPa)
   E) Soil Surcharge (Live) = 50 psf (2.4 kPa)
   F) Concrete Density (Dead) = 150 lb/ft^3 (23.6 kN/m^3)
   G) Brick Density (Dead) = 128 lb/ft^3 (20.0 kN/m^3)

4. The loads given for equivalent fluid density (live load) in the below grade tables of this appendix are also noted to be UNFACTORED and are also assumed in the design along with the un-factored loads stated in Note 3.

5. Seismic Data and Factors (NOTE Seismic Factors are expressed per Canadian Code Standards).
   i. Seismic Zonal Velocity Ratio:
      a) Seismic Zones 0-1: v = 0.05
      b) Seismic Zones 2-4: v = 0.20
      c) Seismic Zones 5-6: v = 0.40
   ii. Foundation Factor, F = 1.5
   iii. Force Modification Factor, R = 1.5

6. Design assumes that ALL walls are laterally supported by building foundation, roof and floor systems, designed by others.

TACOMA ENGINEERS

7. Design assumes that deflection is limited to L/360.

8. Foundation wall backfill has been designed for maximum allowable surcharge of 50 psf (2.4 kPa) with a horizontal soil coefficient, k_o = 0.5.

9. Foundation walls have been designed for an equivalent fluid density backfill pressure, and therefore have been designed with a horizontal soil coefficient, ka = 1.0.

10. Design assumes that the reinforcing steel will be deformed rebar, placed in accordance with the manuals of standard practice for either the USA or Canada and shall be supplied at the following yield strengths:
    - USA: 60,000 ksi
    - CAN: Grade 400 (400 mPa)

11. Design also assumes that the minimum 28 day compressive strength of concrete used in the installation shall be 3000 psi (20 MPa).

12. All walls shall be proportionally and evenly distributed in both the transverse and longitudinal directions of the building

Design Limitations

13. The following maximum building dimensions are permitted for use:

    A) Building Length = 80 ft (24.4 m)
    B) Building Width = 40 ft (12.2 m)

14. Design is limited to 1 floor below grade and a maximum of 2 storeys above grade.

15. Maximum height of all above grade second floor walls and all above grade 4" (100 mm) walls is 10 ft. (3.05m).

TACOMA ENGINEERS

16. Maximum height of above grade 6" (150 mm) and 8" (200 mm) main floor walls is 16 ft. (4.88 m).

17. Maximum height of foundation walls = 12 ft (3.66 m).

18. Maximum floor clear span = 24 ft. (7.32 m).

19. Maximum roof clear span = 40 ft. (12.2 m).

20. It is the responsibility of the roof or floor designer to ensure adequate bearing for all framing members is provided on the concrete walls.

Use of Design Tables- Specific Notes Re. Vertical & Horizontal Steel Specification

General

21. Height of foundation wall is defined as "the distance from the top of the basement floor slab to the point of bearing for the floor system".

22. Backfill height is defined as "the distance from the top of the basement floor slab to the finished exterior grade level".

23. For walls below grade, vertical reinforcing shall be placed at 38mm (1½") from interior face of forms (to the tension side of the wall).

24. Interpolation between backfill heights and soil equivalent fluid density is not permitted.

25. For walls above grade, vertical reinforcing shall be placed at the middle (or center axis) of the wall.

26. Horizontal reinforcing to consist of 10M continuous bars at 457mm (18") o.c., plus one 10M continuous bar 150mm (6") from the top of wall and at floor levels.

TACOMA ENGINEERS

27. With respect to vertical reinforcing specifications, in some cases, spacing of wall vertical wall reinforcing in the design tables of this appendix may exceed minimum requirements according to Clause 14.3 of CSA A23.3 (Canada), where maximum stress does not exceed 67% of the reinforced wall's capacity. Horizontal temperature and shrinkage steel is also set at # 4 (10M) horizontal bars @ 18" (457 mm) o.c. for wall thicknesses up to 8" (203 mm). This is due to ideal curing conditions within the NUDURA ICF system, which reduce the risk of cracking. Also, since finishes are not applied directly to the concrete wall, the risk of potential cracks propagating to the surface of the finishes is minimized.

Furthermore, testing conducted by the Portland Cement Association demonstrated that the strength of reinforced concrete walls could be predicted using conventional reinforced concrete equations with reinforcing spacing of up to 4'-0" (1.22 m) o.c.

Rules for Reinforcement at Openings

28. In addition to the wall reinforcing indicated with the design table of this appendix, a minimum of 2- #4 (10M) bars shall be installed at both sides of all openings in concrete, maintaining a minimum cover of 2" (50 mm). Bars shall extend vertically for the full height of the wall pour, as shown in drawing L1 located within the Design Limitations document for concrete lintels. Vertical bars shall be installed with adequate splices at construction joints. 2 -#4 (10M) bars shall also be installed at base of opening - again extending bars a minimum of 24" (610) mm beyond both sides of the opening.

29. For foundation walls, the length of solid wall between two openings should be equal to the average width of the openings and shall be no less than a minimum of 4'-0" (1.22m).

30. Openings in a foundation wall shall not exceed a maximum width of 6'-0" (1.83m).

TACOMA ENGINEERS

31. For sections of wall between openings conforming to Note 29 above, the spacing of the vertical reinforcing must be decreased in these walls by a factor as calculated within the following formula:

$$\frac{\text{width of wall between openings}}{\text{(width of wall between openings + average width of the two openings)}}.$$

32. Where there is only a single opening in a length of wall, or if the length of wall between openings exceeds 10ft (3.05m), the spacing of the vertical reinforcing indicated within the structural tables of this appendix shall be cut in half for a distance equal to half the opening width on each side of the opening.

33. If the spacing of the wall vertical reinforcing required between or on each side of openings is determined by factor calculations per notes 31 and 32 to be less than 4" (100mm), a local design professional shall be retained to prepare the design in accordance with applicable standards.

Minimum Shear Wall Lengths

34. A minimum length of solid concrete shear wall without openings is required in each building direction. The following table indicates the minimum solid shear wall lengths without openings as either two solid wall sections within the length of a wall, or one solid wall section within the length of the wall.

Seismic Zone	One Storey Concrete Structure or Top Floor of 2 Storey Concrete Structure	Lower Floor of 2 Storey Concrete Structure
Za or Zv ≤ 1	2 - 6'-6" Solid Wall Lengths or a Single 9'-6" Wall Length	2 - 10'-0" Solid Wall Lengths or a Single 15'-0" Wall Length
Za or Zv ≥ 2 & ≤ 4	2 - 15'-0" Solid Wall Lengths or a Single 21'-6" Wall Length	2 - 16'-0" Solid Wall Lengths or a Single 24'-0" Wall Length
Za or Zv ≥ 5	2 - 16'-0" Solid Wall Lengths or a Single 24'-0" Wall Length	2 - 18'-6" Solid Wall Lengths or a Single 26'-0" Wall Length

35. For residential buildings with a square footage less than 2500 ft², the minimum shear wall lengths indicated in the table above may be reduced by a factor equal to the residential building area, divided by 2500 ft². However, in no instance shall the

minimum shear wall length be reduced to less than 2 - 6'-6" solid wall lengths or a single 9'-6" wall length.

Point Loads

36. All point loads, such as concentrated loads created by girder trusses, columns and beams, shall bear directly on top of the concrete wall, and shall not be hung or in any other manner create an eccentric loading on the concrete wall.

37. The minimum length of solid wall without openings directly below point loads, such as concentrated loads created by girder trusses, columns and beams, shall be 6'-0 (1.83 m). In addition to the wall reinforcing required within the structural tables of this appendix, two additional #5 (15M) vertical bars shall be installed directly below the point load.

Reinforcement at Corners

38. Two full height vertical bar, equal to the vertical reinforcing within the wall system, is to be installed at all corners.

Installation

General

39. The design and construction of all work on site shall conform to the latest editions of the applicable building codes for the region where installation is taking place, including local applicable code regulations and bylaws as well as all applicable health and safety regulations.

Footing Reinforcement

40. Strip footings (or thickened edge slabs) are to be fitted with dowels to provide connection between the footing and the wall cavity. Dowels shall be minim #5 (15M) bars x 20" (500 mm) long to be installed along the center axis of the strip

footings at 4'-0" (1.22 m) o.c. with a minimum projection into the wall cavity of 8" (203 mm).

General Reinforcement Installation

41. Reinforcement placement must be in accordance with the specified design as per these notes and drawings produced in accordance with the NUDURA Structural Tables contained in Appendices D & E.

42. Minimum bar lap length shall be:
    A) 18" (450 mm) for #4 (10M) bars
    B) 26" (650 mm) for #5 (15M) bars
    C) 30" (750 mm) for #6 (20M) bars

Concrete Placement

43. Concrete work shall conform to the latest editions of the following standards for materials and workmanship:

    i. USA: ACI 318
    ii. CAN: C.S.A. A23.1,2,3.

44. Construction joints shall be made and located so as not to impair the strength of the structure. All specified reinforcing bars shall have minimum lap lengths across all construction joints.

45. The contractor shall employ high frequency vibration to place all concrete.

46. Concrete pours shall be terminated at locations of lateral support, such as provided by roof and floor systems.

Protection of Structure During Installation

47. Adequate frost protection shall be provided for all foundation walls and footings both during construction and in the final installation.

TACOMA ENGINEERS

48. The contractor shall make adequate provision to protect concrete from exposure to freezing temperatures and precipitation at least seven days after concrete placement.

49. NOTE: Hydrostatic pressure due to water build-up has not been included in the design and analysis. Backfill shall be drained in accordance with the following Code Requirements:
    - CAN: N.B.C.C. 1995 Section 9.4.4.6.

50. Walls shall be laterally supported at top and bottom prior to backfilling.

51. Surface grading around the foundation shall be sloped away from building to allow surface runoff to drain away.

52. The contractor shall make adequate provision for construction loads and temporary bracing to keep structure plumb and in true alignment at all phases of construction.

53. All work shall conform to the latest editions of ANY of the following codes and standards that are deemed applicable for your region:

    USA:
    - International Residential Code 2000 or 2003
    - BOCA National Building Code 1999
    - Standard Building Code 1999
    - Uniform Building Code 1997
    - Florida Building Code 2001 or 2004
    - Other local State or regional building code, local regulations and bylaws
    - Occupational Safety and Health Association Regulations (OSHA).

    CAN:
    - National Building Code of Canada 1995 or 2005
    - Other local Provincial or regional building code, local regulations and bylaws
    - Workplace and Hazardous Material Health and Safety (WHMS) & Ontario Ministry of Labour Safety Regulations.

TACOMA ENGINEERS

NUDURA INTEGRATED BUILDING TECHNOLOGY Building Value.

LICENSED PROFESSIONAL ENGINEER D.J. TACOMA 45409505 MAR 2 2 2006 PROVINCE OF ONTARIO

Tacoma Engineers Inc.
176 Speedvale Avenue West
Guelph, Ontario, N1H 1C3
Telephone: (519) 763-2000
Fax: (519) 824-2000
Web: www.tacomaengineers.com

Vertical Steel Reinforcement for Below-Grade Walls in Seismic Zones 0-1 Built with NUDURA™ Insulated Forms (Imperial)

Wall Height ft	Backfill Height ft	Vertical Reinforcement						Horizontal Steel Reinforcement
		Free Draining Backfill Soil Type (Maximum Equivalent Fluid Density)						
		Sand & Gravel 30 pcf		Sand, Gravel with Silt or Clay 45 pcf		Inorganic Silt or Clay 60 pcf		All Soils
		6" Wall	8" Wall	6" Wall	8" Wall	6" Wall	8" Wall	All Wall Thicknesses
8.0	4.0	See Note 2	See Note 2	See Note 2	See Note 2	See Note 2	See Note 2	#4 @ 18"
	5.0	See Note 2	See Note 2	#4 @ 16 in	See Note 2	#4 @ 16 in	See Note 2	#4 @ 18"
	6.0	#4 @ 16 in	See Note 2	#4 @ 16 in	See Note 2	#4 @ 16 in	#5 @ 24 in	#4 @ 18"
	7.0	#4 @ 16 in	See Note 2	#5 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 16 in	#4 @ 18"
9.0	4.0	#4 @ 32 in	#4 @ 32 in	#4 @ 24 in	#4 @ 32 in	#4 @ 16 in	#4 @ 24 in	#4 @ 18"
	5.0	#4 @ 16 in	#4 @ 24 in	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#4 @ 18"
	6.0	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 24 in	#4 @ 18"
	7.0	#4 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 16 in	#4 @ 18"
	8.0	#5 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 16 in	#5 @ 8 in	#5 @ 16 in	#4 @ 18"
10.0	4.0	#4 @ 24 in	#4 @ 32 in	#4 @ 24 in	#4 @ 32 in	#4 @ 16 in	#4 @ 24 in	#4 @ 18"
	5.0	#4 @ 16 in	#4 @ 24 in	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#4 @ 18"
	6.0	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 24 in	#4 @ 18"
	7.0	#4 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 16 in	-	#5 @ 16 in	#4 @ 18"
	8.0	#5 @ 16 in	#5 @ 24 in	-	#5 @ 16 in	-	#5 @ 16 in	#4 @ 18"
	9.0	#5 @ 16 in	#5 @ 16 in	-	#5 @ 16 in	-	#5 @ 16 in	#4 @ 18"
12.0	4.0	#4 @ 24 in	#4 @ 32 in	#4 @ 16 in	#4 @ 32 in	#4 @ 16 in	#4 @ 24 in	#4 @ 18"
	5.0	#4 @ 16 in	#4 @ 24 in	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#5 @ 24 in	#4 @ 18"
	6.0	#4 @ 16 in	#4 @ 16 in	#5 @ 16 in	#5 @ 24 in	-	#5 @ 24 in	#4 @ 18"
	7.0	#5 @ 16 in	#5 @ 24 in	-	#5 @ 16 in	-	#5 @ 24 in	#4 @ 18"
	8.0	-	#5 @ 16 in	-	#5 @ 16 in	-	#5 @ 16 in	#4 @ 18"
	9.0	-	#5 @ 16 in	-	#5 @ 16 in	-	#5 @ 8 in	#4 @ 18"
	10.0	-	#5 @ 16 in	-	#5 @ 8 in	-	#5 @ 8 in	#4 @ 18"
	11.0	-	#5 @ 16 in	-	#5 @ 8 in	-	-	#4 @ 18"

Note:

1. **This table is to be used in conjunction with "Design Limitations" and "Structural Engineering Analysis Report" prepared by Tacoma Engineers Inc**
2. As per Part 9 of the National Building Code, for the wall and backfill height noted an unreinforced wall with f'c = 20 Mpa is adequate.
3. Refer to Design Limitations for info on construction methods, material specs, design loads, additional wall reinforcing around openings, min. wall length, etc.

D TABLE D-2 REINFORCEMENT FOR BELOW GRADE WALLS
(SEISMIC ZONES 0-1) (METRIC)

TACOMA ENGINEERS

NUDURA INTEGRATED BUILDING TECHNOLOGY Building Value.

Tacoma Engineers Inc.
76 Speedvale Avenue West
Guelph, Ontario, N1H 1C3
Telephone: (519) 763-2000
Fax: (519) 824-2000
Web: www.tacomaengineers.com

LICENSED PROFESSIONAL ENGINEER D.J. TACOMA 45409505 MAR 22 2006 PROVINCE OF ONTARIO

Vertical Steel Reinforcement for Below-Grade Walls in Seismic Zones 0-1 Built with NUDURA™ Insulated Forms (Metric)

Wall Height ft (m)	Backfill Height ft (m)	Vertical Reinforcement						Horizontal Steel Reinforcement
		Free Draining Backfill Soil Type (Maximum Equivalent Fluid Density)						
		Sand & Gravel 30 pcf (480 kg/m^3)		Sand, Gravel with Silt or Clay 45 pcf (720 kg/m^3)		Inorganic Silt or Clay 60 pcf (960 kg/m^3)		All Soils
		6" (150 mm) Wall	8" (200 mm) Wall	6" (150 mm) Wall	8" (200 mm) Wall	6" (150 mm) Wall	8" (200 mm) Wall	All Wall Thicknesses
8.0 (2.44)	4.0 (1.22)	See Note 2	See Note 2	See Note 2	See Note 2	See Note 2	See Note 2	10M @ 18" (457)
	5.0 (1.53)	See Note 2	See Note 2	10M @ 400 (16)	See Note 2	10M @ 400 (16)	See Note 2	10M @ 18" (457)
	6.0 (1.83)	10M @ 400 (16)	See Note 2	10M @ 400 (16)	See Note 2	10M @ 400 (16)	15M @ 600 (24)	10M @ 18" (457)
	7.0 (2.13)	10M @ 400 (16)	See Note 2	15M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 400 (16)	10M @ 18" (457)
9.0 (2.74)	4.0 (1.22)	10M @ 800 (32)	10M @ 800 (32)	10M @ 600 (24)	10M @ 800 (32)	10M @ 400 (16)	10M @ 600 (24)	10M @ 18" (457)
	5.0 (1.53)	10M @ 400 (16)	10M @ 600 (24)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	10M @ 18" (457)
	6.0 (1.83)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 600 (24)	10M @ 18" (457)
	7.0 (2.13)	10M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 400 (16)	10M @ 18" (457)
	8.0 (2.44)	15M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 400 (16)	15M @ 200 (8)	15M @ 400 (16)	10M @ 18" (457)
10.0 (3.05)	4.0 (1.22)	10M @ 600 (24)	10M @ 800 (32)	10M @ 600 (24)	10M @ 800 (32)	10M @ 400 (16)	10M @ 600 (24)	10M @ 18" (457)
	5.0 (1.53)	10M @ 400 (16)	10M @ 600 (24)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	10M @ 18" (457)
	6.0 (1.83)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 600 (24)	10M @ 18" (457)
	7.0 (2.13)	10M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 400 (16)	-	15M @ 400 (16)	10M @ 18" (457)
	8.0 (2.44)	15M @ 400 (16)	15M @ 600 (24)	-	15M @ 400 (16)	-	15M @ 400 (16)	10M @ 18" (457)
	9.0 (2.74)	15M @ 400 (16)	15M @ 400 (16)	-	15M @ 400 (16)	-	15M @ 400 (16)	10M @ 18" (457)
12.0 (3.66)	4.0 (1.22)	10M @ 600 (24)	10M @ 800 (32)	10M @ 400 (16)	10M @ 800 (32)	10M @ 400 (16)	10M @ 600 (24)	10M @ 18" (457)
	5.0 (1.53)	10M @ 400 (16)	10M @ 600 (24)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	15M @ 600 (24)	10M @ 18" (457)
	6.0 (1.83)	10M @ 400 (16)	10M @ 400 (16)	15M @ 400 (16)	15M @ 600 (24)	-	15M @ 600 (24)	10M @ 18" (457)
	7.0 (2.13)	15M @ 400 (16)	15M @ 600 (24)	-	15M @ 400 (16)	-	15M @ 600 (24)	10M @ 18" (457)
	8.0 (2.44)	-	15M @ 400 (16)	-	15M @ 400 (16)	-	15M @ 400 (16)	10M @ 18" (457)
	9.0 (2.74)	-	15M @ 400 (16)	-	15M @ 400 (16)	-	15M @ 200 (8)	10M @ 18" (457)
	10.0 (3.05)	-	15M @ 400 (16)	-	15M @ 200 (8)	-	15M @ 200 (8)	10M @ 18" (457)
	11.0 (3.35)	-	15M @ 400 (16)	-	15M @ 200 (8)	-	-	10M @ 18" (457)

Note:

1. **This table is to be used in conjunction with "Design Limitations" and "Structural Engineering Analysis Report" prepared by Tacoma Engineers Inc.**
2. As per Part 9 of the National Building Code, for the wall and backfill height noted an unreinforced wall with f'c = 20 Mpa is adequate.
3. Refer to Design Limitations for info on construction methods, material specs, design loads, additional wall reinforcing around openings, min. wall length, etc.
4. Vertical wall steel spacing indicated in mm (in).

D TABLE D-3 REINFORCEMENT FOR BELOW GRADE WALLS
(SEISMIC ZONES 2-6) (IMPERIAL)

TACOMA ENGINEERS

NUDURA INTEGRATED BUILDING TECHNOLOGY Building Value.

LICENSED PROFESSIONAL ENGINEER D.J. TACOMA 45409505 MAR 2 1 2006 PROVINCE OF ONTARIO

Tacoma Engineers Inc.
176 Speedvale Avenue West
Guelph, Ontario, N1H 1C3
Telephone: (519) 763-2000
Fax: (519) 824-2000
Web: www.tacomaengineers.com

Vertical Steel Reinforcement for Below-Grade Walls in Seismic Zones 2-6 Built with NUDURA™ Insulated Forms (Imperial)

Wall Height ft	Backfill Height ft	Vertical Reinforcement: Free Draining Backfill Soil Type (Maximum Equivalent Fluid Density) — Sand & Gravel 30 pcf — 6" Wall	Sand & Gravel 30 pcf — 8" Wall	Sand, Gravel with Silt or Clay 45 pcf — 6" Wall	Sand, Gravel with Silt or Clay 45 pcf — 8" Wall	Inorganic Silt or Clay 60 pcf — 6" Wall	Inorganic Silt or Clay 60 pcf — 8" Wall	Horizontal Steel Reinforcement — All Soils — All Wall Thicknesses
8.0	4.0	See Note 2	See Note 2	See Note 2	See Note 2	See Note 2	See Note 2	#4 @ 18"
	5.0	See Note 2	See Note 2	#4 @ 16 in	See Note 2	#4 @ 16 in	See Note 2	#4 @ 18"
	6.0	#4 @ 16 in	See Note 2	#5 @ 16 in	See Note 2	#5 @ 16 in	#5 @ 16 in	#4 @ 18"
	7.0	#4 @ 16 in	See Note 2	#5 @ 16 in	#5 @ 16 in	#5 @ 16 in	#5 @ 16 in	#4 @ 18"
9.0	4.0	#4 @ 24 in	#4 @ 32 in	#4 @ 16 in	#4 @ 24 in	#4 @ 16 in	#4 @ 16 in	#4 @ 18"
	5.0	#4 @ 16 in	#4 @ 24 in	#4 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 24 in	#4 @ 18"
	6.0	#4 @ 16 in	#4 @ 16 in	#5 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 16 in	#4 @ 18"
	7.0	#5 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 16 in	#5 @ 8 in	#5 @ 16 in	#4 @ 18"
	8.0	#5 @ 16 in	#5 @ 16 in	#5 @ 8 in	#5 @ 16 in	#5 @ 8 in	#5 @ 16 in	#4 @ 18"
10.0	4.0	#4 @ 24 in	#4 @ 32 in	#4 @ 16 in	#4 @ 24 in	#4 @ 16 in	#4 @ 16 in	#4 @ 18"
	5.0	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 24 in	#4 @ 18"
	6.0	#4 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 16 in	#5 @ 16 in	#5 @ 16 in	#4 @ 18"
	7.0	#5 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 16 in	-	#5 @ 16 in	#4 @ 18"
	8.0	#5 @ 16 in	#5 @ 16 in	-	#5 @ 16 in	-	#5 @ 8 in	#4 @ 18"
	9.0	#5 @ 16 in	#5 @ 16 in	-	#5 @ 16 in	-	#5 @ 8 in	#4 @ 18"
12.0	4.0	#4 @ 16 in	#4 @ 32 in	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#4 @ 18"
	5.0	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 24 in	#4 @ 18"
	6.0	#5 @ 16 in	#5 @ 24 in	#5 @ 16 in	#5 @ 16 in	-	#5 @ 16 in	#4 @ 18"
	7.0	#5 @ 16 in	#5 @ 16 in	-	#5 @ 16 in	-	#5 @ 16 in	#4 @ 18"
	8.0	-	#5 @ 16 in	-	#5 @ 16 in	-	#5 @ 8 in	#4 @ 18"
	9.0	-	#5 @ 16 in	-	#5 @ 8 in	-	#5 @ 8 in	#4 @ 18"
	10.0	-	#5 @ 16 in	-	#5 @ 8 in	-	#5 @ 8 in	#4 @ 18"
	11.0	-	#5 @ 8 in	-	#5 @ 8 in	-	-	#4 @ 18"

Note:

1. **This table is to be used in conjunction with "Design Limitations" and "Structural Engineering Analysis Report" prepared by Tacoma Engineers Inc**
2. As per Part 9 of the National Building Code, for the wall and backfill height noted an unreinforced wall with f'c = 20 Mpa is adequate.
3. Refer to Design Limitations for info on construction methods, material specs, design loads, additional wall reinforcing around openings, min. wall length, etc.

D TABLE D-4 REINFORCEMENT FOR BELOW GRADE WALLS
(SEISMIC ZONES 2-6) (METRIC)

TACOMA ENGINEERS

NUDURA INTEGRATED BUILDING TECHNOLOGY *Building Value.*

Tacoma Engineers Inc.
176 Speedvale Avenue West
Guelph, Ontario, N1H 1C3
Telephone: (519) 763-2000
Fax: (519) 824-2000
Web: www.tacomaengineers.com

LICENSED PROFESSIONAL ENGINEER D.J. TACOMA 45409505 MAR 22 2006 PROVINCE OF ONTARIO

Vertical Steel Reinforcement for Below-Grade Walls in Seismic Zones 2-6 Built with NUDURA™ Insulated Forms (Metric)

Wall Height ft (m)	Backfill Height ft (m)	Vertical Reinforcement — Free Draining Backfill Soil Type (Maximum Equivalent Fluid Density): Sand & Gravel 30 pcf (480 kg/m^3) 6" (150 mm) Wall	Sand & Gravel 30 pcf (480 kg/m^3) 8" (200 mm) Wall	Sand, Gravel with Silt or Clay 45 pcf (720 kg/m^3) 6" (150 mm) Wall	Sand, Gravel with Silt or Clay 45 pcf (720 kg/m^3) 8" (200 mm) Wall	Inorganic Silt or Clay 60 pcf (960 kg/m^3) 6" (150 mm) Wall	Inorganic Silt or Clay 60 pcf (960 kg/m^3) 8" (200 mm) Wall	Horizontal Steel Reinforcement — All Soils — All Wall Thicknesses
8.0 (2.44)	4.0 (1.22)	See Note 2	See Note 2	See Note 2	See Note 2	See Note 2	See Note 2	10M @ 18" (457)
	5.0 (1.53)	See Note 2	See Note 2	10M @ 400 (16)	See Note 2	10M @ 400 (16)	See Note 2	10M @ 18" (457)
	6.0 (1.83)	10M @ 400 (16)	See Note 2	15M @ 400 (16)	See Note 2	15M @ 400 (16)	15M @ 400 (16)	10M @ 18" (457)
	7.0 (2.13)	10M @ 400 (16)	See Note 2	15M @ 400 (16)	15M @ 400 (16)	15M @ 400 (16)	15M @ 400 (16)	10M @ 18" (457)
9.0 (2.74)	4.0 (1.22)	10M @ 600 (24)	10M @ 800 (32)	10M @ 400 (16)	10M @ 600 (24)	10M @ 400 (16)	10M @ 400 (16)	10M @ 18" (457)
	5.0 (1.53)	10M @ 400 (16)	10M @ 600 (24)	10M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 600 (24)	10M @ 18" (457)
	6.0 (1.83)	10M @ 400 (16)	10M @ 400 (16)	15M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 400 (16)	10M @ 18" (457)
	7.0 (2.13)	15M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 400 (16)	15M @ 200 (8)	15M @ 400 (16)	10M @ 18" (457)
	8.0 (2.44)	15M @ 400 (16)	15M @ 400 (16)	15M @ 200 (8)	15M @ 400 (16)	15M @ 200 (8)	15M @ 400 (16)	10M @ 18" (457)
10.0 (3.05)	4.0 (1.22)	10M @ 600 (24)	10M @ 800 (32)	10M @ 400 (16)	10M @ 600 (24)	10M @ 400 (16)	10M @ 400 (16)	10M @ 18" (457)
	5.0 (1.53)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 600 (24)	10M @ 18" (457)
	6.0 (1.83)	10M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 400 (16)	15M @ 400 (16)	15M @ 400 (16)	10M @ 18" (457)
	7.0 (2.13)	15M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 400 (16)	-	15M @ 400 (16)	10M @ 18" (457)
	8.0 (2.44)	15M @ 400 (16)	15M @ 400 (16)	-	15M @ 400 (16)	-	15M @ 200 (8)	10M @ 18" (457)
	9.0 (2.74)	15M @ 400 (16)	15M @ 400 (16)	-	15M @ 400 (16)	-	15M @ 200 (8)	10M @ 18" (457)
12.0 (3.66)	4.0 (1.22)	10M @ 400 (16)	10M @ 800 (32)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	10M @ 18" (457)
	5.0 (1.53)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 600 (24)	10M @ 18" (457)
	6.0 (1.83)	15M @ 400 (16)	15M @ 600 (24)	15M @ 400 (16)	15M @ 400 (16)	-	15M @ 400 (16)	10M @ 18" (457)
	7.0 (2.13)	15M @ 400 (16)	15M @ 400 (16)	-	15M @ 400 (16)	-	15M @ 400 (16)	10M @ 18" (457)
	8.0 (2.44)	-	15M @ 400 (16)	-	15M @ 400 (16)	-	15M @ 200 (8)	10M @ 18" (457)
	9.0 (2.74)	-	15M @ 400 (16)	-	15M @ 200 (8)	-	15M @ 200 (8)	10M @ 18" (457)
	10.0 (3.05)	-	15M @ 400 (16)	-	15M @ 200 (8)	-	15M @ 200 (8)	10M @ 18" (457)
	11.0 (3.35)	-	15M @ 200 (8)	-	15M @ 200 (8)	-	-	10M @ 18" (457)

Note:

1. **This table is to be used in conjunction with "Design Limitations" and "Structural Engineering Analysis Report" prepared by Tacoma Engineers Inc.**
2. As per Part 9 of the National Building Code, for the wall and backfill height noted an unreinforced wall with f'c = 20 Mpa is adequate.
3. Refer to Design Limitations for info on construction methods, material specs, design loads, additional wall reinforcing around openings, min. wall length, etc.
4. Vertical wall steel spacing indicated in mm (in).

D TABLE D-5 REINFORCEMENT FOR ABOVE GRADE WALLS
(WIND SPEEDS ≤ 11.5 PSF) (IMPERIAL)

TACOMA ENGINEERS

NUDURA INTEGRATED BUILDING TECHNOLOGY *Building Value.*

Tacoma Engineers Inc.
176 Speedvale Avenue West
Guelph, Ontario, N1H 1C3
Telephone: (519) 763-2000
Fax: (519) 824-2000
Web: www.tacomaengineers.com

LICENSED PROFESSIONAL ENGINEER TACOMA 43408505 MAR 22 2006 PROVINCE OF ONTARIO

Table 1(a) - Vertical Steel Reinforcement for Above-Grade Walls (all Seismic Zones) built with NUDURA Insulated Forms (Imperial)

Wall Height	Vertical Steel									Horizontal Steel
	Hourly Wind Pressure, $q_{1/30} \leq 11.5$ psf									All Scenarios
	Seismic Zone Classification									
	Za or Zv ≤ 1			Za or Zv ≥ 2 & ≤ 4			Za or Zv ≥ 5			
One Storey Concrete Structure or Top Floor of 2 Storey Concrete Structure Supporting Wood Frame Roof										
ft	4" Wall	6" Wall	8" Wall	4" Wall	6" Wall	8" Wall	4" Wall	6" Wall	8" Wall	
8	#4 @ 32 in	#4 @ 32 in	#4 @ 32 in	#4 @ 32 in	#4 @ 32 in	#4 @ 32 in	#4 @ 24 in	#4 @ 24 in	#4 @ 24 in	#4 @ 18"
9	#4 @ 24 in	#4 @ 32 in	#4 @ 32 in	#4 @ 24 in	#4 @ 32 in	#4 @ 32 in	#4 @ 16 in	#4 @ 16 in	#4 @ 24 in	#4 @ 18"
10	#4 @ 16 in	#4 @ 32 in	#4 @ 32 in	#4 @ 24 in	#4 @ 32 in	#4 @ 32 in	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#4 @ 18"
12	-	**#4 @ 24 in**	**#4 @ 24 in**	-	**#4 @ 24 in**	**#4 @ 24 in**	-	**#4 @ 16 in**	**#5 @ 24 in**	#4 @ 18"
14	-	**#4 @ 16 in**	**#4 @ 16 in**	-	**#4 @ 16 in**	**#5 @ 24 in**	-	**#5 @ 16 in**	**#5 @ 16 in**	#4 @ 18"
16	-	**#4 @ 16 in**	**#5 @ 24 in**	-	**#4 @ 16 in**	**#5 @ 16 in**	-	**#5 @ 16 in**	**#5 @ 16 in**	#4 @ 18"
Lower Floor of 2 Storey Structure Supporting 2nd Storey Wood Frame Walls, Floor and Roof										
8	#4 @ 32 in	#4 @ 32 in	#4 @ 32 in	#4 @ 32 in	#4 @ 32 in	#4 @ 32 in	#4 @ 16 in	#4 @ 16 in	#4 @ 24 in	#4 @ 18"
9	#4 @ 24 in	#4 @ 32 in	#4 @ 32 in	#4 @ 24 in	#4 @ 32 in	#4 @ 32 in	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#4 @ 18"
10	-	#4 @ 32 in	#4 @ 32 in	-	#4 @ 24 in	#4 @ 32 in	-	#4 @ 16 in	#5 @ 24 in	#4 @ 18"
12	-	#4 @ 24 in	#4 @ 24 in	-	#4 @ 16 in	#4 @ 24 in	-	#5 @ 16 in	#5 @ 16 in	#4 @ 18"
14	-	-	#4 @ 16 in	-	-	#5 @ 24 in	-	-	#5 @ 16 in	#4 @ 18"
16	-	-	#5 @ 24 in	-	-	#5 @ 24 in	-	-	#5 @ 8 in	#4 @ 18"
Lower Floor of 2 Storey Concrete Structure Supporting 2nd Storey Concrete Walls and Wood Frame Floor & Roof										
8	#4 @ 32 in	#4 @ 32 in	#4 @ 32 in	#4 @ 24 in	#4 @ 24 in	#4 @ 32 in	#5 @ 24 in	#4 @ 16 in	#5 @ 24 in	#4 @ 18"
9	#4 @ 24 in	#4 @ 32 in	#4 @ 32 in	#4 @ 16 in	#4 @ 16 in	#4 @ 16 in	#5 @ 16 in	#5 @ 16 in	#5 @ 16 in	#4 @ 18"
10	-	#4 @ 32 in	#4 @ 32 in	-	#4 @ 16 in	#5 @ 24 in	-	#5 @ 16 in	#5 @ 16 in	#4 @ 18"
12	-	#4 @ 24 in	#4 @ 24 in	-	#4 @ 16 in	#5 @ 16 in	-	-	#5 @ 8 in	#4 @ 18"
14	-	-	#4 @ 16 in	-	-	#5 @ 16 in	-	-	#5 @ 8 in	#4 @ 18"
16	-	-	#5 @ 24 in	-	-	#5 @ 8 in	-	-	#5 @ 8 in	#4 @ 18"

Note:
1. **Bolded data** indicates reinforcing for ground floor concrete walls only. Second floor concrete walls to be limited to height of 10'-0".
2. **This table is to be used in conjunction with the "Design Limitations" and "Structural Engineering Analysis Report" prepared by Tacoma Engineers Inc.**
3. Refer to Design Limitations for information on construction methods, material specifications, design loads, additional wall reinforcing requirements around openings, minimum wall length, etc.

D

TABLE D-6 REINFORCEMENT FOR ABOVE GRADE WALLS
(WIND SPEEDS ≤ 0.55 kPa) (METRIC)

TACOMA ENGINEERS

NUDURA INTEGRATED BUILDING TECHNOLOGY Building Value.

Tacoma Engineers Inc.
176 Speedvale Avenue West
Guelph, Ontario, N1H 1C3
Telephone: (519) 763-2000
Fax: (519) 824-2000
Web: www.tacomaengineers.com

LICENSED PROFESSIONAL ENGINEER D.J. TACOMA 45409505 MAR 22 2006 PROVINCE OF ONTARIO

Table 1(b) - Vertical Steel Reinforcement for Above-Grade Walls (all Seismic Zones) built with NUDURA Insulated Forms (metric)

Wall Height	Vertical Steel									Horizontal Steel
	Hourly Wind Pressure, $q_{1/30} \leq 0.55$ kPa									All Scenarios
	Seismic Zone Classification									
	Za or Zv ≤ 1			Za or Zv ≥ 2 & ≤ 4			Za or Zv ≥ 5			
One Storey Concrete Structure or Top Floor of 2 Storey Concrete Structure Supporting Wood Frame Roof										
m (ft)	100-mm (4") Wall	150-mm (6") Wall	200-mm (8") Wall	100-mm (4") Wall	150-mm (6") Wall	200-mm (8") Wall	100-mm (4") Wall	150-mm (6") Wall	200-mm (8") Wall	
2.44 (8)	10M @ 800 (32)	10M @ 800 (32)	10M @ 800 (32)	10M @ 800 (32)	10M @ 800 (32)	10M @ 800 (32)	10M @ 600 (24)	10M @ 600 (24)	10M @ 600 (24)	10M@457 (18")
2.75 (9)	10M @ 600 (24)	10M @ 800 (32)	10M @ 800 (32)	10M @ 600 (24)	10M @ 800 (32)	10M @ 800 (32)	10M @ 400 (16)	10M @ 400 (16)	10M @ 600 (24)	10M@457 (18")
3.05 (10)	10M @ 400 (16)	10M @ 800 (32)	10M @ 800 (32)	10M @ 600 (24)	10M @ 800 (32)	10M @ 800 (32)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	10M@457 (18")
3.66 (12)	-	**10M @ 600 (24)**	**10M @ 600 (24)**	-	**10M @ 600 (24)**	**10M @ 600 (24)**	-	**10M @ 400 (16)**	**15M @ 600 (24)**	10M@457 (18")
4.27 (14)	-	**10M @ 400 (16)**	**10M @ 400 (16)**	-	**10M @ 400 (16)**	**15M @ 600 (24)**	-	**15M @ 400 (16)**	**15M @ 400 (16)**	10M@457 (18")
4.88 (16)	-	**10M @ 400 (16)**	**15M @ 600 (24)**	-	**10M @ 400 (16)**	**15M @ 400 (16)**	-	**15M @ 400 (16)**	**15M @ 400 (16)**	10M@457 (18")
Lower Floor of 2 Storey Structure Supporting 2nd Storey Wood Frame Walls, Floor and Roof										
2.44 (8)	10M @ 800 (32)	10M @ 800 (32)	10M @ 800 (32)	10M @ 800 (32)	10M @ 800 (32)	10M @ 800 (32)	10M @ 400 (16)	10M @ 400 (16)	10M @ 600 (24)	10M@457 (18")
2.75 (9)	10M @ 600 (24)	10M @ 800 (32)	10M @ 800 (32)	10M @ 600 (24)	10M @ 800 (32)	10M @ 800 (32)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	10M@457 (18")
3.05 (10)	-	10M @ 800 (32)	10M @ 800 (32)	-	10M @ 600 (24)	10M @ 800 (32)	-	10M @ 400 (16)	15M @ 600 (24)	10M@457 (18")
3.66 (12)	-	10M @ 600 (24)	10M @ 600 (24)	-	10M @ 400 (16)	10M @ 600 (24)	-	15M @ 400 (16)	15M @ 400 (16)	10M@457 (18")
4.27 (14)	-	-	10M @ 400 (16)	-	-	15M @ 600 (24)	-	-	15M @ 400 (16)	10M@457 (18")
4.88 (16)	-	-	15M @ 600 (24)	-	-	15M @ 600 (24)	-	-	15M @ 200 (8)	10M@457 (18")
Lower Floor of 2 Storey Concrete Structure Supporting 2nd Storey Concrete Walls and Wood Frame Floor & Roof										
2.44 (8)	10M @ 800 (32)	10M @ 800 (32)	10M @ 800 (32)	10M @ 600 (24)	10M @ 600 (24)	10M @ 800 (32)	15M @ 600 (24)	10M @ 400 (16)	15M @ 600 (24)	10M@457 (18")
2.75 (9)	10M @ 600 (24)	10M @ 800 (32)	10M @ 800 (32)	10M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	15M @ 400 (16)	15M @ 400 (16)	15M @ 400 (16)	10M@457 (18")
3.05 (10)	-	10M @ 800 (32)	10M @ 800 (32)	-	10M @ 400 (16)	15M @ 600 (24)	-	15M @ 400 (16)	15M @ 400 (16)	10M@457 (18")
3.66 (12)	-	10M @ 600 (24)	10M @ 600 (24)	-	10M @ 400 (16)	15M @ 400 (16)	-	-	15M @ 200 (8)	10M@457 (18")
4.27 (14)	-	-	10M @ 400 (16)	-	-	15M @ 400 (16)	-	-	15M @ 200 (8)	10M@457 (18")
4.88 (16)	-	-	15M @ 600 (24)	-	-	15M @ 200 (8)	-	-	15M @ 200 (8)	10M@457 (18")

Note:
1. **Bolded data** indicates reinforcing for ground floor concrete walls only. Second floor concrete walls to be limited to height of 3.05m (10'-0").
2. **This table is to be used in conjunction with the "Design Limitations" and "Structural Engineering Analysis Report" prepared by Tacoma Engineers Inc.**
3. Vertical wall steel spacing indicated in mm (in).
4. Refer to Design Limitations for information on construction methods, material specifications, design loads, additional wall reinforcing requirements around openings, minimum wall length, etc.

D TABLE D-7 REINFORCEMENT FOR ABOVE GRADE WALLS
(WIND SPEEDS > 11.5 PSF OR ≤ 23 PSF) (IMPERIAL)

TACOMA ENGINEERS

NUDURA INTEGRATED BUILDING TECHNOLOGY *Building Value.*

LICENSED PROFESSIONAL ENGINEER D.J. TACOMA 45409505 MAR 22 2006 PROVINCE OF ONTARIO

Tacoma Engineers Inc.
176 Speedvale Avenue West
Guelph, Ontario, N1H 1C3
Telephone: (519) 763-2000
Fax: (519) 824-2000
Web: www.tacomaengineers.com

Table 1(c) - Vertical Steel Reinforcement for Above-Grade Walls (all Seismic Zones) built with NUDURA Insulated Forms (imperial)

Wall Height	Vertical Steel									Horizontal Steel
	Hourly Wind Pressure, $q_{1/30}$ > 11.5 psf or ≤ 23 psf									All Scenarios
	Seismic Zone Classification									
	Za or Zv ≤ 1			Za or Zv ≥ 2 & ≤ 4			Za or Zv ≥ 5			
One Storey Concrete Structure or Top Floor of 2 Storey Concrete Structure Supporting Wood Frame Roof										
ft	4" Wall	6" Wall	8" Wall	4" Wall	6" Wall	8" Wall	4" Wall	6" Wall	8" Wall	
8	#4 @ 16 in	#4 @ 24 in	#4 @ 32 in	#4 @ 16 in	#4 @ 24 in	#4 @ 24 in	#4 @ 16 in	#4 @ 24 in	#4 @ 24 in	#4 @ 18"
9	#5 @ 24 in	#4 @ 24 in	#4 @ 32 in	#5 @ 24 in	#4 @ 24 in	#4 @ 24 in	#5 @ 24 in	#4 @ 16 in	#4 @ 24 in	#4 @ 18"
10	#4 @ 16 in	#4 @ 16 in	#4 @ 24 in	#5 @ 16 in	#4 @ 16 in	#4 @ 16 in	#5 @ 16 in	#4 @ 16 in	#4 @ 16 in	#4 @ 18"
12	-	**#4 @ 16 in**	**#4 @ 16 in**	-	**#4 @ 16 in**	**#5 @ 16 in**	-	**#4 @ 16 in**	**#5 @ 24 in**	#4 @ 18"
14	-	**#5 @ 16 in**	**#5 @ 24 in**	-	**#5 @ 16 in**	**#5 @ 16 in**	-	**#5 @ 16 in**	**#5 @ 16 in**	#4 @ 18"
16	-	**#5 @ 16 in**	**#5 @ 16 in**	-	**#5 @ 16 in**	**#5 @ 16 in**	-	**#5 @ 16 in**	**#5 @ 16 in**	#4 @ 18"
Lower Floor of 2 Storey Structure Supporting 2nd Storey Wood Frame Walls, Floor and Roof										
8	#4 @ 16 in	#4 @ 24 in	#4 @ 24 in	#4 @ 16 in	#4 @ 24 in	#4 @ 32 in	#4 @ 16 in	#4 @ 24 in	#4 @ 24 in	#4 @ 18"
9	#5 @ 24 in	#4 @ 16 in	#4 @ 16 in	#5 @ 24 in	#4 @ 24 in	#4 @ 32 in	#5 @ 24 in	#4 @ 16 in	#5 @ 24 in	#4 @ 18"
10	-	#4 @ 16 in	#4 @ 16 in	-	#4 @ 16 in	#4 @ 24 in	-	#5 @ 24 in	#5 @ 16 in	#4 @ 18"
12	-	#4 @ 16 in	#5 @ 24 in	-	#4 @ 16 in	#4 @ 16 in	-	#5 @ 16 in	#5 @ 16 in	#4 @ 18"
14	-	-	#5 @ 24 in	-	-	#5 @ 24 in	-	-	#5 @ 16 in	#4 @ 18"
16	-	-	#5 @ 16 in	-	-	#5 @ 16 in	-	-	#5 @ 8 in	#4 @ 18"
Lower Floor of 2 Storey Concrete Structure Supporting 2nd Storey Concrete Walls and Wood Frame Floor & Roof										
8	#4 @ 16 in	#4 @ 24 in	#4 @ 32 in	#4 @ 16 in	#4 @ 24 in	#4 @ 32 in	#4 @ 16 in	#4 @ 16 in	#5 @ 24 in	#4 @ 18"
9	#5 @ 24 in	#4 @ 16 in	#4 @ 32 in	#5 @ 24 in	#4 @ 16 in	#4 @ 16 in	#5 @ 24 in	#4 @ 16 in	#5 @ 16 in	#4 @ 18"
10	-	#4 @ 16 in	#4 @ 16 in	-	#4 @ 16 in	#5 @ 24 in	-	#5 @ 16 in	#5 @ 16 in	#4 @ 18"
12	-	#4 @ 16 in	#5 @ 24 in	-	#4 @ 16 in	#5 @ 16 in	-	-	#5 @ 8 in	#4 @ 18"
14	-	-	#5 @ 24 in	-	-	#5 @ 16 in	-	-	#5 @ 8 in	#4 @ 18"
16	-	-	#5 @ 16 in	-	-	#5 @ 16 in	-	-	#5 @ 8 in	#4 @ 18"

Note:

1. **Bolded data** indicates reinforcing for ground floor concrete walls only. Second floor concrete walls to be limited to height of 10'-0".
2. **This table is to be used in conjunction with the "Design Limitations" and "Structural Engineering Analysis Report" prepared by Tacoma Engineers Inc.**
4. Refer to Design Limitations for information on construction methods, material specifications, design loads, additional wall reinforcing requirements around openings, minimum wall length, etc.

D

TABLE D-8 REINFORCEMENT FOR ABOVE GRADE WALLS
(WIND SPEEDS > 0.55 KPA OR ≤ 1.10 kPa) (METRIC)

TACOMA ENGINEERS

NUDURA INTEGRATED BUILDING TECHNOLOGY Building Value.

Tacoma Engineers Inc.
176 Speedvale Avenue West
Guelph, Ontario, N1H 1C3
Telephone: (519) 763-2000
Fax: (519) 824-2000
Web: www.tacomaengineers.com

Table 1(d) - Vertical Steel Reinforcement for Above-Grade Walls (all Seismic Zones) built with NUDURA Insulated Forms (metric)

Wall Height	Vertical Steel									Horizontal Steel
	Hourly Wind Pressure, $q_{1/30}$ > 0.55 kPa or ≤ 1.10 kPa									All Scenarios
	Seismic Zone Classification									
	Za or Zv ≤ 1			Za or Zv ≥ 2 & ≤ 4			Za or Zv ≥ 5			
One Storey Concrete Structure or Top Floor of 2 Storey Concrete Structure Supporting Wood Frame Roof										
ft	100-mm (4") Wall	150-mm (6") Wall	200-mm (8") Wall	100-mm (4") Wall	150-mm (6") Wall	200-mm (8") Wall	100-mm (4") Wall	150-mm (6") Wall	200-mm (8") Wall	
2.44 (8)	10M @ 400 (16)	10M @ 600 (24)	10M @ 800 (32)	10M @ 400 (16)	10M @ 600 (24)	10M @ 600 (24)	10M @ 400 (16)	10M @ 600 (24)	10M @ 600 (24)	10M@457 (18")
2.75 (9)	15M @ 600 (24)	10M @ 600 (24)	10M @ 800 (32)	15M @ 600 (24)	10M @ 600 (24)	10M @ 600 (24)	15M @ 600 (24)	10M @ 400 (16)	10M @ 600 (24)	10M@457 (18")
3.05 (10)	10M @ 400 (16)	10M @ 400 (16)	10M @ 600 (24)	15M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	15M @ 400 (16)	10M @ 400 (16)	10M @ 400 (16)	10M@457 (18")
3.66 (12)	-	**10M @ 400 (16)**	**10M @ 400 (16)**	-	**10M @ 400 (16)**	**15M @ 400 (16)**	-	**10M @ 400 (16)**	**15M @ 600 (24)**	10M@457 (18")
4.27 (14)	-	**15M @ 400 (16)**	**15M @ 600 (24)**	-	**15M @ 400 (16)**	**15M @ 400 (16)**	-	**15M @ 400 (16)**	**15M @ 400 (16)**	10M@457 (18")
4.88 (16)	-	**15M @ 400 (16)**	**15M @ 400 (16)**	-	**15M @ 400 (16)**	**15M @ 400 (16)**	-	**15M @ 400 (16)**	**15M @ 400 (16)**	10M@457 (18")
Lower Floor of 2 Storey Structure Supporting 2nd Storey Wood Frame Walls, Floor and Roof										
2.44 (8)	10M @ 400 (16)	10M @ 600 (24)	10M @ 600 (24)	10M @ 400 (16)	10M @ 600 (24)	10M @ 800 (32)	10M @ 400 (16)	10M @ 600 (24)	10M @ 600 (24)	10M@457 (18")
2.75 (9)	15M @ 600 (24)	10M @ 400 (16)	10M @ 400 (16)	15M @ 600 (24)	10M @ 600 (24)	10M @ 800 (32)	15M @ 600 (24)	10M @ 400 (16)	15M @ 600 (24)	10M@457 (18")
3.05 (10)	-	10M @ 400 (16)	10M @ 400 (16)	-	10M @ 400 (16)	10M @ 600 (24)	-	15M @ 600 (24)	15M @ 400 (16)	10M@457 (18")
3.66 (12)	-	10M @ 400 (16)	15M @ 600 (24)	-	10M @ 400 (16)	10M @ 400 (16)	-	15M @ 400 (16)	15M @ 400 (16)	10M@457 (18")
4.27 (14)	-	-	15M @ 600 (24)	-	-	15M @ 600 (24)	-	-	15M @ 400 (16)	10M@457 (18")
4.88 (16)	-	-	15M @ 400 (16)	-	-	15M @ 400 (16)	-	-	15M @ 200 (8)	10M@457 (18")
Lower Floor of 2 Storey Concrete Structure Supporting 2nd Storey Concrete Walls and Wood Frame Floor & Roof										
2.44 (8)	10M @ 400 (16)	10M @ 600 (24)	10M @ 800 (32)	10M @ 400 (16)	10M @ 600 (24)	10M @ 800 (32)	10M @ 400 (16)	10M @ 400 (16)	15M @ 600 (24)	10M@457 (18")
2.75 (9)	15M @ 600 (24)	10M @ 400 (16)	10M @ 800 (32)	15M @ 600 (24)	10M @ 400 (16)	10M @ 400 (16)	15M @ 600 (24)	10M @ 400 (16)	15M @ 400 (16)	10M@457 (18")
3.05 (10)	-	10M @ 400 (16)	10M @ 400 (16)	-	10M @ 400 (16)	15M @ 600 (24)	-	15M @ 400 (16)	15M @ 400 (16)	10M@457 (18")
3.66 (12)	-	10M @ 400 (16)	15M @ 600 (24)	-	10M @ 400 (16)	15M @ 400 (16)	-	-	-	10M@457 (18")
4.27 (14)	-	-	15M @ 600 (24)	-	-	15M @ 400 (16)	-	-	-	10M@457 (18")
4.88 (16)	-	-	15M @ 400 (16)	-	-	15M @ 400 (16)	-	-	-	10M@457 (18")

Note:
1. **Bolded data** indicates reinforcing for ground floor concrete walls only. Second floor concrete walls to be limited to height of 3.05m (10'-0").
2. **This table is to be used in conjunction with the "Design Limitations" and "Structural Engineering Analysis Report" prepared by Tacoma Engineers Inc.**
3. Vertical wall steel spacing indicated in mm (in).
4. Refer to Design Limitations for information on construction methods, material specifications, design loads, additional wall reinforcing requirements around openings, minimum wall length, etc.