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CCMC 12641-R

CCMC *EVALUATION REPORT*

DIVISION	**03131**
Issued	**1995-04-26**
Re-evaluated	**2005-04-12**
Re-evaluation due	**2007-04-26**

Arxx High Performance Wallsystems

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1. Purpose of Evaluation

The proponent sought confirmation from the Canadian Construction Materials Centre (CCMC) that "Arxx High Performance Wallsystems" can serve as a modular polystyrene form for the construction of insulated monolithic concrete walls in compliance with the intent of the National Building Code of Canada (NBC) 1995.

2. Opinion

Subject to the limitations and conditions stated in this report, test results and assessments provided by the proponent show that "Arxx High Performance Wallsystems" comply with CCMC's Technical Guide for Modular, Expanded-polystyrene or Polyurethane Concrete Forms, MasterFormat number 03131, dated 2000-09-16, and provides a level of performance equivalent to that required in:

- NBC 1995, Article 4.3.3.1., Subsection 9.3.1., Section 9.4., and Subsection 9.15.4. with respect to wall construction.

Ruling No. 98-04-54 (12641-R) authorizing the use of this product in Ontario, subject to the terms and conditions contained in the Ruling, was made by the Minister of Municipal Affairs and Housing on 6 April, 1998 pursuant to s.29 of the Building Code Act, 1992 (see Ruling for terms and conditions).

Canada Mortgage and Housing Corporation permits the use of this product in construction financed or insured under the National Housing Act.

Note: The attachment of exterior cladding and interior finishing materials has not been assessed by the present evaluation.

3. Description

"Arxx High Performance Wallsystems" is a modular, interlocking, concrete form system in which each unit consists of two expanded-polystyrene panels with polypropylene connectors molded into the polystyrene panels. These are equally spaced horizontally at 200 mm. The extremities of the polypropylene connectors are embedded in the polystyrene panels.

The polystyrene face panels have a preformed interlocking design along their top and bottom edges which facilitates stacking and alignment and prevents leakage of freshly placed concrete.

The forms are dry-laid and stacked in a running bond (staggered) configuration. The stacked units form a rectangular space that, after being filled with concrete, forms an insulated, monolithic concrete wall of uniform thickness.

Reinforcement may be placed where required to satisfy strength requirements for above or below-grade load-bearing walls, beams, lintels and shear walls.

The units have external dimensions of 1220 mm in length and 425 mm in height. The polystyrene panels are 46 mm thick, resulting in 100 mm thick concrete walls, or 60 mm thick resulting in 160, 200 or 250 mm thick concrete walls.

"Arxx High Performance Wallsystems" units are available in 90°, 45° corner forms, ledge forms, taper top forms and adjustable corner forms.

The standard unit is illustrated in Figure 1.

Typical details for residential construction are shown in figures 2 and 3.

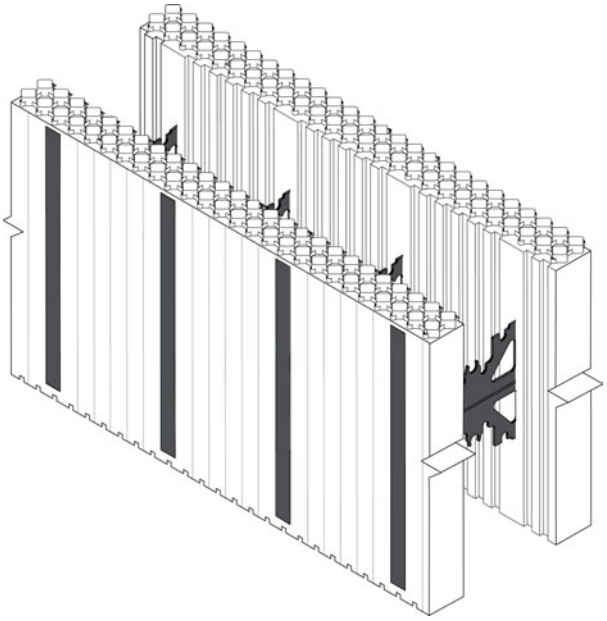

Figure 1. "Arxx High Performance Wallsystems" standard unit

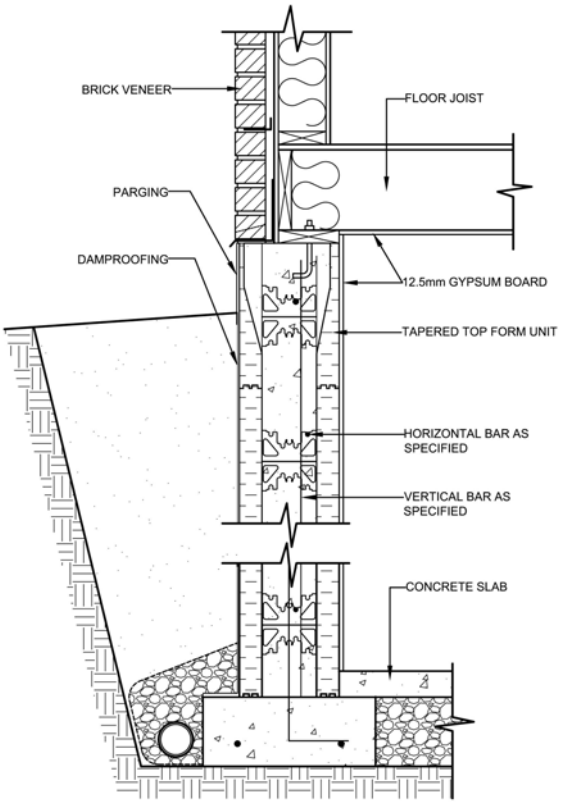

Figure 2. Section of "Arxx High Performance Wallsystems" supporting brick veneer construction

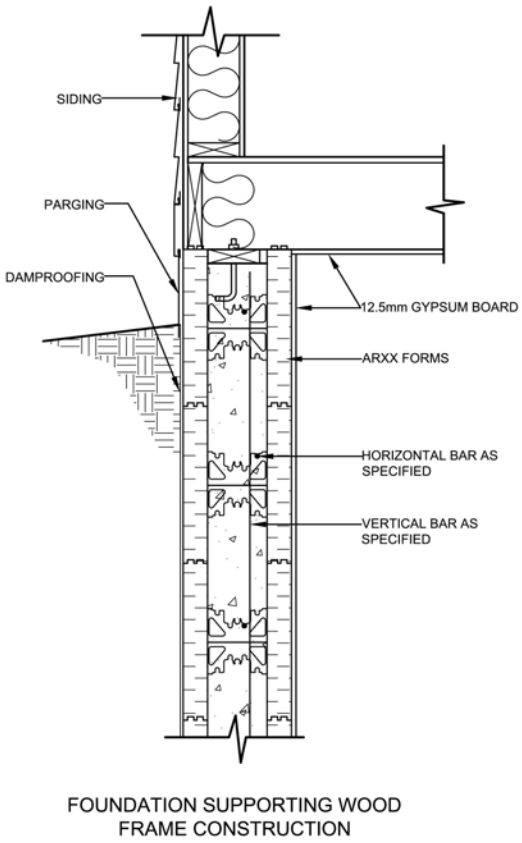

Figure 3. Section of "Arxx High Performance Wallsystems" supporting siding

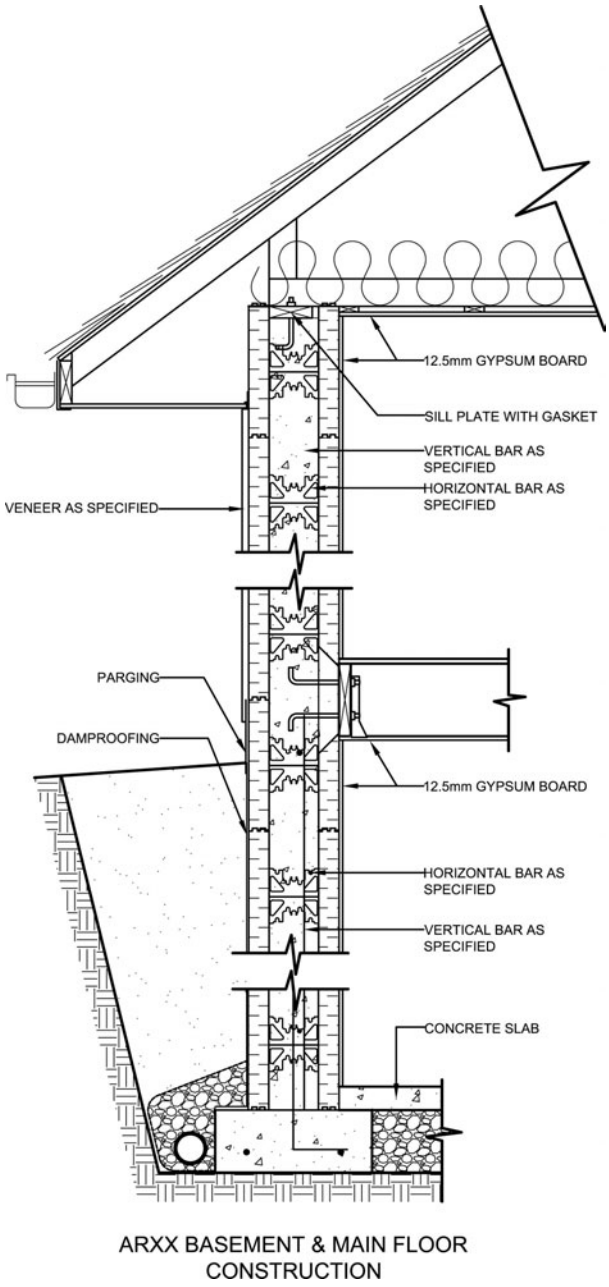

Figure 4. Reinforcing over openings

4. Usage and Limitations

The use of "Arxx High Performance Wallsystems" is permitted in the construction of houses and small buildings up to two storeys high, that fall under the provisions of Part 9 of the NBC 1995, subject to the following conditions:

- The structural applications of "Arxx High Performance Wallsystems" must be in strict accordance with "Arxx Wall System Structural Design Tables for Housing and Small Buildings, Report No. 04E001", dated 30 September 2004, as prepared by "R.W.

Wright Engineering & Design" and from which tables 1, 2, 3a, 3b, 3c and 3d have been reproduced.

- The concrete used in conjunction with "Arxx High Performance Wallsystems" must be Type 10 or Type 30 with a minimum compressive strength of 20 MPa and a maximum slump of 140 ± 25 mm.

- For the wall heights indicated in Tables 1 and 2 the pouring of concrete must be made at a maximum rate of 1.3 m per hour in consecutive lifts; each lift is limited to a maximum height of 1.3 m.

- The EPS insulation used in this system must comply with CAN / ULC-S701-97, "Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering," Type 2.

- The aging of "Arxx High Performance Wallsystems" EPS insulation panels must be not less than three weeks from the date of manufacturing.

- The interior face of "Arxx High Performance Wallsystems" panels shall be protected from the inside of the building in accordance with Sentence 9.10.16.10.(1) of the NBC 1995.

- For above-grade installations, the exterior face of "Arxx High Performance Wallsystems" shall be protected with materials conforming to the NBC 1995, Sections 9.20., 9.27. and / or 9.28.

- For foundation wall installations, the backfill shall be placed in such a way as to avoid damaging the wall, the exterior insulation panel, and the waterproofing and dampproofing protection.

- The concrete must be cured a minimum of seven days before backfilling. The top of the foundation wall must be supported by the first floor prior to backfilling.

- For below-grade installations, dampproofing material compatible with the EPS insulation must be provided in accordance with the NBC 1995, Article 9.13.1.1.

- Where hydrostatic pressure exists, waterproofing that is compatible with the EPS insulation must be provided in accordance with the NBC 1995, Article 9.13.1.2.

- The backfill material must be well-drained and a drainage system must be installed around the footing, in accordance with NBC requirements.

- Installation of the "Arxx High Performance Wallsystems" shall be in strict compliance with the most current version of the Arxx Building Products Inc. Installation Guide.

  Only installers who have been trained and authorized by Arxx Building Products Inc. shall be contracted to set up the wall system.

5. Performance

Compliance of the expanded polystyrene thermal insulation with the requirements of CAN / ULC-S701-97 was assessed at laboratories recognized by CCMC.

The design analysis of walls using "Arxx High Performance Wallsystems" as prepared by R.W. Wright Engineering & Design, Report No. 04E001, dated 30 September, 2004, for Arxx Building Products™ Inc. is summarized in tables 1, 2, and 3a, 3b, 3c and 3d.

The tables provide steel reinforcement designs for a number of different wall and lintel applications, based on the structural loads and the design assumptions indicated below each table. When "Arxx High Performance Wallsystems" is used in structural applications outside the scope of the referenced design analysis, a registered professional engineer skilled in concrete design must certify the structural analysis and design for such applications. The engineer shall certify that the construction provides a level of performance equivalent to that required by Part 4, and / or Part 9 of NBC 1995.

Table 1 - Vertical & Horizontal Steel Reinforcement for Below Grade Walls for Seismic Zones of 6 or less*

Wall Height (m)	Backfill Height (m)	Max. Spacing for Vertical Reinforcement			Max. Spacing for Horizontal Reinforcement	
		160-mm Wall	200-mm Wall	250-mm Wall	160-mm &, 200-mm Walls	250-mm Walls
2.44	1.22	10M @ 400	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	1.53	10M @ 400	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	1.83	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	2.14	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
3.05	1.22	10M @ 400	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	1.53	10M @ 400	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	1.83	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	2.14	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	2.44	10M @ 100 or 15M @ 200	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	2.75		10M @ 100 or 15M @ 200	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
3.66	1.22	10M @ 400	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	1.53	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	1.83	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	2.14	10M @ 100 or 15M @ 200	10M @ 200 or 15M @ 400	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	2.44		10M @ 100 or 15M @ 200	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	2.75		10M @ 100 or 15M @ 200	10M @ 200 or 15M @ 400	15M @ 425	10M + 15M @ 425 or 20M @ 425
	3.05		10M @ 100 or 15M @ 200	10M @ 100 or 15M @ 200	15M @ 425	10M + 15M @ 425 or 20M @ 425
	3.36			10M @ 100 or 15M @ 200	15M @ 425	10M + 15M @ 425 or 20M @ 425

Table 2 - Vertical/Horizontal Steel Reinforcement for Above Grade Walls in all Seismic Zones of 6 or less*

Wall Height (m)	Max Spacing of Vertical Reinforcement			Max. Spacing for Horizontal Reinforcement		
	100 mm Wall	160 mm Wall	200 mm Wall	100 mm Wall	160 mm Wall	200 mm Wall
Single-Storey concrete construction supporting a wood-frame roof structure						
2.44	10M @ 300	10M @ 400	15M @ 400	10M @ 300	15M @ 425	15M @ 425
3.05	10M @ 300	10M @ 400	15M @ 400	10M @ 300	15M @ 425	15M @ 425
3.66		10M @ 400	15M @ 400		15M @ 425	15M @ 425
Ground floor concrete construction supporting a second storey wood frame & wood frame roof structures						
2.44	10M @ 300	10M @ 400	15M @ 400	10M @ 300	15M @ 425	15M @ 425
3.05	10M @ 300	10M @ 400	15M @ 400	10M @ 300	15M @ 425	15M @ 425
3.66		10M @ 400	15M @ 400		15M @ 425	15M @ 425
Ground floor construction supporting a second storey concrete construction & a wood frame roof structure						
2.44	10M @ 300	10M @ 400	15M @ 400	10M @ 300	15M @ 425	15M @ 425
3.05	10M @ 300	10M @ 400	15M @ 400	10M @ 300	15M @ 425	15M @ 425
3.66		10M @ 400	15M @ 400		15M @ 425	15M @ 425

Note: Shaded area means not feasible. Specific design is required.

Table 1 and 2 are based on the following assumptions:

1. The design is applicable to seismic zone of 6 or less
2. Maximum building width is 12.2 m.
3. Maximum building length is 18.3 m.
4. Maximum floor clear span is 6.0 m..
5. Maximum roof clear span is 12.2 m.
6. Roof Dead Load is 0.60 kPa.
7. Floor Dead Load is 0.7 kPa.
8. Snow Load is 4.0 kPa.
9. Use and occupancy Live Load is 1.9 kPa.
10. All materials and workmanship shall conform to the requirements of the NBC 1995 and its Revisions and Errata as of the issue date of these tables.
11. Wall design detailing bends, placement, spacing, splicing and protection of reinforcing shall be in accordance with CSA A23.3 (R2000).
12. In below grade applications, the centreline of vertical reinforcement is 45 mm from the inside face of the concrete. In above grade applications, the centerline of vertical reinforcement is placed within the middle 1/3 of the wall.
13. Two 15M bars shall be placed around all openings and extend 600 mm (24”) beyond each side of opening.
14. Reinforcing bars shall be hard grade deformed bars conforming to CSA-G30.12, Grade 400.
15. Minimum 28-day concrete compressive strength is 20 MPa. Mix design in accordance with manufacturers recommendations.
16. Concrete shall be allowed to cure for a minimum of seven days prior to backfilling.
17. Basement walls are considered to be supported at the top by the floor system.
18. Floor and roof connections to ICF walls shall be designed to accommodate diaphragm action in seismic zones and zones of high wind pressure.

Table 3a. Minimum steel reinforcement of lintels for 100 mm Arxx Wall

Opening Width (mm)	Lintel Depth (mm)	Factored Uniformly Distributed Load kN/m)													
		3		5		10		15		20		25		30	
		Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist
1000	250	1-15M	0	1-15M	0	1-15M	0	1-15M	0	1-15M	245	1-15M	300	1-15M	330
	400	1-15M	0	1-15M	0	1-15M	0	1-15M	0	1-15M	0	1-15M	0	1-15M	0
1500	250	1-15M	0	1-15M	0	1-15M	240	1-15M	410	1-15M	495	1-15M	550	1-15M	580
	400	1-15M	0	1-15M	0	1-15M	0	1-15M	0	1-15M	0	1-15M	400	1-15M	460
2000	250	1-15M	0	1-15M	0	1-15M	485	1-15M	660	1-15M	745	1-20M	800		
	400	1-15M	0	1-15M	0	1-15M	0	1-15M	410	1-15M	560	1-15M	650	1-15M	710
2500	250	1-15M	0	1-15M	220	1-15M	740	1-15M	915	1-20M	1000				
	400	1-15M	0	1-15M	0	1-15M	365	1-15M	660	1-15M	810	1-15M	900	1-20M	960
3000	250	1-15M	0	1-15M	470	1-20M	990								
	400	1-15M	0	1-15M	0	1-15M	615	1-15M	910	1-20M	1060	1-20M	1150	2-15M	1210
3500	250	1-15M	0	1-20M	735										
	400	1-15M	0	1-15M	0	1-15M	865	1-20M	1165	2-15M	1310	1-25M	1405		
4000	250	1-15M	0												
	400	1-15M	0	1-15M	0	1-20M	1120	1-25M	1420						
4500	250	1-15M	0												
	400	1-15M	0	1-15M	475	1-25M	1375								
5000	250	1-15M	285												
	400	1-15M	0	1-20M	735										

Note: Shaded area means not feasible. Specific design is required.

Table 3b. Minimum steel reinforcement of lintels for 160 mm Arxx Wall

Opening Width (mm)	Lintel Depth (mm)	Factored Uniformly Distributed Load kN/m)													
		3		5		10		15		20		25		30	
		Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist
1000	250	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	230
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0
1500	250	2-15M	0	2-15M	0	2-15M	0	2-15M	210	2-15M	345	2-15M	425	2-15M	480
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0
2000	250	2-15M	0	2-15M	0	2-15M	0	2-15M	460	2-15M	600	2-15M	675	2-15M	730
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	440	2-15M	535
2500	250	2-15M	0	2-15M	0	2-15M	435	2-15M	710	2-15M	845	1-25M	935	1-25M	990
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	550	2-15M	690	2-15M	785
3000	250	2-15M	0	2-15M	0	2-15M	685	1-25M	970						
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	565	2-15M	800	2-15M	940	2-15M	1035
3500	250	2-15M	0	2-15M	0	1-25M	955								
	400	2-15M	0	2-15M	0	2-15M	350	2-15M	815	2-15M	1050	2-15M	1190	3-20M	1290
4000	250	2-15M	0	2-15M	370										
	400	2-15M	0	2-15M	0	2-15M	600	2-15M	1065	1-25M	1305				
4500	250	2-15M	0												
	400	2-15M	0	2-15M	0	2-15M	850	3-30M	1330						
5000	250														
	400	2-15M	0	2-15M	0	3-20M	1120								

Table 3c. Minimum steel reinforcement of lintels for 200 mm Arxx Wall

Opening Width (mm)	Lintel Depth (mm)	Factored Uniformly Distributed Load kN/m)													
		3		5		10		15		20		25		30	
		Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist
1000	250	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0
1500	250	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	230	2-15M	340	2-15M	410
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0
2000	250	2-15M	0	2-15M	0	2-15M	0	2-15M	315	2-15M	485	2-15M	590	2-15M	660
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	410
2500	250	2-15M	0	2-15M	0	2-15M	220	2-15M	565	2-15M	740	1-25M	850	2-20M	920
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	365	2-15M	545	2-15M	660
3000	250	2-15M	0	2-15M	0	2-20M	470	1-25M	835	2-15M	1000				
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	615	2-15M	785	2-15M	910
3500	250	2-15M	0	2-15M	0	2-15M	750								
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	570	2-15M	865	2-15M	1045	1-25M	1170
4000	250	2-15M	0	2-15M	0										
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	820	2-20M	1125	3-20M	1305	2-25M	1420
4500	250	2-15M	0												
	400	2-15M	0	2-15M	0	2-15M	475	3-20M	1090	2-25M	1380				
5000	250	2-15M	0												
	400	2-15M	0	2-15M	0	2-20M	745								

Table 3d. Minimum steel reinforcement of lintels for 250 mm Arxx Wall

Opening Width (mm)	Lintel Depth (mm)	Factored Uniformly Distributed Load kN/m)													
		3		5		10		15		20		25		30	
		Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist	Bottom Steel	Stirrup End Dist
1000	250	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0
1500	250	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	240	2-15M	320
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0
2000	250	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	360	2-15M	490	2-15M	575
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0
2500	250	2-15M	0	2-15M	0	2-15M	0	2-15M	395	2-15M	610	2-15M	740	2-15M	845
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	365	2-15M	515
3000	250	2-15M	0	2-15M	0	2-15M	215	1-25M	645	1-30M	860				
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	395	2-15M	615	2-15M	765
3500	250	2-15M	0	2-15M	0	2-15M	465								
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	0	2-15M	645	2-15M	865	1-25M	1020
4000	250	2-15M	0	2-15M	0										
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	525	2-25M	895	1-30M	1130	2-25M	1280
4500	250	2-15M	0												
	400	2-15M	0	2-15M	0	2-15M	0	2-15M	775	2-15M	1175	2-30M	1395		
5000	250	2-15M	0												
	400	2-15M	0	2-15M	0	2-15M	0	2-30M							

Tables 3(a) 3(b), 3(c) and 3(d) are based on the following assumptions:

1. Tables 3(a) to 3(d) to be used in conjunction with Figure 3.
2. All materials and workmanship shall conform to the requirements of the NBC 1995 and its Revisions and Errata of the issue of these tables.
3. Lintel design and detailing bends, placement, spacing, splicing and protection of reinforcing in accordance with CSA A23.3 (R2000).
4. Deflection is limited to l/240.
5. Maximum lintel height/Depth (D) = 406 mm.
6. Reinforcing bars shall be hard grade deformed bars conforming to CSA-G30.12, Grade 400. Stirrups are single leg fabricated from 10M bars spaced at 125 mm o.c. for 250-mm-deep lintels and 240 mm o.c. for 400-mm-deep lintels.
7. Lintel reinforcing is located at bottom of the lintel and projects 600 mm into the lintel support on each side of opening.
8. Minimum 28 day concrete compressive strength is 20 MPa. Mix design in accordance with manufacturer's recommendations.

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