

**APPENDIX 3C – PLAIN MASONRY RETAINING WALLS**

**3C.1 THE USE OF THIS APPENDIX**

**3C.1.1 A1** When using this appendix it should be noted that:

- (a) It must be used in conjunction with Section 3;
- (b) If wall thickness is to be determined according to paragraph 3C.2, all appropriate design conditions given in this appendix must be satisfied;
- (c) Walls should comply with the relevant requirements of BS 5628, with the exception of the provisions given in paragraph 3C.3;
- (d) The guidance is based upon the minimum unit strength and gross density as given in Tables 3C.1 to 3C.18.
- (e) The walls in this Appendix are analyzed by consideration of forces and moments acting on simply supported members carrying lateral and vertical loads\*\*;
- (f) The guidance is also based on the provision of reinforcement required in accordance with this appendix to resist stresses at window openings or as may be required to control cracking.

**3C.2 THICKNESS OF WALLS**

**3C.2.1 A1** General wall thickness may be determined according to this appendix provided:

- (a) The conditions relating to the building of which the wall forms a part (paragraph 3.5), and
  - (b) The conditions relating to the wall (Table 3.1 and paragraphs 3.6 to 3.11.)
- are met.

**3C.2.2 A1** For external retaining walls, the thickness of wall should be not less than the minimum thickness\* of the wall or that otherwise required by Tables 3C.1 to 3C.18 subject to a tolerance of up to – 5 mm to allow for unit sizes.

**Table 3C.1** Minimum thickness for 2.7m high plain masonry retaining wall having 7N/mm<sup>2</sup> blocks or 10 N/mm<sup>2</sup> bricks with a weight of 1800 kg/m<sup>3</sup>

Soil type	h	Vertical dead load (KN/m)						
		55	45	35	25	15	5	
Required thickness of wall (mm) for given vertical load								
Granular	2.7	265	315	385	495	645	875	
	2.6	255	305	365	465	615	845	
	2.5	235	285	345	445	585	815	
	2.3		245	305	385	525	735	
	2.1			255	335	455	655	
	1.9			215	285	395	585	
	1.7				235	325	505	
	1.5					265	415	
	1.3		Min thickness* 200					345
	1.1							265
Clay	2.7	355	415	505	625	795	1045	
	2.6	335	395	475	595	765	1005	
	2.5	315	375	455	565	725	965	
	2.3	275	325	395	495	645	875	
	2.1	235	275	335	435	575	785	
	1.9		235	285	365	495	695	
	1.7			235	305	415	605	
	1.5				235	335	505	
	1.3		Min thickness* 200					265
	1.1							325

\* Minimum wall thickness may be reduced to 150 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

\*\* Ref: Kingston University. Plain Masonry Basement Walls. Final Report. Project 39/03/470 (cc1590). Kingston University. February 2000. 60pp.

**Table 3C.2** Minimum thickness for 2.7 m high plain masonry retaining wall having 7 N/mm<sup>2</sup> blocks or 10 N/mm<sup>2</sup> bricks with a weight of 1200 kg/m<sup>3</sup>

Soil type	h	Vertical dead load (KN/m)						
		55	45	35	25	15	5	
		Required thickness of wall (mm) for given vertical load						
Granular	2.7	275	325	405	525	715	1035	
	2.6	255	305	385	495	685	995	
	2.5	245	295	365	465	645	955	
	2.3		255	315	415	575	865	
	2.1		215	265	355	505	775	
	1.9			225	295	425	675	
	1.7				245	355	585	
	1.5					285	485	
	1.3		Min thickness* 200				215	395
	1.1						305	
Clay	2.7	365	435	535	675	895	1245	
	2.6	345	405	505	645	855	1195	
	2.5	325	385	475	605	815	1145	
	2.3	285	335	415	535	725	1035	
	2.1	235	285	355	455	635	925	
	1.9		235	295	385	545	815	
	1.7			235	315	455	705	
	1.5				245	365	585	
	1.3		Min thickness* 200				275	475
	1.1						375	

\* Minimum wall thickness may be reduced to 150 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.3** Minimum thickness for 2.7 m high plain masonry retaining wall having 7 N/mm<sup>2</sup> blocks or 10 N/mm<sup>2</sup> bricks with a weight of 600 kg/m<sup>3</sup>

Soil type	h	Vertical dead load (KN/m)						
		55	45	35	25	15	5	
		Required thickness of wall (mm) for given vertical load						
Granular	2.7	285	335	425	565	825	1355	
	2.6	265	315	405	535	785	1295	
	2.5	245	295	375	505	745	1245	
	2.3	215	255	325	445	655	1115	
	2.1		215	275	375	565	995	
	1.9			225	315	475	865	
	1.7				255	385	735	
	1.5					305	605	
	1.3		Min thickness* 200				235	485
	1.1						365	
Clay	2.7	375	455	565	745	1055	1635	
	2.6	355	425	535	705	1005	1575	
	2.5	335	395	505	665	955	1505	
	2.3	285	345	435	575	845	1355	
	2.1	245	295	375	495	725	1205	
	1.9		245	305	415	615	1055	
	1.7			245	335	505	905	
	1.5				265	405	745	
	1.3		Min thickness* 200				305	595
	1.1					215	455	

\* Minimum wall thickness may be reduced to 140 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.4** Minimum thickness for 2.7 m high plain masonry retaining wall having 3.5 N/mm<sup>2</sup> blocks or 5N/mm<sup>2</sup> bricks with a weight of 1800 kg/m<sup>3</sup>

Soil type	h	Vertical dead load (KN/m)					
		55	45	35	25	15	5
		Required thickness of wall (mm) for given vertical load					
Granular	2.7			385	495	645	875
	2.6			365	465	615	845
	2.5			345	445	585	815
	2.3				385	525	735
	2.1					455	655
	1.9					395	585
	1.7						505
	1.5						415
	1.3						345
	1.1						
Clay	2.7	355	415	505	625	795	1045
	2.6		395	475	595	765	1005
	2.5		375	455	565	725	965
	2.3			395	495	645	875
	2.1				435	575	785
	1.9				365	495	695
	1.7					415	605
	1.5						505
	1.3						415
	1.1						

\* Minimum wall thickness may be reduced to 215 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.5** Minimum thickness for 2.7 m high plain masonry retaining wall having 3.5 N/mm<sup>2</sup> blocks or 5N/mm<sup>2</sup> bricks with a weight of 1200 kg/m<sup>3</sup>

Soil type	h	Vertical dead load (KN/m)					
		55	45	35	25	15	5
		Required thickness of wall (mm) for given vertical load					
Granular	2.7			405	525	715	1035
	2.6			385	495	685	995
	2.5			365	465	645	955
	2.3				415	575	865
	2.1				355	505	775
	1.9					425	675
	1.7					355	585
	1.5						485
	1.3						395
	1.1						
Clay	2.7	365	435	535	675	895	1245
	2.6	345	405	505	645	855	1195
	2.5		385	475	605	815	1145
	2.3		335	415	535	725	1035
	2.1			355	455	635	925
	1.9				385	545	815
	1.7					455	705
	1.5					365	585
	1.3						475
	1.1					375	

\* Minimum wall thickness may be reduced to 215 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.6** Minimum thickness for 2.7 m high plain masonry retaining wall having 3.5 N/mm<sup>2</sup> blocks or 5 N/mm<sup>2</sup> bricks with a weight of 600 kg/m<sup>3</sup>

Soil type	h	Vertical dead load (KN/m)					
		55	45	35	25	15	5
		Required thickness of wall (mm) for given vertical load					
Granular	2.7		335	425	565	825	1355
	2.6			405	535	785	1295
	2.5			375	505	745	1245
	2.3			330	445	655	1115
	2.1				375	565	995
	1.9					475	865
	1.7					385	735
	1.5						605
	1.3		Min thickness* 325				
1.1						365	
Clay	2.7	375	455	565	745	1055	1635
	2.6	355	425	535	705	1005	1575
	2.5	335	395	505	665	955	1505
	2.3		345	435	575	845	1355
	2.1			375	495	725	1205
	1.9				415	615	1055
	1.7				335	505	905
	1.5					405	745
	1.3		Min thickness* 325				
1.1						455	

\* Minimum wall thickness may be reduced to 215 mm where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.7** Minimum thickness for 2.6m high plain masonry retaining wall having 7N/mm<sup>2</sup> blocks or 10 N/mm<sup>2</sup> bricks with a weight of 1800 kg/m<sup>3</sup>

Soil type	h	Vertical dead load (KN/m)						
		55	45	35	25	15	5	
		Required thickness of wall (mm) for given vertical load						
Granular	2.6	245	285	355	455	605	835	
	2.5	225	275	335	425	575	795	
	2.3	205	235	295	375	515	725	
	2.1		205	255	325	445	655	
	1.9			215	275	385	575	
	1.7				225	325	495	
	1.5					255	415	
	1.3		Min thickness* 190					345
	1.1						265	
Clay	2.6	322	380	461	576	745	992	
	2.5	303	358	435	546	710	953	
	2.3	264	314	383	484	637	870	
	2.1	226	269	330	421	561	782	
	1.9		225	277	357	484	691	
	1.7			226	294	406	598	
	1.5				234	330	505	
	1.3		Min thickness* 190					412
	1.1						322	

\* Minimum wall thickness may be reduced to 150 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.8** Minimum thickness for 2.6 m high plain masonry retaining wall having 7 N/mm<sup>2</sup> blocks or 10 N/mm<sup>2</sup> bricks with a weight of 1200 kg/m<sup>3</sup>

Soil type	h	Vertical dead load (KN/m)					
		55	45	35	25	15	5
		Required thickness of wall (mm) for given vertical load					
Granular	2.6	245	295	365	475	665	985
	2.5	235	275	345	455	635	945
	2.3	205	245	305	395	565	855
	2.1		205	255	345	495	765
	1.9			215	285	415	675
	1.7				235	345	575
	1.5					275	485
	1.3		Min thickness* 190				215
1.1						305	
Clay	2.6	335	395	485	625	835	1175
	2.5	315	375	455	585	795	1125
	2.3	275	325	405	515	705	1025
	2.1	235	275	345	445	625	925
	1.9		235	285	375	535	815
	1.7			235	305	445	705
	1.5				245	355	585
	1.3		Min thickness* 190				275
1.1					205	365	

\* Minimum wall thickness may be reduced to 150 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.9** Minimum thickness for 2.6 m high plain masonry retaining wall having 7 N/mm<sup>2</sup> blocks or 10 N/mm<sup>2</sup> bricks with a weight of 600 kg/m<sup>3</sup>

Soil type	h	Vertical dead load (KN/m)					
		55	45	35	25	15	5
		Required thickness of wall (mm) for given vertical load					
Granular	2.6	255	305	385	515	765	1275
	2.5	235	285	365	485	725	1215
	2.3	205	245	315	425	635	1105
	2.1		215	265	365	555	985
	1.9			225	305	465	855
	1.7				245	385	725
	1.5					305	605
	1.3		Min thickness* 190				225
1.1						365	
Clay	2.6	335	405	515	675	975	1545
	2.5	315	385	485	645	925	1475
	2.3	275	335	425	565	815	1345
	2.1	235	285	355	485	715	1195
	1.9		235	295	405	605	1045
	1.7			245	325	495	895
	1.5				255	395	745
	1.3		Min thickness* 190				295
1.1					215	455	

\* Minimum wall thickness may be reduced to 150 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.10** Minimum thickness for 2.6 m high plain masonry retaining wall having 3.5 N/mm<sup>2</sup> blocks or 5N/mm<sup>2</sup> bricks with a weight of 1800 kg/m<sup>3</sup>

Soil type	h	Vertical dead load (KN/m)					
		55	45	35	25	15	5
		Required thickness of wall (mm) for given vertical load					
Granular	2.6			355	455	605	835
	2.5			335	425	575	795
	2.3				375	515	725
	2.1				325	445	655
	1.9					385	575
	1.7					325	495
	1.5						415
	1.3						345
	1.1						
Clay	2.6	325	385	465	575	745	995
	2.5		355	435	545	715	955
	2.3			385	485	635	875
	2.1			335	425	565	785
	1.9				355	485	695
	1.7					405	595
	1.5					335	505
	1.3						415
	1.1						325

\* Minimum wall thickness may be reduced to 215 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.11** Minimum thickness for 2.6 m high plain masonry retaining wall having 3.5 N/mm<sup>2</sup> blocks or 5N/mm<sup>2</sup> bricks with a weight of 1200 kg/m<sup>3</sup>

Soil type	h	Vertical dead load (KN/m)					
		55	45	35	25	15	5
		Required thickness of wall (mm) for given vertical load					
Granular	2.6			365	475	665	985
	2.5			345	455	635	945
	2.3				395	565	855
	2.1				345	495	765
	1.9					415	675
	1.7					345	575
	1.5						485
	1.3						395
	1.1						
Clay	2.6	335	395	485	625	835	1175
	2.5	315	375	455	585	795	1125
	2.3		325	405	515	705	1025
	2.1			345	445	625	925
	1.9				375	535	815
	1.7					445	705
	1.5					355	585
	1.3						475
	1.1						365

\* Minimum wall thickness may be reduced to 215 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.12** Minimum thickness for 2.6 m high plain masonry retaining wall having 3.5 N/mm<sup>2</sup> blocks or 5 N/mm<sup>2</sup> bricks with a weight of 600 kg/m<sup>3</sup>

Soil type	h	Vertical dead load (KN/m)					
		55	45	35	25	15	5
		Required thickness of wall (mm) for given vertical load					
Granular	2.6			385	515	765	1275
	2.5			365	485	725	1215
	2.3				425	635	1105
	2.1				365	555	985
	1.9					465	855
	1.7					385	725
	1.5						605
	1.3						475
	1.1						365
Clay	2.6	335	405	515	675	975	1545
	2.5	315	385	485	645	925	1475
	2.3		335	425	565	815	1345
	2.1			355	485	715	1195
	1.9				405	605	1045
	1.7				325	495	895
	1.5					395	745
	1.3						595
	1.1						455

\* Minimum wall thickness may be reduced to 215 mm where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.13** minimum thickness for 2.5m high plain masonry retaining wall having 7N/mm<sup>2</sup> blocks or 10 N/mm<sup>2</sup> bricks with a weight of 1800 kg/m<sup>3</sup>

Soil type	h	Vertical dead load (KN/m)					
		55	45	35	25	15	5
		Required thickness of wall (mm) for given vertical load					
Granular	2.5	215	265	325	415	555	785
	2.3	195	225	285	365	495	725
	2.1		195	245	315	435	645
	1.9			205	265	375	575
	1.7				225	315	495
	1.5					255	415
	1.3					195	335
	1.1						265
	Clay	2.5	295	345	415	525	695
2.3		255	305	375	475	625	865
2.1		215	265	325	415	555	775
1.9		185	215	275	345	475	685
1.7				225	285	405	595
1.5					235	325	505
1.3						255	415
1.1						185	325

\* Minimum wall thickness may be reduced to 150 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.14** Minimum thickness for 2.5 m high plain masonry retaining wall having 7 N/mm<sup>2</sup> blocks or 10 N/mm<sup>2</sup> bricks with a weight of 1200 kg/m<sup>3</sup>

Soil type	<i>h</i>	Vertical dead load (KN/m)						
		55	45	35	25	15	5	
		Required thickness of wall (mm) for given vertical load						
Granular	2.5	225	265	335	435	615	925	
	2.3	195	235	295	385	545	845	
	2.1		205	255	335	475	755	
	1.9			215	285	405	665	
	1.7				235	345	575	
	1.5				185	275	485	
	1.3	Min thickness* 170					205	385
	1.1							295
Clay	2.5	295	355	435	565	775	1115	
	2.3	265	315	385	505	695	1015	
	2.1	225	265	335	435	605	915	
	1.9	185	225	275	365	525	805	
	1.7		185	225	305	435	695	
	1.5				235	355	585	
	1.3	Min thickness* 170				185	275	475
	1.1						195	365

\* Minimum wall thickness may be reduced to 140 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.15** Minimum thickness for 2.5 m high plain masonry retaining wall having 7 N/mm<sup>2</sup> blocks or 10 N/mm<sup>2</sup> bricks with a weight of 600 kg/m<sup>3</sup>

Soil type	<i>h</i>	Vertical dead load (KN/m)						
		55	45	35	25	15	5	
		Required thickness of wall (mm) for given vertical load						
Granular	2.5	225	275	345	465	695	1195	
	2.3	195	235	305	415	615	1085	
	2.1		205	255	355	535	965	
	1.9			215	295	455	845	
	1.7				235	375	725	
	1.5				185	295	595	
	1.3	Min thickness* 170					225	475
	1.1							355
Clay	2.5	305	365	465	615	895	1455	
	2.3	265	325	405	545	795	1325	
	2.1	225	275	345	465	695	1185	
	1.9	185	225	285	395	585	1035	
	1.7		185	235	315	485	885	
	1.5			185	255	385	735	
	1.3	Min thickness* 170				185	295	595
	1.1						215	455

\* Minimum wall thickness may be reduced to 140 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.16** Minimum thickness for 2.5 m high plain masonry retaining wall having 3.5 N/mm<sup>2</sup> blocks or 5N/mm<sup>2</sup> bricks with a weight of 1800 kg/m<sup>3</sup>

Soil type	<i>h</i>	Vertical dead load (KN/m)					
		55	45	35	25	15	5
		Required thickness of wall (mm) for given vertical load					
Granular	2.5			325	415	555	785
	2.3				365	495	725
	2.1				315	435	645
	1.9					375	575
	1.7					315	495
	1.5						415
	1.3						335
	1.1						
		Min thickness* 300					
Clay	2.5		345	415	525	695	935
	2.3			375	475	625	865
	2.1			325	415	555	775
	1.9				345	475	685
	1.7					405	595
	1.5					325	505
	1.3						415
	1.1						325
		Min thickness* 300					

\* Minimum wall thickness may be reduced to 215 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.17** Minimum thickness for 2.5 m high plain masonry retaining wall having 3.5 N/mm<sup>2</sup> blocks or 5N/mm<sup>2</sup> bricks with a weight of 1200 kg/m<sup>3</sup>

Soil type	<i>h</i>	Vertical dead load (KN/m)					
		55	45	35	25	15	5
		Required thickness of wall (mm) for given vertical load					
Granular	2.5			335	435	615	925
	2.3				385	545	845
	2.1				335	475	755
	1.9					405	665
	1.7					345	575
	1.5						485
	1.3						385
	1.1						
		Min thickness* 295					
Clay	2.5		355	435	565	775	1115
	2.3		315	385	505	695	1015
	2.1			335	435	605	915
	1.9				365	525	805
	1.7				305	435	695
	1.5					355	585
	1.3						475
	1.1						365
		Min thickness* 295					

\* Minimum wall thickness may be reduced to 215 mm below dotted line where window opening does not exceed 1.0 m from upper level of restraint

**Table 3C.18** Minimum thickness for 2.5 m high plain masonry retaining wall having 3.5 N/mm<sup>2</sup> blocks or 5 N/mm<sup>2</sup> bricks with a weight of 600 kg/m<sup>3</sup>

Soil type	$h$	Vertical dead load (KN/m)					
		55	45	35	25	15	5
		Required thickness of wall (mm) for given vertical load					
Granular	2.5			345	465	695	1195
	2.3			305	415	615	1085
	2.1				355	535	965
	1.9				295	455	845
	1.7					375	725
	1.5					295	595
	1.3	Min thickness* 285					475
	1.1						355
Clay	2.5	305	365	455	605	885	1445
	2.3		315	405	535	785	1315
	2.1			345	465	685	1175
	1.9				385	585	1025
	1.7				315	485	885
	1.5					385	735
	1.3	Min thickness* 285					585
	1.1						445

\* Minimum wall thickness may be reduced to 210 mm where window opening does not exceed 1.0 m from upper level of restraint

Note to tables 3C.1 to 3C.11:

1. These tables assume simple vertical span and thinner walls may be possible where appropriate two way action can be justified and determined by appropriate calculations.
2. These tables assume units and mortar in accordance 3C.3.5 to 3C.3.8 and thinner walls may be possible where higher strength materials are used and can be justified and determined by appropriate calculations.

### 3C.3 CONSTRUCTION MATERIALS AND WORKMANSHIP

**3C.3.3 A1** Any reinforcement used for structural purposes for controlling cracking in plain masonry walls should be Grade 500 deformed bars and the wall ties in paragraph 3A.3.1 should be Grade 250, complying with BS 4449, BS 6744 (steel types 304S31 and 316S33), or BS 970 (steel types 304S15, 304S31 and 316S33) as appropriate.

**3C.3.4 A1** The reinforcement indicated in paragraph 3C.3.3 should:

- (a) In buried masonry and masonry continually submerged in fresh water or external parts built where the exposure category given in Table 10 of BS 5628: Part 3 is 'Sheltered/moderate' or 'Moderate/severe', be of carbon steel;
- (b) In masonry exposed to freezing whilst wet, subjected to heavy condensation, or exposed to cycles of wetting by fresh water and drying out, or external parts built where the exposure category given in Table 10 of BS 5628: Part 3 is 'Severe' or 'Very severe', be of carbon steel galvanised following the procedure given in BS 729 to give a minimum mass of zinc coating of 940 kg/m<sup>2</sup>;
- (c) In masonry exposed to salt or moorland water, corrosive fumes, abrasion or the salt used for de-icing, be of austenitic stainless steel or carbon steel coated with at least 1 mm of stainless steel.

**3C.3.5 A1** The plain retaining wall of brick and block construction should be properly bonded and solidly put together with mortar and constructed of:

- (a) Clay bricks or blocks conforming to BS 3921; or
- (b) Calcium silicate bricks conforming to BS 187: or BS 6649; or

(c) Concrete bricks or blocks conforming to BS 6073: Part 1.

**3C.3.6 A1** The compressive strength of bricks and blocks, when tested in accordance with the appropriate British Standard, should be not less than the values given in Tables 3C.1 to 3C.18

**3C.3.7 A1** The weight of bricks and blocks, when tested in accordance with the appropriate British Standard, should be not less than the values given in Tables 3C.1 to 3C.18

**3C.3.8 A1** Mortar should be designation (i) or (ii) as given in BS 5628: Part 3, or 1:0 to ¼ :3 (cement : lime : sand) measured by volume of dry materials. A designation (iii) mortar may be used where the masonry is adequately protected to ensure a low risk of saturation (e.g as may be provided by an adequate external waterproofing system).

**3C.3.9 A1** Masonry should be adequate for the prevailing exposure conditions.

**3C.3.10 A1** Where there is no reinforcement to control cracking a check should be made on the water proofing system that it can cope with the possible cracks that may develop in the plain masonry.

**3C.3.11 GP** A vertical crack size of 1.2 mm should be appropriate when assessing the effects on the water-proofing system along the length of the wall. This assumes a crack spacing equal to the height of the wall and that care has been taken in protecting the materials and construction in accordance with the recommendations given in BS5628 Part 3. A horizontal crack width of 0.5 mm due to bending in the height of the wall may typically be considered.

**3C.3.12 A1** Assessment of crack width on the waterproofing system along the length of the wall will generally not be necessary where minimum horizontal reinforcement in accordance with 3A.3.11 is provided. Reinforcement will only generally be required in a horizontal direction since the masonry will typically be free to move in the vertical plane. However, consideration should be given to the provision of vertical reinforcement where vertical restraint can occur.

**3C.3.13 A1** Any reinforcement introduced for plain masonry walls in accordance with 3C.3.11 should comply with BS 4449, BS 6744 (steel types 304S31 and 316S33), or BS 970 (steel types 304S15, 304S31 and 316S33) as appropriate.

**3C.3.14 A1** The reinforcement as indicated in paragraph 3C.3.11 should be of carbon steel in buried masonry, masonry continually submerged in fresh water or external masonry. Where the masonry is exposed to sea water or flowing water with a pH less than or equal to 4.5, specialist advice should be obtained.

**3C.3.15 A1** Any bed joint reinforcement used to control cracking or bending should be of austenitic stainless steel positioned to maintain a cover of 15 mm both from the outside and inside faces of the masonry wall.

**3C.3.16 A1** The size and bar spacing of reinforcement to achieve the cross sectional areas in paragraphs 3B.3.5 to 3B.3.8 may be obtained from Table 3A.6.

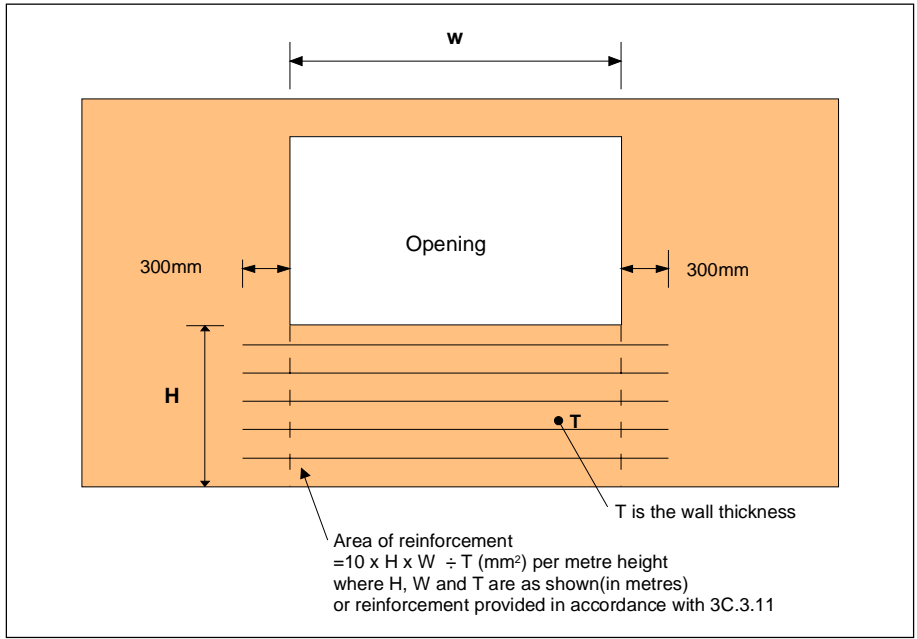
**3C.3.17 A1** The spacing of any reinforcement to control cracking should not exceed 500 mm.

**3C.3.18 A1** Any window openings in a plain masonry wall (and where reinforced solely to control cracking) should be limited in accordance with Table 3.2, 3.3 or 3.4 or as may be limited by Tables 3C.1 to 3C.18. Intermediate sizes may be determined by linear interpolation.

**3C.3.19.A1** Horizontal reinforcement should be positioned in accordance with Figure 3C.1 or reinforcement in accordance with Appendix 3B provided.

**3C.3.20 A1** The reinforcement in 3C.3.18 should be positioned on the inner face with a cover as given in 3C.3.14.

**3C.3.21 A1** Openings larger than in 3C.3.17 (up to 3.0m) may be introduced where shown adequate by appropriate calculations.



**Figure 3C.1** provision of reinforcement at openings