GUYANA STANDARD

Building Code of Guyana
Section 8: Concrete and block masonry

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GUYANA NATIONAL BUREAU OF STANDARDS

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Foreword

The Concrete and Block Masonry Section is divided as follows:

Part 1 - Reinforced Concrete Practice
Part 2 - Block Masonry Building – Design and Construction
Part 3 - Masonry other than Hollow Unit Masonry

These sections were taken from a draft of the original Caribbean Uniform Building Code Project (CUBIC) which was intended to form the basis for Building Codes revised to be more appropriate to the needs and the technical culture of individual Caribbean countries.

It was generally agreed that conciseness and easy of reference should characterise any document in general circulation. Accordingly, we considered it prudent to use the British Standards Institution (BSI) and the American Society for Testing Materials (ASTM) as sources of reference where particular procedures for testing were deemed necessary. In this way we were able to avoid lengthy summaries of well established criteria.

In addition, the Barbados Building Code and the Dominica Building Code were made available as guides to what was found acceptable in other parts of the Caribbean. They were useful, although their recommendations were already largely incorporated in our text, and only the form of presentation was amended to improve clarity. In particular, we found the sketches of construction detail in these cases worthy of emulation by such users of the Code who might not have ready access to advice from professional Architects or Engineers. This is of special application in the remoter areas of Guyana.

These sketches should be amended to suite our own practices and conditions, with the relevant acknowledgements made to incorporate them in our Code. It should be noted therefore that these sketches are not yet available but, on completion, would be included as a separate appendix.

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Section 8: Concrete and block masonry

1 Scope

The provisions of this Building Code Section shall govern the materials, control, design construction and quality of concrete and masonry used in structures.

2 Definitions

2.1 **admixtures:** Materials other than water, aggregate or hydraulic cement, used as an ingredient of concrete and added to concrete before or during its mixing to modify its properties.

2.2 **aggregate:** Granular materials, such as sand, gravel, crushed stone and iron blast furnace slag, used with a cementing medium to form a hydraulic cement concrete or mortar.

2.3 **cast stone:** A building stone manufactured from portland cement concrete precast and used as a trim, veneer or facing on or in buildings or structures.

2.4 **concrete:** A mixture of portland cement or any other hydraulic cement, fine aggregate, course aggregate, and water with or without admixtures.

2.5 **masonry:** A built-up construction or combination of building units of materials of clay, shale, concrete glass, gypsum, stone or other approved units bounded together with or without mortar or grout or other accepted method of joining.

2.6 **mortar:** A plastic mixture of approved cementitious materials, fine aggregates and water used to bond masonry or other structural units.

2.7 **plain concrete:** Structural concrete with no reinforcement or with less reinforcement than the minimum amount specified for reinforced concrete.

2.8 **precast concrete:** A structural concrete element cast elsewhere than its final position in the structure.

2.9 **prestressed concrete:** Structural concrete in which internal stresses have been introduced to reduce potential tensile stresses in concrete resulting from loads.

2.10 **reinforced concrete:** Structural concrete reinforced with not less than the minimum amount of prestressing tendons (e.g. wires, cables, rods, bars) or nonprestressed reinforcement as specified in AC I.

2.11 **reinforced masonry:** Masonry construction in which reinforcement acting in conjunction with the masonry is used to resist forces.

1.12 **solid Masonry:** Masonry consisting of solid masonry units laid contiguously with the joints between the units filled with mortar.

2.13 **Stone masonry:** Masonry composed of field, quarried, or cast stone units bonded by mortar.

2.14 **Structural concrete:** Concrete used for structural purposes including plain and reinforced concrete.

Part 1

3 Reinforced concrete practice

This part of the Concrete and Block Masonry Section of the Building Code does not cover the methodology of structural design, as this is considered to be the prerogative of a registered Engineer whose judgment would be appropriate to the circumstances. It deals with the aspect of construction practice in the use of reinforced concrete.

Likewise, details of the bending and placement of reinforcing bars have not been included as these are covered in many standard texts and there is no special consideration related to this country.

Prestressed is not a form of construction currently in use in Guyana and any standards in use elsewhere would not be of immediate application within the construction industry in Guyana. Such standards, appropriately modified, will form an addendum to this section when warranted.

Standard methods for testing materials which comprise reinforced concrete have not been included but it is recommended that the provisions of the American Society for Testing Materials (ASTM) or the British Standards Institution (BSI) be used.
Included as an appendix to this Section is a recommendation on the selection and use of aggregates of local origin.

3.1 Materials

3.1.1 Tests of materials

The Building Official or Contract Officer shall have the right to order testing of any materials used in concrete construction to determine if the materials are of the quality specified.

3.1.2 Tests of materials and of concrete shall be made in accordance with the standards of the American Society for Testing Materials or of the British Standards Institution.

3.1.3 A complete record of tests of materials and of concrete shall be available for inspection during progress of the work and for two years after completion of the project and shall be presented by the Inspecting Engineer or Architect for that purpose.

3.2 Cement

Cement shall conform to the specification for Portland Cement given by the Society for Testing Materials or the British Standards Institution.

3.3 Aggregates

3.3.1 Concrete aggregates shall normally conform to the specifications laid down by the American Society for Testing Materials or by the British Standards Institution. Aggregates failing to meet these specifications but which have been shown by special test or actual service to produce concrete of adequate strength and durability may be used when authorised by the Building Official or Contract Officer.

3.3.2 Nominal maximum size of coarse aggregates shall not be larger than:-

(a) 1/5 the narrowest dimension between sides of forms, nor;

(b) 1.3 the depth of slabs, nor;

(c) 3.4 the minimum clear spacing between individual reinforcing bars or bundles of bars.

3.3.3 These limitations may be varied if, in the judgement of the Engineer, workability and methods of consolidation are such that concrete can be placed without honeycomb or voids.

3.4 Water

3.4.1 Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be deleterious to concrete or reinforcement.

3.4.2 Non-potable water shall not be used in concrete unless the following are satisfied:-

(a) selection of concrete proportions shall be based on concrete mixes using water from the same source; or

(b) mortar test cubes made with non-potable drinking water shall have 7-days and 28-days strengths equal to at least 90% of strengths of similar specimens made with potable water.

3.5 Metal reinforcement

Reinforcement may consist of round steel bars, deformed or plain, interwoven or welded mesh fabrics in accordance with specifications of the American Society for Testing materials or the British Standards Institution.

3.6 Storage of materials

3.6.1 General considerations

There should always be an adequate supply of materials so that double handling on site is avoided. Precautions should be taken to prevent deterioration of materials during storage.

Advantage should be taken of any difference in level at the site which would facilitate the movement of materials. The fine aggregates should be kept separate from the coarse aggregates and as more coarse aggregates than fine is required, it is better to stack the forms as near as possible to the mixer.

3.6.2 Aggregates

Aggregates should be stored on a clean hard surface and not directly on the ground as, apart from wastage of material, mud and dirt may become mixed with the concrete. When a hard surface is not available it is advisable to spread a layer of weak concrete over the ground on which the aggregates are to be stored. This weak layer should be given a gradient to allow water from the aggregates to drain without collecting at the bottom of the heap.

3.6.3 Cement

Cement should be stored in a damp-proof and draught-free shed on a raised floor to prevent deterioration and should be used in the order in which it is received. Bags should not be stacked more than 1.5 m high to avoid set due to compaction. In the absence of a shed, bags should be stacked on a raised platform of boards and completely covered by tarpaulins which overlap generously.
Cement containing lumps should not be used unless the lumps can be crushed with the fingers.

3.6.4 Reinforcement

Reinforcing bars should be stacked on the site so that they do not become covered with mud and in a way that makes it easy for the bar-bender to find the various sizes and lengths required. When bars have been bent ready for fixing, each bundle should be clearly marked with a number corresponding to the bar list so that the steel fixer has no difficulty in selecting the correct bar.

4 Concrete quality

4.1 Specification of concrete

4.1.1 General

The characteristics of strength and durability of concrete can be varied in accordance with the design requirements of a particular structure. The Engineer or Architect would specify the quality required. For general guidance it is convenient to separate concrete mixes into classes related to design requirements.

4.1.2 Classification of concrete mixes

For the purpose of this Section of the Code the classes of concrete will be as follows:

(a) **Ordinary structural concrete**

Such concrete would have the normal ingredients of Portland Cement, aggregate and water as described in **3.2**, **3.3**, and **3.4** There shall be no additives.

(b) **Special structural concrete**

This is concrete containing special additives required to produce particular properties.

(c) **Designed mix**

In this class, the contractor would select the mix proportions to achieve the required strength and workability but the Engineer would specify the minimum cement content and any other properties required to achieve durability.

(d) **Prescribed mix**

In this class the Engineer will specify the mix proportions in order to provide the strength and durability required.

4.1.3 Grades of concrete

The grade of concrete will be determined by design requirements for strength and the conditions of exposure to which concrete is subjected. The following table defines the grades:

Grade use*	Characteristics + Strength N/mm^2	Lowest grade for in categories
7	70	Plain concrete
10	10.0	
15	15.0	Reinforced concrete with lightweight aggregate.
20	20.0	Reinforced concrete with dense aggregate.
25	25.0	

Note: * **This grading reference is taken from CP110 of the BSI.**

\+ **The characteristic strength is that determined from test cubes at 28 days.**

4.1.4 Minimum cement content

Durability of concrete is affected by its permeability. Appropriate low permeability is achieved by observance of the following:-

(a) low water cement ratio;

(b) good compaction of concrete mix;

(c) sufficient hydration of cement through proper curing.

4.1.6 Minimum cement content required for particular sizes aggregate is specified in **Table 2**.

4.1.7 Maximum cement content

A cement content greater than 550kg/m^3 should not be used because of the risk of cracking due to shrinkage of thin sections during drying or to thermal stresses in thicker sections.

4.1.8 Requirements for ordinary structural concrete as at a of 4.1.2

The workability of fresh concrete should be such as to enable ease of handling and placing so that on compaction would surround all reinforcement and completely fill the formwork without entrapping and producing honeycombing.

Workability should be assessed by the Slump Test or Compaction Factor Test.

4.1.9 Requirements for designed mixes as at c of 4.1.2

The concrete mix should be designed to have about the required minimum cement content and to have a mean strength greater than the characteristic strength shown at **4.1.3** by an acceptable margin.

Two thirds the characteristic strength will be an acceptable margin for determining the strength of the designed mix.

4.1.10 Requirements for prescribed mixes as at d of 4.1.2.

5 Production of concrete

5.1 General

The components of a concrete mix should be measured by weight except that aggregate may be measured by volume where weighing devices are not immediately available.

Water should preferably be measured by volume.

Mechanical mixers should be used at all times except for very small quantities of concrete where manual means may be used with specific permission from the Engineer or Architect or Building Official.

Water content of each batch of concrete should be adjusted to ensure workability in accordance with **Table 3**.

Mixing time shall be in accordance with the recommendations of the manufacturers of the mixing device.

5.2 Sampling and testing

Sampling for test purposes should be done at the rate of one sample for every 10 batches of mix.

Workability should be determined from the following criteria:

Slump test	± 25 mm	
	or	± 1/3 required value, whichever is greater.

Compacting Factor ± 0.03 when the required value is 0.90 or ± 0.04 when the required value is 0.90 but more than 0.80.

± 0.05 when the required value is 0.80 or less.

5.3 Mixing and placing concrete

5.3.1 Preparations before concrete placement shall include the following:

(a) all equipment for mixing and transporting concrete shall be clean;

(b) all debris shall be removed from spaces to be occupied by concrete;

(c) forms shall be properly coated;

(d) masonry filler units that will be in contact with concrete shall be thoroughly wetted;

(e) reinforcement shall be thoroughly clean of deleterious coatings;

(f) water shall be removed from the place of deposit;

(g) All Lattice and unsound material shall be removed from hardened concrete before additional concrete is placed against it.

5.3.2 Mixing

All concrete shall be mixed until there is a uniform distribution of materials and shall be discharged completely before mixer is recharged.

5.3.3 Ready-mixed concrete shall be mixed and delivered in accordance with requirements of Specification for Ready-Mixed Concrete" (ASTM C 94) or "Specification for Concrete Made by Volumetric Batching and Continuous Mixing" (ASTM C 685).

5.3.4 Job-mixed concrete shall be mixed in accordance with the following:

(a) Mixing shall be done in a batch mixer of approved type.

(b) Mixer shall be related at a speed recommended by the manufacturer.

(c) Mixing shall be continued for at least 1.5 min after all materials are in the drum, unless a shorter time is shown to be satisfactory by the mixing uniformity tests of Specification for Ready-Mixed Concrete" (ASTM C 94).

(d) Materials handling, batching, and mixing shall conform to applicable provisions of "specification for Ready-Mixed Concrete" (ASTM C 94).

(e) A detailed record shall be kept to identify:

(i) number of batches produced;

(ii) proportions of materials used;

(iii) approximate location of final deposit in structure;

(iv) time and date of mixing and placing.

5.4 Conveying

5.4.1 Concrete shall be conveyed from mixer to place of final deposit by methods that will prevent separation or loss of materials.

5.4.2 Conveying equipment shall be capable of providing a supply of concrete at site of placement without separation of ingredients and without interruptions sufficient to permit loss of plasticity between successive increments.

5.5 Depositing

5.5.1 Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing.

5.5.2 Concreting shall be carried on at such a rate that concrete is at all times plastic and flows readily into spaces between reinforcement.

5.5.3 Concrete that has partially hardened or been contaminated by foreign materials shall not be deposited in the structure.

5.5.4 Re-tempered concrete or concrete that has been remixed after initial set shall not be used unless approved by the Engineer.

5.5.5 After concreting is started, it shall be carried on as a continuous operation until placing of a panel or section, as defined by its boundaries or predetermined joints, is completed.

5.5.6 Top surfaces of vertically formed lifts shall be generally level.

5.5.7 All concrete shall be thoroughly consolidated by suitable means during placement and shall be thoroughly worked around reinforcement and embedded fixtures and into corners of forms.

5.6 Curing

5.6.1 Concrete (other than high-early-strength) shall be maintained above 10C and in a moist condition for at least the first 7 days after placement.

5.6.2 High-early-strength concrete shall be maintained above 10^0C and in a moist condition for at least the first 3 days.

5.6.3 Accelerated curing

5.6.3.1 Curing by high pressure steam, steam at atmospheric pressure, heat and moisture, or other accepted processes, may be employed to accelerate strength gain and reduce time of curing.

5.6.3.2 Accelerated curing shall provide a compressive strength of the concrete at the load stage considered at least equal to required design strength at that load stage.

5.6.4 Hot weather requirements

During hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures of water evaporation that may impair required strength or serviceability of the member or structure.

6 Formwork, embedded pipes, and construction joints

6.1 Design of formwork

6.1.1 Forms shall result in a final structure that conforms to shapes, lines and dimensions of the members as required by the design drawings and specifications.

6.1.2 Forms shall be substantial and sufficiently tight to prevent leakage of mortar.

6.1.3 Forms shall be properly braced or tied together to maintain position and shape.

6.1.4 Forms and their supports shall be designed so as to maintain position and shape.

6.1.5 Design of formwork shall include consideration of the following factors:-

(a) rate and method of placing concrete;

(b) construction loads, including vertical, horizontal, and impact loads;

(c) special form requirements for construction of shells, folded plates, domes, architectural concrete, or similar types of elements.

6.1.6 Forms for pre-stressed concrete members shall be designed and constructed to permit movement of the member without damage during application of pre-stressing force.

6.2 Removal of forms and shores

6.2.1 No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.

Sufficient strength shall be demonstrated by structural analysis considering proposed loads, strength of forming and shoring system, and concrete strength data. Concrete strength data may be based on tests of field-cured cylinders or, when approved by the Building Official, on other procedures to evaluate concrete strength. Structural analysis and concrete strength test data shall be furnished to the Building Official when so required.

6.2.2 No construction loads exceeding the combination of superimposed dead load plus specified live load shall be supported on any unshored portion of the structure under construction, unless analysis indicates adequate strength to support such additional loads.

6.2.3 Forms shall be removed in such manner as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not be to damaged thereby.

6.3 Conduits and pipes embedded in concrete

6.3.1 Conduits, pipes and sleeves of any material not harmful to concrete may be embedded in concrete with approval of the Engineer, provided they are not considered to replace structurally the displaced concrete.

6.3.2 Conduits and pipes of aluminum shall not be embedded in structural concrete unless effectively coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.

6.3.3 Conduits, pipes and sleeves passing through a slab, wall or beam shall not significantly impair the strength of the construction.

6.3.4 Conduits and pipes, with their fittings, embedded within a column shall not displace more than 4 percent of the area of cross-section on which strength is calculated or which is required for fire protection.

6.3.5 Except when plans for conduits and pipes are approved by the Structural Engineer, conduits and pipes embedded within a slab, wall or beam (other than those merely passing through) shall satisfy the following:

They shall not be larger in outside dimension that 1/3 the overall thickness of slab, wall or beam in which they are embedded.

They shall not be spaced closer than 3 diameters or widths on centre.

They shall not significantly impair the strength of the construction.

6.3.6 Conduits, pipes, and sleeves may be considered as structurally replacing in compression the displaced concrete provided:

They are not exposed to rusting or other deterioration.

They are of uncoated or galvanized iron or steel not thinner than standard schedule 40 steel pipe.

They have a nominal inside diameter not over 50 mm and are spaced not less than 3 diameters on centres.

6.3.7 In addition to other requirements of **Clause 6.3**, pipes that contain liquid, gas or vapor may be embedded in structural concrete under the following conditions:

Pipes and fittings shall be designated to resist effects of the material, pressure, and temperature to which they will be subjected.

Temperature of liquid, gas, or vapor shall not exceed 70^{o}C.

Maximum pressure to which any piping or fittings shall be subjected shall not exceed 1.5 MPa above atmospheric pressure.

All pipings and fittings except **Clause 7.3.7** shall be tested as a unit for leaks before concrete placement. Testing pressure above atmospheric pressure shall be 50 percent in excess of pressure to which pipings and fittings may be subjected, but minimum testing pressure shall not be less than 1 MPa above atmospheric pressure. Pressure test shall be held for 4 h with no drop in pressure except that which may be by air temperature.

Drain pipes and other piping designed for pressures of not more than 10kPa above atmospheric pressure need not be tested.

Pipes carrying liquid, gas, or vapor that is explosive or injurious to health shall be tested again as specified above after concrete has hardened.

No liquid, gas, or vapor except water not exceeding 30^{0} C nor 0.3 MPa pressure, shall be placed in the pipes until the concrete has attained its desired strength.

Concrete cover for pipes and fittings shall not be less than 40 mm for concrete exposed to earth or weather, or 20 mm for concrete not exposed to weather or in contact with ground.

Reinforcement with an area not less than 0.002 times area of concrete section shall be provided normal to piping.

Piping and fittings shall be assembled by welding, brazing, solder-sweating, or other equally satisfactory method. Screw connections shall not be permitted. Piping shall be so fabricated and installed that cutting, bending, or displacement of reinforcement from its proper location will not be required.

6.4 Construction joints

6.4.1 Surface of concrete construction joints shall be cleaned and laitance removed.

6.4.2 Immediately before new concrete is placed, all construction joints shall be wetted and standing water removed.

6.4.3 Construction joints shall be so made and located as not to impair the strength of the structure. Provision shall be made for transfer of shear and other forces through construction joints.

6.4.4 Construction joints in floors shall be located within the middle third of spans of slabs, beams, and girders. Joints in girders shall be offset a minimum distance of two times the width of interselecting beams.

6.4.5 Beams, girders, or slabs supported by columns or walls shall not be cast or erected until concrete in the vertical support members is no longer plastic.

6.4.6 Beams, girders, haunches, drop panels and capitals shall be placed monolithically as part of a slab system unless otherwise shown in design drawings or specifications.

7 Details of reinforcement

7.1 Standard hooks

The term "Standard hook" is used in this Code shall mean one of the following:-

7.1.1 180-deg bend plus $4d_b$ extension, but not less than 60 mm at free end of bar.

7.1.2 90-deg bend plus $12d_b$ extension, at free end of bar.

7.1.3 For stirrup and tie hooks:-

(a) 15 bar and smaller, 90-deg bend plus $6d_b$ extension at free end of bar; or

(b) 20 and 25 bar 90-deg bend plus $12d_b$ extension at free end of bar; or

(c) 25 bar and smaller, 135-deg bend plus $6d_b$ extension free end of bar.

7.2 Minimum bend diameters

7.2.1 Diameter of bend measured on the inside of the bar, other than for stirrups and ties in sizes 10 through 15, shall not be less than the values in **Table 6**.

7.2.2 Inside diameter of bend for stirrups and ties shall not be less than $4d_b$ for 15 bar and smaller. For bar larger than 15, diameter of bend shall be in accordance with **Table 6**.

7.2.3 Inside diameter of bend in welded wire fabric (smooth or deformed) for stirrups and ties shall not be less than $4d_b$ for deformed wire larger than D6 and $2d_b$ for all other wires. Bends with inside diameter of less than $8d_b$ shall not be less than $4d_b$ from nearest welded intersection.

7.3 Bending

7.3.1 All reinforcement shall be bent cold, unless otherwise permitted by the Engineer.

7.3.2 Reinforcement partially embedded in concrete shall not be field bent, except as shown on the design drawings or permitted by the Engineer.

7.4 Surface conditions of reinforcement

7.4.1 At the time concrete is placed, metal reinforcement shall be free from mud, oil, or other non-metallic coatings that adversely effect bonding capacity.

7.4.2 Metal reinforcement with rust, mill scale, or a combination of both shall be considered satisfactory, provided the minimum dimensions (including height of deformations) and weight of a hand-wire-brushed test specimen are not less than applicable ASTM specification requirements.

7.5 Placing reinforcement

7.5.1 Reinforcement and ducts shall be accurately placed and adequately supported before concrete is placed and shall be secured against displacement within the tolerances permitted.

7.5.2 Unless otherwise specified by the Engineer, reinforcement shall be placed within the following tolerances:

Tolerance for depth d, and minimum concrete cover in flexural members, walls and compression members shall be as follows:

	Tolerance on d	**Tolerance on minimum concrete cover**
$d \geq 200$ mm	± 10 mm	- 10 mm
$d \geq 200$ mm	± 12 mm	- 12 mm

Except that tolerance for the clear distance to formed soffits shall be minus 6 mm and tolerance for cover shall not exceed minus 1.3 the minimum concrete cover required in the design drawings or specifications.

Tolerance for longitudinal location of bends and ends of reinforcement shall be ± 50 mm except at discontinuous ends of members where tolerance shall be ± 12 mm.

7.5.3 Welded wire fabric (with wire size not greater than W5 or D5) used in slabs not exceeding 3 mm in span may be curved from a point near the top of slab at midspan, provided such reinforcement is either continuous over, or securely anchored at support.

7.5.4 Welding of crossing bars shall not be permitted for assembly of reinforcement unless authorized by the Engineer.

7.6 Spacing limits for reinforcement

7.6.1 Clear distance between parallel bars in a layer shall be not less than d_b nor 25 mm.

7.6.2 Where parallel reinforcement is placed in two or more layers, bars in the upper layers shall be placed directly above bars in the bottom layer with clear distance between layers not less than 25 mm.

7.6.3 In spirally reinforced or tied reinforced compression members, clear distance between longitudinal bars shall be not less than $1.5d_b$ nor 40 mm.

7.6.4 Clear distance limitation between bars shall apply also to the clear distance between a contact lap splice and adjacent splices or bars.

7.6.5 In walls and slabs other than concrete joist construction, primary flexural reinforcement shall be spaced not farther apart that three times the wall or slab thickness, nor 500 mm.

7.7 Concrete protection for reinforcement

7.7.1 Cast-in-place concrete

The following minimum concrete cover shall be provided for reinforcement:

		Minimum cover, mm
(a)	Concrete cast against and permanently exposed to earth.	70
(b)	Concrete exposed to earth or weather:	
	No. 20 through No. 55 bars	50
	No. 15 bar, W31 or D31 wire, and smaller	40
(c)	Concrete not exposed to weather or in contact with ground:	
	Slabs, walls, joists:	
	No. 45 and No. 55	40
	No. 35 bar or smaller	20
	Beans, columns:	
	Primary reinforcement, ties stirrups, spirals	40
	Shells, folded plate members:	
	No. 20 bar and larger	20
	No. 15 bar, W31 or D31 wire, and smaller	15

7.7.2 Precast concrete (manufactured under plant control conditions)

The following minimum concrete cover shall be provided for einforcement:

		Minimum cover, mm
(a)	Concrete exposed to earth or weather:	
	No. 45 and No. 55 bars	40
	No. 35 bar and smaller	20
	Other members:	
	No. 45 and No. 55 bars	50
	No. 20 through No. 35 bars	40
	No. 15 bar, W31 or D31 wire, and smaller	30
(b)	Concrete not exposed to weather or in contact with ground:	
	Slabs, walls, joists:	
	No. 45 and No. 55 bars	30
	No. 35 bar and smaller	15
	Beams, columns:	
	Primary reinforcement	d_b but not less than 15 and need not exceed 40
	Ties, stirrups, spirals	10
	Shells, folded place members:	
	No. 20 bar and larger	15
	No. 15 bar, W31 or D31 wire, and smaller	10

8 Precast concrete units

8.1 Handling and transport

Precast concrete should resist, without permanent damage, all stresses induced by handling, storage and transport. The minimum age for handling and transport should be determined by the design of the mix and its requirements.

8.1.1 The engineer should specify, preferably on design drawings, the positions of lifting and supporting points and the type of equipment to be used for transportation and lifting.

8.1.2 Points of support during storage must be specified and these should be chosen to prevent damage to or permanent distortion of the units. Supports may allow settlement but not induce stress within the units. When a stack is several units high, packing should be vertical above each other to prevent the development of stress in any of the units.

8.2 Assembly and erection

Methods of assembly and erection shall be specified as part of the design.

As soon as a unit is in position, and before the lifting equipment is removed, temporary supports or temporary connections between members should be provided. Temporary supports should have adequate structural properties to prevent collapse of the unit during erection. They shall not be removed until the required strength of the structure is attained.

8.2.1 Protection

At all stages, and until completion of the work, precast units should be properly protected to avoid damage to surface finish or disfigurement of the units placed together. Such protection could be provided by timber strips, Hessian etc.

9 Concrete floors

9.1 Materials

All materials and their processing required for the production of concrete shall conform to the requirements of this section.

9.2 General requirements

9.2.1 The concrete floor shall not be less than 10 cm thick and be supported on not less than 20 cm of compacted non plastic granular material. Such granular material may be sand, gravel or cracked stone. Care shall be taken to ensure that no oversize particles protrude above the compact surface in such a manner as to cause severe stress and cracking in the floor which may settle under subsequent loading.

9.2.2 As a protection against flooding, the finished surface of the floor should be locate not less than 30 cm above the highest recorded flood level in the immediate vicinity.

9.3 Damp proof course

9.3.1 A damp proof course of 500 gauge polythene or other approved materials shall be laid over the compacted floor foundation prior to casting the concrete floor.

9.3.2 Laps in the damp proof membrane shall not be less than 15 cm.

9.3.3 The damp proof course shall extend into the surrounding walls to prevent the rise of moisture in the walls unless other features are incorporated into the design of the walls to prevent such occurrence.

9.4 Reinforcement

9.4.1 Reinforcement shall be placed on the floor slab in accordance with the loading stresses determined during its design. Under no circumstances should the slab revision unreinforced. Nominal mesh reinforcement shall be placed in order to inhabit cracking and where necessary such reinforcement shall be placed 2–1/2 cm below the top of the slab.

9.5 Finishes

The slab should be floated immediately after pouring. Alternatively, a sand-cement screen not less than 2 cm thick may be applied to the rough surface of the concrete.

The surface must be cleared and washed before application of the screen. Proportions of 1 part of cement to 4 parts of sand, by volume, would be suitable.

9.6 Services

All pipes and conducts for services must be laid before the floor reinforcement is placed and must be so arranged that the required concrete cover to the reinforcement is maintained.

10 Recommendations concerning the selection and use of aggregates for concrete construction in Guyana

10.1 The economical use of concrete in Guyana depends largely on the selective application of local materials. Such local materials, coarse and fine aggregate, are required to be processed according to standards identified in this Code but there needs to be flexibility in judging their suitability and such suitability is determined largely by comparison with results achieved elsewhere in the production of concrete of good quality. It is therefore necessary to have such concrete construction designed and supervised by competent professionals.

10.2 General provisions

Aggregates shall be hard, clean and shall be from sources proven to provide strong and durable concrete locally. New or unproven aggregates shall not be used without substantiation of their fitness for the intended function.

10.3 Coarse aggregate

The traditional sources are centered around Bartica and are granites, gabbro, dolerites of gneisses. Sometimes there are schists.

All of these have an outward physical appearance of strength but the following precautions should be taken:

10.4 Flakiness

The flakiness index can sometimes be higher than recommended by the BSI. Although locally no limits are recognised it would be prudent to restrict the flaky particles to 35% of the weight of coarse aggregate.

In the interior districts such as the Rupununi, Mabura and the North West Districts, the use of laterite gravel has become increasingly popular because of its availability. It is recommended that lateritic gravels are screened and graded before use in reinforced concrete construction. For plain concrete, rigid gradation may not be necessary depending on the type of work to which it is applied.

10.5 Fine aggregate or sand

Sand from Timehri or Mahaica is very popular. Brown river sand is also available in good quantities. Sand from the seashore has heavy chloride content and is not to be recommended for ordinary work.

Gradations rarely conform to standards recommended and local practice has shown them to give reasonable results. If however, high quality concrete is required for a specific purpose then the appropriate mix design should give attention to the gradation of sand from the popular sources.

Part2

11 Block masonry building – design and construction

11.1 Block masonry - general

11.1.1 These requirements cover the use of hollow concrete blocks from Portland Cement, water and natural and use in load bearing walls.

11.2 Block units

11.2.1 Dimensions and tolerance

Concrete blocks shall be manufactured to standard nominal size:

400mm long x 200 mm high with a tolerance of ± 3mm in both dimensions.
Unit dimensions may include for one mortar joint of 3 mm in thickness.

Standard nominal thickness shall be 100 mm , 150 m or 22 mm

Other uses of block may be used provided that they conform with one of the standards for dimensioning used in this column and with Guyana National Building Code specifications for Hollow Concrete Blocks classifications.

Grade A-for load bearing and load bearing purposes, and Grade B-Special high attempt blocks for specific load bearing purposes.

11.3 Design

The design of block masonry structures must satisfy the structural performance criteria as set out in and in specifications below. This section applies to buildings in masonry including Block Masonry to them Concrete Block (HEB) made from Portland Cement, water and natural aggregate.

The standards and Specifications in this section are appropriate for block work subjected to moderate to heavy wondering stresses in load bearing and panel walls.

(a) in single and two storey buildings in the Residential Groups only constructed of Hollow Concrete Block (HEB) masonry, and:

(b) for buildings, the roof area of which done not exceed 230m^2 and provided that

(i) the building has alright-weight roof of metal, fibre cement or asphalt sheet, concrete or clay tiles and where the total weight of roofing, casting, insulation and other material supported by the trusses or rafters does not exceed 1.0 kN/m^2.

(ii) the unsupported height of any wall above the finished floor level is not more than 2.5 m and the height if any parapet or fine wall along the roof is not more than 1 m

(iii) the roof is adequately broaded or sheafted and securely fixed and tied down to resist lateral and uplift forces without undue distortion.

(iv) Roof trusses bearing on top of masonry walls bear clear span of not more than 9.7 m and rafters on tissues supported by a ledger bolted to the face of a masonry wall, have a clear span of not more than 5 m.

(a) the horizontal thrust at areas extended by sloping rafters that are not supported by internal walls is resisted by ceilings joists, ties, or collar ties or

(b) the horizontal thrust at eaves is resisted by reuse of restrained at intervals by abutting interior walls.

Note: **This specification provides for acceptable structural integrity and protection against structural failure but not from cracks and other minor damage**.

11.4 Certification

All applications for permission to build for block masonry structures, in whole or in part, carried out in accordance with these Specifications and Codes of Practice must be accompanied by a certificate from a registered architect or engineer.

Blocks shall be of two hole pattern and shall have a net cross sectional area not less that 50% nor greater than 60% of the gross sectional area. The thickness of face, shell and web shall be 35 mm.

Where open ended units are used, minimum web thickness shall be 35 mm.

11.5 Manufacture and physical requirements

The manufacture shall state the standard to which blocks are supplied, but in any case, specific requirements stated in this section shall take precedence over any other standard.

11.6 Absorption

Maximum absorption of water shall not exceed 208 kg/m^3 of normal weight concrete for Grade A blocks when tested in accordance with ASTM C140 (Sampling and testing).

11.7 Compression test

Test for compression strength of blocks shall be made with cells vertical and shall be made at 28 days in accordance with the corresponding standard listed.
Stress at failure is based on gross area of section of the specimen. A test shall be carried out for each 5000 blocks or part thereof. Each test shall consist of 5 blocks.

11.8 Suggested strengths for hallow concrete masonry units

Designation	Average of 5 blocks	Lowest individual Block
Grade 1	1500	1000 p.p.m
Grade 2	700	600 p.p.m

11.9 Mortar and cement

11.9.1 Mortar for block joints shall be proportioned with parts of volume of cement: sand as follows:-

1 part cement: 3 parts sand

to achieve a minimum compressive strength on 150 mm cube at 28 days of 10N/mm^2 Portland Cement shall comply with BNS69.

11.9.2 Mortar for block work shall be proportioned with 1 part cement (Portland): 2 parts line: 4 parts sand by volume to achieve a minimum compression strength of 150 mm cubes at 28 days of 10N/MM^2.

Note: The line is optional. Where ordinary plasticiser is used, the line portion of the mix shall be omitted.
Portland Cement used shall comply with GNBS approved Portland Cement (Ordinary and Rapid Hardening).

11.10 Concrete infill of cavities

11.10.1 Concrete for filling block cavities shall be a nominal mix of parts by volume of current: fine aggregate: coarse aggregate as follows:
1 part cement:3 parts sand:6 parts coarse aggregate, to achieve a minimum compressive strength on 150 mm cubes at 28 days of 15N/mm^2.

Note: (1) **Max aggregate size shall be 20 mm but in no case greater than ¼ % the minimum dimension of the cavity**.

(2) **Water/cement ratio may exceed conventional ratios for normal concrete, provided that slumps specified by GNBS for tips are not exceeded.**

(3) **Infill concrete may be proportioned in accordance with the rules in the Sub-Section for normal reinforced concrete provided that the required specification are achieved.**

The infill concrete and grout shall have a consistency to fill all spaces but slumps shall be between 115 mm and 230 mm.

11.12 Reinforcing steel

11.12.1 (a) Reinforcing steel shall comply with GBNS approved.

Reinforcing steel for steel fabric for the reinforcement of concrete.

Reinforcing hard drawn mild steel wire for the reinforcement of concrete.

Reinforcing specification for carbon steel bars for the reinforcement of concrete.

(b) Horizontal bed reinforcement shall comply with the relevant parts of B.S. 5628.2 - Structural use of reinforced and prestressed masonry.

(c) Reinforcement bans shall be clean of rust, grease, dirt, stale, hardened cement and other deleterious substances casting.

11.13 Water

Water for mixing of concrete and mortar shall be from the mains and shall otherwise be clean and free form injurious amounts of salts, oil, acid alkali, organic or inorganic matter and other harmful substances.

11.14 Storage, curing and protection

Blocks, cement, lime and aggregate shall be stored in an appropriate manner until use.

Note: **Blocks should be stacked under cover in a dry place which is not in contact with ground but should but should be daily sprinkled with clean water from a hose after the initial set has taken place.**

11.15 Construction

11.15.1 Footings

(a) All walls shall provide with footings and starter bars shall be embedded therein. Footing shall be designed to resist ground, bearing preserver to superlatives and to resist settlement to acceptable limits with size depth and reinforcement where necessary in accordance with requirements for the design and construction of footings for buildings.

The top of the footings shall be rough finished with at least 3 mm amplitude to provide bond with the first course of blocks, and kept clean and free of loose concrete and deleterious substances prior to commencement of block laying.

Where the site may be subjected to flooding, greater protection from moisture penetration and greater structural integrity can be obtained by casting instiu with the footing and upstand or foundation wall to height of 150 mm above the highest recorded flood level.

Footings and concrete upstand or foundation walls may be provided with steel reinforcement and starter bars as conditions demand.

11.16 Laying and bond

Thickness of block masonry walls between effective restraints shall be such that the ratio of height to thickness does not exceed 25 for any wall with a minimum of

(i) 150 mm for exterior walls and fire walls.

(ii) 100 mm for interior non load bearing walls subject to reqments for grouted and reinforced joints and cavities.

(b) Blocks shall be laid with mortar across all webs and face shells in vertical joints in general stretcher or running bond. Blocks shall be strung over vertical reinforcing bars in place, or bars may be inserted into cavities of blocks ensuring a lap of at least 200 mm.

(c) Load bearing blocks walls shall be reinforced vertically within minimum 100 mm m.s bars at 800 mm centres throughout the walls.

(d) Mortar joint thickness shall be 10 mm with tolerance 3 mm subject to a minimum thickness necessary to accommodate any horizontal reinforcement.

(e) Where stack bond is specified for load bearing walls, special horizontal reinforcement shall be provided as determined by the designing Engineer or Architect.

11.17 Embedded pipes and conduits

(a) No horizontal or diagonal chases for pipes or conduits shall be permitted unless specified by the designing Engineer or Architect.

(b) Any vertical pipes or conduits to be inserted shall preferably be installed within the wall cavity during construction thus avoiding any cutting to damage to the wall surface.

(c) Where unavoidable, vertical chases may be cut for a conduit or pipe not exceeding 12 mm diameter, provided the maximum dimension of the chase is not more than 40 mm and concrete cover to the pipe or conduit is not less than 12 mm.

Where a chase is cut into the face shall of an unfilled cavity, the cavity shall be filled with concrete grout after the pipe or conduit is inserted.

11.18 Concrete grout infill

(a) Concrete grout or infill shall be poured in the cavities of all load bearing block walls and thoroughly rammed and consolidated using a 16 mm diameter rod or similar device.

(b) Each lift of concrete infill shall terminate at least 12 mm below the top of the block to ensure a lateral key.

11.19 Support during a construction

11.19.1 Rate of construction

(a) HCB units shall be placed while mortar is still soft and plastic. Mortar shall be discarded if not used within:-

(i) 2 hours where cement: line ratio is 2.0 or less

(ii) 1 hr where current line ratio is more than 2.0.

(b) The minimum period which shall elapse before loads other than own weight loads can be applied to a newly constructed block wall shall be determined from the design loading conditions, but in no case shall be less than 4 days.

(c) Concreting of block cavities shall proceed at intervals not exceeding 600 mm in height, or 3 courses, which ever is greater.

11.19.2 Temporary bracing of walls

During construction of a building, block masonry walls shall be adequately braced against overturning during high wind conditions.

Where under normal conditions up to wind speed of say 50 kmh the unbraced height of a wall subject to wind pressure during construction should not exceed

4 m	for 200 mm	thick walls
2.5 m	for 150 mm	thick walls, or
1 m	for 100 mm	thick walls.

11.19.3 Lintels and reinforcement at openings

Lintels seating in block walls shall be a minimum of 250 mm and the size of lintels shall be as follows:

Size of concrete lintels

Span of lintel metres	Size w x d (mm)	Top and bottom reinforcement (placed with 25 mm cover)
Up to 1.0	150 x 200	2 x 8 mm bars
1.0 to 1.8	200 x 200	3 x 8 mm bars
1.8 to 2.4	200 x 300	3 x 12 mm bars

Note:

1. **Strength of concrete to be not less than 20 MPa.**

2. **Concrete masonry reinforced lintel or bond beam blocks may be used instead of reinforced concrete lintels.**

(b) Where no reinforced concrete stiffener column is adjacent to an opening, block cavities immediately adjoining the opening shall have at least one vertical reinforcement bar of at least 12 mm diameter and the cavities shall be filled with concrete grout.

(c) A minimum of 12 mm diameter bar, or equivalent cross sectional area of smaller bars, shall be placed horizontically in the mortar joint adjacent to the sill for all openings and shall extend not less than 600 mm beyond the edge of the opening. Bars may be inserted in a ring beam or in ordinary blocks where the top of webs have an appropriate recess.

(d) Any sectional of a load-bearing block masonry wall between openings shall be not less than 400 mm long, otherwise steel or reinforced concrete column shall be used.

11.19.4 Stiffener columns

(a) In block masonry walls which exceed an area of 23m^2 between cover walls or other lateral support, stiffener columns shall be provided at not more than 6 mm intervals.

Such columns shall be at least 300 mm in width and maximum thickness not less than that of the walls.

(b) Stiffener columns and ring beams shall be cast after adjacent block walls have been built up to beam level. Half blocks shall be used at junctions with stiffener columns to complete bond courses. Alternatively blocks may be cut to a neat vertical line such as that made with a mechanical saw provided at least 2 webs are left intact.

(c) Concrete stiffener columns shall be poured and vibrated in lifts not exceeding 1.8 m. If necessary openings shall be provided in full height forms to facilitate this.

(d) Reinforcement in stiffener columns shall have a cover of 25 mm minimum and

(i) comprise a minimum of 4 vertical bars of 12 mm diameter m.s. or of an area 0.010 times the gross cross-sectional area of the concrete.

(ii) be tied with 6 mm in diameter stirrups spaced not more than 300 mm apart and not more than 150 mm from any beam supported by the column.

(iii) have vertical bars anchored to the footing and belt beam, with splices lapped 30 bar diameters for deformed bars and 40 diameters for plain bars.

(iv) structurally designed columns may be substituted for the stiffener columns herein required.

11.19.5 Ring or belt beams

(a) Belt beams of reinforced concrete shall be placed in all walls of unit masonry at each floor or roof level and at such intermediate level as may be required to limit the vents and height of the masonry panel to 5 m.

Bond beams may be used in lieu of poured concrete belt beams.

(b) Arming beams shall be not less than 200 mm in depth and not less in width than the wall supporting it.

(c) Ring beams shall be cast after adjacent block walls have been built to beam level. Precaution shall be taken to seal any specified infill cavities to prevent loss of concrete from ring beams during casting.

(d) Reinforcement in ring beams shall have a cover of at least 25 mm and

(i) comprise at least 4 steel bars of 12 mm diameter placed two at the top and two at the bottom of the beam.

(ii) be tied with 6 mm in diameter stirrups spaced not more than 300 mm apart on the depth of the beam, whichever is less.

(iii) be continuous horizontally with splices spaced at least 600 mm or 30 mm diameters for deformed bars and 40 mm for plain bars.

(e) Vertical reinforcement in block walls and columns shall be continuous through or be fully anchored within the ring beam.

(f) any change of level of a ring beam shall be made at a column. A ring beam may follow the rake of a roof gable end.

(g) the concrete in ring beams shall be placed to bond with the masonry units and shall not be separated therefrom by wood, felt or nay other material which may prevent bond.

Part 3

12 Masonry other than hallow unit masonry

12.1 General

Masonry other than hollow unit masonry shall be designed in accordance with the foregoing sections of the Building Code except for the specific requirements set out in this Sub-Section.

12.2 Materials

12.2.1 Reference documents

The following standards apply tentatively to masonry materials and the testing thereof.

ASTM C90 – 85	Specification for Hollow load –bearing concrete masonry units.
ASTM C129 – 85	Specification for New load bearing concrete masonry units.
ASTM C145 – 75 (1981)	Specification for Solid-load-bearing concrete masonry unit.
ASTM C55 – 85	Specification for Concrete building block.
ASTM C140 –75 (1988)	Method of Sampling and testing concrete masonry units.
ASTM C34 – 84	Specification for Structural clay loan-bearing wall tile.
ASTM C212 – 60 (1986)	Specification for Structural clay facing tile.
ASTM C56 - 71 (1986)	Specification for Structural clay non-loading bearing tile.
ASTM C57 – 57 (1983)	Specification for Structural clay floor tile.

12.2.2 Concrete masonry units

Hollow load bearing	ASTM C90
Solid Load bearing	ASTM C145
Hollow non-load bearing	ASTM C129
Brick	ASTM C55
Method of Test	ASTM C140.

12.2.3 Structural clay bricks and blocks

For walls	-	load bearing	ASTM C34, C212
For walls	-	non load bearing	ASTM C56
For floors or pavements			ASTM C57.

12.2.4 Criteria for masonry units

Masonry units shall be of a type, quality and grade consistent with the applicable provisions and extent of the referenced documents considering:

(i) the extended usage such as structural or non-structural.

(ii) the surrounding environment, such as the presence of water, contact with the ground, exposure to the weather and/or enclosure within a building.

12.2.5 Initial rate of absorption

At the time of laying, burnt clay units shall have a rate of absorption not exceeding 0.12 ml per square centimetre during a period of one minute.

In the absorption test the surface of the unit shall be 3 mm below the surface of the water. Water content shall be that of the units to be laid. Units shall not be dried.

12.2.6 Re-use of masonry units

Masonry units may be re-used when clean, whole and in conformity with the requirements of this section. Conformity must be established by tests of representative samples.

12.3 Cast stone

Every unit of cast stone more than 460 mm in any dimension shall conform with the requirements for concrete in Part 1.

12.4 Natural stone

Natural stone shall be sound, clean and in conformity with other provisions of this Sub-Section.

12.5 Shrinkage of concrete units

Concrete masonry units used for structural purpose shall have a maximum linear shrinkage of 0.065 per cent from the saturated to the over-dry condition.

12.6 Types of construction

The types of masonry construction described in clause B.102.1 may be used for structure or non-structural purposes and the type of masonry construction in B.102.2 may be used for non-structural purposes subject to requirements of Parts 1 and 2.

12.7 Stone masonry

Stone masonry is that form of construction made with natural or cast stone with all joints thoroughly filled. In ashlar masonry bond stones uniformly distributed shall be provided to the extent of not less than 10 percent of the area exposed faces.

Rubble stone masonry 600 mm or less in thickness shall have bond stones with a maximum spacing of 1 m horizontally and 1 m vertically, and if the masonry is of greater thickness than 600 mm, shall have one bond stone for each 0.6 m^2 of wall surface on both sides.

12.8 Solid masonry

Solid masonry shall be solid concrete or clay brick units laid contiguously in mortar. The bonding of adjacent wythes in bearing and non-bearing walls shall conform to specified methods.

12.9 Metal ties

The facing and backing shall be bonded with corrosion resistant unit metal ties or cross wires or approved joint reinforcement for cavity walls. Unit thies shall be of sufficient length to engage all wythes, with ends embedded not less than 25 mm in mortar, or shall consist of two lengths, the inner embedded ends of which are hooked and lapped not less than 50 mm.

Note:

1. **The thickness of plaster castings may be considered in satisfying thickness ratios and minimum thickness requirements but shall not be used to take stresses.**

2. **These thicknesses may be reduced to 150 mm for grouted walls and 200 mm for solid masonry walls in one-storey buildings when the wall is not more than 2.75 mm in total height, provided that when gable construction is used an additional 1.8 m in height is permitted to the peak of the gable.**

12.10 Minimum requirements for walls of brick or stone masonry

12.10.1 Lateral supports - slenderness – openings

(a) Every wall shall be supported at right angles to the wall face by other walls, columns or buttresses.

(b) The distance between such lateral supports for walls shall not exceed:

(i) for load bearing walls - 20 times the wall thickness for bricks, 14 times wall thickness for stone.

(ii) for non-load bearing walls - 30 times wall thickness.

For purposes of this clause, wall thickness shall be taken to the thickness excluding any surface finish or rendering.

(c) In any unframed building other than a garage:

(i) the total width of openings in any wall shall not exceed one half of the length of that wall.

(ii) the total width of openings in the external walls of any storey shall not exceed on third of the length of the external walls of that storey.

(iii) the horizontal distance between openings in a wall shall not be less than:

(a) twice the thickness of the wall or

(b) one third the width of the wider opening or

(c) 500 mm whichever is greater.

(iv) the horizontal distance between opening of a load bearing wall and any corner of a wall or wall intersection shall not be less than:

(a) twice the thickness of the wall or

(b) 500 mm whichever is greater.

12.11 Construction requirements for average to good ground conditions

Note: **In every case it is required that walls be so constructed as to allow floor levels adjacent to them to be above the highest recorded flood level in the particular location.**

12.12 General requirements

Single storey buildings

External walls and other load bearing walls shall be constructed of either:-

(i) Masonry set in mortar and not less than 400 mm thick, or

(ii) Burnt clay bricks set in mortar and not less than 210 mm thick.

12.13 Two storey buildings

External walls and other load bearing walls two storeys high shall have the upper storey constructed to comply with requirements for walls not exceeding 2.75 m high as set out in Table 7. The lower walls shall be constructed of:

(i) Masonry set in mortar and not less than 450 mm thick; or

(ii) Burnt clay bricks set in mortar and not less than 210 mm thick.

12.14 Construction details - stone masonry

(i) The part of the building on which the wall stands shall be roughened and cleaned to provide a good bond;

(ii) The stones shall be set in mortar not weaker than a mix of 1:4 (cement to sand);

(iii) All joints shall be completely filled with mortar which shall be promptly used after mixing;

(iv) All stones shall be wetted before being laid;

(v) All walls shall be plumb and correctly bonded to corners, columns and other walls.

12.15 Construction details - brick walls

(i) Bricks shall be wet burnt sound, square edged and correct to shape and size within a tolerance of ± 6 mm.

(ii) Blocks and bricks shall be set in mortar not weaker than the mix specified and all joints shall be completely filled with mortar which shall be used promptly after mixing.

(iii) Where specified, expanded metal or other reinforcement shall extend the entire width of wall, less 25 mm cover on each side.

(iv) Reinforcement, where specified, shall be tied or otherwise securely fixed to vertical reinforcement at either end.

(v) Reinforcement, where specified, shall have an overlap not less than 300 mm at laps.

12.16 Belt beams

A. General requirements

Belt beams are required for all walls constructed of stone masonry or bricks other than infilling walls or curtain walls of framed buildings.

(i) there shall be a suitable continuously reinforced concrete belt beam on top of each wall.

(ii) there shall be another belt beam at the level of each floor which is suspended above ground level; provided that where the floor is of reinforced concrete the belt beam may be designed as part of the floor.

(iii) each belt bean shall be suitably connected to the walls or any other parts of the building on which it rests or which rests on it.

(iv) each belt beam shall extend over the full width of wall.

TABLE 2

Minimum cement content required in Portland cement concrete to ensure durability under specified conditions of exposure.