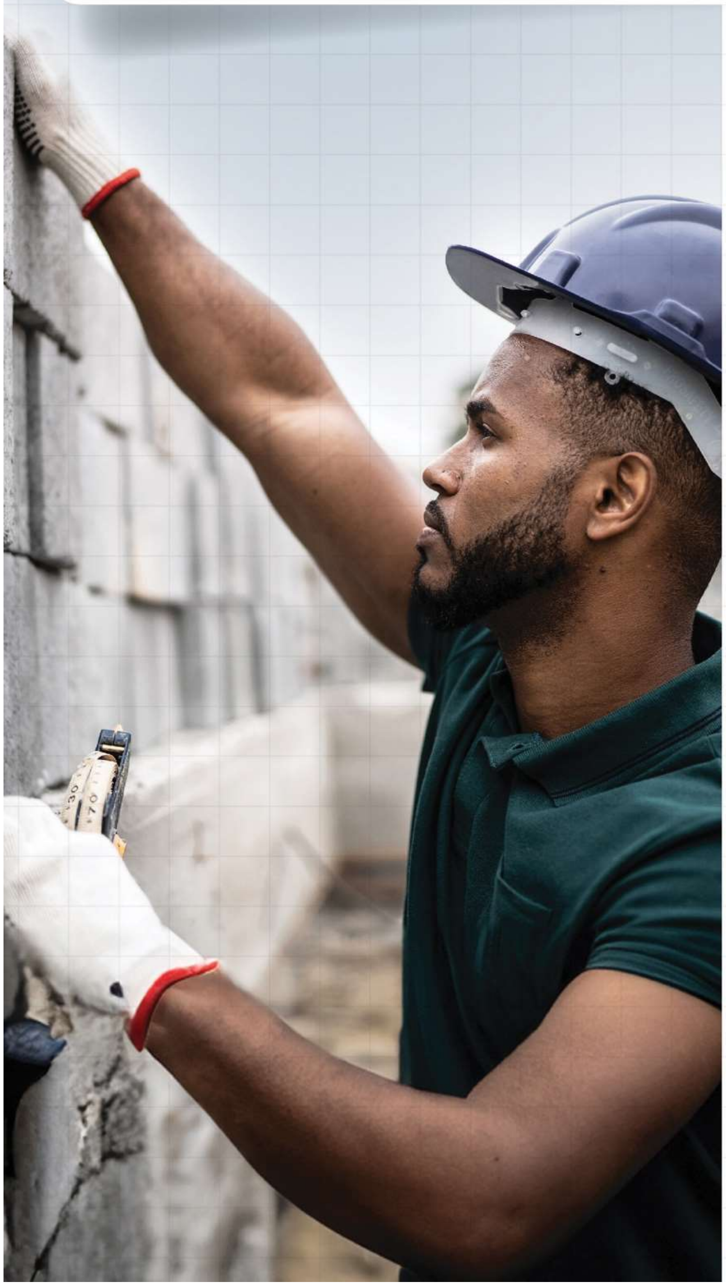
CARICOM REGIONAL ORGANISATION FOR STANDARDS & QUALITY
CROSQ

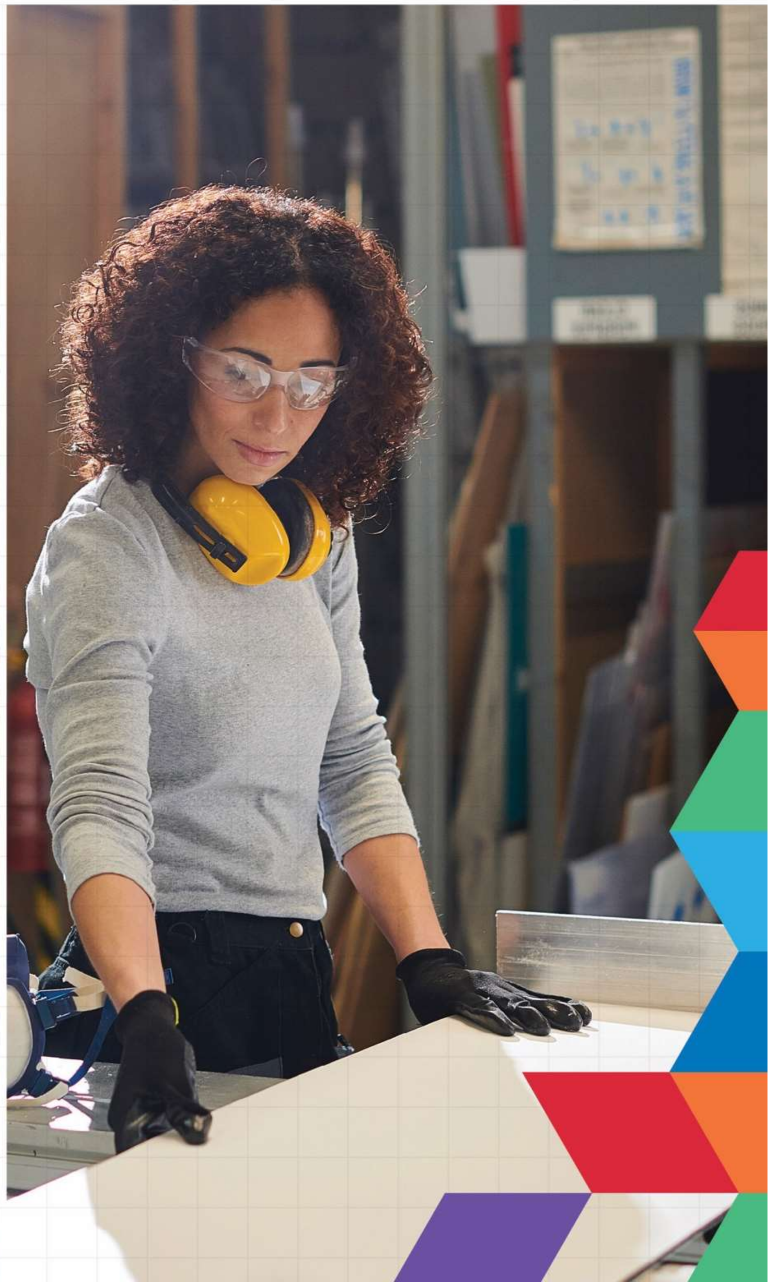
CDEMA
CARIBBEAN DISASTER EMERGENCY MANAGEMENT AGENCY

CARICOM REGIONAL CODE OF PRACTICE

CONSTRUCTION OF HOUSES

CRCP 10: 2023





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Preface

The economic cost of disasters in the Caribbean has been substantial, exceeding US$28 billion over the last seven decades. Between 1950 and 2016 these costs surpassed $22 billion (in constant 2009 dollars)[1]. Since then, several other hazards have wreaked havoc in the region. Some of the costliest disasters include Hurricane Maria in 2017, which resulted in $1.3 billion in damages and losses in Dominica[2]. In 2019, Dorian, the strongest hurricane on record to affect The Bahamas, resulted in $3.2 billion in damages and losses[3]. In 2021, the eruption of La Soufrière resulted in $233 million in damages and losses[4] in Saint Vincent and the Grenadines. That same year, on August 14th, a 7.2 magnitude earthquake affected the southern peninsula of Haiti resulting in more than $1.6 billion in damages and losses. At least 137,500 buildings were damaged or destroyed.[5] Disasters are costly, and they also take lives. In the Caribbean, more than 250,000 people were killed from disasters over the period 1950 to 2022[6]. The August 2021 Haiti-earthquake resulted in 2,246 deaths, 12,763 injured and 329 missing persons. More than 660,000 people were affected.

Post disaster damage and loss assessments reveal that in the Caribbean, a significant portion of damage from disasters has been in the housing sector. Moreover, much of this damage could be avoided as repeatedly, the application of building codes was found to be inconsistent and there was weak to no legislation in place to address safe building. Poor building practices were evident as was the absence of sensitization to safe building practices. There are also indications that a substantial portion of the housing stock in the Caribbean has been built through the informal construction sector which does not necessarily adhere to formal building codes and standards. Moreover, many practitioners within the informal sector, in most instances, have never received formal skills training or certification. These realities provide the basis for the development of the CARICOM Regional Standard CRS 10: 2023, Construction of Houses — Code of Practice.

As the regional inter-governmental agency for disaster management in the Caribbean Community (CARICOM), the Caribbean Disaster Emergency Management Agency (CDEMA) is the facilitator, driver, coordinator and motivating force for the promotion and engineering of Comprehensive Disaster Management (CDM) in its nineteen (19) Participating States, which encompasses the 15 CROSQ Member States. CDM requires leadership by all people and sectors in building the resilience of the region. This ethos underpins the Regional CDM Strategy and Results Framework 2014-2024. CROSQ is responsible for developing CARICOM Regional Standards[7] including building codes that are approved by the Council for Trade and Economic Development (COTED) of CARICOM. CROSQ plays a critical role in advancing the regional goal of a *Safer, more resilient and sustainable CDEMA Participating States through Comprehensive Disaster Management* " and is contributing to achieving Pillar II, *Safeguarding Infrastructure,* of the "Caribbean Pathway for Building Resilience' adopted by CARICOM Heads of Government in July 2018.

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[1] İnci Ötker and Krishna Srinivasan (2018) Bracing For The Storm, Finance & Development, March 2018, Vol. 55
[2] Government of the Commonwealth of Dominica (2017) Post-Disaster Needs Assessment Hurricane Maria
[3] ECLAC, IDB, PAHO, WHO (2019) Assessment of the Effects and Impacts of Hurricane Dorian in the Bahamas - Executive Summary
[4] Government of Saint Vincent and the Grenadines (2021) La Soufrière Volcanic Eruption Post Disaster Needs Assessment Saint Vincent and the Grenadines
[5] Government of the Republic of Haiti, Ministry of Planning and External Cooperation (2021) Post Disaster Needs Assessment in Haiti
[6] EM-DAT, Centre for Research on the Epidemiology of Disasters (CRED) / UCLouvain, Brussels, Belgium – www.emdat.be
[7] Agreement Establishing CROSQ: https://website.crosq.org/wp-content/uploads/2020/12/Agreement-Establishing-CROSQ-Updated-4-December-2001.pdf

The CARICOM Regional Standard CRS 10: 2023, Construction of Houses — Code of Practice has been developed under the authority of CROSQ in partnership with CDEMA. CDEMA coordinated and financed its development under the project *Support to the Advancement of Comprehensive Disaster Management (CDM) in the CDEMA Participating* States with funding from the Government of Norway. This third iteration of the Code of Practice has its genesis with the Caribbean Disaster Emergency Response Agency (CDEMA's predecessor) as the *Code of Practice for the Construction of Houses: An Instruction Manual for Foremen and Experienced Artisans* (also referred to as the Safer Building Programme) which was developed in 2005 with support from the Organisation of American States and funding from the Canadian International Development Agency (CIDA). Between 2005 and 2011-2014 under the Caribbean Hazard Mitigation Capacity Building Programme (CHAMP) and the CDM-HIP project[8] respectively. It was piloted in post-secondary institutions in Antigua and Barbuda, Barbados, Belize, British Virgin Islands, Dominica, Grenada, Haiti, Saint Lucia, The Bahamas, and St. Kitts and Nevis.

The development of the CRCP (third phase) was undertaken within the period 2021- 2023. During this phase, CROSQ led the review and updating of the working draft document: Code of Practice for the Construction of Houses as a CARICOM Regional Standard. This was done under an overarching project with five components that included the development of an accompanying Caribbean Vocational Qualification (CVQ) to the COP to support institutionalisation and sustainability. The offering of certified training in the rudiments of the COP through the CVQ; and the provision of training by vocational institutions in eight Member States, Antigua and Barbuda, Barbados, British Virgin Islands, Dominica, Grenada, Saint Lucia, St. Kitts and Nevis and St. Vincent and the Grenadines. CDEMA partnered with the Caribbean Association of National Training Agencies (CANTA) which led the development of the **CVQ- Building and Construction Site Supervision– Level 3** that was subsequently approved by the CARICOM Council for Human and Social Development (COHSOD). CVQs are competency-based occupational regional qualifications, that will provide a means for certifying persons practicing in the industry; and facilitate the free movement of skilled certified workers within the Caribbean single market economy. Special acknowledgement is given to the development partners that supported the development of the CVQ, training and marketing- the United States Agency for International Development (USAID) under the Caribbean Climate Resilience Initiative (CCRI) project, the Government of Norway, the Caribbean Development Bank, and the Building the Resilience of the CARIFORUM States to Disaster Risks and Climate Change Impacts project, financed by the European Union through the 11th European Development Fund.

The CVQ will be the basis for delivering training through the CANTA network of National Training Authorities and vocational training providers. This training will build capacity amongst foremen and experienced artisans and the next generation of builders, for the safe construction of houses in the region. Safe housing is a basic need of society, and adequate housing is a human right. This CRCP is commended to artisans, homeowners, building authorities, policy makers and financial institutions for the construction of safer, and more resilient housing in the Caribbean region.

[8] CDM HIP- CDM Harmonised Implementation Programme (CDM HIP) Phase 1 was a 5-year programme implemented by CDEMA through the support of CIDA and DFIID.

AMENDMENTS ISSUED SINCE PUBLICATION

AMENDMENT NO.	DATE OF ISSUE	TYPE OF AMENDMENT	NO. OF TEXT AFFECTED	TEXT OF AMENDMENT

ATTACHMENT PAGE FOR CRS AMENDMENT SHEETS

Committee representation

This CARICOM Regional Standard was developed under the supervision of the Regional Project Team (RPT) for Code of Practice for the Construction of Houses hosted by the CARICOM Member State, Dominica and St. Vincent and the Grenadines, which at the time comprised the following members:

Members	Representing
Dr Bertilia Barley (Chairperson)	Ministry of Public Works and the Digital Economy, Dominica
Mr Aiden Greenaway	Department of Environment, Antigua and Barbuda
Mr Nkosi Cochrane	Development Control Authority, Antigua and Barbuda
Mr Alexis Joseph	Bureau du Secrétaire d'État pour l'Intégration des Personnes Handicapées, Haiti
Mr Corège Dorismond	Ministère des Travaux Publics, Transports et Communication, Haiti
Mr Samuel Therassen	Institut National de la Formation Professionnelle, Haiti
Mr Colin Layne	Physical Planning Department, St. Vincent and the Grenadines
Mr Desmond Pompey	Physical Planning Department, St. Vincent and the Grenadines
Mr Imran Williams	Physical Planning Department, St. Vincent and the Grenadines
Ms Cornelly Olivieira	N.V. Cornelly's GALA-XY – TACO OSO (Building division), Suriname
Mr Mario Wijntuin (Alternate)	N.V. Energy Bedrijven, Suriname (N.V. EBS), Suriname
Mr Erick Redmount	General Contractors Association, Suriname
Mr Pierre Fitzgerald Van Zichem	Chamber of Commerce & Industry, Suriname
Ms Puja Bhagwandin	Suriname Bureau of Standards
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Mr Colin Sinarine (Alternate)	Association of Professional Engineers of Trinidad and Tobago
Mr Derrick Guiste	Dominica State College
Dr Gerona Joseph	Climate Resilience Executing Agency of Dominica (CREAD)
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Ms Heidi Gillette	Guyana Association of Professional Engineers
Mr. Hemraj Sanichara	Guyana National Bureau of Standards
Mr Humphrey Regis	Ministry of Physical Development, Housing and Urban Renewal Architectural Section, St. Lucia
Mr Mark Renee	Renee's Construction Co. Ltd, St. Lucia
Mr Rohan John Baptiste	Sir Arthur Lewis Community College, St. Lucia
Mr. Jonathan Platt	Barbados National Standards Institute
Mr Dwight Simmonds (Observer)	Ministry of Sustainable Development, St. Kitts and Nevis
Dr Grenville Phillips II (Consultant)	Walbrent College, Barbados
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Ms Jennifer Douglas-Bullock (Technical Secretariat)	St. Vincent and the Grenadines Bureau of Standards

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Foreword

This CARICOM Regional Standard CRS 10: 2023, Construction of Houses — Code of Practice has been developed under the authority of the CARICOM Regional Organisation for Standards and Quality (CROSQ). It was approved as a CARICOM Regional Standard by the CARICOM Council for Trade and Economic Development (COTED) at its 56th Meeting in June 2023.

Residents in CARICOM Member States risk being impacted by a diverse set of natural hazards including earthquakes, hurricanes, floods, landslides, volcanoes, tsunamis, torrential rainfall, and the predicted negative effects of climate change. Houses built in CARICOM Member States may be prematurely weakened by corrosion, moisture, insects, heat, and the sun's ultra-violet rays.

This standard is intended to outline the specifications for constructing houses in CARICOM Member States. It was necessary to develop this standard to align the residential construction industry in CARICOM Member States, to a common standard including those for strength and durability for improved resilience.

Where houses are constructed using structural steel, guidance could be sought from other recognised codes for small and residential buildings, for example Tobago Standard (TTS 599:2006) Guide to the design and construction of small buildings.

This document gives guidance for post construction maintenance and designing for persons with disabilities (See Annex A).

This standard was developed to reduce the vulnerability of houses in the Caribbean, which is part of the mandate of the Caribbean Disaster Emergency Management Agency (CDEMA) in their management of the Comprehensive Disaster Management Framework.

The Caribbean region is committed to Comprehensive Disaster Management (CDM) as described in the Regional CDM Strategy and Results Framework 2014-2024. The regional goal is to realise "Safer, more resilient and sustainable CDEMA Participating States through Comprehensive Disaster Management"[9].

Comprehensive Disaster Management (CDM) is an anticipatory management approach that views hazard exposure as an ongoing process, and aims to reduce vulnerability across all sectors. The strategic objective of CDM is the integration of disaster management considerations into the development planning and decision-making process of CDEMA's Participating States.

There are four Comprehensive Disaster Management (CDM) Priority Areas defined in the Framework, namely.

1. Strengthened institutional arrangements for CDM.
2. Increased and sustained knowledge management and learning for CDM.
3. Improved integration of CDM at sectoral levels.
4. Strengthened and sustained community resilience.

The Caribbean Disaster Emergency Management Agency (CDEMA) is the facilitator, driver, coordinator and broker of this Framework.

In preparing this standard considerable assistance was derived from the following:

<u>British Standards Institute (BSI)</u>

BS EN 1992-1-1:2004. Eurocode 2: Design of concrete structures. Part 1-1: General rules and rules for buildings

BS EN 1998-1:2004. Eurocode 8: Design of structures for earthquake resistance – Part 1: General rules, seismic actions and rules for buildings

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[9] Regional Comprehensive Disaster Management (CDM) Strategy & Results Framework 2014 – 2024. Caribbean Disaster Emergency Response Agency, 2014.

BS EN 206:2013+A1:2016. Concrete – Specification, performance, production and conformity
BS 4449:2005. Steel for the reinforcement of concrete – Weldable reinforcing steel – Bar, coil and decoiled product – Specification
BS 4482:1985. Cold reduced steel wire for the reinforcement of concrete
BS 8666:2005. Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete – Specification

ASTM International
ASTM C90-16. Standard Specification for Loadbearing Concrete Masonry Units
ASTM A615-15. Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C652-19 Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
ASTM A653-15. Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924-17. Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

American Concrete Institute
ACI 318-14, Building Code Requirements for Structural Concrete.

American Society of Civil Engineers.
ASCE 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures
ASCE 7-05, Minimum Design Loads and Associated Criteria for Buildings and Other Structures

American Wood Council.
National Design Specification for Wood Construction with Commentary, 2018

The Masonry Society.
TMS-402/602-16, Building Code Requirements and Specification for Masonry Structures

Organisation of Eastern Caribbean States.
OECS Building Code, 2016.

1 Scope

This document applies to single storey houses up to 7.62 m x 12.19 m (25 ft x 40 ft) plan, with hollow block masonry or timber framed walls, and timber framed or concrete roofs. It provides the user with the technical information to supervise the construction of a safe and durable house, and to facilitate checks on whether a safe and durable house is being built.

This document does not include construction details for utilities (including plumbing, electrical, communications, security, and natural gas. It also does not include construction details for solid brick masonry.

2 Normative references

The following documents are referred in the text in such a way, that some of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Organisation of Eastern Caribbean States

OECS Building Code, 2016

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
batter boards
temporary frames consisting of a horizontal board connected to vertical posts. They are set beyond the foundations at corners and perpendicular to internal walls to allow builders to accurately set out foundations and walls.

3.2
concrete
specific mixture of cement, sand, aggregate, and water, with a slump between 50 mm (2”) and 100 mm (4”)

3.3
concrete cover
minimum distance between the embedded reinforcement and the outer surface of the concrete. It is used to protect the steel reinforcement from corrosion, fire and slippage.

3.4
concrete curing agent
agent that reduces the loss of moisture from the concrete. This allows the concrete to develop its full design strength.

3.5
concrete formwork
temporary moulds into which concrete is poured to allow the concrete to harden to the designed shape.

3.6
concrete spacer blocks
permanent blocks made of concrete, metal or plastic, to be attached to reinforcement to maintain a minimum concrete cover.

3.7
contractor
person or company who contracts to build. The building contractor may be contracted to provide labour or labour and building materials to complete the building project.

3.8
curing
process of allowing the concrete to attain its design compressive strength by keeping it continuously moist, damp, or wet, for a duration of seven (7) days.

3.9
damp proof membrane
waterproof membrane, normally a plastic sheet, that is used to prevent the migration of water or dampness.

3.10
employer
person or company who contracts a building contractor to build. The employer is responsible for paying the contractor for work done in accordance with the building contract.

3.11
fill
excavated soil or quarried rock.

3.12
footings
part of the foundations that are in contact with, and spread to load to the underlying supporting soil or rock.

3.13
form release agent
an agent that is applied to formwork before the concrete is poured. It allows formwork to be stripped from the hardened concrete without significantly damaging the formwork. This allows the reuse of the stripped formwork.

3.14
grout
specific mixture of cement, sand, aggregate, and water with a slump of between 115 mm (4.5”) and 230 mm (9”)

3.15
mortar
specific mixture of cement, sand, and water.

3.16
pad footings
isolated footings that spread concentrated loads from columns.

3.17
rebar
metal reinforcing bar normally used to reinforce the strength of concrete.

3.18
roof metal cladding
waterproof covering to the roof to protect the interior of the building from wind, rain and direct sunlight.

3.19
slump
measure of the workability of concrete. (Notes 1 and 2)

3.20
strip footings
strip of footing to spread continuous loads from walls.

Note 1 to entry: It is measured by filling a 300 mm (12”) high x 200 mm base x 100 mm frustum slump cone, in three equal compacted lifts of 100 mm (4”).

Note 2 to entry: The concrete is compacted using the 16 mm (5/8”) dia. rod with end rounded as the tamping rod and tamping for 28 times for each lift; then lifting the cone, and measuring the slump, which is the distance between the height of the cone and the height of the concrete.

4. Symbols and abbreviated terms

dia	diameter
ft	foot or feet
gal	US gallon
km	kilometre
kn	kilonewton
kg	kilogram
l	litre
m	metre
m^2	square metre
m^3	cubic metre
mm	millimetre
MPa	megapascal
mph	miles per hour
m/s	metres per second
Mw	moment magnitude
N	newton
No.	number
psi	pounds per square inch
sq. ft or ft^2	square feet
SS	structural select
USA	United States of America

5. Pre-construction planning

5.1 Planning approval

It is recommended that the employer (client) obtain all regulatory approvals before construction starts.

A property that has planning approval should have, among other things:

a) accurate and identifiable boundary markers;
b) dimensions to set out the house;
c) provision for sewage disposal.

5.2 Contract

Before construction starts, the contractor (builder) should have a written contract with the employer (homeowner). The contract should include:

a) contractor’s obligations;
b) employer’s obligations;
c) procedures for making changes to the contract;
d) procedures for resolving disputes;

e) insurance requirements.

NOTE Variations to the contract that change the internal or external geometry of the building should be resubmitted for development planning approval.

5.2.1 Contractor's obligations

The contractor's obligations should include the agreement to build the house that was approved by the planning authorities, using specified construction standards (as described in clause 6), for a specified amount of money, and within a specified time.

The contractor should be aware of and comply with the requirements of the local authorities, including notification requirements to the planning, utilities (including electrical and water), and environmental (including sewage and drainage) authorities as required.

5.2.2 Employer's obligations

The employer's obligations should include the agreement to pay a specified sum of money, within a specified time after receiving the contractor's invoice, and according to a specified payment schedule. The employer should be aware of and comply with the requirements of the local authorities, including notification requirements to the planning, utilities (including electrical and water), and environmental (including sewage and drainage) authorities as required.

5.2.3 Variations

Whenever an employer requests a change to their building project (or contract), the contractor should provide the employer with the additional cost (or saving) of the change, and the extension or reduction in time to complete the change for the employer's written approval.

5.2.4 Resolving disputes

Contracts should have a named independent adjudicator, who shall be agreed to by both parties, and who may be invited by either side to decide an unresolved dispute within two weeks. The adjudicator's decision shall be final and binding, unless one party notifies the other in writing, within two weeks of the decision of their intent to appeal the decision through arbitration or litigation. In that case, the adjudicator's decision is binding until practical completion, or should the contract be terminated.

5.3 Insurance

The contractor should indemnify the employer and insure against personal injury or death of any person, and damage to property, while completing the contracted work. The insured amount should a minimum of five (5) years of earnings if no national legislation exists. If the contractor fails to secure this insurance, the employer should obtain the insurance and deduct the cost from amounts due to the contractor.

5.4 Drawing review

The contractor shall examine all drawings to check whether they contain sufficient information to price and build the house. The contractor should request any missing information from the employer. The contractor should state any assumptions used in the price quotation if the missing information is not provided. The contractor should state the assumed depth to the footings.

6. Construction best practices

6.1 Construction materials

6.1.1 Cement

For normal use above ground, and for footings bearing on limestone, cement should be ordinary Portland Cement (Type I, CEM I, or equivalent). For footings in high sulphate soils, the cement should be Sulphate Resistant Cement (Type V or equivalent). For concrete or plaster in dense urban areas, with high automobile traffic, the cement may also be Sulphate Resistant (Type V or equivalent).

NOTE: Users are encouraged to consult CRS 54: Cement—Specification

6.1.2 Sand (fine aggregate)

Sand (fine aggregate) should be clean and natural from an inland source, free of clay, organic material, and broken shells. Beach sand should not be used. Where this is not available, sand may be derived from the crushing of larger aggregates. Sand used for mortar should be sifted through a sieve to remove larger sized particles.

6.1.3 Stone (coarse aggregate)

Stone (coarse aggregate) for reinforced concrete should be crushed stone or gravel with a minimum size of 6 mm (1/4") and a maximum size of 20 mm (3/4"), free of a coating of dust. However, a maximum size of 25 mm (1") may be used as directed by a professional engineer, considering the concrete cover, spacing of reinforcement and the element used. A maximum size of 37.5 mm (1.5") may be used for unreinforced concrete.

6.1.4 Water

It is recommended to use water that is clean and free of impurities such as salt, chlorides, sulphates, and organic matter, which may affect the concrete quality. A continuous supply of water should be available during all concrete mixing, placing, and curing operations.

6.1.5 Concrete

Concrete in a mixer should be used within 1h 15m (75 minutes) after adding water. Admixture agents may be added to achieve better flow with a higher slump (superplasticiser), delayed setting (retarder), or rapid setting.

NOTE In this standard, concrete is used to construct concrete footings, walls, beams, columns, and slabs.

6.1.6 Grout

Grout should be used within 1h 15m (75 minutes) after adding water.

NOTE In this standard, grout is used to fill cores in concrete masonry blocks.

6.1.7 Mortar

Mortar should be used within one (1) hour of adding water.

Note 1 In this standard, mortar is used to bond concrete blocks together, and plaster concrete walls and the underside of concrete slabs.

Note 2 Lime is highly recommended to improve the waterproofing capability and durability of mortar plaster used on external walls.

6.1.8 Mixing cementitious materials

6.1.8.1 Concrete, grout and mortar should be mixed in a concrete mixer, or on a hard, smooth, and relatively impermeable (non-absorptive) surface.

NOTE A concrete binding bed can be used.

6.1.8.2 Table 1 provides recommended mixes for concreted and grouted elements and Table 2 for mortar.

Table 1 – Mixtures for concreted and grouted elements

Elements	**28-Day Compressive Cube Strength** MPa (psi)	**Cement** l [cu-ft] (gal)	**Sand** l [cu-ft] (gal)	**Aggregate** l [cu-ft] (gal)	**Water** l (gal)	**Slump** mm (in)
Footings	21 (3,000)	28.4 [1] (1.5 x 5)	56.8 [2] (3 x 5)	113.6 [4] (6 x 5 l)	18.9 (5)	50 to 100 (2” to 4”)
Beams Suspended slabs Columns	25 (3,600)	28.4 [1] (1.5 x 5)	42.6 [1.5] (2.25 x 5)	85.2 [3] (4.5 x 5)	18.9 (5)	50 to 100 (2” to 4”)
Walls (grout for block’s cores)	15.8 (2,300)	28.4 [1] (1.5 x 5)	85.2 [3] (4.5 x 5)	170.3 [6] (9 x 5)	18.9 (5)	115 to 230 (4 ½” to 9”)
NOTE One (1) bag of cement = 94 lb bag = 1 cu-ft = 1.5 x 5-gallon buckets = 28.4 litres (l).						

Table 2 – Mixtures for mortar

Element	**28-Day Compressive Cube Strength** MPa = N/mm^2 (psi)	**Cement** l [cu-ft] (gal)	**Lime (optional, but highly recommended for plaster)** l [cu-ft] (gal)	**Sifted Sand** l [cu-ft] (gal)
Mortar for repairs and below grade masonry work	16.8 (2,400)	28.4 [1] (1.5 x 5 gal)	9.5 [½] (0.75 x 5)	85.2 [3] (4.5 x 5)
Mortar for block joints and plastering walls above grade	11.2 (1,600)	28.4 [1] (1.5 x 5)	9.5 [½] (0.75 x 5)	113.6 [4] (6 x 5)

6.1.8.2 The 18.9 l (5 gallons) of water is provided as a guide, since other factors like the dampness of the aggregate, may affect the amount of water required.

6.1.8. The compressive strength of concrete is normally measured at 28 days. It should be sampled at the site in either 150 mm (6") cubes or 100 mm (4") diameter, 200 mm (8") long cylinders, and crushed. The cylinder strength is approximately 80% of the cube strength (BS EN 1992-1-1:2004, Table 3.1) as shown in Table 3.

Table 3 – Cylinder and cube compressive strength

28-day Compressive strength class	**Minimum characteristic cylinder strength** MPa (psi)	**Minimum characteristic cube strength** MPa (psi)
C12/15	12 (1,740)	15 (2,175)
C16/20	16 (2,320)	20 (2,900)
C20/25	20 (2,900)	25 (3,625)
C25/30	25 (3,625)	30 (4,350)
NOTE Information (except bracketed) was taken from BS EN 206:2013+A1:2016, Table 12		

6.1.9 Concrete curing agents

Concrete curing agents may be spray-on curing compounds which are specified for tropical weather. Alternative curing methods are to cover the concrete with sand and keep it continuously wet for at least three (3) days or cover the concrete with a plastic (polythene) sheet for at least three (3) days.

6.1.10 Formwork release agents

Formwork release agents should effectively strip the formwork from the hardened concrete. Where used as a formwork release agent, used oil should not contain sulphate (SO_4).

NOTE Vegetable, mineral and engine oils are effective formwork release agents.

6.1.11 Reinforcement (rebar)

6.1.11.1 Steel reinforcement (rebar) may be ribbed (deformed) high tension (high yield) steel rods (bars), or smooth mild steel rods (bars). All main structural rebars should be ribbed (deformed). The rebar should be reasonably free from loose rust (which should be removed with a wire brush) and tied together using mild steel tying wire.

NOTE 1 Rebar normally used in CARICOM is manufactured to the "American standard" ASTM A615/615Mand the "British standards" BS 4449 and BS 4482. The American ASTM A615/615M rebar grades are Grade 60 for high tension 420 MPa (60,000 psi), and Grade 40 for mild steel 280 MPa (40,000 psi).

NOTE 2 The British BS 4449 rebar grade is B500B for high tension 500 MPa (72,500 psi). The British BS 4482 rebar grade for mild steel is 250 MPa (36,260 psi). Table 4 shows the diameters of each grade.

Table 4 – Rebar diameters of each grade

ASTM A615/615M-15			BS 4449:2005 and BS 4482:1985	
Bar Designation No.	Rebar diameter mm (inches)	Nominal rebar diameter mm (inches)	Rebar diameter mm (inches)	Nominal rebar diameter mm (inches)
	-	-	6 (1/4")*	6.0 (0.236")*
	-	-	8 (5/16")*	8.0 (0.315")*
3	10 (3/8")	9.5 (0.345")	10 (3/8")*	10.0 (0.345")*
4	13 (4/8")	12.7 (0.5")	12 (4/8")*	12.0 (0.5")*
5	16 (5/8")	15.9 (0.625")	16 (5/8")	16.0 (0.625")
6	19 (6/8")	19.1 (0.75")	20 (6/8")	20.0 (0.75")
8	25 (8/8")	25.4 (1")	25 (1")	25.0 (0.984")
NOTE Information taken from ASTM A615-15, Table 1; BS 4449:2005, Table 7 and BS 4482:1985, Table 1. Values with an asterisk are from both BS 4449:2005 and BS 4482:1985, otherwise they are from BS 4449:2005 only.				

6.1.11.4 In this standard, high tension rebar diameters are prefixed with "H". For example, a 12 mm (1/2") diameter high tension rod is referenced *H12*. Mild steel diameters are prefixed with "R". For example, an 8 mm (5/16") diameter mild steel rod is referenced *R8*.

6.1.12 Rebar bend diameters

6.1.12.1 Rebars should be bent around minimum bending diameters. Table 5 shows the minimum rebar diameters.

NOTE 1 For ASTM A615 high tension (Grade 60) rebars, the minimum bending diameter of the round former (mandrel), for rebar diameters 10 mm (3/8") to 25 mm (1") is six (6) times the diameter of the rebar (ACI 318-14, Table 25.3.1). For mild steel links (stirrups) it is four (4) times the diameter of the rebar (ACI 318-14, Table 25.3.1).

NOTE 2 For BS 4449 high tension 500 MPa and BS 4482 mild steel 250 MPa, the minimum diameter of the bending mandrel (round former), for rebar diameters less than or equal to 16 mm (5/16") is four (4) times the rebar diameter. For rebar diameters greater than 16 mm (5/16"), the minimum diameter of the bending mandrel (round former is seven (7) times the rebar diameter (BS 8666-2020,Table 2. BS EN 1992-1-1:2004, Table 8.1N).

Table 5 – Minimum bend diameters when type or rebar is known

Bar Designation No.	**ASTM A615**		**BS 4449 and 4482***	
	Minimum inside bend diameter mm (inches)	Minimum inside bend diameter mm (inches)	Minimum inside bend diameter mm (inches)	Minimum inside bend diameter mm (inches)
	-	-	6 (1/4")*	24 (0.94")*
	-	-	8 (5/16")*	32 (1.26")*
3	10 (3/8")	57 (2.24")	10 (3/8")*	40 (1.57")*
4	13 (1/2")	76 (3.0")	12 (4/8")*	48 (1.90")*
5	16 (5/8")	95 (3.75")	16 (5/8")	64 (2.52")
6	19 (3/4")	115 (4.5")	20 (6/8")	140 (5.51")
8	25 (1")	152 (6.0")	25 (1")	175 (6.90")

6.1.12.2 If the type of rebar is unknown, the conservative minimum bend diameters shown in Table 6 should be used.

Table 6 – Minimum bend diameters when type of rebar is unknown

Bar Designation No.	ASTM A615	BS 4449 and 4482*	Minimum inside bend diameter
	Bar diameter mm (inches)	Bar diameter mm (inches)	Bar diameter mm (inches)
	-	6 (1/4”)*	25 (1”)
	-	8 (5/16”)*	32 (1.25”)
3	(3/8”)	10 (3/8”)*	60 (2.36”)
4	(1/2”)	12 (4/8”)*	76 (3”)
5	(5/8”)	16 (5/8”)	95 (3.75”)
6	(3/4”)	20 (6/8”)	115 (4.5”)
8	(1”)	25 (1”)	175 (6.90”)

6.1.13 Rebar lap lengths

To effectively transfer the tension load from one bar to another, the minimum lap length is fifty (50) times the rebar diameter.

6.1.14 Anchor bolts in concrete

Anchor bolts in concrete shall be high-strength Grade 8.8 or equivalent ASTM option. Washers in contact with timber should be minimum 40 mm (1.5”) diameter, 3 mm (1/8”) thick galvanised steel.

6.1.15 Reinforced concrete

Reinforced concrete should require:

a) an accurate concrete mixture to obtain a minimum compressive strength and durability;
b) safe reinforcement bend diameters and lap lengths to allow load transfer;
c) spacers installed on all sides of the formwork, to obtain sufficient protective concrete cover to the reinforcement;
d) compaction with a concrete vibrator, to obtain a dense concrete;
e) curing to attain the intended (design) strength.

6.1.16 Concrete cover

6.1.16.1 The minimum cover requirements are determined from the most conservative American (ACI 314-14, Table 20.6.1.3.1) and British (BS EN 1991-1-1 and BS EN 1991-1-2) requirements and are provided in Table 7.

NOTE Concrete cover is used to protect the steel reinforcement from corrosion from exposure to the natural environment, and deformation from exposure to fire.

Table 7 – Concrete cover to rebars to give a minimum fire protection of 1.5 hours

Element	Concrete cover mm (inches)
Foundations – in contact with the ground	75 (3”)
Slabs, walls, beams and columns exposed to weather	40 (1.5”)
Slabs not exposed to weather	25 (1”)
Walls not exposed to weather	25 (1”)
Beam not exposed to weather	40 (1.5”)
Column not exposed to weather	40 (1.5”)

6.1.17 Concrete blinding

Concrete blinding may be used if the compacted fill on which the rebar is to be supported is uneven. A thin (generally 50 mm (2”) thick to address localised ridges and depressions) mass concrete blinding layer should provide a flat surface to accommodate the placement of reinforcement. A concrete blinding mixture that gives a 28-day compressive strength of approximately 7 MPa (1,000 psi) is 1 (cement) : 4 (sand) : 8 (aggregate), with 5 gallons of water for each cubic-foot bag of cement.

6.1.18 Concrete formwork

6.1.18.1 Figure 1 shows a typical example of formwork for strip footings.

It is recommended to check internal dimensions for accuracy.

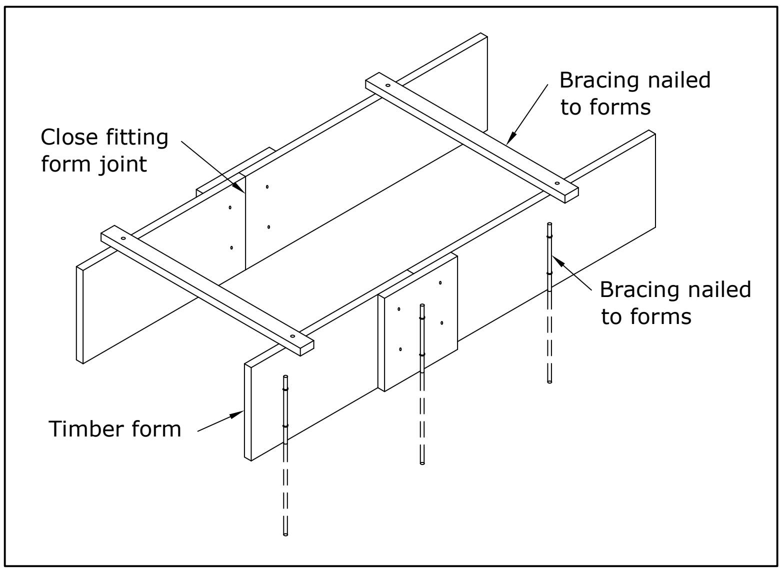


Figure 1 – Formwork for strip footings

6.1.19 Concrete spacer blocks

Concrete spacer blocks or plastic or metal chairs are used to provide the specified concrete cover to the steel reinforcement, to protect the rebars from corrosion and fire**.** They should be connected to the rebar closest to the formwork as shown in Figure 2. Footings should be used to raise the rebar off the ground surface. The concrete used for the spacer blocks should be of similar strength of the concrete being formed.

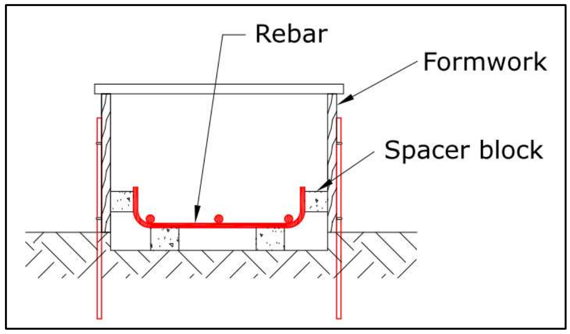


Figure 2 – Spacer block arrangement for strip footings

6.1.20 Concrete and clay blocks

6.1.20.1 Hollow concrete blocks should conform with the requirements of ASTM C90. Hollow clay blocks should comply with the requirements of ASTM C652. The dimensional requirements are provided in Figure 3 and Table 8.

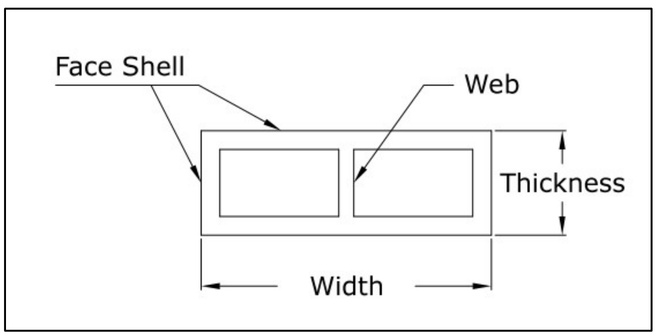


Figure 3 – Plan of concrete block

Table 8 – Dimensions of concrete block

Nominal block size (Thickness x Width) mm (inches)	**Concrete blocks**		**Clay blocks**	
	Face shell thickness mm (inches)	Web thickness mm (inches)	Face shell thickness mm (inches)	Web thickness mm (inches)
150 x 400 (6” x 16”)	25 (1”)	19 (3/4”)	25 (1”)	25 (1”)
200 x 400 (8” x 16”)	32 (1.25”)	19 (3/4”)	32 (1.25”)	25 (1”)

6.1.20.2 The concrete blocks should have two hollow cores and provide a minimum 28-day compressive strength of 7 MPa (1,000 psi) over the gross cross sectional plan area. [In Trinidad & Tobago, the minimum compressive strength of one concrete block shall be 12.4 MPa (1,800 psi), and the average of three (3) blocks should be a minimum of 13.8 MPa (2,000 psi).

6.1.20.3 The clay blocks should have two hollow cores and provide a minimum 28-day compressive strength of 15.2 MPa (2,200 psi) over the gross cross sectional plan area.

6.1.20.4 During the construction of the supporting footings and slabs, cement should be washed off of the aggregate in areas where walls are to be built, to improve the bond.

6.1.20.5 Blocks walls below ground level shall be 200 mm (8”) thick. Block walls above ground level should be a minimum of 150 mm (6”) thick for single storey houses.

NOTE Should the developer choose the option of adding another storey in the future, the single storey blocks above ground shall be 200 mm (8”) thick.

6.1.20.6 All cores on external walls below ground level should be filled solid with grout. Above ground, those cores with rebars, and those damaged by chasing, should be filled solid with grout. The grout should be poured in maximum lifts of three rows (courses) of blocks (or 600 mm (24”)), leaving a 25 mm (1”) key to resist lateral loads.

6.1.21 Concrete and clay block rebars

6.1.21.1 Rebars should be placed and grouted at all wall junctions and ends, and at the open cores bounding window and door openings. Exterior wall rebars should be high tension H12 (1/2”) at 600 mm (24”) centres. Interior wall rebars should be H12 (1/2”) at 800 mm (32”) centres).

6.1.21.2 At block wall junctions, one H12 (1/2” diameter) rebar should be placed and grouted in the intersecting core, and in all cores bounding that intersecting core. Horizontal reinforcement should be placed in every other row (spaced 400 mm (16”)). R6 (1/4” diameter mild steel) horizontal ties should be used to tie the vertical rebars at junctions. The ties should be spaced 400 mm (16”) apart vertically.

6.1.22 Fill

Fill shall be well graded granular fill, well compacted and placed in layers not exceeding 200 mm (8”) thick before compaction.

6.1.23 Utility pipes (plumbing, electrical, and communications)

6.1.23.1 Cold water supply pipes should be minimum Schedule 40 PVC pipes.

NOTE It is highly recommended that plumbing pipes permanently exposed to sunlight be Schedule 80 PVC.

6.1.23.2 To join PVC pipes:

a) the contact surfaces of the pipe and the connector to be joined shall be cleaned with pipe cleaner and then have pipe cement applied;
b) the pipe shall be inserted into the connector fully, and then turned one quarter of the circumference;
c) the pipe shall be held in the connector for at least 15 seconds to prevent it from dislocating.

6.1.23.3 Plumbing pipes should be pressure tested for leaks:

a) before pipes are covered by concrete;
b) before pipes are embedded in walls;
c) before floors and walls are finished.

6.1.23.4 Other utility pipes should be checked for blockages at these times. Pipes should be pressure tested to 1.5 times the operating pressure, and that pressure held for 24 hours.

6.1.23.5 It is recommended that concrete or clay block walls should not be cut diagonally or horizontally to install pipes. Only vertical chases should be permitted (preferably using an electric saw with a masonry blade to avoid excessive damage), and the blocks should be repaired by filling with grout.

6.1.23.6 All pipelines should be capped after the pipes in the line are laid and connected. The cap should then be removed to connect the line to junction boxes or fixtures.

6.1.24 Timber frames

Timber should be sound, straight, and well-seasoned, with a moisture content between 15 % and 19%. Soft woods (e.g. pine) should be pressure treated against insect attack.

6.1.25 Timber walls on concrete

Anchor bolts, 12 mm (1/2”) in diameter, should be installed at 800mm (32”) centres to connect the wall to the concrete beam or slab. A damp-proof membrane should be placed between the timber and the concrete to reduce the risk of wet rot.

6.1.26 Nails

Nails should be minimum 8d (8 penny, 63 mm (2.5”) long, 3.4 mm (1/8”) diameter) galvanised common wire nails. They should mainly be used to hold timber in place until a permanent connection is made with wood-grip screws.

6.1.27 Roof metal cladding

Corrugated metal roof cladding should be minimum 0.6 mm (24 gauge) thick profiled metal sheeting, connected to the timber frame with No.12 wood grip screws for external use. The metal cladding should be protected from corrosion, by complying with the following standards, or their equivalent: ASTM A653, or ASTM A924.

NOTE In Guyana and Suriname, the roof cladding thickness may be 0.5 mm (26 gauge) or as determined by the competent authority in Suriname and Guyana.

6.1.28 Damp proofing membrane (DPM)

Damp proofing membrane (DPM) should be minimum 500-gauge (125 microns) polythene vapour membrane barrier with 350 mm (14”) taped laps. Utility pipes protruding through the DPM should also be taped.

6.2 Site preparation

6.2.1 Site Inspection

The contractor shall inspect the site to determine:

a) the location of boundary markers, resident neighbours, access roads, trees on the site, and nearby drainage or sewerage wells;
b) the direction of prevailing winds;
c) the slope of the site;
d) the condition of nearby drains and any flooding concerns;
e) the locations for storing excavated soil, materials and equipment delivered to the site;
f) waste materials (components of a waste management plan).

6.2.2 The contractor should obtain professional advice as required.

6.2.3 Site Investigation

6.2.3.1 The contractor should investigate the site by:

a) protecting boundary markers;
b) clearing the site of overgrown vegetation;
c) setting out the external walls;
d) excavating to hard formation at the corners and approximate centre of the building to determine the likely depth of footings;
e) excavating any contractual sewage or drainage disposal wells to determine likely subsoil conditions.

6.2.3.2 Professional engineering advice should be obtained if any voids (caves), cracks (joints or fissures), large boulders, large trees, compressible material (peat, other organic material, refuse), fill, ground water, or weak soil layers below the planned footings are observed.

6.2.3.3 The employer should be notified in writing about any new issue that may increase construction costs, delay construction activities, and extend the duration of the construction contract.

6.2.4 Work plan

Based on the results of the site inspection and investigation, the contractor prepares a workplan (project schedule) of construction activities, including an ordered list of activities, and when they should be completed given the available contractor resources.

NOTE Additional resources may be required to complete the project within the specified time.

6.2.5 Setting Out

A dimensioned grid, aligned with the middle of the walls, should be drawn on the plan. Any missing dimensions that prevent the accurate setting out of the grid on the site, should be requested from the employer.

6.2.6 Material storage

Cement bags, timber, and rebars should be stored in a dry location and elevated at least 100 mm (4") off the ground. Sand and stone should be covered to prevent them from being blown or washed away, and to prevent excessive wetting which may alter the water content of the concrete and/or mortar mixture.

6.2.7 Batter Boards

Batter boards should be aligned to the grids. Batter boards, where the horizontal member is greater than 300 mm (12") from the ground surface, should have a 25 mm x 100 mm (1" x 4") diagonal bracing member installed, as shown in Figure 4. Three nails should be installed at the top of the horizontal members, representing the middle and edges of the proposed walls.

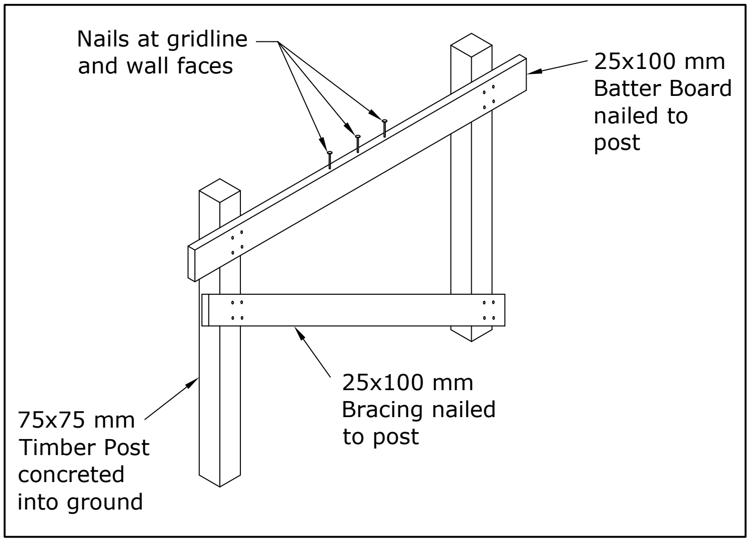


Figure 4 – Batter boards

6.3 Risk assessments

The health and safety of workers and visitors to the construction site may be improved through assessing health and safety risks and developing effective risk mitigation measures. The risk assessments for the site preparation activities are provided in Table 9.

Table 9 – Risk assessments

Activities	Risks	Risk Mitigation Measures
Walking around the site	Stepping on nails	Wear hard shoes
Walking around the site	Being accused of trespassing	Wear a safety vest
Constructing batter boards	Harm to body with hand tools (hammer and saws)	Wear safety gloves Wear safety glasses Wear hardhat
Excavating well	Falling into open well	Securely cover the open well

6.4 Foundations

Foundation activities include:

a) assessing the bearing capacity of the layer of soil on which footings are to be founded;
b) excavating to that bearing layer;
c) applying termite treatment to that layer;
d) constructing the footing.

6.4.1 Bearing capacity

Where available, national soil maps with bearing capacities, and national authorities with jurisdiction to determine soil bearing capacities, should be consulted to determine the bearing capacity of the soil. If there is uncertainty, then engineering advice should be obtained.

The maximum allowable safe bearing capacity for various soils is provided in Table 10.

Table 10 – maximum allowable safe bearing capacity of soils

Soil	Maximum Allowable Safe Bearing Capacity when Dry (Wet)	
	kn m^2	tons sq. ft
Thick layers (beds) of hard un-weathered limestones and sandstones.	4,000 (4,000)	40 (40)
Strong shales, mudstones, and siltstones.	2,000 (2,000)	20 (20)
Thin layers (beds) of limestones and sandstones.	1,000 (1,000)	10 (10)
Compact well-graded fill.	400 (200)	4 (2)
Loose well-graded sands	200 (100)	2 (1)
Compact uniform sands.	200 (100)	2 (1)
Loose uniform sands.	100 (50)	1 (0.5)
Stiff clays and sandy clays.	200 (100)	2 (1)
Firm clays and sandy clays.	100 (50)	1 (0.5)
Soft clays and silts.	50 (0)	0.5 (0)
NOTE Information taken from OECS Building Code, 2016. Table 13-1.		

6.4.2 Excavations

6.4.2.1 Excavate a minimum of 900mm (3 ft) to a good foundation layer (dense sand, stiff clay), or to rock, to reduce or prevent settlement. If the depth of excavation is greater than 1.2m (4 ft), then support the sides by installing vertical planks and horizontal struts or cut back the sides to a slope of 1.5 horizontal :1 vertical.

6.4.2.2 Inspect the bottom of the excavation. If the foundation is rock, a key should be provided by excavating at least 50 mm (2”) into the rock. If the bottom of the excavation is loose, the foundation bottom can be compacted by ramming. If pockets of unsuitable material (e.g., clay) are found, they should be removed. Deep areas and over excavated areas may be backfilled with compacted granular material or with mass concrete (1 (cement) : 3 (sand) : 6 (stone)). If clay is found or if there is uncertainty, engineering advice should be obtained.

6.4.3 Termite treatment

After excavating to **a good bearing layer**, the ground under the **footings** and floors should be treated for termites. A reputable pesticide company that offers a minimum 5-year warrantee should be used.

6.4.4 Footings

6.4.4.1 Footings should be designed to support the building by the underlying material (including soil: type, moisture content, and slope), and to prevent the building from moving during natural hazards.

6.4.4.2 Masonry-walled houses should be founded on reinforced concrete: strip footings, pad footings, or slab-on-ground foundations. Timber-walled houses should be founded on one of the same type of footings for masonry-walled houses, or on timber posts.

6.4.4.3 Strip footings

6.4.4.3.1 Strip footings should have the size and reinforcement specified in Table 11, that corresponds to the soil type and bearing capacity. A typical strip footing is shown in Figure 5.

NOTE On relatively flat ground, with slope less than 1 (Vertical), 8 (Horizontal), reinforced concrete strip footings may be a more economical option.

Table 11 – strip footing sizes and reinforcement

Structural Element [Bearing Capacity]	Minimum Size (width x depth)	Minimum Concrete 28-day compressive cube strength (see Table 3 for equivalent cylinder strengths)	Minimum Reinforcement (Equivalent Grade 60 rebar sizes in Table 4 may be used)
Strip footing on stiff clays. [100 kN/m^2 (1 Ton/sq-ft)]	760 mm x 300 mm (30”x12”)	21 MPa (3,000 psi)	2 x H12 (1/2”) rebars longitudinally + H12 mm rebars spaced at 300 mm (12”) centres transversely.
Strip footing on compacted granular soil. [200 kN/m^2 (2 Tons/sq-ft)]	600 mm x 275 mm (24”x11”)	21 MPa (3,000 psi)	2 x H12 (1/2”) rebars longitudinally + H12 mm rebars spaced at 300 mm (12”) centres transversely.
Strip footing on rock. [450 kN/m^2 (4.5 Tons/sq-ft)]	400 mm x 275 mm (16”x11”)	21 MPa (3,000 psi)	2 x H12 (1/2”) rebars longitudinally + H12 mm rebars spaced at 300 mm (12”) centres transversely.
Ring beam at floor level.	200 mm x 200 mm (8”x8”)	25 MPa (3,600 psi)	4xH12mm (1/2”) bars with T6mm links at 150mm (6”) spacing.

NOTE The bearing capacities in Table 10 were used to determine the prescriptive footing sizes. Building of other soils will require advice.

6.4.4.3.2 The construction method includes the following:

a) excavate to a good bearing layer;
b) apply termite treatment to the soil under the footings;
c) place mass concrete (1:4:8) blinding;
d) erect formwork to fit the strip footings;
e) place reinforcement, including wall starter bars, in the formwork;
f) install spacers to the bottom and sides;
g) remove any debris from within forms;
h) apply a release agent to the formwork surface to be in contact with concrete;
i) pour, compact, level, trowel finish, and cure the concrete.

6.4.4.3.3 Once the concrete has been cured, the foundation walls should be built as shown in Figure 5. The method includes the following:

a) install foundation wall rebars;
b) lay foundation blocks;
c) grout foundation blocks every three (3) courses, leaving a key.

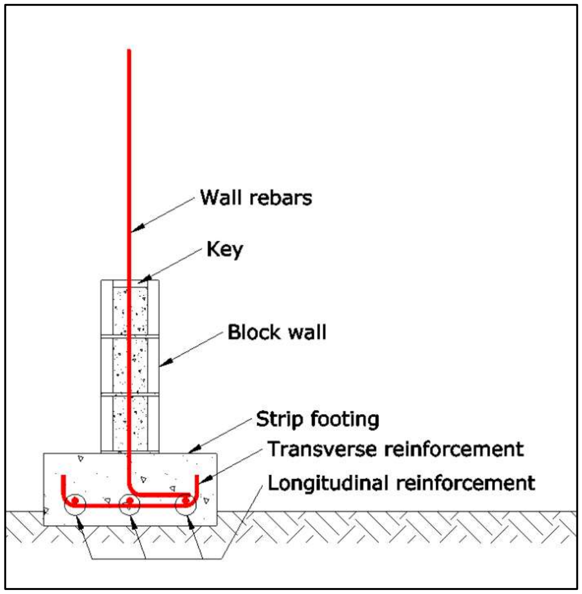


Figure 5 – Strip footing

6.4.4.4 Pad footings

6.4.4.4.1 If the land is sloping steeply, or undulating severely, then reinforced concrete (RC) pad footings, supporting RC columns and beams may be an economical option.

6.4.4.4.2 Pad footings are to have the size, strength, and reinforcement specified in Table 12, that corresponds to the soil type and bearing capacity. They should be connected with 200 mm x 300 mm (8" x 12") RC tie beams (with 2 H12 (two 12 mm diameter high tension) longitudinal rebars and R6 @ 200 links (6 mm diameter mild steel links spaced 200 mm apart)] to prevent them from moving during seismic loads. Figure 6 illustrates a typical pad footing with column

Table 12 – Pad footing sizes and reinforcement

Soil type	Pad footing [Bearing capacity] kN/m² (Ton/sq-ft)	Minimum size (length x width x depth) mm (inch)	Minimum concrete 28-day compressive cube strength (see Table 3 for equivalent cylinder strengths) MPa (psi)	Minimum reinforcement (Equivalent Grade 60 rebar sizes in Table 4 may be used)
Stiff clay	100 (1)	1,200 x 1,200 x 300 (48 x48 x12)	21 (3,000)	H12 at 150 mm (6”) spacing each way top and bottom
Compacted granular	200 (2)	950 x 950 x 300 (39 x39 x12)	21 (3,000)	H12 at 150 mm (6”) spacing each way top and bottom
Rock	450 (4.5)	650 x 650 x 300 (27 x 27 x 12)	21 (3,000)	H12 at 150 mm (6”) spacing each way top and bottom

NOTE The bearing capacities listed in Table 10 were used to determine the prescriptive footing sizes. Building of other soils will require engineering advice.

6.4.4.4.3 The construction method includes the following:

a) excavate to a good bearing layer;
b) apply termite treatment to the soil under the footings;
c) place mass concrete (1:4:8);
d) erect formwork to fit the pad;
e) place reinforcement including column starter bars in the formwork;
f) install tie-beam reinforcement;
g) install spacers to the bottom and sides;
h) remove any debris from within the forms
i) apply a release agent to the formwork surface to be in contact with concrete;
j) pour, compact, level, trowel finish, and cure the concrete.

6.4.4.4.4 Once the concrete has cured, the columns and beams should be constructed. The method includes the following:

a) lap column rebars at midspan, and install the column links (stirrups);
b) install the formwork on three sides;
c) install the spacers;
d) install formwork release agent;
e) install the final formwork side;
f) pour, compact, level, trowel finish, and cure the concrete;
g) install beam formwork;
h) install beam rebars;
i) install starter bars for concrete block walls, or anchor bolts for the timber frame;
j) install spacers
k) install formwork release agent;
l) pour, compact, level, trowel finish, and cure the concrete.

6.4.4.4.5 Columns are to have the size, strength, and reinforcement specified in Table 13, and arranged as in Figure 6, that corresponds to the column height.

Table 13 – Concrete column sizes and reinforcement

Column height m (ft)	**Minimum size** mm (in)	**Minimum concrete 28-day compressive cube strength** (see Table 3 for equivalent cylinder strengths) MPa (psi)	**Minimum reinforcement** (Equivalent Grade 60 rebar sizes in Table 4 may be used)
< 3.0 (10)	200 x 200 (8 x 8)	25 (3,600)	Mai rebars: 4xH12 Links: T6 at 150 mm spacing
3.0 to 3.65 (10 to 12)	250 x 250 (10 x 10)	25 (3,600)	Mai rebars: 4xH16 Links: T8 at 200 mm spacing
3.65 to 4.3 (12 to 14)	300 x 300 (12 x12)	25 (3,600)	Mai rebars: 4xH20 Links: T8 at 250 mm spacing

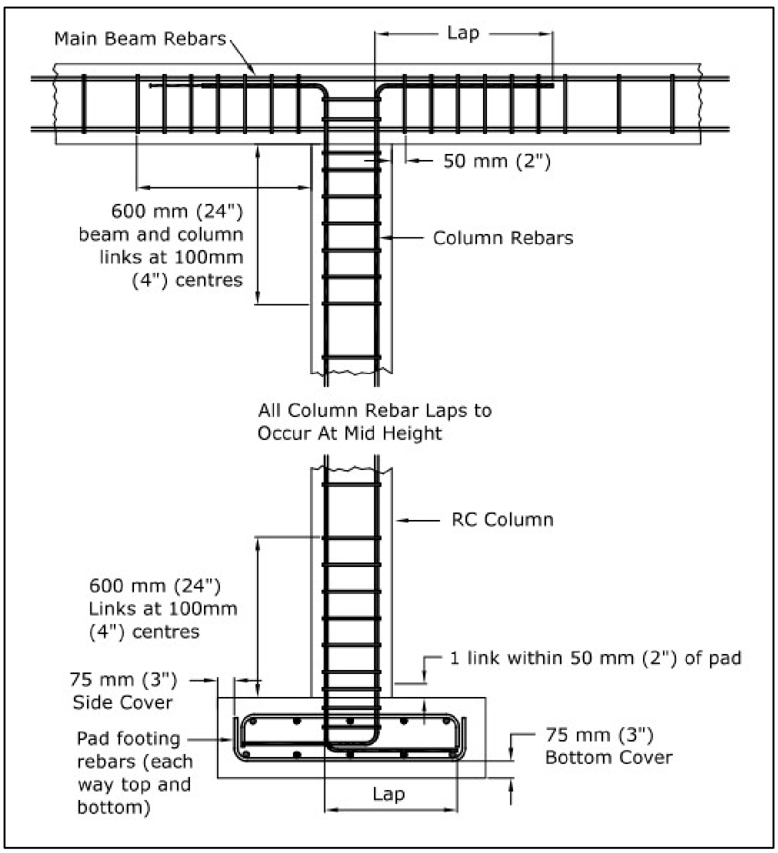


Figure 6 – Recommended design for pad footing and columns

6.4.4.5 Slab-on-Ground footings

6.4.4.5.1 When good bearing soil is deep, then a slab-on-ground foundation, which integrates the footings into the ground floor slab, can be supported on well compacted granular fill material. A slab-on-ground foundation may also be used on relatively flat land, where hard rock is close enough to the surface to allow the footings to be cast on the rock, or on fill on the rock.

6.4.4.5.2 Slab-on-ground footings, with masonry walls, should have the minimum layout as shown in Figure 7. The minimum 28-day concrete compressive cube strength should be 21 MPa (3,000 psi). Figure 8 illustrates the rebar layout for masonry walls. Figure 9 illustrates the rebar layout for timber framed walls.

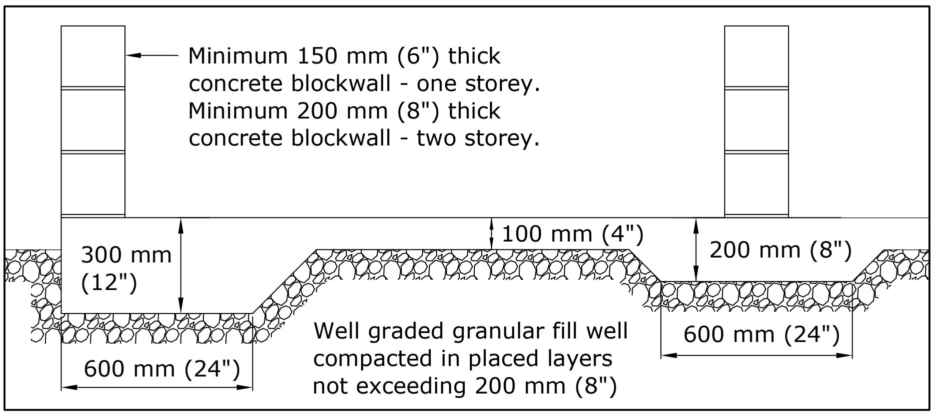


Figure 7 – Layout of slab-on-ground footing

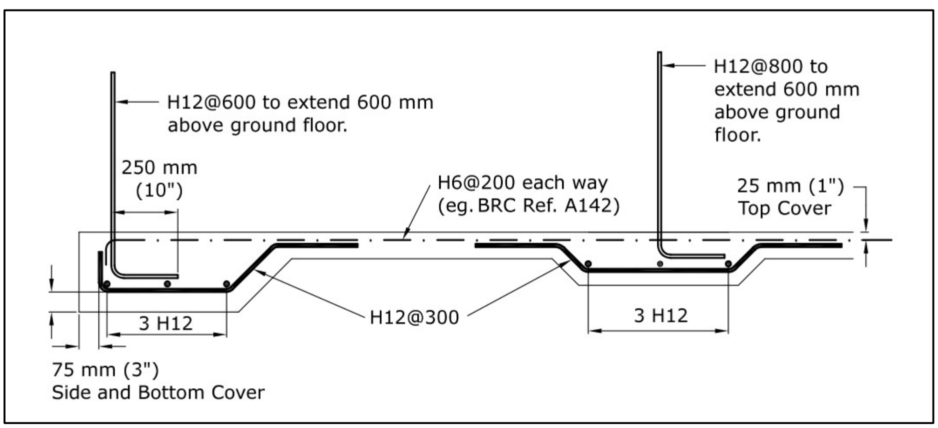
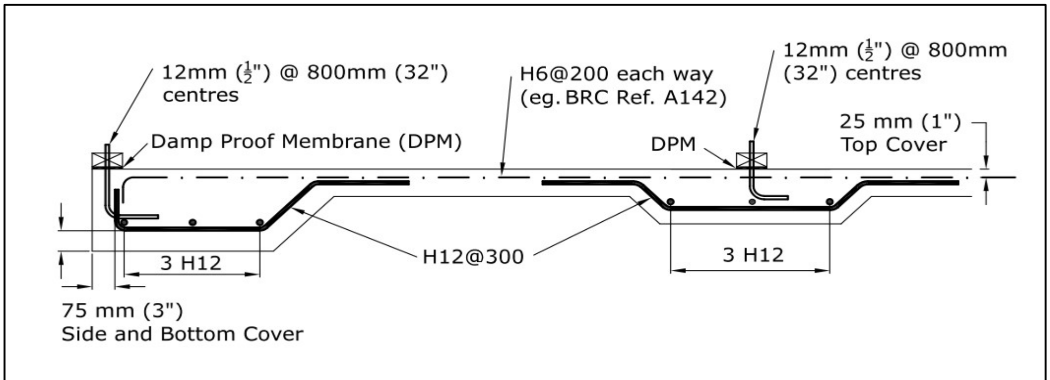


Figure 8 – Rebar layout of slab-on-ground footing for masonry walls



NOTE 1 BRC Ref. A142 is a square mesh or 6 mm (1/4”) rebar at 200 mm (8”) square pattern.

Figure 9 – Rebar layout of slab-on-ground footing for timber framed walls

6.4.4.5.3 The construction method includes the following:

a) excavate to a good bearing layer;
b) apply termite treatment to the soil under the slab and footings;
c) install fill;
d) cut trenches for slab thickenings;
e) install plumbing waste, electrical, communications, and security pipes in the fill;
f) install termite treatment;
g) erect formwork;
h) place damp proof membrane;
i) place reinforcement;
j) place wall starter rebars for masonry walls or anchor bolts for timber walls;

6.4.4.6 Timber posts

6.4.4.6.1 A relatively inexpensive foundation for a timber building is to drive 100 mm x 100 mm (4”x4”) minimum Greenheart or termite treated braced timber posts at least 1.2 m (4 ft) into the ground, as shown in Figure 10. The posts may also be placed in an excavated (augured) hole and concrete around. The embedded posts should be waterproofed, for example, with bituminous paint.

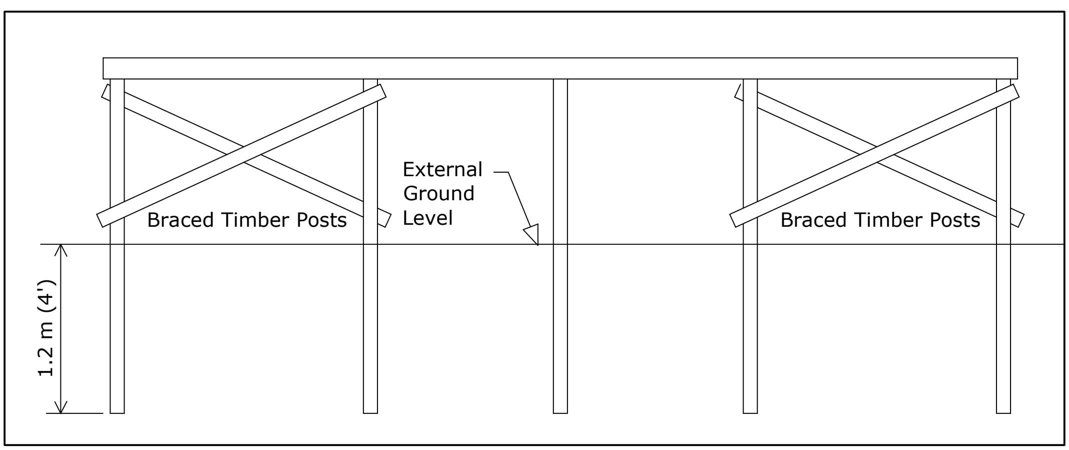


Figure 10 – Braced timber post foundation

6.4.4.6.2 For concreted posts, the construction method includes the following:

a) excavate a hole;
b) apply termite treatment to the sides and top;
c) place the timber post in the hole;
d) pour, compact, level, trowel finish, and cure the concrete;
e) brace the posts.

6.5 Floors

The floor is used to support the floor loads and to transmit them to the foundations. There are three (3) types described in this standard:

a) reinforced concrete slab on fill;
b) suspended reinforced concrete slab;
c) suspended timber floor.

6.5.1 Reinforced concrete slab on fill

6.5.1.1 There are two types of concrete slabs on fill:

a) the slab-on-ground foundation covered in Clause 6.4.4.5;
b) the slab on strip footings as shown in Figure 11 covered in Clause 6.4.4.3.

6.5.1.2 Once the footings have been built, the construction method includes the following:

a) install fill;
b) install utility pipes;
c) install termite treatment pesticide;
d) install damp proof membrane, including blinding where necessary;
e) install beam and slab rebars;
f) install starter bars for concrete block walls, or anchor bolts for timber frame;
g) install formwork;
h) install spacers;
i) install water supply pipes;
j) install formwork release agent;
k) pour, compact, level, trowel finish, and cure the concrete;
l) plaster the external walls.

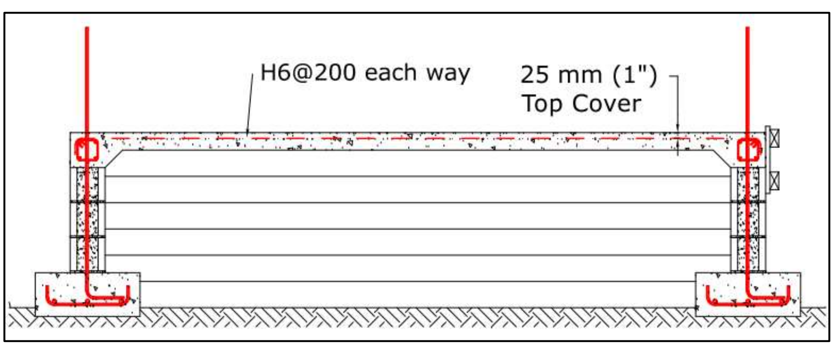


Figure 11 – Slab on strip footings

6.5.2 Suspended reinforced concrete floor slab

Suspended reinforced concrete slabs are supported by reinforced concrete beams on strip footings or columns.

Suspended reinforced concrete slabs as shown in Figure 12, should have the strength size and reinforcement as specified in Table 14 that corresponds to the span. These suspended slabs are applicable for floors and roofs.

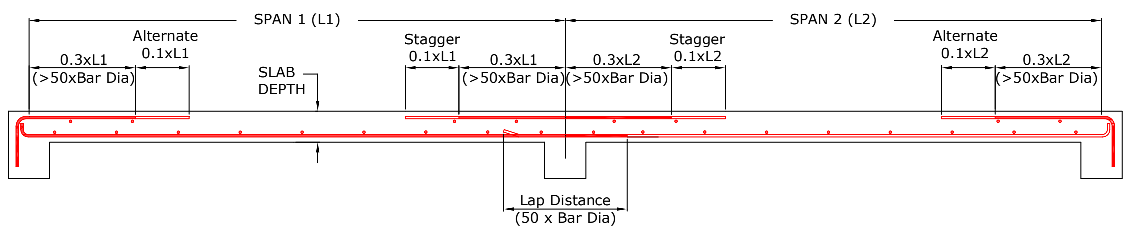


Figure 12 – Slab rebar layout

Table 14 – Slab thickness and reinforcement

Slab thickness mm (in)	**Span between supporting walls**					
	1.8 m (6 ft)	**2.4 m (8 ft)**	**3 m (10 ft)**	**3.6 m (12 ft)**	**4.3 m (14 ft)**	**4.8 m (16 ft)**
100 (4)	H12@300					
125 (5)		H12@300	H12@300			
150 (6)			H12@300	H12@300		
175 (7)				H12@300	H12@250	
200 (8)					H12@250	H12@200
225 (9)						H12@200

NOTE 1 Minimum secondary rebars to be H10 (3/8") at 300 mm (12") centres.

NOTE 2 Use the thicker slab for higher than normal loads (e.g., library, storage, home-gym), or some stone floor tiles where smaller deflections (e.g., span/720) are required (e.g. porcelain) but engineering advice should be obtained for verification.

NOTE 3 Concrete 28-day compressive cube strength to be 25 MPa (3,600 psi).

NOTE 4 Equivalent Grade 60 rebar sizes in Table 4 may be used.

6.5.3 Cantilevered reinforced concrete slab

The main reinforcement in cantilevered reinforced concrete slabs as shown in Figure 13, should have the strength size and reinforcement as specified in Table 15 that corresponds to the span.

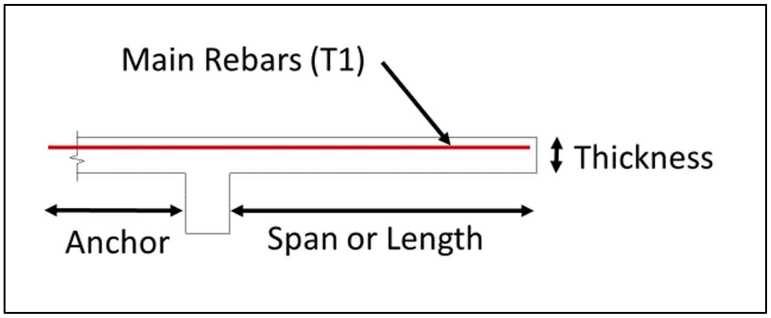


Figure 13 – Cantilever slab, showing only main rebars

Table 15 – Cantilever slab thickness and reinforcement

Cantilever Slab Thickness mm (inch)	**Cantilever span or length**			
	1.2 m (4 ft)	**1.8 m (6 ft)**	**2.4 m (8 ft)**	**3.0 m (10 ft)**
125 (5”)	H12@300			
150 (6”)	H12@300	H12@300		
150 (6”)		H12@300		
200 (8”)			H12@200	
200 (8”)			H12@200	H12@150
250 (8”)				H12@150

NOTE 1 Minimum secondary rebars to be H10 (3/8”) at 300 mm (12”) centres.

NOTE 2 Use the thicker slab for higher than normal loads (e.g. storage, home-gym), or stone floor tiles (e.g. porcelain) but Engineering advice should be obtained for verification.

NOTE 3 Concrete 28-day compressive cube strength to be 25 MPa (3,600 psi).

NOTE 4 Minimum anchorage to be the greater of: (a) 1.5 x cantilever span, (b) 0.3 x supported span, or (c) 50 x bar diameter.

NOTE 5 Equivalent Grade 60 rebar sizes in Table 4 may be used.

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6.5.4 Suspended timber floor

6.5.4.1 Suspended timber floor joists ought to have the sizes of Pine (Structural Select) and Purpleheart specified in Table 16 for 400 mm (16”) spacing, and Table 17 for 600 mm (24”) spacing.

Table 16 – Timber joist sizes at 400 mm (16") spacing

Span range m (ft)	Joist size at 400mm centres	
	Pine SS mm (in)	**Purpleheart** mm (in)
1.5 to 1.8 (5 to 6)	50 x150 (2 x 6)	50 x 100 (2 x 4)
1.8 to 2.4 (6 to 8)	50 x 200, 75 x 150 (2 x 8, 3 x 6)	50 x 150 (2 x 6)
2.4 to 3.3 (8 to 10)	50 x 250, 75 x 200 (2 x 10, 3 x 8)	50 x 200, 75 x 150 (2 x 8, 3 x 6)
3.3 to 3.6 (10 to 12)	75 x 200 (3 x 8)	50 x 200 (2 x 8)
3.6 to 4.3 (12 to 14)	75 x 250 (3 x 10)	50 x 250, 75 x 200 (2 x 10, 3 x 8)
4.3 to 4.8 (14 to 16)	75 x 300 (3 x 12)	75 x 250 (3 x 10)

Table 17 – Timber joist sizes at 600 mm (24") spacing

Span range m (ft)	Joist size at 600mm centres	
	Pine SS mm (in)	**Purpleheart** mm (in)
1.5 to 1.8 (5 to 6)	50 x 150 (2 x 6)	50 x 100 (2 x 4)
1.8 to 2.4 (6 to 8)	50 x 200, 75 x 150 (2 x 8, 3 x 6)	50 x 150(2 x 6)
2.4 to 3.3 (8 to 10)	75 x 200 (3 x 8)	50 x 150 (2 x 6)
3.3 to 3.6 (10 to 12)	75 x 250 (3 x 10)	50 x 200, 75 x 150 (2 x 8, 3 x 6)
3.6 to 4.3 (12 to 14)	75 x 300 (3 x12)	50 x 200, 75 x 200 (2 x 8, 3 x 8)
4.3 to 4.8 (14 to 16)	100 x 300 (4x12)	50 x 250, 75 x 200 (2 x 1, 3 x 8)

6.5.4.2 When placing timber on concrete, a damp-proof membrane should be placed between the timber and the concrete member.

6.5.4.3 If the size of timber joists are not available, then the joist's span may be reduced by installing a timber bearer beam on concrete or masonry piers (plinths), as shown in Figure 14.

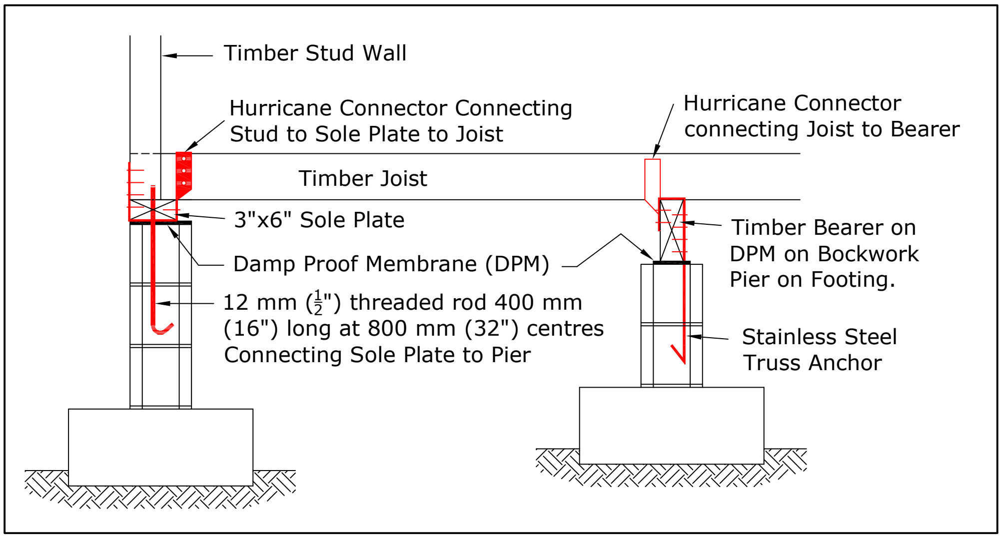

Figure 14 – Timber bearer on masonry plinth

6.5.4.4 The construction method includes the following:

a) construct the supporting beam;
b) install a damp proof membrane;
c) bolt a 75 mm x 150 mm (3"x6") timber sole plate/sill to the concrete beam;
d) connect timber joists to the sole plate;
e) install 25 mm (1") thick tongue and groove floor planks to the joists;
f) install joist bracing, as shown in Figure 15, at 2.1 m (7 ft) intervals if the joist depth is 200 mm (8") or more.

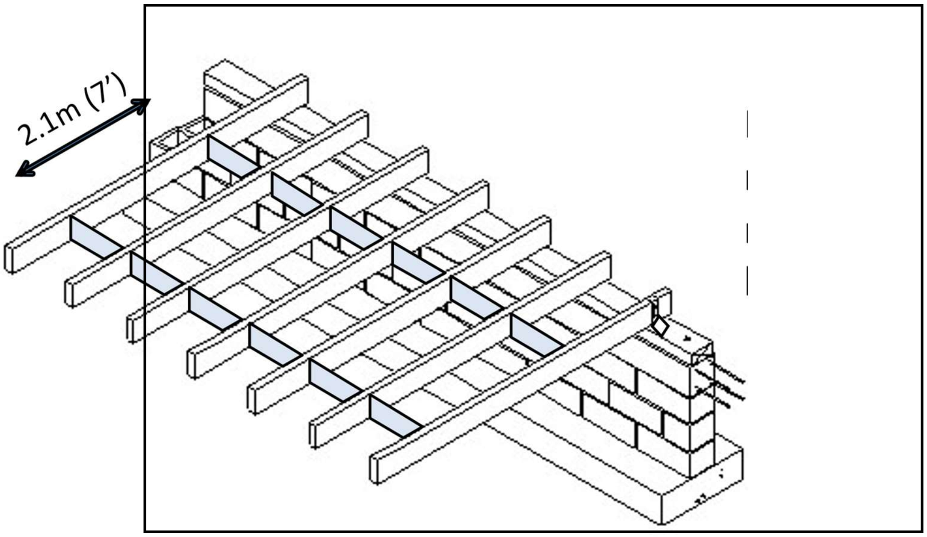

Figure 15 – Joist bracing

6.5.5. Stairs

Reinforced concrete stairs ought to have the layout as shown in Figure 16 and Table 18, and the strength and reinforcement as specified in Table 19 that corresponds to the span. The maximum rise or riser is 210 mm (8.25”) (See OECS Building Code 2016, Table 5-5), but 150 mm (6”) is comfortable and practical. The minimum run or tread is 227 mm (9”), but 300 mm (12”) is comfortable and practical. The minimum landing is 915 mm (36”) (See OECS Building Code 2016, Section 505.10).

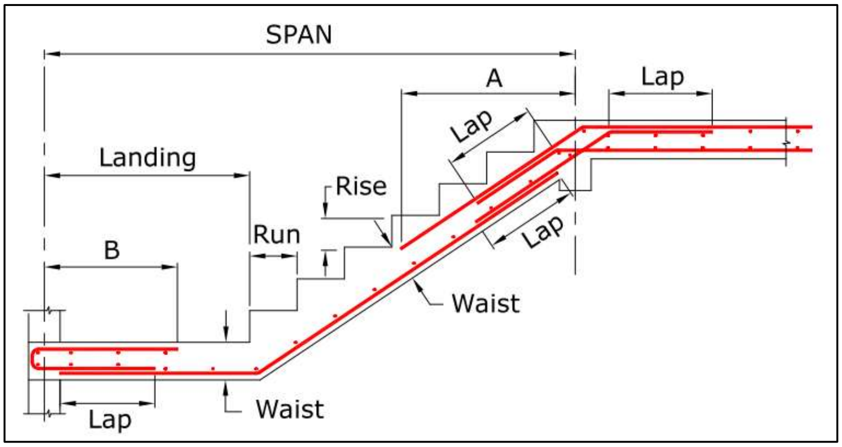

Figure 16 – Stair layout and rebars

Table 18 – Stair geometry

Span m (ft)	**A** m (in)	**B** m (in)	**Waist** mm (in)
2.4 (8)	0.7 (28)	0.6 (24)	125 (5)
3 (10)	0.9 (36)	0.6 (24)	150 (6)
3.6 (12)	1.1 (42)	0.6 (24)	175 (7)
4.2 (14)	1.3 (51)	0.65 (26)	200 (8)

Table 19 – Slab thickness and reinforcement

Slab thickness mm (in)	Span between supporting walls.					
	1.8 m (6 ft)	**2.4 m (8 ft)**	**3 m (10 ft)**	**3.6 m (12 ft)**	**4.3 m (14 ft)**	**4.8 m (16 ft)**
100 (4)	H12@300					
125 (5)		H12@300	H12@300			
150 (6)			H12@300	H12@300		
175 (7)				H12@300	H12@250	
200 (8)					H12@250	H12@200
225 (9)						H12@200

NOTE 1 Minimum secondary rebars to be H0 (3/8") at 300 mm (12") centres.

NOTE 2 Use the thicker slab for higher than normal loads or stone floor tiles (e.g. porcelain), but engineering advice should be obtained for verification.

NOTE 3 Concrete 28-day compressive cube strength to be 25 MPa (3,600 psi).

NOTE 4 Equivalent Grade 60 rebar sizes in Table 4 may be used.

6.6 Walls and beams

Two types of walls are specified in this standard: concrete block masonry and timber framed.

6.6.1 Concrete block walls

6.6.1.1 Masonry walls can fail in both horizontal and vertical planes. Therefore, these walls should be reinforced both horizontally and vertically as shown in Figure 17.

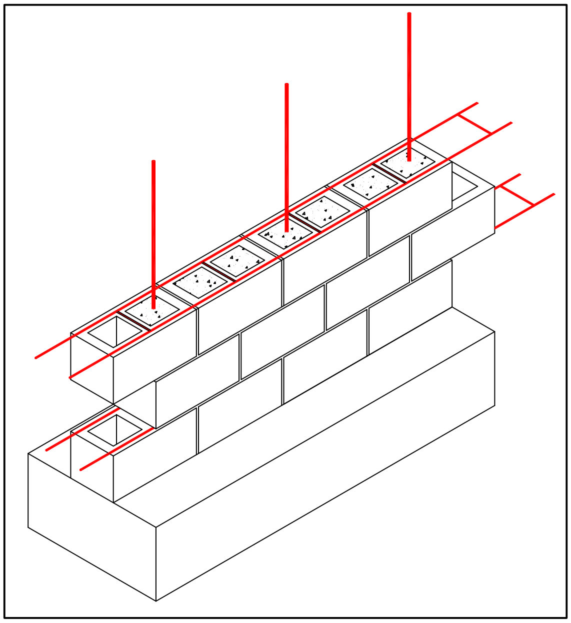

Figure 17 – Horizontal and vertical masonry reinforcement

6.6.1.2 Each wall elevation ought to have shear resistance, consisting of either one 3.0 m (10 ft) long shear walls, or two 1.8 m (6 ft) long shear panels. These shear walls ought to be constructed from foundation to roof, with no openings such as windows or doors.

6.6.1.3 Vertical reinforcement for external walls is to be H12@600 (1/2” bars at 24” centres). Vertical reinforcement for internal walls is to be H12@800 (1/2” bars at 32” centres). Horizontal reinforcement is to be 3.6 mm diameter galvanised wire at each face, at 400 mm (16”) centres.

6.6.1.4 The construction method includes the following:

a) construct the floor with wall starter bars extending 600 m (2 ft) above the floor level;
b) install wall vertical reinforcement;
c) lay three block courses, including horizontal rebar and links every other course and raked joints,
d) grout the courses with rebar every three courses, and include a key;
e) repeat items ii to iv until the roof beam level;
f) install beam formwork;
g) install beam rebars;
h) install spacers;
i) install hurricane truss anchors;
j) install spacers;
k) pour, compact, level, trowel finish, and cure the concrete;
l) plaster the wall.

6.6.2 Concrete Stiffeners

6.6.2.1 Reinforced concrete stiffeners are required every 7.6 m (25 ft) of unbraced wall. If the unbraced length is long, then multiple stiffeners ought tot be installed at 6 m (20 ft) maximum spacing. Stiffeners should be at least 300mm (1 ft) wide, and toothed into the wall as shown in Figure 18. The thickness of the concrete stiffener is the wall thickness.

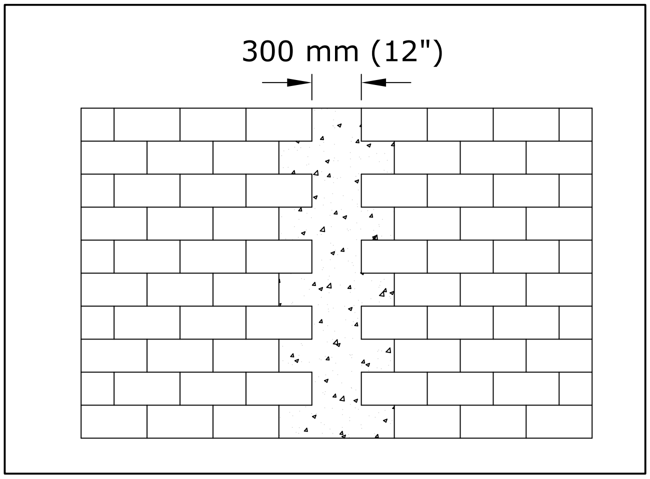

Figure 18 – Concrete stiffener in masonry wall

6.6.2.2 Minimum vertical rebars ought to be 4 H12 (1/2") anchored to the foundation and perimeter beam. Minimum links ought to be R6 (1/4") spaced at 300 mm (12") centres.

6.6.3 Reinforced concrete wall support suspended beams

The components of a reinforced concrete suspended beam are shown in Figures 19 and 20. Reinforced concrete suspended beams ought to have the strength, size and reinforcement as specified in Table 20 that corresponds to the span.

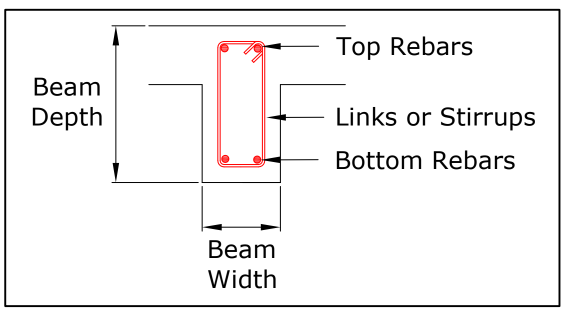

Figure 19 – Reinforced concrete suspended beam

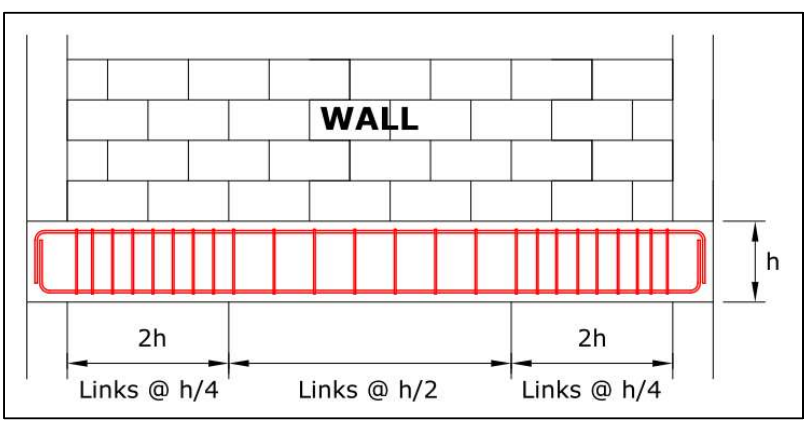

Figure 20 – Reinforced concrete suspended beam

Table 20 – Beam sizes and rebars

Maximum span m (ft)	Minimum depth mm (in)	Top rebars	Bottom rebars	Links @ spacing mm (in)
2.4 (8)	325 (13)	2H12	2H16	H8@150 (6)
3.0 (10)	350 (14)	2H12	2H16	H8@150 (6)
3.6 (12)	375 (15)	2H16	2H20	H8@200 (8)
4.3 (14)	400 (16)	2H20	2H25	H8@200 (8)

NOTE 1 Concrete 28-day compressive strength to be 25 MPa (3,600 psi).

NOTE 2 If using less than the specified minimums, Engineering advice should be obtained for verification.

NOTE 3 Assumes beam supports concrete block wall and part of roof.

NOTE 4 Equivalent Grade 60 rebar sizes in Table 4 may be used.

6.6.4 Reinforced concrete lintel beams

Reinforced concrete lintel beams ought to have the strength, size, and reinforcement as specified in Table 21 that corresponds to the span as shown in Figure 21.

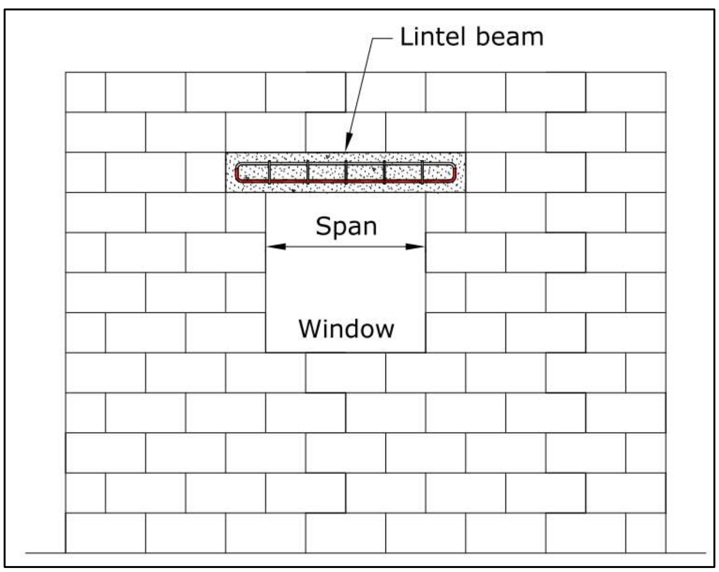

Figure 21 – Lintel beam

Table 21 – Lintel beam sizes and rebars

Span of Lintel m (ft)	Beam size (width x depth) mm (in)	Main rebar Number x Size	Links Dia @ mm centres
Up to 1.0 (0 to 3)	150 x 200 (6 x 8)	4xH12	H8@150 mm
1.0 to 1.8 (3 to 6)	200 x 200 (8 x 8)	4xH12	H8@150 mm
1.8 to 2.4 (6 to 8)	200 x 400 (8 x 16)	2xH12 (top) 2xH16 (bottom)	H8@200 mm

NOTE 1 Concrete 28-day compressive cube strength to be 25 MPa (3,600 psi)

NOTE 2 If using less than the specified minimums, engineering advice should be obtained for verification.

NOTE 3 Equivalent Grade 60 rebar sizes in Table 4 may be used.

6.6.5 Timber walls

6.6.5.1. Timber walls ought to be constructed of 2.4 m (8') high 50 mm x 100 mm (2"x4") timber studs. Pine studs should have a minimum spacing of 450 mm (18") on centre. Greenheart and Purpleheart studs should have a minimum spacing of 600 mm (24") on centre. Studs should be doubled at the wall's ends, top and around openings. A typical stud layout is shown in Figure 22. Wall cladding is specified in Clause 6.6.5.4.

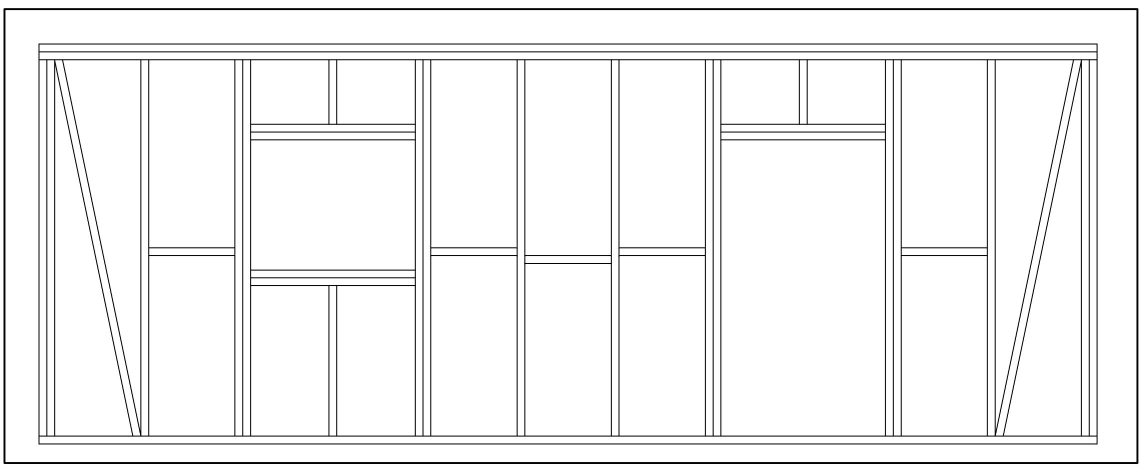

Figure 22 – Layout of wall timber frame

6.6.5.2 All wall junctions ought to be braced as shown in Figure 23.

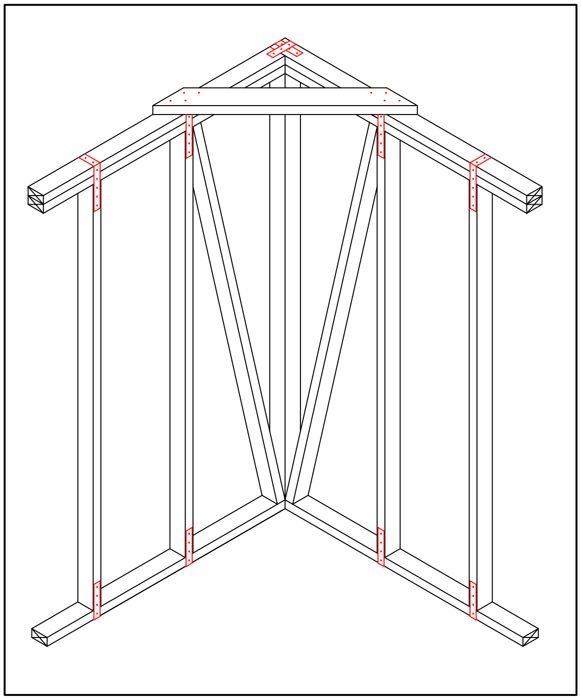

Figure 23 –Timber frame bracing at wall junctions

6.6.5.3 The construction method includes the following:

a) construct the sole plate or timber beam to support the studs;
b) install the vertical studs;
c) install additional studs at the at corners, and the sides of windows and doors;
d) install the top plate;
e) install diagonal bracing and noggins;

NOTE: The diagonal bracing ought to be installed at the ends of both internal and external walls.

f) install utility pipes and junction boxes;
g) install hurricane straps to support the rafters;
h) install wall cladding.

6.6.5.4 Wall cladding for internal and external walls should be: 20 mm (3/4”) thick ship lap boards or 10 mm (3/8”) thick plywood sheets, or equivalent. Wall cladding should be painted with a waterproof paint.

6.7 Roof

6.7.1 This Code of Practice provides guidelines for timber roof frames supported by reinforced concrete beams on masonry walls, and timber framed walls.

6.7.2 The roof consists of cladding, supported on 50 mm x 100 mm (2”x4”) treated Pine purlins or battens spaced at 600 mm (24”). The purlins ought to be supported on 16 mm (5/8”) thick plywood, supported on rafters, supported on walls. The purlins may be supported directly on the rafters as shown in Figure 24.

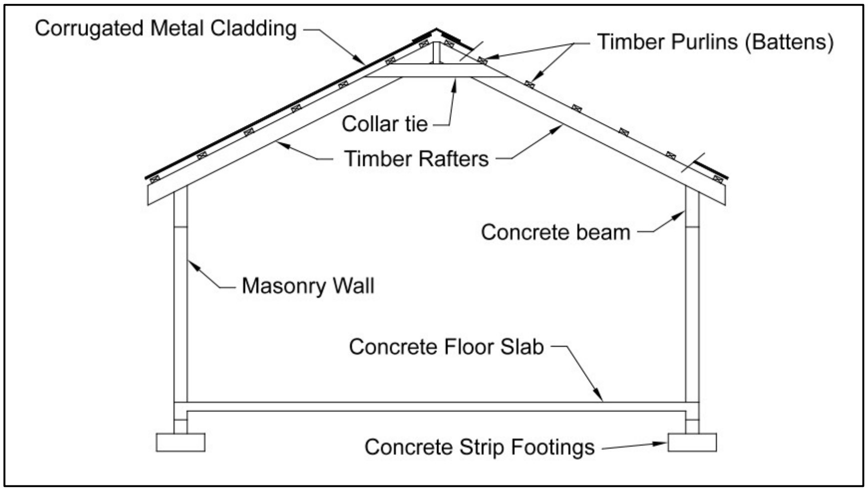

Figure 24 – Section through house showing roof

6.7.3 Main or common timber rafters, for hipped roofs, ought to have the strength size and spacing as specified in Tables 22 and 23 for Category 5 hurricanes that corresponds to the rafter span. For comparison, common rafters for a Category 2 hurricane are shown. Hip and ridge members should be 50 mm (2") deeper than the connecting rafters.

Table 22 – Rafter sizes at 400 mm (16") span

Span	**Category 5 Hurricane**		**Category 2 Hurricane**	
	Rafter size at 400mm (16") centres		**Rafter size at 400mm (16") centres**	
m (ft)	**Pine SS** mm (in)	**Purpleheart** mm (in)	**Pine SS** mm (in)	**Purpleheart** mm (in)
1.5 to 1.8 (5 to 6)	50 x150 (2 x 6)	50 x 100 (2 x 4)	50 x 100 (2 x 4)	50 x100 (2 x 4)
1.8 to 2.4 (6 to 8)	75 x 150 (3 x 6)	50 x 150 (2 x 6)	50 x 150 (2 x 6)	50 x 100 (2 x 4)
2.4 to 3.3 (8 to10)	75 x 200 (3 x 8)	75 x 150, 50 x 200 (3 x 6, 2 x 8)	50 x 150 (2 x 6)	50 x 150 (2 x 6)
3.3 to 3.6 (10 to 12)	75 x 200 (3 x 8)	75 x 150, 50 x 200 (3 x 6, 2 x 8)	50 x 150 (2 x 6)	50 x 150 (2 x 6)
3.6 to 4.3 (12 to 14)	75 x 250 (3 x10)	50 x 200 (2 x 8)	75 x 150 (3 x 6)	50 x 150 (2 x 6)
4.3 to 4.8 (14 to 16)	75 x 300 (3 x 12)	75 x 200 (3 x 8)	75 x 150 (3 x 6)	50 x 150 (2 x 6)
NOTE If using less than the specified minimums, engineering advice should be obtained for verification.				

Table 23 – Rafter sizes at 600 mm (24") span

Span	Category 5 Hurricane		Category 2 Hurricane (Trinidad)	
	Rafter size at 600mm (24") centres		Rafter size at 600mm (24") centres	
m (ft)	Pine SS mm (in)	Purpleheart mm (in)	Pine SS mm (in)	Purpleheart mm (in)
1.5 to 1.8 (5 to 6)	50 x 150 (2 x 6)	50 x 100 (2 x 4)	50 x 150 (2 x 6)	50 x 100 (2 x 4)
1.8 to 2.4 (6 to 8)	50 x 200 (2 x 8)	50 x 150 (2 x 6)	50 x 150 (2 x 6)	50 x 150 (2 x 6)
2.4 to 3.3 (8 to10)	75 x 250 (3 x 10)	50 x 200, 75 x 150 (2 x 8, 3 x 6)	50 x 200, 75 x 150 (2 x 8, 3 x 6)	50 x 150 (2 x 6)
3.3 to 3.6 (10 to 12)	75 x 250 (3 x 10)	75 x 200 (3 x 8)	75 x 200 (3 x 8)	50 x 150 (2 x 6)
3.6 to 4.3 (12 to 14)	75 x 300 (3 x 12)	75 x 200 (3 x 8)	75 x 200 (3 x 8)	75 x 150 (3 x 6)
4.3 to 4.8 (14 to 16)	75 x 300 (3 x 12)	75 x 250 (3 x 10)	75 x 250 (3 x 10)	75 x 150 (3 x 6)
NOTE If using less than the specified minimums, engineering advice should be obtained for verification.				

6.7.4 Roof on masonry walls

For a roof on masonry walls, the construction method includes the following:

a) erect falsework to support the ridge members;
b) install the ridge members, including any hips;
c) install the rafters;
d) install hurricane connectors;
e) install concrete to fill the space between rafters;
f) install tongue and groove close-boards or plywood, for example T1-11;
g) install purlins or battens;
h) install insulation (optional);
i) if metal cladding is to be used, install a damp proof membrane, rubberised paint, or rubberised tape on top of purlins;
j) install cladding.

6.7.5 Roof on timber framed walls

For a roof on timber framed walls, the construction method includes the following:

a) erect falsework to support the ridge member;
b) install the ridge members, including any hips;
c) install the rafters;
d) install hurricane connectors;
e) install tongue and groove close-boards or plywood, for example T1-11;
f) install purlins or battens;
g) install insulation (optional);
h) if metal cladding is to be used, install a damp proof membrane, rubberised paint, or rubberised tape on top of purlins;
i) install cladding.

6.7.6 Reducing the Span

Rafter sizes can be reduced by reducing the span by: Some reduced span concepts are shown in Figure 25.

a) supporting the rafter on an internal wall;
b) installing a 50 mm x 150 mm (2"x6") timber collar tie at a lower level, including making an A frame;
c) building a truss.

EXAMPLE Some reduced span concepts are shown in Figure 25.

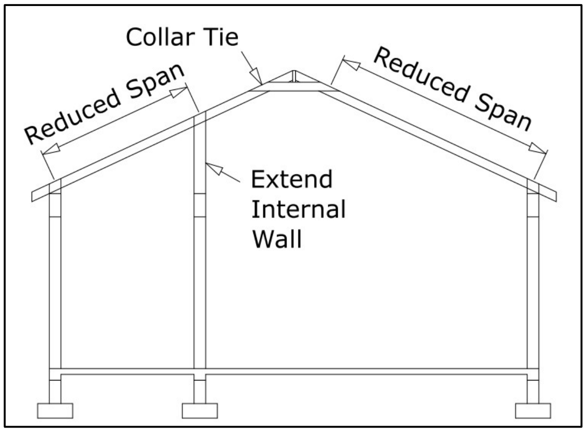

Figure 25 – Span reducing concepts

6.7.7 Roof Connections

Roof cladding connections ought to be made as shown in Figures 26 to 29. The hurricane connectors should be minimum 1.0 mm thick (18 gauge) galvanised metal with a minimum tensile strength of 450 MPa.

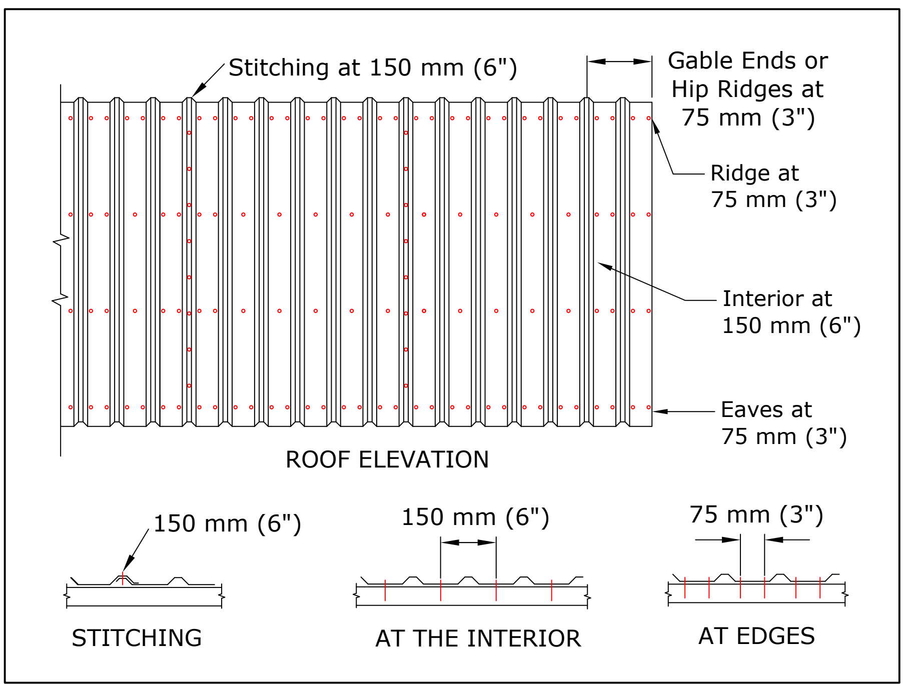

Figure 26 – Roof cladding connections

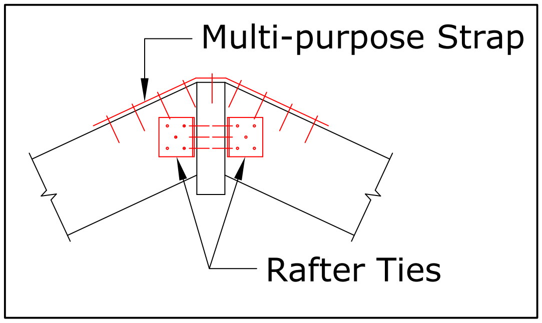

Figure 27 – Rafter connections at the ridge

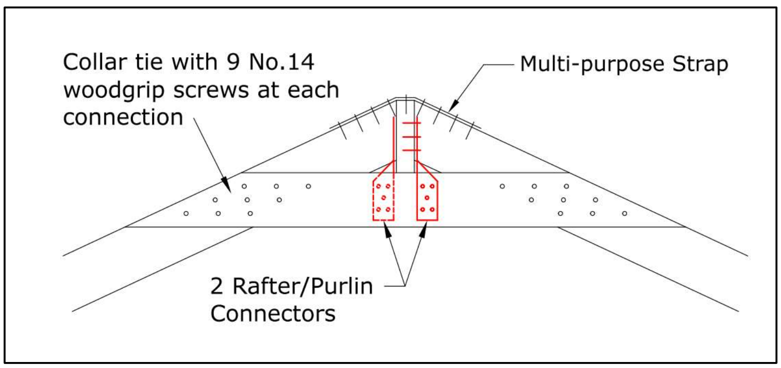

Figure 28 – Collar tie at ridge

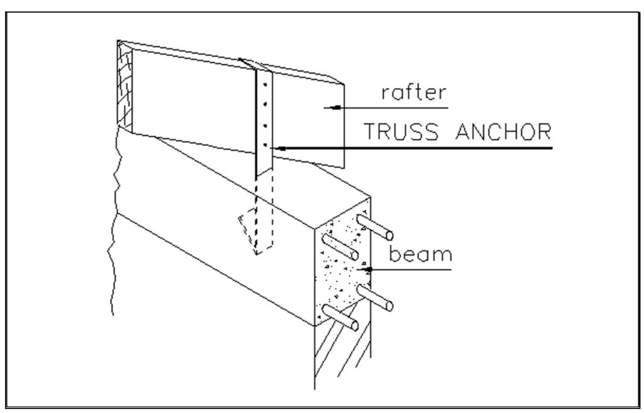

Figure 29 – Truss anchor

Annex A
(Informative)

A.1 Post construction maintenance
Maintenance

A.1.1 There are four (4) principal construction phases, (i) design, (ii) construction, (iii) maintenance, and (iv) demolition. Neglecting the maintenance requirements can hasten the start of the demolition phase. Addressing the building's maintenance may prolong the design life of the building.

A.1.2 Houses in the Caribbean may deteriorate rapidly if their materials are not protected from the environment. Examples of deterioration are: (i) corrosion of metal reinforcement, cladding and fixings, (ii) moisture damage to timber and paints, (iii) insect damage to timber, (iv) tree root damage to footings and walls, (v) air pollution damage to concrete, (vi) head and ultra-violet light damage to paint, pipes, plastic gutters, and soil chemistry damage to concrete footings.

A.1.3 To reduce the maintenance requirements, low-maintenance materials and construction methods should be used. The following are recommended:

a) Use compacted concrete and grout.
b) Protect reinforcement with adequate concrete cover.
c) Use strong blocks and mortar.
d) Install damp proof membrane below ground floor slabs.
e) Use suspended ground floor slabs or slabs supported on well compacted fill on rock.
f) Use treated timber.
g) Use stainless steel straps and fixings.
h) Use stainless steel or bronze hinges.
i) Use cleaned and cemented schedule 80 PVC pipes externally.
j) Use paint with fungicide (eg. Trowel Plastic).
k) Seal all open spaces (around pipes, around openings, between rafters.)
l) Install roof gutters and discharge stormwater away from foundations.
m) Seal joints and paint all exposed timbers.
n) Apply waterproofing agent to basement walls, and install a drain.

EXAMPLE Vandex, Penetron, Xypex, or equivalent.

A.2 Design for Elderly and Disabled People

A.2.1 Maintenance

Elderly and disabled persons normally have a challenge in maintaining their properties. If good quality materials are used and assembled properly, then the house will not attract high maintenance requirements.

A.2.2 Building Access

The walkway from the street to the house should be at least 1.5 m (5 ft) wide with a slope of at least 1:20. Allowance should be made for a ramp width of 914 mm (32") and slope of 1:12. At the entrance, the length of the landing should be at least 2 m (80") as shown in Figure A.1.

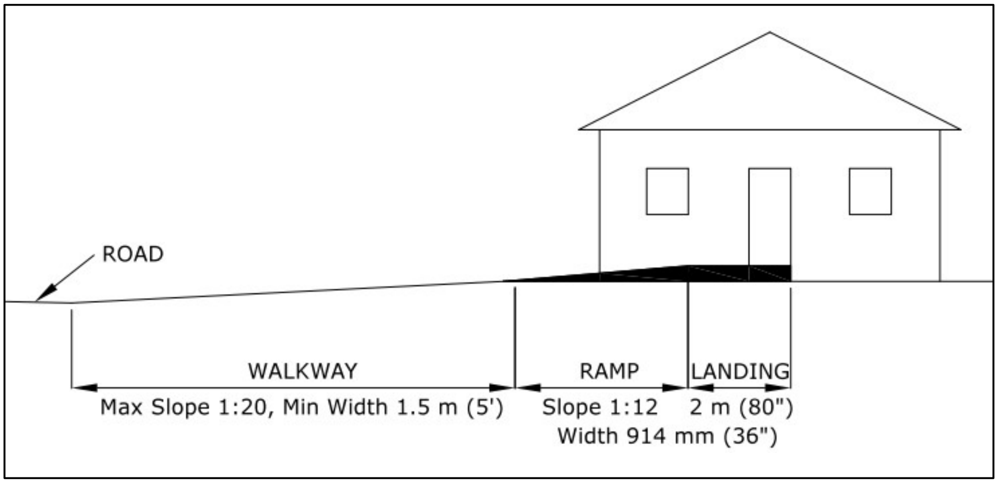

Figure A.1 – Access for disabled.

A.2.3 Doors and Corridors

All external doors and bathroom doors should open outwards. All door openings should be 810 mm (32") wide. Door levers should be used, not door knobs. All corridors should be a minimum width of 1 m (40").

A.2.4 Kitchen, Laundry and Bathrooms

A clearance of 1,370 mm (54") should be provided around all: cabinets, counter tops, ovens, washers, driers, tubs, and any other furniture or appliance.

A.2.5 Electrical Light Fixtures

All electrical light bases are to accommodate screw type bulbs.

END OF DOCUMENT

CARICOM REGIONAL ORGANISATION FOR STANDARDS AND QUALITY

The CARICOM Regional Organisation for Standards and Quality (CROSQ) was created as an Inter-Governmental Organisation by the signing of an agreement among fourteen Member States of the Caribbean Community (CARICOM). CROSQ is the regional centre for promoting efficiency and competitive production in goods and services, through the process of standardization and the verification of quality. It is the successor to the Caribbean Common Market Standards Council (CCMSC), and supports the CARICOM mandate in the expansion of intra-regional and extra-regional trade in goods and services.

CROSQ is mandated to represent the interest of the region in international and hemispheric standards work, to promote the harmonization of metrology systems and standards, and to increase the pace of development of regional standards for the sustainable production of goods and services in the CARICOM Single Market and Economy (CSME), and the enhancement of social and economic development.

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The premier CARICOM organisation for the development and promotion of an Internationally Recognised Regional Quality Infrastructure; and for international and regional harmonized CARICOM Metrology, Standards, Inspection, Testing and Quality Infrastructure

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