SECTION 17

STRUCTURAL STEEL

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SECTION 17

STRUCTURAL STEEL

1701 SCOPE

a) This Section deals with the design and construction of steel buildings which must be carried out in accordance with Part 2 Section 7B "Structural Design Requirements - Structural Steel" of the Caribbean Uniform Building Code, CUBiC.

b) The construction of small steel framed buildings using standard steel sections is dealt with in Section 18 Sub-section 1804 of the Code.

c) The general requirements for construction of light gauge steel framed structures are given in Sub-section 1714, while the requirements for the construction of small houses using light steel frame construction are given in Section D of the Building Guidelines.

1702 BASIS OF DESIGN

a) Steel and iron members shall be designed by methods admitting of rational analysis according to established principles of mechanics.

b) The quality, design, fabrication and erection of steel and iron used structurally in buildings or structures shall conform to the provisions of this Code and to Part 2 Section 7 "Structural Design Requirements - Structural Steel" Caribbean Uniform Building Code (CUBiC) or to any other relevant standard approved by the Authority.

1703 APPLICATION

The requirements set forth in 1701 to 1713 inclusive, herein, are applicable to structures and do not apply to members formed of flat-rolled sheet or strip steel, light gauge steel construction, (except structural frames) or other miscellaneous light steel construction.

1704 MATERIAL STANDARDS

Steel for structural applications in buildings shall conform to the "Standard Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use" by the American Society for Testing and Materials, ANSI/ASTM A6.

1705 COLD FORMED STAINLESS STEEL CONSTRUCTION

The design, fabrication and erection of cold-formed stainless steel construction shall conform to the "Specification for the Design of Cold-Formed Stainless Structural Members" of American Iron and Steel Institute.

1706 COLD FORMED STEEL STRUCTURAL MEMBERS

a) The design and construction of cold formed steel structural members shall be in accordance with Part 2 Section 7B Sub-section 14 of CUBiC. This Sub-section provides information on the working stress design for structural members formed from the shaping of flat rolled steel at ambient temperature to form a structural section.

b) The developer may utilise any other method of design provided the material used, and the design developed, will lead to a building which is resistant to hurricane and earthquake forces and to the corrosive environment of the OECS. The materials used and design adopted must be approved by the Director.

c) Other references are·

i) ANSI/ASTM A446-76:

Steel Sheet, Zinc Coated (Galvanised) by the Hot-Dip Process, Structural (Physical) Quality (Grades A, B, C, D and F)

ii) ANSI/ASTM A525-79:

Steel Sheet, Zinc Coated (Galvanised) by the Hot-Dip Process, General Requirements.

iii) ANSI/ASTM A606-75:

Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, High Strength, Low Alloy, with Improved Corrosion Resistance.

(iv) AISI

Cold-Formed Steel Design Manual, 1986

1707 OPEN WEB STEEL JOIST CONSTRUCTION

The design, fabrication and erection of open web steel joist construction shall comply with the following specifications: "Standard Specifications for Open Web Steel Joists, H -Series" adopted by American Institute of

Steel Construction and Steel Joist Institute or to Part 2 Section 7B Subsection 17 of CUBiC.

1708 WELDING

Details of design, workmanship and technique for welding, inspection of welding, and qualification of welding operators shall conform to the following specifications:

a) "Structural Welding Code" by American Welding Society.

b) "Specifications for Welding Sheet in Buildings" by American Welding Society.

1709 HIGH TENSION BOLTS

The design and assembly of structural joints and connections using high strength steel bolts shall conform to the "Specifications for Structural Joints Using ASTM A325 or ASTM A490 Bolts" approved by the Research Council or Riveted and Bolted Structural Joints of the Engineering Foundation.

1710 TESTS

The owner shall provide the Director with test results and/or mill records to determine the quality of materials and assemblies.

1711 DESIGN LOADS

Designs shall be based on the dead, live, wind and other loads set forth in Section 12 and the additional stress considerations set forth in Section 17.

1712 MINIMUM THICKNESS OF MATERIAL

(a) The minimum thickness of steel and iron used in buildings or other structures or to resist wind forces, shall be not less than as set forth in BS 5950 "Structural Use of Steelwork in Buildings" or equivalent American standard and where structural members are exposed to industrial fumes, salt water, salt water spray and other corrosive agents, such members shall have a minimum web thickness of 0.25 inches unless the steel used is an atmospheric corrosion-resistant grade approved by the Director. It is recommended that in the corrosive atmosphere of the OECS, all steel members be protected against corrosion by encasing the steel in concrete or by other approved forms of protection.

(b) In the main structural framework of buildings primary members shall be construed to include any steel member used as a column, beam or to support walls or partitions including trusses, isolated lintels spanning openings of 8 feet or more and any member required to brace a column or a truss or to support 200 or more sq.ft of floor or roof area.

(c) Secondary members shall be construed to include all other steel members, including filling-in beams of floor systems which individually support less than 200 sq.ft of floor or roof area.

(d) For primary members of the structural frame all steel used shall be at least 0.20 inches in thickness for interior work. All steel in exterior walls of structures except lintels spanning an opening of less than 8 feet shall be at least 0.20 inches in thickness when protected as required in 1710 and at least 0.25 inches thick when not so protected.

(e) Unless otherwise determined by tests, the thickness of fire-resistive members shall be assumed to have the resistance ratings detailed in Table 17-1.

Table 17-1

Fire resistance of Concrete Members

Inches of	1 Hr.	2 Hr.	3 Hr.	4 Hr.
Cement concrete over 2,000 psi.	1	1-1/2	2	2
Cement concrete 1,600 - 2,000 psi	1-1/2	2	3	4
Cement concrete 1,600 - 2,000 psi with wire fabric	1-1/2	2	2	3
Concrete block (nominal dimensions)	-	-	4	4

1713 CONNECTIONS

(a) Any suitable mechanical fastener, special device or other means may be used to join component parts provided that the type of fastening device is compatible with the service connections.

(b) High strength steel bolts, may be used in lieu of rivets.

(c) Welded connections shall be in accordance with BS 2642 "General Requirements for the Arc Welding of Steel" and/or CSA Standard W59, "Welded Steel Construction (Metal-Arc Welding)".

(d) A competent welding supervisor, who shall be approved by the Director or by the design engineer where employed by the owner, shall be present at all times when welding is in progress.

(e) It shall be permissible to use ribbed or spliced bolts in place of rivets or ordinary bolts. The diameter of the bolt shall be identical to that of the rivet.

1714 PIPE COLUMNS

1714.1 General

(a) Steel or wrought-iron pipes may be used as compression members. The pipes shall be new material, the shell shall be straight and the wall thickness shall be not less than 3/16".

(b) Where pipe columns support loads in excess of 1,000 lb or are required to be fire-resistive, the pipe shall be filled with 1:3:6 concrete.

1714.2 Allowable load

(a) Only the load-bearing capacity of the shell shall be considered in determining the allowable load on a pipe compression member when filled with concrete.

(b) Load-bearing pipe columns shall be provided with steel bearing plates so designed that the bearing stresses of the material on which the column is to be placed shall not be exceeded and so that the bending stresses in the steel plate shall not exceed those permitted.

1715 COMPOSITE BEAMS

1715.1 Definition

a) Composite beams shall be the term used to apply to any rolled or fabricated steel floor beam entirely encased in a poured concrete haunch supporting a concrete slab on either side. At its narrowest point the concrete haunch shall be at least 4 inches wider than the flange of the beam. The top of the beam shall be at least 2" above the bottom of the slab and at least 1-1/2" below the top of the slab. There should be no openings in the slab adjacent to the beam. The concrete casing shall be adequately provided with mesh or other reinforcement throughout its depth and across its soffit.

b) Uncased beams may be designed as composite beams provided that this is based on the requirements of BS 5950 or equivalent standard approved by the Authority.

1715.2 Basis of Design

The design of composite beams shall be carried out by a professionally qualified engineer using a method acceptable to the Director. Particular attention shall be paid to the design of shear connectors, and to the provision of adequate resistance to end shear forces.

1715.3 Protection of the Metal

All field rivets and bolts and abrasions to the shop coat shall be spot-painted. Buildings or structures not encased in concrete shall be field painted, in addition to the shop coats, with not less than 1 coat of lead, graphite, asphalt paint or other approved paint which will not act as a solvent for the shop coat.

1716 LIGHT GAUGE STEEL CONSTRUCTION

1716.1 Application

a) Light gauge steel construction shall include structural decks or members formed of sheet or strip steel less than 3/16" thick, and used for load bearing purposes.

b) The use of light gauge steel construction shall be reserved for single or two storey buildings in Group E Occupancy or in Group D(b) Occupancy provided the building is not greater than 2,000 square feet in floor area.

c) Section 18 provides information on the framing requirements for small steel structures using standard sections, and Section D of the Building Guidelines provides outline performance specifications for small single storey buildings.

1716.2 Duties of the Developer

a) For the design, fabrication and erection of prefabricated steel buildings composed of light gauge steel members, the developer shall file with the Director duplicate copies of a certificate from a recognised testing laboratory to the effect that tests have been made on this particular type of prefabricated construction. The test reports should show the loads including the live loads and wind loads sustained by the building in pounds per sq.ft together with a physical description of the building and a description of the tests.

b) Panels and other elements tested for loads shall sustain without failure a superimposed load equal to two times the live load.

Recovery within 24 hours after removal of the full test load, shall be not less than 75 percent of the observed deflection. The measured deflection for any panel or element under full live load shall not be greater than 1/360 of the span for panels that will be plastered or 1/240 of the span for other panels and 1/180 of the span for roof decks without ceilings.

c) All tests must be carried out in accordance with the applicable standard of the ASTM or the relevant British Standard.

d) It is the responsibility of the developer to prove by calculations or test results that the design proposed will provide a building that is resistant to the wind and earthquake forces and other loads given in Section 12, and that the corrosion protection of the steel members will be adequate over the projected life of the building. The building must have the fire resistance required for the class of use.

e) It is expected that the developer will supply the following information when applying for a building permit:

i) complete structural drawings of the building. The drawings and written information must give the sizes and thickness of all members, the connections used, and methods of field assembly.

ii) test results required under 1716.2 a).

iii) test data and specifications of the corrosion method to be used.

iv) other standard information required by the Authority as per Section 1 of the Code.

1716.3 General Standards

The design and construction of light gauge steel structures shall be carried out in accordance with the relevant standards set forth by the American Iron and Steel Institute or the British Standard or other relevant standard or Code approved by the Authority.

The design requirements given in 1716.3 may be varied by the developer, provided that tests on the materials and assemblies show that the structure can accommodate the imposed loads safely and can resist the wind and earthquake forces in accordance with the requirements of Section 12.

1716.4 **Structural Members other than Decks**

Design and fabrication shall be as set forth in 1716.2. Special attention shall be paid to the following:

(a) All primary and secondary members must be designed in accordance with the standards given in 1716.1 and 1716.2 or in accordance with any other standard approved by the Authority. Except that the minimum thickness of steel of primary members shall be 16 gauge, and the spacing of studs shall be no greater than 24 inches on centres and provision shall be made to resist horizontal wind forces by diagonal members or diaphragm panels attached to the studs.

(b) Light-gauge steel for the treads, risers, stringers and landings of stairways shall have a minimum thickness of 12 gauge.

(c) Light-gauge steel studs for non-bearing partitions shall have a minimum thickness of 18 gauge.

(d) Light gauge steel joists or rafters shall be designed with due consideration for wind pressure and suction at the relevant level.

(e) Unless otherwise provided for in the design, the joist or rafter members shall have not less than 4" of bearing on reinforced concrete nor less than 2" on steel supports, except that where opposite joists butt over a steel support and positive, approved means of attachment to the steel is furnished, a shorter bearing length may be used. Each end of each member shall be anchored. Resistance to diaphragm action shall be provided by the deck or by diagonal members. Bridging shall be provided, spaced not further apart than 32 times the flange width. Such bridging shall be solid sections of the joist material or be cross bridging formed from approved open-welded joists.

(f) Light-gauge steel used in sandwich construction for wall panels for the exterior or enclosing walls of buildings shall have a minimum thickness of 24 gauge for the sheeting. The minimum thickness for secondary members supporting exterior panel construction shall be 18 gauge.

(g) Light-gauge steel members resisting lateral stresses in interior partitions of buildings two storeys or more in height shall be not less than 16 gauge.

(h) Light-gauge steel structural members shall not be used in locations subject to corrosive agents or continuous dampness.

1717 STRUCTURAL SHEETS

Structural sheet-metal sections may be used for floor decks, roof decks and wall cladding to span between supports, provided the design is based on rational analysis, and design and fabrication comply with the standard set forth in 1703 or with any other standard approved by the Authority and as follows:

(a) Sheet-metal sections shall have a minimum thickness of 18 gauge for floors, or 24 gauge[1] for roof and walls and shall be protected as set forth in this subsection.

(b) The span of sheet-metal sections used for floor systems shall not exceed 40 times the overall depth of the section.

(c) No structural value shall be allowed for any fill material used with deck systems except in the case of composite floor systems which shall be designed to the approval of the Director.

(d) The shape of the sections as placed in buildings shall be such as to eliminate any possibility of lateral displacement for compression area.

(e) Where large openings occur, the perimeter of the openings shall be framed with adequate supports for the floor panels. Small openings shall be reinforced so that the allowable stresses in adjoining materials are not exceeded.

(f) Positive anchorage for sheet-metal roofs or decks shall be provided by proven mechanical connectors. The anchorage must be capable of resisting the uplift forces caused by hurricane winds and other loads described in Section 12.

(g) Bolts and rivets shall be not less than 3/16" in diameter Lead, neoprene, or other approved washers not less than 1/2" in diameter shall be provided under the heads of all bolts and rivets.

(h) Roofing sheets and other structural sheet metal sections spanning between supports shall be designed to support the live load without deflecting more than 1/180 of the span and without permanent deformation.

(i) All members formed of light-gauge strip or sheet-metal shall be treated with protective paint coatings or shall be galvanised. The anti-corrosion treatment must be approved by the Authority.

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[1]*Note: United States Standard Gauge used throughout*

(j) Valley fixings for corrugated roof sheets are stronger than ridge fixings. and are recommended provided that measures are taken to avoid leaks, such as the use of suitable washers and the use of self aligning tools for the installation of fixing screws in accordance with the manufacturer's instructions.