

Approved Document for Maldives Building Code **Structure** Clause B1 & **Durability** Clause B2

Prepared by the Construction Industry Development Section of the Ministry of Construction and Public Infrastructure based on the Approved Document prepared by the Building Industry Authority of New Zealand.

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Maldives Building Code

Clause B1 Structure

This Clause is extracted from the Maldives Building Code.

Clause B1—STRUCTURE	Limits on application
Provisions	
<p>OBJECTIVE B1.1 The objective of this provision is to:</p> <ul style="list-style-type: none"> (a) Safeguard people from injury caused by structural failure, (b) Safeguard people from loss of <i>amenity</i> caused by structural behaviour, and (c) Protect <i>other property</i> from physical damage caused by structural failure. 	
<p>FUNCTIONAL REQUIREMENT B1.2 <i>Buildings, building elements and sitework</i> shall withstand the combination of loads that they are likely to experience during <i>construction</i> or <i>alteration</i> and throughout their lives.</p>	
<p>PERFORMANCE</p>	
<p>B1.3.1 <i>Buildings, building elements and sitework</i> shall have a low probability of rupturing, becoming unstable, losing equilibrium, or collapsing during <i>construction</i> or <i>alteration</i> and throughout their lives.</p>	
<p>B1.3.2 <i>Buildings, building elements and sitework</i> shall have a low probability of causing loss of <i>amenity</i> through undue deformation, vibratory response, degradation, or other physical characteristics throughout their lives, or during <i>construction</i> or <i>alteration</i> when the <i>building</i> is in use.</p>	
<p>B1.3.3 Account shall be taken of all physical conditions likely to affect the stability of <i>buildings, building elements and sitework</i>, including:</p>	
<ul style="list-style-type: none"> (a) Self-weight, (b) Imposed gravity loads arising from use, (c) Temperature, (d) Earth pressure, (e) Water and other liquids, 	

Provisions	Limits on application
<p>(f) Wind, (g) <i>Fire</i>, (h) Impact, (i) Explosion, (j) Reversing or fluctuating effects, (k) Differential movement, (l) Vegetation, (m) Adverse effects due to insufficient separation from other <i>buildings</i>, (n) Influence of equipment, services, non-structural elements and contents, (o) Time dependent effects including creep and shrinkage, and (p) Removal of support.</p> <p>B1.3.4 Due allowance shall be made for: (a) The consequences of failure, (b) The intended use of the <i>building</i>, (c) Effects of uncertainties resulting from <i>construction</i> activities, or the sequence in which <i>construction</i> activities occur, (d) Variation in the properties of materials and the characteristics of the site, and (e) Accuracy limitations inherent in the methods used to predict the stability of <i>buildings</i>.</p> <p>B1.3.5 The demolition of <i>buildings</i> shall be carried out in a way that avoids the likelihood of premature collapse.</p> <p>B1.3.6 <i>Site work</i>, where necessary, shall be carried out to: (a) Provide stability for <i>construction</i> on the site, and</p>	

Provisions

(b) Avoid the likelihood of damage to *other property*.

B1.3.7 Any *sitework* and associated supports shall take account of the effects of:

- (a) Changes in ground water level,
- (b) Water, weather and vegetation, and
- (c) Ground loss and slumping.

Clause B2—DURABILITY	Limits on application
Provisions	
<p>OBJECTIVE</p> <p>B2.1 The objective of this provision is to ensure that a <i>building</i> will throughout its life continue to satisfy the other objectives of this code.</p>	
<p>FUNCTIONAL REQUIREMENT</p> <p>B2.2 <i>Building</i> materials, components and <i>construction</i> methods shall be sufficiently durable to ensure that the <i>building</i>, without reconstruction or major renovation, satisfies the other functional requirements of this code throughout the life of the <i>building</i>.</p>	
<p>PERFORMANCE</p> <p>B2.3 From the time a <i>code compliance certificate</i> is issued, <i>building elements</i> shall with only normal maintenance continue to satisfy the performances of this code for the lesser of; the <i>specified intended life</i> of the <i>building</i>, if any, or:</p> <p>(a) For the structure, including <i>building elements</i> such as floors and walls which provide structural stability: the life of the <i>building</i> being not less than 50 years.</p>	

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Acceptable Solution B1 and B2/AS1

1.0 The requirements in Clause B1 and B2 of the Maldives National Building Regulation are deemed to be satisfied if the design and construction of a building comply with the specifications set out in paragraphs 1.1 to 1.7

1.1 LOADS

- 1.1.1 The building shall be able to resist loads determined in accordance with the following standards-
- (a) Dead loads -
 - (i) BS 648 ; Schedule of Weights of Building Materials, and
 - (ii) BS 6399; Part 1: 1996 Loading for Buildings. Code of practice for dead and Imposed Loads.
 - (b) Imposed floor and ceiling loads, dynamic loads due to crowd movement, loads on parapets and balustrades, loads on vehicular barrier for car parks, accident loads.
 - (i) BS 6399; Loading for Buildings. Code of practice for dead and Imposed Loads Part 1: 1996 Code of practice for dead and imposed loads.
 - (c) Wind loads -
 - (i) BS 6399; Code of Basic Data for the Design of Building: Loading Wind Loads. Part 2: 1997 Code of practice for wind loads BRE Digest 436: Parts 1, 2 and 3 (Brief guidance for using BS 6399: Part 2)
 - (ii) Basic wind speed chart – Maldives

1.2 STRUCTURAL DESIGN

- 1.2.1 The design of the building structures shall comply with the following standards -
- (a) Reinforced and prestressed concrete structures -
 - (i) BS 8110; Code of Practice for Structural Use of Concrete Part 1: 1997 Code of practice for design and construction. Part 2: 1985 Code of practice for special circumstances. Part 3: 1995 Design charts for singly reinforced beams, doubly reinforcement and regular columns.
 - (ii) BS 8103; Part 4 : 1995 Structural design of low rise buildings
 - (b) Steel Structures –
 - (i) BS 5950; Structural Use of Steelworks in Building: Part 1: 2000 Code of practice for design in simple and continuous construction: hot rolled and welded sections. Part 2: 2001 Specification for materials, fabrication and erection, hot rolled sections. Part 3: Section 3.1: 1990 Code of practice for design of simple and continuous composite beams. Part 4: 1994 Code of practice for design of composite slabs with profiled steel sheeting. Part 5: 1998 Code of practice for design of cold formed thin gauge sections.
 - (ii) BRE Digest 437 - Industrial Platform floors: mezzanine and raised storage.
 - (c) Precast concrete structures
 - (i) BS EN 1992; Code of Practice for Precast Concrete Slab and Wall Panel

- (d) Structural Masonry –
 - (i) BS 5628; Code of practice for use of masonry.
 - (ii) BS 8103; Structural design of low – rise buildings
Part 1: 1995 Code of practice for stability, site investigation, foundation and ground floor slabs for housing.
Part 2: 1996 Code of practice for masonry walls for housing.
- (e) Foundations –
 - (i) BS 8004; 1986 Code of Practice for Foundations.
- (f) Aluminium structures-
 - (i) BS 8118; Structural Use of Aluminium.
Part 1: 1991 Code of practice for design.
Part 2: 1991 Specification for materials, workmanship and protection.
- (g) Timber structures –
 - (i) BS 5268; Code of Practice for Structural Use of Timber
- or
 - (ii) BS 8103; Structural design of low – rise buildings
Part 3: 1996 Code of practice for timber floors and roofs for housing.
- (h) Aqueous retaining concrete structures–
 - (i) BS 8007; Code of Practice for Design of Concrete Structures for Retaining Aqueous Liquids: 1987
- (i) Retaining structures –
 - (i) BS 8002; 1994 Code of practice for Earth Retaining Structures
- (j) Bridges –
 - (i) BS 5400; Steel, Concrete and Composite Bridges.
- (k) Assessment of concrete –
 - (i) BS 1881; Testing Concrete.
 - (ii) BS 6089; Guide to Assessment of Concrete Strength in Existing Structures.

1.3 EXISTING BUILDINGS SITE INVESTIGATION AND INSTRUMENTATION

- 1.3.1 Site investment and instrumentation shall be carried out in accordance with the following Standards –
 - (a) BS 5930; Code of Practice for Site Investigations.
 - (b) BS 1377; Method of Test for Soil for Civil Engineering Purposes.

1.4 FOUNDATION INVESTIGATION

- 1.4.1 It is the responsibility of the designer to order adequate soil exploration (including test borings) for any building or structure of any height. As a rule, test borings shall be required for G+10 Buildings and higher. Trial Pits by Excavation shall be required for G+2 and higher Buildings. The number, location as well as the depth of exploration shall be in accordance with the requirements of BS 8004. (Code of Practice for Foundations).
- 1.4.2 The soil classification shall be based on observation and any necessary tests of the materials disclosed by boring or excavations made in appropriate locations. Additional studies may be necessary to evaluate soil strength, the effect of moisture variation on soil-bearing capacity, compressibility, liquefaction and expansiveness.
- 1.4.3 A written report of the investigation to be submitted to the local authority For G+2 or higher buildings which shall include, but need not to be limited to, the following information:

- a) A plot showing the location of all test borings and / or excavations.
 - b) Descriptions and classifications of the materials encountered.
 - c) Elevation of the water table, if encountered.
 - d) Recommendation for foundation type and design criteria, including bearing capacity, provisions to mitigate the effects expensive soils, provisions to mitigate the effects of liquefaction and soil strength, and the effects of adjacent loads.
 - e) For G+10 and higher buildings, expected total and differential settlement.
- (e) Prestressing tendon –
 - (i) BS 8110; Code of Practice for Structural Use of Concrete
 - (ii) BS 5400; Steel, Concrete and Composite Bridges. Specification for Materials and Workmanship, Concrete. Reinforcement and Prestressing Tendons: Part 7.
 - (f) Prestressing steel –
 - (i) BS 5896; Steel for the Prestressing of Concrete.
 - (g) Concrete –
 - (i) BS 5328; Concrete – Guide to Specification Concrete & Methods for Specifying Concrete Mixes.
 - (ii) BS EN 206; Performance, production and conformity.
 - (h) Admixture –
 - (i) BS 5075; Concrete Admixture – BS 5075; Part 1: Accelerating Admixture, Retarding Admixture and Water-reducing Admixture. BS 5075; Part 3: super plasticizing Admixtures.

1.5 CONSTRUCTION MATERIALS

1.5.1 Construction materials shall comply with the following Standards.

- (a) Cement –
 - (i) BS 12; Ordinary Portland cement.
 - (ii) BS 4027; Specification for Sulphate – resisting Portland Cement.
 - (iii) BS 4248; Specification for Super – sulphated Cement
 - (iv) BS 6699; Portland Blast furnace Cement
- (b) Aggregates –
 - (i) BS 812; Aggregates from Natural Sources for Concrete.
- (c) Water –
 - (i) BS 3148; Methods of Test for Water for Making Concrete
- (d) Steel reinforcement –
 - (i) BS 4449; Steel for Reinforcement of Concrete
 - (ii) BS 8666; Specifications for Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete
- (i) Structural Steel –
 - (i) BS 7668; Specification for Weldable Structural Steels. Hot Finished Structural Hollow Sections in Weather Resistant Steels
 - (ii) BS EN 10025; Hot Rolled Products of Non-alloy Structural Steels: Technical Delivery Conditions.
 - (iii) BS EN 10137; Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions.
 - (iv) BS EN 10113; Hot Rolled Product in Weldable Fine Grain Structure Steel.
 - (v) BS EN 10155; Structural Steel with Improved Atmospheric Corrosion Resistance.
 - (vi) BS EN 10210; hot finished Structural Hollow Sections of Non-alloy and Fine Grain Structural Steel.

- (vii) NS EN 10219; Cold Formed Welded Structural Sections of Non-alloy and Fine Grain Steel.
- (j) Aluminium and aluminum alloys –
 - (i) BS EN 485; Sheet, Strip and Plate.
 - (ii) BS EN 515; Wrought Product: Temper Designation.
 - (iii) BS EN 573; Chemical Composition and Form of Wrought Product.
BS 1474; Extruded Rod/Bar, Tube and Profiles – DS EN 755: Part 1; Engineering Use
- (k) Fixing of claddings –
 - (i) BS EN ISO 3506; Mechanical Properties of Corrosion-resistant Stainless Steel Fasteners.

1.6 CONSTRUCTION TESTS

- 1.6.1 Construction tests for the materials and the structural members or element of a building shall comply with the following standards –
- (a) Cement –
 - (i) BS 4550 and BS EN 196; Methods of Testing Cement.
 - (b) Aggregate –
 - (i) BS 812 and BS EN 1097; Methods of Testing Aggregates.
 - (c) Water –
 - BS 3148; Methods of Test for Water for Making Concrete.
 - (d) Concrete –
 - (i) BS 1881; Testing Concrete - and
 - (ii) BS 6089; Assessment of Concrete Strength in Existing Structures.
 - (e) Steel reinforcement –
 - (i) BS 4449; Steel for the Reinforcement of Concrete.
 - (ii) BS 4482; Cold-reduced Steel Wire for the Reinforcement of Concrete and the Manufacture of Welded fabric.
 - (iii) BS 4483; Welded Steel Fabric for the Reinforcement of Concrete.
 - (iv) BS 4449; Specification for Carbon Steel Bars for the Reinforcement of Concrete.

- (f) Structural steel –
 - (i) BS EN 10137; Plates and Wide Flats Made of High Yield Strength Structural Steels in the quenched and Tempered Precipitation Hardened Conditions.
 - (ii) BS 5950; Structural Use of Steelworks in Building:
 - Part 1: 2000 Code of practice for design in simple and continuous construction: hot rolled and welded sections.
 - Part 2: 2001 Specification for materials, fabrication and erection, hot rolled sections.
 - Part 3: Section 3.1: 1990 Code of practice for design of simple and continuous composite beams.
 - Part 4: 1994 Code of practice for design of composite slabs with profiled steel sheeting.
 - Part 5: 1998 Code of practice for design of cold formed thin gauge sections.
- (g) Prestressing wires, strands or bars –
 - (i) BS 5896; Specification for Higher Tensile Steel Wire and Strand for the Prestressing of Concrete.
 - (ii) BS 4486; Specification for Hot Rolled and Processing High Tensile Alloy Steel Bars for the Prestressing of Concrete.
- (h) Weld quality –
 - (i) BS EN 1290; Non-destructive Examination of Welds, Magnetic Particle Examination of Welds.
 - (ii) BS EN 1291; Non-destructive Examination of Welds, Magnetic Particle Testing of Welds. Acceptance Levels.
 - (iii) BS EN 571; Non-destructive testing. Penetrant Testing.
 - (iv) BS EN 1714; Non-destructive Examination of Welded Joints
 - (v) Methods for Ultrasonic Examination of Welds – BS 3923
 - (vi) BS EN 1435; Non-destructive Examination of Welds.

Radiographic Examination of Welded
Joints

- (i) Pile load test –
 - (i) BS 8004; Code of Practice for Foundations.