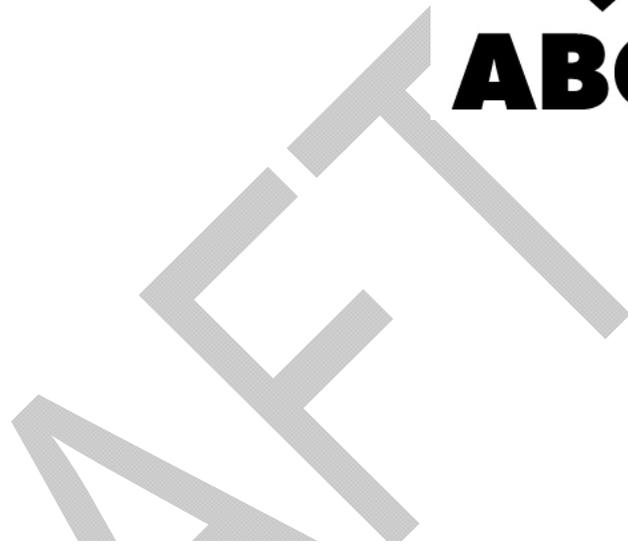
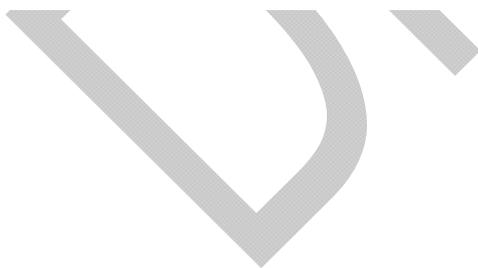




ABCB



**DRAFT STANDARD FOR CONSTRUCTION
OF BUILDINGS IN FLOOD HAZARD AREAS**



VERSION 6

JULY 2011

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¹ The Australian Building Codes Board (ABCB) is a joint initiative of all three levels of government in Australia and includes representatives from the building and construction industry, and the plumbing industry. The mission of the ABCB is to address issues relating to safety and health, and amenity and sustainability in the design and performance of buildings through the National Construction Code (NCC) Series, and the development of effective regulatory systems and appropriate non-regulatory solutions. This is set out in an inter-government agreement between the Commonwealth, States and Territories.

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General Manager – Australian Building Codes Board
GPO Box 9839
Canberra ACT 2601

Phone 1300 134 631 – Fax 02 6213 7287

Preface

Currently, the National Construction Code (NCC) does not contain detailed construction practice for buildings *in flood hazard areas*. However, although not targeted at technical solutions for building *in flood hazard areas*, the NCC does contain performance provisions requiring all buildings to have structural resistance to the action of liquids, ground water and rainwater ponding by requiring compliance with Australian Standards for structural design. The performance requirements with respect to surface water are designed to ensure that if the ponding of surface water occurs then drainage and disposal of surface water must be conveyed to an appropriate outfall and avoid water damaging or entering a building.

In recognition of the absence of technical standards relating to flooding within the NCC, the Australian Government and State and Territory Government Building Ministers responsible for building construction standards decided to develop a standard for the design and construction of certain new buildings *in flood hazard areas* (the Standard). The Standard aims to reduce the risk of death or injury of building occupants as a result of buildings subjected to certain flood events. It is anticipated that subject to regulation impact in accordance with the Council of Australian Governments (COAG) Best Practice Regulation Guide and ABCB Board approval, the Standard would be referenced in the NCC Volumes One and Two in 2013.

It must also be emphasised that the Standard is not a stand-alone solution to mitigating life safety risk due to flooding. Reducing life safety risk due to flooding requires a comprehensive set of measures that consider flood hazard and aim to reduce risk to a manageable level. This set of measures generally involves a combination of effective land use planning considering flood hazard, flood mitigation measures, flood warning and emergency response strategies for flooding, and building standards. Sufficient awareness of the flood risk and the safety measures required by the occupants and those assisting them during a flood emergency are essential prerequisites.

Therefore, with the application of this Standard within *flood hazard areas*, in the absence of supporting measures, it is not possible to guarantee that a building constructed in accordance with the Standard will eliminate the risk of serious injury or fatality even in the *defined flood event*.

In addition, larger floods than the *defined flood event* (DFE) can occur and even floods of the scale of the DFE can vary in behaviour and could exceed the design parameters and limitations in this Standard. Availability of assistance from emergency services or other avenues are important considerations not treated in this Standard.

Acknowledgements

The ABCB acknowledges the contribution of members of an expert Reference Group that assisted the development of the Standard.

The following organisations were represented on the Reference Group –

- Australian Government Attorney-General's Department
- Brisbane City Council
- Bureau of Meteorology
- Geoscience Australia
- Gold Coast City Council
- Hawkesbury City Council
- Housing Industry Association
- Insurance Australia Group
- Master Builders Association
- NSW Department of Planning and Infrastructure
- NSW Office of Environment and Heritage
- Queensland Department of Local Government and Planning
- Risk Frontiers
- Tasmania Department of Justice

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1 Scope and General

1.1 General

The National Construction Code (NCC) is an initiative of the Council of Australian Governments (COAG) developed to incorporate all on-site construction requirements into a single code. The NCC comprises the Building Code of Australia (BCA), Volume One and Two; and the Plumbing Code of Australia (PCA), as Volume Three.

The BCA is produced and maintained by the Australian Building Codes Board (ABCB) on behalf of the Australian Government and each State and Territory Government.

The BCA is a uniform set of technical provisions for the design and construction of buildings and other structures throughout Australia whilst allowing for variations in climate and geological or geographic conditions.

The BCA contains requirements to ensure new buildings and structures, and subject to State and Territory legislation alterations and additions to existing buildings, located in *flood hazard areas* do not collapse during a flood when subjected to flood actions resulting from the *defined flood event*.

The Standard provides additional requirements *in flood hazard areas* consistent with the objectives of the BCA which primarily aim to protect the lives of occupants in buildings in events up to and including the *defined flood event*. *Flood hazard areas* are identified by the relevant State/Territory or Local Government authority having jurisdiction.

Section 2 of the Standard contains basic design requirements including a fundamental Performance Requirement that describes the level of performance required for the construction of buildings *in flood hazard areas*.

Section 2 also contains Deemed-to-Satisfy design criteria for the design of buildings *in flood hazard areas*. These provisions only apply if certain limits such as maximum flow velocity and depth of submersion, are not exceeded. This does not mean that buildings cannot be constructed if they fall outside these limits. It means that such a proposal would need to be considered as an Alternative Solution under the relevant Performance Requirements and must be assessed accordingly.

The Standard also does not contain provisions that specify particular materials or design solutions which comply with the Performance Requirement. Therefore, in all instances, designers are required to use professional judgment in order to develop designs intended to comply with the Performance Requirement.

It must also be emphasised that the Standard is not a stand-alone solution to mitigating life safety risk due to flooding. Mitigating risk to life in flooding requires a comprehensive set of measures that consider flood hazard and aim to reduce residual flood risk to a manageable level. This set of measures generally involves a combination of effective land use planning considering flood hazard, flood mitigation measures, emergency response strategies for flooding, and building standards.

Therefore, with application of this standard within flood hazard areas, in the absence of supporting measures, it is not possible to guarantee that a building constructed in accordance with the Standard will eliminate the risk of serious injury or fatality even in the defined flood event.

In addition, larger floods than the defined flood event can occur and even floods of the scale of the defined flood event can be unpredictable and could exceed the design parameters and limitations in this Standard. Also, assistance from emergency services or other avenues may not be available to individual properties.

It is important to understand that flood is a local hazard whose parameters, including depth and velocity, vary significantly within the flood hazard area. Modelling of flood hazard generally provides information on average velocities across an area for an event rather than velocities at all points across a location. It is possible to have strong local currents not being shown by such modelling.

In addition, there are significant variations in the information available on flooding between areas within a local authority and between local authorities within Australia. This may result from the age of studies, the type of modelling undertaken, the information available to understand flood behaviour, or the reliance of historical flood information or estimates used to provide an understanding of flood risk. This will mean that the information available is not uniform.

Flood investigations may have also resulted in mitigation works which may alter flood behaviour. These are local by nature and their benefits would generally be considered in studies on flooding for the area and considered by the local authority in determining the flood hazard area.

In many cases information about flow velocities will not be known or will be limited. Modelling of the DFE may provide velocities at the peak of flow within an area rather than peak velocities at a specific location. Therefore it is unlikely that the local authority will have specific information on flow velocities at a particular site in all cases.

Existing development in more active flow areas, including floodways, is more likely to be subjected to higher velocities of flow than permitted in the Standard and is also more likely to impact upon flood behaviour elsewhere. Any additional development or redevelopment in these

areas is also likely to be exposed to more hazardous conditions it requires careful consideration and assessment. Also note that the flow velocities could also be expected to exceed the limits set in this Standard in many areas subject to local overland flooding.

The local authority may need to rely upon judgement upon where the Standard applies or request specific information from the proponent. This may limit the application of the Standard by the local authority to backwater and inactive flow areas in the DFE where it is less likely the velocity nominated in the Standard would be exceeded.

In many cases detailed information on the depth of inundation at the development in question will rely upon the provision of survey advice from the proponent relative to flood level information determined in the DFE.

In some cases the local authority may require the proponent to engage a suitably qualified professional to determine the DFE and/or to gain a more detailed understanding of flood behaviour at the location. This may include ascertaining the specific design criteria necessary to enable consideration of the development in relation to the Standard and meeting other requirements established by the local authority.

1.2 Scope

The Standard specifies requirements for flood-resistant design and construction of buildings that are subject to BCA requirements and that are located, in whole or in part, in *flood hazard areas*.

The ABCB has also prepared an Information Handbook which provides additional information relating to the construction of buildings in *flood hazard areas*. The Handbook is available on the ABCB website www.abcb.gov.au.

1.3 Application

1.3.1 Identification of applicable *flood hazard areas*

A *flood hazard area* is an area subject to flooding during the defined flood event (DFE) as determined by the authority having jurisdiction, or where this information is not available, by the proponent in accordance with standards set, or referred to, by the authority having jurisdiction.

This Standard only applies to *flood hazard areas* with the following characteristics:

- (a) The area is not subject to mudslide or landslide during periods of rainfall and runoff.
- (b) The area is not subject to storm surge.

1.3.2 Identification of applicable buildings

This Standard only applies to new Class 1, 2, 3, 9a health care and 9c buildings and Class 4 parts of buildings and, subject to State and Territory legislation, alterations and additions to existing buildings of these classifications.

1.4 Limitations

The Standard is not intended to –

- (a) override or replace any legal rights, responsibilities or requirements; or
- (b) override any land use planning controls imposed by the authority having jurisdiction; or
- (c) address administrative requirements for construction of buildings *in flood hazard areas*.

1.5 Normative References

The following documents are referred to in this Standard:

- (a) AS/NZS 1170.0.
- (b) AS/NZS 1170.1.
- (c) AS/NZS 1170.2.

1.6 Units

Except where specifically noted, this Standard uses the SI units of kilograms, metres, seconds, pascals and newtons (kg, m, s, Pa, N).

1.7 Definitions

Defined terms used within the text of the Standard are printed in italics. For the purposes of the Standard the following definitions apply:

Defined flood level (DFL): the flood level associated with a *defined flood event (DFE)* relative to a specified datum. The *DFL* plus the *freeboard* determines the extent of the *flood hazard area*.

Defined flood event (DFE): the flood event selected for the management of flood hazard for the location of specific development as determined by the authority having jurisdiction.

Depth of submersion: the depth of water above the floor level of the lowest non-*habitable room* for the *flood hazard level*.

Finished floor level: the uppermost level of the finished floor, not including any floor covering such as carpet, tiles and the like.

Flood hazard area: the area (whether or not mapped) under the *flood hazard level* which has been determined by the authority having jurisdiction as a *flood hazard area*. The area relates to that part of the allotment on which a building stands or is to be erected.

Flood hazard level (FHL): the flood level used to determine the height of floors in a building and represents the *defined flood level (DFL)* plus the *freeboard*.

Freeboard: the height above the *defined flood level (DFL)* typically used to provide a factor of safety and to compensate for effects such as wave action and localised hydraulic behaviour. Depending upon the circumstances of the individual event, *freeboard* may provide protection from floods marginally above the *DFL*. However, *freeboard* should not be relied upon to provide protection for flood events larger than the *DFE*.

Habitable room: a room used for normal domestic activities, and-

(a) includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom; but

(b) excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes-drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.

Hydrodynamic action: the action caused by a fluid in motion.

Hydrostatic action: the pressure exerted by a fluid at equilibrium due to the force of gravity.

Wet flood proofing: includes permanent or contingent measures applied to a building that prevent or provide resistance to damage from flooding while allowing floodwaters to enter and leave the building.

1.8 Notation

The following letters and symbols have the following meanings:

G	permanent action (dead load) (AS/NZS1170.1)
Q	imposed action (live load) (AS/NZS 1170.1)
F_l	flood action, resulting from the <i>DFE</i>
W_u	ultimate wind action (AS/NZS 1170.2)
Ψ_c	combination factor for imposed action (AS/NZS 1170.0)
D_e	equivalent surcharge depth in metres
C	shape factor
V	velocity of moving water in m/s
g	gravitational acceleration in m/s^2
Pa	pascal
N	Newton
m	metre
s	second
kg	kilogram

1.9 Performance-Based Standards

The Standard is presented as a performance-based document. Buildings to be constructed in *flood hazard areas* must be designed to comply with the Performance Requirement in Clause 2.3. The Performance Requirement lists various 'heads of consideration' that must be considered during the design process.

The Performance Requirement enables the design of a building to be constructed in *flood hazard areas* to be developed from first principles to maximise its potential to meet specific client needs for a specific site.

1.10 Design Pathways

The Standard provides two pathways for compliance. One pathway involves formulating an Alternative Solution which complies with the Performance Requirement. This involves the application of engineering practice from first principles and requires designers to apply professional judgment on all design issues. The other pathway involves compliance with the Deemed-to-Satisfy Provisions.

The alternative solution pathway involves the application of engineering practice in combination with appropriate design consideration as an alternative to the requirements in Clauses 2.4 to 2.13.

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2 Basic Design Requirements

2.1 Objective

The objective of the Standard is, in the event of a flood, to -

- (a) safeguard people from injury caused by structural failure; and
- (b) safeguard people from loss of amenity caused by structural behaviour; and
- (c) safeguard people from illness or injury caused by utility failure; and
- (d) protect other property from physical damage caused by structural failure.

2.2 Functional Statement

A building is to withstand the combination of loads and other actions to which it may be reasonably subjected during a flood event.

2.3 Performance Requirement

- (a) A building in a *flood hazard area*, to the degree necessary, must be designed, constructed, connected and anchored to resist flotation, collapse or permanent movement resulting from the action of hydrostatic, hydrodynamic, erosion and scour, wind and other actions during the *DFE* or lesser in accordance with the requirements of this Standard.
- (b) The actions and requirements to be considered to satisfy (a) include but are not limited to-
 - (A) flood actions; and
 - (B) elevation requirements; and
 - (C) foundation requirements; and
 - (D) requirements for enclosures below the *DFL*; and
 - (E) requirements for structural connections; and
 - (F) material requirements; and
 - (G) flood proofing; and
 - (H) requirements for utilities; and
 - (I) requirements for egress; and
 - (J) impacts to other structures and properties.

Limitations:

Clause 2.3 only applies to-

- (a) **Class 1, 2, 3, 9a health care and 9c buildings, and Class 4 parts of buildings; and**
- (b) **areas that are not subject to landslip, mudslide, storm surge or coastal wave action.**

2.4 Deemed-to-Satisfy Provisions

Where a building solution is proposed to comply with the Deemed-to-Satisfy Provisions, Performance Requirement 2.3 is satisfied by complying with Clauses 2.5 to 2.13.

2.5 Application

The Deemed-to-Satisfy Provisions only apply to *flood hazard areas* with the following characteristics:

- (a) The maximum flow velocity is not greater than 1.5 m/s. Where the authority having jurisdiction is not able to determine whether the maximum flow velocity is not greater than 1.5 m/s, the Deemed-to-Satisfy Provisions of this Standard can only apply to inactive flow or backwater areas.

2.6 Flood Actions

2.6.1 General

- (a) Values of flood actions for use in design must be established that are appropriate for the type of structure or structural element, its intended use and exposure to flood action.
- (b) The flood actions must include, but not limited to, the followings as appropriate: *hydrostatic actions, hydrodynamic actions, debris actions, wave actions, erosion and scour.*
- (c) The flood action must be based at least on the worst combination of impacts in the *DFE*.

2.6.2 Hydrostatic Actions

- (a) *Hydrostatic actions* caused by a depth of water to the level of the *DFL* must be applied to all surfaces, both above and below ground level.
- (b) Reduced uplift and lateral actions on surfaces of enclosed spaces below the *DFL* must apply only if provisions are made for entry and exit of flood water.

2.6.3 Hydrodynamic Actions

- (a) Dynamic effects of moving water must be determined by a detailed analysis based on the principles of fluid mechanics.
- (b) Where water velocities do not exceed 1.5 m/s, the hydrodynamic actions can be approximated into equivalent hydrostatic actions by increasing the *DFL* by an equivalent surcharge depth D_e , equal to

$$D_e = (C V^2)/2g$$

Where

V = velocity of moving water in m/s

g = gravitational acceleration (9.8 m/s²)

C = shape factor (1.25)

- (c) This surcharge depth must be added to the *FHL* and applied to the vertical projected area of the building or structure that is perpendicular and upflow to the flow. Surfaces parallel to the flow or downflow will be subjected to the *DFL* hydrostatic pressures only.

2.6.4 Debris Actions

Where required, impact actions caused by objects transported by flood waters striking against buildings and structures must be determined using a rational approach as concentrated loads acting horizontally at the most critical location at or below the *DFL*.

2.6.5 Wave Actions

Where required, wave actions caused by water waves propagating over the water and striking a building or other structure must be determined using a rational approach. Wave actions include wash and wind generated waves but the Standard does not cover coastal waves.

2.6.6 Erosion and Scour

The effects of erosion and scour must be included in the calculation of actions on building foundations and other structures *in flood hazard areas*. The Standard does not cover coastal erosion.

2.6.7 Combinations of Actions

In addition to the combinations specified in AS/NZS 1170.0, the following combinations must be considered for structures located in a *flood hazard area*-

- (a) [1.2 G , $\psi_c Q$, Y_F , F_I]; and

(b) [0.9 G, W_u, Y_F, F].

Where F₁ represents the flood related actions for the DFE, including hydrostatic (including buoyancy), hydrodynamic, wave and debris actions as appropriate; and

Y_F is the flood load factor as given in Table 2.6.7.

Table 2.6.7

Defined Flood Event (DFE)	Flood load factor Y _F
DFE based on annual probability of exceedance of not more than-	
1:100	1.0
1:50	1.2
1:25	1.4
DFE based on maximum recorded flood with record length of not less than-	
100 years	1.1
50 years	1.3
25 years	1.5

2.7 Elevation Requirements

Unless otherwise specified by the authority having jurisdiction-

- (a) floors of *habitable rooms* must be above the *flood hazard level*; and .
- (b) floors of enclosed non-*habitable rooms* must be no more than 1.0 m below the *DFL*.

2.8 Foundation Requirements

2.8.1 General

Foundations of structures must provide the required support to prevent flotation, collapse or permanent movement resulting from the flood actions specified in Section 2.6.

2.8.2 Geotechnical Considerations

Foundation design must account for instability and decrease in structural capacity associated with soil properties when wet, erosion and scour, liquefaction, and subsidence resulting from the flood actions specified in Section 2.6, depending on the geotechnical characteristics of the site.

2.8.3 Foundation Depth

Foundation depth must be adequate to provide the support required in 2.8.1 taking into account the geotechnical considerations of 2.8.2.

2.8.4 Foundation Walls

Foundation walls must contain openings to allow for automatic entry and exit of floodwater for the *DFE* in accordance with Section 2.9.

2.8.5 Piers, Posts, Columns or Piles

Piers, posts, columns and piles used to elevate buildings to the required elevation must take account of-

- (a) the potential erosion action due to flood; and
- (b) the potential debris actions.

2.8.6 Use of Fill

Fill must be designed to be stable under conditions of flooding, including rapid rise and draw-down of flood waters, prolonged inundation, erosion and scour.

2.8.7 Use of Slabs-on-Grade

Slabs-on-grade must comply with the following-

- (a) the slab must be installed on fill in accordance with 2.8.6, or on undisturbed soil of adequate bearing capacity; and
- (b) the slab must have adequate strength to resist the design actions even if the supporting soil under the slab is undermined by erosion; and

-
- (c) the bottom of the slab edges (usually the slab footing) must be at or below the depth of expected scour.

2.9 Requirements for Enclosures Below the *Flood Hazard Level*

Any enclosure below the *flood hazard level* must have openings to allow for automatic entry and exit of floodwater for all floods up to the *flood hazard level*.

2.10 Requirements for Structural Connections

- (a) Erosion control structures must not be connected to the foundation or superstructure of the building.
- (b) Decks, patios, stairways, ramps and the like below the *flood hazard level* that are attached to the building must be structurally adequate and not reduce the structural capacity of the building during the *DFE*.

2.11 Material Requirements

- (a) Materials used for structural purposes and located below the *flood hazard level* must be capable of resisting damage, deterioration, corrosion or decay due to direct and prolonged contact with flood water.
- (b) Materials used for structural purposes include loadbearing columns, bracing members, structural connections, fasteners, wall framing members and the like.

2.12 Requirements for Utilities

2.12.1 General

- (a) Utilities and related equipments must not be placed below the *FHL* unless they have been designed specifically to cope with flood water inundation.
- (b) Buried systems must be placed at a depth sufficient to prevent damage due to scour and erosion during the *DFE*.
- (c) Exposed systems must be designed to withstand the flood related actions (buoyancy, flow, debris and wave) as appropriate.

2.12.2 Electrical

- (a) Electrical meters and switches must be placed above the *FHL* and made accessible during the *DFE*.
- (b) Electrical conduits and cables installed below the *FHL* must be waterproofed or placed in waterproofed enclosures.

2.12.3 Plumbing and drainage

Plumbing and drainage openings below the *flood hazard level* must be protected from backflow.

2.12.4 Mechanical and HVAC systems, tanks and the like

Ductwork, tanks, gas storage cylinders and the like shall be placed above the *FHL* or designed, constructed, installed and anchored to resist all flood-related actions and other actions during the *DFE* with appropriate load factors as given in 2.6.7. Potential buoyancy and other flood related actions on the empty tank during the *DFE* condition shall be considered.

2.13 Requirements for Egress

Egress from a balcony, verandah, deck, door, window or the like must be available to allow a person in the building to be rescued by emergency services personnel, if rescue during a flood event up to the *DFE* may be required.

2.14 Additional State or Territory requirements

State or Territory agencies may have a range of requirements for the location, construction and use of buildings to be constructed *in flood hazard areas*. It is also necessary to determine whether legislation requires –

- (a) approval for construction; or
- (b) conditions of approval; or
- (c) limitations on use.

The ABCB Information Handbook presents an outline of requirements in each State and Territory.

3 References

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