Construction Technology for Builders

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Glenn P. Costin

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Construction Technology for Builders
1st Edition
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BRIEF CONTENTS

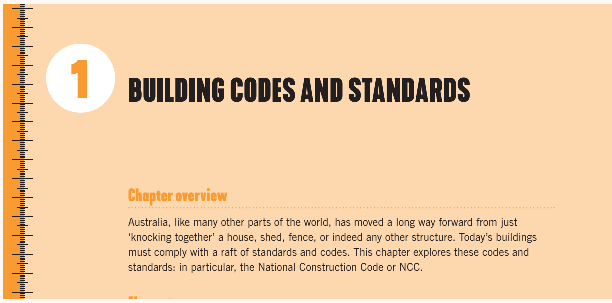
CONTENTS

Guide to the text

As you read this text you will find a number of features in every chapter to enhance your study of Construction Technology for Builders and help you understand how the theory is applied in the real world.

CHAPTER-OPENING FEATURES

A list of **Elements** gives you a clear sense of what topics each chapter will cover. It will indicate what you should be able to do after reading the chapter within that part.

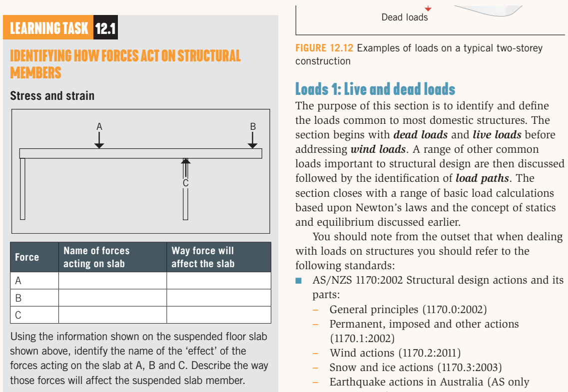

1 BUILDING CODES AND STANDARDS

Chapter overview

Australia, like many other parts of the world, has moved a long way forward from just 'knocking together' a house, shed, fence, or indeed any other structure. Today's buildings must comply with a raft of standards and codes. This chapter explores these codes and standards: in particular, the National Construction Code or NCC.

FEATURES WITHIN CHAPTERS

Learning tasks encourage you to practically apply the knowledge and skills that you have just read about.


LEARNING TASK 12.1

IDENTIFYING HOW FORCES ACT ON STRUCTURAL MEMBERS

Stress and strain

Force	Name of forces acting on slab	Way force will affect the slab
A		
B		
C		

Using the information shown on the suspended floor slab shown above, identify the name of the 'effect' of the forces acting on the slab at A, B and C. Describe the way those forces will affect the suspended slab member.

Dead loads

FIGURE 12.12 Examples of loads on a typical two-storey construction

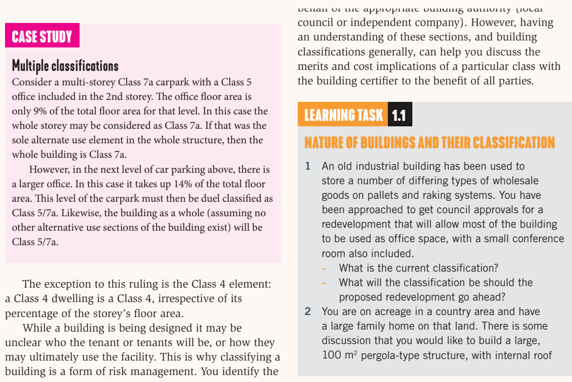
Loads 1: Live and dead loads

The purpose of this section is to identify and define the loads common to most domestic structures. The section begins with *dead loads* and *live loads* before addressing *wind loads*. A range of other common loads important to structural design are then discussed followed by the identification of *load paths*. The section closes with a range of basic load calculations based upon Newton's laws and the concept of statics and equilibrium discussed earlier.

You should note from the outset that when dealing with loads on structures you should refer to the following standards:

- AS/NZS 1170:2002 Structural design actions and its parts:
  - General principles (1170.0:2002)
  - Permanent, imposed and other actions (1170.1:2002)
  - Wind actions (1170.2:2011)
  - Snow and ice actions (1170.3:2003)
  - Earthquake actions in Australia (AS only

Case studies provide step by step instructions on how to perform specific tasks/processes.


CASE STUDY

Multiple classifications

Consider a multi-storey Class 7a carpark with a Class 5 office included in the 2nd storey. The office floor area is only 9% of the total floor area for that level. In this case the whole storey may be considered as Class 7a. If that was the sole alternate use element in the whole structure, then the whole building is Class 7a.

However, in the next level of car parking above, there is a larger office. In this case it takes up 14% of the total floor area. This level of the carpark must then be duel classified as Class 5/7a. Likewise, the building as a whole (assuming no other alternative use sections of the building exist) will be Class 5/7a.

The exception to this ruling is the Class 4 element: a Class 4 dwelling is a Class 4, irrespective of its percentage of the storey's floor area.

While a building is being designed it may be unclear who the tenant or tenants will be, or how they may ultimately use the facility. This is why classifying a building is a form of risk management. You identify the

council or independent company). However, having an understanding of these sections, and building classifications generally, can help you discuss the merits and cost implications of a particular class with the building certifier to the benefit of all parties.

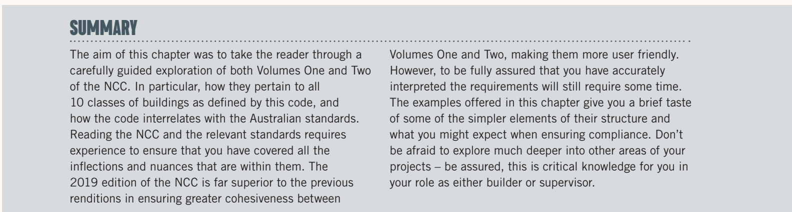
LEARNING TASK 1.1

NATURE OF BUILDINGS AND THEIR CLASSIFICATION

1 An old industrial building has been used to store a number of differing types of wholesale goods on pallets and raking systems. You have been approached to get council approvals for a redevelopment that will allow most of the building to be used as office space, with a small conference room also included.
   - What is the current classification?
   - What will the classification be should the proposed redevelopment go ahead?
2 You are on acreage in a country area and have a large family home on that land. There is some discussion that you would like to build a large, 100 m² pergola-type structure, with internal roof

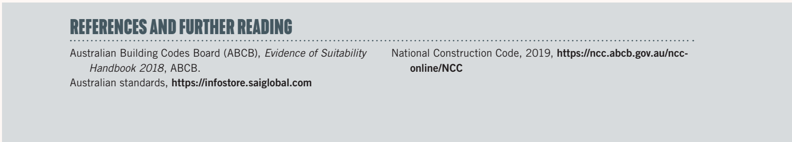
END-OF-CHAPTER FEATURES

Chapter summaries highlight the important concepts covered in each chapter as well as link back to the key competencies.


SUMMARY

The aim of this chapter was to take the reader through a carefully guided exploration of both Volumes One and Two of the NCC. In particular, how they pertain to all 10 classes of buildings as defined by this code, and how the code interrelates with the Australian standards. Reading the NCC and the relevant standards requires experience to ensure that you have covered all the inflections and nuances that are within them. The 2019 edition of the NCC is far superior to the previous renditions in ensuring greater cohesiveness between Volumes One and Two, making them more user friendly. However, to be fully assured that you have accurately interpreted the requirements will still require some time. The examples offered in this chapter give you a brief taste of some of the simpler elements of their structure and what you might expect when ensuring compliance. Don't be afraid to explore much deeper into other areas of your projects – be assured, this is critical knowledge for you in your role as either builder or supervisor.

The **references and further reading sections** provide you with a list of each chapter's references as well as links to important text and web-based resources.


REFERENCES AND FURTHER READING

Australian Building Codes Board (ABCB), *Evidence of Suitability Handbook 2018*, ABCB.
Australian standards, **https://infostore.saiglobal.com**
National Construction Code, 2019, **https://ncc.abcb.gov.au/ncc-online/NCC**

Guide to the online resources

FOR THE INSTRUCTOR

Cengage is pleased to provide you with a selection of resources that will help you prepare your lectures and assessments. These teaching tools are accessible via http://login.cengage.com.

SOLUTIONS MANUAL

The Solutions Manual includes solutions to end-of-chapter worksheets and answers to in text activities.

WORKSHEETS

All chapter worksheets are available as writeable pdfs for your students.

There are additional resources for this text so contact your Cengage Learning Consultant for more information.

COMPETENCY MAPPING GRID

The downloadable competency mapping grid demonstrates how the text aligns to the Certificate IV in Building and Construction (Building).

FOR THE STUDENT

Visit http://www.cengagebrain.com and search for this book to access the bonus study tools available on the Construction Technology for Builders companion website.

The website contains resources for each chapter, including:

- Chapter worksheets

AUSTRALIAN STANDARD UNITS OF MEASURE

The structural principles of construction derive from the school of engineering. As such, these principles require a firm grasp of common mathematical processes and notation. In particular, those of length, area, volume and mass, as well as force and pressure.

The basic units

These are the units with which you will mostly be familiar, those of length, mass and time. These all have lower case letters as their symbols:

- Length: **m** for metre
- Mass: **g** for gram
- Time: **s** for seconds

Larger and smaller values are denoted by prefixes to these basic units; For values less than a million, the prefixes are also in lower case

For values of a million or greater, the prefixes are in capitals, i.e.:

- mega (M) one million (10^6) × the basic unit
- kilo (k) one thousand or (10^3) × the basic unit
- milli (m) one thousandth (10^{-3}) × times the basic unit (note the '–3')

One millimetre (mm) is therefore one thousandth part of a metre.

One kilogram (kg) is 1000 grams.

Scientific and engineering notation

Scientific notation was developed so that very large, or very small, numbers could be expressed in a manner that was easier to understand at a glance than one with lots of zeros in front or behind.

For example

In the case of 1 000 there are three zeros after the '1'. This number can be expressed as 1×10^3 which simply means $1 \times 10 \times 10 \times 10$ which equals 1 000.

Note the correlation – the equation has three '10s' in multiply mode, the resultant number has three zeros and so we write 10^3.

In the case of 1 000 000 there are 6 zeros. So, we can write it as 1×10^6. I.e. $1 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$ which equals one million.

The little numbers '3' and '6' attached to the 10 in the examples above (i.e. 10^3 and 10^6) are known as *indices* or *index* numbers.

But the number doesn't have to be all zeros. We can apply this approach to any number.

For example

In a number like 64 875 352.0 you would take the first number '6' and count back the number of digits that follow after it until you reach the decimal point. In this case there are seven (7) so our number could look like:

6.4875352×10^7

Only this hasn't really helped us as we still have all the numbers to look at. So, we reduce those numbers down to required or desired *level of accuracy*. In our example, we will use the first four (4) numbers of the original.

So, our long number now looks like this:

6.488×10^7

Note the last '8'. This has come about through what is known as '*rounding*'. If the number after the last figure you want is 5, or greater, then you round up. If less than 5 then you round down (i.e. leave the last number alone).

- So: 6.487**5** becomes 6.48**8**

Alternatively, if we had a number like 4.2572, then:

- 4.257**2** becomes 4.25**7**

This applies no matter how many numbers follow after the one you wish to stop at.

- i.e.: 4.257**2**7983 still becomes 4.25**7** the numbers after the '2' are ignored
- and 6.487**5**7983 still becomes 6.48**8** the numbers after the '5' are ignored

The number 6.488×10^7 is an expression of '**scientific notation**'. In '**engineering notation**', however, you will find that only indices divisible by 3 are used. That is:

1×10^3; 1×10^6, 1×10^9

and so on.

So, our number would look like this:

64.88×10^6

Working from our original number of 64 875 352.0, in engineering notation its best to work from the decimal point outwards. Because in engineering the indices must be divisible by 3, we count in groups of 3.

64 **875 352**.0 $\Rightarrow 64.88 \times 10^6$

Two groups of three, so the decimal point has moved six places, hence our index number is '6'.

Note: In using scientific or engineering notation for very small numbers the same basic rules apply.

For example

0.**001** $\Rightarrow 1.0 \times 10^{-3}$

The decimal point has moved one group of three to the right or 'backwards' so index becomes negative 3 or '–3'.

NO matter how small the number the same approach of counting backwards in groups of three can be used.

0.000064875352 $\Rightarrow$ 0.**000 064** 875 352 $\Rightarrow 64.88 \times 10^{-6}$

Note: In engineering notation you can have up to three numbers to the left of the decimal point in your final expression; i.e.:

523.34×10^6

Units of force

The definition of force is:

Force = mass × acceleration

or

$F = ma$

Where acceleration is measured in metres per second squared or m/s^2.

Where the acceleration is due to gravity, that acceleration is $9.8\ m/s^2$.

This figure is frequently rounded up to $10\ m/s^2$ for simplicity, plus it adds a bit of 'head room' in our calculations to allow for minor errors.

Hence, the units involved in our equation of force are:

Force = kg × m/s^2 or $kg.m/s^2$ (where the '.' means '×' or multiply)

This is rather a messy looking suffix to put after a number, so it has been given a name after an historical figure associated with it. In this case, Sir Isaac Newton.

So our 'unit of force' derived from this combination is known as a '**newton**' or **N**.

Where:

$1\ \text{N} = 1\ \text{kg} \times 1\ \text{m/s}^2$

Since gravity is 10 m/s^2 (when rounded off) the force of 1 kg under the gravitational pull of the earth is:

$1\ \text{kg} \times 10\ \text{m/s}^2 = 10\ \text{N}$

or

$0.1\ \text{kg} \times 10\ \text{m/s}^2 = 1\ \text{N}$

Construction projects are generally much too heavy to use units as small as a newton (N). Instead we generally use kilonewtons (kN), i.e.:

1 kN = 1 000 N

Mass vs weight

Mass and weight are two different concepts which are frequently misused.

- Weight is a force. Mass is not.

Mass is measured and stated in kg but is not a force in itself. Mass, when combined with acceleration gives force. This force we call weight. A stationary 10-kg object in deep space will still have a mass of 10 kg. It will have no ‘weight’, however, so long as no acceleration is acting upon it.

Therefore, if you have a *load* (a mass) in kilograms (kg) you must multiply it by the gravitational pull of Earth to get the *force* being applied. That is, multiply it by 9.8 or 10 to convert it into newtons of force.

A useful conversion is:

$10\ \text{kg/m}^2 = 0.1\ \text{kN/m}^2$ (i.e divide kg/m^2 by 100 to get kN/m^2)

Units of pressure

Pressure is a force applied evenly over a defined area. For example, a concrete footing applies pressure to the foundation material, a brick column puts pressure on a footing and so on.

The units for calculating pressure are newtons of force per square metre of area. This is another combination where a relevant historical person’s name is use. In this case, French mathematician Blaise Pascal. So, we refer to this combination as a Pascal (Pa). That is:

$1\ \text{Pa} = 1\ \text{N/m}^2$

and

$1\ \text{Pa.m}^2 = 1\ \text{N}$

As this could be equated to, say, 100 g of sand spread over 1.0 metre square of concrete, this unit of measure is too small for construction purposes. So instead, the units of **kPa** (1 000 Pascals) or **MPa** (1 000 000 Pascals) are used. Most students of construction will already be familiar with MPa as the statement of concrete’s compressive strength – e.g. 20 MPa or 25 MPa concrete for paths and basic footings.

INTRODUCTION

Welcome to the first edition of *Construction Technology for Builders*. A long time in the making, this book is designed specifically for advanced students of building, particularly those seeking to gain a builder's licence, understand the building process and structural principles more fully, or seeking to gain a greater grasp of construction management.

There is wealth of material in this text that requires you to engage with various standards and codes. It is important that you have ready access to these throughout your studies. The most significant is the National Construction Code, a multi-volume document of which the first two are frequently referenced in various chapters. Accessing these, and the Australian standards – of which a significant number will need to be sourced – is outlined below.

In addition to the main chapters, each of which aligns with a specific competency unit in the Certificate IV in Building and Construction, there is a glossary of terms and a number of appendices at the end of the book. The glossary you will find invaluable when some of the more technical terms are necessarily used. The appendices provide additional learning or explanatory material, or information such as plans and specification documents that are referenced in the examples and exercises.

A book of this type is a huge undertaking that relies upon a broad range of skilled professionals to create. It is never the work of one person. Yet it remains, arguably, a work in progress, with a further volume yet to be compiled. Feedback on this first edition will be welcomed so that over time it may be improved and eventually cover all the most commonly required areas of study. But that is another story in the making…

Accessing the National Construction Code (NCC)

The NCC is a free to download suite of documents. New editions are compiled every three years with the current edition being 2019. This edition will therefore remain current until May 2022.

Access is via the internet, go to: https://ncc.abcb.gov.au

You will need to create a free login account before you can download the documents.

Once this is done, please download and save to your computer or portable drive the following documents:

- NCC 2019 Volume One
- NCC 2019 Volume Two

These documents do not have an expiry date so you may open them through Adobe or Foxit pdf Readers whenever you require. Due to their size and complexity, they are best viewed electronically rather than in print form.

Accessing Australian standards

Accessing the many Australian standards referenced in the chapters is also via the internet. The complexity is that all Australian standards must be purchased individually – and they are expensive. There are, however, two avenues by which you may gain free access.

Your TAFE or university library

Most TAFE campus or university libraries will have access to the Australian standards database. Your enrolment provides you with free access to any standard you might require.

State and national libraries

For those using this book for study through a private registered training organisation (RTO) or simply for their own benefit (such as an owner builder) there is still a way to access the standards for free.

The Australian federal government has ensured that, due to the excessive cost, the standards have been made available for free through the National Library of Australia and the State Library of each state or territory. Membership is free in each case, and may be completed online. Once a member, you may access the Australian standards database and again download any standard required.

Note 1: This access is paid for by the library or organisation in question. Due to the cost, access is limited, in some cases to only a few (3 or 4) concurrent users at any one time. This means you should access and download the standards you want onto your computer and then log off as early as you can, otherwise others cannot get into the system.

Note 2: Australian standards are best viewed through Foxit pdf Reader instead of Adobe. You will have less issues with reading and exploring them with that application. Foxit pdf Reader is freeware that comes as part of the standard software package on many Windows PCs from major companies such as HP, Acer and ASUS. It may also be downloaded free from the developer's website: https://www.foxitsoftware.com/pdf-reader/

National Association of Steel-framed Housing (NASH) standards

These standards are referred to only in passing, so you do not need to access them in any specific manner. However, if you require them you will most likely have to pay, or find a library that holds them in hard or single access electronic copy. Some TAFEs and universities that deliver construction-based courses do hold them, so it is best to ask before having to purchase.

Australian standard units of measure

The following pages outline the standard units of measure used in Australia and New Zealand (and many other countries). You should refer to this when dealing with any of the chapters that involve calculations, particularly Chapters 12 and 13 that deal with structural principles.

ABOUT THE AUTHOR

Glenn Costin PhD, BEd, BA, Cert IV Building and Construction, Cert IV TAE, Certificate of Trade, Carpentry & Joinery, is currently a Senior Lecturer within Deakin University's School of Architecture and Built Environment. Prior to this Glenn was at Riverina Institute of TAFE for 24 years where his duties included delivery of all levels of Construction trade, post trade and pre-apprenticeship courses. In addition Glenn taught across a range of fields and courses including computing, environment, social inclusion and arts. Glenn was also heavily involved in Worldskills Australia as the chief judge and national and regional designer of carpentry for a decade. Outside of education, Glenn designs heritage renovations, additions and new homes from both a sustainability and energy efficiency or zero carbon perspective. In addition, Glenn has worked internationally in a range of countries and travelled extensively.

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ACKNOWLEDGEMENTS

Dr. Igor Martek PhD, University of Melbourne; Master of International Relations, Australian National University; MBA, AGSM University of NSW; Bachelor of Architecture (Hons.) University of Melbourne School of Architecture and Built Environment, Deakin University.
CH 2 Legal requirements for building and construction projects
CH 4 Work health and safety

Sharon Rumble is a CPA qualified accountant who has been teaching with TAFE NSW for the last 10 years and is currently teaching small business finances for a range of TAFE NSW qualifications including Certificate IV Building and Construction, Certificate IV New Small Business and Certificate IV Leadership and Management.
CH 9 Small business finances

Josef Fritzer Bachelor of Building, and Bachelor of Housing, University of Western Sydney, is qualified in assessment planning, designing and validation and has taught in the vocational sector
Chapter learning tasks
Worksheets

Glen Rodgers Bachelor of Architecture (Honours), Bachelor of Arts (Anthropology), Cert IV Training and Assessment, Cert IV NatHERS assessment, is a sessional tutor in the Deakin University School of Engineering and Built Environment and a registered architect with a broad range of experience in ecologically sustainable design, community development, contract administration, and client liaison.
CH 11 Simple building sketches and drawings

UNIT CONVERSION TABLE

Pressure	Multiply by...	Equals...
kPa	0.145	psi (lbs/in^2)
Psi (lbs/in^2)	6.895	kPa
kPa	4	Inches WG
Inches WG	0.25	kPa
kPa	10	mb
mb	0.1	kPa
Inches Hg	13.6 x 0.25	kPa
Heat energy & power	**Multiply by...**	**Equals...**
MJ	947.8	BTU
BTU	0.001055	MJ
kWh	3.6	MJ
MJ	0.2778	kWh
kWh	3412	BTU
BTU	0.2931	kWh
MJ/m^3	26.76	BTU/cu.ft
BTU/cu.ft	37.37	MJ/m^3
Volume	**Multiply by...**	**Equals...**
m^3	35.32	cu.ft
cu.ft	0.128	m^3
m^3	1000	L
Imp. Gallon	4.546	L
L	0.22	Imp. Gallon
US Gallon	3.785	L
L	0.2642	US Gallon
Imp. Gallon	0.8326	US Gallon
US Gallon	1.201	Imp. Gallon
Area	**Multiply by...**	**Equals...**
mm^2	0.01	cm^2
m^2	10.764	ft^2
ft^2	0.0929	m^2
Length	**Multiply by...**	**Equals...**
m	3.281	ft
ft	0.3048	m

Abbreviations			
kPa	(kilopascals)	m^3	(cubic metres)
psi	(pounds per square inch)	cu.ft	(cubic feet)
Inches WG	(inches water gauge – also "WG)	m^2	(square metres)
Inches Hg	(inches mercury – also "Hg)	mm^2	(square millimetres)
mb	(millibars)	ft^2	(square feet)
MJ	(megajoules)	L	(litres)
kWh	(kilowatt hour)		
BTU	(British thermal units)		

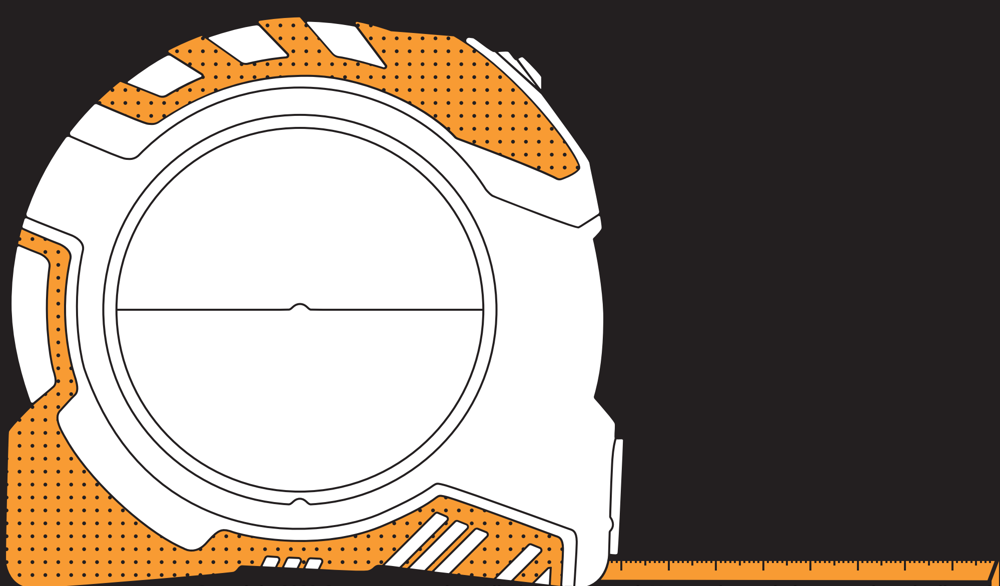
LIST OF FIGURES

COLOUR PALETTE FOR TECHNICAL DRAWINGS

Colour name	Colour	Material
Light Chrome Yellow		Cut end of sawn timber
Chrome Yellow		Timber (rough sawn), Timber stud
Cadmium Orange		Granite, Natural stones
Yellow Ochre		Fill sand, Brass, Particle board, Highly moisture resistant particle board (Particle board HMR), Timber boards
Burnt Sienna		Timber – Dressed All Round (DAR), Plywood
Vermilion Red		Copper pipe
Indian Red		Silicone sealant
Light Red		Brickwork
Cadmium Red		Roof tiles
Crimson Lake		Wall and floor tiles
Very Light Mauve		Plaster, Closed cell foam
Mauve		Marble, Fibrous plasters
Very Light Violet Cake		Fibreglass
Violet Cake		Plastic
Cerulean Blue		Insulation
Cobalt Blue		Glass, Water, Liquids
Paynes Grey		Hard plaster, Plaster board
Prussian Blue		Metal, Steel, Galvanised iron, Lead flashing
Lime Green		Fibrous cement sheets
Terra Verte		Cement render, Mortar
Olive Green		Concrete block
Emerald Green		Terrazzo and artificial stones
Hookers Green Light		Grass
Hookers Green Deep		Concrete
Raw Umber		Fill
Sepia		Earth
Vandyke Brown		Rock, Cut stone and masonry, Hardboard
Very Light Raw Umber		Medium Density Fibreboard (MDF), Veneered MDF
Very Light Van Dyke Brown		Timber mouldings
Light Shaded Grey		Aluminium
Neutral Tint		Bituminous products, Chrome plate, Alcore
Shaded Grey		Tungsten, Tool steel, High-speed steel
Black		Polyurethane, Rubber, Carpet
White		PVC pipe, Electrical wire, Vapour barrier, Waterproof membrane

PART 1

CODES AND STANDARDS



1 BUILDING CODES AND STANDARDS

Chapter overview

Australia, like many other parts of the world, has moved a long way forward from just 'knocking together' a house, shed, fence, or indeed any other structure. Today's buildings must comply with a raft of standards and codes. This chapter explores these codes and standards: in particular, the National Construction Code or NCC.

Elements

This chapter provides knowledge and skill development materials on how to:

1. access and interpret relevant codes and standards
2. classify buildings
3. analyse and apply a range of solutions to a construction problem for compliance with the NCC
4. apply fire protection requirements.

To gain the most from this chapter, you must have access to the National Construction Code, Volumes One and Two. These codes are available for free download, after free registration from the following internet site: https://ncc.abcb.gov.au/ncc-online/NCC.

Download the following documents:

- NCC 2019, Volume One (Building Code of Australia Class 2 to Class 9 Buildings)
- NCC 2019, Volume Two (Building Code of Australia Class 1 and Class 10 Buildings)

Introduction

This chapter introduces Volumes One and Two of the National Construction Code (NCC), the legal guide by which buildings constructed in Australia are governed. This is a large and complex document which will take you time to become confident using. The chapter begins with a brief history and overview of the NCC and Australian standards as a whole. The next section then discusses the different classifications of buildings, it being these classes that determine which part of the code applies to any given structure. The following two sections provide guidance on accessing and interpreting the various clauses of the code, particularly how to identify the standards relevant to your project. These sections also explore the two pathways to meeting the NCC's requirements as a whole; i.e. through the 'deemed-to-satisfy' provisions or by way of a 'Performance Solution'. The final section of the chapter will look at fire protection measures as outlined in both volumes.

History and purpose of the National Construction Code

Before looking too deeply into the **National Construction Code (NCC)**, it is worth gaining a basic understanding of its history and purpose. Australia's search for a national set of **standards** and codes began in 1965, but it was not until 1988 that the first Building Code of Australia (BCA) volume was published; and it wasn't until the mid 1990s that all states and territories actually became signatories to the code. That is, Australia's construction codes are actually a very recent regulatory innovation. Up to this point, the BCA was what is called a '**prescriptive**' code, meaning that it defined the what, when and how of all building works and, in so doing, set minimum building standards.

In 1996, the BCA96 was introduced; this reflected an important shift in the aim of the document as it was now '**performance**'-based rather than prescriptive; thereby allowing alternative approaches and encouraging innovation. Again, there was a delay until 1998 before all states and territories adopted this new code. In 2003, annual amendment cycles were introduced and so from 2004 the BCA became BCA 2004, BCA 2005 and so on.

In 2011, the regulations governing the BCA and the Plumbing Code of Australia (PCA) were consolidated, giving rise to the National Construction Code or NCC. As of 2016, the annual amendment cycle was changed to a three-year cycle, reflecting both the acceptance and the stability of the current codes.

The NCC consists of three main volumes, and two secondary texts as follows:

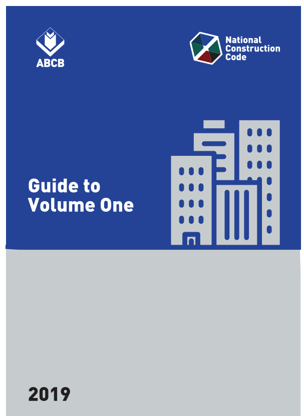
Primary volumes:

- NCC, Volume One – Building Code of Australia Class 2 to Class 9 Buildings
- NCC, Volume Two – Building Code of Australia Class 1 and Class 10 Buildings
- NCC, Volume Three – Plumbing Code of Australia (All building classifications).

Source: ©Australian Building Codes Board

Secondary texts:

- Guide to NCC Volume One (provides clarification, illustrations and examples)
- Consolidated Performance Requirements (provides guidance on the above volumes).



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Note: Only Volumes One and Two are discussed in this chapter.

The purpose of the NCC is to provide minimum standards by which buildings and associated structures (fences, pools and the like) may be constructed, with consideration to:

- occupant health and safety
- amenity and accessibility
- bushfire survivability
- sustainability and energy efficiency
- structural integrity
- climate and geographical location
- innovation.

As a 'national' construction code, the above is applicable to all Australian states and territories. It is also the avenue by which relevant Australian standards are given authority; i.e. unless an Australian standard is called up by the NCC it has guidance value only to the construction industry.

To ensure that the NCC's purpose is based upon sound factual data, its elements are constantly tested for workability, practicality and effectiveness – being restrictive only so much as to be in the public's and industry's best interests. This is exampled by the NCC being a 'performance'-based document, with two pathways of compliance: deemed-to-satisfy (DTS) provisions and Performance Solutions.

Deemed-to-satisfy provisions

Deemed-to-satisfy (DTS) provisions are known and modelled (within the NCC) ways of creating a particular part of a structure. For example, the size, shape and appropriate reinforcement of a concrete slab will be offered for a particular soil type, given load, width of structure and strength of concrete. Such an example will be fully documented within the code. Alternatively, the code may specify an Australian standard (such as AS 1684 Residential timber-framed construction) as the means by which a particular Performance Requirement of the code may be met.

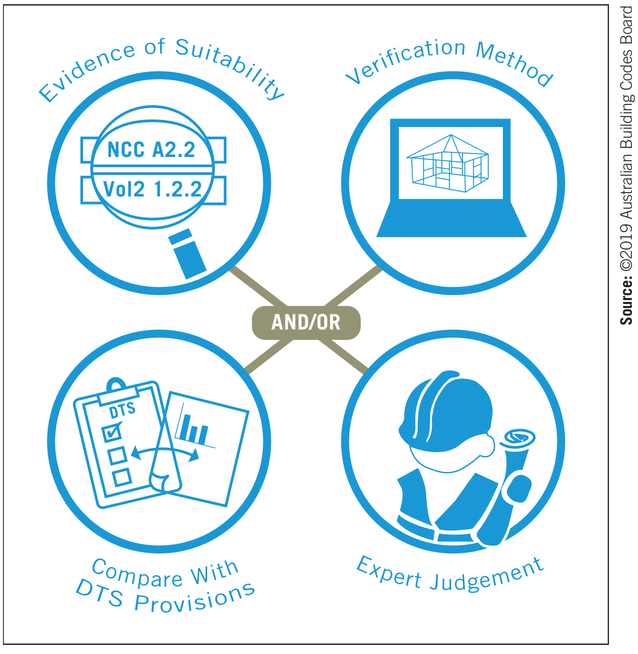
Performance Solutions

Performance Solutions, previously known as 'alternative' solutions, are those that have been specifically developed by the builder, designer, or product or material supplier. Such being the case, they are not documented within the NCC. Rather, they directly respond to the Performance Requirements of the NCC and are shown to do so by one or more of the assessment methods offered. These assessment methods are described within the general requirements section at the front of each of the NCC volumes. There are four methods offered, any combination of which may be used to determine compliance:

- Evidence of suitability – i.e. evidence, as per the general requirements, is supplied
- Verification methods – tests, calculations, inspections or the like as deemed appropriate within the NCC or by an appropriate authority (as defined by the NCC)
- Comparison with the DTS provisions – the proposed solution is compared with existing deemed-to-satisfy examples offered within the NCC
- Expert judgement – a qualified and experienced person judges that a particular approach complies with the Performance Requirements.

Over time, solutions alternative to those already documented within the NCC (i.e. the DTS provisions) may be fed into the NCC volumes and become, of themselves, DTS provisions.

The main point you should understand from this section is that you have a choice: you can follow the examples provided in the NCC, *or* you can develop one of your own – *provided* that you can show that it satisfies the Performance Requirements for that particular element of the structure.



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Types of standards

Standards are globally recognised as the means by which we structure and define both the quality and the approach to much of our daily lives. Originally, standards were industry and commerce focused; today they are integral to almost all aspects of our society, including product safety and reliability, legal systems and workplace safety. In the construction industry there is an Australian standard to cover every aspect of the structure, including the materials and equipment used to create that structure – right down to the sand in the mortar and the brush used to apply the paint.

There are basically three types of standards that you may encounter: international, regional and national. Common international standards will have the prefix ISO (International Organization for Standardization) or IEC (International Electrotechnical Commission). Regional standards are those developed and adopted by an economically aligned 'zone', such as the European Union or EU. Australia and New Zealand often adopt the one standard and these will have the prefix AS/NZS.

Australian standards

National standards are the ones you will most commonly come across in your daily work. Australian standards are developed by Standards Australia, the government and internationally recognised peak body for standards in this country. This organisation develops and revises standards based upon public input, international comparison and through access to some 9000 volunteer technical committee members. The resultant standards are currently distributed through a separate, now privately owned, organisation called Standards Australia International Global – better known as SAI Global. Baring Private Equity Asia, the current owner of SAI Global, has committed to continuing the online distribution and sale of Australian standards until 2023.

Australian standards are prefixed with simply AS. You can identify genuine Australian standards by the logo of Standards Australia and the 'wordmark' Australian Standard®. Joint Australian and New Zealand standards will have both the Australian and New Zealand logos as well as the trade mark Australian/New Zealand Standard™.

Individual standards are identified by name, number, part number (if applicable) and year of approval as per the examples below:

- AS/NZS 4505:2012 Garage doors and other large access doors
- AS 1684.2 – 2010 Residential timber-framed construction. Part 2: Non-cyclonic areas

Other prefixes you may come across include HB (Handbook), and SA TS (Standards Australia Technical Specification), such as:

- HB 195-2002 The Australian Earth Building Handbook
- SA TS 101:2015 Design of post-installed and cast-in fastenings for use in concrete

Standards Australia are not the only source of standards referenced within the NCC. The National Association of Steel-Framed Housing (NASH) is an important example. NASH develop and market all the referenced steel framing standards listed within the NCC.

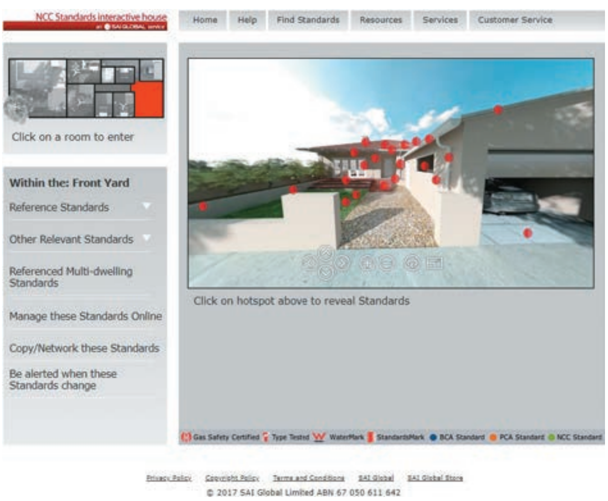

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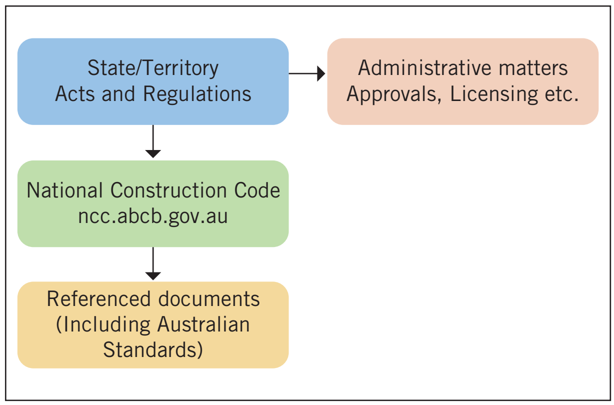
FIGURE 1.1 SAI Global's interactive NCC House, showing the Australian standards involved in various building elements

Aside from being the access point for standards, SAI Global also host a very useful web-based interactive by which you can explore how those standards are applied to the domestic house by the NCC (https://bca.saiglobal.com/ProductsServicesPage.asp?path = house). It is strongly recommended that you take the opportunity to use it as way of raising your awareness of the number of standards that can apply to any one area of a house.

Legal authority of the NCC and Australian standards

No code or regulation has legal effect unless legislation has been passed enforcing it. Each Australian state and territory has passed an Act of Parliament giving legal power to the NCC.

The NCC, in turn, gives legal effect to those Australian standards applicable to the Performance Requirements.



Source: Diagram, Regulatory Framework, ©2019 Australian Building Codes Board, https://ncc.abcb.gov.au

FIGURE 1.2 Regulatory path leading to the adoption of a standard (Australian or otherwise)

The administration and compliance supervision of the NCC is therefore the role of the individual states and territories, not the federal government or the **Australian Building Codes Board (ABCB)** who develop it. In the main, compliance and administration of the NCC falls upon local government authorities (councils) or private building certifiers.

Note that it is no longer a requirement that building approvals and inspections be conducted by, or through, the local council. Private certifiers are commonly available in most regions of Australia and are competitive in price and quality of service.

The NCC classes of buildings

The elements for this unit of competency are ordered so that identifying a building's classification follows after accessing and interpreting codes. For comprehension and logical flow, you should become familiar with the NCC's classes of buildings before proceeding further.

Determining the nature of a building

The NCC works through the systematic application of Performance Requirements to specifically identified classes of buildings and other structures. The determination of a classification depends much upon the nature of the structure. By 'nature', we mean the form and function, or purpose, of the structure, a building, or a designated part of a building. In many cases this may seem straightforward – and is; in other cases, the nature of a structure is less clear cut.

In general, the nature of a building falls into one of four categories, it is either a:

- private dwelling
- public building
- commercial building
- industrial building.

However, there are structures that don't fit any of these categories – such as fences, farm buildings and sheds, swimming pools, laboratories, private hospitals, car parks, bushfire shelters and many more.

In determining the nature of a building for the purposes of the NCC, therefore, you must consider carefully its function and use.

Function vs use

The function of a structure differs from its use in a few simple but important factors. The function of a farm shed, for example, could be to provide protection against sun, rain, dust and wind for a tractor. However, the same shed may also be 'used' for the mechanical servicing of the tractor by mechanics or other farmhands employed on the property and set up accordingly; i.e. it is a workshop. Used as shelter only, the shed fits a very different category to that of a workshop. Likewise, a medical practitioner's 'rooms' serve as a place for his or her practice. In general, this would include the physical treatment of only minor medical complaints. If, however, the rooms are used to carry out treatments that could render patients unconscious or non-ambulatory – i.e. the patient must stay resident at the rooms for some period after treatment – then its use is considered to be very different by the NCC. Function and form may be effectively the same in each instance; the use, however, is very different and so the NCC classification changes.

You must also consider all possible uses. This is because you may not be aware at the outset who the tenant may be, or exactly what they may use the building for. The farm shed offered earlier is the classic example. In these cases, you take the scenario that imposes the most onerous requirements – i.e. that the shed will most probably be used for maintenance, not just storage.

Having determined the nature of a building, you are then in a position to identify its NCC classification. This, in turn, will determine factors such as access and egress requirements, light and ventilation, fire control measures and a raft of other important design and construction factors.

Identifying a building's classification

An important element of deciding a building's classification is that, in doing so, you are identifying the risks associated with its intended use and purpose. Getting it right means you will not over- or under-specify the building – either of which has cost implications. Additionally, correctly identifying a building's classification ensures that the purposes of the NCC outlined earlier are being met; i.e. health and safety, amenity, energy efficacy, sustainability and structural integrity.

The NCC provides for 10 classes of buildings, along with a number of sub-classifications. Each classification provides for the often highly divergent natures of the buildings, and hence the design elements and materials that must be incorporated into them. The NCC outlines these classifications in Part A6 of both Volumes One and Two. These NCC definitions tend to be brief but are quite specific. For the purposes of introduction, a more simplified set of descriptions is initially offered in Table 1.1 below. These will then be discussed in more detail.

NCC building classes: some expanded commentary

Table 1.1 gives you a rough guide to the classes of buildings defined by the NCC. Further commentary is required, however, for a full understanding of each. We will begin with defining the concept of one 'storey' of a building, before following on with the expanded descriptions of each building class.

Storey: NCC definition

The NCC definition of one '**storey**' of a building is interesting and provides for some peculiar interpretation in one or two instances. You will find it in both NCC Volumes One and Two, within Schedule 3, Definitions (Vol. One, p. 518; Vol. Two, p. 663). It reads as follows:

Storey means a space within a building which is situated between one floor level and the floor level next above, or if there is no floor above, the ceiling or roof above, but not —

(a) a space that contains only —

(i) a lift shaft, stairway or meter room; or

(ii) a bathroom, shower room, laundry, water closet or other sanitary compartment; or

(iii) accommodation intended for not more than 3 vehicles; or

(iv) a combination of the above.

(b) a mezzanine.

TABLE 1.1 NCC building classifications

Classification		Description
Class 1	Class 1a	Single dwellings such as a detached house, or an attached row of houses, units, town houses or the like, separated by a fire-resisting wall continuous from ground to roof apex.
	Class 1b	Boarding or guest houses/hostels with max floor area of less than 300 m². Generally, less than 12 occupants, but can include 4 or more single dwellings on the one allotment for use as short-term holiday accommodation.
Class 2		Apartment buildings. Usually multi-residential structures with each apartment considered a sole-occupancy unit or SOU (see below). Often multi-storey, but may be single storey when the units share same subfloor or roof space not separated by a fire-resisting wall.
Class 3		Residential buildings that don't fit Class 1 or 2. Larger guest houses/hostels, dormitory-style accommodation, detention centres, workers quarters, or care facilities not considered to be Class 9a.
Class 4		A dwelling in an otherwise non-residential building of Class 5 through to 9. There can only be one Class 4 dwelling in a building. A caretaker's residence in an office complex is a common example.
Class 5		Office buildings used commercially or professionally by lawyers, accountants, doctors, government bodies and the like. Excludes buildings Classed 6, 7, 8 or 9.
Class 6		Shops, restaurants, cafés and the like. Retail or service outlets to the general public. Includes shopping centres, public laundries, bars and funeral parlours.
Class 7	Class 7a	Buildings serving as carparks except private garages of 3 cars or less.
	Class 7b	Storage or wholesale display buildings such as warehouses.
Class 8		Laboratories, factories or workshops used for trade, sale or gain such as production, repair, maintenance, altering, packing or cleaning.
Class 9 Public Buildings	Class 9a	Public buildings including health-care facilities (e.g. hospitals) and clinics in which patients may become unconscious or otherwise unable to move without assistance. Can include a laboratory without the need for multi-classification (laboratories are normally considered Class 8).
	Class 9b	Assembly buildings such as theatres, churches, night clubs, schools and preschools, sports facilities, gyms, train and bus stations.
	Class 9c	Residential aged care facilities in which 24-hour care services are provided.
Class 10	Class 10a	Non-habitable buildings or structures such as sheds, carports and private garages. There can only be one storey or level of garage space within any single building.
	Class 10b	Non-habitable buildings or structures such as fences, antenna masts, retaining walls, swimming pools and the like.
	Class 10c	Bushfire shelter when associated with, but not attached to, a Class 1a building.
SOU		A Sole-Occupancy Unit (SOU) is not a class of building. It is a part of a building otherwise classed 1b, 2, 3, 5, 6 or 9 that is intended for the exclusive use of its owner(s), tenant or lessee. There may be multiple SOUs within the one building.
Storey		*See definition in text.*

This suggests that a private garage for three cars, coupled with a laundry, toilet and bathroom, located as the first level of a domestic house on a level block of land does not constitute a 'storey'; i.e. such a house is in fact a single-storey building. This only becomes an issue if you are working in a state where the low-rise definition of licenced work applies. And only in instances such as a Class 1b guest house that is sited above a private garage for three or less cars – this is because a two-storey guest house is a Type B construction (see Chapter 13, 'Low-rise construction: a definition') and therefore outside your scope of works. You should check with your local building authority for their interpretation before accepting to contract such works.

Class 1a

The most common form in this class is the typical Australian suburban home (Figure 1.3). However, Class 1a also includes homes that are attached to each other. Buildings of this type include terrace, row, or town houses, as well as units. What defines a cluster of attached dwellings as Class 1a is that each dwelling is separated by a vertical fire-resisting wall that is continuous from the ground through to the roof (see Figure 1.3). This includes any basements or subfloor garages. Class 1a buildings may be more than one storey, indeed there is no limit defined within the NCC; however, it is uncommon to see them exceed three storeys. Likewise, there is no limit to the number of dwellings or homes in any single development; i.e. a set of row or

Source: Glenn Costin

FIGURE 1.3 Class 1a: suburban home

town houses could run the full length of a street. The key limitation to both Class 1a and Class 1b buildings is that they cannot be constructed above, or below, any other class of building except a Class 10a private garage. Nor can they be stacked one upon the other.

Class 1a defining characteristics:

- a residential dwelling
- attached dwellings may be attached horizontally only
- attached dwellings must be separated by a fire-resisting vertical wall running from ground to roof
- cannot be constructed above or below any other class of building except a Class 10a private garage.

Class 1b

Boarding and guest houses or hostels (Figure 1.4) with a maximum floor area of less than 300 m^2 is the common definition for this class. In general, we are looking at less than 12 occupants overall, though this is not a definitive limit, and that occupants are transitory (short term). In a boarding house (or lodge), occupants may be resident for extended periods of time, but they are not regarded as tenants in that they do not hold a leasing agreement; as such, the buildings still fit this classification. A bed and breakfast also fits this class on the basis of short-term accommodation for which there is typically no lease agreement.

Source: Peter Redmond

FIGURE 1.4 Class 1b: boarding or guest houses and hostels

This class also includes four or more single dwellings on the one allotment for use as short-term holiday accommodation; again, on the basis of there being typically no lease agreement. Common examples include individual cabins in caravan parks, resorts, and on farm-stay type properties. Note that up to three single dwellings on the one allotment retain the Class 1a classification.

As with Class 1a, Class 1b buildings cannot be constructed above, or below, any other class of building except a Class 10a private garage. Nor can they be stacked one upon the other.

Class 1b defining characteristics:

- a residential dwelling
- occupants are typically transient (generally short term) without a lease
- structured such that not more than 12 people would ordinarily occupy it
- floor area less than 300 m^2
- cannot be constructed above or below any other class of building except a Class 10a private garage.

Class 2

These are apartment buildings: multi-residential structures with each apartment considered a **sole-occupancy unit (SOU)**. They can be, and often are, multi-storey. However, a single-storey cluster of units that are situated above a common subfloor or basement, or have a common ceiling space, or are built above a common Class 7a carpark, all fit the Class 2 category. The latter example is a multi-classification building.

Class 2 defining characteristics:

- a residential dwelling
- apartments are defined by the NCC as sole-occupancy units or SOUs
- no limit to height of building, number or size of units
- may share a common subfloor or ceiling space
- can be constructed above or below another class of structure except a Class 1.

Class 3

These are larger guest houses or hostels where long term and/or transient people may reside; length of stay is therefore not important. They exceed the floor area limitations of a Class 1b and include dormitory-style accommodation, detention centres and workers quarters. This class also includes care-type facilities not considered to be Class 9a, such as shared accommodation for people with a disability, the elderly (but not infirm), children and refugees.

Class 3 defining characteristics:

- a residential dwelling
- occupants may be long term or transient without a lease
- floor area larger than 300 m^2
- can be constructed above or below another class of structure except a Class 1.

Class 4

A Class 4 building is not really a building at all, but rather an integrated residential element of an otherwise non-residential structure – structures classified Class 5 through to 9. A Class 4 'building' is effectively an SOU. However, there can only be one Class 4 dwelling in any given building – that includes the whole building, not just a single storey of that building. A caretaker's residence in an office complex is a common example.

Class 4 defining characteristics:

- a residential part of non-residential building
- is a sole-occupancy unit (SOU)
- not limited by size
- only one Class 4 element in any one building.

Class 5

These are office buildings used commercially or professionally by lawyers, accountants, doctors, government bodies and the like. There is generally more than one office in the building, making each office an SOU. They are *not* shops, however (which are Class 6). They are also not doctor's surgeries where patients are likely to undergo medical treatment that may leave them unconscious or non-ambulatory (unable to move without assistance); in such cases the building is Class 9a.

Class 5 defining characteristics:

- a non-residential building
- is an office, or is made up of offices, used for commercial or professional purposes
- not defined by size
- can be constructed above, below or within another class of non-residential building.

Class 6

Shops, restaurants, cafés and the like all fit this classification. These are buildings that serve as retail or service outlets to the general public. Where there are multiple shops, each 'shop' is an SOU by definition of the NCC. Class 6 buildings include shopping centres, public laundries, bars and funeral parlours. They are not defined by size, only by purpose; so they can be incredibly small (**Figure 1.5**), independently large, or form part of a multi-class building.

Class 6 defining characteristics:

- a non-residential building
- a retail or service outlet, or is made up of SOUs that have retail or service purposes
- not defined by size
- can be constructed above below or within another class of non-residential building.

Class 7a

These are buildings that serve as carparks. A garage associated with a building classed other than Class 1 (a or b) that holds more than three vehicles is classified as a 7a carpark: a typical example being a garage space under a Class 2 building that holds more than three vehicles.

Source: Glenn Costin

FIGURE 1.5 Class 6: shops, restaurants and cafés

Class 7a carparks can also be separate single- or multi-storey buildings. A farm shed where more than three tractors (or other farming vehicles) are parked also fits this category.

Class 7a defining characteristics:

- a non-residential building, and not associated with a Class 1 building
- designed for the express purpose of storing vehicles
- defined by the minimum number of vehicles stored (more than three)
- can be constructed independently, or above, below, or within another class of non-residential building.

Class 7b

Generally, a Class 7b building will be some form of warehouse or storage facility. However, this classification also includes buildings that not only store, but also display goods or produce for wholesale purposes. Class 7b buildings are not 'shops'; i.e. the owner/occupiers/tenants do not engage in retail to the general public, but rather offer bulk supply to those who do. Class 7b buildings can include multiple SOUs provided they are occupied for wholesale transactions.

Class 7b defining characteristics:

- a non-residential building
- a building used for storage, and/or the display of produce or goods sold wholesale
- not defined by size
- can be constructed independently, or above, below, or within another class of non-residential building.

Class 8

These are factories or workshops in which some form of production, repair, maintenance, packing, assembling or other handicraft or processes takes place. In all cases, such activities are for the purposes of trade, sale or gain. This classification includes mechanics workshops, abattoirs, canneries and other food processing factories. Farm sheds where tractors or other farming equipment are stored, but also where mechanics are employed to service them, would fit this category. It also includes laboratories unless they are constructed as part of a Class 9a building.