AS 5100.2 Supp 1—2007
AP-G15.2C/06

AS 5100.2 Supp 1—2007

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Bridge design—Design loads—Commentary (Supplement to AS 5100.2—2004)

STANDARDS Australia

AUSTRALASIAN RAILWAY ASSOCIATION INC

AUSTROADS

This Australian Standard Supplement was prepared by Committee BD-090, Bridge Design. It was approved on behalf of the Council of Standards Australia on 26 October 2006.
This Supplement was published on 1 March 2007.

The following are represented on Committee BD-090:

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- Australasian Railway Association
- AUSTROADS
- Bureau of Steel Manufacturers of Australia
- Cement Concrete & Aggregates Australia—Concrete
- Engineers Australia
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Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through public comment period.

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AS 5100.2 Supplement 1—2007

Bridge design—Design loads—Commentary (Supplement to AS 5100.2—2004)

First published as HB 77.2 Supp 1—1996.
Revised and redesignated AS 5100.2 Supp 1—2007.

Published by Standards Australia, GPO Box 476, Sydney, NSW 2001, Australia

ISBN 0 7337 8062 8

PREFACE

This Commentary was prepared by the Standards Australia Committee BD-090, Bridge Design to supersede HB 77.2 Supp 1, *Australian Bridge Design Code—Design loads—Commentary (Supplement to SAA HB 77.2—1996)*.

The objective of this Commentary is to provide users with background information and guidance to AS 5100.2—2004.

The Standard and Commentary are intended for use by bridge design professionals with demonstrated engineering competence in their field.

In this Commentary, AS 5100.2—2004 is referred to as 'the Standard'.

The clause numbers and titles used in this Commentary are the same as those in AS 5100.2, except that they are prefixed by the letter 'C'. To avoid possible confusion between the Commentary and the Standard, a Commentary clause is referred to as 'Clause C…..' in accordance with Standards Australia policy.

CONTENTS

STANDARDS AUSTRALIA

Australian Standard

Bridge design—Design loads—Commentary (Supplement to AS 5100.2—2004)

C1 SCOPE AND GENERAL

C1.1 Scope

(No Commentary)

C1.2 General

Although details of loads commonly occurring on bridge structures are outlined in the Standard, the designer should consider the possibility of other unusual loads occurring. The general principles of AS 5100.1, *Bridge design—Scope and general principles*, should be observed when assessing unusual loads, and most importantly the designer should ensure that damage cannot occur which is out of all proportion to the original cause.

It is particularly important that the fundamental design information, including as-constructed data, be recorded on the front sheet of the bridge drawings.

The abbreviation of SM1600 is introduced to provide a single abbreviation to indicate that the bridge has been designed for the worst effects induced by each of the W80, A160, M1600 and S1600 road traffic design loads.

The abbreviation 300LA is introduced to provide a single abbreviation to indicate that the bridge has been designed for the worst effects induced by each of the 360 kN axle load, the 1560 kN simulated locomotive and the 1560 kN simulated locomotive coupled to any number of 1200 kN vehicles as specified in Clause 8 of the Standard.

C2 REFERENCED DOCUMENTS

The Standards listed in Clause 2 are subject to revision from time to time and the current edition should always be used. The currency of any Standard may be checked with Standards Australia.

C3 DEFINITIONS

Technical definitions are provided in the Clause. Some technical definitions that are applicable to only one Clause are given in the Clause in which they are relevant.

C4 NOTATION

The basis of the notation is generally in accordance with ISO 3898, *Bases for Design of Structures—Notations—General Symbols*. Standards Australia's policy is to use ISO recommendations on notation wherever practicable in structural design Standards such as AS/NZS 1170 series, AS 2327.1, *Composite structures—Simply supported beams*, AS 3600, *Concrete structures*, AS 4100, *Steel structures* and AS/NZS 4600, *Cold-formed steel structures*.

C5 DEAD LOADS

C5.1 General

The weights per cubic metre given in Tables C5.1(A) and C5.1(B) may be used in calculating the nominal dead load unless a more precise determination has been made. The value to be used should be the mean value, not a characteristic value, as the load factors take this into account. Where a range of values is given, calculations should be performed using the extremes of the expected range and the most critical case used for design.

The value of g, which has been used in calculating the weights, per cubic metre, given in the tables is 9.8 m/s^2.

Approximate values of concrete weight per cubic metre are given in Table C5.1(B) for different aggregate types and cement contents.

TABLE C5.1(A)

WEIGHTS FOR CALCULATING NOMINAL DEAD LOADS

Material	Weight per cubic metre kN/m^3
Aluminium alloy	26.7
Bituminous wearing surface, asphalt	22.0
Compacted earth filling	16.0–19.0
Compacted gravel, road metal	19.0–23.0
Concrete (light weight)	22.5–26.0
Masonry	23.5
Neoprene	11.3
Sand-fine (dry)	15.5–17.5
Sand-coarse (dry)	18.0–19.5
Sand (saturated)	22.5
Steel and other ferrous metals	77.0
Timber, softwood (see Note)	8.3
Timber, hardwood (see Note)	12.3
Water, fresh	9.8
Water, salt	10.0

NOTE: AS 1684.1, *Residential timber-framed construction—Design criteria.*

TABLE C5.1(B)

WEIGHT PER CUBIC METRE OF UNREINFORCED CONCRETE

Typical coarse aggregates				Density of coarse aggregates kg/m³	Cement content kg/m³	Weight per cubic metre kN/m³
Adelaide quartzite	Brisbane gravel	Perth granite	Sydney gravel	2500	450	24.0
					330	22.5
				2700	450	24.5
					330	23.0
	Melbourne basalt	Sydney basalt		2900	450	25.5
					330	24.0
		Hobart dolerite		3100	450	26.0
					330	25.0

NOTES:

1 The values given in the Table apply to normal concrete, have no added air and the accuracy is approximately ±0.5 kN/m³.

2 The values given do not include any allowance for reinforcement. For reinforced concrete, the values should be increased by 0.6 kN/m³ for each one percent by volume of reinforcement.

C5.2 Dead load of structure

The load factors to be applied to concrete dead loads are based on the assumption that the designer has sufficient knowledge of the concrete properties to select a design density close to that of the concrete used in the structure. Where the designer has no knowledge of the concrete density, a suitably high value should be selected for calculations where the concrete dead load is unfavourable, and a low value for calculations where the dead load increases the structural safety.

A balanced cantilever is a statically determinate structure in which the cantilevers are rigidly connected to and extend either side of the support, such that the dead load bending moments at either side of the support are approximately balanced.

An anchor cantilever is a statically determinate structure, which is supported at two points and extends past at least one of these supports to form a cantilever.

For either of these structural types, or other similar types, and for certain elements of the structure which are subject to both unfavourable and favourable dead loads, such as the supports, the design dead loads should be obtained by applying the load factors, given in Table 5.2, for type structures (b) or (c), to the dead load of the appropriate parts of the structure.

For other structural elements, which are for instance subject to unfavourable dead loads only such as the cantilevers themselves, the design dead loads should be obtained by applying the load factors given in Table 5.2, type structure (a), to the nominal dead load on the element.

C5.3 Superimposed dead load

For the design of a bridge having a concrete wearing surface, the design load due to an added 75 mm thick bituminous wearing surface should be considered even though there may be no immediate intention to place such a layer.

The design superimposed dead load should be obtained by applying the load factors given in Table 5.3 of the Standard to the nominal superimposed dead load on the element.

C5.4 Soil loads on retaining walls and buried structures

The Commentary to AS 5100.3, *Bridge design—Foundation and soil supporting structures* contains design information on various soils and rocks, their properties and methods of calculating soil imposed loads and resistances.

Soil loads and properties may be also obtained from AS 4678, which should be treated as a guide only. The design methods and factors specified in AS 4678 are not compatible with the design methods and factors contained within AS 5100.3. Nevertheless, AS 4678 does contain much information which is useful for design purposes.

The factors in Table 5.4 of the Standard account for the differing levels of uncertainty associated with controlled fills and other types of fills and soils. These factors apply to active, at rest and passive conditions, as relevant.

Pressures imposed by groundwater can be significant, with effects depending on its level with respect to the structure and the effectiveness of the drainage provisions. Variations in groundwater levels should be accounted for in the design.

C5.5 Railway ballast and track loads

The maximum amount of ballast to be considered should be the amount that might be placed on a flat deck with normal height kerbs where excess ballast would fall to the ground below the bridge. It does not apply to through girders, where the maximum amount of ballast should be taken as the maximum amount that could reasonably be foreseen.

The design superimposed dead load for railway bridges should be obtained by applying the load factors given in Table 5.5 of the Standard to the nominal railway ballast and track loads on the element.

A typical ballasted track structure consistent with the 300LA live load will have a dead load of approximately 12 kPa. The dead load for a transom top structure will be approximately 5 kN/m. It should be noted that axle loads are not the only factors to be considered in the design of track work, e.g., the track structure for a high speed passenger railway may be identical to that for a heavy haul railway because of track stability considerations.

C6 ROAD TRAFFIC

C6.1 General

The Austroads Bridge Design Code, ABDC-1992 (HB 77.2—1996) (Ref. 1) loading model was revised in 1999 with the objective of providing for the maximum anticipated increases in vehicle size and weight over the life of bridges. Thus the loading model is based on the maximum anticipated traffic load well into the future rather than the traffic load that exists at the time of construction.

Economic studies (see Gordon and Boully (1997) (Ref. 2)) have shown that marginal costs associated with providing stronger bridges are small in comparison with the benefits of a more efficient transport system. It is intended that bridges designed for this load will have adequate strength for their expected lifespan of at least 100 years.

The traffic loads specified in the Standard, including the various factors, have been determined to cover the effects of—

(a) a large number of legal or marginally overloaded vehicles. This defines the loading spectra;

(b) a small number of grossly overloaded vehicles; and

(c) heavily loaded vehicles following one another.