AS 1597.2-1996

Australian Standard®

Precast reinforced concrete box culverts

Part 2: Large culverts (from 1500 mm span and up to and including 4200 mm span and 4200 mm height)

This Australian Standard was prepared by Committee CE/26, Precast Reinforced Concrete Box Culverts. It was approved on behalf of the Council of Standards Australia on 5 December 1995 and published on 5 April 1996.

The following interests are represented on Committee CE/26:

Association of Consulting Engineers, Australia

Australian Chamber of Commerce and Industry

Australian Geomechanics Society

AUSTROADS

Cement and Concrete Association of Australia

Concrete Pipe Association of Australasia

Institute of Municipal Engineering, Australia

Institution of Engineers, Australia

National Precast Concrete Association

Railways of Australia

Swinburne Institute of Technology

University of Adelaide

University of Sydney

This Standard was issued in draft form for comment as DR 94049.

Review of Australian Standards. To keep abreast of progress in industry, Australian Standards are subject to periodic review and are kept up to date by the issue of amendments or new editions as necessary. It is important therefore that Standards users ensure that they are in possession of the latest edition, and any amendments thereto.

Full details of all Australian Standards and related publications will be found in the Standards Australia Catalogue of Publications; this information is supplemented each month by the magazine 'The Australian Standard', which subscribing members receive, and which gives details of new publications, new editions and amendments, and of withdrawn Standards. Suggestions for improvements to Australian Standards, addressed to the head office of Standards

Suggestions for improvements to Australian Standards, addressed to the head office of Standards Australia, are welcomed. Notification of any inaccuracy or ambiguity found in an Australian Standard should be made without delay in order that the matter may be investigated and appropriate action taken.

AS 1597.2-1996

Australian Standard®

Precast reinforced concrete box culverts

Part 2: Large culverts (from 1500 mm span and up to and including 4200 mm span and 4200 mm height)

PUBLISHED BY STANDARDS AUSTRALIA (STANDARDS ASSOCIATION OF AUSTRALIA) 1 THE CRESCENT, HOMEBUSH, NSW 2140

PREFACE

This Standard was prepared by the Standards Australia Committee CE/26 on Precast Reinforced Concrete Box Culverts.

In the course of preparation of this Standard, the Committee found that there was support for specifying design by prototype testing as well as for specifying limit states design using load factors. The Committee agreed that both criteria be specified as alternative but not coincidental as a basis for design and acceptance of the culverts and culvert units.

The objective of this Standard is to set out minimum requirements for the design, testing, manufacture and installation of precast reinforced concrete rectangular box culverts of span 1500 mm or greater. AS 1597.1—1974, *Precast reinforced concrete box culverts*, Part 1: *Small culverts not exceeding 1200 mm width and 900 mm depth*, covers box culverts up to 1200 mm span and 900 mm height. It is intended to revise AS 1597.1 and to extend the range of that Standard to include box culverts up to 1200 mm span and 1200 mm height.

The term 'culvert cell' is commonly used to refer to a complete conduit made up of a number of units placed end-to-end. For the purposes of this Standard, the term 'culvert' is used to refer to a single cell or a multiple cell structure, and associated link slabs and base slabs.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

© Copyright – STANDARDS AUSTRALIA

Users of Standards are reminded that copyright subsists in all Standards Australia publications and software. Except where the Copyright Act allows and except where provided for below no publications or software produced by Standards Australia may be reproduced, stored in a retrieval system in any form or transmitted by any means without prior permission in writing from Standards Australia. Permission may be conditional on an appropriate royalty payment. Requests for permission and information on commercial software royalties should be directed to the head office of Standards Australia.

Standards Australia will permit up to 10 percent of the technical content pages of a Standard to be copied for use exclusively in-house by purchasers of the Standard without payment of a royalty or advice to Standards Australia.

Standards Australia will also permit the inclusion of its copyright material in computer software programs for no royalty payment provided such programs are used exclusively in-house by the creators of the programs.

Care should be taken to ensure that material used is from the current edition of the Standard and that it is updated whenever the Standard is amended or revised. The number and date of the Standard should therefore be clearly identified.

The use of material in print form or in computer software programs to be used commercially, with or without payment, or in commercial contracts is subject to the payment of a royalty. This policy may be varied by Standards Australia at any time.

CONTENTS

Р	a	g	е
-		\mathbf{n}	-

SECTI	ON 1 SCOPE AND GENERAL	
1.1	SCOPE	5
1.2	APPLICATION	5
1.3	REFERENCED DOCUMENTS	5
1.4	DEFINITIONS	6
1.5	ΝΟΤΑΤΙΟΝ	9
1.6	USE OF ALTERNATIVE MATERIALS OR METHODS	11
1.0	TYPES OF CULVERTS	12
1.7	CLASSIFICATION	12
1.0		12
SECTI	ON 2 MATERIALS, MANUFACTURE AND DIMENSIONING	
2.1	SCOPE	14
2.2	FORMWORK	14
2.3	REINFORCEMENT	14
2.4	CONCRETE MATERIALS	14
2.5	SPECIFICATION AND MANUFACTURE OF CONCRETE	14
2.6	HANDLING, PLACING AND FINISHING OF CONCRETE	15
2.7	CURING	15
2.8	JOINTS	16
2.9	DIMENSIONS	16
2.10	COVER TO REINFORCEMENT	16
2.11	MEASUREMENT OF DIMENSIONS	18
2.12	TOLERANCES	19
2.13	PROVISION FOR LIFTING	19
2.14	WORKMANSHIP AND FINISH	19
2.15	DEFECTS	20
2.16	MARKING	21
2.17	FINISHING AND REPAIRS	21
SECTI	ON 3 DESIGN REQUIREMENTS AND PROCEDURES	
3.1	GENERAL	22
3.2	DESIGN LOADS	23
3.3	LOAD EFFECT ANALYSIS	28
3.4	THEORETICAL STRENGTH AND SERVICEABILITY CALCULATIONS	29
3.5	REINFORCEMENT DETAILING	30
SECTI	ION 4 LOAD TESTING FOR DESIGN	
4.1	SCOPE	32
4.2	GENERAL REQUIREMENTS	32
4.3	TEST SPECIMENS	32
4.4	TEST LOADS	34
4.5	PROTOTYPE PROOF LOAD TESTS FOR SERVICEABILITY	35
4.6	PROTOTYPE PROOF LOAD TESTS FOR ULTIMATE STRENGTH	39
4.7	FAILURE LOAD TESTS	40

Page

SECT	ION 5 ROUTINE SAMPLING AND TESTING	
5.1	GENERAL	45
5.2	REQUIRED TESTS	45
5.3	SAMPLING FOR LOAD TESTING	46
5.4	COMPLIANCE	46
5.5	ACCEPTANCE	46
SECT	ION 6 INSTALLATION	
6.1	SCOPE	47
6.2	EXCAVATION	47
6.3	FOUNDATION PREPARATION	47
6.4	PLACING PRECAST UNITS	47
6.5	COMPACTION	48
6.6	BACKFILLING	48
6.7	CONSTRUCTION LOADS ON CULVERTS	49
APPE	NDICES	
А	PURCHASING GUIDELINES	50
В	MEANS FOR DEMONSTRATING COMPLIANCE WITH THIS	
	STANDARD	51
С	LOW PRESSURE STEAM CURING OF CONCRETE UNITS	53
D	METHODS FOR COVER TESTING OF UNITS	54
Е	MEASUREMENT OF CRACK WIDTH	56
F	GRAVITY FORCES AND DENSITIES OF MATERIALS	
	FOR CULVERT DESIGN	57
G	FLOW CHARTS FOR PROTOTYPE TESTING	58
Η	METHOD FOR CRACK LOAD TESTING (ROUTINE TESTING)	
	OF CULVERT UNITS LINK OR BASE SLABS	64
Ι	TABLES OF SERVICEABILITY TEST LOADS FOR STANDARD	
	CULVERT UNITS AND LINK SLABS	68
J	TABLES OF BASIC TEST LOADS FOR STANDARD CULVERT	
	UNITS AND LINK SLABS	70
Κ	SAMPLING SCHEME FOR ROUTINE TESTING	84

First published as AS 1597.2-1996.

STANDARDS AUSTRALIA

Australian Standard Precast reinforced concrete box culverts

Part 2: Large culverts (from 1500 mm span and up to and including 4200 mm span and 4200 mm height)

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE This Standard sets out minimum requirements for the design, testing, manufacture and installation of precast reinforced concrete rectangular box culverts for conveying water not under pressure, and for carrying roadway and railway loadings permitted by Australian road and railway authorities.

Design requirements are based on the methods of limit state design, using theoretical strength and serviceability calculations, or prototype testing.

This Standard is applicable to rectangular precast culvert units having a maximum length of 3600 mm, a maximum height of 4200 mm and a span from 1500 mm to 4200 mm and having a height of fill over the top of the culvert unit not exceeding 10 m.

NOTES:

- 1 Guidelines to purchasers on requirements that may need to be agreed upon at the time of calling for tenders or quotations are detailed in Appendix A.
- 2 Methods for demonstrating compliance with this Standard are given in Appendix B.
- 3 For precast reinforced box culverts of internal dimensions exceeding 4200 mm span or height, additional design considerations may be necessary. Additional design considerations are required for special culverts, e.g. skewed ends, culvert units with large holes, culverts subject to loading other than standard roadways and railways loadings.

1.2 APPLICATION All large precast reinforced concrete rectangular box culverts designed, manufactured, tested and installed in accordance with this Standard shall comply with the relevant requirements of Sections 1 to 6, with the alternative requirements as applicable.

1.3 REFERENCED DOCUMENTS The following documents are referred to in this Standard:

AS

- 1012 Methods of testing concrete
- 1012.1 Part 1: Sampling of fresh concrete
- 1012.8 Part 8: Method for making and curing concrete compression, indirect tensile and flexure test specimens, in the laboratory or in the field
- 1012.9 Part 9: Method for the determination of the compressive strength of concrete specimens
- 1199 Sampling procedures and tables for inspection by attributes
- 1289 Methods of testing soils for engineering purposes
- 1289.5 Part 5: Soil compaction and density tests
- 1289.5.1.1 Determination of the dry density/moisture content relation of a soil using standard compactive effort

AS		
1289.5.3.2	Determination of the field dry density of a soil—Sand replacement method using a sand pouring can, with or without a volume displacer	
1289.5.4.1	Compaction control test—Dry density ratio, moisture variation and moisture ratio	
1289.C6.1	Part C: Soil classification tests — Determination of the particle size distribution of a soil — Standard method of analysis by sieving	
1289.E3.5	Part E: Soil compaction and density tests—Determination of the field dry density of a soil—Water replacement method	
1289.E5.1	Part E: Soil compaction and density tests—Determination of minimum and maximum dry density of a cohesionless material	
1289.E6.1	Part E: Soil compaction and density tests—Compaction control test—Density index method for a cohesionless material	
1302	Steel reinforcing bars for concrete	
1303	Steel reinforcing wire for concrete	
1304	Welded wire reinforcing fabric for concrete	
1379	The specification and manufacture of concrete	
1399	Guide to AS 1199—Sampling procedures and tables for inspection by attributes	
1478	Chemical admixtures for concrete	
1726	Geotechnical site investigations	
2758 2758.1	Aggregates and rock for engineering purposes Part 1: Concrete aggregates	
3582	Supplementary cementitious materials for use with portland cement	
3582.1	Part 1: Fly ash	
3582.2	Part 2: Siag—Ground granulated from blast-furnace Part 3: Silica fume	
3600	Concrete structures	
3972	Portland and blended cements	
AS/NZS	Quality management and quality accurance. Vocabulary	
ISO 0000	Quality management and quality assurance — vocabulary	
ISO 9000.1	Part 1: Guidelines for selection and use	
ISO 9004 ISO 9004.1	Quality management and quality system elements Part 1: Guidelines	
SAA HB18 HB18.28	Guidelines for third party certification and accreditation Guide 28—General rules for a model third-party certification scheme for products	
AUSTROADS 1992 AUSTROADS Bridge Design Code		
ANZRC	Railway Bridge Design Manual	

1.4 **DEFINITIONS** For the purpose of this Standard, the definitions below apply.

1.4.1 Administrative

1.4.1.1 Approved—approved by the regulatory authority or its nominated representative.

6

1.4.1.2 Informative—not an integral requirement of this Standard and provided for information only.

1.4.1.3 *Manufacturer*—person(s) or corporate body responsible for the manufacture of the precast reinforced concrete box culverts.

1.4.1.4 *Normative*—an integral and mandatory requirement of this Standard.

1.4.1.5 *Purchaser*—person(s), corporate body or regulatory authority for whom the manufacturer has contracted to manufacture the precast reinforced concrete box culverts.

1.4.1.6 *Regulatory authority*—an authority which is empowered by statute to exercise jurisdiction over the construction of a culvert in the relevant location or region.

1.4.1.7 Specified—stated in writing in any document (including orders, drawings or specifications, or both) which forms a part, or the whole of the contract between the purchaser and the manufacturer.

1.4.2 Technical

1.4.2.1 *Batch*—a group of culvert units, link or base slabs of the same class complying with a particular design and produced under uniform conditions during a given production period, by the same process.

1.4.2.2 *Bed zone*—the area between the foundation and the underside of the culvert (see Figure 1.1).

1.4.2.3 Concentrated sampling—sampling of prototype units concentrated in time and location of manufacture.

1.4.2.4 *Cover*—distance between the outside of the reinforcing steel and the nearest permanent surface of the member excluding any surface finish.

1.4.2.5 *Critical loading*—loading with increasing critical load(s) until the ultimate load capacity is reached (following proportional loading to a specified level).

1.4.2.6 Critical load(s)—the load(s) with the greatest load factor(s) in accordance with the relevant design load combination.

1.4.2.7 *Culvert*—a single cell or a multiple cell structure, and associated link slabs and base slabs.

1.4.2.8 *Culvert cell*—a complete conduit made up of a number of units placed end-to-end.

1.4.2.9 Culvert unit—a single unit, whether integral or a combination of U-shaped sections with a slab.

1.4.2.10 Dispersed sampling — sampling of prototype units taken evenly from at least five batches, either manufactured at five different locations or drawn evenly from one location at intervals of not less than two months.

1.4.2.11 Failure load—a load applied to determine the ultimate load capacity.

1.4.2.12 *Fill*—one or more of the following:

- (a) *Backfill or embankment fill*—material placed over the overlay zone or the side zone for the purpose of refilling a trench or creating an embankment (see Figure 1.1).
- (b) Ordinary fill—material obtained from excavation of the trench or elsewhere and containing no more than 20% by mass of aggregates with a size between 75 mm and 150 mm and none larger than 150 mm.
- (c) *Selected fill*—material obtained from excavation of the trench or elsewhere with a particle size not greater than 75 mm, and which conforms with the following soil classes, as defined in AS 1726: