AS/NZS 2041.1:2011
(Incorporating Amendment No. 1)

AS/NZS 2041.1:2011

Australian/New Zealand Standard™

Buried corrugated metal structures

Part 1: Design methods

STANDARDS Australia

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This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee CE-025, Corrugated metal Drainage Pipes and Arches. It was approved on behalf of the Council of Standards Australia on 12 July 2011 and by the New Zealand Standards Approval Board on 15 July 2011.
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The following are represented on Committee CE-025:

AUSTROADS
Australasian Railway Association
Australian Chamber of Commerce and Industry
Australian Industry Group
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Main Roads Department Queensland
New Zealand Heavy Engineering Research Association
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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee CE-025, Corrugated Metal Drainage Pipes and Arches, to supersede, in part, AS/NZS 2041:1998, *Buried corrugated metal structures*, AS 1762—1984, *Helical lock-seam corrugated steel pipes—Design and installation*, AS 3703.2—1989, *Long-span corrugated steel structures*, Part 2: *Design and installation*.

This Standard incorporates Amendment No. 1 (September 2018). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

The objective of this Standard is to provide designers, manufacturers and installers of buried corrugated metal structures with requirements for the structural design of such structures for use in earthworks, primarily as drainage culverts or access ways.

This Standard is Part 1 of the AS/NZS 2041 series, *Buried corrugated metal structures*, which comprises the following parts:

AS/NZS
2041 Buried corrugated metal structures
2041.1 Part 1: Design methods (this Standard)
2041.2 Part 2: Installation
2041.4 Part 4: Helically formed sinusoidal pipes
2041.6 Part 6: Bolted plate structures

Other parts of the series being proposed include the following:

Part 3: Assessment of existing structures
Part 5: Helically formed ribbed pipes
Part 7: Bolted plate structures with transverse stiffeners
Part 8: Metal box structures

This Edition includes the following changes:

(a) The design methods are now applicable to any of the products in the AS/NZS 2041 series of Standards.

(b) Installation requirements have been moved to AS/NZS 2041.2.

(b) Design criteria for aluminium included.

(c) Clearer presentation of the design model.

(d) Limit state method included (harmonized with the Canadian Highway Bridge Design Code).

(e) Current Australian, New Zealand and selected overseas design loads, including earthquake loads.

(f) Greater comprehensive discussion of durability issues.

(g) Method included for approval of profiles other than sinusoidal profiles.

(h) Notations have been brought in line with ISO 3898, Bases for design of structures—Notation—General symbols.

(i) Background material guidance on the requirements of various clauses in the Standard included (Appendix B and Appendix E).

Design requirements are based on empirical formulae established by full scale testing. Details of the methods for full size testing to determine properties are also included.

In this document, the words ‘this Standard’ indicates AS/NZS 2041.1.

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.

Statements expressed in mandatory terms in notes to Tables and Figures are deemed to be an integral part of the Standard. Notes to the text contain information and guidance and are not considered to be integral parts of the Standard.

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FOREWORD

Buried corrugated metal structures are flexible members that rely on soil-structure interaction. Manufacture, design and installation to this series of Standards (AS/NZS 2041) should ensure such interaction occurs. This Foreword is intended to introduce the series, give information on the interaction of the various parts of AS 2041 series, background on how the Parts interact and emphasize the most important considerations for these buried corrugated metal structures.

The series is composed of a design Standard (AS/NZS 2041.1), an installation Standard (AS/NZS 2041.2), and product Standards (see Preface for a list of Parts). The product Standards describe a range of products from simple round helical pipes to bolted plate structures of varying shape (round, arched, elliptical, etc.).

The design Standard (AS/NZS 2041.1) covers the determination of the structural basis metal wall thickness (by structural analysis) taking into account durability and other considerations.

Correct installation is essential to performance. Adequate compaction of selected appropriate fill material *must* be carried out in order to meet the design assumptions for strength. This is covered by the requirements of the installation Standard.

Design and construction following good engineering practice would include the following aspects:

(a) Adequate investigation of the site conditions (soil, soil acidity, drainage, flow, foundations).

(b) Expected life of the structure (structure size or significance, aggressivity of environment).

(c) Appropriate material selection (metal durability, backfill properties, coating systems).

(d) Structural design method appropriate for the structure size (e.g., small diameter pipe versus large span arch).

(e) Design of any foundations or geotechnical considerations.

(f) Manufacture of the metal structure (materials, fabrication and quality).

(g) Material supply and assembly (supply of backfill, handling of flexible metal structure, transport, bolting together).

(h) Methods and equipment for installation, backfilling and compaction (hand-held compactor versus heavy machinery).

(i) Construction loads (heavy trucks or equipment).

This Standard (AS/NZS 2041.1) includes Appendices that give guidance on some of the above items.

The various product Standards describe the different products and refer to AS/NZS 2041.1 and AS/NZS 2041.2 for design and installation. These products are considered to perform satisfactorily when designed and installed using this series. The design method may not be appropriate for use with other profiles unless performance is confirmed by experimental investigation, as given in this Part (AS/NZS 2041.1). The products covered include the following:

(i) *Various corrugation types*—sinusoidal corrugations with pitches ranging from 38 mm to 400 mm, and ribbed corrugations of various profiles.

(ii) *Various metal types*—galvanized steel, and aluminium and polymer-coated steel.

(iii) *Various manufacturing types*—helically wound pipes with a mechanically folded seam, plates (of standard size but varying curvature) bolted together to form a predetermined shape.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
Buried corrugated metal structures

Part 1: Design methods

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies structural design methods for buried corrugated metal structures of circular or other shape installed under a flexible pavement.

Buried corrugated metal structures are primarily intended for use in stormwater drainage and access tunnels, and for the support of roadway and railway and other loadings. Construction consists of corrugated section shapes buried in an embankment or in a trench situation. Correct installation in a soil envelope is essential to the performance of the structure.

The design methods in this Standard are intended to apply to the products described in the other parts of this AS/NZS 2041 series with profiles that satisfy the following criteria:

(a) $\frac{p}{H_c} \leq 8$

(b) $\frac{p}{w_r} \leq 5$

where

p = pitch of corrugation, in millimetres

H_c = height of corrugation rib, in millimetres

w_r = width of corrugation rib, in millimetres

These products range from small pipes to large arch-type structures, from off-the-shelf systems to significant long-span structures.

NOTES:

1 Guidelines on information that should be supplied by the designer and/or owner to the manufacturer and installer are given in Appendix A.

2 This Standard is intended to cover buried structures comprising a flexible corrugated metal shell and a soil envelope governed by soil-structure interaction. It must be recognized that both soil and metal structure play a vital part in the structural design; therefore proper installation is essential for the final performance. Background on the Standard material, including the ring compression theory, is given in Appendix B.

3 In order to ensure good performance, general design procedures should include site investigation, backfill material selection, flow design, durability assessment, structural design, handling and laying and, backfill compaction.

4 For non-flexible pavements, specialist advice should be sought.