AS 4060 Supplement 1—1992

Loads on buried vitrified clay pipes — Commentary

(Supplement to AS 4060-1992)

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Association of Hydraulic Services Consultants, Australia

Australian Clay Pipe Manufacturers Association

Department of Conservation and Environment, Victoria

Engineering and Water Supply Department, South Australia

Federated Master Plumbers of Australia

Melbourne Water

Public Works Department, New South Wales

Water Authority of Western Australia

Water Board, Sydney — Illawarra — Blue Mountains

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PREFACE

This Supplement was prepared by the Standards Australia Committee on Vitrified Clay Pipes as a commentary to provide background information and explanation of the application of AS 4060.

It is not intended that the Standard should be interpreted as preventing the use of methods of load assessment other than those specified, as indeed such alternative methods will possibly be required for circumstances not covered by the Standard. However, it is considered that in the more usually encountered situations, the methods outlined in the Standard are those most acceptable to all concerned, due to their relative simplicity and the length of satisfactory experience so far obtained in their application.

The paragraph numbers of this Commentary are prefixed with the letter 'C' and refer directly to the respective clause numbers of AS 4060, e.g. Paragraph C6.3.2 refers to Clause 6.3.2. Where there is no commentary to a clause of the Standard, the paragraph number does not appear. Figures and tables are designated 1.1, 1.2, etc., and do not correspond to those of AS 4060.

References noted in the text are listed in Appendix A.

Appendix B contains examples illustrating the application of the Standard to the selection of the appropriate crushing strength class, complying with AS 1741-1991, *Vitrified clay pipes and fittings with flexible joints — Sewer quality*. The examples are in the form of typical selection problems each followed by a worked solution.

Appendix C contains data for description, identification, and classification of soils that meet the definition for select fill (see Clause 4 of AS 4060).

CONTENTS

Page

FOREWORD

Designers should be aware that installed pipes may also be subjected to non-vertical loads of considerable magnitude (e.g. at the toe of a slope). The vertical and horizontal components of such loads should be carefully assessed and appropriate action taken to ensure that they can be resisted by the pipes and adequately transferred to the foundations.

Methods of pipe laying and embedment preparation or other aspects of pipeline design and construction, e.g. trench stops, migration of fines, are not stipulated in the Standard because the continuing and rapid development of specialized earthmoving equipment and procedures would soon render such requirements obsolete. However, in Appendix CA, detailed procedures for the compaction of non-granular bedding and haunch support are outlined, as experience has indicated this to be one of the most difficult tasks in the installation of the relevant support types. Attention is also drawn to Geotechnical Branch Training Manuals* which contain much useful information on the subject.

* GEOTECHNICAL BRANCH. Denver, (Colorado): U.S. Department of the Interior, Bureau of Reclamation, Engineering and Research Centre. *Training Manuals* Nos 1, 2, 3 and 7.

STANDARDS AUSTRALIA

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GENERAL The design principles and parameters used in the Standard are based on —

(a) the theories and research into related parameters of Marston, Schlick and Spangler on the working loads on pipes due to trench fill, embankment fill and in-situ material for tunnels (Ref. 1);

(b) research to examine the bedding factors for different support types by the Water Research Centre, UK (Ref. 2) and the Clay Pipe Development Association, UK (Ref. 3); and

(c) the working loads on pipes due to traffic loading specifications by NAASRA (Ref. 4).

The primary purpose of the Standard is to use recent research along with existing knowledge in relation to bedding factors to develop a design standard that is specific to vitrified clay pipe complying with Ref. 5. Long established and universally used equations for the working loads on pipes have been adopted.

A secondary purpose of the Standard is to reduce the large variety of likely installation conditions and support types to a small number.

A support type with the foundation shaped to fit the outside diameter of the pipes has been omitted, as there has been a definite trend away from its use in Australia.

C6 WORKING LOADS

C6.1 Types The total working load is the summation of the different types of working loads for particular application (see Appendix B).

C6.2 Data

(b) The assessed unit weight of the trench fill, embankment fill or in-situ material should preferably be known or measured and a design value determined prior to commencing calculations. In most cases there will be change in soil strata both along the route of the pipeline and at different levels down to the proposed pipe crown level. It is recommended that the greatest unit weight found be used, rather than complicate calculations with different unit weights for different lengths of pipeline. In the absence of more specific data, the values given below from Ref. 6 relate to materials (see Figure 8 of AS 4060) and may be used for assessment of working loads —

(i) saturated clay (fluid): 21 kN/m^3;

(ii) normal wet clay: 19 kN/m^3;

(iii) sandy clay: 18 kN/m^3;

(iv) clayey sand: 16 kN/m^3; and

(v) loose granular material: 15 kN/m^3.

C6.3 Working loads due to trench fill, embankment fill or in-situ material The various equations given in the Standard for calculating dead loads due to fill materials were derived from load conditions associated with particular configurations of an installation. These configurations have been traditionally classified on the basis of the relative levels of the finished surface and the crown of the pipe with respect to the level of the adjacent existing surface, which can be most clearly seen in a cross-section of an installation (see Figures 2, 3, 4, 6 and 7 of AS 4060). Thus embankment or trench installation conditions are shown as cross-sections where the finished surface is, respectively, above or at the level of the adjacent existing surface, and positive or negative projection conditions shown as cross-sections, where the top of the pipe is, respectively, above or below the level of the existing surface.

C6.3.2 *Narrow trench condition* The coefficient C_t obtained from Figure 8 of AS 4060 includes an allowance for the development and continuation of a beneficial friction between the trench wall and the trench fill. If for some reason this friction is decreased or not developed, the load on the pipe will be greater than that given by Equation 6.3.2(1) of AS 4060. Decreased or non-development of this friction may occur if, during construction, withdrawal of a trench wall support system (shoring or sheeting) destroys the contact between the trench walls and the trench fill or if the area is subjected to prolonged heavy traffic vibrations. Designers should therefore take into consideration the construction techniques and regulatory requirements likely to apply in the particular project or location and adopt appropriate bedding factors.

The Clause specifies that the load for the narrow trench condition shall be taken as the lower value derived from either the narrow trench or the wide trench or embankment equations. Generally speaking, as a trench becomes wider, the frictional forces noted above become a decreasing proportion of the total vertical forces acting on the pipe until a width is reached where a wide trench or an embankment condition begins to dominate. The theoretical transition width between the narrow trench and the wide trench or the