Comments on the new Highways England, Design Manual for Roads and Bridges, Manual of Contract Documents for Highway Works in respect to changes affecting the specification of chamber tops (manhole covers) relating to CD534 and Series 500 documents.

The respondant

Wrekin Products Limited manufacture and supply to the UK road network in excess of 20,000 tonnes of BS EN124 ironwork castings, which represents a substantial proportion of the total market. Our technical team lead developments associated with the parent and national Standards as well as consulting with other interested parties developing; supplementary guidance, sponsored University research, derivation of Specifications for major authorities including; utilities and highway agencies. A significant proportion of our studies includes; research and defect investigations of; failed installations. Our portfolio of knowledge extends to a number of civil engineering disciplines associated with structural access systems and geosynthetic ground stabilisation.

Overview

Our observations of the proposed changes are that there has been a substantial reallocation of requirements from the predecessor document [HA104/09] to the intended CD534 and MCHW Series 500 documents. In so doing, most of the requirements for chamber tops have been retained.

However, there are a small number of significant changes to the overall content, some of which cause concern to the technical engineers within our organisation, entrusted with design and selection of safe and durable ironwork for the UK road network.

Relevant principles of chamber top (manhole cover) operation

<u>Relationship of traffic loads to chamber substructure and load transfer through intermediate materials</u>:

Loads applied during traffic overrun of chamber tops are initially transferred through the cover components to cover locations where contact is made with the supporting frame component. The frame then transfers these traffic-induced loads into the supporting sub-structure materials local to or in contact with frame.

However, as the UK preference of highway-grade chamber tops is to utilise loose-linked double-triangular cover arrangements to achieve stable cover operation, the contact locations between cover and frame components is isolated at the cover corner locations (only). As a consequence of this, traffic loads are also concentrated at these locations and hence, also in the sub-structure immediately in contact with and below the frame component. This means there is a heterogeneous distribution of traffic-induced stresses around the frame support structure, with the frame locations coincident with the cover seating positions being the locations of highest stress.

As the parent Standard for chamber tops is BS EN124:2015, the maximum bedding pressure (stress) allowed for under the Standard is 7.5N/mm2 (Clause 6.15) which is based on an average bedding stress distribution calculated by dividing the Design Test Load by the Frame flange area in contact with support structure.

Unfortunately, this Standard's method of calculation assumes a homogeneous distribution of traffic loads and an appropriate level of support structure mechanical properties to sustain those loads, without distress or failure.

In light of the fact that double-triangular product's frame load distribution is heterogeneous, there is an immediate disparity between what the BS EN124 Standard assumes (homogeneous) and the actual in-service stress distribution. The result is an increase of overload risk for the frame support structure coincident with the double-triangular cover contact (seating) positions, particularly, if the support structure in those locations has not developed its full mechanical properties when exposed to the now-concentrated traffic forces.

This disparity was identified by the former UK Highways Agency (HA) from co-sponsored research with Nottingham University in 1997. The research findings confirmed the presence of heterogeneous stress distribution under traffic loads. From the research findings subsequent publications of Highways Agency's DMRB HA104/00 & 09 documents recommended frame bedding pressure values not exceeding 2.1N/mm2 in order to reduce the risk of bedding structural failure.

Coincident with this, frame bedding material mechanical properties were also described in HA104 document publications and have been retained by Highways England in the proposed Series 500 documents. The significance of this is that the mechanical properties stated were selected to correspond with the calculated maximum frame bedding pressure. Hence, if the maximum bedding pressure value (of 2.1N/mm2) is removed, but the mechanical properties of the bedding mortar are kept the same, there is a risk of stress incompatibility likely to result in a substantially increased likelihood of bedding failure… The most common cause of installation failure in the UK.

Therefore, as the operational and service conditions have not reduced since the issue of the HA104 documents, it is entirely logical that as the bedding material property requirements are being retained in the Series 500 documents, then so should the 2.1N/mm2 maximum frame bedding pressure value in order maintain installation-component compatibility.

<u>Relationship of skid resistance values and the method of testing</u>:

The proposed CD534 document also makes reference to two sets of skid resistance requirements, using PSRV and WRc units. By the citation of two different units whose values are equated, it appears that chamber top products can offer values in either (or both) units in order to comply with the CD534 document's relevant threshold values.

However, the derivation of the WRc test was driven by an acknowledgement that the PSRV test (Pendulum Test to BS EN13036-4 2011) was vulnerable to operator error when employed on raised profile surfaces, like chamber tops. One of the main reasons for this vulnerability is that the test datum is not clearly defined for profiled surfaces such that an operator can arbitrarily select the point at which the Pendulum Test Shoe contacts and leaves the surface of the chamber top cover as the cover 'surface' is not defined.

In essence, there are two possible cover surfaces on a conventional BS EN124-compliant chamber top. One is the main planar plate of the cover the other is the top faces of any raised profile.

As the top surface of the raised profile is the predominant feature that contacts vehicle tyres, this is the logical datum position at which the Pendulum Test should be conducted in order to arrive at a more representative PSRV skid-resistance value. This location therefore needs to be defined in any published CD534 and/or Series 500 documents.

Further, as skid resistance is specifically retained and segregated in CD534, its prominence as a safety critical characteristic is clear, but the lack of a Third Party Certification requirement means that chamber top products can legitimately be offered on a self-certification basis by suppliers and manufacturers.

In Summary, the current draft variants of CD534 and MCHW Series 500 [as devolution recipients of former HA104/09 data] contain critical discrepancies relating to chamber tops for:

- Loss of 2.1N/mm2 maximum frame bedding pressure (cited in former HA104/09)
- Lack of definition for the PSRV test location (not defined in any document)
- Lack of Third Party Certification (ideally from UKAS accredited test facilities) as independent validation of acknowledged, safety-critical skid-resistance data and Chamber Top Standards compliance

Primary Contact for Wrekin Products Ltd: Barry Turner (barry.turner@wrekinproducts.com)