GERMAN

DWA Rules and Standards

Advisory Leaflet DWA-M 149-4E

Conditions and Assessment of Drain and Sewer Systems Outside Buildings

Part 4: Detection of Bedding Defects and Cavities by Means of Geophysical Techniques

July 2008

Zustandserfassung und -beurteilung von Entwässerungssystemen außerhalb von Gebäuden
Teil 4: Detektion von Lagerungsdefekten und Hohlräumen mittels geophysikalischer Verfahren

German Association for Water, Wastewater and Waste
Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V.

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The German Association for Water, Wastewater and Waste (DWA) is intensively involved with the development of reliable and sustainable water management. Being a politically and economically independent organisation it operates specifically in the areas of water management, wastewater, waste and soil protection.

In Europe the DWA is the association in this field with the greatest number of members and, due to its specialist competence it holds a special position with regard to standardisation, professional training and information of the public. The approximately 14,000 members represent specialists and managers from municipalities, universities, consulting engineers, authorities and businesses.

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Foreword

Since the end of the last century, it has been a favourable development objective of "Wave Technicians" to determine the compactness of soil layers and to test structures in a destruction-free way. Electromagnetic waves, acoustic waves, radiation and impulses of various kinds are intended to help to make things that are invisible for the human eye visible and to assess them.

So far, it was only possible to test visible components of structures. The condition of underground sewers was predominantly assessed on the basis of a camera accessing the sewer. In the most beneficial case, conclusions could be drawn about the condition of the entire structure, especially bearings and bedding.

This Advisory Leaflet describes techniques, by means of which the invisible areas beyond the sewer wall and below the road surface in the soil as well as the backfill of the former construction pit can be assessed.

It has to be taken into consideration that the visualisation of the deformation by means of waved requires interpretation due to differences in density, reflections and diffractions. The interpretation requires references. As the case when a doctor identifies and assesses aberrances when examining a radiography or ultrasound based on his experience, the technician needs indications to find critical areas. Obviously, soil explorations and dynamic probing in the area to be explored serve as such indications.

The working group dealt with various geophysical methods for detecting bedding defects and cavities in field tests in road space. The result of this experience forms the basis for this Advisory Leaflet. The Advisory Leaflet correspondingly contains an evaluation and weighting of the techniques.

With the current development status, destruction-free detection methods provide versatile applications. From the road surface as well as from the sewer, inspections are possible. Currently, methods for a general comprehensible presentation of the inspection results form the focus. For the time being, the interpretation of the results is to be left to professionals exclusively.

An automated computer-based interpretation with coded presentation of the irregularities can lead to standardised analysis of results of geophysical methods in the future.

The Advisory Leaflet is structured as follows:

- DWA-M 149-1: Conditions and Assessment of Drain and Sewer Systems Outside Buildings – Part 1: Visual Inspection (in preparation)
- DWA-M 149-2: Conditions and Assessment of Drain and Sewer Systems Outside Buildings – Part 2: Visual Inspection Coding System
- DWA-M 149-3: Conditions and Assessment of Drain and Sewer Systems Outside Buildings – Part 3: Condition classification and assessment
- DWA-M 149-4: Conditions and Assessment of Drain and Sewer Systems Outside Buildings – Part 4: Detection of Bedding Defects and Cavities by Means of Geophysical Techniques

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User Notes

This Advisory Leaflet has been produced by a group of technical, scientific and economic experts, working in an honorary capacity and applying the rules and procedures of the DWA and the Standard DWA-A 400. Based on judicial precedent, there exists an actual presumption that this document is textually and technically correct.

Any party is free to make use of this Advisory Leaflet. However, the application of its contents may also be made an obligation under the terms of legal or administrative regulations, or of a contract, or for some other legal reason.

This Advisory Leaflet is an important, but not the sole, source of information for solutions to technical problems. Applying information given here does not relieve the user of responsibility for his own actions or for correctly applying this information in specific cases. This holds true in particular when it comes to respecting the margins laid down in this Advisory Leaflet.

Introduction

The intact bedding of sewers is a fundamental prerequisite for the safe and long-term operation of sewer networks. Until today, the current condition of bedding could only be determined definitely by trenches, destructive sampling and laboratory tests.

In the sewer inventory, groundwater ingress and entry of soil material often led to an impairment of the load bearing capacity of the pipe bedding and to the formation of cavities in the surrounding of defective sewers. Besides direct damages on the pipes, also damages in the form of bedding defects and cavities that lead to subsidence of the surface in the long term and can also cause collapse of the road surface.

Bedding defects cannot be located with the visual inspection techniques applied today. After the collapse of the road surface, sewers are often rehabilitated according to the "firefighting strategy" (see also Advisory Leaflet DWA-M 143-14E).

Until today, preventive methods were limited to proper construction including final testing and repetitive visual inspection. A continuous compaction testing is only possible in connection with suitable and economically justifiable geophysical methods.

An early detection of bedding defects and cavities – if possible already before the approval of structures – which decisively influence the functionality and durability of the pipe-soil-system decisively intend to save the network operator from costly wrong decisions when selecting the time or technique of rehabilitation.

1 Scope

1.1 Objective

DWA-Working group ES-8.13 "Detection of Bedding Defects" submits this Advisory Leaflet, which describes the latest state of technology and presents it with practical reference.

For this purpose, relevant information is compiled for the most important areas of application with regard to detection of bedding defects. Fields of application that are supported by experience are provided.

Furthermore, research and development projects are presented in Clause 4.4. They include:

- acoustic inspection,
- gamma-gamma probe.

Using the techniques introduced in the Advisory Leaflet is only sensible in well-founded suspicious cases that are based on other investigation techniques (e. g. visual inspection, investigation of road condition). In such cases, geophysical techniques can provide supplementary information, whereas the limits of application of the single techniques need to be observed.

1.2 Scope

This Advisory Leaflet describes techniques by means of which non-visible areas beyond the sewer wall and under the road surface in the soil as well as in the backfill of a former construction pit can be assessed in a destruction-free way.