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English Version

Drain and sewer systems outside buildings - Management and control of activities - Part 2: Rehabilitation

Réseaux d'évacuation et d'assainissement à l'extérieur des bâtiments - Gestion et contrôle des activités opérationnelles - Partie 2: Réhabilitation

Entwässerungssysteme außerhalb von Gebäuden - Management und Überwachung von Maßnahmen - Teil 2: Sanierung

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European foreword

This document (FprEN 14654-2:2020) has been prepared by Technical Committee CEN/TC 165 “Wastewater Engineering”, the secretariat of which is held by DIN.

This document is currently submitted to the formal vote.

This document will supersede EN 14654-2:2013.

The changes to the text in this document are largely editorial and relate to the separation of the duplicated text. Annex A has also been deleted as this is now incorporated into EN 752:2017. The technical changes made is the addition of 7.5.5 on detailed design of the optimal solution.

EN 14654 consists of the following parts, under the general title *Drain and sewer systems outside buildings — Management and control of activities*:

— *Part 1: General*; (the present document)

— *Part 2: Rehabilitation*

— *Part 3: Drain and sewer cleaning*

— *Part 4: Control of inputs from users*

Other parts, dealing with other activities, may be added later.

In drafting this part of EN 14654, account has been taken of other available standards, in particular EN 752, *Drain and sewer systems outside buildings*” and EN 13508 *Investigation and assessment of drain and sewer systems outside buildings*”.

1 Scope

This document establishes requirements for the management and control of activities in drain and sewer systems outside buildings and specifies requirements for development and implementation of work programmes, and the selection of techniques.

This document covers the management and control of rehabilitation activities.

It is applicable to drain and sewer systems from the point where wastewater leaves a building, roof drainage system, or paved area, to the point where it is discharged into a wastewater treatment plant or receiving water body.

Drains and sewers below buildings are included provided that they do not form part of the drainage system of the building.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 752:2017, *Drain and sewer systems outside buildings - Sewer system management*

EN 13508-1:2012, *Investigation and assessment of drain and sewer systems outside buildings - Part 1: General Requirements*

FprEN 14654-1:2020, *Drain and sewer systems outside buildings — Management and control of activities — Part 1: General*

EN 16323:2014, *Glossary of wastewater engineering terms*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 16323:2014, FprEN 14654-1:2020 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia available at http://www.electropedia.org/

NOTE: Certain key definitions from EN 16323:2014 have been repeated below for clarity. The following additional terms used in this European Standard are defined in EN 16323:2014.

— drain

— sewer

— receiving water body

— surface receiving water body

— sewer system

— wastewater treatment plant

3.1
extraneous water
unwanted flow in a drain or sewer system

[SOURCE: EN 16323:2014, definition 2.1.4.7]

3.2
inspection chamber
chamber with a removable cover constructed on a drain or sewer that permits the introduction of cleaning and inspection equipment from surface level, but does not provide access for personnel

[SOURCE: EN 16323:2014, definition 2.2.4.13]

3.3
maintenance
routine work undertaken to ensure the continuing performance of an asset

[SOURCE: EN 16323:2014, definition 2.1.6.2]

3.4
manhole
chamber with a removable cover constructed on a drain or sewer to permit entry by personnel

[SOURCE: EN 16323:2014, definition 2.2.4.15]

3.5
pipeline section
continuous section of drain or sewer between two adjacent nodes

[SOURCE: EN 16323:2014, definition 2.2.3.7]

3.6
rehabilitation
measures for restoring or upgrading the performance of existing systems, including renovation, repair and replacement

[SOURCE: EN 16323:2014, definition 2.1.6.3]

3.7
renovation
work incorporating all or part of the original fabric of the drain or sewer by means of which its current performance is improved

[SOURCE: EN 16323:2014, definition 2.1.6.4]

3.8
repair
rectification of local damage

[SOURCE: EN 16323:2014, definition 2.1.6.5]

3.9
replacement
construction of a new drain or sewer, on or off the line of an existing drain or sewer, the function of the new drain or sewer incorporating that of the old

[SOURCE: EN 16323:2014, definition 2.2.1.7]

3.10
wastewater
water composed of any combination of water discharged from domestic, industrial or commercial premises, surface run-off and accidentally any sewer infiltration water

[SOURCE: EN 16323:2014, definition 2.3.10.65]

4 General

Rehabilitation includes a wide range of activities to restore or upgrade the performance of a drain or sewer system including those examples shown in Table 1.

Table 1 — Scope of rehabilitation

Objective	Examples of system related measures	Examples of component related measures
Restore original performance	— Remove extraneous water — …	— Cleaning — Repair — Renovation — Replacement (like for like).
Upgrade original performance	— Maximize use of existing flow capacity — Reduce hydraulic input to the drain or sewer system — Attenuate peak flows — …	— Replacement (increased capacity).

This document applies the process described in EN 14654-1 for implementing rehabilitation activities in the integrated drain and sewer system management plan. This document shall be used in conjunction with EN 14654-1.

5 Integrated sewer system management planning

Rehabilitation activities are included in the rehabilitation plan, as part of an Integrated Sewer System Management Plan. A rehabilitation plan (see EN 752:2017, 6.4.4.4) should be in place for the drain and sewer system prior to carrying out any rehabilitation activities. However, this is not always possible if works are required urgently (e.g. in response to a drain or sewer failure).

6 Preparation of rehabilitation programme

6.1 Introduction

The rehabilitation programme defines a series of projects, in line with the rehabilitation plan, to ensure that the drain and sewer system meets the performance requirements. The rehabilitation programme should define the objectives for each project in sufficient detail so that a project specification can then be produced in accordance with Clause 7.

6.2 Review of the rehabilitation plan

A review should be undertaken of the rehabilitation plan within the integrated sewer system management plan.

6.3 Investigation

The scope of the investigations necessary to produce the rehabilitation programme will depend on the extent of the investigations carried out during the preparation of the integrated sewer system management plan.

Investigations shall be carried out where further information is required in order to produce the rehabilitation programme. Examples can include:

a) further inspection in parts of the system where the original assessment was based only on sample inspections;

b) production of more detailed sewer flow simulation models, where the original assessment was based on a simplified model;

c) more detailed studies of the impact of any discharges on receiving water bodies.

The types of investigation can include:

1) investigations of the existing drain and sewer system (e.g. visual inspections, radar, sonar, flow measurements, sewer flow simulation modelling, wastewater quality simulation modelling);

2) more detailed investigations of the impact of proposed new developments in the area (e.g. hydraulic modelling etc.);

3) other investigations to determine feasibility of options (e.g. preliminary topographical, geotechnical and other investigations (see EN 752:2017, 8.3.1).

Details of investigation techniques for existing drains and sewers are described in EN 13508-1.

6.4 Assessment

The assessment should identify the location of those components of the drains and sewer system where proactive or reactive rehabilitation are to be carried out. This shall be based on:

a) a knowledge of the characteristics and structural condition of the drain and sewer system;

b) an understanding of existing and past failures and their association with performance deficiencies including their impact on operations and maintenance of parts of the drain and sewer system concerned;

c) an analysis of the performance of the drain and sewer system;

d) a review of the available information including the evolution of failures and performance deficiencies over time.

The individual pipeline sections and other components shall be described with the existing information, in order to optimize the rehabilitation programme.

It is advisable to carry out an analysis of the information to be able to determine:

e) the extent and the nature of the structural defects, leak tightness, hydraulic deficiencies and mechanical damage and chemical attack (corrosion and abrasion);

f) causes of these failures and performance deficiencies;

g) environmental impacts of the defect.

6.5 Development of the programme

6.5.1 Introduction

The rehabilitation programme defines the activities that will be undertaken to meet the rehabilitation objectives in the form of a series of rehabilitation projects. It defines the scope and objectives of each rehabilitation project, the phasing of the projects and the relationship to any external constraints such as budgets, new developments, and interactions with other utility or development programmes (e.g. highway works).

The objectives of rehabilitation activities should be expressed through the following performance requirements:

— hydraulic performance,

— structural performance,

— environmental performance,

— operational performance.

6.5.2 Developing options

This should include issues relating to new development and solutions involving major upgrading work and maintenance, as well as changes to operational practices. Within this framework a number of feasible options should be developed.

Where appropriate the options should include solutions that address a number of problems. Examples include:

— replacement of a pipe to resolve a structural problem could also be used to resolve a hydraulic problem on a neighbouring area by diverting flow from a neighbouring area into the new pipe;

— reduction of flows could be used both to reduce flooding and to reduce discharges from combined sewer overflows.

The assessment of each performance deficiency identified in the rehabilitation plan should be reviewed, taking account of the additional information collected in developing the programme (see 6.3 and 6.4). The options should specify the group and class of solution. Examples of solutions are given in Table 2.

Table 2 — Solution types, groups and classes for rehabilitation

Type	Group	Class
Hydraulic	Maximize use of existing flow capacity.	Removal of constrictions.
		Reducing hydraulic pipeline roughness (including head losses at structures, junctions, etc.).
		Cleaning.
	Source control – Reducing the hydraulic input to the drain or sewer system.	Diversion of surface water flows to infiltration drainage systems or pervious areas.
		Use of porous pavements.
		Diversion of flows to another system.
		Manage surface water on the surface.
		Reduction of infiltration and inflow of extraneous water.
	Attenuate peak flows.	Utilization of existing storage potential within the system (strategically placed flow controls).
		Utilization of surface storage (including storage within the property boundary).
		Provision of additional storage (tank sewer or detention tank).
	Increase drain or sewer system flow capacity.	Replacement with larger pipe.
		Construction of additional pipeline.
Environmental	Reduce pollutant inputs to system in accordance with FprEN 14654-4:2020.	Sediment basins and grit separators.
		Use of vegetation to absorb pollutants from runoff before entering the system.
		Controlling inputs (e.g. industrial wastewater inputs).
	Decrease planned pollutant discharges to receiving water bodies.	Increase of flows to treatment (see hydraulic solutions above).
		Treatment of surface water discharges (e.g. by separators, retention ponds, etc.).
		Improve solids retention and hydraulic performance of combined sewer overflows.
		Real time control.
	Decrease impact by relocation of points of discharge.	
	Reduce exfiltration by rehabilitation measures.	Repair techniques (e.g. sealing leaks).
		Renovation techniques (e.g. provision of watertight lining).
		Replacement of pipeline using open-cut or trench-less techniques.

Type	Group	Class
Structural	Protect fabric of drain or sewer by provision of appropriate linings or internal coatings.	
	Rehabilitate pipeline.	Repair (see EN 15885).
		Renovation (see EN 15885).
		Replacement (see EN 1610, EN 12889, EN 15885).
Operational	Planned inspection and cleaning of a drain or sewer. The management and control of sewer cleaning activities should be carried out in accordance with FprEN 14654-3:2020.	
	Increased frequency of maintenance of pumps or pumping stations.	
This list is not exhaustive.		

Examples of the decision processes for considering solutions are given in Figures 1 and Figure 2. Figure 1 gives an example of the decision process for the solutions involving only structural rehabilitation of the fabric of pipelines and Figure 2 gives an example of the process for solutions involving hydraulic rehabilitation.

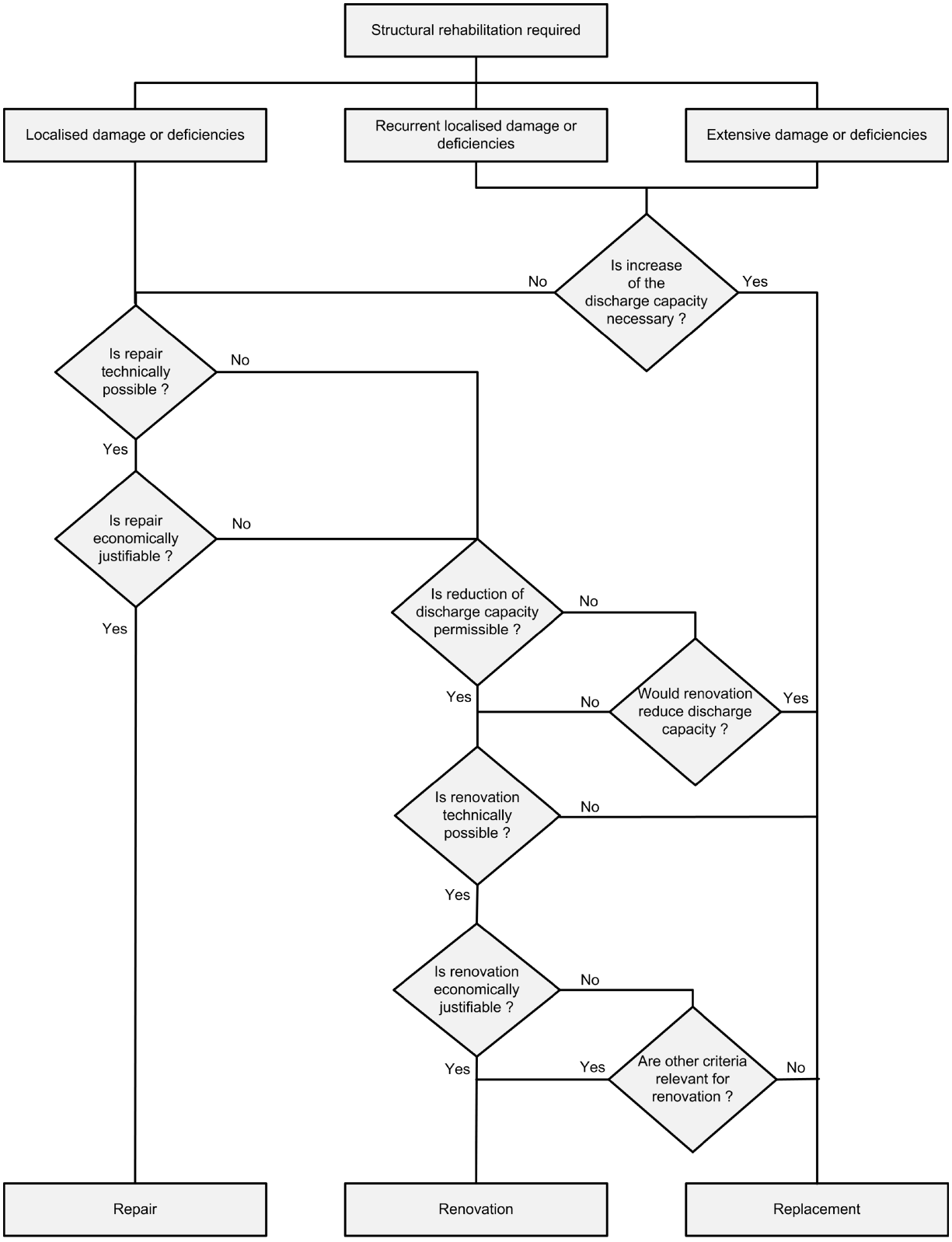

Figure 1 — Example of process for selection of technique class for structural rehabilitation of pipelines

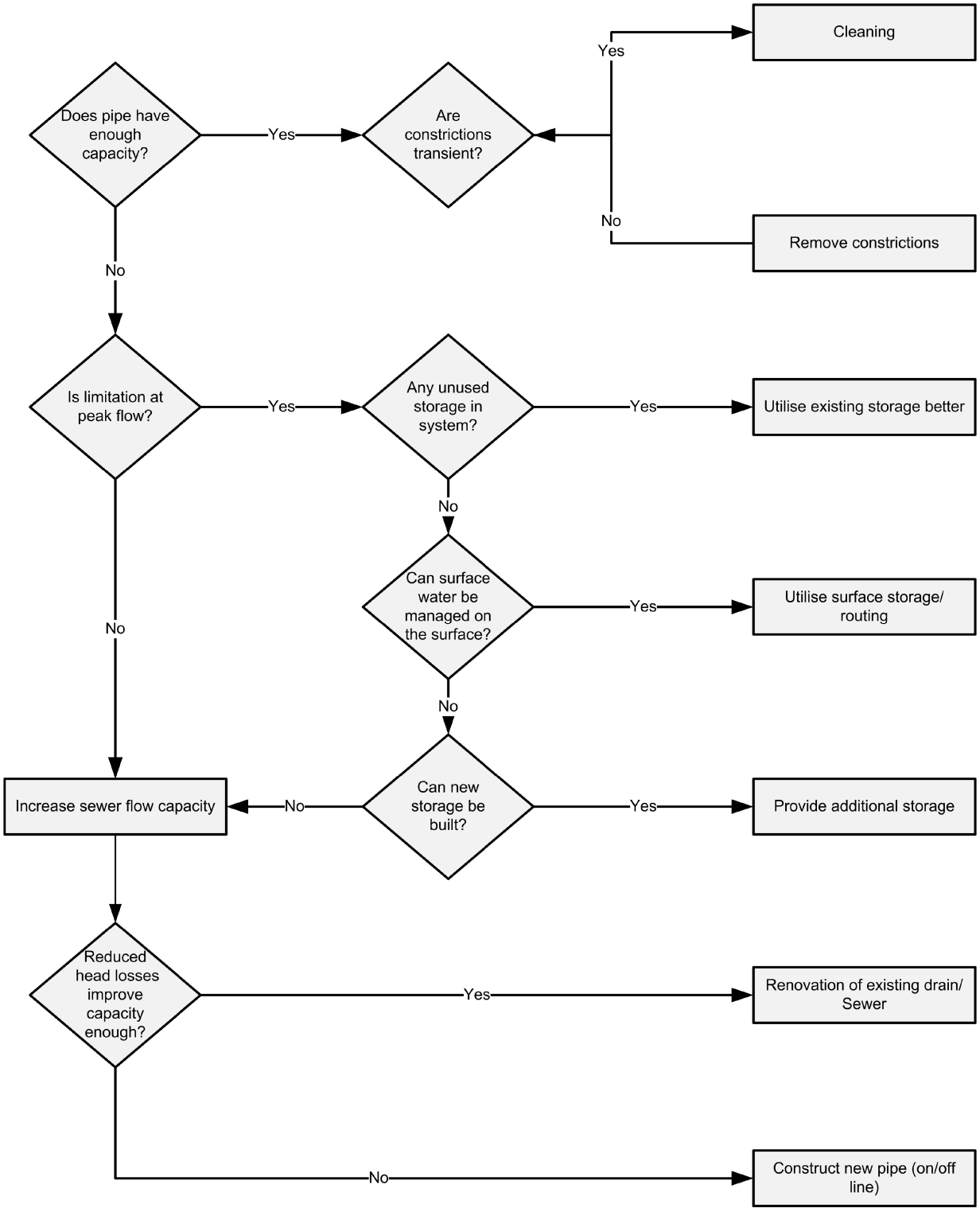

Figure 2 — Examples of process for selection of technique class for hydraulic solution types

6.5.3 Assess feasibility of solutions

In addition to the factors specified in FprEN 14654-1:2020, 6.5.4, the following factors should be considered:

For hydraulic solutions the study should establish effects and feasibility of, for example:

a) the extent of works necessary to remove constrictions;

b) reducing hydraulic inputs and the effect of those reductions;

c) mobilising storage in the system or in ponds or tanks;

d) diverting flows out of the system;

e) the route and profile of new pipelines;

f) increasing flow capacity by renovation of pipelines.

For environmental solutions the study should establish effects and feasibility of, for example:

g) reducing pollutant inputs and the scope of works necessary;

h) reducing discharges by increasing hydraulic capacity;

i) improving performance of combined sewer overflows or relocating the discharge point;

j) the class of solution necessary to reduce exfiltration.

For structural solutions the study should establish, for example:

k) the group or class of solution necessary to restore the structural integrity of a pipeline.

For operational solutions the study should establish, for example:

l) the feasibility of increasing capacity by drain or sewer cleaning.

6.5.4 Select optimum solution

The optimum solution should be selected in accordance with FprEN 14654-1:2020, 6.5.4. As well as the costs, the relative benefits of each option should also be taken into account.

6.5.5 Producing the programme

In addition to the information specified in FprEN 14654-1:2020, 6.5.6, the programme should specify any items that are conditional on any new developments;

7 Preparation of the project specification

7.1 Introduction

The rehabilitation project specification should contain all the information, including any drawings, necessary to carry out the rehabilitation project.

7.2 Review of the project description and project objectives

The review should be carried out in accordance with FprEN 14654-1:2020, 7.2 and should include an assessment as to whether there have been any changes to the information identified during the preparation of the rehabilitation programme.

7.3 Investigation

The types of investigations necessary to produce the project specification can include:

a) Further investigations of the existing drain or sewer system. Information on these techniques can be found in EN 13508 (all parts). Examples of such investigations include:

   1) detailed visual inspections or other investigations of existing structures to determine feasibility of a particular renovation technique;

   2) more detailed sewer flow simulation modelling to determine the inputs from new developments as the designs of these are completed or to obtain more accurate information on inputs from other parts of the system;

   3) investigations to determine the effect of other projects in the programme that have already been implemented.

b) Other investigations to determine the feasibility of options or to provide information for design calculations include:

   1) detailed topographical surveys;

   2) geotechnical investigations;

   3) investigations to determine the location of other utility services;

   4) investigations to determine any possible impact on adjacent structures.

c) Investigations to determine the impact of the proposed works include:

   1) investigations of the likely social disruption associated with different construction techniques (e.g. traffic surveys, noise surveys, etc.);

   2) environmental studies to determine the impact of construction.

7.4 Assessment

The assessment should be carried out in accordance with FprEN 14654-1:2020, 7.4.

7.5 Drafting the project specification

7.5.1 Introduction

In accordance with FprEN 14654-1:2020, 7.5, the drafting of the project specification involves the following stages:

a) prepare potential solutions;

b) assess feasibility of solutions;

c) select optimal solution;

d) detailed design of optimal solution.

7.5.2 Prepare potential solutions

The rehabilitation programme will have selected the class of solution (see Table 2) from which potential solutions should be derived where appropriate. These more detailed levels of solution are referred to as technique families. For renovation and repair systems these technique families and their classification characteristics are described in more detail in EN 15885. For other classes of solution no standardized classification of technique families currently exists.

Within the scope described in the rehabilitation programme for the project, a number of possible detailed options for the project should be developed taking into account the data from the investigation and the assessment (see 7.3 and 7.4).

Calculations should be carried out as appropriate to confirm the feasibility of each option. The detailed preparation of the options phase should be used to check that all the essential points are taken into account in the specification.

Where the problem is related to the structural rehabilitation of an existing pipeline (including manholes), the process for the selection of the technique family should initially be undertaken using the following criteria:

a) external loads capacity – the capacity of the rehabilitated structure to resist internal negative pressures, external groundwater pressure, ground loads, traffic loads and other imposed loads (see EN 15885:2018, 8.2.1);

b) internal pressure capacity – the capacity of the rehabilitated structure to resist internal positive pressures either due to surcharging of the drain or sewer or deliberate pressurization (see EN 15885:2018, 8.2.2);

c) structural integrity of the rehabilitated pipe based on internal loads capacity – whether the technique has the capacity to span holes in the pipe, has independent ring stiffness (not dependent on adhesion of a liner to the host pipe), or can resist failure of the host pipe (see EN 15885:2018, 8.2.2);

d) site impacts – the surface area and extent of excavation required for installation (see EN 15885:2018, 8.3);

e) size of pipe – whether the technique is suitable for the size of pipe;

f) shape of pipe – whether the technique is suitable only for circular pipes or non-circular pipes;

g) hydraulic performance – whether the installation of the technique in this situation would result in an unacceptable deterioration in the hydraulic performance of the system.

7.5.3 Assess feasibility of solutions

Depending on the class of solution the following criteria should be used, where relevant, to establish the technical feasibility of each option:

a) **Physical criteria of the existing pipelines** – The physical criteria correspond to the condition of the drain or sewer described in the investigation (see 7.3). The possible solutions should be compatible with the following features of the host pipe:

   1) its material and construction;

   2) its shape and its interior dimensions (production tolerances, etc.);

   3) dimensional variations (particularly out-of-roundness);

   4) singular points of the profile (disconnections, joint gaps, reverse slopes, etc.):

      i) connections and laterals;

      ii) associated installations and their junctions, etc.

b) **Hydraulic criteria** - The hydraulic criteria correspond to the functional specifications of the drain or sewer with regard to its usage and its purpose once rehabilitated:

   1) required level of leak tightness (of the installation, the joints if they exist, the connections, the branches and the associated installations (inspection manholes, inspection chambers, etc.));

   2) hydraulic capacity (average/extreme operating conditions, flow rates, speeds);

   3) pressures, depressions (water hammer, siphon effect).

c) **Mechanical criteria** - The mechanical criteria correspond to the mechanical strength and mechanical durability conditions which the rehabilitated drain or sewer are required to meet:

   1) external loads (traffic loads, coverage, fill, type of soil, water table);

   2) internal stresses (internal pressure, abrasion).

d) **Chemical criteria** - The chemical criteria correspond to the compatibility of the elements involved. Taking sufficient account of these criteria can ensure the resistance and durability of the rehabilitated drain or sewer in terms of corrosion and durability, and contributes to safety in the construction and operating phases (hydrogen sulphide, etc.):

   1) effluent characteristics (temperature, acidity or alkalinity, electrical conductivity, etc.);

   2) environment characteristics (terrain, water table, etc.);

   3) stray electrical currents (neighbouring networks, railways, etc.).

e) **Implementation criteria** - The implementation criteria correspond to the requirements of the relevant authority and the possibilities linked to the surroundings of the installation (on surface or in sub-soil).

f) **Installation environment and conditions** - Possibilities for access and activity by personnel and use of equipment inside or outside the drain or sewer:

1) scale of the operation;

2) length of sections;

3) number of interventions;

4) total intervention time (procurement, preparation, rehabilitation work, connections, controls, etc.).

g) **Surface proximity constraints:**

1) conditions of access to the installation;

2) area covered by work site;

3) storage zone, etc.

h) **Sub-soil proximity constraints:**

1) surrounding networks;

2) cavities in the soil;

3) risks of subsidence, etc.

i) **Social and environmental constraints** - Specific characteristics of the site concerning the inconvenience caused:

1) roads (public transport, cars, car parks, resident access, pavements, shoulder, etc.);

2) land use (shops, public gardens, public and private buildings, etc.);

3) sensitivity to nuisances (noise, dust, odours, etc.);

4) risks of pollution (of soil, groundwater, surface receiving water bodies and air);

5) type of materials used in the installation to be rehabilitated (asbestos cement, etc.);

6) specific crossing points (railways, roads, rivers, buildings, etc.);

7) ecological disturbance (e.g. designated sites);

8) impact on heritage (e.g. archaeological or religious sites).

j) **Other constraints:**

1) flow management constraints (by blocking and storage in upstream part, by storage in detention tank, by bypass with or without pumping);

2) pre-cleaning requirements, etc.

7.5.4 Select optimal solution

Where more than one solution is feasible, the optimal solution shall be selected in accordance with FprEN 14654-1:2020, 7.5.4.

7.5.5 Detailed design of optimal solution

After selection of the optimal solution, further detailed design work should be carried out if appropriate (e.g. providing access, temporary flow management, operating pressure of jetting).

7.5.6 Prepare project specification

For the selected option further detailed calculations should be carried out and a detailed description of the works should be produced (including drawings) to provide all the information necessary for the construction of the works.

7.6 Performance indicators

7.6.1 Introduction

Performance indicators should be selected in accordance with FprEN 14654-1:2020, 7.6.

7.6.2 Indicators for the assessment of the work quality

Performance indicators should be selected in relation to each of the rehabilitation objectives:

a) structural integrity:

    1) mechanical or physical characteristics of:

        i) rehabilitated pipe;

        ii) rehabilitation technique;

        iii) soil/rehabilitated pipe interaction;

        iv) bonding between any lining and the host pipe.

b) leaktightness:

    1) leakage from the pipe;

    2) rate of infiltration into the pipe.

c) hydraulic:

    1) longitudinal profile;

    2) cross section;

    3) hydraulic capacity.

d) chemical resistance.

e) abrasion resistance.

7.6.3 Indicators for the assessment of the effectiveness of the project or programme

Examples of indicators might include:

— percentage of extraneous water collected in drain or sewer;

— percentage of exfiltration;

— number of flooding incidents per year and per kilometre;

— number of blockages per year and per 1 000 km;

— fissures per kilometre;

— number of collapses per year and per 1 000 km;

— rate of sedimentation.

8 Implementation of projects

8.1 Introduction

The implementation of the project should be in accordance with FprEN 14654-1:2020, Clause 8.

8.2 Rehabilitation report

The contractor shall submit a report to the client on completion of the work in accordance with FprEN 14654-1:2020, 8.11.

9 Measurement of conformity

9.1 Measuring conformity with the project specification

9.1.1 General

The contract shall specify the particular requirements in respect of leaktightness (it may specify the reduction rate for extraneous water or the permeability to be reached) and flow.

9.1.2 New or replacement drains or sewers

The performance of the drains and sewers shall be verified during and after installation.

Verifications tests can include (for example):

a) visual inspection;

b) leaktightness testing (using air or water testing or infiltration testing);

c) compaction.

9.1.3 Renovation and repair systems

Conformity verification of materials and components used for renovation or repair of drains and sewers should consider (where appropriate) both requirements at the “M” (manufactured) stage and the “I” (installed) stage.

The contract shall specify the testing requirements. The renovated or repaired parts of the system shall be visually inspected following installation and tested for leak tightness in accordance with testing requirements specified in the contract. The dimensions of the renovated or repaired pipe and the hydraulic roughness of the pipe wall shall be checked against the specification to ensure there is adequate hydraulic capacity. The thickness and shape of any lining shall be checked to ensure there is adequate structural stability in accordance with the specification.

9.1.4 Measuring conformity

The tools that will be used to measure the performance indicators should be stated in the project specification. Examples include:

a) visual inspection – see EN 13508-1:2012, 5.8.3;

b) leaktightness - see EN 1610;

c) sampling – removal of samples for testing in laboratory to measure the thickness of the renovation system; the quality of the bond between the liner and the host pipe and the contact between the soil and the host pipe, and/or for testing of the mechanical properties of the installed material;

d) load testing to measure the mechanical characteristics of the renovated pipe (see EN 13508-1:2012, 5.8.4);

e) mechanical impedance testing to identify the presence of cavities, failures of bond or compaction of the materials (see EN 13508-1:2012, 5.8.4);

f) ground probing radar to evaluate the thickness of the structure and identify the presence of cavities and the state of the pipe bedding (see EN 13508-1:2012, 5.8.4);

g) ultrasonic imaging to evaluate the bonding of grouts;

h) infrared thermography to examine and assess the bond of the grout;

i) endoscopy or videoscopy to look assess the effectiveness of the treatment of any cracks or fractures in existing pipes;

j) injection monitoring to ensure that cavities around any pipes or linings have been properly filled;

k) pipe permeability test – by means of a water pressure test on a sample of the pipe material.

9.2 Non-conformities

When non-conformities are found, these should be dealt with in accordance with FprEN 14654-1:2020, 9.2.

9.3 Post project appraisal

Following the completion of each project, the upgraded system should be assessed using performance indicators (see 7.6) and other measurements to establish whether the objectives of the project, as set out in the rehabilitation programme, have been achieved.

10 Review of plan and programme

The remaining stages of the programme and the rehabilitation plan shall be reviewed:

a) on completion of a rehabilitation project;

b) if the performance of the rehabilitated system is significantly different to that anticipated in the programme.

c) after any urgent works have been completed.

Bibliography

[1] EN 1610, *Construction and testing of drains and sewers*

[2] EN 12889, *Trenchless construction and testing of drains and sewers*

[3] FprEN 14654-3:2020, *Drain and sewer systems outside buildings - Management and control of activities — Part 3: Cleaning*

[4] EN 13508-2, *Investigation and assessment of drain and sewer systems outside buildings — Part 2: Visual inspection coding system*

[5] EN 15885, *Classification and characteristics of techniques for renovation, repair and replacement of drains and sewers*

[6] EN ISO 14001, *Environmental management systems - Requirements with guidance for use (ISO 14001)*