

ACS1450 Rehabilitation of pipelines and culverts using insitu mortar

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ACS1450.1 Scope

This section covers the rehabilitation of pipelines, manholes and culverts by insitu application of repair mortars.

ACS1450.2 Materials

All imported materials, products, and systems, shall be tested, appraised, and certified in New Zealand or Australia by an IANZ/NATA accredited laboratory to the requirements of the Auckland Codes of Practice, appropriate AS/NZS Standard and NZ Building Code (as applicable).

In addition, the Contractor shall provide evidence of the material's / product's manufacturing process (e.g. mill certificates). Any alternative testing regime, of an equivalent standard, shall be agreed by the Engineer.

Where testing is done outside of New Zealand and Australia, the Contractor shall be required to prove the chain of custody of materials to ensure that there has been no substitution of untested materials.

ACS1450.2.1 Mortars

Mortars shall be specifically designed for use in pipelines, manholes and culverts. The Contractor shall determine the exposure conditions due to soils, groundwater and conveyed stormwater based on data supplied with the Tender. The Contractor shall demonstrate that the selected mortar shall meet the service life requirements under those conditions.

The minimum service life of the mortar system shall be at 50 years. Service life expectancy shall be supported by independent documented tests and analysis.

The rehabilitation method and materials shall protect the concrete and reinforcing steel of the existing pipes, to prevent further or ongoing attack and further loss of strength.

The rehabilitation mortar shall have sufficient abrasion resistance to accommodate the migration of silt, sand, and debris along the pipe. It shall be sufficiently robust not to be

damaged by pipe cleaning equipment that may be required to remove future blockages or debris accumulation in the pipeline.

An accurate record shall be kept of all mortar supplies used in the contract, including full details of the batch number of each batch of mortar supplied to the contract. All mortar supplies are to be kept in a clean, dry temperature and humidity-controlled environment until immediately before they are mixed.

ACS1450.3 General

Prior to commencement of the work, the Contractor shall satisfy the Engineer that the proposed materials, methodology, equipment, and labour proposed at the time of tender remains unchanged. Where required by the Engineer, the Contractor shall submit a detailed Methodology Statement and detailed Construction Programme which together demonstrate exactly how the Works will be undertaken. Where amendments are required to the methodology, equipment or labour, such amendments shall be discussed with the Engineer in advance of the implementation thereof and the Engineer's acceptance of these amendments obtained.

ACS1450.4 Ventilation and lighting

The Contractor shall provide adequate ventilation and lighting in the pipeline, entry and exit points to ensure that a safe working environment is maintained at all times. The Contractor shall provide, maintain, and operate gas monitoring in the confined spaces.

ACS1450.5 Confirmation of information shown on construction drawings

Construction drawings are generally prepared from the Council's GIS and the information shown is indicative only and may not be accurate.

The Contractor shall be responsible for confirming all dimensions and the location of all features before undertaking any work or purchasing any materials.

The host pipe shall be inspected to confirm the extent of all pre-installation works required to be undertaken in accordance with *ACS1450.7 (CCTV inspections)*. The Engineer shall be notified immediately of any differences between the construction drawings and site observations and any required actions shall be agreed before proceeding.

ACS1450.6 Pipe preparation

ACS1450.6.1 Cleaning

The interior surfaces to be rehabilitated shall be fully cleaned to remove all loose and degraded material in accordance with Auckland Council Standard Specification *ACS1410 Pipe Cleaning* (full cleaning).

The substrate shall be thoroughly cleaned and prepared. This shall include removal of:

- Grease, fat, oils, slime deposits, mineral deposits, laitance
- Corrosion products, laitance, loose or corroded mortar and/or concrete
- Any previously applied coating or lining materials
- Any substance that could adversely affect the application of the mortar or reduce its bond strength to the concrete substrate.

The cleaning of concrete surfaces must be continued until the completely clean, uncorroded remaining concrete is exposed. A satisfactory phenolphthalein etch test result shall be obtained, demonstrating consistent alkalinity, and complete removal of all decayed concrete.

ACS1450.6.2 Surface preparation

All inflow and infiltration defects shall be rectified. Specialised rapid setting cementitious plugging products may be used to seal small holes or cracks, but external grouting with hydrophilic urethane grouts or similar shall be used to seal larger infiltration defects where plugging is impracticable.

Where the substrate is insufficiently roughened after high pressure water blasting, the substrate surface shall be scabbled to achieve the degree of roughness required for satisfactory application of the mortar.

ACS1450.6.3 Preparation of exposed reinforcement

If the cleaning and preparation process exposes any underlying reinforcing steel, this shall be prepared to provide a suitable surface for etching and priming before application of the mortar. Reinforcing steel must be cleaned sufficiently to allow for determination of its condition and remaining intact diameter. In practice, this means that it must be taken back to bare metal or thin corrosion still present and tightly adhering after the cleaning.

Notwithstanding this, the preparation shall be fully in accordance with the mortar manufacturer's directions.

ACS1450.7 CCTV inspections

A pre-installation, post-cleaning CCTV inspection in accordance with Auckland Council Standard Specification *ACS1510 Internal Inspection of Pipelines* shall be carried out to confirm that the standard of preparation has been satisfactory.

Inspection records are to be reviewed with the Engineer, and no other repair preparation work shall proceed until the Engineer is satisfied with the level of cleaning.

ACS1450.8 Flow management

The Contractor shall manage flow in the pipe to be rehabilitated, and in any connecting pipes.

ACS1450.8.1 Flow management plan

The Contractor shall provide a Flow Management Plan to accommodate pipe flow for any sections around which flow is to be diverted for the works. The Flow Management Plan shall include contingency provisions for failure of equipment, power supply, or other components of the flow management facilities. It shall also provide for the increased flows caused by rain in the bypass pumping period.

The Flow Management Plan and the Project Programme shall allow for each bypass operation to be in service for an agreed trial period before any of the works in the pipeline proceed.

Details of each flow diversion operation shall be submitted for approval to the Engineer and shall be approved by them before each flow diversion commences. The Engineer shall have the final decision as to when and whether a diversion operation shall commence. The Contractor shall make reasonable allowance for inability to work during periods of wet weather.

Approval of the Flow Management Plan shall not relieve the Contractor of their responsibilities to ensure that sufficient and adequate pumping or other flow arrangements are provided at all times for the flows.

ACS1450.8.2 Bypass capacity and pipe protection

When flow in the main and connecting pipes is plugged, blocked, or bypassed, sufficient precaution shall be taken to protect all upstream pipelines from surcharging and damage. Precautions shall be taken to ensure that control operations do not cause overflows, flooding, or other damage to public or private properties.

The Contractor shall ensure that surcharges or overflows of the pipe as a result of lack of capacity in the main diversion system do not occur. It will be the Contractor's responsibility to

assess the flow in each line and to ensure that all plant and equipment used for the temporary diversion of flows is adequate for the required duties.

If the diversion capacity is exceeded by flow in the pipeline, the Contractor shall either:

- Cease work at the earliest possible time and reinstate flow to the main and connecting pipes

OR

- Continue to work by increasing the diversion system capacity to match the higher actual or anticipated flow.

The Contractor shall be responsible for clean-up and restoration of any area affected by surcharge, overflows, or spillage associated with these works, to the satisfaction of the Engineer.

An indication of the flows that will need to be pumped at various stages in the project may be shown in the Tender Documents. Where such flows are shown, the minimum installed capacity of bypass provisions should exceed these values with a satisfactory safety margin.

ACS1450.8.3 Bypass pumping

Where required, the Contractor shall set up pumps and hose or pipeline routes with the capacity to maintain the stormwater service to all the properties within the catchment.

Where hose or pipeline routes cross roads, access ways, etc, the Contractor shall make all necessary arrangements for continued vehicle access with property owners and occupiers and obtain all necessary permits from local authorities.

Where properties cannot readily be served by the bypass pumping arrangements, suitable provision shall be made to hold back flow or other suitable means to maintain stormwater service.

All costs of establishment of bypass pumping routes, traffic management, obtaining of permits, reinstatement of surfaces, and tidying up on completion shall be included for in the Schedule of Prices.

ACS1450.8.4 Flow management contingency plans

These and other flow contingencies need to be provided for:

- a) Full or partial blockage or failure of bypass pumping equipment (pump or hoses)
- b) Failure of a pipe plug
- c) Flow from any major source upstream increasing rapidly

d) Any other likely cause of high flows or flow levels in the specific location.

The Contractor's Safety Management Plans shall recognise and make provision for these eventualities.

ACS1450.8.5 Standby pumps and equipment

At all times during the period of bypass pumping, the Contractor shall have standby pumps kept on site, sufficient to maintain the full bypass pumping requirement. Standby pumps shall be capable of full operation independent of primary pump power sources.

Additional pipelines, hoses, and fittings shall be available on site to provide for any pipeline failure during a bypass operation, and to meet all flow management contingency plans.

ACS1450.8.6 Work downstream from plugged pipelines

The Contractor shall take particular care to secure in place any pipe plugs that are required for bypass pumping or for flow retention.

ACS1450.9 Water

The Contractor shall make their own arrangements for supply of water for the purposes of the pipeline cleaning and mortar application.

Water used for mortar mixing shall be clean potable water.

ACS1450.10 Mortar application

Once the surface preparation in any area is complete, the surface must be kept free from any form of contamination. The mortar is to be applied to a newly cleaned section of pipe as soon as possible following cleaning, and in all cases, before it is exposed to stormwater flows again. If the surface does become re-contaminated, a further cleaning operation shall be undertaken.

Mortar application shall be strictly in accordance with the manufacturer's instructions.

Unless otherwise specified, the finished thickness of the mortar coating shall be at least 25 mm. The maximum thickness of a single layer must not exceed 50 mm.

ACS1450.10.1 Sprayed application

The mortar shall be applied by either dry or wet shotcreting.

Spray application of mortar shall only be carried out by trained and experienced personnel. In general, an applicator will need to have had at least 3 years' experience to work with these materials unsupervised.

The water content of the mortar is to be adjusted continuously to achieve consistent compaction with the minimum practicable rebound, and no visible sag. Addition of water shall be strictly in compliance with the mortar manufacturer's instructions.

The applicator must continuously monitor the process to ensure that the CAC mortar does not slump or slough from the application surface, and that the water/cement ratio remains within the permitted range at all times.

Construction joints in manholes should be avoided. If this is not possible, the joints should have their edges feathered to provide an upward sloping surface inside the joint.

ACS1450.10.2 Finishing

The finished surface of all sewer channels and benching is to be trowelled to the equivalent to a U3 finish, as described and illustrated in NZS 3114:1987: 'Concrete surface finishes'. Other surfaces shall be finished as described below.

For dry-sprayed material, material should be left with an "off the gun" finish. Trowelling is not permitted.

For wet-sprayed material, trowelling should be minimised. However, subject to approval by the Engineer, it may be applied to achieve a smoother finish than "off the gun" where required. However, extreme care must be taken to avoid pulling the material away from the substrate when doing so.

Particular attention will be required to ensure that corners and hollows are fully coated, and no voids are left behind the coating in these areas.

ACS1450.11 Quality assurance

The Contractor shall submit test data to substantiate that the values for material properties of proposed lining mortars.

A visual method of verification of the mortar thickness is required. The contractor should attach pins or nibs of the same length as the required mortar thickness, at a spacing of no

more than 1 per 10 m². The coverage of these is to be recorded by photographs in the As-built Quality Assurance Records for the project, which must be supplied on completion of the works.

They may include:

- a) Identification and timing information, including the date and time at which critical elements of the rehabilitation process variables were recorded, as implemented. Where relevant, temperature information shall also be recorded
- b) Observations, measurements and tests, and all necessary Hold, Witness, and Verification Points
- c) All tasks carried out by Subcontractors employed to perform works under the contract
- d) Verification by the operator of all works performed, and acceptance of responsibility for the works performed, whether by Contractor or Subcontractor personnel. The verification shall include a statement that all of the Works have been performed in accordance with the Contractor's Process Plans
- e) Procedures where test results do not conform with specified parameters.

The QAP shall also include appropriate completed checklists, tests of samples of the installed mortar, video records, photographs, approvals, computer printouts, electronic information, as-built details recorded, and the like.

ACS1450.12 Quality tests

The Contractor shall be responsible for the quality of all products, processes and services utilised or provided under the Contract, and shall procure and provide all test facilities, required to verify conformance of all products, processes and services to the technical requirements of the Contract.

Unless otherwise agreed by the Contractor and the Engineer, all laboratory tests undertaken by the Contractor shall be performed by laboratories currently registered with an authority recognised by International Accreditation New Zealand (IANZ).

The Contractor shall establish and maintain documented procedures for unique identification of individual products or batches of work as appropriate. This traceability shall include, but not be limited to:

- a) The source(s), specifications, and quality assurance procedures for material and equipment used
- b) Instructions, equipment (processing, inspection, measuring and testing equipment) and personnel utilised for performing activities essential in meeting the specified customer needs, throughout the production, installation, delivery and commissioning phase of the product

- c) The distribution and location of the product after delivery.

The Contractor shall submit to the Engineer, original copies of documents as evidence that the work has complied with the specified quality requirements, including all pertinent Subcontractor or secondary consultant records.

The Contractor is to advise the Engineer's Representative as soon as practicable in case of any significant non-conformance. Otherwise, quality records are to be submitted within 5 working days after completion of the process to which they relate.

ACS1450.13 Quality process audits

Upon request, the Engineer shall be given access in conjunction with or through the Contractor, to carry out quality audits, quality monitoring, assessment, or reviews to ascertain the effectiveness of the quality system put in place by the Contractor and their Subcontractors.

The Engineer shall be entitled to carry out the second- or third-party audits of the Contractor's and Subcontractors' quality system by:

- a) A review of the Contractor's conformance to the Quality Plan
- b) A review and verification of the Contractor's quality procedures and work instructions and documentary evidence of compliance with the technical requirements of the Contract.

Should the Engineer identify any examples of non-compliance with approved quality processes, a non-conformance notice may be issued in respect of that non-compliance. In extreme cases, where it is considered by the Engineer that there may be a risk to health and safety, or that the quality of the completed works may be compromised, the Engineer may order suspension of work in accordance with *NZS 3910:1998*, Clause 6.7 until such time that the Contractor rectifies the cause of the non-compliance to the satisfaction of the Engineer.

ACS1450.14 Quality records

The Contractor shall submit to the Engineer original documents as evidence that the work has complied with the specified quality requirements, including all pertinent Subcontractor or secondary consultant records. These reports shall be submitted within 24 hours if unsatisfactory, and seven days if satisfactory.

ACS1450.15 Inspection

The Engineer shall be given access in conjunction with or through the Contractor to all laboratories and other facilities used for quality control tests to verify that specified requirements are being met.

The Contractor shall make suitable arrangements to notify the Engineer when a Hold, Witness, or Verification Point will be reached so that the Engineer can review and/or witness, if required, any work process or test being undertaken by the Contractor.

The Engineer shall have the right to carry out at Hold, Witness, or Verification Points, inspections or tests to verify that the Contractor is implementing and maintaining the quality system in accordance with the contract documents.

ACS1450.15.1 Post installation CCTV inspections

A post-installation CCTV inspection shall be carried out in compliance with the Stormwater Standard Specification *ACS1510 Internal Inspection of Pipelines*.

An inspection is to be carried out on each newly rehabilitated section of pipeline. Flow shall not be allowed through the pipeline until the Engineer is satisfied that the quality of the rehabilitation meets the requirements of the specification.

A final CCTV inspection is to be carried out at the end of the maintenance period.

ACS1450.16 Completion and handover procedure

On completion of the refurbishment of both the pipeline and the manholes (where included in the Contract), the following as-built information is to be provided by the Contractor:

- a) A description of the pipe preparation work
- b) A record of the condition of each section of the pipe after cleaning but before application of the mortar commenced
- c) A list of the materials utilised in the liner and in any associated work, with relevant test certificates for the materials
- d) Records detailing the mortar preparation and installation procedures, including copies of the log sheets recording compliance with the Quality Plan for each stage of the mortar handling and installation process
- e) Measurement records verifying achievement of the specified mortar thickness
- f) A CCTV record of the completed works, clearly showing critical aspects of the mortar rehabilitation and any associated manhole repairs.