

Guide to Surveillance of Precast Concrete

Technical Bulletin No 47



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Foreword

This Guide provides a methodology for quality surveillance of precast concrete production for VicRoads contracts and works. The main aims of the Guide are to ensure that:

- Surveillance is carried out in a uniform and consistent manner, following principles of quality management
- Observation records of precast concrete production contain sufficient detail

ABOUT VICROADS

VicRoads is the Victorian State Road Authority responsible for the management of the road network.

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1.1 Purpose

The purpose of this Guide is to:

- Set criteria for the qualification and accreditation of Precast Concrete Surveillance Officers
- Provide guidance to Precast Concrete Surveillance Officers in working with quality assurance contracts
- Promote consistency in the surveillance of quality assurance contracts
- Provide a training basis for Precast Concrete Surveillance Officers.

The Guide is intended for use in quality assessment of VicRoads construction and maintenance contracts which include the manufacture of precast concrete units.

1.2 Scope

This document puts in place a recommended system for the appointment and duties of a Precast Concrete Surveillance Officer, and provides a set of checklist guides, to ensure quality standards, specifications and contract obligations are met.

The Guide does not cover every possible contingency, and the information herein can be expanded both in scope and depth as the need arises. There will always be a need for the Precast Concrete Surveillance Officer to apply judgement and, when in doubt, seek further specialist advice.

1.3 Manufacture of Precast Concrete Units

Activities in the manufacture of precast concrete include supply of concrete, reinforcing and prestressing steel, manufacture of forms, placing of reinforcement, stressing, curing, handling and transport of the completed units.

2.1 The Quality Assurance Environment

Quality assurance is applied in precast concrete contracts as a part of a management system to ensure that:

- Contractor/sub-contractor relationships are working
- Processes are being managed
- People have sufficient empowerment and responsibility to do their jobs
- Products meet the specified criteria, i.e., standards and specifications are achieved.

2.2 The VicRoads Framework for Quality Assurance Contracting

This Guide has been produced by VicRoads to complement the Austroads publications *Quality Assurance in Contracts*¹ and *Guide to Field Surveillance of Quality Assurance Contracts*². The second publication is referred to within this Guide as the Austroads Guide.

The contents of this Guide specifically address Contractor surveillance activities associated with the implementation of that portion of the Quality Plan for the manufacture of precast concrete units. The Quality Plan covering the manufacture of precast concrete units is generally owned by the Precast Concrete Sub-contractor and is reviewed by the Contractor.

2.3 Aim of Surveillance of Precast Concrete

The surveillance of the manufacture of precast concrete units determines, in a systematic manner, that the Contractor's and Precast Concrete Sub-contractor's Quality Plans are implemented, that the Contract Specification requirements for the manufacture of precast concrete units are complied with, and that the specified quality is achieved. Although surveillance is carried out on both the manufacture and erection of new precast concrete units, this Guide covers the manufacture only.

Each process used in the manufacture of precast concrete units should be observed for verification that the detail of the process has been carried out in accordance with written instructions and that the specified requirements have been achieved.

The personnel who carry out surveillance require detailed knowledge of the procedures for the manufacture of concrete and of precast concrete units and must be trained to observe and seek appropriate evidence of compliance with procedures. In particular these personnel must be particularly conversant with the following VicRoads Standard Specifications for Roadworks and Bridgeworks:

- Section 610 – *Structural Concrete*
- Section 611 – *Steel Reinforcement*

- Section 619 – *Manufacture, Testing and Delivery of Precast Reinforced Concrete Box Culverts*
- Section 620 – *Precast Concrete Units*
- Section 622 – *Pre-Tensioning of Concrete Units*

The Precast Concrete Surveillance Officer is retained by, and acts on behalf of, the Contractor and generally carries out surveillance of sub-contracted manufacture of precast concrete units. In the event that the precast concrete work is not sub-contracted, then the Precast Concrete Surveillance Officer will be retained by the manufacturer of the precast concrete units, who in this instance is also the Contractor.

All precast concrete surveillance shall be carried out by Precast Concrete Surveillance Officers who are authorised signatories employed by organisations holding inspection accreditation with the National Association of Testing Authorities, Australia (NATA). Accreditation shall be to AS/NZS ISO/IEC 17020 - *General Criteria for the Operation of Various Types of Bodies Performing Inspection*³, for surveillance of precast concrete, in accordance with the accreditation criteria in this Guide.

The criteria for accreditation of Precast Concrete Surveillance Officers and companies offering these surveillance services are stated in Appendix A.

Under VicRoads specifications, the Superintendent reserves the right to undertake independent audit and surveillance activities, notwithstanding the fact that a Precast Concrete Surveillance Officer may be deployed on the works.

3.1 The Role of VicRoads in Precast Concrete Manufacture

A VicRoads officer is normally appointed as the Superintendent of VicRoads awarded contracts. The Superintendent may arrange surveillance and audits to verify the effectiveness of the Contractor's Quality System and compliance with the management plans and procedures.

3.2 The Role of the Contractor

Contractors have the responsibility for the conduct of regular surveillance and audit of all on-site and off-site sub-contractors. Contractors are responsible for establishing, undertaking and continuing control and process checks to ensure the specified criteria for precast concrete are met.

Where manufacture of precast concrete units is carried out as a sub-contract, the Contractor shall conduct surveillance of the sub-contracted works utilising the services of a Precast Concrete Surveillance Officer. It is the responsibility of the Contractor to procure the services of a Precast Concrete Surveillance Officer to undertake surveillance of sub-contracted precast concrete manufacture works. A specific aspect of the Contractor's Quality Plan should cover the surveillance of sub-contracted manufacture of precast concrete units. The Precast Concrete Sub-contractor shall prepare a separate Quality Plan covering processes associated with the manufacture of precast concrete units. It is essential that the Precast Concrete Sub-contractor's Quality Plan is reviewed by the Contractor.

The Contractor must monitor the performance of the Sub-contractor by surveillance of the manufacture of precast concrete units to obtain assurance that the Sub-contractor complies with the quality system and meets the specified quality criteria.

3.3 The Role of the Precast Concrete Surveillance Officer

The Precast Concrete Surveillance Officer acts on behalf of the Contractor and carries out surveillance of sub-contracted, precast concrete unit manufacture.

The Precast Concrete Surveillance Officer verifies the implementation of the Precast Concrete Sub-contractor's Quality Plan, the conduct of the manufacturing processes and verification of specified requirements for manufacture of precast concrete units during the contract delivery process. The general role of surveillance officers in Contract Delivery is described in the Austroads Guide.

Where specifications nominate 'Hold Points' during the course of a contract, these can only be released by the Precast Concrete Surveillance Officer.

4.1 General

In a manufacture process for precast concrete, the activities undertaken by the Contractor and the Precast Concrete Surveillance Officer involve the following:

- Preparation of Contractor's Quality Plan (Contractor activity)
- Review of the Precast Concrete Sub-contractor's Quality Plan (Contractor activity)
- Pre-construction activities (Contractor & Surveillance Officer activity)
- Field surveillance activities (Surveillance Officer activity)

4.2 Quality Plans

Under AS/NZS ISO 9001:2000⁴ *"The organization shall establish, document, implement and maintain a quality management system and continually improve its effectiveness in accordance with the requirements of this International Standard.*

The organization shall:

- (a) identify the processes needed for the quality management system and their application throughout the organization,*
- (b) determine the sequence and interaction of these processes,*
- (c) determine criteria and methods needed to ensure that both the operation and control of these processes are effective,*
- (d) ensure the availability of resources and information necessary to support the operation and monitoring of these processes,*
- (e) monitor measure and analyse these processes, and*
- (f) implement actions necessary to achieve planned results and continual improvement of these processes.*

Where an organization chooses to outsource any process that affects product conformity with requirements, the organization shall ensure control over such processes. Control of such outsourced processes shall be identified within the quality management system.

The organization shall plan and carry out production and service provision under controlled conditions".

To demonstrate compliance with AS/NZS ISO 9001:2000 both the Contractor and Precast Concrete Sub-contractor normally prepare a Quality Plan for each job, which becomes the basis for surveillance and technical audit. The Quality Plan covering processes associated with precast concrete unit manufacture is generally prepared and owned by the Precast Concrete Sub-contractor and is reviewed by the Contractor.

For precast concrete unit manufacture, the Quality Plan covering processes for each job shall:

- Be site or contract specific
- Describe the processes and reference the standards for precasting that the Contractor will follow to achieve the agreed standard of work

- Specifically describe the areas of responsibility and accountability of the Contractor's personnel
- Provide details of materials such as reinforcing and prestressing steel, concrete, connectors, hold-downs, moulds, etc. and names of suppliers
- Provide details of manufacturing processes and procedures
- Provide details of any sub-contractors to be used and their responsibility in the process
- List the quality records to be kept which provide evidence of compliance
- Provide inspection and testing plans and checklists for materials and processes
- Provide for identification of non-conformances and methods to deal with them
- Contain or refer to other relevant documents such as the Contractor's Quality Manual and Operating Procedures Manual
- Provide certificates of material performance and outline process for traceability and identification.

When used during the manufacturing process, the above documents collect information which demonstrate that the Quality Plan has been followed.

4.3 Surveillance Checklists

When surveillance of precast concrete is conducted, surveillance checklists should be used to ensure all relevant items are covered. Appendix B contains checklists based on the system elements of AS/NZS ISO 3834, Part 3 Standard Quality Requirements. The checklists in Appendix B are considered a minimum standard and shall be supplemented to include items specific to the particular contract.

4.4 Surveillance Processes

The Precast Concrete Surveillance Officer conducts surveillance of the Precast Concrete Sub-contractor's processes by observing each process, at a frequency determined by the surveillance schedule. Verification should be made that the details of the process have been carried out in accordance with the written instructions and that the specified requirements have been achieved. The use of checklists is recommended. Reporting of the results of surveillance should be made to the contract party that is one level above that which is being surveilled.

Pre-Manufacture activities, field surveillance activities and reporting are described in Sections 5, 6 and 7 of this Guide, respectively.

5.1 Introduction

This section describes activities that the Precast Concrete Surveillance Officer shall carry out prior to commencement of manufacture of precast concrete units. These activities are covered generally in Section 6 of the Austroads Guide.

5.2 Contract Quality Plan

The Quality Plan will detail requirements for the activities to be carried out by the Precast Concrete Surveillance Officer. These requirements will cover, for example, the conduct of communications between parties, a process for reporting and resolution of non-conformances, maintenance of diary records, etc.

Steps	Actions
1	Review the contents of the project Contract Quality Plan to understand what is required
2	Identify and become familiar with all the requirements of the contract procedures that relate to the duties of a Precast Concrete Surveillance Officer

5.3 Surveillance Documentation and Reporting System

The Precast Concrete Surveillance Officer shall use a secure system for reporting and storing information collected during the course of the surveillance. Each surveillance shall have a unique identification code.

Steps	Actions
1	Establish an appropriate system for storing information and reports

5.4 Contract Documentation (Contract Quality Plan, Drawings, Specification)

The Precast Concrete Surveillance Officer must have a thorough understanding of all relevant documentation applicable to precast concrete. This documentation includes:

- Contractor's Quality Plan relating to precast concrete
- Quality Plan from Precast Concrete Sub-contractor
- Drawings and specification for the precast concrete units
- Relevant standards and guidelines

Steps	Actions
1	Obtain all documentation related to precast concrete
2	Review documentation to obtain an understanding of technical and specification requirements

5.5 Manufacturing Processes

The Precast Concrete Surveillance Officer must be familiar with the processes related to precast concrete manufacture and subsequent transport and onsite works, particularly for processes where the results of quality cannot be verified by subsequent inspection and testing of the product and where, for example, processing deficiencies may become apparent only after the product is in use. The sequence and interaction of these processes shall also be determined. For precast concrete, such processes may include the placement of sacrificial formers, welding, installation of hold-downs, stressing, placement of concrete and curing.

Steps	Actions
1	Identify any processes
2	Identify the particular requirements for assessment of the process, for example: <ul style="list-style-type: none"> • Verifying the process in production or as a procedure test • Sighting evidence provided by the precast concrete contractor



Figures 5.1 *Surveillance checklists will include observation of lifting and storage methods, such as the storage of completed beams, pictured here in the casting yard.*

6.1 Introduction

This section describes the activities the Precast Concrete Surveillance Officer may carry out during manufacture of precast concrete units. Some of these activities are covered generally in Section 7 of the Austroads Guide.

6.2 Surveillance Schedule

The Precast Concrete Surveillance Officer shall develop a surveillance schedule for the approval of the Contractor. This schedule should be based on the risk of specific aspects of the process and requirements of the specification.

Surveillance frequency should be higher in the early stages of manufacture. An initial surveillance is required at the commencement of the contract to assess compliance with supervision, qualification of personnel and procedures, material supply and inspection requirements. As manufacturing procedures are observed to be in place and delivering the required product quality, the frequency of surveillance may be reduced. However, both the frequency and duration of surveillance should be increased where non-conformances arise which are detrimental to product quality or the potential service life, or both of these aspects.

The Precast Concrete Surveillance Officer attends the Precast Concrete Sub-contractor's works or worksite in accordance with the surveillance schedule.

Surveillance near contract completion is required to assess compliance with inspection and testing, and resolution of non-conformances.

Surveillance is required to observe critical production activities, including measurement of dimensions of moulds, placement of reinforcement, prestressing, manufacture and placing of concrete, curing, transfer of prestress, lifting of units, measurement of final dimensions and shape, and storage and delivery of units.

Steps	Actions
1	Conduct surveillance at intervals to cover contract start-up, completion and any intermediate stages
2	Witness specific activities as required by the schedule

6.3 Surveillance Record

Surveillance by the Precast Concrete Surveillance Officer shall be recorded on checklists and Surveillance Record and Report Forms.

Other activities and important site events during the contract are also to be recorded to provide an accurate account of events and resources observed during surveillance. Photographic and video methods may be used to record progress of the works and significant events or products.

Steps	Actions
1	Maintain a record of each surveillance <ul style="list-style-type: none"> • Completed after each surveillance • Legible and understandable by others • Relevant, comprehensive and unbiased

6.4 Sub-Contracting

In the manufacture of precast concrete, some activities are supplied by sub-contractors to the Precast Concrete Sub-contractor. The Precast Concrete Surveillance Officer should assess that the Precast Concrete Sub-contractor has evaluated and selected sub-contractors/suppliers on their ability to meet specified requirements, including quality.

Steps	Actions
1	Review Precast Concrete Sub-contractor's records of approval of sub-contractors and suppliers
2	Participate in surveillance of activities of sub-contractors and suppliers

6.5 Hold Points

Hold Points are identified from two sources:

- Those defined in the specification
- Those arising on the job when work does not comply with specifications and a Non-Conformance Report is raised

The three Hold Points defined in precast concreting contracts are:

- VicRoads Standard Specification 610 – Structural Concrete, 610.7:
Concrete may not be placed until mix design has been reviewed by the Superintendent
- VicRoads Standard Specification 610 – Structural Concrete, 610.8:
Concrete may not be placed until forms, reinforcement and embedments have been reviewed by the Precast Concrete Surveillance Officer as conforming to specifications
- VicRoads Standard Specification 622 – Pre-Tensioning of Concrete Units, 622.06:
All stressing operations shall take place in the presence of the Precast Concrete Surveillance Officer

The Precast Concrete Surveillance Officer shall be present to witness and release 'Hold Points' nominated in the specification. Review of the concrete mix design remains the responsibility of the Superintendent.

Steps	Actions
1	Become familiar with the requirements of the defined Hold Points
2	If the Hold Point is not released: <ul style="list-style-type: none"> • Thoroughly document the reasons for non-release • Formally advise the Contractor

6.6 Non-Conformance

The Precast Concrete Sub-contractor shall raise non-conformance reports when work is not in accordance with the specification or drawings.

If the Precast Concrete Surveillance Officer discovers a non-conformance, this shall be raised as a non-conformance with the Contractor. The Contractor will then deal with the issue in accordance with the contract.

Steps	Actions
1	Raise any non-conformance with the Contractor, to allow the issue to be dealt with in accordance with the Contractor's quality
2	When required, comment on the practicality of the disposition and actions to prevent recurrence
3	Conduct surveillance to verify that the agreed disposition has occurred prior to close-out of the Non-Conformance Report
4	Complete the required record and documentation



Figure 6.1 *A Surveillance Officer must ascertain that specified testing is carried out, such as measuring elongation of tendons during stressing operations, pictured here*

Reporting of Surveillance

Surveillance reports shall include any requirements for the National Association for Testing Authorities Australia (NATA) endorsement of the report, as well as specific information resulting from the surveillance. Surveillance reports shall be made within two working days of conducting the surveillance.

The Precast Concrete Surveillance Officer shall make available to the Contractor and to VicRoads, at the request of the Superintendent, all relevant documentation collected during the course of the surveillance.

Appendix C of this document contains an example of a basic Surveillance Record and Report Form.

Steps	Actions
1	Report surveillance in accordance with the standard reporting requirements and any contract specific requirements. Include verification of activities, verification of inspections and any remedial action completed, and details of non-conformances and achievement of agreed dispositions
2	Issue surveillance reports within 2 working days of surveillance
3	Issue reports only to the Contractor and to the Superintendent upon request



Figure 7.1 *Surveillance reports may include photographs or comment on items such as formwork preparation ready for casting a bridge parapet.*

- 1 Austroads, *Quality Assurance in Contracts*, Sydney 1994, AP-115/94
- 2 Austroads, *Guide to Field Surveillance of Quality Assurance Contracts*, Sydney 1995, AP-38/95
- 3 Standards Australia, AS/NZS ISO/IEC 17020—*General Criteria for the Operation of Various Types of Bodies Performing Inspection*
- 4 Standards Australia, AS/NZS ISO 9001—*Quality Management Systems—Requirements*
- 5 Standards Australia, AS 1379—*Specification and Supply of Concrete, 1997*

- National Association of Australian State Road Authorities, 1969, *Duties and Responsibilities of Superintending Officers*, Vol II, Contract Bridgeworks
- National Association of Australian State Road Authorities, 1983, *Prestressed Concrete Inspection Practice*
- Standards Australia, AS 2159—1995, *Piling—Design and installation*
- Standards Australia, AS 2159 Supp 1—*Design and installation—Guidelines*
- Standards Australia, AS 3600—1994, *Concrete structures*
- Standards Australia, AS 3600 Supp 1—1994, *Concrete structures—Commentary*
- Standards Australia, AS 3850, *Tilt-up concrete and precast concrete elements for use in buildings*
- Standards Australia, HB 25—1992, *Australian building and construction definitions*
- Standards Australia, HB 64—1994, *Guide to concrete construction*
- Standards Australia, HB 67—1995, *Concrete practice on building sites*
- Standards Australia, HB 77.5—1996, *Concrete*
- Standards Australia, HB 77.5 Supp 1—1996, *Concrete—Commentary*
- VicRoads, GeoPave, Technical Bulletin No. 42 – *Curing of Concrete*
- VicRoads, Code of Practice RC 500.11, *Code of Practice for Surveillance of Testing Materials and Work*

Company Accreditation

All companies conducting surveillance of precast concrete shall hold inspection accreditation with the National Association of Testing Authorities, Australia (NATA). Accreditation shall be to AS/NZS ISO/IEC 17020 – *General Criteria for the Operation of Various Types of Bodies Performing Inspection*³, for surveillance of precast concrete, in accordance with this Guide.

Business Rules

Companies conducting surveillance of precast concrete shall have evidence of the following business information:

- Australian Business Number
- WorkCover Employe Registration Number
- Details of Public Liability and Professional Indemnity Insurance as specified in the primary VicRoads contract.

Personnel Qualifications

In addition to the general requirements specified by NATA, personnel shall meet the following requirements for qualifications and experience before gaining inspection accreditation as an authorized signatory for precast concrete surveillance:

1. Attendance at a two-day course on surveillance of construction works, conducted by a recognised training authority
2. Attendance at a two-day course in auditing or quality management principles, conducted by a recognised quality training organisation
3. Completion of a trade certificate in a relevant industrial field such as carpentry or boiler-making, or a relevant certificate of technology (or equivalent) from a recognised technical institution

Documented evidence of qualifications and courses shall be provided at the initial assessment by NATA. Accredited companies shall retain copies of this documentation for verification at subsequent re-assessments by NATA or at subsequent audits.

Personnel Experience

All personnel conducting surveillance of precast concrete shall meet the following experience requirements:

- Sound and demonstrated knowledge of relevant material standards, application codes, specifications, production procedures and work standards, including the application and use of AS1379⁵
- Demonstrated competence to read and understand contract and shop drawings, material compliance certificates, mechanical testing reports, calibration reports, inspection and test reports, including the assessment of compliance of these documents with specification criteria.

- Ability to prepare surveillance reports
- Participation in at least three surveillance visits as a trainee surveillance officer, under the mentorship of a person trained in quality auditing and experienced in the manufacture of precast and prestressed concrete units, prior to gaining NATA signatory status.
- Practical experience in the inspection of or production and erection of structural works which should include:
 - Manufacture of precast concrete units
 - Manufacture of prestressed concrete units
 - Manufacture of concrete

Referee persons, such as a principal of the surveillance company or of the Contractor's company, shall independently verify experience by signing experience statements at the appropriate entries.

Resources, Records and Reports

The accredited surveillance company shall establish and maintain a surveillance record and reporting system. All personnel conducting surveillance of precast concrete shall use the surveillance reporting system established by the accredited surveillance company. Surveillance reports shall be issued to the Contractor within two working days of the surveillance. Security and confidentiality of records and reports shall be maintained. Records and reports shall be held for three years after expiry of the contract defects liability period.

Surveillance reports shall comply with the requirements of the NATA accreditation.

Ethics and Independence

All surveillance companies and personnel conducting surveillance of precast concrete shall:

- Exercise their professional and technical skills and judgement to the best of their ability and discharge their professional and technical responsibilities with honesty, integrity and thoroughness
- Accurately and impartially record and report surveillance findings without the influence of any internal or external pressures or considerations
- Disclose to the Contractor any commercial or other relationships they may have, or have had, with organisations to be assessed or related organisations or competitors
- Ensure that they do not disclose their surveillance findings, or any part of their findings, to any third party other than VicRoads

1&2 Checklist for DOCUMENTATION

Item	Requirements and Reference	Comments	Evidence
1.0	QUALITY SYSTEM		
1.1	Does the Precast Concrete Sub-contractor have a Quality System, as evidenced by a Quality Manual?		
1.2	Is the Quality System accredited to: AS/NZS ISO 9001? Certifying body is: Certificate number: Date of original certification: Date of latest continuation audit:		
1.3	Does a Quality Plan or Inspection & Test Plan from the Precast Concrete Sub-contractor exist?		
1.4	Is there a schedule of internal quality audits? Do records exist for these audits?		
1.5	Are non-conformances listed in a register?		
1.6	Are non-conformances and corrective actions raised and closed out?		
2.0	CONTRACT DOCUMENTATION		
2.1	Is the Precast Concrete Contractor using the latest approved drawings and specifications? What is the revision status of the drawings?		

Appendix B

Checklists for Surveillance of Precast Concrete Contracts

3 Checklist for STRUCTURAL CONCRETE

Item	Requirements	Comments	Evidence
3.1	<p>Concrete Mix Design Has the concrete mix design been reviewed by the Superintendent? Check the following are in accordance with the reviewed mix:</p> <ul style="list-style-type: none"> - Source type and proportions of constituent materials - Aggregates - Chemical admixtures - Nominated slump and where a superplasticizer is used, the final slump - Water supply - Maximum water content and maximum water/cementitious material ratio <p>Are soluble salts, VPV (volume of permeable voids), drying shrinkage and strength within tolerance of contract specifications? Are required testing procedures in place?</p>	<p><i>HOLD POINT</i> <i>Concrete shall not be placed until the mix design has been reviewed by the Superintendent</i> Mix designs found not to be in compliance with the contract, or changes to the mix design require approval of the Superintendent</p>	
3.2	<p>Aggregates Are aggregate stockpiles well labelled at the concrete batch plant? Are aggregates tested at the frequency specified?</p>		
3.3	<p>Chemical Admixtures Are all admixtures used in accordance with the reviewed mix design? If air entraining admixture is used, is on-site testing undertaken in accordance with AS 1012 and AS 1379? Does air content exceed 5%?</p>	<p><i>Air entraining admixtures shall not be used unless approved by the Superintendent</i></p>	
3.4	<p>Manufacture & Delivery of Premixed Concrete Do the manufacture and delivery procedures match contract requirements? Did mixing occur within the temperature range of 5 to 35°C? Does the batch identification certificate include:</p> <ul style="list-style-type: none"> · Total water in the batch? Including: <ul style="list-style-type: none"> - Water in aggregates - Batch water - Water added at the slump stand - Total amount of water permitted to be added on site - Water added on site before commencement of discharge · Cement brand and type? <ul style="list-style-type: none"> - Proportions of components? - Total mass of cement? · Chemical admixtures? <ul style="list-style-type: none"> - Types? - Brand? · Slumps <ul style="list-style-type: none"> - Nominated slump? - Estimated slump? - Measured slump? <p>Manufacture & Delivery of Premixed Concrete Is the use of water controlled satisfactorily? - Is the moisture content of both fine and coarse aggregate determined on a regular basis? - Is this allowed for in the total water added in the concrete? - Is the addition of water by drivers at the slump stand (at the mixing plant) under control and recorded on the delivery docket? If water is added on site, is that undertaken using a calibrated measuring device? Prior to discharge of concrete, is the agitator operated at mixing speed for a minimum of 1 minute? Is the discharge of concrete on site completed within 1 hour of mixing?</p>		
3.5	<p>Incoming Raw Materials at Mixing Plant Is the receiving of incoming goods handled in a satisfactory manner? Are test results for raw materials available for review?</p>		

Item	Requirements	Comments	Evidence
3.6	<p>Cement Silos at Mixing Plant Are all intake pipes well marked to enable identification of the various types of cementitious materials?</p>		
3.7	<p>Calibration of Equipment at Mixing Plant Is the following equipment adequately calibrated? - Aggregate scales? - Cement scales? - Admixture dispensers? - Batch water meter? - Slump stand water meter?</p>		
3.8	<p>Standby Mixing Plant Is an alternative supply of equivalent concrete mix available in case of emergency?</p>		
3.9	<p>Traceability Are all concrete batches traceable by unique identification number?</p>		
3.10	<p>Control, Sampling and Testing Are all correct testing and sampling procedures being carried out at the frequency specified? Has the contractor implemented a site sampling procedure to assure concrete quality? When a superplasticiser is added, is a slump measurement undertaken both before and after the addition of a superplasticiser? Is slump checked and recorded: - within 30 minutes of adding cement to the aggregate? - Immediately prior to discharge when actual haul time exceeds 30 minutes? - And/or when water is added to the mixed batch? Has each batch been visually inspected to ensure consistency and estimated slump recorded on identification certificate? Have the correct number of sample cylinders been collected and labelled? Are the correct methods and schedules for testing cylinders and/or concrete cores in place for: - Compressive strength? - VPV (volume of permeable voids)? - Curing procedure? - Acceptance criteria? Have any concrete requirements deviated from the specification requirements? If so, has a non-conformance been raised? - Is additional compressive strength testing done? - Is additional VPV testing done? - Cylinders for fresh concrete? - Concrete cores for hardened concrete? If the additional testing is not satisfactory, has the contractor proposed to undertake suitable improvement measures as required by the Superintendent?</p>		
3.11	<p>Temperature and Evaporation Limits Are correct precautions in place to protect the concrete for extreme temperature, humidity, wind or rain conditions? Such as: - Minimising evaporative moisture loss - Keeping steelwork cool - Application of evaporative retarding compound</p>		

Item	Requirements	Comments	Evidence
3.12	<p>Placing and Compacting Concrete</p> <p>Was the temperature of concrete prior to placement in the range of 10 to 32°C?</p> <p>Did placement occur within the ambient temperature range of 5 to 35°C?</p> <p>Is a system in place to ensure:</p> <ul style="list-style-type: none"> - No concrete is dropped freely from a height exceeding 2 metres - Concrete is not moved horizontally using a vibrator - Knitting in of fresh concrete into previously placed concrete so that no cold joints develop - Filling of every part of the form? - No displacement of reinforcing and voids? - Coarse aggregate is worked back from the face? - Air bubbles and voids are removed? <p>Are vibrators in place of adequate:</p> <ul style="list-style-type: none"> - Size? - Number? - Frequency? <p>Is vibration applied to the full depth of each layer and extended into the top 100 mm of the underlying layer?</p> <p>Are vibrators inserted vertically into the concrete?</p> <p>Are vibrators allowed to rest on the steel reinforcement?</p>	<p><i>HOLD POINT</i></p> <p><i>Concrete shall not be placed until the Precast Concrete Surveillance Officer has reviewed evidence that the forms, reinforcement and embedments conform to the required specifications and drawings</i></p>	
3.13	<p>Casting Sequence</p> <p>Is a casting sequence specified in the drawings?</p> <p>Have 7 days elapsed between castings?</p>		
3.14	<p>Construction Joints and Bonding of New Concrete</p> <ul style="list-style-type: none"> - Do the locations and details of construction joints comply with the drawings? - Has the existing concrete been roughened up to remove all laitance and sufficient mortar to expose the coarse aggregate to a depth of 3 mm? 		
3.15	<p>Insertions and Greased Joints</p> <p>Have abutting surfaces been separated by grease, coating, insertions of bituminous impregnated felt or fibreboard as shown on the drawings?</p>		
3.16	<p>Temperature Differential Limit Across Any Element</p> <ul style="list-style-type: none"> - Has the temperature differential been checked to ensure it does not exceed 20°C? - Have special precautions been considered if the 20°C is likely to be exceeded? 		
3.17	<p>Curing</p> <p>Have proposed methods of curing been reviewed?</p> <p>Have specified requirements been satisfied for:</p> <ul style="list-style-type: none"> - Water curing, methods and timing of curing (eg, spraying, ponding, wet hessian or sand blankets)? - Curing compound to AS 3799 and specification? - Polyethylene sheet? - Steam curing? <p>Where a curing compound is used, is it applied with a pressurised sprayer and at the specified rate?</p> <p>Is the specified rate checked in accordance with specs?</p> <p>Is the curing compound applied in two coats?</p>		

Item	Requirements	Comments	Evidence
3.18	<p>Steam Curing</p> <p>Does proposed steam curing cycle meet specifications?</p> <p>Are steam covers placed correctly?</p> <p>Are adequate temperature controls in place?</p> <ul style="list-style-type: none"> - Have the initial maturity requirements, prior to steam application, been satisfied? - Does the steam temperature rise exceed 24°C/hr? - Is the temperature rise exceeding 6°C/hr in any 15 minute period? - Is the maximum temperature within the range of 75°C plus or minus 5°C? - Prior to removal of steam covers has temperature fallen to within 30°C of the ambient temperature? - Does rate of loss of temperature under the covers after shutting off the steam exceed 30°C/hr? - Is temperature under the covers uniform such that the difference in temperature between any two points does not exceed 10°C? <p>Are recording thermometers calibrated?</p> <p>Do temperature charts show:</p> <ul style="list-style-type: none"> - Date cure commenced? - Unique identification and description of item? - Temperature correction? - Time correction? - Batching of concrete? - Temperature of concrete when placed? - Ambient temperature when covers are removed? - Name of contractor or manufacturer? <p>Have correct number of testing cylinders been placed for specified steam curing?</p> <p>Have the test cylinders been placed correctly?</p> <p>If partial steam curing is adopted, does subsequent passive curing continue for a minimum of 7 days from time of finishing the concrete, in accordance with specification?</p> <p>Does subsequent passive curing commence within a half hour of cessation of steam curing?</p> <p>Has sufficient compressive strength been achieved prior to lifting out of the moulds to end partial steam curing?</p>		
3.19	<p>Radiant Heat Curing</p> <p>Does proposed radiant heat curing cycle meet specification requirements?</p> <p>**Are the requirements of Item No. 1.18 (Steam Curing) satisfied for radiant heat curing?</p> <p>Is the top surface of the finished concrete kept moist throughout the radiant heat curing cycle?</p> <p>Does the hot water temperature exceed 75°C?</p> <p>Is the temperature difference between ingoing and outgoing water less than 10°C?</p> <p>Does the temperature difference between the cylinder box and the rest of the hot water heating system exceed 10°C?</p> <p>Is the radiant heat curing regime applied until at least the 7 day compressive strength is obtained?</p>	<p>**Except that reference to steam is replaced by the application of hot water</p>	
3.20	<p>Cracking of Concrete</p> <p>Have crack widths greater than 0.10 mm been identified as a non-conformance?</p> <p>If so, has the contractor submitted a preventative and/or remedial measure/procedure for approval?</p>		
3.21	<p>Removal of Formwork</p> <p>Has the specified time period elapsed before removal of formwork?</p>		
3.22	<p>Surface Finish</p> <p>Does the surface finish meet that specified in the contract?</p>		
3.23	<p>Tolerances</p> <p>Do tolerances deviate from those specified in the drawings such as:</p> <ul style="list-style-type: none"> - Placing of reinforcement? - Concrete cover? - Hog (for pre-tensioned concrete)? - Bow (for pre-tensioned concrete)? - Squareness of ends? - Length or diagonal lengths, etc.? 		
3.24	<p>Concrete Repairs</p> <p>Are approved repair procedures for cracked, spalled, honeycombed, etc., concrete in place?</p> <p>Are repair materials approved?</p>		

4 Checklist for STEEL REINFORCEMENT

Item	Requirements	Comments	Evidence
4.1	<p>Standards Does all reinforcement supplied comply with the relevant Australian Standards as required by the contract specifications?</p>		
4.2	<p>Reinforcement Supply Is there a schedule for supply of reinforcement in the contract? Was reinforcement supplied: - Cut to length? - Bent to shape? - Free from millscale? - Free from thick rust or other coating?</p>		
4.3	<p>Testing Has steel reinforcement been tested for conformity with the specified requirements in accordance with the relevant Australian Standards, by a NATA accredited laboratory? Has at least one sample of each size been tested for each bar to be used?</p>		
4.4	<p>Bending Do all hooks and bends conform only to those on the drawings? If re-bending is required on site, is there an approved procedure in place?</p>		
4.5	<p>Identification Is all reinforcement bundled and tagged for identification?</p>		
4.6	<p>Handling and Storage Is reinforcement stored free of loose or thick rust, oil, grease, tar, paint, mud or any other deleterious substance?</p>		
4.7	<p>Placing Are minimum specified concrete cover requirements met for all steelwork? Does tie wire have the minimum concrete cover specified? Is all reinforcement secured from displacement during placing and compacting of concrete? Is placed reinforcement free of mortar, oil, dirt, loose mill scale, heavy rust, grease, paint or any other coating which may reduce or destroy the bond between the reinforcement and concrete?</p>		
4.8	<p>Splicing Was any splicing carried out and if so, was it within the specifications of the drawings?</p>		
4.9	<p>Projecting Reinforcement Has there been any damage to any protruding steel reinforcement?</p>		

5 Checklist for FORMWORK

Item	Requirements	Comments	Evedence
5.1	<p>Formwork Design</p> <p>Is the formwork constructed to produce the dimensions specified in the drawings particularly:</p> <ul style="list-style-type: none"> - Formwork joints? - Sealing procedures? - Ties? - Size and spacing of framework? - Any proprietary fittings or systems required? 		
5.2	<p>Formwork Materials</p> <p>Is the formwork constructed from steel?</p>		
5.3	<p>Formwork Construction</p> <p>Confirm:</p> <ul style="list-style-type: none"> - All reinforcement and other fixtures specified in the drawings can be inspected - There are no protrusions into the surface of the concrete (such as bolts or wires) other than those specified in the drawings - Any embedded ties remain embedded with specified concrete cover - All recesses are filled with a shrinkage compensating mortar or are filled according to surface specifications - Any defects or non-conformances have been rectified before concrete is placed 		
5.4	<p>Removal of Formwork</p> <p>Check that removal of formwork adheres to the schedule specified in the contract</p>		
5.5	<p>Void Formers</p> <p>Are void formers of a quality able to prevent ingress of concrete slurry, and rigid enough to withstand placing and compaction of concrete without damage or deformation?</p> <p>Check all void formers are securely restrained in position during placement of concrete, to resist any buoyancy effect or lateral pressure</p> <p>Check any restraining is secured by external means and not by securing the void formers to the steel reinforcement</p>		

6 Checklist for BOX CULVERTS

Item	Requirements	Comments	Evidence
6.1	<p>Dimensional Tolerances Are all specified tolerances met in relation to:</p> <ul style="list-style-type: none"> - Internal and external dimensions? - Thickness? - Length? - Straightness? - Squareness? - Ends? - Sections? 		
6.2	<p>Provision for Lifting Are lifting procedures according to specifications and drawings in regard to:</p> <ul style="list-style-type: none"> - Inverts? - Lids? - Crown and base? - Lifting loops? 		
6.3	<p>Work Standard and Finish Does the surface meet specified finish? Are all dents and bulges within specified tolerance?</p>		
6.4	<p>Identification Does each unit have identification of:</p> <ul style="list-style-type: none"> - Nominal dimensions? - Date of manufacture? - Name of contractor and trade mark if applicable? - Locality of supplying factory? - Maximum mass? 		
6.5	<p>Testing at the Manufacturer's Works Are units correctly batch allocated?</p>		
6.6	<p>Proof Load Test Have the specified proof-loading tests been carried out? Has the testing equipment been calibrated?</p>		
6.7	<p>Transport and Storage on Site Are inverts and crowns stored in stacks of identical units up to 2 metres high or 2 units, whichever is higher and separated by timber packers? Are lids or base slabs stored in stacks of identical units up to a maximum of 6 units, separated by timber packers?</p>		

7 Checklist for PRECAST CONCRETE UNITS

Item	Requirements	Comments	Evidence
7.1	<p>Forms</p> <p>Does the formwork meet all the dimensional and finish specifications of the drawings? Are void formers adequately secured? Check no wires or bolts will extend into the surface of the concrete other than those specified in the drawings Check all embedded ties will remain embedded with the specified concrete cover</p>		
7.2	<p>Removal of Units from Forms</p> <p>Have units complied with specified compressive strength to permit removal from forms?</p>		
7.3	<p>Projecting Reinforcement</p> <p>Has protruding steel reinforcement been damaged or dislodged during curing process? Are the continuity bars within 3mm of the positions specified on the drawings?</p>		
7.4	<p>Sole Plates and Bearing Retainers</p> <p>Do the following comply with contract specifications: - Grade of steel for sole plates and bearing retainers? - Welding? - Galvanising? Are sole plates set at the correct angles?</p>		
7.5	<p>Markings</p> <p>Is the identification number and date of casting marked on every unit? <i>Piles</i> Are piles marked and numbered at 500 mm increments?</p>		
7.6	<p>Handling and Storage</p> <p>Check handling and storage is carried out in accordance with specifications Are units to be lifted and supported with top surface uppermost? Are bearers on a firm foundation with precautions to prevent movement? Are units supported on bearers clear of the ground? Are bearers placed beneath their specified lifting points, clear of any sole plates? Are beams laterally supported?</p>	<p>Where method of handling and storage is not specified, the contractor shall submit for review by the Precast Concrete Surveillance Officer, details of proposals, 14 days prior to lifting and supporting the units</p>	
7.7	<p>Transporting</p> <p>Will the units be transported after the minimum after-casting time requirements of the contract have elapsed? Is bracing, or top flange bracing required during transport? Ascertain that no bow will occur during transport in excess of 1 in 400 of the length or 75 mm, whichever is less and steps shall be taken to ensure integrity of the bow tolerance throughout the journey</p>		
7.8	<p>Traceability of Precast Concrete Units</p> <p>Do all units have a unique identification number to allow tracing from completion of manufacture to their final location?</p>		

8 Checklist for PRETENSIONING CONCRETE UNITS

Item	Requirements	Comments	Evidence
8.1	<p>Supply of Tendons</p> <p>Do the steel wires or strands comply with those specified in the contract?</p> <p>Have the Certificate of Compliance of Australian Standards and related test certificates and load extension graphs been provided for each coil of wire or strand?</p> <p>Does strand comply with specified relaxation requirements?</p> <p>Have samples, identified by the coil number, been tested by a NATA accredited laboratory?</p> <p>Are the coils of wire or strands of sufficient diameter to remain straight when unwound?</p> <p>Is there any evidence of damage such as kinks, bends, etc?</p> <p>Is there more than light surface rust or pitting?</p> <p>Has wire been kept free from loose rust, oil, grease, tar, paint, mud or any other deleterious substance?</p>		
8.2	<p>Traceability of Materials</p> <p>Is all wire or strand labelled as specified in AS1310 and AS 1311?</p> <p>Can all individual lengths of wire or strand be traced from the point of manufacture to their final location, by a unique identification number?</p> <p>Will the final pre-tensioned concrete units be traceable from the point of manufacture to their final location, by a unique identification number?</p>		
8.3	<p>Placing Tendons</p> <p>When tendons are placed, are they kept free of contact with oiled surfaces of the form?</p>		
8.4	<p>Stressing Precautions</p> <p>Is sufficient care being taken to ensure the safety of all persons in the vicinity, during tensioning?</p> <p>Are heavy barriers provided?</p> <p>Are warning signs of adequate letter size?</p>		
8.5	<p>Tensioning</p> <p>Are calibration certificates for the jack and pressure gauges, or other force measuring devices available for review, and have they been calibrated as a single operating unit?</p> <p>Are qualified personnel performing the tensioning operation?</p> <p>Does the measuring equipment allow sufficient accuracy of measurement as required by AS 2193?</p> <p>Does sag take-up force exceed 20% of tendon force, or is it less than 10% of tendon force or 10% of gauge pressure?</p> <p>Is anchorage sufficient to prevent slippage/deflection?</p> <p>Is concrete to be cast within 24 hours of tensioning?</p> <p>Is any variation of force within -2% to +2% of the force specified in the drawing?</p> <p>Have methods of tensioning and stressing calculations been submitted to the designer for review, including:</p> <ul style="list-style-type: none"> - Arrangement and layout of each strand? - Calculation of forces at anchorage and all deflection points? - Estimated friction losses? <p>Has evidence of the review by the Designer been given to the Superintendent?</p> <p>Does the method of tensioning ensure the required force is produced in all tendons and at the middle of all units?</p> <p>Has the jacking force been recorded and checked?</p> <p>Has the required elongation been adjusted in the case that the modulus of elasticity of the batch varies by more than 3%?</p>		

Item	Requirements	Comments	Evidence
8.5 cont.	<p>Tensioning (cont.) Has the tensioning force stated on the calibration certificate varied from the actual elongation measurement by more than 4%? If so, has the stressing equipment been re-calibrated or the wire or strand re-tested? Are tendons marked at both the jacking and the dead end for:</p> <ul style="list-style-type: none"> - Measurement of elongation? - Observation of any slippage? <p>Has any slippage occurred requiring appropriate retensioning of the tendons?</p>		
8.6	<p>Failure of Tendons Has any tendon failed during the curing process?</p>		
8.7	<p>Transfer of Prestress Has the concrete met the minimum strength required for transfer of the prestressing forces as specified in the drawings? Have all tendons been marked to enable checking of the amount of pull-in and testing for tightness? Do tendons require application of heat for stress release? If so, are the following according to specifications:</p> <ul style="list-style-type: none"> - The order of severance of tendons? - Release of straining devices? - Method of applying heat? <p>Has the maximum pull-in of tendons been measured to be less than 6 mm at any end?</p>	<p>The contractor shall submit to the Precast Concrete Surveillance Officer for review, the details of proposed method of transfer of prestress, not less than 14 days prior to commencement of tensioning</p>	
8.8	<p>Data to be Recorded Has the following data been recorded where applicable and forwarded to the Superintendent identification of unit prior to delivery of units to site</p> <ul style="list-style-type: none"> - Identification of unit - Identification number of each dynamometer, gauge, and jack with calibration certificates - Identification particulars of tendons, e.g., coil number and manufacturer - Sag take-up forces (or pressures) when tendons are marked for measurement of elongation - Tendon forces (or pressures) and elongations obtained on completion of tensioning prior to lock-off - Elongations remaining after release of jacks - Elongations obtained at intervals during tensioning, together with corresponding forces (or pressure gauge readings), as required by the Superintendent - Recorded pull-in - Concrete compressive strength at time of transfer of prestress steam curing charts - Measurement of hog at time of transfer of prestress and at later ages as specified on the drawings 		
8.9	<p>Protection of Exposed Ends Have ends of prestressing wires or strands been cleaned of any deleterious material and coated with a minimum of 6 mm clear epoxy?</p>		
8.10	<p>Protection of Tendon Hold-Downs Have tendon hold-downs been protected from corrosion in the manner specified in the contract?</p>		

Appendix C

Sample Surveillance Record and Report Form

Contractor	<input type="text"/>	Surveillance No	<input type="text"/>
Sub-Contractor/Supplier	<input type="text"/>		
Contract No.	<input type="text"/>		
Job/Product	<input type="text"/>		
Surveillance Officer	<input type="text"/>	Date of Surveillance	<input type="text"/>
Job Engineer	<input type="text"/>		
Location of Surveillance	<input type="text"/>		
Procedures/Plans/ Tests Checked	<input type="text"/>		
Observations	<input type="text"/>		
Checklists Used	<input type="text"/>		
Number of Non-Conformances Observed	<input type="text"/>		
Details of Non-Conformances	<input type="text"/>		
Comments	<input type="text"/>		
Number of Non-Conformances Resolved	<input type="text"/>		
Date of Notification of Non-Conformance Resolutions	<input type="text"/>		
Disposition of Non-Conformances	<input type="text"/>		
Signature	<input type="text"/>	Date	<input type="text"/>

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