SECTION 930

CONCRETE – MATERIALS AND PRODUCTION

INDEX

930.01 SCOPE

This specification covers the Department's requirements for all materials used in the production of concrete structures, including precast concrete. This specification also covers concrete batching, delivery, placement and sampling and testing. All work, plant, equipment and materials shall be in strict accordance with CSA A23.1 and CSA A23.2, unless otherwise specified.

930.02 REFERENCES

Reference standards shall be the latest revision at the date of Tender closing. This specification refers to the following standards, specifications or publications:

- AASHTO M182 "Specification for Burlap Cloth made from Jute or Kenaf and Cotton Mats"
- ACI PRC-211.1 "Selecting Proportions for Normal-Density and High Density-Concrete Guide"
- ASTM C171 "Standard Specification for Sheet Materials for Curing Concrete"
- ASTM C260 "Standard Specification for Air-Entraining Admixtures for Concrete"
- ASTM C309 "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete"
- ASTM C403 "Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance"
- ASTM C457 "Standard Test Method for Microscopical Determination of parameters of the Air-Void System in Hardened Concrete"

- ASTM C494/C494M “Standard Specification for Chemical Admixtures for Concrete”
- ASTM C793 “Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants”
- ASTM C920 “Standard Specification for Elastomeric Joint Sealants”
- ASTM C1017/C1017M “Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete”
- ASTM C1202 “Standard Test Method for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration”
- CRD-C 661-06 “Specification for Antiwashout Admixtures for Concrete”
- CSA A23.1 “Concrete materials and methods of concrete construction”
- CSA A23.2 “Test methods and standard practices for concrete”
- CSA A23.3 “Design of concrete structures”
- CSA A23.4 “Precast concrete – Materials and construction”
- CSA A283 “Qualification code for concrete testing laboratories”
- CSA A3000 “Cementitious materials compendium”
- CSA S6 “Canadian Highway Bridge Design Code”

930.03 DEFINITIONS

Engineer of Record: The Professional Engineer who completed and sealed the design of the specific component or system.

High Performance Concrete (HPC): Concrete that meets performance requirements (increase strength and durability) that cannot always be achieved routinely by using conventional materials and normal placing and curing practices.

Infill Concrete: A body of concrete used to fill in an excavated area or void space with dimensions large enough (thickness > 1m) for which consideration is given to temperature rise caused by the hydration of cementing materials in order to keep cracking to a minimum.

Owner’s Representative: An applicable Government employee responsible for the project or any Third Party who has been authorized by the Department to conduct work on the Department’s behalf.

Professional Engineer: An individual who is registered and in good standing with PEGNL.

Supplementary Cementing Materials (SCM): Means material that, when used in conjunction with hydraulic cement, contributes to the properties of hardened concrete through hydraulic or pozzolanic activity or both.

Tremie Concrete: Concrete deposited underwater through a pipe or tube fitted with a hopper at its upper end.

930.04 MATERIALS

All materials used in the production of concrete shall conform to the referenced standards. All materials are subject to inspection, testing or rejection at any time and must be made available for sampling and testing prior to and at any point during the work at the request of the Owner's Representative to ensure compliance with this specification.

930.04.01 Cement

All cementing materials shall be in accordance with CSA A3000.

Cement for High Performance Concrete (HPC), exposure class C-XL and bridge components, exposure class C-1, shall be a blended Portland, silica fume, fly ash or slag, Type GUb F/SF or GUb S/SF.

The minimum proportion by mass of the total Supplementary Cementing Materials (SCM) for exposure classifications C-XL and C-1 shall contain silica fume from 5% to a maximum of 8%. The minimum proportion by mass of the total cementing materials for fly ash or slag is 15%. The total mass of SCM's should not exceed 30% of the total weight of cementitious material.

Cement for all other concrete shall be Portland cement Type GU or GUL, a portion of which may be replaced by fly ash or slag up to 25% by mass of the total cementing material. Blending a combination of both fly ash and slag for incorporation into the GU or GUL cement is not permitted.

930.04.02 Aggregates

The Contractor will determine the source of the fine and coarse aggregates but all aggregates shall be normal density.

Fine and coarse aggregate stockpiles shall be stored separately and constructed to prevent segregation and contamination and such that no equipment will be operated on the piles. Fine and coarse aggregates shall conform to the grading limits as specified in Table 10.0 and Table 11.0, respectively, of CSA A23.1.

The coarse and fine aggregate test data required to be submitted with the concrete mix design shall include but not be limited to:

- CSA A23.2-30A – Standard Practice for sampling, testing and inspection of aggregate products for use in concrete for qualification and acceptance purposes.
- Annex P – Impact of sulphides in aggregate on concrete behaviour and global approach to determine potential deleterious reactivity of sulphide bearing aggregates.

All submitted test results shall be from tests completed within one (1) calendar year of submission to the Department, apart from those modified below.

A satisfactory history of testing to demonstrate the aggregate does not have the potential for deleterious expansion due to alkali reactivity shall consist of at least five (5) consecutive passing tests performed in accordance with CSA A23.2-25A or CSA A23.2-26A and/or CSA A23.2-14A over a period not to exceed ten (10) years and not less than five (5) years. For exposure classes C-2, C-3 and F-1, if the aggregate does not meet this requirement, preventive measures shall be identified in accordance with CSA A23.2-27A and must provide evidence demonstrating effectiveness as per CSA A23.2-28A. Aggregates that are identified as potentially alkali reactive in accordance with CSA A23.2-27A shall not be permitted in C-XL or C-1 concrete mixes.

The maximum size of coarse aggregate to be used for the different thicknesses of concrete shall be 20 mm unless otherwise specified by the Department. In no case shall the maximum size of coarse aggregate used be greater than either, 2/3 the clear distance between the reinforcement or 2/3 the clear distance between the exterior bars and the face of the structure. With the exception of girders where the latter criteria shall be 0.8 times the clear distance between the exterior bars and the face of the structure.

The sources and test results of all aggregate materials shall be clearly identified. The aggregate tests shall be conducted by a laboratory CCIL Certified in accordance with CSA A283 to perform the aggregate tests. The aggregate properties shall be signed and stamped by the Engineer of Record. The Engineer of Record shall attest to the validity of the material test data.

930.04.03 Water

All water shall be clear and free from deleterious substances and shall be potable. Water of unknown quality shall not be used in concrete unless the requirements of CSA A23.1 Clause 4.2.2 and Table 9.0 are met. A declaration of potability or water quality testing as per CSA A23.1 Clause 4.2.2.4 must be submitted with the concrete mix design submission.

All water used for curing shall be a minimum temperature of 10 ºC and be clean, free of chlorides, oils, dirt, other deleterious materials and any other material which would cause staining or discoloration of the concrete. The temperature of curing water shall be within 20°C of the concrete surface temperature at all times and shall not cause temperature differentials greater than those specified in Table 1.0 in Section 931.

The Contractor shall not use water of unknown quality and/or water from shallow, stagnant or marshy sources.

930.04.04 Admixtures

All concrete shall be air entrained with an air-entraining admixture conforming to ASTM C260/C260M.

For underwater concrete operations, precautions shall be taken to prevent loss of cementitious material by the washing action of water. The use of anti-washout admixtures confirming to U.S. Army Corps of Engineers CRD-C 661-06, Specification for Anti-Washout Admixtures for Concrete is mandatory.

Any other admixture, utilized in the concrete must conform to ASTM C494/C494M.

All admixtures shall be stored in accordance with the manufacturer’s recommendations and above freezing temperatures. There shall be no purposefully added calcium chloride in any admixtures.

930.04.05 Concrete Mixtures

Concrete mixtures shall conform to the requirements of CSA A23.1. Additional guidance for determining mixture proportions is provided in ACI PRC-211.1. The Concrete Supplier will be responsible for the mix design, accompanied by the trial batch mix data and quality control of concrete production. Concrete aggregate gradation analysis must also be completed on the material used for the trial mix and be included in the mix design report.

All concrete mixture design proportioning including the mix quality control operations shall be performed by a Laboratory CCIL Certified in accordance with CSA A283. All testing shall be completed by CCIL certified technicians in accordance with CSA-A23.1 and A23.2. The proposed mixture design shall be signed and stamped by the Engineer of Record who has a minimum of 5 years experience in the development of concrete mixture designs. Curriculum Vitae (CV) to be provided. The Engineer of Record shall attest to the validity of the material test data.

Concrete strengths shall be in accordance with Table 1.0, unless otherwise specified in the contract documents.

TABLE 1.0

Element[1]	Prestressed Girders/ High Performance Concrete[4]	All Bridge Components[4] and Traffic Light Foundations	Roadway[5] & Weir Baffles	Tremie Concrete[6,7,8]	Levelling & Infill Concrete
Exposure Class	C-XL	C-1	C-2	C-3[9]	F-1
Compressive Strength Within 28 or 56 Days[2]	50 MPa	40 MPa	35 MPa	30 MPa	30 MPa
Maximum Water/ Cementitious Material Ratio	In accordance with Table 2.0 of CSA A23.1				
Slump [3]	In accordance with the approved mix design and the requirements of CSA A23.1 clause 4.3.2.3.2				
Air Content, %	In accordance with the requirements of CSA A23.1 Table 4.0.				
Rapid Chloride Permeability (ASTM C1202)	<1000 Coulombs	<1500 Coulombs	N/A	N/A	N/A
Air Void Spacing Factor (ASTM C457) (average)	230 µm MAX	230 µm MAX	230 µm MAX	N/A	230 µm MAX

NOTES:
1. Cement shall be in accordance with Section 930.04.01.

2. For concrete utilizing blended Portland Cement GUb, compressive strength is tested for compliance at 56 days.
3. If High Range Water Reducer (HRWR) are used, the maximum concrete slump in a superplasticized condition shall be limited to 230 mm. The mix design shall state the design slump before and after the addition of superplasticizers along with the appropriate tolerances.
4. *Deleted Note*.
5. Roadway concrete is concrete used for sidewalk, curbs and median barriers that are not a part of a bridge structure. Where slip form concrete is utilized or required as per contract documents, then a slip form specific concrete mix design must be prepared and submitted in accordance with 930.04.05.01.
6. Air entrainment is required if the concrete will be exposed to freeze thaw conditions.
7. Tremie concrete requires the use of an anti-washout admixture.
8. The maximum water-to-cementitious materials ratio of Tremie Concrete is 0.45.
9. For seawater exposures the requirement for S-3 concrete exposure class shall also be met.

The verification of the mixture design through trial batching must meet the specified requirements in Table 1.0. Each mixture design shall have a unique mixture design code, it must be indicated on the mix design, as provided by the Concrete Supplier. This unique mixture design code must be present on the delivery ticket for all concrete placed on Department projects. In the event that an additional admixture is required (set retarder, anti-wash out, etc.) a different mixture design code is required.

High range water reducing agents (superplasticizers) may only be used if included in the original mix design submission.

Set retarding admixtures may be used as ambient and site conditions warrant. The dosage rate shall be supplied by the mix design Engineer of Record in a signed and stamped letter provided in advance of concrete placement. The letter should indicate the dosage rate and associated delay in the initial set time.

This specification incorporates material and constructability requirements that will enhance durability and serviceability with the goal to achieve sustainable concrete structures. Enhancing sustainability of concrete as a construction material requires consideration for the sourcing of raw materials, production, delivery, placing, finishing, curing, testing, acceptance, performance in service and recycling at the end of life. The Owner supports innovation in new construction and maintenance of existing infrastructure. CSA A23.1, Annex M provides information on innovative alternatives for

materials, construction methods, testing, performance specifications and decommissioning. Contractors considering to implement any of the ideas presented in Annex M or other innovative alternatives shall make a formal request to the Owner's Representative for review and approval.

930.04.05.01 Mixture Design Submittal

The Owner's Representative will not accept or pay for any concrete mixture produced and placed without written acknowledgement from the Materials Engineering Division (MED).

For a concrete mixture with a tendered quantity of more than 50 cubic metres, the mixture designs and trial test results are only considered valid for up to two years from the date of the final compressive strength results. For a concrete mix with a tendered quantity of 50 cubic metres or less the test results are considered valid for up to five years from the date of the final compressive strength results.

The Concrete Supplier must inform the Owner's Representative of any of the following:

- A change in the source of cement.
- A change in admixtures.
- A change in the source of the aggregates.
- A change in SCM proportions.

Implementation of any of the aforementioned changes will result in the requirement for the development of a new concrete mix design. Failure on the Concrete Supplier's behalf to inform the Owner's Representative of any of these changes will result in the complete rejection of all concrete, with no payment made.

930.04.05.01.01 Yearly Supplier Submittal

Suppliers may elect to submit their mixture designs yearly to MED for approval. Submission(s) are required between January 1st and March 31st.

The following information, based on actual trial mixes, is required:

- Name of the Certifying laboratory and applicable CCIL certifications.
- Identify the Engineer of Record, including their Curriculum Vitae (CV).
- Unique mixture design code. This must be indicated on the mix design.
- Concrete trial batch report containing all fresh and hardened properties test results.

- CCIL certificate of testing personnel.
- Mix slump and air content range and results, before and after addition of HRWR.
- All admixtures with dosage rates.
- Slump and air content loss over time.
- Aggregate test report as per requirements of 930.04.02.
- Source of water supply, including a declaration of potability or documentation demonstrating compliance as per Section 930.04.03.
- Estimate of the initial time of set.
- Verification that the concrete mix design yields 1 m^3.
- Type of Cement and test data showing conformance with CSA A3000.
- Documentations verifying the certified calibration of all plant scales used in the production of concrete within the last six (6) months
- Proof of current Atlantic Concrete Association (ACA) membership certificate for ready-mix concrete.
- Proof of CSA certification for the product category of precast concrete, where applicable.

Written acknowledgement will be provided by MED once all requirements are met. Concrete mixture designs shall be valid from the date of the 28 day or 56 day break results, whichever compressive strength acceptance is based upon. Suppliers will then be added to the list of prequalified concrete mixtures. **Resubmission is required for all mix designs, including those previously approved on a yearly basis**.

Any Contractor requesting to use a prequalified mixture must submit the following information at least one week (7 days) in advance of concrete placement:

- Project number and title description.
- Contractor company name with contact information.
- Ready mix or Precast Concrete Supplier.
- Unique mixture design code, intended use, approximate quantity and method of placement.

This information shall be provided on company letterhead and signed by a representative of the Contractor. Prequalification does not alleviate the Contractor of liability for the product supplied.

930.04.05.01.02 Project Specific Contractor Submittal

For concrete mix designs not on the prequalified list, the Contractor shall provide, with

the proposed mixture design, the information detailed in Section 930.04.05.01.01 Mixture Design Submittal, at least two weeks (14 days) in advance of the concrete placement.

930.04.06 Pre-Packaged Proprietary Products

In the event a pre-packaged proprietary product is selected for use as a repair material, the product shall be reviewed for the intended purpose and accepted by the Chief Bridge Engineer and MED in advance of placement.

Where possible materials should be selected that have similar material characteristics to the parent concrete and meet the minimum strength requirements as defined in Table 1.0.

Acceptance for the use of a pre-packed propriety product shall not relieve the Contractor of any performance or warranty responsibilities for the performance of the product. The Department is not obligated to accept any or all proposed products. In the opinion of the Department, demonstrated unsatisfactory performance of a product could result in product rejection.

930.04.06.01 Pre-Packaged Proprietary Products Submittals

Pre-packaged proprietary products must be submitted for use 14 days in advance of placement. The submission shall include:

- Project number and title description.
- Contractor company name with contact information.
- Product name and associated technical data sheet and material safety data sheet.
- Intended use and application type (vertical, horizontal, overhead, etc.).
- Approximate quantity, method of mixing and placement.
- Placing conditions including temperatures.
- Any variations from standard curing practices.
- Aggregate test report as per Section 930.04.02, if additional aggregate is added.
- Source of mixing water and requirements of Section 930.04.03.

930.04.07 Controlled Low Strength Material (CLSM)

Controlled Low Strength Material (CLSM) shall consist of a mixture of cement, fine aggregate, water and admixtures (as required).

Cement must be GU or GUL in conformance with 930.04.01. Aggregate, water and admixtures must meet the requirements of 930.04.02 to 930.04.04. CLSM shall have a compressive strength of 1-5 MPa at 28 days.

A theoretical mix design, completed within five (5) years from project submission, and aggregate report must be submitted 14 days in advance of placement for review by MED. The proposed mixture design shall be signed and stamped by the Engineer of Record who has a minimum of 5 years experience in the development of concrete mixture designs. Curriculum Vitae (CV) to be provided. The Engineer of Record shall attest to the validity of the material test data. The Owner's Representative will not accept or pay for any CLSM produced and placed without written acknowledgement from MED.

Only CLSM supplied from a certified concrete plant will be acceptable for use. Material that does not meet the approved mix design or strength shall be removed and replaced at the Contractor's expense.

930.04.08 Reinforcement

Reinforcement shall be in accordance with Section 905.

930.04.09 Form work and Falsework

Form work and falsework shall be in accordance with Section 907.

930.04.10 Burlap

Burlap shall conform to AASHTO M182 Class 4 and shall be free from substances that are deleterious to concrete. The burlap shall have no tears or holes.

930.04.11 Liquid Membrane-Forming Curing Compounds

Liquid membrane-forming curing compounds shall meet the requirements of ASTM C309.

A minimum of seven (7) days prior to the application of the curing compound, the following shall be submitted to the Owner's Representative, for information purposes:

- Literature stating the manufacturers recommended rate of application.
- Description of the equipment to be used.
- A statement from the manufacturer of the curing compound approving the equipment.

930.04.12 Concrete Curing Sheet Materials

Sheet materials that conform to ASTM C171, may be used as a cover to inhibit moisture loss during the concrete curing period.

930.04.13 Concrete Surface Retarders

A minimum of seven (7) days prior to the application of the surface retarder, the following shall be submitted to the Owner's Representative, for information purposes:

- Literature stating the manufacturers recommended rate of application.
- Description of the equipment to be used.

All surface retarders shall be stored and applied as per the manufactures instructions.

930.04.14 Joint Sealant

Joint sealant shall meet the requirements of ASTM C920 and must be Grade NS, minimum Class 50, use Type T and must pass the accelerated weathering test as per ASTM C793.

Joint sealant products shall be one of the following or an approved equal:

- DOWSIL 888 Silicone Joint Sealant
- TREMCO Dymeric 240

All work shall be in strict accordance with the manufacturer's recommendations.

930.04.15 Miscellaneous Materials

The supply and installation of miscellaneous materials shown on the drawings or mentioned in the Supplementary General Conditions but which have not been listed on the Unit Price Table, are considered incidental to the work and no separate payment will be made.

This shall include, but not necessarily limited to, all miscellaneous concrete accessories, evaporation retardant, abutment weep holes, drip grooves and guide rail modified end shoes.

930.05 EQUIPMENT

The Contractor shall supply the Owner's Representative, before commencement of the project, with adequate details of all equipment to be used. Equipment shall include but

not be limited to consolidation equipment such as internal or external vibrators, finishing tools, screed rails, finishing machines, spray equipment, compressor, etc. The intention is not to limit the Contractor's operation but to ensure adequate planning is undertaken.

The Contractor and Concrete Supplier shall maintain all equipment used for handling, mixing, transporting, depositing, compacting, curing and finishing the concrete in a clean condition and in proper working order.

Batch plant and mixing equipment shall be as defined in 930.06

930.06 CONCRETE PRODUCTION

930.06.01 Batch Plant Requirements

The batching of concrete, unless otherwise authorized by the Owner's Representative, shall be done in a batch plant that is certified in accordance with the requirements for certification as per the Atlantic Concrete Association (ACA) or equivalent. Precast concrete manufacturers shall be certified in accordance with the CSA A23.4.

All materials shall be stored in a manner that will prevent contamination, segregation, deterioration and intermingling. Cementing materials must be stored in suitable bins that will provide protection against dampness. Aggregates shall be separated into fine and coarse sizes as determined by the concrete mix design.

The equipment for batching shall have the capacity to produce at such a rate as to preclude cold joints in the concrete placement. In any event, equipment is subject to the approval of the Owner's Representative.

930.06.02 Measurement of Materials during Batching

All materials used in the production of concrete shall be measured by weighing. Materials shall be added to produce concrete conforming to the approved mix design prepared as per 930.04.05.

Scales and other mass-measuring devices must be accurate and meet the requirements of Table 23.0 of CSA A23.1. The Concrete Supplier shall provide standard certified test weights and/or devices for checking the accuracy of the controls. Checks shall be made as requested by the Owners Representative. Recalibration shall be performed if the batching plant is moved or any major alterations performed. The Concrete Supplier shall carry out all tests in the presence of the Owner's Representative and shall supply them with results of all tests and make any and all alterations, repairs or replacements required

to the equipment before authorization will be given to place concrete.

The volume of concrete discharged by the Concrete Supplier's equipment shall be expressed in cubic metres. All batch weights shall be recorded and made available for audit by the Owner's Representative upon request.

Cement in standard bags need not be weighed.

930.06.03 Mixing Concrete

The mixing of concrete, unless otherwise authorized by the Owner's Representative, shall be done in either a central mixer or truck mixer. The mixer shall carry the manufacturer's rating plate in a prominent position, indicating:

- The gross volume of the mixer.
- The rated maximum mixing capacity.
- The minimum and maximum mixing and agitating speeds.

The mixer must be capable of combining the ingredients of the concrete within a time or number of revolutions recommended by the manufacturer of the mixer to produce a thoroughly mixed and uniform mass.

The Owner Representative reserves the right to subject any truck used to transport concrete suspected of poor mixing to uniformity testing as outlined in CSA A23.1 Clause 5.2.4.5. If the truck in question fails the uniformity test, then the concrete and the truck shall be rejected. The truck shall not be permitted on Department sites until appropriate repairs have been completed and certified.

Concrete transported in a truck mixer, agitator, or other transportation device shall be discharged at the job and placed in its final position in the forms within 120 minutes from the time of initial mixing, except in hot weather or under other conditions contributing to quick stiffening of the concrete. Discharge shall also be extended if set retarding admixtures are used.

Any concrete truck on site that does not comply with the above shall have the entire load of concrete rejected, with no payment, and no concrete shall be placed from that truck.

930.06.04 Concrete Temperatures for Delivery

The temperature of the concrete to be placed must be within the temperature limits of Table 2.0.

TABLE 2.0

LEAST DIMENSION OF SECTION	CONCRETE TEMPERATURE[1]	
	MINIMUM ^{O}C	MAXIMUM ^{O}C
LESS THAN 0.3 M	10	32
0.3 M TO 1 M	10	30
1 TO 2 M	5	25
MORE THAN 2 M	5	20

NOTES:
1. The temperature of HPC shall not exceed 25ºC.

Where possible, concrete placement temperatures shall be kept as close as possible to the minimum temperatures shown in Table 2.0.

In cold weather, temperatures can be obtained by heating the water or the aggregate or both; water and aggregate shall then be combined in the mixer first and the temperature of the mixture shall not exceed 38 degrees Celsius when the cement is added.

At temperatures below freezing, aggregates are required to be heated prior to incorporation into the mixture. The aggregates shall be uniformly heated in the stockpiles and/or bins by steam, either injected live or circulated in coils, or by using dry heat before the aggregates are placed in the mixer. Whatever system is used, it shall be designed to give uniform heating that will avoid local overheating which may be injurious to the materials. No frozen lump of aggregate will be allowed in the concrete mix and shall be discarded before batching.

The use of salt, calcium chloride or other chemicals to lower the freezing point or accelerate the set is prohibited.

In hot weather, the aggregates and water shall be kept as cool as practicable. Aggregate stockpiles should be shaded from the sun and kept moist by sprinkling. Sprinkling should be adjusted to avoid producing excessive variations in the aggregate surface moisture content. Aggregates can also be cooled by circulated air, immersion in cold water and vacuum cooling.

Mixing water should be obtained from a cool source and stored so it is not exposed to direct sunlight. Ice can be used as part of the mixing water but must be completely melted by the time mixing is completed. The volume of ice used shall not replace more than 75%

of the total batch water and the combined amount of water and ice shall not exceed the total mixing water requirements. The ice source shall meet the requirements of Section 930.04.03 Water.

930.06.05 Pre-Packaged Proprietary Products

Small quantities of pre-packed proprietary concrete mixtures may be mixed on site, as authorized by the Owner's Representative, and must follow all preparation, mixing and placing requirements set forth by the manufacturer of the proprietary product.

Water used for the production of pre-packaged proprietary products must be in accordance with 930.04.03.

The Department will not perform QA testing on any Pre-Package Proprietary Product that does not comply with this specification nor the manufacturer's preparation, mixing and placing requirements. Any product produced and placed by the Contractor that does not comply with this specification or the manufacturer's preparation, mixing and placing requirements will be rejected and no payment will be made. Any material placed by the Contractor that was rejected by the Owner's Representative must be removed at the Contractor's expense.

930.07 SAMPLING AND TESTING

The Contractor and Concrete Supplier shall co-operate fully with the Owner's Representative in enabling quality assurance tests to be carried out. Samples for quality testing purposes will normally be taken from concrete as delivered to the site (at the point of discharge from the delivery equipment). However, depending on the method of placement, random sampling of the concrete as incorporated into the structure shall also be performed to verify the above specified properties. This process shall entail the sampling of fresh concrete as close to the point of deposit in the structure as is practicable. Coring of the in-place hardened concrete may also be performed. The Department reserves the right to designate the point of acceptance, with prior notice given to the Contractor.

Field quality assurance testing will be carried out by an Owner's Representative for acceptance purposes. If the material appears defective or it was determined there was a change in the process or product, the Department may take additional samples. The Contractor shall provide and maintain a suitable location for the storage and proper curing of compressive test specimens in accordance with CSA A23.2-3C.

Quality assurance tests carried out by the Department shall conform to the following

guidelines:

COMPRESSIVE STRENGTH ≥ 40 MPa

FRESH PROPERTIES TESTS	Each load until 5 consecutive batches meet the requirements then test every second load thereafter.
COMPRESSIVE STRENGTH SPECIMENS	At least 1 set of Laboratory cylinders per 50 cubic metres, minimum 1 set per day plus 1 set of field cures per category of concrete, if required by the Owner's Representative.

COMPRESSIVE STRENGTH < 40 MPa

FRESH PROPERTIES TESTS	Each load until 5 consecutive batches meet the requirements then test every third load thereafter.
COMPRESSIVE STRENGTH SPECIMENS	At least 1 set Laboratory cylinders per 50 cubic metres, minimum 1 set per day plus 1 set of field cures per category of concrete if required by the Owner's Representative.

A set of laboratory cylinders will consist of 3 specimens (one 7 day and two 28 day) for mixtures utilizing GU and GUL cement. A set of laboratory cylinders will consist of 5 specimens (one 7 day, two 28 day and two 56 day) for mixtures utilizing GUb cement.

If either the measured slump, air content or temperature fall outside the limits specified, a repeat test shall be made. Any adjustments made onsite shall be in accordance with 930.07.02. Failure to meet the contract requirements shall result in rejection of the concrete, at the Owner's Representatives discretion. Acceptance of the concrete will depend on the results and consistency of all the above testing results being satisfactory.

The Owners Representative will not accept or pay for any concrete placed prior to satisfactory fresh properties testing results from the Department.

The Department will perform QA verification to determine appropriate unit price adjustments and material acceptance/rejection. The Contractor may perform their own QC testing, however third party results will not replace Department QA. QC testing is solely for the Contractor's information.

930.07.01 Additional Strength Tests

Additional strength tests will be required when early indications of strength are required such as before transport, removal of falsework, backfilling structure, etc. These additional

test specimens must be cured in conditions that simulate as closely as possible the conditions under which the concrete is cured.

For precast concrete, the strength of elements at the time of transfer of prestress and stripping shall be determined by test cylinders cured under temperature and moisture conditions that simulate as closely as possible the conditions under which the concrete in the precast forms is cured.

930.07.02 Onsite Concrete Adjustments

Water shall not be added after batching for any reason.

The slump adjustment of superplasticized concrete shall be permitted but with admixture only. The amount of admixture to be added shall be supplied by the Concrete Supplier and the measured quantity shall be recorded on the delivery ticket. Remixing of concrete onsite after the addition of superplasticizer must be completed at mixing speed for at least 30 revolutions (or equivalent time limit).

The air content adjustment of air entrained concrete shall be permitted by the addition of admixture only. The amount of admixture to be added shall be supplied by the Concrete Supplier and the measured quantity shall be recorded on the delivery ticket. Remixing of concrete onsite after the addition of air entraining admixture shall ensure proper dispersion. Concrete that is adjusted onsite for air content shall be retested when 90 minutes from batching has elapsed for compliance.

930.07.03 Testing of Out of Province Precast Products

In the event, precast concrete is completed out of province and the Department cannot complete quality assurance testing, the manufacturer shall submit a project specific Quality Control Plan to the Department at least four (4) weeks prior to commencement of manufacturing.

As a minimum, the Quality Control plan shall include:

- Concrete mixture design in accordance with 930.04.05 including all fresh and hardened concrete test results (slump, temperature, total air content, mass density, compressive strength, air void parameters, chloride ion penetrability) as well as aggregate properties and cement.
- Mill certificate information from prestressing wire and reinforcing steel.
- Shop drawings for each element showing dimensions, tolerances for the completed element, concrete cover, and pretensioning stress.
- Detensioning procedures.

- Precast concrete sampling frequency of fresh and hardened concrete tests.
- Most recent fresh and hardened concrete test results (slump, temperature, total air content, mass density, compressive strength, air void parameters, chloride ion penetrability) from the proposed mix design last used for precast operations.
- Concrete Placement Plant as per Section 931.04.01.
- Curing procedures and Thermal Control Plan as per Section 931.04.01.02.
- Finishing and repair procedures.
- Storage procedures.
- Delivery procedures where the manufacturer is responsible for delivery.
- Certificate of accuracy for all scales or measuring devices used during the production of concrete, including batch scales, verified by a qualified technician employed by an authorized Scale Manufacturer or Company.
- List of Type SF CCIL Certified technicians as well as proof of certification.
- Proof of Laboratory CCIL Certification.
- Production schedule.

During production, the manufacturer shall provide the Department with weekly or monthly summary reports, depending on the production schedule. Summary reports shall include records of daily checks (temperature, etc.) and all testing conducted per individual element. This shall include the date of manufacturer and be signed off by the manufacturer.

930.07.04 Testing of Pre-packaged Products

The testing of prepackaged products shall be as determined by the Owners Representative and in accordance with the product data sheet provided by the manufacturer.