Implementing Service Life During Construction

IBC Workshop: W-8 Service Life Design

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June 14, 2018
This part of the worked example covers:

• Implementation of service life design during construction of concrete structures:
  – QA/QC process
  – Prequalification
  – Production inspection and testing
  – Verification
  – Non-conformances
Quality Control and Quality Assurance

• Quality control and quality assurance during construction are essential to achieve the service life requirements.

• **Quality control:** activities carried out by the Contractor to ensure that the work complies with the project specifications

• **Quality assurance:** activities carried out by the Owner to verify that the Contractor’s Quality Control process is effective

• For concrete structures, this process typically will consist of two phases:
  
  – Prequalification phase;
  – Production and construction phase.
Prequalification Phase

• Prequalification phase:
  – Review of properties of the concrete mix constituents (aggregates, cementitious materials, admixtures, mix designs) to verify that what is proposed will meet the requirements of the project.
  – Review of data sheets, mill reports, aggregates source reports, etc. to verify the materials are in compliance with the Project Specifications.
  – Testing of constituent material properties if test data is missing.
  – When the constituents are confirmed to satisfy the requirements, a series of laboratory trial mixtures are completed using one or more of the proposed cementitious material combinations and appropriate testing is done to demonstrate that all requirements are met:
    • Compressive strength
    • Chloride migration coefficient – NT Build 492
    • Air void spacing factor – ASTM C457
    • Freeze-thaw and scaling resistance – ASTM C666 and C672
Production and construction phase:
- During construction, monitoring of the key properties is done by testing samples obtained from production concrete:
  - Compressive strength
  - Plastic air content
  - Chloride migration coefficient
- Pre-pour QC checks include:
  - Dimensional tolerances
  - Cover thickness
- In some cases as-built concrete cover thickness is also measured.
- Measured values from the construction phase are compared with design values to assess if the service life criteria will be met.
Other factors influencing the service life are subject to rigorous quality control:
- placement, consolidation, finishing, and curing procedures for concrete
- surface preparation, application procedures, weather conditions and monitoring procedures for coatings.

The quality control and quality assurance of these operations should be described in the Project Specifications and the project Quality Management Plan.

The Owner should implement effective Quality Assurance program to verify that the Contractor’s Quality Control plan is effective.
Thermal Control Plan

- Required for mass concrete and precast
- Determines when and where a TCP is required
- Thermal control plan will describe:
  - Allowable concrete temperature at point of placement
  - Pre-cooling requirements
  - Allowable temperature increase during curing phase
  - Allowable maximum temperature and maximum thermal gradient
  - Monitoring requirements
  - Corrective action if temperature limits are exceeded
Verification

• Who has responsibility?
  – Review of inspection and test reports
  – Tracking of test results – control charts
  – Who initiates action ???!!!
    • Accept and proceed
    • Non-conformance:
      – Remedial action to address the specific non-conformance
      – Corrective action to prevent further non-conformances
Dealing With Non-Conformances

• Prevention vs reaction:
  – Review of test and inspection reports
  – Action? Who?
  – Control charts

• Assess consequences of non-conformance:
  – Maintenance and repair expectations
  – Local anomaly vs reduced service life

• Remediation measures:
  • Look at actual exposure conditions and material properties
  • Does it meet service life requirements?
  • What remediation is required (if any)?
  • Apply protection or repair as directed by designer