METHODS OF SAMPLING AND TESTING
MT 100-22
CONTRACTOR SUBMITTED CONCRETE MIX DESIGN

1 Scope

1.1 This document describes required mix design procedures for independent concrete mix designs and establishes the information required for a mix design submittal.

1.2 This procedure applies to the Montana Department of Transportation (MDT) projects requiring an approved concrete mix design. It is to be used for preparation of a mix design by the contractor for submission to MDT's Materials Bureau for final approval.

1.3 It is the responsibility of the contractor to provide mix designs meeting the required specifications of Section 551, plans, supplemental requirements, and any special provisions included in the contract.

The testing of the contractor's proposed mix design must be performed by a certified laboratory or performed by a certified technician with a Professional Engineer as the signature of record. A certified laboratory is any laboratory meeting the requirements of ASTM C1077. A certified technician will have current ACI Field, Laboratory and Strength Testing certifications or corresponding current WAQTC certifications.

Perform concrete mix designs in conformance with Montana, AASHTO, ACI and ASTM procedures. Mix Designs submitted by Certified Precast or Prestressed concrete plants are exempt from this subsection. A Certified plant is any concrete plant listed on the MDT's Qualified Products List (QPL).

2 Referenced Documents

ASTM

C1077 Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

MT Materials Manual

MT 601 Materials Sampling, Testing, and Acceptance Guide Index

3 Procedure

3.1 A mix design must be submitted to the Project Manager for each class of concrete to be used on an MDT project. Mix designs, including all required information, must be submitted 15 working days prior to concrete placement. Mix designs are to be submitted as either a new mix design or a mix design transfer.

3.2 *Materials:* All materials proposed are subject to approval. Refer to MT 601 for sampling and testing requirements.

3.3 *New Mix Design (Trial Batches):* Submit new mix design requests on form MDT-MAT-008 using the Original Submittal Form sheet.

When submitting a new mix design, trial batches must be performed. Batches must be based on the same materials and proportions proposed for the project. Trial batches must be completed 15 working days before concrete placement. The Materials Bureau will review all documentation and accept or reject the mix design.

Create at least one trial batch for each concrete mix design. Simulate haul time and mixing conditions to ensure proper workability at the jobsite. It is also recommended that a larger, more representative trial batch be made in the same manner as intended for project placement.

For each trial batch, test in accordance with Annex A.1. All mix designs must include aggregate properties testing information for each aggregate size in accordance with Annex A.2. For alternative mix designs, per contract specifications, test in accordance with Annex A.3.

Include data sheets for cementitious materials and admixtures with the design submittal. The trial batch will be subject to rejection if any test results fail to meet specified ranges and a new trial batch will be requested. For each trial batch, cast a minimum of three sets of three test cylinders in 4" x 8" molds. Test and average one set at 3 days, one set at 7 days, and one set at 28 days. If earlier strength information is needed for de-tensioning prestressed applications, post tensioning, form removal, etc., submit strength data for the anticipated work. The average of the cylinders at 28 days must meet the minimum strength requirements of the contract. When permeability testing is required, perform testing of three cylinders cast from the trial batch in accordance with either AASHTO T 277 or AASHTO T 358. Cylinders used for AASHTO T 358 testing may be subsequently used for compressive strength determination. Based on the anticipated application of the mix design, cast and test as many specimens as needed to supply sufficient information. When Class Pave is required, test and average one (1) set of two (2) flexural beam specimens at 28 days in accordance with AASHTO T 97.

3.4 *Mix Design Transfer:* Submit mix design transfer requests on form MDT-MAT-008 using the Transfer Form sheet.

Concrete mix designs used on MDT projects are valid for three years, provided they are transferred within 12 months of their previous use. Any request for transfer after three years will require new trial batches and resubmittal of the mix design. The contractor may request, in writing, the transfer of a concrete mix design to another project. There will be no substitutions of any materials or changes in mix proportions under this method. The Department may deny the transfer for any reason including, but not limited to, past performance, failing materials test results, raw material property changes, etc.

4 Acceptance

4.1 *Approval:* A representative of the MDT's Materials Bureau will verify and sign off approval of the new or transferred concrete mix design provided required information, test results, and proper forms are submitted, and all required MDT specifications are met. When a signed copy of approval is issued to the contractor, concrete placement may begin. Any time before or after approval of the design, the Material's Bureau may request additional materials for testing. Throughout the project, MDT may request additional tests be performed by the contractor to ensure proper placement and satisfactory test results.

4.2 *Rejection:* If a mix design produces failing results, a new mix design must be submitted for approval. The Materials Bureau may reject any design on the basis of any one failing test result.

4.3 In no case will the approval of a concrete mix design relieve the contractor of producing material meeting the contract requirements. Any changes or modifications to a mix design needed in the field must be approved by the Project Manager. A halt in production may be required for additional testing. Review and approval of the concrete mix design by a representative of the MDT's Materials Bureau does not constitute acceptance of the concrete. Acceptance of concrete will be based solely on the test results of concrete placed on the project.

ANNEX

A.1 The following tests are required for all concrete mix design submittals:

- AASHTO R 39 Making and Curing Concrete Test Specimens in the Laboratory
- AASHTO R 60 Sampling Fresh Concrete
- AASHTO T 22 Compressive Strength of Cylindrical Concrete Specimens
- AASHTO T 119 Slump of Hydraulic Cement Concrete
- AASHTO T 121 Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- AASHTO T 152 Air Content of Freshly Mixed Concrete by the Pressure Method
- AASHTO T 345 Passing Ability of Self-Consolidating Concrete by J-Ring (if applicable)
- AASHTO T 347 Slump Flow of Self-Consolidating Concrete (if applicable)
- AASHTO T 351 Visual Stability Index of Self-Consolidating Concrete (if applicable)
- ASTM C1064 Temperature of Freshly Mixed Hydraulic Cement Concrete
- MT 101 Making and Curing Concrete Test Specimens in the Field

A.2 The following tests are required for aggregates for all concrete mix design submittals:

- AASHTO R 90 Sampling Aggregate Products
- AASHTO T 11 Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
- AASHTO T 21 Organic Impurities in Fine Aggregates for Concrete
- AASHTO T 27 Sieve Analysis of Fine and Coarse Aggregates (Including Fineness Modulus)
- AASHTO T 84 Specific Gravity and Absorption of Fine Aggregate
- AASHTO T 85 Specific Gravity and Absorption of Coarse Aggregate
- AASHTO T 96 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- AASHTO T 104 Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- AASHTO T 112 Clay Lumps and Friable Particles in Aggregate
- AASHTO T 113 Lightweight Pieces in Aggregate
- MT 121 Effect of Organic Impurities in Fine Aggregate on Strength Of Mortar*

  *As required per Specification 701.01.1(D)

A.3 The following tests are required for alternative mix designs and for specific classes of concrete:

- AASHTO T 97 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
- AASHTO T 277 Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
- AASHTO T 358 Surface Resistivity Indication of Concrete's Ability to Resist Chloride Ion Penetration
- ASTM C157 Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
- ASTM C512 Standard Test Method for Creep of Concrete in Compression
- ASTM C469 Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
- ASTM C457 Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete