Chapter 600

Concrete & Item 600 - 23

This chapter is not part of the Project specifications but is a guide for project personnel in interpreting CDOT specifications, understanding ASTM, AASHTO, and Colorado test procedures, and for completing CDOT forms.

ITEM 601, STRUCTURAL CONCRETE

Concrete Design Mixes

All concrete placed on the project shall conform to a design mix, which has been approved according to CP 62. The design mix is defined by the proportions and sources of all ingredients in the concrete.

The Contractor (or Supplier) will establish and is responsible for the concrete design mix proportions and source of all ingredients for each class of concrete used. The Region Materials Engineer (RME) or the Concrete & Physical Properties (CPP) Unit may verify any or all properties of the submitted mix design before approval. When a trial mix check is requested, aggregate sources will be sampled by the Contractor and the samples submitted to the CPP Unit.

The concrete Table 601-1 in Section 601 of the Standard Specification or the Special Provisions for the project gives the data for each class of concrete. The column "Concrete Class" lists each class of concrete and the required field compressive strength.

When a concrete mix design is approved, a CDOT Form 1373 will be issued for the project.

Standard approved mix designs will be placed on the Pre-Approved Concrete Mix Designs list: https://www.codot.gov/business/apl/concrete-mix-designs Mix designs remain on the APL for up to two years from the date the mix was trialed or when the aggregate was sampled, whichever occurs first.

Concrete mix designs are to be submitted to the Concrete & Physical Properties Unit at: dot_concretemixdesigns@state.co.us.

REFERENCING PRE-APPROVED MIX DESIGNS

Projects may choose to reference existing pre-approved concrete mix designs. The concrete mix designs used on CDOT projects are to be referenced in the following manner:

1. Mixes must be reviewed and approved by the CPP Unit or RME before use.

2. Cross-reference the contractor's mix design number with the CDOT mix design number on the Pre-Approved Concrete Mix Design list.

3. Document the Concrete Mix Design on a CDOT Form 1188, listing the CDOT mix number.

Upon approval of the concrete mix design, the mix design will be assigned to the project in SMM/LIMS and a CDOT Form 1373 can be printed from CAR for the project.

REVIEW OF CONTRACTOR'S MIX DESIGN

All concrete mix designs shall be reviewed and approved by CCP Unit or RME per CP 62 before placement

AGGREGATES

A minimum of three 60 lb. sacks of the coarse (1-1/2 in. to 3/4 in.); three 60 lb. sacks of intermediate (3/4 in. to plus #4); and three 60 lb. sacks of sand (minus #4) per class of concrete are required when mix design checks are performed.

One additional sack of each aggregate will be required for Class S50, and P mixes.

Aggregate Tests Required for Design Mixes

The following test will be performed by the Contractor:

1. specific gravity
2. absorption
3. organic impurities in sand
4. sieve analysis
5. sand equivalent
6. L.A. abrasion
7. percent passing the No. 200 sieve
8. fineness modulus
9. unit weight and voids in aggregate
10. potential alkali reactivity
11. Soundness by the sodium sulfate method.

COMPRESSIVE STRENGTH TESTING

The determination of the compressive strength of concrete shall be done per ASTM C 39. This method consists of applying a compressive axial load to molded cylinders or cores at a rate within the prescribed range until failure occurs. The compressive strength of the specimen is calculated by dividing the maximum load attained during the test by the cross-sectional area of the specimen. The following details, from the test procedure, are noted:

1. The initial cure of specimens is per AASHTO T 23 as modified.

2. Testing machine. Calibration of the testing machine shall be performed at least annually, but not to exceed 13 months. Recalibration is required upon installation or relocation of the machine, or whenever there is reason to doubt the accuracy of test results. The diameter of the sphere of the top-loading head on the machine shall be at least 75% of the diameter of the specimen to be tested.

3. Concrete specimens shall not be tested if any individual cylinder diameter differs from other diameters of the same cylinder by more than 2%. No cylinder shall depart from perpendicularity to the axis by more than 0.5°; the top of the cylinder may not deviate by more than 1/16 inch in 12 inches. When neoprene caps are used, each end of the cylinder shall be planed within 0.125 inches across any diameter and no depression in the concrete surface deeper than 0.125 inches is tolerated. The diameter used for calculating the cross-sectional area of the cylinder shall be determined to the nearest 0.01 inches by averaging two diameters measured at right angles about the mid-height of the specimen. Core length shall be measured to the nearest 0.05 inch.

4. Procedure. Test the cylinders as molded in the field. The loading rate shall be within the range of 20 to 50 psi/second. During the first half of the anticipated load, a higher rate of loading is allowed. When using neoprene caps an additional three to five seconds of the load is applied to ensure completion of the test and avoidance of premature breaks.

5. Neoprene Pads. Only one side of the pad shall be used when testing the cylinders. Each pad shall not be used to test more than 100 cylinders. Record the number of tests for each pad. The neoprene pad's shore hardness shall be the following for the specified compressive strengths:

    - 50 for 1500 – 6000 psi
    - 60 for 2500 – 7000 psi
    - 70 for 4000 – 7000 psi

A 60 durometer pad is recommended for testing all classes of concrete except for Class S50 which requires sulfur capping or end grinding.

The neoprene pads shall be removed from the retaining rings and inspected after each test.

QUALITY ASSURANCE PROGRAM FOR CDOT CONCRETE CYLINDER TESTING

Introduction

This defines a quality assurance program for testing concrete cylinders. This program assures the conformance of CDOT equipment and procedures to ASTM Standards by the following:

1. Equipment checks using a standard checklist.

2. Procedure checks using a standard checklist.

3. Inter-Lab (Round Robin) testing with all labs testing replicate specimens at the same time.

4. Training offered by the Concrete Unit of Staff Materials & Geotechnical Branch.

5. ACI certification of CDOT employees.

Cylinders shall be tested with equipment that has been checked and found to be in conformance with ASTM criteria. Testing shall be conducted by an employee who is certified as an ACI Concrete Laboratory Testing Tech I or ACI Concrete Strength Testing Technician.

Equipment

The cylinder testing equipment will be examined, using the equipment checklist, a minimum of once a year, or when the equipment is moved. The person checking the equipment must meet one of the following criteria:

1. Examined by CCRL (Cement and Concrete Reference Laboratory) for procedures and equipment.

2. Trained by the Concrete Unit of Staff Materials & Geotechnical Branch.

Procedures

The person will be observed conducting the test by a proctor using the procedures checklist a minimum of once a year. The proctor checking the procedures must be certified as an ACI Concrete Laboratory Testing Tech I or ACI Concrete Strength Testing Technician.

Inter-Lab Testing (Round Robin)

The Concrete Unit will mold replicate cylinders and distribute these to each Region. All cylinders will be tested at approximately the same time. The Concrete Unit will compile the results and distribute a brief report. Excessive deviations will be investigated by the Region.

Training

The Concrete Unit will conduct training for Region personnel who perform concrete cylinder testing. Classes will be approximately 4 hours and will normally have four trainees per class.

ACI Certification

American Concrete Institute (ACI) offers one-day certifications. These certifications include testing of concrete cylinders and a complete battery of tests conducted on concrete aggregate and concrete. ACI Certifications are offered through the Colorado Ready Mixed Concrete Association. CRMCA may be contacted at 303-290-0303 or http://www.crmca.org/

Documentation

Region Materials Laboratories will maintain documentation on equipment calibration, equipment checks, procedure checks, employee training, employee ACI certification, and Inter-Lab results.

The Concrete Unit of the Central Laboratory will maintain documentation of equipment and procedure checks conducted by the Concrete Unit and Inter-Lab results.

Equipment and Documentation Checklist for
Compression Testing of Concrete Cylinders

Date _____ Location

Inspection Team

Compression Machine

Mfg. & Model

Capacity

Installation Date

Calibration Date

The calibration interval did not exceed 13 months or calibrated since moved.

Loading head free moving (4° in any direction).

Head diameter: [A minimum dimension of at least 3% greater than the diameter of the specimen, to be tested.

Head radius > radius of the sphere.

Other Equipment Noted and Available

Condition of neoprene pads and extrusion controllers.

The water temperature of cylinder storage area (73.4^{o}F ± 3 ^{o}).

Temperature recording device operating.

Water saturated with lime.

Documentation / Records on File

Compression machine calibration documentation immediately available.

Water temperature, neoprene pad durometer, and neoprene pad usage recorded (100 uses per pad maximum).

Diameter, load, and psi of cylinders recorded.

2020 FMM

Procedure Checklist for
Compression Testing of Concrete Cylinders

Date _____ Location _____

Proctor _____

Proctor Credentials _____
Employee Observed _____

Employee Training and Certification _____

_____

Procedure

_____ Remove the specimen from moist storage, maintain moisture.

_____ Measure diameter to nearest 0.01 in by averaging two diameters measured at right angles to each other, using calipers, at mid-height of the specimen.

_____ Wipe clean bearing surfaces of upper and lower blocks.

_____ Center the cylinder to the spherical head.

_____ Bring top block to bear gently and uniformly on the specimen while rotating the movable portion by hand.

_____ Load the cylinder (20 to 50 psi/sec. for hydraulically operated machines).

_____ Take cylinders to failure (additional 3-5 seconds may be required to ensure completion of break).

_____ Record the maximum load.

_____ Calculate the compressive strength and report to the required precision (nearest 10 psi)

Comments: _____

2020 FMM

UNIT WEIGHT, YIELD, AND GRAVIMETRIC AIR CONTENT OF CONCRETE

AASHTO T 121

The unit weight of the concrete is determined by AASHTO T 121.

Refer to AASHTO T 121 for full details of the test procedure and calculations for determining the following: Unit weight (pounds per cubic foot), yield (volume of concrete produced per batch), relative yield (ratio of the actual volume to the volume as designed for the batch), and air content (percentage of voids in the concrete).

EXCESSIVE WATER DEMAND

Water-cement ratios, which exceed the specified maximum may result from one of the following:

1. Incorrect batch weights, due to mathematical errors or scales out of adjustment.

2. Stockpiles of aggregate drying to less than a saturated surface-dry condition, requiring more water than the design. Water added to the batch to bring the aggregates to SSD shall not be included in the w/cm ratio calculation.

It is the Contractor's responsibility to maintain water-cement ratios at or below the specified maximum.

MAKING AND CURING CONCRETE
CYLINDERS IN THE FIELD

Acceptance (QA) Cylinders

Test cylinders made for determination of compliance with strength specifications are referred to as "acceptance cylinders". These cylinders are tested 28 days after casting for all classes of concrete.

Acceptance cylinders made at the job site shall be made and cured per AASHTO T 23 except that the initial cure shall be in a water tank with a temperature of $73.4^{o}F \pm 3^{o}$.

When a Class 2 lab trailer is not specified and when approved by the Region Materials Engineer cylinders may be cured per AASHTO T23. The curing temperature shall be $70^{o}F \pm 10^{o}$. The minimum and maximum temperature of the curing shall be recorded.

Information Cylinders

Test cylinders made for determining form removal time or when a structure may be put into service are referred to as "information cylinders". Information cylinders are no longer allowed. Maturity meters shall be used.

Numbering and Marking Cylinders

See the instructions and examples of CDOT Form 82 in this chapter for the correct method of numbering cylinders. Mark the identifying number and information on the cylinders with a water-proof marking. Do not scratch numbers on the end of the cylinders as it will affect test results.

Any OA (QA) strength specimens (cylinders and beams) that will not be exclusively secured by CDOT require the use of an additional marking. Central Lab has sample tags that are placed on the inside and outside of the molds and bond to the concrete specimen. These sample tags are serialized/barcoded and have a felt-like backing. The serial number shall be scanned and recorded and then verified before transport to the CDOT lab to make sure the strength specimen cast was not swapped out by the contractor. This is highly unlikely, but FHWA has identified this as a possible opportunity for fraud. These tags are not required when specimens are cast and secured in a CDOT facility the contractor does not have access to.

DOCUMENTATION AND TRANSFER OF CONCRETE TEST CYLINDERS

Field sheet Numbering System

The CDOT Form #82, Concrete Cylinder Transmittal, is used to document and provide information for concrete cylinders submitted for compressive strength testing. SMM/LIMS sample ID shall be recorded on the CDOT Form #82.

Concrete Cylinder Transport

Concrete specimens being transported 48 hours after molding are left in the molds. Upon arrival at the designated testing facility, cylinders are removed from the molds and stored in a suitable curing area. Specimens to be transported after 48 hours of age are removed from the molds in 24 $\pm$ 8 hours. Curing shall be in saturated limewater @ 73.4^{o}F $\pm$ 3^{o} until the time of transport. During transportation, the specimens must be protected and kept moist with cushioning material in padded boxes or suitable protective containers. Moisture loss shall be prevented by wrapping the specimens in plastic, wet sand, or burlap. The project tester or designated project representative will be responsible for the proper transfer of the specimens. The cylinders shall be removed from the molds and marked with the project number, cylinder set number, and break date.

For concrete mix designs with 15% or more Class F fly ash, it is recommended that the cast cylinders remain in the initial curing condition for the majority of the allowed 48 hour time. Concrete with 15% or more Class F fly ash can develop strength slower and transporting them sooner can lead to low break strengths.

Reporting Test Results

The cylinder test information is entered in a reporting program from the CDOT Form #82, Concrete Cylinder Transmittal Report. Compressive test results and cylinder measurements are performed on the specified break dates with compressive strength test results reported on CDOT Form #192, Report of Concrete Tests. Reports are obtained through CARS. It is the responsibility of the Engineer in charge of the laboratory to ensure the proper testing and reporting of compressive strength test results.

TECHNICAL COMPLAINTS

Questions or problems should be directed to the Concrete / Physical Properties Unit Program Manager at 303-398-6542. The evaluation process will include an investigation ensuring that correct procedures were adhered to in the following areas:

1. Paperwork
2. Testing procedures
3. Machine Calibration and settings

A verbal reply will be issued, written replies upon request.

AIR ENTRAINMENT

Definition

Air entrainment is the introduction of air that causes the development of a system of microscopic air bubbles in concrete during mixing.

Measurement

Determination of air content at the job site shall be made per AASHTO T 152 and the apparent air content reported. Do not correct the air meter reading for air in the aggregate, but report total percent air.

The following may affect the quantity and quality of entrained air in concrete.

1. **Fly Ash**
   Fly Ash may substantially change the amount of air-entraining admixture required to produce the required air content. Fly ash with a high loss of ignition (LOI) has a high content of carbon and it usually causes the greatest air reduction.

2. **Temperature**
   Rising temperatures generally require increased amounts of air-entraining agents.

3. **Water**
   An increase in the water-cement ratio may increase the air content of the concrete. Contaminants present in many water sources, especially streams, can cause highly variable air content in the water.

4. **Mixing**
   A normal dosage of A.E.A. that does not produce adequate air entrainment may indicate inadequate mixing. Trucks with worn blades will not entrain satisfactory amounts of air within the specified number of mixing revolutions. However, prolonged mixing may increase concrete temperature and further reduce air content. The addition of more air-entraining agents to a truck on the job site is allowed.

5. **Cement**
   The ability of the mortar to entrain air will decrease with the increase of the fineness of the cement, and with an increase in the cement content of the mortar.

6. **Fine Aggregate**
   Changes in the sand may alter the volume of air entrainment in the mortar. An increase in the quantity of very fine particles (minus No. 30 plus No. 100 sieve) will tend to increase the volume of air in the mortar.

7. **Pumping Concrete**
   Pumping concrete may reduce the air content of the concrete. Several factors in the pump configuration may influence the quantity of air loss. It is the responsibility of the Contractor to ensure that the air content leaving the pump be within the specified limits.

ADMIXTURES

Pre-Approved Acceptance. Admixtures are required to conform to applicable AASHTO or ASTM specifications. When using an admixture, attention should be given to the instruction provided by the manufacturer. The amount shown on the laboratory design mix is merely a guide and may require adjustment.

Check the Approved Products List at https://www.codot.gov/business/apl for approved admixtures.

Surface Retarders

To produce exposed aggregate textures, surface retarders may be used. Sample panels may be constructed on the job site using the design mix and surface retarder if required by contract documents. This will not only provide a measure of the effectiveness of the retarder but will give a preview of the color and texture of the final result. It is important, as with other admixtures, to follow the manufacturer's instructions. Sample panels, if required, should be a minimum of 2' X 2' for 3/4" exposed coarse aggregate. If a larger-sized coarse aggregate is required, the panel dimensions should be increased. Most surface retarders require an initial curing period before the removal of the matrix.

Workability Agents and Pumping Aids

Improved workability is important for concrete placed in heavily reinforced members or placed by pumping or tremie methods. Frequently, increasing the cement content or the amount of fine aggregate will give the desired workability. One of the best workability agents is entrained air. It acts as a "lubricant" and is especially effective in improving workability and preventing segregation.

Finely divided materials are also used as admixtures to improve the workability of mixes deficient in material passing the No. 50 and No. 100 sieves. These materials may be chemically inert or pozzolanic. Inert materials include ground quartz, ground limestone, hydrated lime, and talc. Pozzolans include fly ash, volcanic glass, silica fume, diatomaceous earth, and some clays and shales heat-treated or raw.

Fly ash from an approved source may be used as a cement replacement in all classes of concretes, provided a design mix has been run using the substitution. Class C Fly Ash shall not be used in concrete that may be subjected to sulfate exposure in soil or water.

Monomolecular Film Coatings / Water Fog Sprays
Monomolecular Film Coatings may be applied to concrete slabs or other flatwork as a method to effectively retard surface evaporation. When placing bridge deck concrete or roadway concrete pavement, a film coating shall never be used ahead of the finishing machine.

Accordingly, its usage shall be subject to the established construction guidelines, per approval of the Engineer. A monomolecular film coating may be used after the finishing operation to prevent evaporation until the wet curing material is in place. The film shall be applied as a fine mist in small quantities. Once applied to a surface, the surface may not be reworked. There is no reason to delay wet curing, any minor scoring of the surface is preferential to drying of the surface.

Preformed Expansion Joint Material
Damage may occur during shipping, handling, and/or storage on the project. Therefore, immediately before use, project personnel shall inspect the material for physical damage, dryness, bleaching, etc. Any portion of a shipment may be rejected before use at the direction of project personnel.

ITEM 602, REINFORCING STEEL (EPOXY COATED)

NOTE: Only producers of epoxy-coated reinforcing steel, under CP 11, that are on CDOT's Qualified Manufacturers List can be used: www.codot.gov/business/apl

COC Acceptance. Bars shall meet the requirements of Subsection 709.01 before coating. Epoxy-coated bars shall meet the requirements of the latest edition of AASHTO M 284.

Coated bars shall be tied with coated tie wires and placed on plastic supports or fully coated steel supports.

Field-inspect epoxy-coated steel carefully. Document field inspection and attach mill test reports to the CDOT Form 157. Retain all copies in the field Project Files.

ITEM 602, REINFORCING STEEL

Note: Only Reinforcing Steel Mills, under CP 11, that are on CDOT's Qualified Manufacturers List can be used: www.codot.gov/business/apl

Field inspections, by the Engineer, should indicate that the reinforcing steel is clean and if Epoxy-Coated, that the coating is not chipped, cracked, or scratched. The steel should also be checked for proper size and grade using the information listed below.

The CDOT Staff Bridge Branch uses several different strengths of reinforcing steel for design purposes. It is necessary to watch the bar list on the bridge plans for higher strength grades, find their exact locations on the bridge plans, and be sure the correct steel is being used in that location.

Grade 60 has a yield strength of 60,000 psi and has either a "60" on the bar or a single continuous longitudinal line through at least five spaces offset from the center of the bar-side. This grade may be substituted on an equal basis for Grade 40 without prior approval. However, make note of this in the project records if substitution is made.

The metric equivalent to Grade 60 is Grade 420. It has either a "4" on the bar or a single continuous longitudinal line through at least five spaces offset from the center of the bar-side.
Grade 75 has a yield strength of 75,000 psi and has either a "75" on the base or two continuous longitudinal lines through at least five spaces offset each direction from the center of the bar.

The metric equivalent to Grade 75 is Grade 520. It has either a "5" on the base or two continuous longitudinal lines through at least five spaces offset each direction from the center of the bar.
Metric markings are being phased out by the Concrete Reinforcing Steel Institute (CRSI) to reduce confusion and the chance of errors/delays from the construction supply chain.

Information on bar markings at CRSI website:

NOTE: **This resource is no longer available as it used to be. It is part of a field inspection guide and can be purchased at CRSI for $25.00:**
http://resources.crsi.org/resources/field-inspection-of-reinforcing-bars-guide/

There is also a CRSI app on the Google and Apple app stores. The mill identification part of the guide is $3 per user.
http://resources.crsi.org/resources/rebar-reference-mobile-app/

An effort should be made to note in the project diary and on appropriate CDOT forms the grades of reinforcing steel used and especially note when different grades were used in special locations.

Concrete blocks or chairs for support of reinforcing steel need not be tested or documented unless there is reason to believe they lack conformance with CRSI recommended practices.

Certain items contain reinforcing steel, which is not included in the quantities of Item 602. These include precast, concrete bridge caissons, drop inlets, manholes, sign footings, slope and ditch pavements, and dowels in concrete pavement. When totaling up the payment quantity for these items, be sure the steel for these items is not included in reporting Item 602.

WIRE MESH

Wire mesh: Field-inspect. Document in the Project Files.

The term "gage" is used by the metal industry to denote a nominal dimension. This table defines those dimensions. Galvanized sheet steel is, of course, thicker than bare sheet steel. This difference is caused by the application of a double surface coating of zinc representing 2 to 2.5 oz. per sq. ft.

Wire gage is the diameter of the finished product whether galvanized or bare. The galvanizing on the wire may vary from a thin film to as much as 2 oz. per sq. ft. of area. In the case of chain link fence wire, a 2 oz. the coating may contribute as much as 0.007 in. to the diameter.

The figures in Table 600-1 pertain to actual thicknesses and diameters but may vary because of the manufacturer's tolerances. For example, culvert sheets might be, 0.006 to 0.009 in. undersize. Multi-plate sheets may be as much as 0.012 in. undersize. The wire can vary as much as $\pm$0.005 in. from the given diameter. To determine spelter thickness, consider 1 oz. per sq. ft. of zinc coating to be 0.0017 in. thick.

TABLE OF GAGE MEASUREMENTS
TABLE 600-1

SHEET STEEL Bare Inches	SHEET STEEL Galv Inches	WIRE GAGE Diameter Inches		SHEET STEEL Bare mm	SHEET STEEL Galv mm	WIRE GAGE Diam. mm	
.2758	.280	1	.283	7.005	7.112	1	7.188
.2451	.249	3	.244	6.225	6.325	3	6.197
.2145	.218	5	.207	5.448	5.537	5	5.258
---	---	6	.192	---	---	6	4.877
.1838	.188	7	.177	4.668	4.775	7	4.496
.1793	---	7	.170	4.554	---	7	4.318
.1644	.168	8	.162	4.176	4.267	8	4.115
---	---	9	.148	---	---	9	3.759
.1345	.138	10	.135	3.416	3.505	10	3.429
---	---	11	.120	---	---	11	3.048
.1046	.109	12	.105	2.657	2.769	12	2.667
---	---	12	.099	---	---	12	2.515
.0747	.079	14	.080	1.897	2.007	14	2.032
---	---	14	.076	---	---	14	1.930
.0598	.064	16	.0625	1.152	1.626	16	1.588
.0478	.052	18	.0475	1.214	1.321	18	1.207
.0359	.040	20	.0348	0.912	1.016	20	0.884
.0299	.034	22	.0286	0.760	0.864	22	0.726

ITEM 603 Culverts & Sewers
604 Manholes, Inlets, Meter Vaults
624 Drainage Pipe

CORRUGATED METAL PIPE

Final acceptance is based on field inspection by Project Personnel.

SPELTER DAMAGE REPAIR

Zinc-rich paint conforming to the Department of Defense DOD-P-21035A should be used for repainting damaged spelter. A Certificate of Compliance is required that indicates that the zinc-rich paint meets the above-referenced specification.

CONCRETE CULVERT PIPE

Note: Only Precast Concrete Manufacturers, under CP 11, that are on CDOT's Qualified Manufacturers List can be used:
https://www.codot.gov/business/apl/qualified-manufacturers-list.html

Inspection of the individual pieces of the lot is left to the supplier and the field personnel. The field inspection is to be done per AASHTO M 170.

After final pay quantities are known, document them on a CDOT Form 157.

VITRIFIED CLAY PIPE

The project field personnel should field-inspect the pipe and document information in the Project Files.

PIPE JOINT SEALING COMPOUND

Most joints will require some type of sealing material. The choice is limited to either performed plastic sealing compound or bituminous mastic. Both must meet AASHTO M 198 specifications. Portland cement grout is not allowed. Rubber gaskets are required for siphon and sanitary sewers and also may be used without further approval on storm sewers and culverts.

The performed plastic sealing compound is supplied with removable paper strips between layers. A primer is required. Instructions require the primer to dry hard before applying the joint sealer. It is strongly recommended that the primer be applied by the contractor at the Jobsite rather than by the pipe manufacturer in his plant. This helps keep dirt off the primer surface and coats any chipped surfaces. Cold and wet weather require special installation procedures.

On the CDOT Form 157 that accompanies the sample list trade name, manufacturer, and any analysis or specification data found on the label.

ITEM 604, MANHOLES

Manholes will have stamped on each section the date of manufacture and the name or trademark of the fabricator. Inspect these sections for the same characteristics listed and explained under Concrete Culvert Pipe. Document in the Project Files that the material was field-inspected and is acceptable, and add a statement to the effect that the material was in good condition when installed.

ITEM 606, GUARDRAIL

Treated Timber Posts & Galvanized Steel Posts

Project personnel will inspect all posts upon arrival on the project regardless of their source. This inspection will be documented on CDOT Form 157, an example of which appears at the end of this chapter. See Special Notice to Contractors for additional information.

Final acceptance is based on field inspection by project personnel.

Type 3 W-Beam Guard Rail

When either the weathering steel or galvanized steel arrives on the job, it must be stored in such a way that water will not get in between the stacked rails. Water in a confined area, as it would be between these rails, causes a rapid loss of galvanizing in the form of white rust and a definite kind of rusting in the weathering steel that leads to flaking and pitting, as well as an uneven rust pattern. The acceptance documentation can be done on the same CDOT Form 157 as used for acceptance of the posts.

ITEM 606, END ANCHORAGE

For individual components of end anchors and types, refer to the M & S Standards for a description of parts on each type. Further details are shown in the Standard Specifications, Section 710, and Subsection 710.09. The acceptance documentation can be done on the same CDOT Form 157 as used for acceptance/verification of the posts. List the above information on the CDOT Form 157.

ITEM 607, FENCES

Treated Timber Posts

Project personnel will inspect posts and note the source, field-inspect for compliance, and document on CDOT Form 157

ITEM 613, LIGHTING*

Luminaires

Many manufacturers of luminaires that comply with our specifications are "nationally known brands". It must be understood that they also manufacture luminaires that do not meet our specifications and therefore, it is necessary to check the ratings of the luminaires furnished against the requirements of the plans and specifications. Document this inspection on a CDOT Form 157. See Special Notice to Contractors for additional information.

Metal Light Standards (pole and arms)*

Many suppliers are capable of providing approved standards. Because the standards received on the job were made by a company previously approved, does not imply that they meet the requirements of the plans and specifications, since they also supply poles and arms in other sizes and to other specifications. It is necessary to check all features against the requirements of the plans and specifications. Document this inspection on a CDOT Form 157. See Special Notice to Contractors.

* See the Schedule for Item 613

ITEM 614, TRAFFIC CONTROL DEVICES

Sign Posts

Structural Steel: These posts have the break-away feature which requires the bolts to be torqued. The upper, or fuse plate bolts, are normally shop tightened. Therefore, field checking of these fuse plate bolts should be necessary. The lower or break-away bolts are tightened more than the required torque so that during shipment and erection, the two parts stay attached. Therefore, it is necessary after erection, for the contractor to loosen these break-away bolts and retighten them with a torque wrench to the torque values shown on the plans (Standard Drawing S-614-5). Be careful not to over-tighten them. It is very important to burr the threads of the break-away bolts to prevent the nuts from loosening. **Be sure to check the torque of all bolts because if they are not tightened properly, the sign will not function as designed.** Document in Project Files.

Flashing Yellow Beacons

Be sure that all features required by the standard drawing and the specifications are met by the models supplied.

Anchor Bolts for Sign Bridge Structure

The anchor bolts for wide flange posts and sign structures that go into these footings are part of the sign structure but are shipped ahead of them. Small structure anchor bolts and regular bolts should be field inspected and documented in Project Files. See Special Notice to Contractors.

ITEM 615, WATER CONTROL DEVICES

Drawing M-615-A requires the use of a joint sealer meeting Federal Specification SS-S-168 or approved equivalent to make the adjustable elbows watertight.

ITEM 618, POST-TENSIONING GROUT

Each project will collect a sample and send it to the Central Lab before use. The Chemical Lab will test the 1st sample from particular grout and send that result to each project that sends a sample for that grout until the test results are greater than 6 months old. Then the next sample submitted after the 6 months would be tested. The grout submittal shall comply with Section 618.09.

ITEM 624, DRAINAGE PIPE

There are several different types of drainage pipe materials available, each with different abrasion and corrosive resistant characteristics. To take economic advantage of this, ten different classes have been defined and the available drainage pipe materials designated as useable or not useable for each class, so the contractor can select the most economical material.

Most projects will have no corrosive problems. However, when they are encountered, they should be recognized during the soil survey. The decision on what Class of pipe to use is detailed in the CDOT Pipe Material Selection. The Soils Survey portion of Chapter 200 gives details on what to look for and when to suspect the existence of a corrosive condition.

CDOT Materials Forms - Applicable for Concrete

https://www.codot.gov/library/forms/form-numbers-broken-down

Materials Forms, Instructions & Examples Chapter

Form	Title
1188	Concrete Mix Submittal [Preceded by Contractor's supplemental documentation]
1373	Concrete Mix Design Report – [*computer output]*
157	Field Report for Sample Identification or Materials Documentation
46	Concrete Truck Mixer Inspection Certification
82	Concrete Specimen Transmittal
156	Concrete Test Results Summary
192	Report of Concrete Tests – [*computer output]*
193	Inspection- Quality Assurance Acceptance Report – [*computer output]*
196-A	Physical Test Report – [*computer output*]
199	Concrete Core Tests – [*computer output*]
276	Report of Concrete Placed
281	Concrete Batched and Placed
389	Field Report for Joint Sealant Testing
626	Field Laboratory Test Results
1372	Reinforcing bar Physical Test Report – [*computer output*]
1375	Concrete Field Tests Report – [*computer output*]