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DEPARTMENT ORDER)
)
 NO. 32)
 Series of 2025)
 dt. 2/11/2025

**SUBJECT: DPWH Standard Specification for
 Item 405 – Structural Concrete**

To support the Department's commitment to updating its standard specifications and adopting effective/appropriate solutions for specific project needs, the attached revised Standard Specification for **Item 405 – Structural Concrete** is hereby prescribed for adoption in DPWH infrastructure projects that require the utilization of such on the Program of Works.

The revised Standard Specification shall form part of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II. Likewise, the additional Pay Item subscripts are now included in the Standard Pay Item List and Project and Contract Management Application (PCMA).

This Order shall take effect immediately.


MANUEL M. BONOAN
 Secretary

Encl: DPWH Standard Specification for Item 405– Structural Concrete

Department of Public Works and Highways
 Office of the Secretary



WIN5U02110



DPWH Standard Specification for Item 405 – Structural Concrete

405.1 Description

405.1.1 Scope

This Item shall consist of furnishing, placing and finishing concrete in all structures except pavements in accordance with this Specification and conforming to the lines, grades, and dimensions shown on the Plans. Concrete shall consist of a mixture of Portland Cement, fine aggregate, coarse aggregate, admixture when specified, and water mixed in the proportions specified or approved by the Engineer.

405.1.2 Classes and Uses of Concrete

Five (5) classes of concrete are provided for in this Item, namely: A, B, C, P and Seal. Each class shall be used in that part of the structure as called for on the approved Plans.

The classes of concrete will generally be used as follows:

1. Class A

All superstructures and heavily reinforced substructures. The important parts of the structure included are slabs, beams, girders, columns, arch ribs, box culverts, reinforced abutments, retaining walls, and reinforced footings.

2. Class B

Footings, pedestals, massive pier shafts, pipe bedding, and gravity walls, unreinforced or with only a small amount of reinforcement.

3. Class C

Thin reinforced sections, railings, precast reinforced concrete piles and cribbing and for filler in steel grid floors.

4. Class P

Pre-stressed concrete structures and members.

5. Seal

Concrete deposited in water.

405.2 Material Requirements

405.2.1 Portland Cement

It shall conform to the applicable requirements of Item 700, Hydraulic Cement.

405.2.2 Fine Aggregate

It shall conform to the applicable requirements of Item 703, Aggregates.

405.2.3 Coarse Aggregate

It shall conform to the applicable requirements of Item 703, Aggregates, except that gradation shall conform to Table 405.1, Grading Requirements for Coarse Aggregate.

Table 405 (1).1 Grading Requirements for Coarse Aggregate

Sieve Designation, mm	Mass Percent Passing				
	Class A	Class B	Class C	Class P	Class Seal
63.0					
50.0	100	100			
37.5	95 - 100	-			100
25.0	-	35 - 70		100	95 - 100
19.0	35 - 70	-	100	-	-
12.5	-	10 - 30	90 - 100	-	25 - 60
9.5	10 - 30	-	40 - 70	20 - 55	-
4.75	0 - 5	0 - 5	0 - 15*	0 - 10*	0 - 10*

Note: *The measured cement content shall be within plus (+) or minus (-) 2 mass percent of the design cement content.

405.2.4 Water

It shall conform to the requirements of Item 714, Water.

405.2.5 Reinforcing Steel

It shall conform to the requirements of Item 710, Reinforcing Steel and Wire Rope.

405.2.6 Admixtures

Admixtures shall conform to the requirements of Item 311, Portland Cement Concrete Pavement.

405.2.7 Curing Materials

Curing materials shall conform to the requirements of Item 311, Portland Cement Concrete Pavement.

405.2.8 Elastomeric Compression Joint Seals

It shall conform to ASTM D2628, Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

405.2.9 Storage of Cement and Aggregates

Storage of cement and aggregates shall conform to the applicable requirements of Subsection 311.2.11, Storage of Cement and Aggregate.

405.3 Production Requirements

405.3.1 Proportioning and Strength of Structural Concrete

The concrete materials shall be proportioned in accordance with the requirements for each class of concrete as specified in Table 405.2, using the absolute volume method as outlined in the American Concrete Institute (ACI) Standard 211.1, "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete". Other methods of proportioning may be employed in the mix design with prior approval of the Engineer.

Trial mixes shall be done and it shall meet the concrete strength requirements as specified on the approved Plan. A change in the source of materials during the progress of work may necessitate a new mix design.

405.3.2 Consistency

Concrete shall have a consistency such that it will be workable in the required position. It shall be of such a consistency that it will flow around reinforcing steel but individual particles of the coarse aggregate when isolated shall show a coating of mortar containing its proportionate amount of sand. The consistency of concrete shall be gauged by the ability of the equipment to properly place it and not by the difficulty in mixing and transporting. The quantity of mixing water shall be determined by the Engineer and shall not be varied without his consent. Concrete as dry as it is practical to place with the equipment specified shall be used.

405.3.3 Batching

Measuring and batching of materials shall be done at a batching plant.

1. Portland Cement

Either sacked or bulk cement may be used. No fraction of a sack of cement shall be used in a batch of concrete unless the cement is weighed. All bulk cement shall be weighed on an approved weighing device. The bulk cement weighing hopper shall be properly sealed and vented to preclude dusting operation. The discharge chute shall not be suspended from the weighing hopper and shall be so arranged that cement will neither be lodged in it nor leak from it.

Accuracy of batching shall be within plus (+) or minus (-) 1 mass percent.

2. Water

Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not more than 1 percent.

3. Aggregates

Stockpiling of aggregates shall be in accordance with Subsection 311.2.10. All aggregates whether produced or handled by hydraulic methods or washed, shall be stockpiled or binned for draining for at least 12 hours prior to batching. Rail shipment requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. If the aggregates contain high or non-uniform moisture content, storage or stockpile period in excess of 12 hours may be required by the Engineer.

Batching shall be conducted as to result in a two (2) mass percent maximum tolerance for the required materials.

4. Bins and Scales

The batching plant shall include separate bins for bulk cement, fine aggregate and for each size of coarse aggregate, a weighing hopper, and scales capable of determining accurately the mass of each component of the batch.

Scales shall be accurate to one-half (0.5) percent throughout the range used.

5. Batching

When batches are hauled to the mixer, bulk cement shall be transported either in waterproof compartments or between the fine and coarse aggregate. When cement is placed in contact with moist aggregates, batches will be rejected unless mixed within 1-1/2 hours of such contact. Sacked cement may be transported on top of the aggregates.

Batches shall be delivered to the mixer separate and intact. Each batch shall be dumped cleanly into the mixer without loss, and, when more than one batch is carried on the truck, without spilling of material from one batch compartment into another.

6. Admixtures

The Contractor shall follow an approved procedure for adding the specified amount of admixture to each batch and will be responsible for its uniform operation during the progress of the work. He shall provide separate scales for the admixtures which are to be proportioned by weight, and accurate measures for those to be proportioned by volume. Admixtures shall be measured into the mixer with an accuracy of plus or minus three (3) percent.

The use of Calcium Chloride as an admixture will not be permitted.

405.3.4 Mixing and Delivery

Concrete may be mixed at the site of construction, at a central point or by a combination of central point and truck mixing or by a combination of central point mixing and truck agitating. Mixing and delivery of concrete shall be in accordance with the appropriate requirements of AASHTO M 157 except as modified in the following paragraphs of this section, for truck mixing or a combination of central point and truck mixing or truck agitating. Delivery of concrete shall be regulated so that placing is at a continuous rate unless delayed by the placing

operations. The intervals between delivery of batches shall not be so great as to allow the concrete in place to harden partially, and in no case shall such an interval exceed 30 minutes.

In exceptional cases and when volumetric measurements are authorized, for small project requiring less than 75 cu.m. per day of pouring, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture condition of the aggregates, including the bulking effect in the fine aggregate. Batching and mixing shall be in accordance with ASTM C685, Section 6 through 9.

Concrete mixing, by chute is allowed provided that a weighing scales for determining the batch weight will be used.

For batch mixing at the site of construction or at a central point, a batch mixer of an approved type shall be used. Mixer having a rated capacity of less than a one-bag batch shall not be used. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity as shown on the manufacturer's standard rating plate on the mixer except that an overload up to 10 percent above the mixer's nominal capacity may be permitted, provided concrete test data for strength, segregation, and uniform consistency are satisfactory and provided no spillage of concrete takes place. The batch shall be so charge into the drum that a portion of the water shall enter in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first 15 seconds of the mixing period. Mixing time shall be measured from the time all materials, except water, are in the drum. Mixing time shall not be less than 60 seconds for mixers having a capacity of 1.5 m³ or less. For mixers having a capacity greater than 1.5m³, the mixing time shall not be less than 90 seconds. If timing starts, the instant the skip reaches its maximum raised position, 4 seconds shall be added to the specified mixing time. Mixing time ends when the discharge chute opens.

The mixer shall be operated at the drum speed as shown on the manufacturer's name plate on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed off by the Contractor at his own expenses.

The timing device on stationary mixers shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the Contractor will be permitted to continue operations while it is being repaired, provided he furnishes an approved timepiece equipped with minute and second hands. If the timing device is not placed in good working order within 24 hours, further use of the mixer will be prohibited until repairs are made.

Retempering concrete will not be permitted. Admixtures for increasing the workability, for retarding the set, or for accelerating the set or improving the pumping characteristics of the concrete will be permitted only when specifically provided for in the Contract, or authorized in writing by the Engineer.

1. Mixing Concrete: General

Concrete shall be thoroughly mixed in a mixer of an approved size and type that will insure a uniform distribution of the materials throughout the mass.

All concrete shall be mixed in mechanically operated mixers. Mixing plant and equipment for transporting and placing concrete shall be arranged with an ample auxiliary installation to provide a minimum supply of concrete in case of breakdown of machinery or in case the normal supply of concrete is disrupted. The auxiliary supply of concrete shall be sufficient to complete the casting of a section up to a construction joint that will meet the approval of the Engineer.

Equipment having components made of aluminum or magnesium alloys, which would have contact with plastic concrete during mixing, transporting or pumping of Portland Cement concrete, shall not be used.

Concrete mixers shall be equipped with adequate water storage and a device of accurately measuring and automatically controlling the amount of water used.

Materials shall be measured by weighing. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. The accuracy of all weighing devices except that for water shall be such that successive quantities can be measured to within one (1) percent of the desired amounts. The water measuring device shall be accurate to plus or minus 0.5 mass percent. All measuring devices shall be subject to the approval of the Engineer. Scales and measuring devices shall be tested at the expense of the Contractor as frequently as the Engineer may deem necessary to insure their accuracy.

Weighing equipment shall be insulated against vibration or movement of other operating equipment in the plant. When the entire plant is running, the scale reading at cut-off shall not vary from the weight designated by the Engineer more than one (1) mass percent for cement, one and a half (1-1/2) mass percent for any size of aggregate, or one (1) mass percent for the total aggregate in any batch.

2. Mixing Concrete at Site

Concrete mixers may be of the revolving drum or the revolving blade type and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. The pick-up and throw-over blades of mixers shall be restored or replaced when any part or section is worn 20 mm or more below the original height of the manufacturer's design. Mixers and agitators which have an accumulation of hard concrete or mortar shall not be used.

When bulk cement is used and volume of the batch is 0.5 m³ or more, the scale and weigh hopper for Portland Cement shall be separate and distinct from the aggregate hopper or hoppers. The discharge mechanism of the bulk cement weigh hopper shall be interlocked against opening before the full amount of cement is in the hopper. The discharging mechanism shall also be interlocked against opening when the amount of cement in the hopper is underweight by more than one (1) mass percent or overweight by more than three (3) mass percent of the amount specified.

When the aggregate contains more water than the quantity necessary to produce a saturated surface dry condition, representative samples shall be taken and the moisture content determined for each kind of aggregate.

The batch shall be so charged into the mixer that some water will enter in advance of cement and aggregate. All water shall be in the drum by the end of the first quarter of the specified mixing time.

Cement shall be batched and charged into the mixer so that it will not result in loss of cement due to the effect of wind, or in accumulation of cement on surface of conveyors or hoppers, or in other conditions which reduce or vary the required quantity of cement in the concrete mixture.

The entire content of a batch mixer shall be removed from the drum before materials for a succeeding batch are placed therein. The materials composing a batch except water shall be deposited simultaneously into the mixer.

All concrete shall be mixed for a period of not less than 1-1/2 minutes after all materials, including water, are in the mixer. During the period of mixing, the mixer shall operate at the speed for which it has been designed.

Mixers shall be operated with an automatic timing device that can be locked by the Engineer. The time device and discharge mechanics shall be so interlocked that during normal operation no part of the batch will be charged until the specified mixing time has elapsed.

The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand, and water to coat inside of the drum without reducing the required mortar content of the mix. When mixing is to cease for a period of one hour or more, the mixer shall be thoroughly cleaned.

3. Mixing Concrete at Central Plant

Mixing at central plant shall conform to the requirements for mixing at the site.

4. Mixing Concrete in Truck

Truck mixers, unless otherwise authorized by the Engineer, shall be of the revolving drum type, water-tight, and so constructed that the concrete can be mixed to insure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured and charged into the drum at the proportioning plant. Except as subsequently provided, the truck mixer shall be equipped with a device by which the quantity of water added can be readily verified. The mixing water may be added directly to the batch, in which case a tank is not required. Truck mixers may be required to be provided with a means of which the mixing time can be readily verified by the Engineer.

The maximum size of batch in truck mixers shall not exceed the minimum rated capacity of the mixer as stated by the manufacturer and stamped in metal on the mixer. Truck mixing, shall, unless otherwise directed be continued for not less than 100 revolutions after all ingredients, including water, are in the drum. The mixing speed shall not be less than 4 rpm, nor more than 6 rpm.

Mixing shall begin within 30 minutes after the cement has been added either to the water or aggregate, but when cement is charged into a mixer drum containing water or surface wet aggregate and when the temperature is above 32°C, this limit shall be reduced to 15 minutes.

The limitation in time between the introduction of the cement to the aggregate and the beginning of the mixing may be waived when, in the judgement of the Engineer, the aggregate is sufficiently free from moisture, so that there will be no harmful effects on the cement.

When a truck mixer is used for transportation, the mixing time specified in Subsection 405.4.4 at a stationary mixer may be reduced to 30 seconds and the mixing completed in a truck mixer. The mixing time in the truck mixer shall be as specified for truck mixing.

5. Transporting Mixed Concrete

Mixed concrete may only be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturers of the equipment as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable point for adequate placement and consolidation in place.

Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity. They shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point.

The rate of discharge of mixed concrete from truck mixers or agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within one hour, or before 250 revolutions of the drum or blades, whichever comes first, after the introduction of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 30°C, or above, a time less than one hour will be required.

6. Delivery of Mixed Concrete

The Contractor shall have sufficient plant capacity and transportation apparatus to insure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete. The rate shall be such that the interval between batches shall not exceed 20 minutes. The methods of delivering and handling the concrete shall be such as will facilitate placing of the minimum handling.

405.4 Method of Measurement

The quantity of structural concrete to be paid for will be the final quantity placed and accepted in the completed structures. No deduction will be made for the volume occupied by pipe less than 100 mm in diameter or by reinforcing steel, anchors, conduits, weep holes or expansion joint materials.

405.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 405.4, Method of Measurement shall be paid for at the Contract Unit Price for each of the Pay Item listed below that is included in the Bill of Quantities.

Payment shall constitute full compensation for furnishing, placing and finishing of the Concrete Work including all form materials, labor, equipment, tools and incidentals necessary to complete the work prescribed in the Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
405 (1)a1	Structural Concrete (Class A, 20.68 MPa, 7 days)	Cubic Meter
405 (1)a2	Structural Concrete (Class A, 20.68 MPa, 14 days)	Cubic Meter
405 (1)a3	Structural Concrete (Class A, 20.68 MPa, 28 days)	Cubic Meter
405 (1)b1	Structural Concrete (Class A, 27.58 MPa, 7 days)	Cubic Meter
405 (1)b2	Structural Concrete (Class A, 27.58 MPa, 14 days)	Cubic Meter
405 (1)b3	Structural Concrete (Class A, 27.58 MPa, 28 days)	Cubic Meter
405 (1)c1	Structural Concrete (Class A, 30.0 MPa, 7 days)	Cubic Meter
405 (1)c2	Structural Concrete (Class A, 30.0 MPa, 14 days)	Cubic Meter
405 (1)c3	Structural Concrete (Class A, 30.0 MPa, 28 days)	Cubic Meter
405 (1)d1	Structural Concrete (Class A, 36.0 MPa, 7 days)	Cubic Meter
405 (1)d2	Structural Concrete (Class A, 36.0 MPa, 14 days)	Cubic Meter
405 (1)d3	Structural Concrete (Class A, 36.0 MPa, 28 days)	Cubic Meter
405 (1)e1	Structural Concrete [41.0 MPa, (Non-Shrink) 7 days]	Cubic Meter
405 (1)e2	Structural Concrete [41.0 MPa, (Non-Shrink) 14 days]	Cubic Meter
405 (1)e3	Structural Concrete [41.0 MPa, (Non-Shrink) 28 days]	Cubic Meter
405 (1)f3	Structural Concrete (Class A, 42.0 MPa, 28 days)	Cubic Meter
405 (1)g1	Structural Concrete (Class A, 35.0 MPa, 7 days)	Cubic Meter
405 (1)g2	Structural Concrete (Class A, 35.0 MPa, 14 days)	Cubic Meter
405 (1)g3	Structural Concrete (Class A, 35.0 MPa, 28 days)	Cubic Meter
405 (1)h1	Structural Concrete (Class A, 40.0 MPa, 7 days)	Cubic Meter
405 (1)h2	Structural Concrete (Class A, 40.0 MPa, 14 days)	Cubic Meter
405 (1)h3	Structural Concrete (Class A, 40.0 MPa, 28 days)	Cubic Meter
405 (1)i1	Structural Concrete (Class A, 45.0 MPa, 7 days)	Cubic Meter
405 (1)i2	Structural Concrete (Class A, 45.0 MPa, 14 days)	Cubic Meter
405 (1)i3	Structural Concrete (Class A, 45.0 MPa, 28 days)	Cubic Meter
405 (1)j1	Structural Concrete (Class A, 50.0 MPa, 7 days)	Cubic Meter
405 (1)j2	Structural Concrete (Class A, 50.0 MPa, 14 days)	Cubic Meter
405 (1)j3	Structural Concrete (Class A, 50.0 MPa, 28 days)	Cubic Meter
405 (1)I3	Structural Concrete (Class A, 21 MPa, 28 days)	Cubic Meter
405 (2)a	Structural Concrete (Class B, 20.68 MPa)	Cubic Meter
405 (2)b	Structural Concrete (Class B, 27.58 MPa)	Cubic Meter
405 (2)c	Structural Concrete (Class B, 18.0 MPa)	Cubic Meter
405 (2)d	Structural Concrete (Class B, 16.50 MPa)	Cubic Meter
405 (3)a	Structural Concrete (Class C, 20.68 MPa)	Cubic Meter

Pay Item Number	Description	Unit of Measurement
405 (3)b	Structural Concrete (Class C, 27.58 MPa)	Cubic Meter
405 (4)a1	Structural Concrete (Class P, 34.47 MPa, 7 days)	Cubic Meter
405 (4)a2	Structural Concrete (Class P, 34.47 MPa, 14 days)	Cubic Meter
405 (4)a3	Structural Concrete (Class P, 34.47 MPa, 28 days)	Cubic Meter
405 (4)b1	Structural Concrete (Class P, 41.37 MPa, 7 days)	Cubic Meter
405 (4)b2	Structural Concrete (Class P, 41.37 MPa, 14 days)	Cubic Meter
405 (4)b3	Structural Concrete (Class P, 41.37 MPa, 28 days)	Cubic Meter
405 (4)c1	Structural Concrete (Class P, 38.0 MPa, 7 days)	Cubic Meter
405 (4)c2	Structural Concrete (Class P, 38.0 MPa, 14 days)	Cubic Meter
405 (4)c3	Structural Concrete (Class P, 38.0 MPa, 28 days)	Cubic Meter
405 (4)d3	Structural Concrete (Class P, 50.0 MPa, 28 days)	Cubic Meter
405 (4)e3	Structural Concrete (Class P, 40 MPa, 28 days)	Cubic Meter
405 (5)	Seal Concrete	Cubic Meter
405 (6)	Structural Concrete, painting works	Square Meter
405 (7)a	Structural Concrete for Box Girder (Class Y, 42.0 MPa)	Cubic Meter
405 (7)b	Structural Concrete for Segmental Box Girder (Class Y, 55.0 MPa)	Cubic Meter
405 (8)	Protective Mortar (using PCM w/ Lithium)	Square Meter
405 (9)a	Structural Precast Concrete (34.5 MPa, 7 days)	Square Meter
405 (9)b	Structural Precast Concrete (34.5 MPa, 14 days)	Square Meter
405 (9)c	Structural Precast Concrete (34.5 MPa, 28 days)	Square Meter
405 (10)a	Structural Precast Concrete (34.5 MPa, 7 days)	Cubic Meter
405 (10)b	Structural Precast Concrete (34.5 MPa, 14 days)	Cubic Meter
405 (10)c	Structural Precast Concrete (34.5 MPa, 28 days)	Cubic Meter