

## \_\_\_\_\_ PLACING

a. General. - The Contractor shall notify the Contracting Officer before batching begins for placement of concrete. Unless inspection is waived for that specific placement, placing shall be performed only in the presence of an authorized Government inspector. Placement shall not begin until all preparations are complete and the concrete placement check-out card has been signed by the Contractor or his representative and the authorized representative of the Contracting Officer, substantiating completion of all preparations for that placement.

All surfaces upon or against which concrete is to be placed shall be prepared in accordance with paragraph \_\_\_\_\_ (Preparation for Placing).

Retempering of concrete will not be permitted. Concrete which has become so stiff that proper placing cannot be assured shall be wasted.

Concrete shall not be placed in standing water except with written permission from the Contracting Officer, and the method of placing shall be subject to approval. Concrete shall not be placed in running water, and shall not be subjected to running water until after the concrete has hardened.

Concrete shall be deposited as nearly as practical in its final position and shall not be allowed to flow in such a manner that the lateral movement will cause segregation of the coarse aggregate from the concrete mass. Methods and equipment employed in depositing concrete in forms shall minimize clusters of coarse aggregate. Clusters that occur shall be scattered before the concrete is vibrated.

Forms shall be constantly monitored and their position adjusted as necessary during concrete placement in accordance with paragraph \_\_\_\_\_ (Forms).

All concrete <sup>1</sup>(, except concrete in tunnel lining and concrete placed on unformed slopes,) shall be placed in approximately horizontal layers. The depths of layers shall not exceed 20 inches. The Government reserves the right to require lesser depths of layers where concrete cannot otherwise be placed and consolidated in accordance with the requirements of these specifications. Exposed construction joints shall be made straight and level or plumb except as shown otherwise on the drawings.

Except as shown otherwise on the drawings, construction joints intersecting sloping exposed concrete surfaces shall be inclined near the exposed surface to prevent feathered edges. The angle between such an inclined surface and the form shall be not less than 50E nor more than 130E, and that surface angle shall extend into the concrete member for at least 3 inches.

To facilitate consolidation and bond at construction joints, structural concrete placements <sup>2</sup>(containing 1-1/2-inch or less nominal maximum size aggregate) shall either be started with an oversanded mix or else the concrete immediately above the joint shall be vibrated with twice as much time and effort as normally needed for concrete of that consistency. The

oversanded mix shall be placed 2 to 6 inches deep on the joint and shall contain 3/4-inch-nominal maximum size aggregate; a maximum net water-<sup>1</sup>(cement) (cementitious materials) ratio of 0.47, by weight; 2 percent additional sand, by volume of total aggregate, based on standard 3/4-inch mix; 6 percent air, by total volume of concrete; and having a maximum slump of 4 inches. <sup>2</sup>(Structural concrete placements containing 3-inch nominal maximum size aggregate shall be started with the above-specified oversanded mix placed 2 to 6 inches deep on the joint.)

<sup>1</sup>[If concrete is placed monolithically around openings having vertical dimensions greater than 2 feet, or if concrete in decks, floor slabs, beam girders, or other similar parts of structures is placed monolithically with supporting concrete, the following requirements shall be strictly observed:

- (1) Concrete shall be placed up to the top of the formed openings at which point further placement will be delayed to accommodate settlement of fresh concrete. If bevels are specified beneath nearly horizontal structural members such as decks, floor slabs, beams, and girders, such bevels being between the nearly horizontal members and the vertical supporting concrete below, concrete shall be placed to the bottom of the bevels before delay of placement.
- (2) The last 2 feet or more of concrete placed below horizontal members or bevels shall be placed with a 2-inch or less slump and shall be thoroughly consolidated.
- (3) Placing of concrete shall be delayed from 1 to 3 hours, but in no case shall placement be delayed so long that the concrete placed before the delay is not readily penetrated by vibrators.

When consolidating concrete which is placed over formed openings after the delay period has elapsed and placement resumes, it is especially important that adequate consolidation be achieved in the concrete at the interface of the fresh concrete and the underlying plastic concrete. The vibrator shall repeatedly penetrate and thoroughly reconsolidate the upper portion of the underlying concrete which was placed before the delay.]

<sup>1</sup>(The equipment used in placing concrete tunnel lining and the methods of operation shall not cause concrete to be discharged into the forms at high velocity. The end of the discharge line shall be kept well buried in the fresh concrete during placement of the arch and sidewalls to assure complete filling. The depth of this burial shall be from 5 to 10 feet depending upon the thickness of the arch. The end of the discharge line shall be marked so as to readily indicate the depth of burial at all times.

Pneumatic equipment, if used to place the tunnel invert, shall be equipped to prevent separation and segregation of the concrete during discharge.)

<sup>3</sup>(Where placements are terminated with sloping joints, the Contractor shall thoroughly consolidate the concrete at such joints to a reasonably uniform and stable slope. If thorough

consolidation at the sloping joints is not obtained, the Government reserves the right to require the use of bulkhead construction joints. The concrete at the surface of such sloping joints shall be clean and surface dry before being covered with fresh concrete. The cleaning of such sloping joints shall consist of the removal of all loose and foreign material.)

In placing concrete on unformed slopes so steep as to make internal vibration of the concrete impractical without forming, the concrete shall be placed ahead of a nonvibrating slip-form screed extending approximately 2-1/2 feet back from its leading edge. Concrete ahead of the slip-form screed shall be consolidated by internal vibrators so as to ensure complete filling under the slip-form.

A cold joint is an unplanned joint resulting when a concrete surface hardens before the next batch is placed against it. Cold joints are undesirable and should be avoided. However, in the event of equipment breakdown or other unavoidable prolonged interruption of continuous placing when it appears that unconsolidated concrete may harden to the extent that later vibration will not fully consolidate it, the Contractor shall immediately consolidate such concrete to a stable and uniform slope. If delay of placement is then short enough to permit penetration of the underlying concrete, placement shall resume with particular care being taken to thoroughly penetrate and revibrate the concrete surface placed before the delay. If concrete cannot be penetrated with a vibrator, the cold joint shall then be treated as a construction joint if the design requirements are such that a construction joint is practical. If a construction joint will impair the structural integrity, as determined by the Contracting Officer, the concrete shall be repaired as determined by the Contracting Officer. Repairs in some instances will include removal of all or a portion of the previously placed concrete and the Contractor will not be entitled to any payment for such work.

Care shall be taken to prevent cold joints when placing concrete in any part of the work. The concrete-placing rate shall ensure concrete is placed while the previously placed, adjacent concrete is plastic so that the concrete can be made monolithic by normal use of the vibrators.

Concrete shall not be placed in rain sufficiently heavy or prolonged to wash mortar from concrete. A cold joint may necessarily result from prolonged heavy rainfall.

The Contractor shall be entitled to no additional payment, over the unit prices bid in the schedule for concrete, by reason of any limitations in the placing of concrete required under the provisions of this paragraph.

b. Transportation. - Normally, concrete shall be deposited in its final position in the placement within 90 minutes after the introduction of the mix water and <sup>1</sup>(cement) (cementitious materials) into the mixer. This limitation may be waived if the concrete is of such slump after the 90-minute time limit that it can be satisfactorily placed without the addition of water. Furthermore, a time limit less than 90 minutes may be invoked during hot weather or under conditions contributing to quick stiffening of the concrete. The methods and equipment used for transporting concrete from the batch plant and the elapsed time

during transportation shall not cause measurable segregation of coarse aggregate or slump loss exceeding 2 inches.

Concrete shall be deposited as near as practical to its final position by use of buckets, chutes, conveyors, or concrete pumps. The use of aluminum pipe or aluminum chutes for delivery of concrete will not be permitted. Concrete buckets shall be capable of promptly discharging concrete of the specified mix design, and the dumping mechanism shall be capable of discharging at one location repeated small portions of concrete from a full bucket. Buckets and conveyors shall be designed for attaching drop chutes or tremies which shall be used to deposit concrete whenever the concrete must be dropped more than 10 feet from the bucket to the placing surface.

Concrete pumps shall be equipped with slicklines having a minimum diameter of 5 inches. Pumps and slicklines shall be capable of transporting concrete containing a maximum amount of coarse aggregate and a minimum amount of sand, cement, and water. The minimum proportion of 3/4- to 1-1/2-inch aggregate shall be 5.5 cubic feet (solid volume) per cubic yard of concrete and, dependent upon the shape and texture of the aggregate utilized, this proportion will be increased as practical.

Buckets, chutes, hoppers, pumps, transit mix trucks, and other equipment shall readily handle and place concrete of the specified slump. The Contractor shall, when directed, replace inadequate transporting equipment with acceptable equipment.

c. Consolidation. - Concrete shall be consolidated by vibration. The vibration shall be sufficient to remove all undesirable air voids from the concrete, including the air voids trapped against forms and construction joints. Close attention and additional effort may be required to adequately consolidate concrete adjacent to construction joints and sloping surfaces. Such close attention and additional effort required to consolidate concrete adjacent to construction joints and sloping surfaces shall be at no additional cost to the Government. After consolidation, the concrete shall be free of rock pockets and honeycomb areas, and shall be closed snugly against all surfaces of forms, construction joints, and embedments.

Except as hereinafter provided, consolidation of all concrete shall be by immersion-type vibrators. Immersion-type vibrators shall be operated in nearly vertical position and the vibrating head shall penetrate and revibrate the concrete in the upper portion of the underlying layer. Care shall be exercised to avoid contact of the vibrating head with embedded items and with formed surfaces which will later be exposed to view. Concrete shall not be placed upon other plastic concrete until the previously placed concrete has been thoroughly consolidated.

<sup>1</sup>(Consolidation of concrete in the sidewalls and arch of tunnel lining shall be by rigidly attached form vibrators supplemented where practicable by immersion-type vibrators.)

<sup>1</sup>[Form vibrators shall be used in conjunction with slip-form lining machines to consolidate concrete in <sup>1</sup>(canal, lateral, and reservoir) linings. Immersion-type vibrators shall be used to

supplement form vibrators when needed to adequately consolidate linings. Such vibrators shall be arranged for effective uniform consolidation of the concrete. The Government may remove samples of the hardened concrete for testing and examination, and the Contractor shall repair, at no cost to the Government, concrete from which such samples are removed.]

Immersion-type vibrators shall be operated at speeds of at least 7,000 vibrations per minute when immersed in concrete. <sup>1</sup>(Form vibrators shall operate at speeds of at least 8,000 vibrations per minute when consolidating concrete.) The Contractor shall immediately replace improperly operating vibrators with acceptable vibrators.

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<sup>1</sup>Delete or revise as required.

<sup>2</sup>Delete when concrete containing aggregate larger than 1-1/2-inch nominal maximum size is not specified.

<sup>3</sup>Include for free-flow tunnels only.

3-15-85 Revisions: Revised subparagraph b. Other minor revisions throughout.