

BUILDING MATERIALS CONCRETE PROPORTIONING, BATCHING, AND MIXING

STANDARD ENGINEERING SPECIFICATIONS

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Page 1 of 3

1. GENERAL

1.1 Standard Engineering Specification SC1A applies to and is a part of this specification.

2. COMPRESSIVE STRENGTH AND CLASSIFICATION

2.1 Compressive Strength. The class of concrete or design strength indicated on the drawings is based on the minimum ultimate compressive strength at 28 days when normal or air-entraining cement is used, or at 7 days with the use of high early-strength cement.

2.1.1 Classification. Dense Aggregate Concrete. The minimum compressive strength and minimum allowable quantity of cement used shall be as shown in Table I.

Table I

Class	Compressive Strength PSI	Min. Allowable Cement per Cu. Yd.
A	5000	6.5 cu. ft.
B	4000	5.5 cu. ft.
C	3000	4.7 cu. ft.
D	2500	4.4 cu. ft.
E	1500	4.0 cu. ft.

2.1.2 Classification. Lightweight Aggregate Concrete. Compressive strength of concrete made from Types I or II aggregates (Std. Eng. Spec. SB3A) shall be as indicated on the drawings. The minimum quantity of cement used shall be as determined by the Testing Laboratory.

3. PROPORTIONING

3.1 Determination of Proportions. The proportions of cement, aggregates, and water necessary to produce concrete having the required strength shall be determined by the Testing Laboratory designated by du Pont (see Std. Eng. Spec. SB5A). Proportioning in the field shall follow the design of the mix, as set forth by this Testing Laboratory, for the particular strength of concrete involved.

3.1.1 The mix shall be designed with the cement and aggregates, conforming to the applicable Standard Engineering Specifications, and which are proposed for use in the work, and a necessary

quantity of these materials shall be forwarded to the Laboratory at least 35 days prior to the starting of concrete work.

3.1.2 In the event that sufficient and reliable test records are furnished on concrete of the same class (consisting of the same materials from the same source as that proposed for use in this project and used in current work), and provided that such test records are acceptable to du Pont, the necessity for determination of proportions for the particular class of concrete involved, as specified above, will be waived.

3.1.3 Only Type I and Type II lightweight aggregates conforming to the requirements of Std. Eng. Spec. SB3A shall be used in lightweight concrete for structural purposes. A dense fine aggregate may be used, at the discretion of the Testing Laboratory, providing use of such aggregate does not increase the weight of the concrete beyond that desired.

3.1.4 Proportions of cement and aggregates for concrete made from Type III aggregates, Std. Eng. Spec. SB3A, shall be 1 part cement to 6 parts aggregate, unless otherwise called for in the project specifications.

3.2 If, during the progress of the work, there is a desire to use materials other than those originally approved or if the materials from the sources originally approved change in characteristics, there shall be submitted for approval evidence satisfactory to du Pont that the new combination of materials will produce concrete meeting the requirements of this specification and of the Testing Laboratory; and that their use will not bring about objectionable changes in appearance of the building or structure.

4. CONSISTENCY

4.1 Concrete shall be of such consistency and composition that it can be worked readily into the corners and angles of the forms and around the reinforcement, without segregation of materials or presence of surface water.

4.1.1 Dense Aggregate Concrete. Subject to the limiting requirements of Table II below and du Pont's approval, adjustments shall be made to



the cement-aggregate ratio as may be necessary, during the progress of the work, to produce a mixture which will be easily placeable at all times, due consideration being given to the methods of placing and compaction. The water-cement ratio, as set forth by the Testing Laboratory, must be maintained.

Table II

Portion of Structure	Slump, Inches	
	Max.	Min.
Reinforced foundation walls and footings	6	2
Plain footings, substructure walls	4	1
Slabs, beams, columns, and reinforced walls	6	3
Heavy mass construction	3	1

4.1.1.1 Compaction. When mechanical vibration is used for compaction, the limiting consistencies in Table II may be modified subject to the approval of Testing Laboratory and du Pont. The consistencies, however, shall be such that the full requirements of Paragraph 4.1 shall be satisfied.

4.1.2 Lightweight Aggregate Concrete. For the purpose of design, slump of concrete using Types I or II aggregates shall be approximately 4 inches, but placeability with non-segregation shall, at all times, govern.

4.1.2.1 Concrete, made from Type III aggregate, shall contain enough water to produce a slump of 6 inches to 9 inches.

5. ADMIXTURES

5.1 Dense Aggregate Concrete. Admixtures may be used, subject to the approval of du Pont and the Testing Laboratory. The type used shall depend on the specific quality which it is desired to introduce into the mix. The use of an admixture (any type) shall not, under any circumstances, decrease the ultimate (28-day) strength of the concrete. The manufacturer's directions, as to quantity to be used and the method of using his product, shall be strictly followed.

5.1.1 Whenever air-entraining agents are used, the strength of the resulting concrete must be closely watched and if unsatisfactory, fine aggregate content must be adjusted to suit. This also applies to Item 5.2, below.

5.2 Lightweight Aggregate Concrete. To increase workability, mixes, using Types I or II aggregates,

shall be designed around the use of an air-entraining agent which is acceptable under ASTM specifications. The introduction of the air-entraining agent shall result in approximately 4 percent of entrainment when concrete is tested in accordance with the method outlined in ASTM C185.

6. TEST CYLINDERS

6.1 Dense Aggregate Concrete. During the progress of the work, a reasonable number of test specimens shall be taken, as required by du Pont and local codes. However, at least three test cylinders of dense aggregate concrete shall be made from each 250 cubic yards of each class of concrete or once per week for each class when small quantities are poured.

6.2 Lightweight Aggregate Concrete. Requirements for lightweight concrete made from Type I aggregates shall be the same except that the test specimens shall be taken from each 100 cubic yards, or each day's pour, if less. Test specimens of concrete made from Types II and III aggregate will not be required.

6.3 Specimens shall be taken at random, under du Pont's supervision, and the cylinders shall be made and cured in accordance with the methods specified in ASTM C31.

7. BATCHING

7.1 The cement and both fine and coarse aggregate shall be measured by weight and the batching equipment shall be capable of control within 1 percent of the desired amount. Fine and coarse aggregates shall be measured separately. Cement in standard packages (sacks) need not be weighed but bulk cement and fractional packages shall be measured. Water shall be measured by volume or weight and the measuring device shall be susceptible of control, accurate to plus or minus $\frac{1}{2}$ percent of the tank capacity.

7.2 Measurement of cement and Type III lightweight aggregates shall be by volume.

8. MIXING

8.1 Site Mixing. Mixing equipment shall be capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified time and of discharging the mixture without segregation. Unless otherwise authorized by du Pont, mixing of concrete shall be done in a



batch mixer of an approved type. The volume of mixed material per batch shall not exceed the manufacturer's rated mixer capacity.

8.1.1 Dense Aggregate Concrete. The batch shall be so charged into the mixer that some water will enter in advance of cement and aggregate and all water shall be in the drum by the end of the first 15 seconds of the specified mixing time. The mixing time for mixers of 1 cubic yard capacity or less shall be not less than one minute. For larger mixers, this minimum shall be increased 15 seconds for each cubic yard or fraction thereof of additional capacity. Mixing time shall be measured from the time all cement and aggregates are in the drum.

8.1.2 Lightweight Aggregate Concrete. When Types I or II aggregates are used, the stockpile of coarse aggregate shall be wetted down thoroughly at least 2 hours before mixing is to start. Water and air-entraining agent shall be charged into the mixer first. Dry ingredients shall be placed into the charging skip in the following sequence; sand, cement, and finally coarse aggregates. Minimum mixing time shall be 3 minutes after entire mix is charged into the mixer.

8.1.2.1 Concrete made with Type III aggregate shall preferably be mixed in an approved mixer designed for mixing plaster. Charging sequence shall be that normally used for plaster mixes, using enough water to satisfy absorption of aggregate and slump requirements.

8.2 Ready-Mixed Concrete shall be batched, mixed, and delivered in accordance with ASTM C94, on the basis described under "Alternate No. 2" therein.

8.2.1 When high early-strength cement is used, the concrete shall be delivered so the total elapsed time from the plant to the point of placement does not exceed 50 minutes.

8.2.2 The method and time of delivery shall be controlled by plant delivery slips issued to the driver. These slips shall contain the name and location of the plant, the size and proportions of the batch, and the time mixing started. Upon arrival at the job, each slip shall be delivered to du Pont and be completed to show the time the concrete is discharged from the truck.

8.3 Air-Entrained Concrete. When air-entraining cement is used, the mixing shall be such that fresh concrete will have entrained air of not less than 3 percent or more than 6 percent at the point of placement. Tests for air entrainment shall be made, when directed by du Pont, in accordance with ASTM C173.

9. WATER

9.1 Water shall be clean and free of oil, acids, alkali, and organic materials. In general, water currently being used for human consumption will be satisfactory for use in concrete. All other water must be approved by the Testing Laboratory.

10. RETEMPERING

10.1 Retempering of concrete which has partially hardened (that is, remixing with or without additional cement, aggregate, or water) will not be permitted.

11. COLD WEATHER REQUIREMENTS

11.1 Adequate equipment, approved by du Pont, shall be used for heating the concrete materials during freezing or near freezing weather. No frozen materials or materials containing ice shall be used.

11.2 The heating of materials (aggregates and water) shall result in mixed concrete having a minimum temperature of 50 degrees F. at the point of placement. However, the temperature of materials entering the mixer shall not be more than 125 degrees F.

11.3 The use of chemicals to lower the freezing point of concrete or decrease the time required for initial set will not be permitted, without specific approval of du Pont.

12. METHOD OF MEASUREMENT

12.1 Method of measurement for pay quantities under unit prices shall be on a cubic-yard basis, determined as follows:

12.1.1 Concrete Purchased in Place. The cubic yards for payment shall be computed from the absolute volume yield as determined by actual measurement of concrete in place. All openings and projections shall be deducted and corners shall not be doubled in computing the volume.

12.1.2 Concrete Delivered for Placing. The unit shall be cubic yard, and payment made at the unit prices quoted for the various classes of concrete on the basis of properly completed delivery tickets signed by authorized du Pont personnel at the site of the pour. Quantities indicated on delivery tickets shall be computed by weight at the plant from the design mix currently in effect, and shall be periodically verified by authorized du Pont personnel. Controlled yield tests will be made periodically and comparisons made with quantities indicated on delivery tickets. Should yield be found to be lower than quantities indicated on delivery tickets, the mixes in use shall be readjusted to bring both in line.