

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

PROCEDURAL GUIDELINES FOR MAINTAINING
CONTROL CHARTS
FOR PORTLAND CEMENT CONCRETE

- 1.0 PURPOSE
 - 1.1 To establish guidelines for developing and maintaining control charts to evaluate consistency, percent entrained air, strength characteristics, and the total solids A of portland cement concrete.
- 2.0 SCOPE
 - 2.1 These procedures shall be applicable in all instances in which they can be reasonably and logically applied. For consistency, air, and strength, the applicability will normally depend on the quantity of material used, the continuity of delivery, etc. Control charts for total solids A shall be maintained for all concrete designs used on state work by a concrete producer.
- 3.0 GENERAL PROCEDURE
 - 3.1 Control charts will be maintained at locations where the test samples are taken.
 - 3.2 Control charts will be prepared on a 10 x 10 cross section paper with a width of approximately 560 mm for the sheet presenting the charts for consistency, percent entrained air, and strength characteristics. A separate sheet of sufficient width shall be used to accommodate the control charts for the total solids A for concrete mix designs. A chart length of approximately 760 mm should be displayed at all times. When standard cross section sheets are used, the most recent sheet will be displayed and the previous sheets will be placed chronologically in a holder.

- 3.3 Charts for consistency, air, and strength shall have the item number and/or description of the material noted on the top of the chart and will be visible at all times. charts will have the design number and class of concrete visible at all times.
- 4.0 CHART PREPARATION
- 4.1 At the beginning and end of each sheet (or the length of the displayed portion), vertical red lines will be drawn between the limits of the specification or tolerance; an arrow will be placed at the end of the vertical lines; the specification limits will be written above and below the arrows and the name of the property being graphed and the scale will be indicated between the limits on the left edge of the chart. See Appendix 1 and 2 for typical arrangements.
- 4.2 Scale
- 4.2.1 Consistency - One division of vertical scale will represent 5.0 mm of slump, or 5.0 mm of ball penetration (25 mm - 50 mm).
- 4.2.2 Air Content - One division of vertical scale will represent one-tenth of a percentage point of entrained air (25 mm - 1%).
- 4.2.3 Strength - One division of vertical scale will represent 1 MPa (25 mm = 10 MPa) compressive or 69 KPa (25 mm = 1 MPa) flexural strength.
- 4.2.4 Total solids A - One division of vertical scale will represent .01 (25 mm = 0.1) when the coarse aggregate size is 57, 7, 78, or 8 and .02 (25 mm = 0.2) when the coarse aggregate size is Number 3.
- 4.3 Plotting Test Data
- 4.3.1 Symbols and Color Code - Individual test values will be plotted in blue using the symbol " O ", with the circle being approximately 2.5 mm in diameter. Average test values for consistency, percent air, and strength as well as the averages of consecutive five test values for total

solids A shall be plotted in red using the symbol "  ", with the square being approximately 2.5 mm on each side. Independent Assurance test values developed by the Division, including record samples, will be plotted in green using the symbol "  " with the sides of the triangle being approximately 2.5 mm.

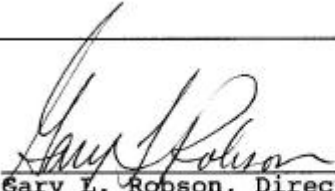
- 4.3.2 Arrangement of Data - All data developed on a production day will be plotted on one heavy, vertical line, however, when two or more individual test values developed on the same production day have the same magnitude, the symbols may be plotted side-by-side on the same horizontal division line. All test data for a characteristic developed on a production day, exclusive of any independent testing conducted by the Division, will be averaged, and the average value plotted on the same vertical line as the individual test values. When an average value and an individual test value have the same magnitude, the plotted symbols may be superimposed.
- 4.3.3 When individual test values fall outside the specification limits, an arrow will be placed on the plotted symbol pointing in the direction of the specification limit.
- 4.3.4 As test data are developed on following production days, it will be plotted on successive heavy vertical lines, 25 mm apart, progressing from left to right across the control chart. As successive averages for consistency, percent air, and strength characteristic are plotted, the symbol "  " will be connected with a heavy red solid line. For total solidsA control chart the moving average is the average of five consecutive test values and is determined by starting with the fifth test value and averaging it with the four preceding test values. The moving average of five symbol "  " will be connected with a heavy red solid line. Individual test values will have the symbol "  " connected with a dashed blue line.

4.3.5 At the bottom of the cross section paper and immediately to the left of the heavy vertical line on which the test data are plotted, the date of sampling and initials of the individual plotting the test data will be recorded.

5.0 FAILING TESTS

5.1 When individual test values fall outside the specification limits, this information will immediately be made available to the supervisory personnel of both the Contractor and the Division.

5.2 Should the moving average of five fall outside the design mixA tolerance, action required by the Specification will be taken. When appropriate action has been taken to bring theA back within tolerance the first individual production sample that is within tolerance shall be used to start a new moving average.



Gary L. Robson, Director
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Attachments

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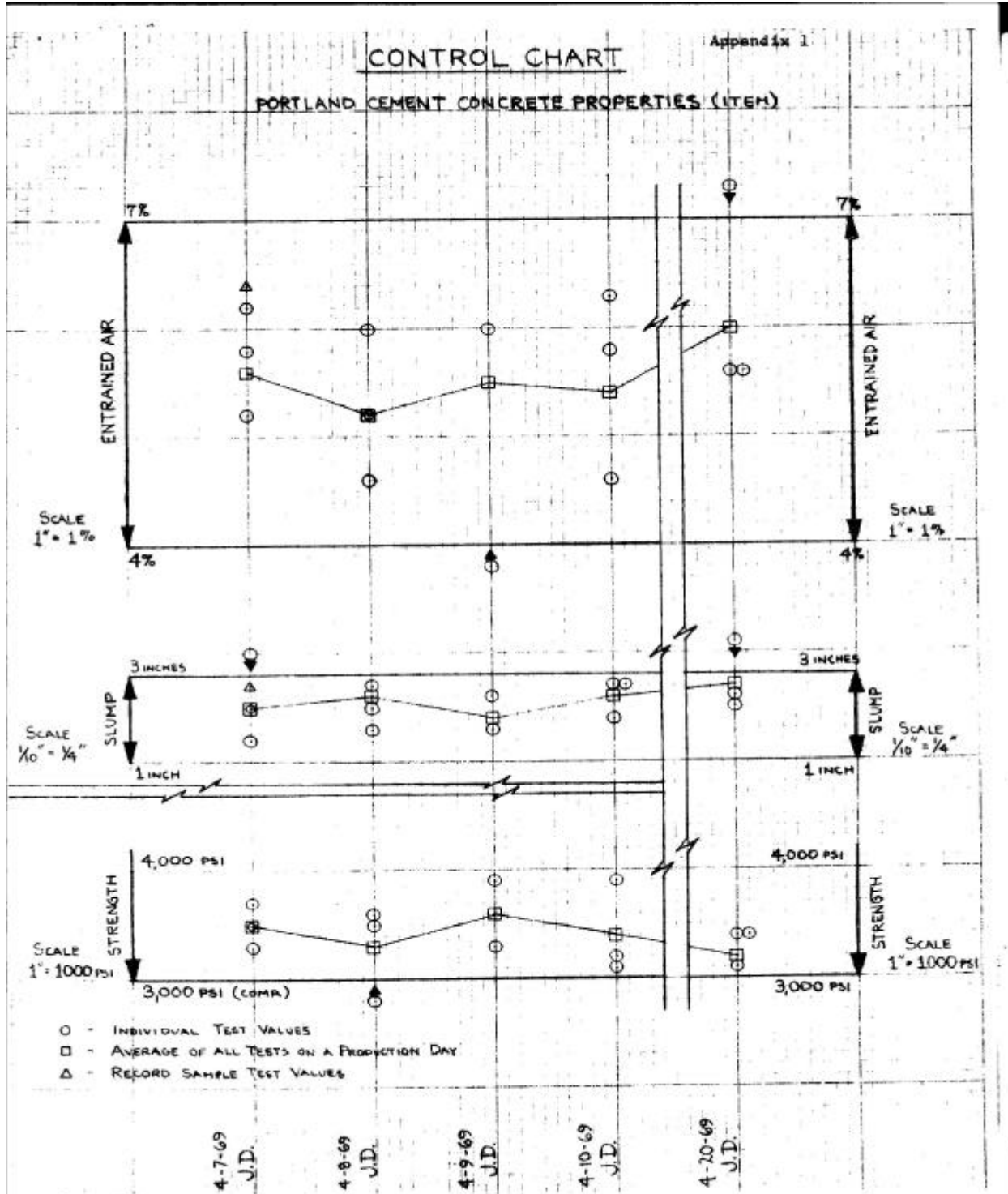
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ATTACHMENT 1

PAGE 1 OF 2



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PAGE 2 OF 2

