SAMPLING AND TESTING MATERIALS

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One of the prime requisites to securing good work is the selection of good materials that go into the construction. Each material should have certain properties or characteristics that render it suitable to withstand the action of climatic changes or the forces exerted by traffic.

Some of the materials commonly used in structural and highway construction are building stone, brick, structural steel, timber, concrete, crushed stone, gravel, cement, and bituminous materials.

In the testing of building stone and building brick, care should be used in the selection of a representative rather than an extreme sample. A structure is only as strong as the weakest part; so inferior block or brick should be rejected. In the testing of building stone and brick, the engineer should look for the following characteristics: weight or density, hardness and toughness, strength and durability. The durability of building materials depends on the weight or density to a great extent; so care should be used to select a dense material. In selecting a dense material, the absorption test is a criterion to be followed. Hardness is determined by the resistance to erosion and abrasion. Under the heading of strength, the usual tests considered are crushing or compressive strength, transverse strength, shearing strength, and elasticity. The test for crushing strength is made by testing to failure a certain-sized specimen in a compressive machine and computing the resistance in pounds per square inch of surface or cross-section.

In the testing of cement a representative sample should be selected and the following tests should be applied: color, thoroughness of burning, fineness, soundness, chemical composition, activity, and strength.

In portland cement the color is determined by the presence or absence of oxides of iron or manganese. Usually a gray or greenish gray is considered best. Bluish gray indicates a probable excess of lime, and brown indicates an excess of clay. An undue proportion of under-burned material is generally indicated by a yellowish shade. There is also, however, a white portland cement that is used when it is desirable to prevent staining of the building stone.

The test for fineness is important, since the strength of the concrete is dependent upon the degree of fineness of the cement. The coarse particles in cement have no setting power and therefore are really an adulterant; however, after these particles are ground and water is added, a crystallization takes place. The test for fineness usually is made by testing with 100- and 200-mesh sieves.

The soundness test refers to the inability of a cement to retain its unimpaired strength and form for an indefinite period. This is usually determined by the pat test. The pat is made by forming a cake of neat cement three or four inches in diameter, about one-half inch thick in the center and tapering to a thin edge. This pat is placed on a clean piece of glass and allowed to cure. Two samples should be used, one cured in air and one under water, and examinations should be made for twenty-eight days. The soundness is determined by the presence of radial cracks, curling, and smoothness of the pat.

The test for activity is usually made by the Gillmore method or the Vicat method. Activity is a measure of the rate of setting. In the Gillmore test, mortar is said to have begun to set when it will just support a wire one-half inch in diameter weighing one-quarter pound. Hard set is accomplished when the sample will bear a wire one-twenty-fourth inch in diameter, weighing one pound.

The test for tensile strength is determined by forming a briquette of the cement and standard Ottawa sand, and testing it in a testing machine. The briquette is molded so that there will be a cross-sectional area of one square inch. The briquette is cured under standard conditions and tested at intervals of one day, seven days, and twenty-eight days.

Sand is used in making mortar; sand and gravel or broken stone are used in making concrete. The quality of the different materials plays a very important part in producing good concrete; therefore the testing of these materials is a very important operation. Here again it is quite necessary to secure a representative sample. This is accomplished by selecting a sample from different locations in the supply so that the materials will not be segregated. In other words, do not select the sample from the edge of the stock pile, as the coarse material will flow to the side of the pile in all cases and a greater amount of the fine material will be deposited in the center of the pile. After a representative sample is secured, mix thoroughly; then quarter and discard the opposite quarters; mix again and quarter until a suitable-sized sample is secured. Then test with sieves to secure the proper grading of the materials as determined by a sieve analysis.

The sand should be tested for sharpness and cleanness. The requisites for good gravel or broken stone are that they should be composed of durable materials, should be clean, and should be properly graded, as noted above, by a sieve-analysis test.

A visual inspection by one who has studied geology will determine whether the materials are composed of durable particles. A test for cleanness is made by washing. In testing the concrete cylinders for compressive strength, it is necessary to prepare the cylinder by casting a base and top of plaster of paris in order to secure two even parallel surfaces, thus insuring an even distribution of the force exerted by the testing machine.