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THE NATIONAL BUREAU OF STANDARDS
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CONCRETE MASONRY UNITS

This is a digest in part of Circular No. 304, "Properties and Manufacture of Concrete Building Units", (June 10, 1936),[1] by Frank A. Hitchcock, issued by the Bureau of Standards, and abstract of Federal Specification SS-C-621 "Concrete Units; Masonry Hollow."[2]

Comparison of concrete units with other materials should take into consideration structural requirements, architectural purposes, economical features, maintenance and fire insurance rates.

Relative costs of laying such units, as frequently set forth in advertising and other literature, must not be definitely applied without investigating costs under local conditions. Size is an important factor which may affect savings over other types of masonry construction, but it does not necessarily follow that a larger unit would be proportionately cheaper. Serious objections to the handling and laying of very large and heavy blocks may materially affect the attitude of local labor.

Color in cement blocks is largely governed by raw materials used and the processes of manufacture. Portland cements may vary from light yellowish gray to slate due principally to the varied content of iron oxide or, in some cases, manganese.

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[1]Available from Superintendent of Documents, Government Printing Office, Washington, D. C. (Price 20 cents)

[2]Available from Superintendent of Documents, Government Printing Office, Washington, D. C. (Price 5 cents)

The merits of special cements for which valuable properties are claimed can only be determined by actual tests and investigations. This is particularly true where it is claimed certain cements would produce a concrete which is impervious to moisture and non-absorbent.

The essential physical requirements for all aggregates are that they shall be clean and durable, of sizes governed by the quality of the concrete, type and dimensions of the unit, and desired surface effects. The aggregates should be graded from fine to coarse within the limiting size, bearing in mind that the workability of the mix, the amount of water required to obtain proper consistency, the density, and particularly the required amount of cement to attain given strengths are greatly affected by wide variations in the sizes of the aggregates. They should pass a sieve having openings not larger than 1/2 the thickness of the thinnest web or shell of the unit. The use of "pit-run" or "run of the crusher" material may be undesirable because such material tends to segregate into sizes with handling. Desired proportions of the relative sizes are obtained by separating the fine and coarse aggregate and recombining them in proper proportions.

Sand is generally understood to be an aggregate which will pass through a No. 4 sieve (openings 0.187 inch square). It should be clean, hard, durable, of uncoated grains, graded from coarse to fine with the coarse grains predominating. It should be free from organic matter or other harmful impurities, and may contain small amounts of silt but not in excess of 10 percent by weight. Mica may be present in quantities not greater than 1 percent, larger amounts proving detrimental, especially in sand for use in surface treatments, which would cause them to dust and peel.

Gravel to be used as coarse aggregate is assumed to be material retained on a No. 4 sieve and should be clean, durable, free from soft, flat or elongated pieces.

Trap rock, sandstones, and limestones, when crushed, make good concrete material and are often used as fine and coarse aggregate while slates, shales and some forms of sedimentary rocks, lacking durability, are not recommended for such use.

Blast furnace slag, affording an economical source of aggregate, can be classified as air-cooled and granulated, and is produced by the respective air and water cooling of molten slag. Its use in concrete should be confined to the air-cooled type, which should be uniform in quality, free from metallic iron and other objectionable matter and the material should weigh no less than 65 pounds per cubic foot. As in other materials, graduation of sizes must be considered and dust should be eliminated if present in excessive quantities.

All cinders are not equally suitable for concrete but, generally speaking, those from power plants provide the best material. They should be crushed to the necessary size and usually require more thorough mixing than other material.

Impurities in the gaging water as well as its temperature may seriously affect the strength and setting time of concrete. It is, therefore, recommended that the water be free from oils, acids, strong alkalies, vegetable matter, or factory wastes and its temperature should not be lower than 60° Fahrenheit.

The value of various admixtures to increase workability, early strength, water resistance properties and the curing of concrete can only be determined by investigation, analysis and tests. These properties of concrete have been discussed in TIBM numbers 5, 6 and 8.

Certain requirements for concrete building units are imposed by conditions of use, while others, such as architectural and structural requirements, are imposed either by local ordinances or by commonly used standards. Generally accepted sizes have been established and are set forth in Simplified Practice Recommendations R 32-32,[1] published by the National Bureau of Standards.

The following is a summary of the requirements set forth in Federal Specification SS-C-621, (April 28, 1931, amended May 1935).[1] The specification provides for hollow masonry wall construction units manufactured from portland cement or other hydraulic cement and aggregates consisting of natural sand and gravel, crushed rock, slag, burnt clay or shale, cinders, or other inert materials. It also requires that the units be sound and free from cracks or other defects which would interfere with the setting or permanence of construction, and if intended for use as a base for plaster or stucco, the units should be sufficiently rough to insure good adhesion.

The specification covers 2 types of units, type I or load-bearing and type II or non load-bearing. The specification requires a 3/4 inch minimum for shell and web thickness, and permits tolerances of plus or minus 3 percent in over-all dimensions.

The average percentage of moisture in the units at time of delivery shall not exceed 40 percent of the total absorption of the units when tested as provided for in the specification.

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[1]Available from Superintendent of Documents, Government Printing Office, Washington, D. C. (Price 5 cents)

Type I (Load-bearing)
Requirements for Compressive Strength

Minimum Thickness of Shells (Outer shells of unit parallel to exposed surface of wall)	Compressive Strength (Pounds per square inch of gross area)	
	Average of 5 or more units	Individual minimum
1 1/4 inches or more	700	600
3/4 to 1 1/4 inches	1000	800

The absorption shall not exceed 16 pounds per cubic foot of concrete. This requirement shall be waived when the units are used in construction not exposed to soil or weather if so stated in invitations for bids.

Type II or non load-bearing units should have a gross area compressive strength of 350 pounds per square inch. These units are intended for use in interior partitions, backing for exterior walls, and fireproofing in skeleton-frame buildings, where the only strength requirements are that they be sufficient to prevent excessive breakage in delivery and handling.

Detailed information of tests for determining compressive strength, absorption, etc., is given in Federal Specification SS-C-621.