



CONSTRUCTION ENGINEERING AND CONSTRUCTION MATERIALS

MD Rasel Ahammed

Completed Diploma in Civil Engineering(4years)
Bogura Govt. Polytechnic Institute, Bangladesh
Bachelor of Civil Engineering
Henan Polytechnic University,China.

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ABSTRACT

Construction Engineering is very important part of Civil Engineering. We can't think about a good and stable structure without good quality of construction. And the construction materials is also play an important role for any construction work. Construction engineering is a professional discipline that deals with the designing, planning, construction and management of infrastructures such as roads, tunnels, bridges, airports, railroads, facilities, buildings, dams, utilities and other projects.

Civil Engineering is a related field that deals more with the practical aspects of projects. Construction engineers learn some of the design aspects similar to civil engineers as well as project site management aspects. Construction Engineers are heavily involved in the design and management/ allocation of funds in these projects. They are charged with risk analysis, costing and planning.

Many types of building materials are used in the construction industry to create buildings and structures.

KEYWORDS: *Construction materials as like Brick, Stone, Cement, Lime-stone, Lime, Water, Reinforcement Steel, Wood etc.*

INTRODUCTION

For a civil engineer need to consider to build safe, beautiful and sustainable structure within the clients amount of budget. For that reason its very important to make sure the quality of construction work and construction materials.

Now i want to describe some important things about some construction materials:

1. Brick:Brick is very important construction materials. It uses all over the world because it is cheap.

STANDARD SIZE OF BRICKS

In Bangladesh according to Public work department specification, each brick should measure 9.5"x4.50"x2.75".This is the standard size of bricks in our country. There are others sizes brick also. But this size is most economical, because when bricks are put in any construction with mortar the size becomes 10"x5"x3" (approximately) the size of walls which are constructed by bricks in our country are 3", 5", 10", 15", 20",25" and 30" so his size of bricks can be used safely without any breakage, hence, this standard size, is most in engineering, constructions in our 9.5"x4.5"x2.75"(inch).

The following are the characteristics Of a Standard Brick:

- * Brick should be uniform in color, size and shape.
- * It should be free from cracks and other flaws such as a bubble, stone nodules etc.
- * The compressive strength of bricks should be in the range of 5000 to 8000 psi.
- * The percentage of soluble salts (Sulphates of Calcium, Mg, Na, and K) should not exceed 2.5% in burnt bricks.
- * They should be neither over burnt nor under burnt.
- * Its weight should generally 6 lbs. per brick and the weight per cubic. feet. Should not be less than 125 lbs.
- * It should have lower thermal conductivity.
- * It should be non-inflammable and in combustible.
- * Brick should not change in volume when wetted.
- * Each edge should be 90 degree angle.



Fig: Brick

CLASSIFICATION OF THE BRICKS

According to the public work department of Bangladesh well burn brick classified into the following categories:

- * First class Brick
- * Second class Brick
- * Third class Brick
- * Picked Brick
- * Jhama Brick
- * Brick bats

First class Brick:

These first class bricks are table molded and of uniform shape and they are burnt in kilns. The surfaces and edges of the bricks are sharp, square, smooth and straight. They comply with all the qualities of good bricks. These bricks are used for important work of permanent nature.

Second class Brick:

The second class bricks are ground molded and they are burnt in kilns. The surface of the second class bricks is slightly rough and shape is also slightly regular. These bricks may have hair cracks and their

edges may not be sharp and uniform. These bricks are commonly used at places where brickwork is to be provided with a coat of plaster.

Third class Brick:

These bricks are ground molded and they are burnt in clamps. These bricks are not very hard and they have rough surfaces with irregular and blunt edges. These bricks give dull sound when they are struck together. They are used for unimportant works, temporary structures and at places where rainfall is not heavy.

As a Structural Materials:

Since the clay bricks or burnt bricks are strong, hard, durable, resistive to abrasion and fire, therefore, they are used as a structural material in different structures.

- ▲ Buildings.
- ▲ Bridges.
- ▲ Foundations.
- ▲ Arches
- ▲ Pavement (Footpath, Streets).

As a Surface finish:

Bricks can be used in different colors, sizes and orientations to get different surface designs. As an aesthetic material bricks can be used-

- ▲ In Pavements.
- ▲ As Facing Brick.
- ▲ For Architectural Purposes.

Steel:

Steel is a combination of iron and carbon. Steel is defined as a material that contains iron, carbon and small amount of other elements. The basic constituent of steel is iron. Iron is widely available all over the world, but only in combination with other elements. Iron products come in three commercial forms:

- ▲ Wrought iron
- ▲ Cast Iron
- ▲ Steel

Wrought iron:

Wrought iron is manufactured by melting and refining iron to a high degree of purity, which can be described as a low-carbon steel (less than 0.1 percent carbon by weight) containing a small amount of slag, usually less than 3 percent.

Cast iron:

Cast iron, which contains 2.1%~6.69% of carbon and quite high amount of various impurities, is manufactured by reheating pig iron and blending it with other materials of known composition.

Cast iron has high compressive strength, but its tensile strength is low.

Steel:

Steel is a product refined, cast, forged as well as heat treated from cast iron.

*Carbon Steel:

1. Low carbon steel (C<0.25%)
2. Medium Carbon Steel (C=0.3%~0.55%)

3. High carbon steel($C > 0.60\%$)

***Alloy Steel:**

1. Low alloy steel($< 5\%$)
2. Medium alloy steel($5\% \sim 10\%$)
3. High alloy steel ($> 10\%$)

Binding Material:

Cementing material:

1. Organic cementing material (resin, asphalt, etc.)
2. Inorganic binding material
- ★ Hydraulic cement (cement)
- ★ Non-hydraulic cement

Cement is any material that binds or units the separated things into an integral always refers to an ingredient in concrete, mortar or grout.

Portland Cement

Portland cement chemistry:

1. Tricalcium silicate (Abbreviation C3S)---
 $3\text{CaO} \cdot \text{SiO}_2$ Usual range by weight ($37\% \sim 60\%$)
2. Dicalcium silicate (Abbreviation C2S)----
 $2\text{CaO} \cdot \text{SiO}_2$ Usual range by weight ($15\% \sim 37\%$)
3. Tricalcium aluminate (Abbreviation C3A)-
 $3\text{CAO} \cdot \text{Al}_2\text{O}_3$, Usual range by weight ($7\% \sim 15\%$)
4. Tetracalcium.aluminoferrite (Abbreviation C,AF)---
 $4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3$ Usual range by weight($10\% \sim 18\%$)

Hydration:

In a favorable environment, within one or two hours after the mixing of cement and water, the sticking paste loses its fluidity, and noticeable stiffening commences. This mechanism is called setting.

Setting and Hardening of Cement:

The term 'Setting' is used to describe the stiffening of the cement paste. Setting of cement refers to changes of cement paste from a fluid to rigid state. Setting differs from Hardening of cement.

The term 'Hardening' refers to the gain of strength of a set cement paste, although during setting the cement paste acquires some strength.

The setting characteristics of Portland cement paste are defined by initial set and final set. Initial set indicates the approximate time at which the paste begins to stiffen considerably. Final set roughly indicates the time at which the cement paste has hardened and can support some load. when the paste in beginning to harden and able to sustain some loads its called permanent set.

Initial setting time indicates the beginning of the setting process when the cement paste starts losing its plasticity. Final setting time is the time elapsed between the moment water is added to the cement and

the time when the cement completely lost its plasticity and can resist certain definite pressure.

These times of set are tested according to standardized procedures and have no special relationship to concrete setting behavior. Setting types are affected by minor constituents in the cement such as alkalis and Sulfates, by fineness, water-cement ratio, ambient temperature and inclusion of mineral and chemical admixtures. Concrete generally sets more slowly than cement paste because of the higher water-cement ratios.

A table is shown below for approximate setting time at different temperature.

Temperature	Approximate Setting Time (hours)
100 Degree F (38 Degree C)	1-2/3
90 Degree F (32 Degree C)	2-2/3
80 Degree F (27 Degree C)	4
70 Degree F (21 Degree C)	6
60 Degree F (16 Degree C)	8
50 Degree F (10 Degree C)	11
40 Degree F (4 Degree C)	14
30 Degree F (-1degree C)	19
20 Degree F (-7 Degree C)	Set will not occur

There are 2 types of abnormal setting behavior that should be mentioned.

False Set: This refers to the rapid setting that occurs without the liberation of much heat. Plasticity can be regained by further mixing without the need to add more water, and thus is not a problem where concrete is mixed for long periods (ready-mixed concrete). Increasing mixing time when possible will help to reduce a false set problem.

Flash Set (or quick set): This behavior is accompanied by the liberation of considerable heat. The plasticity of the mixture cannot be regained with additional mixing or water.

CONCRETE

Concrete is of such importance that almost every civil engineering structure uses concrete in some form. Concrete is defined as a composite material which consists essentially of a binding medium and embedded particles or aggregate fragments. Asphalt and other cements are used to make various types of concrete, but commonly the term 'concrete' refers to Portland cement concrete.

Concrete is used exclusively for foundations of buildings, bridges, and other structures. It is used in dams, canals aqueducts, and other structures to control and divert water. It is used in highways streets, pavements, and sidewalks. Thus, it is a major material in the transportation industry.

Segregation and Bleeding

Segregation and bleeding are two major properties that affect the quality and performances of concrete during its placement. Both of these result in non homogeneity excessive bleeding, in addition, gives rise to weak top layer.

Bleeding: A concrete mix that does not possess proper consistency is unable to hold the mix water, which slowly gets displaced and then rises to the top of the form. This water will eventually be lost, either through evaporation or by leakage through the joints and sides of the forms. This process of segregation of water from the mix is called bleeding.

The methods of controlling bleeding

Air-entrainment is an effective method of controlling bleeding. Increase in the fineness of cement and decrease in water-to-cement ratio decrease bleeding.

Premature finishing may be a cause of excessive bleeding, and may lead to loss of some entrained air, making the concrete vulnerable to scaling when exposed to low temperatures.

Concrete Admixture

The Concrete admixtures are used to improve the behavior of concrete under a variety of conditions.

There are of two main types of Admixture:

1. Chemical Admixture
2. Mineral Admixture

*Chemical Admixture:

The Chemical admixtures reduce the cost of construction, modify properties of hardened concrete, ensure quality of concrete during mixing/transporting/placing/curing, and overcome certain emergencies during concrete operations.

The Chemical admixtures are used to improve the quality of concrete during mixing, transporting, placement and curing. They fall into the following categories:

- * AIR-ENTRAINERS
- * Water Reducers
- * Set Retarders
- * Set Accelerators
- * Super Plasticizers

Specialty Admixtures: which include corrosion inhibitors, shrinkage control, alkali-silica reactivity inhibitors, and coloring.

Mineral admixtures make mixtures more economical, reduce permeability, increase strength, and influence other concrete properties.

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ASTM C494 specifies the requirements for seven chemical admixture types:

- Type-1: Water-reducing admixtures
- Type-2: Retarding admixtures
- Type-3: Accelerating admixtures
- Type-4: Water-reducing and retarding admixtures
- Type-5: Water-reducing and accelerating admixtures
- Type-6: Water-reducing, high range admixtures
- Type-7: Water-reducing, high range, and retarding admixtures.

Sand

Sand is a mixture of small grains of rock and granular materials which is mainly defined by size, being finer than gravel and coarser than silt. And ranging in size from 0.06 mm to 2 mm. Particles which are larger than 0.0078125 mm but smaller than 0.0625 mm are termed silt.

Composition of Sand

Sand is basically made of unconsolidated granular materials consisting of either rock fragments or mineral particles or oceanic materials. It is mainly made of silicate minerals and silicate rock granular particles. Typically quartz is the most dominant mineral here as it possesses highly resistant properties to weather. Other common rock-forming minerals like amphiboles and micas also found in sand. Heavy minerals such as tourmaline, zircon etc can also be present in the sand in smaller concentration. But from a high level, most sand on the beach is made up of gray or tan quartz and feldspar. However, the most common mineral in the sand is quartz—also known as silicon dioxide. This is formed when silicon and oxygen combine. Feldspar is the most found group of minerals on the earth's surface and forms about 65% of the terrestrial rocks. When the wind and sea whip up on the shores, they transport these teeny tiny granules to the beach and make up the sand with this combination.

Classification of Sand According to Size (ASTM)

1.Fine Sand: All the sand particles should pass through No. 16 sieve. This is usually used in plastering works.

2.Moderately Coarse Sand: All the sand particles should pass through No. 8 sieve. This type of sand is generally used for mortar and masonry works.

3.Coarse Sand: All the particles should pass through No. 4 sieve. This type of sand is very suited for concrete work.

Colors of Sand

There are some different colors is found in sand. They are:

1.White Sand: It's made of eroded limestone and may contain coral and shell fragments, in addition to other organic or organically derived fragmental material is may find in this color of sand. Magnetite, Chlorite, Gypsum is also found.

2.Black Sand: Black sand is composed of volcanic minerals and lava fragments and Coral deposits.

3.Pink Sand: Foraminifera, a microscopic organism that has a reddish-pink shell, is responsible for all this color. Coral, shells, and calcium are also found into this mix.

4.Red-orange Color: This color is formed due to the coating of iron oxide.

5.White-grey Color: This sand consists of fine rounded grains and It is well graded.

6.Light-brown Color: It consists of rounded grains.

Curing

Curing is the process of maintaining satisfactory moisture content and temperature in the concrete for a definite period of time.

Hydration of cement is a long-term process and requires water and proper temperature.

Therefore, curing allows continued hydration and, consequently, continued gains in concrete strength.

In fact, once curing stops, the concrete dries out, and the strength gain stops.

If the concrete is not cured and is allowed to dry in air, it will gain only about 50% of the strength of continuously cured concrete.

If concrete is cured for only three days, it will reach about 60% of the strength of continuously cured concrete; if it is cured for seven days, it will reach 80% of the strength of continuously cured concrete.

If curing stops for some time and then resumes again, the strength gain will also non and reactivate.

Curing can be performed by any of the following methods:

1. Maintain the presence of water in the concrete during early ages. Methods to maintain the water pressure include pounding or immersion, spraying or fogging, and wet coverings.
2. Prevent loss of mixing water from the concrete by sealing the surface, Methods to prevent water loss include impervious papers or plastic sheets, membrane-forming compounds, and leaving the forms in place.
3. Accelerate the strength gain by supplying heat and additional moisture to the concrete Accelerated curing methods include steam curing, insulating blanket or covers, and various heating techniques.

Main tips

Curing should start after the final setting of the cement. If concrete is not cured after setting, Concrete will shrink, causing cracks.

Note that preventing loss of mixing water from the concrete by sealing the surface is not as effective as maintaining the presence of water in the concrete during early ages.

CONCLUSION

The knowledge of Construction Engineering and Constructions Materials is very important for build a good quality structure. At present its very important for civil engineering students and also for Practical Civil Engineer. Every country has different Buildings code and it also another main things for construction engineering,so every engineer should choose proper construction material's according to their buildings code.

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Vice-Principle
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#Engineer Md. Harunur Rashid
Bachelor of Civil Engineering(DUET)
Instructor Civil Engineering Department
Bogura Government Polytechnic Institute
#Engineer Md. Mohiuddain
BCS (Technical Education)
Instructor Civil Engineering Department
Khulna Polytechnic Institute,Bangladesh
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#Engineer Md. Zoynal Abedin
BCS(Technical Education)
Vice-Principle
And Former Chief Instructor(Civil Engineering Department)
Bogura Government Polytechnic Institute, Bangladesh.
#Engineer Md Yeasin
Bes (Technical Education)
Sub-Controller of Examination Bangladesh Technical education Board.
#Dr. Yu Jianxin(PHD)
Doctor of Geotechnical Engineering Institute of Rock& Soil mechanics,
University of Chinese Academy of sciences, Wuhan P.R: China.
Lecturer,School of Civil Engineering
Henan Polytechnic University, China