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Study of Concrete: Quality and Economic

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ABSTRACT – Concrete is known as one of the building materials. In general, Portland cement, water, and aggregate are the basic ingredients for making concrete along with various additives to strengthen concrete. The characteristics of the base material will determine the strength, durability, and other capabilities of the concrete. This paper reviews the types of concrete, concrete quality parameters, advantages and disadvantages of concrete and general properties of concrete.

Keywords: concrete, aggregate, portland cement.

A. CONCRETE IS

Many people need to buy concrete material. Minimum purchase to build a house, or for project needs if you get a job related to construction. Concrete is a building material consisting of coarse aggregate, fine aggregate which is bonded using water and cement, often added admixture or additive if needed. Concrete is defined as a mixture of portland cement or other hydraulic cement along with fine aggregate, coarse aggregate and water, as well as adding or not adding additional materials that form a solid mass.

Concrete is the most commonly used building material. In construction, concrete has a very important role. The age of a building is also determined by the strength of the concrete structure. In addition to being the main structure, concrete has plastic properties that allow it to be molded into the desired shape. Concrete has high compressive strength and no settlement.

B. CONCRETE MIXED

All the concrete-forming materials after being mixed will be plastic for a while and then will turn hard and become denser which can be used for technical building needs.

The initial process of making concrete is cement paste, namely the hydration process between water and cement, then if it is added with fine aggregate, it becomes mortar and if it is added with coarse aggregate, it becomes concrete. Normal concrete is concrete that has a density of (2200-2500) kg/m3 using crushed natural aggregate.

C. TYPES OF CONCRETE

Currently there are several types of concrete that can be found. The types of concrete are used based on their function. The description of the types of concrete and their functions are:

a. Light weight concrete. Lightweight concrete has a specific gravity of less than 1,900 kg/m3. Lightweight concrete is often used on non-structural elements. Formation of lightweight concrete by making air bubbles in cement mortar and using lightweight aggregates such as clay / pumice that is burned or or the manufacture of non-sand concrete.
b. Normal concrete. Normal concrete has a specific gravity of 2,200 – 2,500 kg/m3. Normal concrete is used in almost every element of the building structure.
c. Heavy concrete. Heavy concrete has a specific gravity of more than 2,500 kg/m3. Heavy concrete is used for certain structures, such as structures that must withstand atomic radiation.
d. Other types of concrete. Another variety of concrete is concrete used for structures that have special requirements, such as: ferrocement, mass concrete, cyclone concrete, vacuum concrete, fiber concrete, exposed concrete, etc.

The use of normal concrete is generally in the construction industry which can be found in the manufacture of buildings, roads (rigid pavement), weirs, channel and others. The natural aggregate used is in the form of fine aggregate, namely sand and coarse aggregate, namely gravel, both of which are the result of natural disintegration of stone or in the form of crushed stone obtained from the stone crusher industry with grain sizes between 5-40mm. This aggregate usually comes from granite, basalt, quartz, and so on. The average density is 2.5-2.7. The resulting normal concrete has a weight of 2,200-2,500 kg/m3 and a compressive strength of about 15-40 MPa (150-400 kg/cm3).

D. CONCRETE QUALITY PARAMETERS

Characteristics of good concrete can be viewed from the density, strength, water-cement factor,

and texture. The following are the parameters that affect the quality of concrete:

a. Cement quality.
b. The proportion of cement to water in the mixture.
c. Cleanliness and strength of aggregates.
d. Adhesion of cement paste and aggregate.
e. Adequate mixing of the concrete-forming ingredients.
f. Correct placement, finishing and compaction of fresh concrete.
g. Treatment at a temperature not lower than 50°F when the concrete is about to reach its strength.

E. ADVANTAGES AND DISADVANTAGES

In the hardened state, concrete is like stone with high strength. In a fresh state, concrete can be formed in various forms. Apart from being resistant to fire, concrete is also resistant to corrosion. In general, the advantages and disadvantages of concrete are as follows:

1. Advantages
   a. Concrete uses basic materials that are easily available.
   b. Has a very high strength, especially compressive strength.
   c. Resistant to high temperatures.
   d. Low maintenance costs.
   e. Fresh concrete can be easily transported and molded in any shape and size depending on the desire.
2. Disadvantages
   a. Concrete has a low tensile strength which will make the concrete easy to crack, therefore reinforcing steel is needed to overcome it.
   b. Execution of work requires high accuracy.
   c. Concrete has a heavy weight.
   d. Heat of hydration in mass concrete will be very high, the development of this heat can cause problems, namely the emergence of cracks during cooling.

F. GENERAL PROPERTIES OF CONCRETE

In construction, concrete does not have to have all the properties of concrete, because these properties are viewed from the usefulness of the concrete. Several factors that can affect the properties of concrete include the ratio of the concrete mix, the method of molding the concrete, how to compact it, and how to treat the concrete. Some of the common properties possessed by concrete are:

1. Ease of Workability.

   The level of workability is related to the level of workability (thinness) of the concrete mix. The more liquid the concrete mix, the easier it is to work. To measure the level of workability of the concrete mix, a slump test was carried out using the Abrahams cone. The slump value in general will increase in proportion to the water content in the fresh concrete mixture and inversely proportional to the compressive strength of the concrete. Concrete with slump values < 15 mm may not be plastic enough and concrete with slump values > 230 mm may not be sufficiently cohesive (SNI 1972:2008, 2008). The following are several factors that affect the workability/workability of fresh concrete:

   a. Amount of water used. The more water, the easier the concrete is to work.
   b. Mixture of coarse aggregate and fine aggregate.
   c. The shape of the aggregate grains and the spherical surface texture of the aggregate.
   b. Maximum size of gravel used.

2. Separation of Gravel.

   Basically, segregation is the process of decreasing coarse aggregate to the bottom of fresh concrete, or separating coarse aggregate from the mixture due to improper pouring and compaction methods. Several factors that can cause segregation include:

   a. Mixture of lack of water or excess of water,
   b. Insufficient amount of fine aggregate,
   c. Aggregate size that is more than 25 mm.

3. Bleeding

   Bleeding is the event of separation of rising water to the surface after compaction. Laitance is a condition of rising water carrying fine sand grains along with cement, which then forms a layer. This layer will be a bond barrier between the concrete below and the concrete layer above. This event often occurs in a mixture that has too much water, where concrete that has a water content that is too high will make the concrete have a flow of water. This rising water carries grains and fine sand. Bleeding often occurs after molding of the concrete is done visible with the concrete surface filled with water.

4. Compressive Strength.

   The strength of concrete is determined by the composition of the water and cement content, and the amount of compressive

strength in concrete will increase as the concrete ages. Concrete already has a maximum strength at the age of 28 days. The concrete strength value is measured by making a cylindrical test object. Compressive strength readings on cylindrical specimens. The factors that can affect the strength of concrete include:

a. cement water factor,
b. concrete age,
c. aggregate properties,
d. admixture type,
e. care.

According to ACI 214R-11, explains that the magnitude of the variation in the strength of the concrete test sample depends on the quality of the material, manufacture and control in the test.

5. Durability.
   Durability is the resistance of concrete to face all planned conditions, without deteriorating during its service period.

When compared between high quality concrete and ordinary normal concrete then it is focused on strength. The strength of high-strength concrete lies in the compressive strength between 40-80 Mpa. High-strength concrete is a special consideration for aggressive environments because in addition to its high strength, permeability and porosity are also small which will make it more difficult for acid attacks to get to the concrete core. There is an inherent risk in high-quality concrete, namely susceptibility due to decreased resistance to acidic environments, although high-strength concrete always has a stronger bond between paste and aggregate than normal concrete. Several ways to improve the performance of concrete into high-grade and high-performance concrete.

a. Reducing the porosity of concrete by making efforts to reduce the water content in the concrete mix
b. Adding mineral additives such as silicafume or fly ash
c. Adding fiber (fibrous concrete)
d. Concrete with self-compacting

To obtain optimal concrete for a typical use, it is necessary to select the appropriate materials and mix them properly. To know and study the behavior of the combined elements (concrete building materials) it is necessary to know the characteristics of each material.

Thus, each of these components needs to be studied before studying concrete as a whole. In this case, the planner should be able to develop the appropriate selection of materials regarding the right mixture in order to achieve the efficiency of the resulting concrete and meet the required strength standards, and meet other requirements, especially with regard to economic reliability.

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