International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979, Impact Factor: RJIF 5.72
www.allsubjectjournal.com
Volume 3; Issue 6; June 2016; Page No. 358-360

Introduction to the characteristics of self-compacting concrete

Xudong Chen

Chongqing jiaotong university, Chongqing, China

Abstract
It outlines the self-compacting concrete main features in material selection, mix design and the research of self-compacting concrete.

Keywords: Self-compacting concrete, mix proportion, mechanical property, Long-term durability, Microstructure

Introduction

Self-compacting concrete is a kind of high liquidity, no-segregation, uniformity and stability, and the casting is depending on the gravity flow, without vibrating compacted concrete.

In the early 1980 s, the problem of the durability of the concrete structure aroused widespread attention of Japanese scholars. High durability of concrete structures is vibrated by skilled workers to achieve, but many Japanese construction companies is in a serious lack of skilled workers to meet this requirement, which have resulted in the decrease of the quality of the construction [1], So Japanese scholar Okamura put forward the concept of self compacting concrete in 1986.

In the past 20 years, the research and application of self compacting concrete has been widely carried out in the world. Because the self-compacting concrete compared with ordinary concrete has the following advantages:

(1) Improve the production efficiency. Since concrete does not need vibration and casting time significantly shorten, the number of workers and the labor intensity have greatly reduced.
(2) The self-compacting concrete can be guaranteed with the structure of good density, which is difficult to be applied vibrating.
(3) Improve the working environment. It can prevent the noise emitted by vibrating from hurting the surrounding environment and workers.
(4) Increased structural design degrees of freedom. It can be used to cast into complex shapes, thin-walled and reinforced dense structure.
(5) Reduced the overall cost of the project. Multifaceted reduce engineering costs from improving the speed of construction [2], extending the life of the template and reducing the number of workers and ensure quality.

It is late, as self compacting concrete has been introduced to our country at the beginning of 2000, compared to Japan and Europe and the United States. At present, our country in the self-compacting concrete mix design has no uniform standard. However, it is also needs to be improved in the application of self compacting concrete and popularization.

Raw material and mixing ratio requirements

The selection of raw materials

Cement: In theory, all kinds of cement can be used for the preparation of self-compacting concrete, the choice of varieties depends on concrete strength and durability requirements; But considering the workability requirements and the slump loss is small, the priority choice should be C_3A and the cement which has alkali content, low water requirement of normal consistency.

Aggregate: should choose hard, dense, clean aggregate. Needle less coarse aggregate content, maximum particle size is generally in the range of 16mm ~ 20mm, gap-graded and often better than continuous gradation.

Chemical admixtures: water reduction rates should be used more than 20% of super plasticizer, the composition of super plasticizer and ordinary water-reducing agent also can obtain good results.

Mineral admixtures: powder, limestone, dolomite, granite and other fine grinding, particle size less than 0.125 mm or the specific surface area (250 ~ 80o) m² / kg, it is used to improve and maintain their workability as an inert filler [3].

Fly ash: pozzolanic admixtures; high quality fly ash that can improve the quality of liquidity and the durability of hardened concrete, should be preferred should be preferred.

Ground slag: pozzolan admixture, to improve and keep working, is conducive to the durability of hardened concrete.

Silica fume: highly active pozzolanic admixture that is to improve the rheological properties and resistance to segregation and to improve the strength and durability of hardened concrete should be preferred.

Mix design

Thick bone ratio: self compacting concrete can be regarded as the 3 layer system composed of solid-liquid two-phase system. Slurry viscosity is a key factor of affecting the concrete τ_0 and η. It can also be realized by adding the sand ratio of concrete to reduce the interaction between mortar and coarse aggregate separation, however, a high sand ratio has an effect on self-compacting concrete compressive strength and modulus of elasticity, which should be controlled at 40% to 45% in general.

Dosage: according to the slurry and mortar fluidity test to determine the specific amount of different types of admixture, and can also according to the actual situation and experience to select a reasonable value, can be greater than 30% of the total cementitious materials.

Water cement ratio: water cement ratio according to the concrete strength and durability were selected to determine the, general below 0.14 and water should not be over 200 kg /m^3.

From the view of domestic and foreign literature, the conventional self-compacting concrete mixture ratio calculation generally has the following methods:

(1) Fixed sand volume method;
(2) Full calculation method (if applicable to self-compacting concrete remains controversial);
(3) Improve the whole calculation law;
(4) Parametric method;
(5) Aggregate surface area method;
(6) Simple mix design method;
(7) Orthogonal test or "factorial method";
(8) Empirically derived method or a test with France;
(9) Absolute volume method. Current line standard is recommended by absolute volume method, which is similar to the fixed sand and gravel volume method, and the other various design methods also have their advantages and disadvantages. In addition the following kinds of self-compacting concrete mix design method is novel and unique, simple mentioned:
    - Based on the rheological properties of self-compacting concrete mix proportion design method.
    - Based on the theory of particle gradation design Self-compacting concrete mixture ratio method.
    - Uniform experimental design method [4].

The performance of self-compacting concrete

Mechanical property

Self-compacting concrete mixture ratio design low water-cement ratio, high dosage of gelled material and the use of super plasticizer will affect the mechanical properties of self-compacting concrete.

Main features: (1) compared with the same water-cement ratio of ordinary concrete, the compressive strength of self-compacting concrete is a little high, because of the gelled material paste volume of little effect on tensile strength, the tensile strength of self-compacting concrete can be partial safely according to the ordinary concrete values; (2) it is generally believed due to large consumption of the powder materials and high sand ratio, the elastic modulus of self-compacting concrete than ordinary concrete decreases; (3) compared with the ordinary concrete strength grade, the self-compacting concrete creep, shrinkage and elasticity modulus were not significantly different; (5) compared with normal concrete, self-compacting concrete interface transition zone outside the package in the coarse aggregate is more compact and distribution more uniform and bonding performance of self-compacting concrete and reinforcing steel bar should be better than ordinary concrete [5];

Long-term durability

With the durability of concrete structure is becoming more and more serious, the long-term durability of self compacting concrete has also become the focus of attention. With the durability of concrete structure is becoming more and more serious, the long-term durability of self compacting concrete has also become the focus of attention. Studies have shown that under the same conditions, whether it is air-entraining or air-entraining SCC have higher freeze-thaw resistance, and self-compacting concrete chlorine ion penetration depth smaller than ordinary concrete. In general, the volume stability can be better control when the self-compacting concrete with low water binder ratio and a larger amount of mineral admixture and other reasonable mix ratio design.

Microstructure

The composition of concrete is the main factor that affects the microstructure, and the microstructure of concrete is directly related to its macroscopic properties. The results show that the total porosity, pore size distribution and critical pore diameter of self compacting concrete are similar to those of high performance concrete, but the content of $Ca(OH)_2$ is obviously different from that of high performance concrete. This is of great significance for the durability of self compacting concrete. Essentially, concrete is a multiphase porous material. The capillary tension theory believes that with the hydration of cementitious materials, cement stone pore water gradually reduced, meniscus from large pore to pore migration, reduce the critical capillary radius, increase the negative pressure generated inside the pore, resulting in concrete self shrinkage. Therefore, the relationship between concrete self shrinkage and pore structure closely [6].

Conclusion

From the above, the self-compacting concrete due to its superior performance characteristics, has brought great convenience to the engineering application and broad prospects, especially the application in some section size small and difficult to thin wall structure of the vibrating and intensive reinforcement structure in the engineering construction has obvious superiority. At present, the self-compacting concrete has been widely used in some of the large building structures, Bridges, and both new structure reinforcement engineering. And, depending on the actual project need, has successfully developed various types of self-compacting concrete, such as building self-compacting concrete, high strength self-compacting concrete, large volume of self-compacting concrete, precast of lightweight self-compacting concrete, compensating shrinkage of self-compacting concrete, self-compacting steel fiber reinforced concrete, recycled aggregates self-compacting concrete, etc.

Self-compacting concrete despite and wide development prospect, and on the study of self-compacting concrete has made many achievements, but there are still some controversy and not clear, such as the powder material dosage of self-compacting concrete and the relationship between modulus of elasticity, self-compacting concrete shrinkage and crack resistance, etc. Grasp the rheological properties of self-compacting concrete, can better for self-compacting concrete mixture ratio design and new performance assessment, the self-compacting concrete is conducive to the development of technology of self-compacting concrete. Believe that through the understanding of the deepening of the self-compacting concrete, people can better play the role of the dense concrete.

Reference

1. Zhanhui Cui. On the self-compacting concrete [J]. Construction technology and Application, 2013, (18).
2. Weirong Huang, zhenpeng Liu. Review on the characteristics and properties of self compacting concrete [J]. Concrete, 2014, (1).
3. Renchong Xu, Qian Chen. Study on Preparation and properties of C30~C60 self-compacting concrete [J].

Concrete and cement products, 2014, (2).
4. Xingjun LV. Research progress on mixture ratio design of self-compacting concrete [J]. Concrete, 2013, (8).
5. Surong LUO. Experimental study on tensile and compressive creep of self compacting concrete [J]. Engineering mechanics, 2012, 29(12).
6. Yuhong Yang. Study on autogenous shrinkage and micro pore structure of self compacting concrete [J]. Journal of building materials. 2010, 13(5).