A study of mix design of concrete hollow blocks

Concrete has been used In the construction Industry for centuries. A typical concrete is a mixture of fine aggregate (sand), coarse aggregate (rock), cement, and water. Nowadays the usage of concrete Is increasing from time to time due to the rapid development of construction industry-Today, there are many ways to enhance the quality and properties of concrete. One of the technological advances in improving the quality of concrete is Self-consolidating Concrete. Self-consolidating Concrete (SC) has been described as " the most revolutionary placement In concrete construction for several decades".

Originally developed to reduce the need of skilled laborers for concrete filling In construction. It has proved beneficial economically because of a number of factors. For example, vasoconstriction, reduction in site manpower, better surface finishes, easier placing, improved durability, greater freedom in structural design;; thinner concrete sections, safer working environment, and reduced noise levels by the absence of concrete vibrators. According to Walton (19871 Vibration of fresh concrete has five objectives and as follows: 1. Elimination of mechanical voids in the mass. . Elimination of unintentional air voids. 3. Removal of unnecessary water. 4. Shaking the particles In the mix into their closest nesting, providing uniform dispersion and distribution of the large particles, but still retailing the coating of all particle surfaces with cement mortar. 5. Reduction of micro-pores and micro-capillaries. According Fordable (1987) unabbreviated fresh flowing concrete has defoliating shortcomings and as follows: 1. It contains a number of small and medium size air bubbles. 2. There is reduced bond strength to reinforcement. 3.

There are often settlement cracks around steel refers. Originally developed in Japan, SC technology was made possible by the much earlier development of Superciliousness for concrete. SC has now been taken up with enthusiasm across Europe, for both site and precept concrete work. Practical application has been accompanied by much research into the physical and chemical characteristics of SC. Consolidating Concrete consists of same components as to conventional vibrated concrete, which is composed of cement, aggregates, water and with the addition of chemical and mineral admixtures in different ratios.

Chemical admixtures usually used are high-range water reducers(superciliousness), which change the urological properties of concrete. In some cases, cement is replaced by mineral admixtures that are used as an extra fine material. In this study, additional to cementer fly ash, silica fumes and super plasticizing concrete admixture to enhance the playability, workability and compressive strength of the concrete. Development of Self- Compacting Concrete (SC) is a desirable achievement in the construction industry in order to overcome problems associated with cast-in-place concrete.

Self-compacting incorrect is not affected by the skills of workers, the shape and amount of reinforcing bars or the arrangement of a structure and, due to its high-fluidity and resistance to segregation and can be pumped to longer and higher vertical distances. Background of the Study Development of Self-consolidating Concrete The principle of self-compacting is not new. Its application for example like underwater concreting requires concrete that doesn’t need compaction, in such ways that concrete vibration is impossible to do.

Early self-compacting concretes relied on very high contents of cement paste and, once superciliousness became available, hey were added in the concrete mixes. The mixes required specialized and well- controlled placing methods in order to avoid segregation, and the high contents of cement paste made them prone to shrinkage. The overall costs for constructions were very high and applications remained very limited and still needs development. Most of the development of SC up to now has been in Japan, in response to significant durability problems with conventional concrete.

Defects such as honeycombing and segregation caused by poor skill in construction work, particularly insufficient or over-vibration, are major causes of this. In cases where heavy reinforcement and the shape of the cross section is complicated that requires concrete fill, it is difficult to place concrete without defects with the normal level of labor skill. Professor Kumara (1986) proposed two alternative practical solutions for these problems as follows: 1. To establish a durable design method by comprehensive evaluation of material design and construction methods. 2.

To develop a new vibration-free concrete, with which durable and reliable for structures can be easily constructed. This was the motivation overdeveloping self- compacting concrete. Hajjis Kumara (1997) proposed the self- compacting concrete in 1986, but the latter prototype was developed by Professor Kiowa (1989) at the University of Tokyo in 1988. Self-compacting concrete is cast so that no additional inner or outer vibration is The development of self-compacting concrete over the past years can be summarized as follows: (l)on Septet. 1986, Contraindicated his paper entitled, “ Waiting for Innovation incommensurately”; (2)on Gag. 988, Prototype concrete no. L produced bazooka;(3)demonstration to the construction industry at the University footy; Self- Consolidating Concrete (SC) was published by Kiowa, Maker and Kangaroo July 1989; (4)the SC was first used in the construction industry in Japan on 1990; and finally, (5) the research studies on SC had been carried out in United Kingdom, France, Sweden, Canada, Holland, Thailand, Korea, China and Taiwan. Concrete has been used in the construction industry for centuries. SC mixtures have been successfully produced with la inch (38 mm) aggregate, it is easier to design and control with smaller size aggregate.

Control of aggregate moisture content is also critical to producing a good mixture. SC mixtures typically have a Geiger paste volume, less coarse aggregate and higher sand-coarse aggregate ratio than typical concrete mixtures(Bartok, 2000). According to Eden et al(2000), the introduction of “ modern” self-leveling concrete or self-compacting concrete (SC) is associated with the drive towards better quality concrete pursued in Japan around 1983, where the lack of uniform and complete compaction had been identified as the primary bacteriologist for poor performance of concrete structures.

Due to the fact that there were no practical means by which full compaction of concrete on a site was ever to be fully guaranteed, he focus therefore turned onto the elimination of the need to compact, by vibration or any other means. This led to the development of the first practicable SC by researchers

Kumara and Kiowa, around 1986, at the University of Tokyo and the large Japanese contractors (e. G. Jaime Co. , Made Co. , Tastes Group Co. , etc.) quickly took up the idea (Truth, 2003). Statement of the Problem 1 . Self-consolidating Concrete is now widely used in different applications in construction industry.

It is now available in the market and offers a lot of advantages in constructions. Thus, one of the disadvantages of SC is its high cement content. 2. The possible effects of substitute material for the reduction of cement content to the playability, workability and compressive strength of SC. Objective of the Study 1. To produce a High-Strength Self Consolidating concrete mix design with low cement factor limited to raw materials available in the Philippines and to investigate decompressing strength development of different designs. 2.

To observe the playability, workability and compressive strength contribution of the alternative material used on the concrete mix for the reduction of cement content. . Theses low cement factor mix designs differ in cement and fly ash content. 2. The trial mixes are limited only to the following materials: -Ordinary Portland Cement type I(lagans Cement) -Class F Fly Ash(Pizzicato Philippines) -Identified type Silica Fume(Sick Philippines) -Protect SSP-HRS Chemical Admixture(ACS) 3. Island Pizzicato Portland Cement is used on the proposed SC mix. 4.

Vibrato sand from Pangaea and 3/8 coarse aggregate from Motivational used on the proposed SC mix. 5. Target compressive strengths of higher than 6000 SSI at 28 days of curing. 6. The water/binder ratio, weight of Silica fume, volume of water and the dosage of the chemical admixture are kept constant. Significance of the study This research project aims at investigating the potential of new concrete material technology (Self Consolidating Concrete w/ Low Cement Factor) for competitive construction of cast in-situ concrete structural frames in multi-storey residential buildings and other structures that does not need concrete vibration.

Many modifications and developments have been made to improve the performance of concrete, especially in terms of strength and workability. Engineers developed and nowadays use Self-consolidating Concrete. However, common Commies has high commencement that makes construction materials more expensive than typical concrete mixture. The motive for development of High Strength Self Consolidating Concrete with Low-cement Factor is to reduce the cost of labor and materialists to the number of bags effacement in SC available the market and manpower that is utilized using conventional concrete.

Conceptual Framework Definition of Terms. 1. Cohesive Characterized by or causing cohesion; pertaining to the molecular force within the incorrect acting to unite the aggregates, water and binders. 2. Fluidity The state of being fluid; the reciprocal of viscosity; the physical property of concrete that enables it to flow. 3. Segregation Particulate solids tend to segregate by virtue of differences in the size, density, shape and other properties of particles of which they are composed; loss of bond between the aggregates, water and binders. . Concrete Vibration It is the method of consolidating wet or plastic concrete by applying either internal or external vibration to the concrete to remove gross voids and entrapped air pockets. 5. Consolidation

To bring together (separate parts) into a single or unified whole; unite; combine; Remarriages in concrete mixture other than water, fine and coarse aggregates, hydraulic cement, and fibers that are added to the concrete batch immediately before or during concrete mixing. 7.

Viscosity Is a measure of the resistance of a fluid which is being deformed by either shear stress or tensile stress; the state of being thick, sticky, and semisolid in consistency, due to internal friction of binders. 8. Superciliousness Also known as high range water reducers, are chemicals used as admixtures to well- speeded particle suspension are required. 9. Urology Is the study of the flow of matter, primarily in the liquid state, but also as ‘ soft solids’ or solids under conditions in which they respond with plastic flow rather than deforming elastically in response to an applied lateral force. 0. Shrinkage A casting defect brought about by the reduction in volume of concrete as it cools and solidifies. 11. Workability Capability of concrete to being worked, dealt with, or handled; Capable of being put into effective operation; feasible; capable of being done with means at hand and resistances as they are. 12. Yield It is the ratio of the total theoretical concrete density to the total actual concrete density; volume of concrete which the batch was designed to produce, Hyde or mm. 13.

Optional Is a siliceous or siliceous and aluminous material which, in itself, possesses little or no conscientious value but which will, in finely divided form and in the presence of water, react chemically withdrawals hydroxide at ordinary temperature to form compounds possessing conscientious properties. 14. In-situ Being in the original position; not been moved or transferred to another location. 5. Honeycomb Refers to voids left in concrete due to failure of the mortar to effectively fill the spaces among coarse-aggregate particles. 6. Vibrato sand compaction The Vibrato Compaction technique is most suitable for medium to coarse-grained SAND with a silt content of less than 12% passing sieve size of 0. Mm and clay content of less than 2% passing sieve size of 0. Mm. Cohesive soils consisting of silt and clay material will not respond to vibratory compaction. 17. Cement Factor The quantity of cement contained in a unit volume of concrete or mortar, preferably expressed as weight, but frequently given as bags of cement per cubic yard of concrete.

Chapter Review of Related Literature and Studies Related Literature There has been an increase in using Self-consolidating Concrete (SC) in recent years and numerous of papers have been published. SC was first developed in Japan in the late nineteen eighties to be used in the construction of skyscrapers. The introduction of SC represents major technological advances, which leads to a better quality concrete and an efficient construction process.

SC allows the construction of reduction of SC allows the pumping of concrete to a great height and the flow through congested reinforcing bars without the use of compaction other than the concrete self-weight. As a result, the use of SC can lead to a reduction in construction time, labor cost and noise level on the construction site(Bin Mud, 2009). John, 1998 said in his study that present-day self-compacting concrete can be classified as an advanced construction material. As the name suggests, it does not require to be vibrated to achieve full compaction.

This offers many benefits and advantages over conventional concrete. These include an improved quality of concrete and reduction of on-site repairs, faster construction time, and lower overall costs. An important improvement of health and safety is also achieved through elimination of handling of vibrators and a substantial reduction of environmental noise loading on and around a site. The composition of SC mixes includes substantial proportions of fine-grained inorganic materials and this gives possibilities for utilization of mineral admixtures (Truth, 2008).

According to Bin Mud(2009), SC offers many advantages and benefits for the precept, pre-stress industry and for the cast-in-place construction as follows: 1. Can be placed at a faster rate with no mechanical vibration and less screening, resulting in savings in placement costs. 2. Improved and more uniform architectural surface finish with little to no remedial surface work. 3. Ease of filling restricted sections and hard-to-reach areas. Ease undesigning structural and architectural members and surface finishes not achievable with the use of conventional concrete. . Improved consolidation around reinforcement and bond with reinforcement 5. Improved punctuality. 6. Improved uniformity of in-place concrete by eliminating variable operator-related fort of consolidation. 7. Labor savings. 8. Shorter construction periods and resulting cost savings. 9. Quicker concrete truck turn-around times enabling the producer to service the project more efficiently. A. Reduction or elimination of vibrator noise potentially increasing construction hours in urban areas. B. Minimizes movement of ready mixed trucks and pumps during placement. . Increased Jobbers safety by eliminating the need for consolidation. In the following, a summary of the articles and papers found in the literature, about the self-compacting concrete and some of he projects carried out with this type of concrete, is presented. A new type of concrete, which can be compacted into every corner of a foreword purely by means of its own weight, was proposed by Kumara (1997). In 1986, he started a research project on the flowing ability and workability of this special type of concrete, later called self-compacting concrete.

The self-compatibility of this concrete can be largely affected by the characteristics of materials and the mix proportions. In his study, Kumara(1997) has fixed the coarse aggregate content to 50% of the solid illume and the fine aggregate content to 40% of the mortar volume, so that self- compatibility could be achieved easily by adjusting the water to cement ratio and supercritical dosage only (Truth, 2008). After Kumara began his research in 1986, other researchers in Japan have started to investigate self-compacting concrete, looking to improve its characteristics.

One of those was Kiowa (1989) who has done some research independently from Kumara, and in the summer of 1988, he that, an open experiment on the new type of concrete was held at the University of Tokyo, in front of more than 100 researchers and engineers. As a result, intensive research has begun in many places, especially in the research institutes of large construction companies and at the University of Tokyo (Peterson, 2008). The use of self-consolidating concrete can facilitate the placement of concrete in congested members and in restricted areas.

Given the highly foldable nature of such concrete, care is required to ensure adequate stability. This is especially important in deep structural members and wall elements where concrete can segregate and exhibit bleeding and settlement, which can result in local structural defects that can reduce canonical properties. The objective of Ghats's (1997) et al. Research was to evaluate the uniformity of in situ mechanical properties of self-consolidating concrete used to cast experimental wall elements.

Eight optimized SC mixtures with slump flow values greater than 630 mm and a conventional concrete with a slump of 165 mm were investigated. The self-compacting concrete mixtures incorporated various combinations of conscientious materials and chemical admixtures (Bartok, 1992). Aquaria (1993) developed a type of concrete, which contained materials normally mound in conventional concrete such as Portland cement, aggregate, water, mineral and chemical admixtures. The chemical admixtures were added in order to improve the dependability and the viscosity of the concrete.

The newly developed type of concrete was called super-workable concrete and showed excellent dependability and resistance to segregation. It could also fill completely heavily reinforced frameworks without any use of vibrators. After the laboratory tests it was found out that the super-workable concrete had superior properties in the fresh state and excellent durability after hardening. Because of its properties, it was considered that it would be suitable for projects involving heavily reinforced areas(Peterson, 2008).

Self-consolidating(or Self-compacting) Concrete Self-compacting concrete (SC), is a new set of high performance concrete (HP) with an excellent dependability and segregation resistance. It is a flowing concrete without segregation and bleeding, capable of filling spaces in dense reinforcement or inaccessible voids without hindrance or blockage. The composition of SC must be designed in order not to separate and not to bleed. Concrete strength development s determined not only by the water-to-cement ratio, but also is influenced by the content of other concrete ingredients like cement replacement material and admixtures.

Two important properties specific to SC in its plastic state are its playability and stability. The high playability of SC is generally attained by using high range-water-reducing (HRS) admixtures and not by adding extra mixing water. The stability or resistance to segregation of the plastic concrete mixture is attained by increasing the total quantity of fines in the concrete and/or by using admixtures that modify the viscosity of the mixture. Increased fines contents can be achieved by increasing the content of conscientious materials or by incorporating mineral fines.

Admixtures that affect the viscosity of the mixture are especially helpful when grading of available aggregate sources cannot be optimized for cohesive mixtures or with large source variations. A well distributed aggregate grading helps achieve SC at reduced conscientious materials content and/or reduced admixture dosage. Self- its manufacturing and with the identification of the matrix, mechanical behavior, as measured by compressive, tensile and shear strength, is increased. On the other hand, the use superciliousness or high range water reducers, improves the stiffening, unwanted air entrainment, and flowing ability of the concrete.

Practically, all types of structural constructions are possible with this concrete. The use of SC not only shortens the construction period but also ensures quality and durability of concrete. This non-vibrated concrete allows faster placement and less finishing time, leading to improved productivity (Truth, 2008). In the following, a summary of the articles and papers found in the literature, about the self-compacting concrete and mom of the projects carried out with this type of concrete, is presented.

A new type of concrete, which can be compacted into every corner of a foreword purely by means of its own weight, was proposed by Kumara (1997). In 1986, he started a research project on the flowing ability and workability of this special type of concrete, later called self-compacting concrete. The self-compatibility of this concrete can be succeeded in developing self-compacting concrete for the first time. The year after it would be suitable for projects involving heavily reinforced areas(Peterson, 2008). Fly Ash Gabbler and Silkier (1983) studied concretes containing fly ash in order to determine its effect on the air-void stability. 0% to 20% by mass of fly ash was used in the total amount of conscientious material. The tests undertaken indicated that air contents of concrete containing Class C fly ash appeared to be more stable than those of concrete containing Class F fly ash. This occurred primarily because Class C fly ashes have lower organic matter content and carbon content values. The studies revealed that the higher the organic matter content of a fly ash, the higher would be the air-nitrating admixture requirement for concrete in which the admixture is used.

Practically, all concrete containing fly ash required more air-entraining admixture than Standard concrete without fly ash and the concrete containing Class C fly ash tended to lose less air than concretes with Class F fly ash. Nazi and Sings (1997) conducted tests on concretes containing between 15% and 25% by mass Class F and Class C fly ashes, to evaluate time of setting, bleeding, compressive strength, drying shrinkage, and abrasion resistance. The effects of moisture and temperature during curing were also examined.

The results of the research showed that concretes containing Class C fly ash and were moist cured at PUFF (ICC) developed higher early age (1 to 14 days) compressive strengths than concretes with Class F fly ash(Truth, 2008). Fly ash is the finely divided mineral residue resulting from the combustion of powdered coal in electric generating plants. Fly ash consists of inorganic, incombustible matter present in the coal that has been fused during combustion into a glassy, amorphous structure. Coal can range in ash content from 2%-30%, and of this around 85% becomes fly ash.

It can replace up to 50% by mass of Portland Emmet [22], which can add to the final strength of the concrete and increase chemical resistance and durability(Bin Mud, 2009). Silica Fume In their study, Shallow and Houseclean (1999) investigated the influence of silica fume incompressible strength and durability of concrete. The percentage of silica fume was between 1%and 15% and the water-cement ratios ranged from 0. 3 to 0. 6. The coarse and fine segregationist's of river gravel and sand with maximum size of 25 mm and 5 mm, respectively.

The test results indicated that 5 to 10 percent by mass replacement of silica fume for cement provided the highest strength for short ND long terms. Compressive strength of silica fume concrete at 28 days compared to conventional concrete increased by 20 to 40 percent, for all the variables considered. Kathy (1997) et al. Evaluated the influence of silica fume blended with cement on some properties of fresh and hardened concrete. The properties studied were bleeding, slump loss, setting time, and compressive strength. Half of the mixtures were air-entrained and had water- cement ratios ranging from 0. To 0. 6. The remaining half contained non air-entrained mixtures and the water-cement ratios varied between 0. 45 and 0. 7. Studies undertaken revealed that the addition of small percentages of silica fume, usually less than 10%, and proper amount of high range water-reducing admixture (Superciliousness) could decrease the viscosity of the of silica fume can displace some of the water present among flocculated cement particles and fill some of the voids between the coarser particles, which otherwise can be occupied by some of the mix water.

This causes some gain in workability and identification of the fresh paste. Concrete mixtures made with blended silica fume cement exhibited substantially less bleeding than those made with type I Portland Emmet. In addition, mixtures made with blended silica fume cement showed 15 to 20 mm greater loss of slump than concretes without silica fume(Truth, 2008). Silica fume (also known as micro silica) is a byproduct of the reduction of high-purity quartz with coke in electric arc furnaces in the production of silicon and Frederickson alloys.

Silica fume is also collected as a byproduct in the production of other silicon alloys. Because of its extreme fineness and high silica content, silica fume is a highly effective pizzicato material. Silica fume is used as an admixture in Portland cement concretes to improve their qualities. It has been found that silica fume improves compressive strength, bond strength, and abrasion resistance(Bin Mud, 2009). Chemical Admixtures Chemical admixtures represent those ingredients which can be added to the concrete mixture immediately before or during mixing.

The use of chemical admixtures such as water reducers, retards, high-range water reducers or Superciliousness (SP), and Viscosity-Modifying Admixtures (VIM) is necessary in order to improve some fundamental characteristics of fresh and hardened concrete. They make more efficient use of the large amount of conscientious material in high trench and self-compacting concretes and help to obtain the lowest practical water to cementing materials ratio. Chemical admixtures efficiency must be evaluated by comparing strengths of trial batches.

Also, compatibility between cement and supplementary cementing materials, as well as water reducers, must be investigated by trial batches. From these, it will be possible to determine the workability, setting time, bleeding, and amount of water reduction for given admixture dosage rates and times of addition. Due to the fact that this research dealt only with Superciliousness, papers found in the literature about these types of chemical admixtures would be presented in the following(Truth, 2008).

Not all admixtures are economical to employ on a particular project. Also, some characteristics of concrete, such as low absorption, can be achieved simply by consistently adhering to high quality concreting practices. The chemistry of concrete admixtures is a complex topic requiring in-depth knowledge and experience. A general understanding of the options available for concrete admixtures is necessary for acquiring the right product for the Job, based on climatic conditions and Job requirements.

Based on their functions, admixtures can be classified into the following five major categories that are retarding, accelerating, Superciliousness, water reducing and air entraining(Bin Mud, 2009). Superciliousness A study of four commercially available superciliousness used in type I Portland cement concrete mixes was done by Whiting (1979). They represented both melamine- and naphthalene based formaldehyde condensation products. Hardened concrete specimens were prepared and tested for compressive strength development, drying shrinkage.