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Shear Capacity Of Uhpc

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***Abstract*—This study is main aim is to investigate the Shear capacity of Ultra High Performance Concrete (UHPC). Ultra-high performance fiber reinforced concrete (UHPC) is a new class of concrete that has been developed in recent decades, it has enhanced properties such as; very high compressive strength, improved tensile strength. Accordingly, the present work proposes to evaluate the shear capacity of UHPC.**

I. Introduction

UHPC, also known as reactive powder concrete (RPC), exhibits excellent mechanical and durability properties and is one of the latest advances in concrete technology.The high compressive strength (more than 150MPa), tensile strength, toughness, and ductility alongwith negligiblewater and chloride permeability, and therefore high durability, of this new concrete material make it UHPC [1]. The basic principle on which UHPC is based is to achieve a cementmatrix as dense as possible (by reducing microcracks and capillary pores in the cement matrix) and a dense transition zone between cement matrix and aggregate. These requirements of UHPC are achieved by enhancing the homogeneity by replacing coarse aggregate by fine quartz sand with a maximum size of 600 μm[2]; improving the properties of cement matrix by the addition of pozzolanic admixture, such as silica fume in the range of 15% to 30% of the mass of cement [2, 3]; reducing water to binder ratio to below 0.2 (by mass) with the help of a high dosage of superplasticizer; optimizing the particles grading to achieve maximum packing density of mixture; adding an adequate amount of steel fibers to achieve ductility; and adopting a suitable method of curing [4–7].

As a result of extensive research carried out globally during the last few years, the production of UHPC is no longer limited within the domain of patented concrete materials. However, use of a very high amount of silica fume and the requirement of fine quartz sand in UHPC put bottlenecks in producingUHPC in places where such ingredients are locally unavailable. In order to mitigate this problem, the possibility of using locally available alternative materials as partial replacement for silica fume and fine quartz sand should be explored. Several studies are reported on production of UHPC utilizing different mineral admixtures [8–11].

Through a study on use of pulverized fly ash, pulverized granulated blast furnace slag, and silica fume as a partial replacement of cement, Yazıcı [8] has found that high strength concrete with compressive strength more than 170MPa can be produced. Basalt and quartz powder were used as an aggregate in the mixtures and three different curingmethods (standard, autoclave, and steamcuring) were applied to the specimens.

Yazici et al. [9] have reported the effect of partial replacement of the cement and silica fume (SF) by fly ash (FA) and/or ground granulated blast furnace slag (GGBFS) on the performance of RPC. Their test results indicated that the utilization of FA and/or GGBFS in RPC is possible without significant loss of mechanical performance. They concluded that the RPC containing high volume binary (SF-FA or SFGGBFS) or ternary (SF-FA-GGBFS) blends have satisfactory mechanical performance. In other words, utilization of FA and/or GGBFS in RPC production is very effective.

In another study, Yazıcı et al. [10] have investigated the mechanical properties (compressive strength, flexural strength, and toughness) of RPC produced with class-C FA and GGBFS under different curing conditions (standard, autoclave, and steam curing). They have observed that by increasing the GGBFS and/or FA content, the toughness of RPC increases under all curing regimes considerably. Furthermore, SEM micrographs revealed dense microstructure of RPC. The test results also showed that RPC containing high volume mineral admixtures has satisfactory mechanical performance. Although the cement and silica fume contents of these mixtures were lower than the conventional RPC, compressive strength exceeded 200MPa after standard water curing. Finally, they reported that the GGBFS and/or FA can also be used as a fine silica source for RPC.

Van Tuan et al. [11] investigated the possibility of using rice husk ash (RHA) to produce UHPC. RHA is an agricultural waste which possesses a very high amount of amorphous SiO_2 and a large surface area and is therefore classified as a "highly active pozzolana." The result showed that the compressive strength of UHPC incorporating RHA, can be achieved in excess of 150MPa with normal curing regime.The interesting point is that the effect of RHA on the development of compressive strength of UHPC is larger than that of SF. Besides, the sample incorporating the ternary blend of cement with 10%RHAand 10% SF showed better compressive strength than that of the control sample without RHA or SF. This blend proved to be the optimum combination for achieving maximum synergic effect.

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II. EXPERIMENTAL PROGRAM

Ordinary Portland cement of 43 grade of Ultra-tech Cement confirming to IS: 8112-1989 standards was used.

The locally available sand confirming to Zone-II grade of Table 4 of IS 383-1970 has been used as Fine Aggregate.

The locally available crushed granite has been used as coarse aggregate in this investigation.

Silica fume is a byproduct of producing silicon metal or ferrosilicon alloys. One of the most beneficial use of silica fume in concrete is of its chemical and physical properties, it is a very reactive pozzolan. Elkam brand silica fume is used for the investigation and the properties supplied by the supplier are, colour appears to be Gray, Bulk density is 500 Kg/m^3, specific surface are 15-30 m^2/gm and average particle size is 0.2 micron.

To impart the required workability superplasticizer has been used in this investigation. Superplasticizers are linear polymers containing sulfuric acid groups attached to the polymer backbone at regular intervals.

The steel fibers used in this study were straight steel wire fibers (un-deformed). The fibers have aspect ratio (l d) of (80), a nominal diameter of 0.2 mm and a nominal length of 40 mm.

Deformed steel bars were used in the longitudinal reinforcement with various bars diameters (10, 12, 16, 20 and 25 mm) in order to satisfy the specific longitudinal reinforcement ratio.

III. TESTING PROCEDURE

Especial arrangement were made through putting steel plate at loading and supporting locations and center the beam under the loading point and dividing it by stiff steel beam. The locations of loading and supporting, concrete strain gage, inclinometer and dial gage were appointed as shown in typical sketch in Figure (3), at time of starting the loading process, all indicators were adjusted. The load was increased gradually of range 20 and 50 kN for (NSC and HSC) and (UHPC) respectively. At each increment of loading, up to failure, the steel and concrete strain gages, dial gage and inclinometer were recorded.

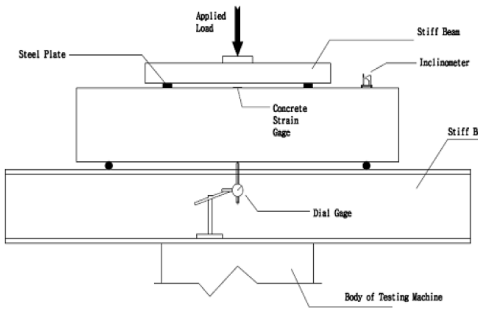

Fig.1: Typical Sketch for Tested Beams

V. RESULTS AND DISCUSSIONS

The first three groups of relationships are shown in Figures. (4, 5 and 6) in which for each group the beams have the same compressive strength and height while have different (a/d) ratios. It can be noted that the ductility of beams increases by increasing (a/d) ratio from (1 to 2) which lead to increasing the moment over the span.

Generally the curves can be divided into two stages; the first stage is elastic (linear stage) in which no flexural or shear cracks appear, after increase the load, the beam becomes in second stage that is inelastic (non-linear stage) in which the flexural cracks are noticed, in these relationships it can be seen that the slope of curve at stage one is steeper than of second stage. The separation between these two stages is more pronounced for higher (a/d) ratios.

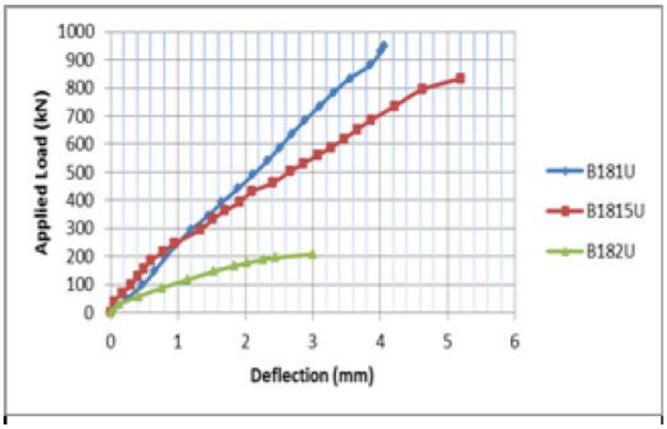

Fig.2: Load-Deflection Curves for G1

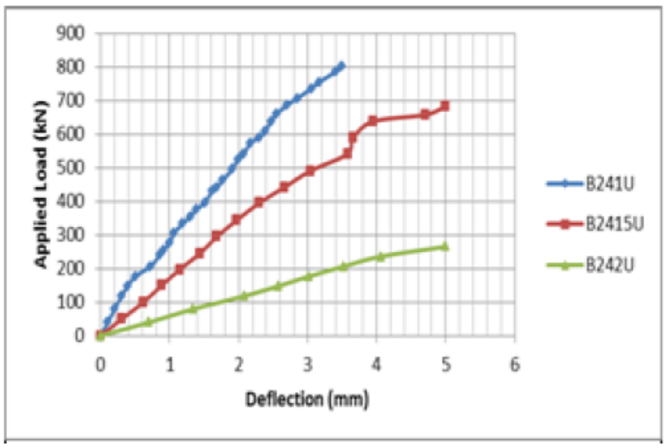

Fig.3: Load-Deflection Curves for G2

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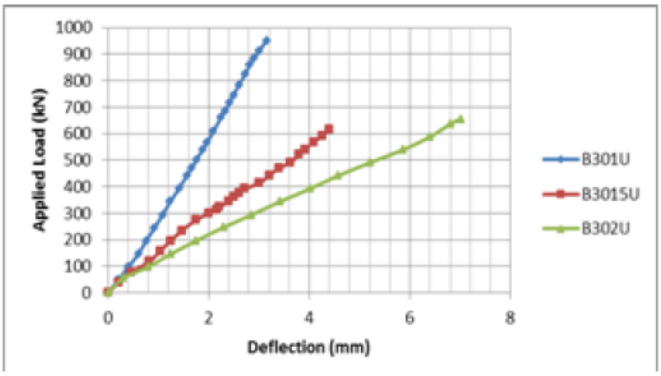

Fig.4: Load-Deflection Curves for G3

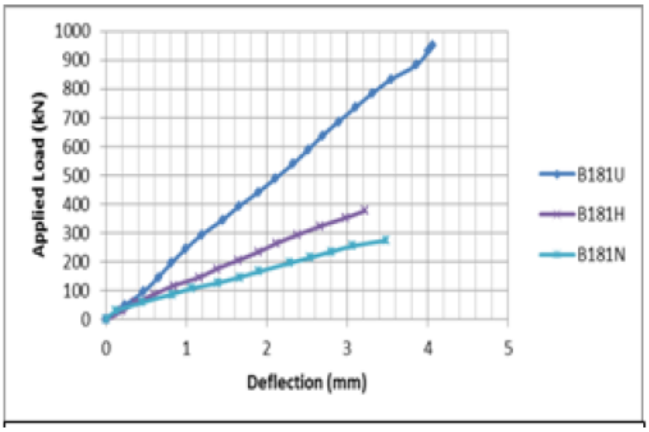

Fig.5: Load-Deflection Curves for different compressive strength

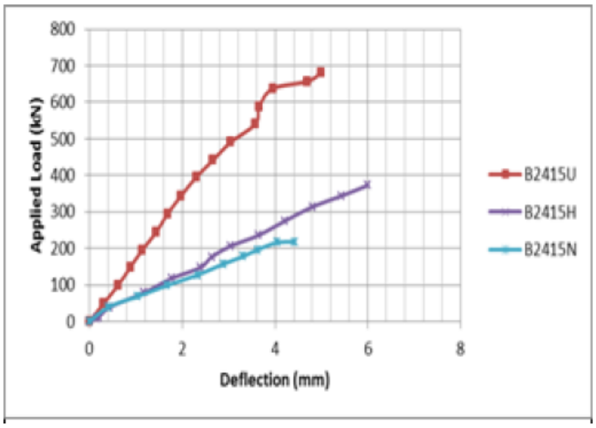

Fig.6: Load-Deflection Curves for different compressive strength

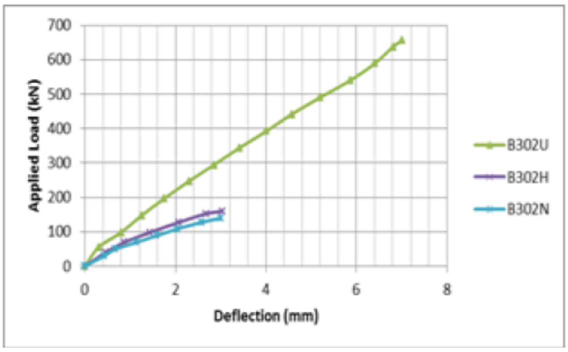

Fig.7: Load-Deflection Curves for different compressive strength

IV. CONCLUSIONS

• At a specific applied load after generation of flexural cracks, the central deflection of beams decreased by 155% and 110% by increasing the compressive strength of concrete from 42 to 134.5 and from 63.75 to 134.5 respectively.

• By increasing the compressive strength of concrete from 42 to 63.75 then to 134.5, the diagonal cracking load increased by 31% and 150% respectively. The failure load is increased by about 44% and 150% when the compressive strength of concrete increased from 42 to 63.75 then to 134.5 respectively.

• The shear span to depth ratio (a/d) has high significant effect on failure load, it can be seen that by increasing (a/d) ratio from 1 to 1.5 then to 2, lead to decreasing the failure load by 30% and 150% respectively. However, as can be noted from many previous researches that this effect is limited beyond (a/d) value of 2 or 2.5.

• (a/d) ratios has small effect on formation the first flexural cracks, while the ratio of first diagonal cracking load to failure load is 28%, 41% and 64% for (a/d) ratios of 1,1.5 and 2 respectively.

• When the beam height increased from (180 to 240) mm a significant decreasing in nominal shear stress can be seen, after which no obvious reducing in nominal shear stress was noticed. The size effect is more pronounced on the nominal shear stress rather than first flexural and diagonal cracking shear stress.

• The flexural cracks formation occurs at about 30% of failure load, while the diagonal cracks occur at 45% of failure load and forms suddenly.

REFERENCES

[1] AASHTO T197. (2000). Time of setting of concrete mixtures by penetration resistance. In American

Association of State Highway and Transportation Officials, Standard Specifications

[2] for Transportation Materials and Methods of Sampling and Testing, Washington, DC.

[3] Abbas, S., Soliman, A., & Nehdi, M. (2015). Exploring mechanical and durability properties of ultra-high performance concrete incorporating various steel fiber lengths and dosages. Construction and Building Materials, 75, 429–441.

[4] ACI 363R-92. (1997). State-of-the-art report on high-strength concrete (p. 55).

[5] AFGC-SETRA (Association Francaise de Genie Civil-Service d'etudes Techniques des Routes et Autoroutes). (2002).

[6] Ultra-high performance fibre—reinforced concretes, recommendations provisoires-interim recommendations (p. 98).

[7] Ahlborn, T., Peuse, E., Misson, D., & Gilbertson, C. (2008). Durability and strength characterization of ultra-high performance concrete under variable curing regimes. In Proceedings of the 2nd International Symposium on Ultra- High Performance Concrete, Kassel, Germany (pp. 197–204).

[8] Aitcin, P. (2000). Cements of yesterday and today—concrete of tomorrow. Cement and Concrete Research, 30(9), 1349–1359.

[9] Allena, S., Newtson, M. (2010). Ultra-high strength concrete mixtures using local materials. In Proceedings of International Concrete Sustainability Conference, Tempe, AZ.

[10] Aoude, H., Dagenais, F., Burrell, R., & Saatcioglu, M. (2015). Behavior of ultra-high performance fiber reinforced concrete columns under blast loading. International Journal of Impact Engineering, 80, 185–202.

[11] Astarlioglu, S., & Krauthammer, T. (2014). Response of normal- strength and ultra-high-performance fiber-reinforced concrete columns to idealized blast loads. Engineering Structures, 61, 1–12.

[12] Bjornstrom, J., Martinelli, A., Matic, A., Borjesson, L., & Panas, I. (2004). Accelerating effects of colloidal nanosilica for beneficial calcium silicate hydrate formation in cement. Chemical Physics Letters, 392(1–3), 242–248.

[13] Blais, Y., & Couture, M. (2000). Precast, prestressed pedestrian bridge—world's first reactive powder concrete structure. PCI Journal, 44(5), 60–71.

[14] Bonneau, O., Lachemi, M., Dallaire, E., Dugat, J., & Aitcin, P. (1997). Mechanical properties and durability of two industrial reactive powder concretes. ACI Materials Journal, 94(4), 286–290.