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Studies on the Mechanical and Durable Properties of Self Compacting Concrete

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ABSTRACT: Self-Compacting Concrete (SCC) is highly flowable, non-segregating concrete that fills uniformly and completely every corner of formwork by its own weight and encapsulate reinforcement without any vibration, whilst maintaining homogeneity. In this current construction practices SCC plays a very vital innovation or alternative to normal concrete. SCC is produced by the same materials as that used for the production of normal concrete. But the properties of every material used for the production has a vital influence on the features of fresh and hardened state of SCC. Flow test, V-Funnel test, I-Box test for fresh or plastic concrete and compressive strength on 7th, 28th and 180 days will be carried out to observe the strength of concrete. The durability of SCC is tested by RCPT, WPT, chemical attack tests like acid and sulphate attack are conducted at the age of 28 and 56 days in SCC specimens.

KEYWORDS: Self Compacting Concrete, Compressive strength, Durability

I. INTRODUCTION

With the recent development of concrete technology, the self-compacting concrete (SCC) was first developed in 1986 by Okamura (1997). Utilizing the SCC will bring some advantages rather than traditional concrete in two main aspects: fresh properties and hardened properties First, it will reduce the cost of labor and construction with the eliminated conventional vibration process and the improved filling ability, especially in intricate architecture designs. Second, because of the excellent workability and dense gradation with more fine sands, the mechanical property of SCC is generally better than that of ordinary concrete, which attributes to the improved interfacial transition zone (ITZ) between cement paste and aggregates. It also leads to a lower permeability and better long-term durability performance comparing with regular concrete. However, along with the improved property and reduced labor requirement, the brittleness in regular concrete also exists in the SCC.

With the increased strength and elastic modulus, the brittle failure is still observed in SCC and even more severe crack propagation at the post-crack stage. To improve the post-peak performance of SCC, many pieces of research have been conducted incorporating different types of steel fibres in SCC. However, the fresh properties of SCC are susceptible to the inclusion of steel fibres, which should be concerned in the application of steel fiber-reinforced SCC in field applications.

II. RELATED WORK

Wang et al., researched that self-compacting concrete (SCC) with the replacement of recycled rubber aggregates is limited for the field application due to high-performance requirements. The steel fibres were introduced to the rubberized SCC (RSCC) to enhance its performance and promote its application. The fresh and mechanical properties and durability performance of steel fiber-reinforced rubber self-compacting concrete (SRSCC) were evaluated. The SRSCC samples were prepared with replaced rubber aggregate based on fine aggregate volume percentages of 10%, 15%, and 25% and a consistent steel fiber ratio of 0.2%. The plain SCC and rubberized SCC samples were also produced for comparison. The fresh performance was evaluated with slump flow, J-ring flow, V-funnel, and U-box tests. The results showed that both filling and passing ability could be affected by the added steel fiber and rubber aggregate. However, the SRSCC could still meet most of the recommended criteria for passing and filling abilities when the rubber content is lower than 25%. Regarding the hardened properties, the compressive strength was reduced in rubber SCC samples with increased rubber contents by comparing with the control SCC samples. Nevertheless, SRSCC samples with 10% rubbers have higher splitting tensile strength than RSCC and plain SCC. Also, the SRSCC specimens showed excellent freeze-thaw resistance after 600 F-T cycles. The relative dynamic modulus of elasticity slightly increased without any dimensional expansion in SRSCC samples. In summary, the proposed SRSCC can meet



required flowability, filling and passing abilities along with good mechanical and freeze-thaw performance. This study will provide lab test data for the applications of recycling waste tire aggregates in steel fibre-reinforced SCC [1, 7, 20]. Ranjbar et al., ascertained that palm oil fuel ash is a waste material generated in power plant due to burning of palm oil industry waste as a fuel to generate electricity. Annual production of such a massive amount of waste requires a huge disposal field that would be a threat to the environment. Therefore, due to the abundance and high pozzolanic characteristics, palm oil fuel ash has attracted many researchers to evaluate the potential of its use in constructional materials. In this study, self-compacting concretes were produced by incorporation of palm oil fuel ash at 10, 15 and 20% by weight of Portland cement and their mechanical and durability potential were evaluated under normal, acid and sulfate attack conditions. It was observed that incorporation of palm oil fuel ash in self-compacting concrete enhanced the acid and sulfate resistance, reduced the dry shrinkage and surface water absorption of the self-compacting concrete without an adverse effect in final compressive strength of the products [2,8,9,10,14,].

Vaidevi et al., observed that self-compacting concrete (SCC) enhances qualities and working conditions due to the elimination of compaction during construction. The usage of river sand in concrete affects natural resources and groundwater. This the paper deals the different testing methods to test high-flow ability, resistance against segregation, and passing ability of self- compacting concrete for M60 grade of concrete with a partial replacement of marble waste as a fine aggregate. Slump flow, V-funnel, L-box and U-box tests were carried out to examine the performance of fresh state SCC. In hardened state, the tests were conducted and cured at different periods to find compressive strength, tensile strength and flexure strength test with the replacement of marble fine aggregate percentage of 0%, 25%, 50% and 100% in SCC for 14, 28 and 56 curing days. The chemical admixture super plasticizer master Glenium sky 8233 and the viscosity modifying agent are used. The specimens are cast with 0.28 water-powder ratio. And also durability of SCC is tested by RCPT, WPT, chemical attack tests like acid and sulphate attack are conducted at the age of 28 and 56 days in SCC specimens. The results are compared with the conventional SCC and found satisfied up to 25% of partial replacement of fine aggregate as a marble aggregate for 28 and 56 curing days [3,15,17,18,19].

Guo et al., informed that research aims to maximize the content of supplementary cementitious material (SCM) and recycled concrete aggregate (RCA) in self-compacting concrete (SCC) by using a combination of fly ash, slag and silica fume. A sustainable SCC was proposed by substantially substituting natural aggregates with RCA and cement with SCM. A total of 23 mixes, including binary, ternary and quaternary mixes were prepared. Binary mixes were prepared with fly ash and ternary mixes were prepared with fly ash and slag. Quaternary mixes were blended with fly ash, slag, silica fume. The mechanical and durability properties were studied. The effect of RCA and SCM was investigated as well as using a combination of fly ash, slag and/or silica fume. The test results indicate that the proposed combination of fly ash, slag and silica fume can compensate for the detrimental effect of RCA and significantly improve the mechanical and durability properties of SCC with RCA, thus optimize the sustainability performance of SCC by minimizing cement and natural resources content [4].

Manikanta et al., researched that the fundamental requirement to reduce the carbon footprint by reducing the consumption of cement in construction industry has been forcing researchers to look for alternate binder materials or mineral admixtures. The use of mineral admixtures as partial replacement of cement in concrete has proved its efficacy with enhanced performance characteristics. In the recent period, the use of ternary and quaternary blended cements in concretes has increased due to the synergistic effect produced by the simultaneous use of multiple mineral admixtures. The present work focuses on studying the properties of high performance self-compacting concretes containing ternary and quaternary blended cements using flyash (FA), silica fume (SF) and graphene oxide (GO). The mechanical and durability characteristics were assessed by evaluating compressive strength, split tensile strength, resistivity, absorption characteristics and rapid chloride penetrability [5].

Sosa et al., informed that the steel industry generated approximately 18 Mt of electric arc furnace slags in 2016. It is estimated that construction generates 10% of man-made CO₂ emissions. To mitigate these two problems, the valorisation of these slags by using them to manufacture siderurgical concrete is considered. As there is a large volume of these aggregates, which have good mechanical properties, it seems sensible to propose their valorisation, even though this implies a series of modifications in concrete properties such as better mechanical properties or higher density. These modifications in the concrete properties make it especially suitable for some concrete applications, such as its use in marine gravity structures, e.g. dams, breakwaters or Gravity-Based Foundation (GBF). In this research, the suitability of these siderurgical concretes for exposure to marine environments has been proved in laboratory and by keeping some reinforced concrete samples in a tidal race for 10 months. Special samples were made in order to analyse the chlorine penetration; truncated conical shaped test pieces were used to analyse the effect of different coating



thicknesses on the protection of the reinforcement. After the concrete characterization, it was found that the designed concretes had an adequate durability for exposure to the marine environment [6].

III. EXPERIMENTAL RESULTS

With the increase in curing period increases strength and durability up to 25% replacement of marble fine aggregate in SCC, where it gives good and optimum results when compared with control SCC. Further percentage replacement of marble aggregate with less curing period reduces the durability and the strength of concrete [3]. The SRSCC could meet most of the requirements in flowability, passing, and filling ability in accordance with typical filed applications. In addition, the SRSCC specimens showed good mechanical strength and freeze-thaw resistance. This study provides test data for the developed SRSCC. The SRSCC is a potential eco-friendly construction material containing recycled waste tire rubber [1]. POFA as a waste material showed great potential to be used as a replacement of Portland cement in self-compacting concrete preserving fresh, mechanical and durability properties in an acceptable range. Increasing the POFA content resulted in reduction in early mechanical properties while the final strength of the POFA containing SCC was comparable to the normal specimens. The specimens which contained higher amount of POFA showed less surface water absorption and higher durability under acid and sulfate attack in comparison to the normal SCC excluding POFA. Incorporation of POFA reduced the amount of portlandite in the system to produce C-S-H gel leading to densification of the matrix and blocking of open porosity networks [2]. it is feasible to use this type of high-performance eco-concrete in gravity-based structures such as dams, breakwaters or Gravity-Based Foundation (GBF). With the materials and manufacturing methods proposed in this work, a highly impermeable and therefore durable concrete has been achieved. These concretes have demonstrated durability in addition to having an environmental advantage and greater stability derived from their higher density [6,11,13,16].

IV. CONCLUSIONS

We have found better results are obtained by using self compacting concrete. Hence self compacting concrete can be used as an alternative for regular concrete.

REFERENCES

- [1] Wang, J., Dai, Q., Si, R., Ma, Y., & Guo, S. (2020). Fresh and mechanical performance and freeze-thaw durability of steel fiber-reinforced rubber self-compacting concrete (SRSCC). *Journal of Cleaner Production*, 277, 123180.
- [2] Ranjbar, N., Behnia, A., Alsubari, B., Birgani, P.M. and Jumaat, M.Z., 2016. Durability and mechanical properties of self-compacting concrete incorporating palm oil fuel ash. *Journal of Cleaner Production*, 112, pp.723-730.
- [3] Vaidevi, C., Kala, T.F. and Kalaiyarrasi, A.R.R., 2020. Mechanical and durability properties of self-compacting concrete with marble fine aggregate. *Materials Today: Proceedings*, 22, pp.829-835.
- [4] Guo, Z., Jiang, T., Zhang, J., Kong, X., Chen, C. and Lehman, D.E., 2020. Mechanical and durability properties of sustainable self-compacting concrete with recycled concrete aggregate and fly ash, slag and silica fume. *Construction and Building Materials*, 231, p.117115.
- [5] Manikanta, D. and Ravella, D.P., 2021. Mechanical and durability characteristics of high performance self-compacting concrete containing flyash, silica fume and graphene oxide. *Materials Today: Proceedings*, 43, pp.2361-2367.
- [6] Sosa, I., Tamayo, P., Sainz-Aja, J.A., Thomas, C., Setién, J. and Polanco, J.A., 2021. Durability aspects in self-compacting siderurgical aggregate concrete. *Journal of Building Engineering*, 39, p.102268.
- [7] D. Karthik, K Nirmalkumar & R. Priyadharshini, "Characteristic assessment of self-compacting concrete with supplementary cementitious materials", *International Journal of Construction and Building Materials* Vol. 297, (2021), No. 123845, Pp 1-14.
- [8] M. Velumani & K Nirmalkumar, "Effect of copper slag on mechanical and durability aspects for different strength concretes", *International Journal of Cement Wapno Beton*, Vol. 26, Issue 2, July 2021, PP. 156-166.
- [9] Bhuvaneswari N & Nirmalkumar K (2019), ' Experimental Study on the Mechanical Strength Properties of Steel Slag in Concrete and Weld Slag in Concrete', *International Research Journal of Engineering and Technology*, Vol. 06, Issue: 02, Feb. 2019, pp. 260-263.
- [10] Yazhini K & Nirmalkumar K (2019), ' Studies on the Mechanical Strength Properties of the Metakaolin Concrete', *International Research Journal of Engineering and Technology*, Vol. 06, Issue: 02, Feb. 2019, pp. 470-474.
- [11] Nirmalkumar K & Sivakumar V., 'A Study on the Durability Impact of Concrete by Using Recycled Waste Water', *JIPC Journal*, Vol. 24(1), pp. 17-22, 2008.
- [12] Nirmalkumar K & Sivakumar V., 'Acid Resistance Behavior of Concrete made using Untreated and Treated



- Tannery Effluent', Journal of Modern Applied Science, Vol. 3, No. 1, pp. 139-143, 2009.
- [13] Karthick M & Nirmalkumar K., 'Durability Properties of High Strength Self Compacting Concrete using Silica Fume and Quarry Dust', International Journal of Scientific Engineering and Applied Science, Volume-2, Issue-4, April 2016, PP. 389-395.
- [14] Soundharya S & Nirmalkumar K., 'Study on the Effect of Calcite-Precipitating Bacteria on Self Healing Mechanism of Concrete', Journal of Engineering Research and Management Technology, Vol. 1, No. 4, pp. 202-207, 2014.
- [15] Soundharya S & Nirmalkumar K., 'Strength Improvement Studies on Self-Healing Characteristics of Bacterial Concrete', International Journal of Engineering Science Invention Research & Development, Vol. 1, No. 4, pp. 162-167, 2014.
- [16] Nirmalkumar K & Sivakumar V., 'Experimental Studies on Durability of Concrete Using Textile Effluent', International Journal of Civil Engineering Research and Practice, Vol. 5, No.1, pp 29-42, 2008.
- [17] Nirmalkumar Krishnaswami, Sampathkumar Velusamy, Chandrasekaran Palanisamy, Gowthaman Govindharajan, Guhan Elanchezhian, Gowtham Ravi, 'Experimental studies on recycled E-waste by using coarse aggregate in concrete', Journal of Materials Today: Proceedings, Vol. 65, PP 1996-2002 (August 2022).
- [18] Nirmalkumar Krishnaswami, Sampathkumar Velusamy, Chandrasekaran Palanisamy, Gowtham Prakash, Kaven Krishna Loganathan, Jithandrakumar Moorthy, 'Experimental studies on light weight concrete using gib & coconut shell in concrete', Journal of Materials Today: Proceedings, Vol. 65, PP 1774-1778 (August 2022).
- [19] Chandrasekaran Palanisamy, Nirmalkumar Krishnaswami, Sampath kumar Velusamy, Harsath Krishnamurthy, Harish kumar Velmurugan, Harish Udhayakumar, 'Transparent concrete by using optical fibre', Journal of Materials Today: Proceedings, Vol. 65, PP 1900-1907 (August 2022).
- [20] Chandrasekaran Palanisamy, Sampath kumar Velusamy, Nirmalkumar Krishnaswami, Keerthevarman Manickam, Logeshwaran Rathinasamy & Ilavarasapandi Annamalai, 'Experimental investigation on self-compacting concrete with waste marble and granite as fine aggregate', Journal of Materials Today: Proceedings, Vol. 65, PP 1900-1907 (August 2022).



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