Utilisation of different types of manufactured sand as fine aggregate in cement mortar

This has reference the technical paper titled 'Utilisation of different types of manufactured sand as fine aggregate in cement mortar' authored by M.C. Nataraja, A.S. Manu and G. Girish published in The Indian Concrete Journal, January 2014, Vol. 88, No. 1, pp 19-25. My comments are as follows:

1. The utilisation of granite crushed sand is an old practice and being used successfully in structural and mass concretes. Utilisation of coarser slag (GBFS) is a good attempt and it is the requirement of the day.

2. The water absorption of fine grained granite is always around 1% or less. Since the crushed sand has been manufactured then why the FM of CGS is 3.13? It must be between 2.60 and 2.70 so that the CGS must fall within Zone II or III.

3. Table 6 needs to be reviewed as the result has been produced for CGS and CBFS has been reflected in the table.

4. In Figure 2, the graphs showing the variation of compressive strengths at 28 days with w/c ratios of 0.5 and 0.6 is misleading as the values of compressive strengths are 44.80 and 36.67 MPa but the difference shown in the graphs is low.

5. The compressive strength of granite is more than 100 MPa. The strength at 28 days of the combination 25% CGS and 75% NS should be more than 49.87 MPa as 100% NS gave the strength of 48.02 MPa.

6. Use of proper FM of CGS, the cost of using superplasticiser may be removed to make the use of manufactured sand cost effective.

Thanking you with warm regards,

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THE AUTHORS' REPLY

The authors thank the discusser for his interest in our paper and for seeking some clarifications. Here are our replies to his comments in the same sequence.

1. I would like to inform the discusser that we used both granite and slag as fine aggregates. No coarse slag is used in the present work.

2. I agree that the water absorption of granite as a block or stone is generally around 1% or less as suggested by the discusser. However for crushed sand made from granite, the water absorption capacity mainly depends on the total surface area of all particles and the amount of fines in the sand. Generally the fines passing through 150 micron absorb more water which is the last fraction in the sieve analysis permitted by the code. Thus the reported water absorption of the sand is correct. Some researchers have reported still higher values of absorption in their paper. As per IS 383, for crushed fine aggregates (here manufactured sand), the maximum permitted fines passing through 75 micron sieve is 15%. With such fines water absorption increases further. Again the fineness modulus of sand is a function of the amount of fractions in the respective sizes of the sieves. As fines passing through 300 and 150 micron are more compared to natural sand, the fineness modulus obtained is higher and is 3.13 as reported. This also indicates that the sand is coarse. Here the sand confirms to Zone I as reported. Generally FM of 2.2 to 2.6, 2.6 to 2.9 and 2.9 to 3.2 indicates that the sand is fine, medium and coarse confirming to grading zones ranging from IV to I.

3. The heading of Table 6 is correct and it is the results for CGS as mentioned. However in the body of the Table it is written as GBFS instead of CGS which is wrong. Thanks to the discusser for identifying this typographical error.

4. The values shown in the graph i.e, Figure 2 are correct. One of the values shown in the Table which is 44.80 should be read as 40.80.

5. The authors agree that the compressive strength of good granite as a block is more than 100 MPa. The parent rock strength also matters with regard to the strength of sand. Normally the impact and crushing strength of sand (if conducted similar to coarse aggregate) will be more if the parent rock is stronger in terms of compressive strength. However the strength of mortar (or concrete) is more influenced by the surface characteristics and bond strength of sand. Bond strength of sand in mortar mainly depends on w/c ratio and the amount of fines. The combination of 25% CGS and 75% NS has given slightly more strength as expected. Probably it should have been little more than the reported as observed by the discusser. In experiment there will always be some scope for errors.

6. Superplasticiser is required to enhance the performance of the mortar. Its use is generally left to the discretion of the engineers in charge of the work. Use of SP alone is not the criteria for cost effectiveness of mortar. Sometimes its use may become mandatory from the durability point of view.

In this work strength and flow properties of mortar with manufactured sand alone are discussed. In addition, durability related properties such as water absorption, porosity and sorptivity should also be studied to assess the transport mechanism through mortar (or concrete) which finally dictates the performance of mortar over a period of time. Serviceability and deterioration of mortar or concrete with time mainly depends on the internal characteristics. Based on such elaborate studies, the complete performance of the manufactured sand can be assessed. No decision should be taken on the use of manufactured sand simply based on strength properties of mortar or concrete.

Once again the authors thank the discusser for his good remarks.

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