RESEARCH ARTICLE OPEN ACCESS

Properties of High Volume. Ultra-Fine Fly Ash modified green concrete

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ABSTRACT
In this research program, high volume ultra-fine fly ash concrete mixes produced with OPC 53 grade cement for higher grade M40, M50 and M60. Initially control mix was produced with 100 % OPC cement. Further 40% of cement content was replaced with ultra-fine fly ash with Alccofine (Metakaolin) and properties were found. The Metakaolin (alccofine) were used in 5, %, 10%, 15% and 20 % to enhance the concrete properties and to reduce cement content for M40, M50 and M60. In such a way overall cement content was reduced up to 60 %. Replacement of cement by UFFA with Metakaolin results in more improved and economical concrete. Results indicated combination of UFFA and Metakaolinreduces the workability of concrete and increased split tensile strength. Maximum split tensile strength 4.60 Mpa is found at 45% UFFA and 5% MK at M50 grade of concrete.

Keywords–Cement, concrete, metakaolin, workability, split tensile strength.

Date of Submission: 01-07-2022 Date of Acceptance: 12-07-2022

I. INTRODUCTION

1 utilized metakaolin to make a HVFAC. In Portland concrete, fly debris was used as a fractional substitute for concrete at a pace of half by weight. Metakaolin was used to supplant the extra concrete in extents of 5%, 10%, 15%, and 20%, individually. With a water folio proportion of 0.44 and two restoring conditions, bubbling and ordinary relieving, the substantial blend for grade M30 was made. The usefulness of cement containing fly debris and metakaolin was viewed as more unfortunate than that of cement containing just Portland concrete. Patil et al. The functionality of a superior exhibition self-compacting concrete containing a combination of fly debris and metakaolin was assessed by 2. Fly debris was utilized in rates of 5%, 15%, and 25%, separately, while metakaolin was utilized in rates of 3%, 6%, and 9%. Fly debris has been found to improve the usefulness of cement. [Muthupriya P. what's more associates, 2011] The conduct of a superior presentation supported substantial segment built utilizing metakaolin and fly debris as a fractional substitute for Portland concrete was explored by 3. Substantial combinations containing 10% fly debris and various proportions of metakaolin were utilized for long and short segments. Concrete containing fly debris and metakaolin exhibited decreased isolation, a lower pace of water retention, and more grounded cohesiveness when contrasted with a regular substantial blend. The impact of mineral added substances like fly debris, GGBS, and limestone powder on the qualities of new cement with low concrete and water content was examined by 4.

II. LITERATURE REVIEW

5 looked investigated the impacts of blending silica seethe with Portland concrete and fly debris in concrete. The rates of fly debris used were 5%, 10%, 20%, and 30%, separately, though the rates of silica smolder utilized were 2.5, 5%, and 10%. It was resolved that raising the silica rage level in substantial builds the water needed for typical consistency, lessens the underlying setting time, and decreases usefulness while keeping a more prominent strength than Portland concrete cement. The impacts of metakaolin and superplasticizer on cement of grade M-35 were investigated by 9. The rates of substitution were 4, 8, 12, 16, and 20%. The water concrete proportion was 0.43 in all occasions, and compression strength was estimated at 3, 7, and 28 days. The utilization of metakaolin influences functionality, albeit this might be remunerated by the utilization of fitting super plasticizers. The ideal measure of metakaolin for not entirely set in stone to be 7.5 percent for M 60 grade concrete [Patil B. B.

what's more Kumbhar P. D., 2012]. 10 utilized metakaolin as a halfway substitute for concrete in the scope of 5% to 20% and found that adding metakaolin to quarry dust concrete improved rheological boundaries like functionality, compactability, dying, and isolation.

Cements containing under 125 kg/m3 of concrete were viewed as fit for fulfilling the ordinary usefulness necessities. 123 went through various scholastic distributions to order an information base on UHPC material characterisation and its true capacity for huge scope field use. The creator found Fly debris is an extraordinary water decrease since it has better functionality and a more drawn out setting time. 124 directed exploration and fostered an information base on UHPC material characterisation and its true capacity for enormous scope field use. Fly debris, as per the creator, is a compelling water decrease with improved functionality and setting time. 32 HVFA mortars were made utilizing three limestone powders: nano-limestone (5%), lime stone with middle molecule sizes of 4.4 m (5-10%), and 16.4 m using class C fly debris (5%) and silica seethe (5%). The creator saw that subbing nano-limestone for concrete by 5% in volume speeds up early age responses and diminishes beginning and last setting times. The response and setting times are impacted by the molecule sizes of the limestone powders. Nano-limestone has been demonstrated to be very compelling.

III. MATERIALS AND THEIR PROPERTIES

Cement

OPC 53 grade cement of Ultra tech was used for this research program.

Natural Sand

Locally procured natural sand was used as fine aggregate in concrete. Locally available Narmada sand (zone-II) was used

Aggregate

A combination of 20mm nominal size aggregate and 10mm nominal size aggregate is used as coarse aggregate in this experimental program. Both types of coarse aggregate were locally procured.

Water

The water used was ordinary tap water from the Bhopal city.

Ultra-Fine Fly ash

Fly ash used in this study was collected from Sarni thermal power plant.

Metakaolin

Commercially available Bags of Metakaolinwere used in various proportions in this study.

IV. RESULTS AND DISCUSSION

Workability of UFFA modified concrete M40

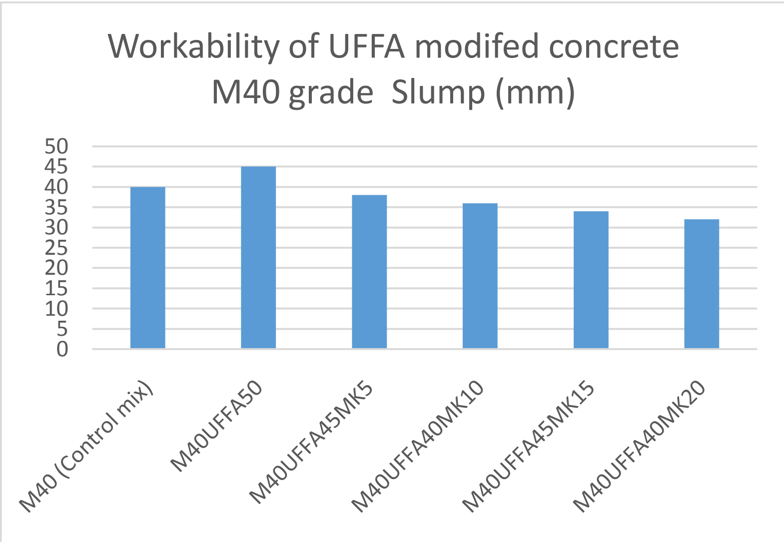

Fig. 4.1 **Workability of ultra-fine fly ash concrete M40**

Fig. 4.1 shows that workability of concrete in combination with UFFA and Metakaoline decreases as compared to OPC concrete as well as UFFA concrete for grade M40. Workability of 50% UFFA concrete is found to be 12.5% more as compare to OPC concrete. Maximum reduction in slump 25 % is found at 40%UFFAand 20%MK.

Workability of UFFA modified concrete M50

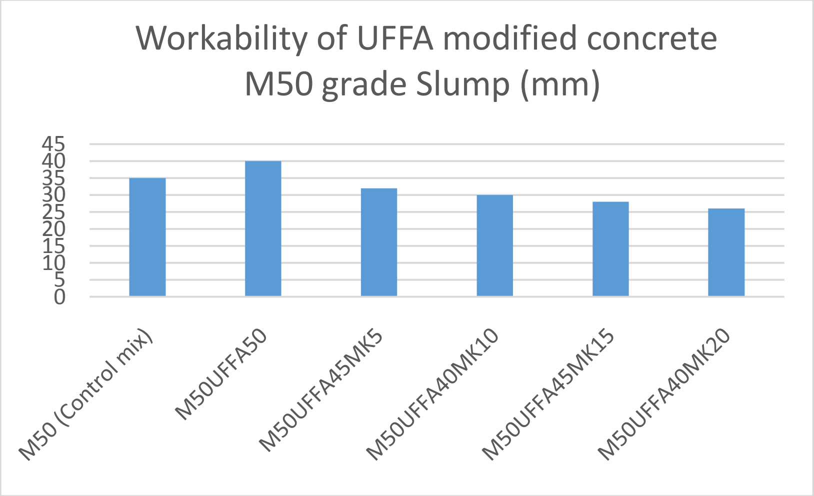

Fig. 4.2 **Workability of ultra-fine fly ash concrete M50**

Fig 4.2 shows that workability of concrete for M50 grade is also found to be reduced. It was found that increase in Metaoline content results in reduction in slump. Maximum decrease in slump was 34.61% for concrete blended with 40%UFFAand 20%MK. Workability of 50% UFFA concrete is found to be 14.28 % more as compare to OPC concrete.

Workability of UFFA modified concrete M60

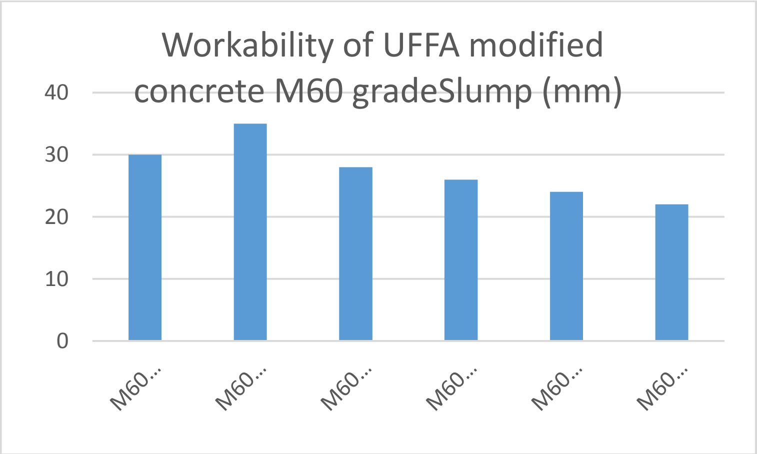

Fig. 4.3 **Workability of ultra-fine fly ash concrete M60**

Fig 4.3 shows that workability of concrete for M60 grade is also found to be reduced. AS percentage of metakoline increases workability decreases. Maximum reduction 36.36% in slump is found at 40%UFFAand 20%MK. Workability of 50% UFFA concrete is found to be 16.67% more as compare to OPC concrete.

Split tensile strength of UFFA modified concrete M40 at 28 days

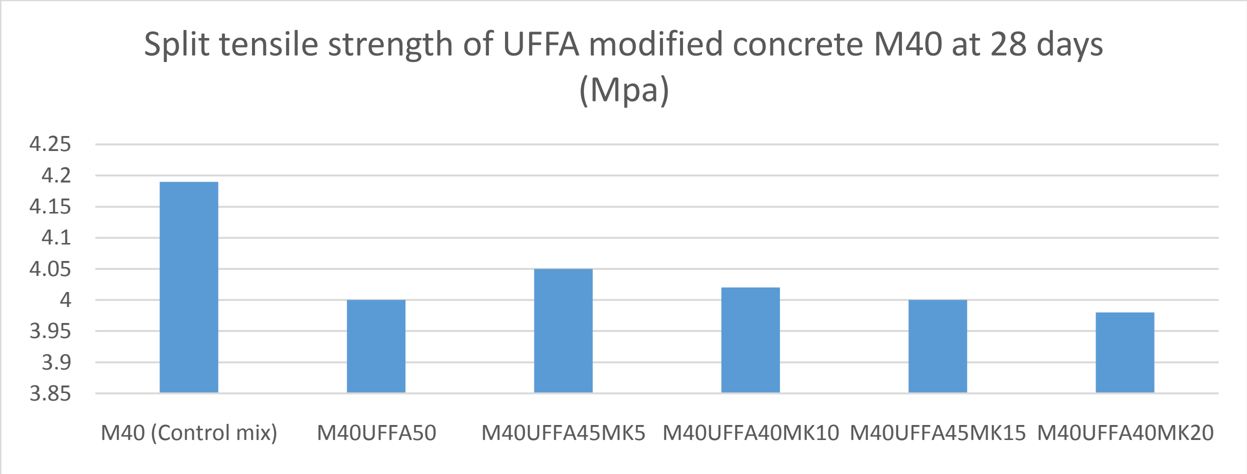

Fig. 4.4**Split tensile strength of ultra-fine fly ash concrete M40 at 28 days**

It is clear that the split tensile strength of UFFA and MK concrete decreases as compared to OPC concrete. Variation split tensile strength of various concrete mixes are shown in above fig.4.13. Maximum Split tensile strength 4.19 Mpa is found at 100% OPC concrete while minimum split tensile strength 3.98 MPa is found at 40%UFFA and 20%MK.

Split tensile strength of UFFA modified concrete M50 at 28 days

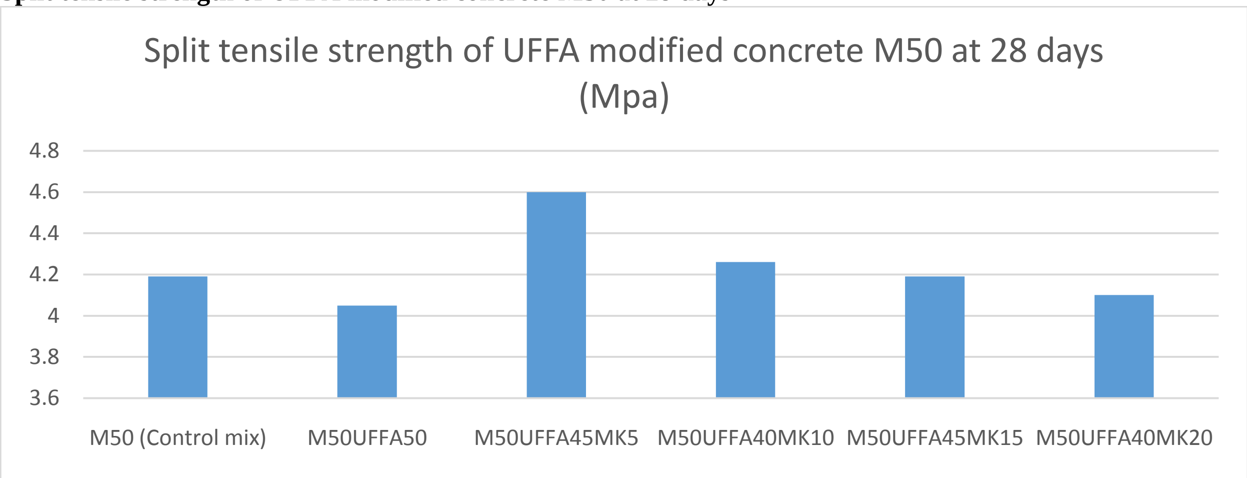

Fig. 4.5**Split tensile strength of ultra-fine fly ash concrete M50 at 28 days**

Variation split tensile strength of various concrete mixes are shown in above fig 4.14. It is observed that concrete containing fly ash and metakaoline results in increased split tensile strength. Maximum split tensile strength 4.60 Mpa is found at M50UFFA45MK5 concrete while minimum split tensile strength 4.05 MPa is found at M50UFFA50.

Split tensile strength of UFFA modified concrete M60 at 28 days

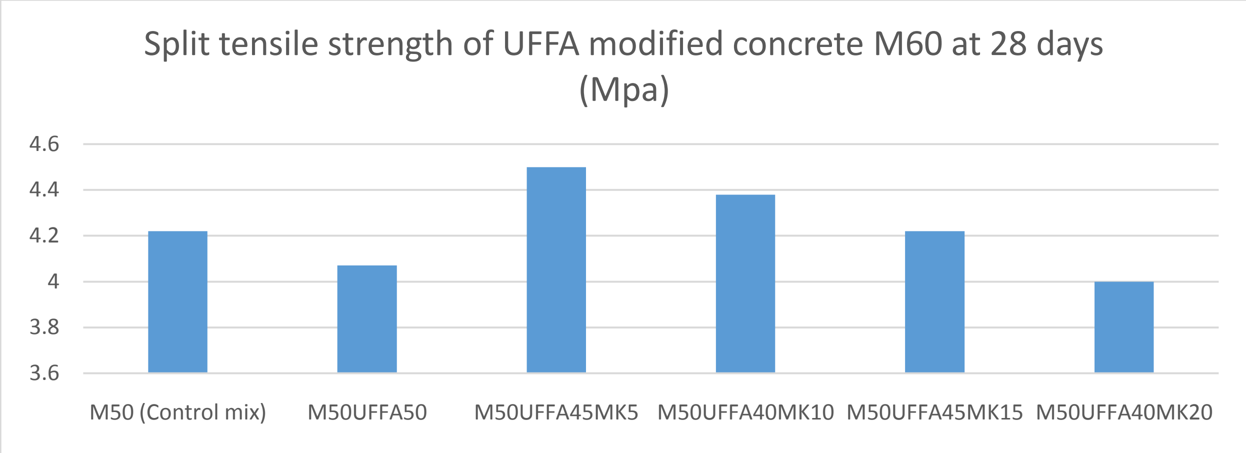

Fig. 4.6**Split tensile strength of ultra-fine fly ash concrete M60 at 28 days**

Variation of split tensile strength of various concrete mixes are shown in above fig (fig.4.15). It is observed that concrete containing fly ash and metakaoline results in increased split tensile strength. Maximum split tensile strength 4.50 Mpa is found at M60UFFA45MK5 concrete while minimum split tensile strength 4.00 MPa is found at M60UFFA40MK20.

V. CONCLUSION

In this study concrete mixes of various proportions with w/c ratio 0.38 to 0.24 were prepared in the laboratory to determine workability and split tensile strength. On the basis of results obtained in the laboratory it can be concluded that use of Metakoline reduces the workability of concrete and increases split tensile strength of concrete. Maximum split tensile strength 4.60 Mpa is found at 45%UFFA and 5% MK for M50 grade of concrete while minimum split tensile strength 3.98 MPa is found at 40%UFFA and 20%MK for M40 grade of concrete.

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