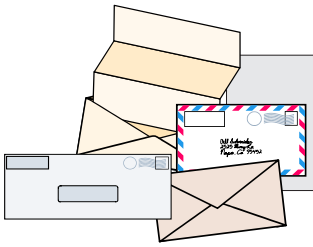

Letters to the Editor

Use of silica fume in concrete

This has reference to the articles in the Special Issue on 'Use of silica fume in concrete', published in the October 2001 issue of *The Indian Concrete Journal* (ICJ), Vol 75, No 10.

1. Mr N.G. Joshi deserves congratulation for explaining lucidly a practical method of mix design for the HPC mixes containing silica fume in his article "Bandra-Worli Sea Link": Evolution of HPC mixes containing silica fume", published on pp. 627-633 in the above issue of *ICJ*.

   He has demonstrated that 74 MPa target strength for M 60 characteristic strength can be achieved more appropriately by a cement content of 330 kg/m^3 and 10 percent silica fume (giving a total binder content of at least 430 kg) and 3 percent dose of a superplasticiser giving a 75 MPa strength as against a 73 MPa strength for a mix with 360 kg/m^3 of OPC, 10 percent silica fume (total binder content of at least 468 kg) and 2.2 percent of superplasticiser. Cost wise the first mix has an equivalent cement content of 610 kg (330 + 8.5 x 33) and the second one of 667 kg (360 + 8.5 x 36). Hence, additional 2 kg of superplasticiser required for the first mix per cubic metre will be justified if this costs less than around Rs 160, which is the cost of additional 57 kg of OPC for the second mix. The discusser would like to know the author's views in this regard and costs of both these mixes as worked out by him.

   Further, as silica fume is 8-9 times costlier than cement and the client's requirement of strength could be achieved by micro-silica content of lesser than 10 percent — say 7 to 8 percent — it would have been perhaps more appropriate for the client to specify water permeability and chloride permeability values for the concrete rather than stipulating silica fume content and that too at such a high minimum value of 10 percent. In fact M 60 concrete used for nuclear power reactor containment dome and the now completed containment structure, having practically zero permeability against water, has used only 7.5 percent silica fume; of course, cement content is now 425 kg/m^3 due to other requirements of tensile strength and modulus of elasticity[1].

   Mr Joshi has used w/b ratio versus compressive strength curve (*Fig* 3) in his mix design and used the term "cementing efficiency" for silica fume binder. Perhaps binder *B* can be equated to "$C + KP$" where *C* is OPC content, *P* is pozzolana content, and *K* is a coefficient depending on the activity index or lime reactivity index of the pozzolana. But time will be a very important factor here particularly when silica fume is used. *K* for fly ash is reported to be 0.3 to 0.8 and the author here has taken cementing efficiency as "3" for silica fume. Can we take *K* for silica fume as "3"? The author's view in this regard will be welcome.

2. The urban viaduct mix reported by Sunil Saini *et al* in their article "High performance concrete for an urban viaduct in Mumbai" in the same issue on pp. 634-640, can not be taken as typical as the mix was designed for M 75 with a target strength of 83.2 MPa, cement content of

500 kg/m^3 and 10 percent of cement as silica fume. The authors there have opined that cement content of 500 kg/m^3 could not be reduced due to certain "non-technical constraints" and by implication the same reason holds good for silica fume percentage as well. Further, from another published report this was a concrete originally specified as M 60 as in other viaducts being done concurrently in Mumbai. Apparently, the cost of such concrete was high and the discusser would be glad if Mr Sunil Saini *et al* can throw some light in this regard.

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Mr N.G. Joshi replies:

Many thanks for the compliments; my reply is given below.

The mix with 330 kg of cement and 33 kg of microsilica was cheaper than 360 kg cement and 36 kg microsilica. The costs of cement microsilica and admixture for 360 and 330 mix worked out to be approximately Rs 2,422 and 2,310, respectively.

Considering the value of K=3, mixes of M 50, 60, 70 and 80 were designed and its cubes were cast. The compressive strengths of cubes gave higher results than expected. This indicated possibility of using the value of K = 4 and the mixes were designed and the cubes were cast accordingly. The initial results are encouraging. Hence presently it appears to be safe to use the value of K = 3.

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Mr Saini and Mr Dhuri reply:

The viaduct superstructure was designed for M 60 grade concrete. The technical specification stated that, "The characteristic strengths for the mixes without microsilica additive should be M 60, M 40 and M 30. When micro silica is added for durability, the characteristics strengths of concrete grades 60, 40 and 30 shall be 75, 60 and 50 MPa, respectively."

As far as cement and silica fume contents are concerned, we would like to state that we were bound by specifications and contractual conditions. There was certainly a scope to reduce both the cement and the silica fume contents. In fact we did make attempts to optimise the mix proportions and thus arrived at reduced dosages of cement and silica fume. However, finally the contractual conditions governed.

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