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Research on long-term properties of high alumina cement concrete

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The Paper is of very considerable interest, not only because it reports really long-term test data, but also because it re-buries the practice of structural use of HAC concrete. The cement, of course, has other uses.

It is gratifying to see how well the Paper complements earlier investigations. As far back as 1958, laboratory experiments on HAC concrete showed a significant loss of strength at a range of temperatures and led to the conclusion that 'this loss is the greater the higher the temperature of storage [and] the greater the humidity.'¹ Further laboratory studies coupled with an investigation of numerous HAC concrete structures in different countries,² led to a general conclusion about the inevitable loss of 'a considerable proportion of [its] strength under ordinary conditions existing outdoors in Europe, including England, over a period of 20 to 30 years.' The same paper² pointed out that the loss of strength 'may lead to an inadequate load factor in prestressed concrete, and the use of HAC in this type of construction is not recommended.' A conclusion that 'there is no critical temperature below which conversion does not take place' has been confirmed by the present tests at 18°C.

The papers of 1958 and 1963 referred to this engineering research; the paper discussed here describes a scientific investigation. Both are necessary; the first because engineering problems need to be treated from an applied standpoint and on a time scale which is often urgent. In the long term it is only science that gives a sound support to engineering judgement. This has now been done.

Reply by the authors

We thank Professor Neville for the kind comments he has made about our paper and would add that our results also support the BRE decision to exclude HAC from cement recommended for sulphate resistance.^{3,4} Although CAH_{10} is extremely resistant to sulphate attack, the conversion product C_3AH_8 is not, and is normally more accessible to the ingress of sulphates as the conversion reaction results in an increase in porosity. A low water/cement ratio is no guarantee that conversion will not take place. The low temperature environment often experienced by foundations may delay conversion but accidental exposure to higher temperatures, especially at early ages, will result in high rates of conversion producing concrete with a very much increased permeability and susceptibility to sulphate attack. There is a considerable risk that this could occur during curing, particularly under adiabatic conditions where the heat of hydration is retained.

The Contributor also rightly points out that HAC has other uses; a promising development patented by British Technology Group on behalf of BRE is a composite HAC/slag cement named BRECEM. This has been designed to overcome the strength loss and permeability problems associated with normal HAC concretes. Extensive long-term durability trials will be carried out before this invention can be fully exploited.

References

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