

MAGAZINE OF CONCRETE RESEARCH

Volume 18, Number 56 : September 1966 : Price Five Shillings

EDITORIAL ADVISORY BOARD

A. L. L. Baker, D.Sc.(Eng.), M.I.C.E., M.I.Struct.E.

Professor of Concrete Structures and Technology, University of London, Imperial College of Science and Technology

W. F. Cassie, Ph.D., M.S., F.R.S.E., M.I.C.E., M.I.Struct.E.

Professor of Civil Engineering, University of Newcastle upon Tyne

R. H. Evans, C.B.E., D.Sc., D.ès Sc., Ph.D., M.I.C.E., M.I.Mech.E., M.I.Struct.E.

Professor of Civil Engineering, University of Leeds

T. W. Parker, M.Sc., Ph.D., F.R.I.C.

Director, The Agrément Board

A. D. Ross, B.Sc., Ph.D., F.R.S.E., M.I.C.E.

Professor of Civil Engineering, University of London, King's College

R. E. Rowe, M.A., Sc.D., A.M.I.C.E.

Director of Research and Development, Cement and Concrete Association

SECRETARY TO THE BOARD AND EDITOR

Anthony E. Brooks, B.A.

Printed and published four times a year by the Cement and Concrete Association

Editorial Office : Wexham Springs, Slough, Bucks : Telephone Fulmer 212 : Telex Advicret Slough 84352

Editorial comment

VERY FEW INVESTIGATORS in the past have been interested in the properties of concrete between two hours and three days and, consequently, there is a considerable gap in our knowledge of concrete. However, this period from two hours to three days is an important one and may have a considerable effect on the later appearance, strength and durability of a concrete member.

The trend in practice is to remove formwork from concrete as early as possible—sometimes after four hours from vertical faces—in order to increase the number of uses from the formwork and to speed construction. Usually, no effective method of curing is applied once the formwork has been removed and, therefore, concrete is often exposed to the weather at this very early age. Advances in construction techniques, such as slip-forming, and the need to economize in formwork—which often accounts for a substantial part of the total cost of concrete members in buildings—will encourage this trend. Research is being undertaken by the Construction Research Department of the Cement and Concrete Association towards establishing criteria from which realistic striking times can be decided. Factors which could be critical in deciding striking times include the rates of development of bond, tensile and compressive strength and increased creep or flow due to early loading. These all depend upon the early temperature history of concrete which in turn depends upon the ambient conditions, the insulation value of the formwork and the heat generated within the concrete. This research has progressed considerably and preliminary studies have been made of the strength and other properties of concrete from an age of four hours onwards, but there is, clearly, a great deal more work to be done.

In practice, curing usually falls far short of normally accepted requirements but without, apparently, giving rise to damage. Nevertheless, there is a need to re-examine curing requirements and in this connexion it should be recognized that, under certain circumstances, the need to protect young concrete against thermal changes is just as important a part of curing as is the prevention of excessive moisture loss. It seems likely that thermal cracking of concrete is at least as common as shrinkage cracking. On roads, for example, Pullar-Strecker⁽¹⁾ has shown that the ambient temperature conditions at the time of laying a concrete road are significant in determining the amount of cracking visible some years after opening to traffic, and this has been confirmed in unpublished work by Gregory at the Road Research Laboratory. Above an ambient temperature of about 70°F, the extent of cracking is related to temperature and most cracking occurs in concrete laid during the mornings

of hot days. In order to develop reliable and economical curing methods including thermal protection for slabs, it is essential first to understand this phenomenon but, although there are several possible explanations, a complete understanding cannot be reached until more is known of the early properties of concrete and the early temperature history within slabs.

Earlier work by the Construction Research Department^(2,3) showed that many of the blemishes in concrete surfaces occur during the period after compaction and before removal of the formwork. Moisture movements from the concrete surface into the form lining and also parallel to the form lining account for a large proportion of colour variations. Moisture absorbed from the concrete into the form lining gives rise to a dark, sometimes black, colour on the concrete surface and the porosity of the surface can be changed to a marked degree depending upon the redistribution of very fine particles in the mix caused by this moisture movement. Moisture movements in the young concrete are influenced by several factors: for example, the absorbency of the form lining, the pressure within the concrete, the temperature gradients and, of course, the composition of the mix. It was found that the appearance of concrete was greatly affected by the so-called 'external factors'—formwork, pressure and curing conditions—and, since variations in surface colour and texture are frequently related to porosity, it seems reasonable to assume that these 'external factors' also exert a considerable influence on other properties of the surface, such as its abrasion resistance and weathering characteristics.

It is hoped that these few remarks may encourage others to enter into this profitable and important field of research, to help build up knowledge of the early properties of concrete and to consider the effects of the various and often extreme conditions to which young concrete may be subjected.

REFERENCES

1. PULLAR-STRECKER, P. J. E. H. *Crack and condition surveys of a section of trunk road A 46, near Narborough, Leicestershire, overlapped in reinforced concrete*. London, Cement and Concrete Association, November 1961. pp. 17. TRA/357.
2. KINNEAR, R. G. *Concrete surface blemishes. A classification of the surface defects and some particular influences of formwork linings, release agents and concrete pressure on the appearance of concrete finishes*. London, Cement and Concrete Association, July 1964. pp. 36. TRA/380.
3. BLAKE, L. S., KINNEAR, R. G. and MURPHY, W. E. Recent research into factors affecting the appearance of in situ concrete. *Symposium on surface treatment of in situ concrete, September 1964*. London, Cement and Concrete Association, 1964. pp. 27.