

## HEAT DEVELOPED IN THE SETTING OF CONCRETE.

Although the fact has long been recognized that during the setting of Portland cement a considerable rise of temperature takes place throughout the mass, with an accompanying disengagement of heat, but little attention has been bestowed hitherto upon this peculiar property of one of our most important constructive materials. One reason for this apparent neglect of so interesting and instructive a subject is no doubt due to the fact that the testing of all samples of cement, concrete, and of nearly every other substance in testing works, laboratories, and similar establishments for the same purpose, is carried out upon so very limited a scale, and upon specimens comparatively so exceedingly small. Under these restricted conditions the particular phenomenon referred to very rarely becomes sufficiently developed to attract any appreciable notice; and even if it did, the absolute rise or difference in temperature would be so small that it would be a matter of great difficulty to measure it with any degree of accuracy.

A very recent experiment has been carried out with the view of obtaining some reliable information upon the whole question, with a mass of solid concrete amounting to nearly 300 cubic yards. The concrete was composed of one part by weight of pure cement, one of sand, and two of rather coarse gravel, so that it had considerable strength and tenacity. In the mass of concrete there was a large number of welding down bolt holes, which served as ready receptacles for the thermometers. Some of these, which were of the ordinary mercurial description, were inclosed in small zinc sheaths or tubes  $\frac{1}{2}$  in. diameter, while others were of larger size, registering maxima and minima, and were placed in tubes  $3\frac{1}{2}$  in. diameter in various parts of the monolith. These thermometers were also differently located with respect to the sides or boundaries of the concrete block. Those of the ordinary pattern were inserted at a distance of 3 ft. from the outer surface of the mass; but the maximum and minimum instruments were placed at a distance of 8 ft. from the external surfaces. The thermometrical observations were made with great rapidity, in order to avoid the registered temperatures being affected by the temporary contact of the instruments with the out-

side air. They were drawn up by means of a small wire attached to each, the readings quickly taken, and they were then redeposited in their little cavities, and a small wooden wedge was inserted, to hold them securely in place.

At the commencement of the experiment, before the setting of the concrete, the temperature was 43° Fahr., and the maximum reached was 86° Fahr. The observations extended over three weeks, and at the expiration of that time all the instruments recorded practically the same temperature as that of the external atmosphere, although the latter had varied in its diurnal and nocturnal limits as much as 20°. There does not appear to be any law regulating the rate of the setting of the concrete subsequent to its commencement and the rate of the rise of temperature, for in the experiment described the maximum temperature was attained at the end of six days after the process of setting had begun. There is a point in connection with the subject of our article which deserves attention. It is that the decrease in temperature after the maximum had been arrived at was slow and gradual, and not of a sudden or spasmodic character. On a future occasion we shall refer to some very interesting experiments undertaken to ascertain the effect upon masses of concrete, of sudden and violent cooling, as in the case of frost. It is perfectly well known

that the origin of fissures and cracks in concrete structures have been attributed to this and collateral causes, and bearing in mind how largely that material is at present employed in engineering and architectural works of very considerable magnitude, there is no necessity for mentioning in a good deal of additional information respecting those causes and their validity, or otherwise, would be very acceptable.

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