Summary

The first paper in this volume, that by *Aitcin et al*, discusses how curing conditions in the Arctic affect the strength gain for concrete specimens. Basically, two sets of experiments were carried out to simulate curing conditions for concrete caisson construction in the Arctic. One set of specimens was cured at 0°C, after 9 h of curing at 39°C. The second set was cured in a standard manner for comparison purposes. It was established that the concrete cured at 0°C achieved its 28-day compressive strength at the 56-day age. However, its modulus of elasticity took longer to achieve the equivalent 28-day design value based on standard curing conditions.

The paper by *Berner, Gerwick, and Polivka* discusses effects of cryogenic temperatures (up to −196°C) on the behavior of high-strength lightweight concrete made with expanded shale aggregates. The key parameters investigated were the compressive and tensile strengths, modulus of elasticity, moisture content, and cyclic loading. The mechanical properties generally increased at low temperatures, with higher gains for specimens with increased moisture content. The cyclic loading induced relatively minor damage. The authors conclude that high-strength lightweight concrete should perform well, even at the cryogenic temperatures encountered in offshore containment vessels.

Carette and Malhotra provide results of a study undertaken to evaluate the performance of limestone and dolostone aggregate concretes subjected to temperatures in the range of 75 to 600°C. The test results show that the dolostone aggregate concrete is unstable under a sustained temperature exposure of 150°C. The limestone concrete was unaffected under similar exposures. It was also found that, as the temperatures increased beyond 150°C, the strength decreased with increasing temperatures and increasing exposure time. The pulse velocity and resonance frequency measurements were taken for monitoring compressive strength loss.

The next paper is by *Gaynor, Meininger, and Khan*. Their research shows that the increased water required for concretes produced at 35°C (95°F), and the subsequent strength loss, can be compensated for by a very modest amount of additional cement. It was determined that an increase in concrete temperature from 18 to 35°C (65 to 95°F) required an average increase of about 4.7 kg (8 lb) of cement to maintain the specified strength levels. On the other hand, an increase in delivery time from 20 to 90 min required an additional 13.6 kg (23 lb) of cement.

The paper by *Mittelacher* also discusses effects of hot weather conditions on the strength of concrete. Data were collected from seven different projects to study the effects of hot weather conditions on the 28-day compressive strength. In general, the test specimens were left exposed to ambient hot weather conditions during the initial curing periods. A statistical analysis was performed on these data. However, no significant correlation was found between the placing temperatures and the strengths of these set-retarded concretes.

The paper by *Naik* examines the validity of the Nurse-Saul maturity function for concrete cured under winter curing conditions. The author concludes that the Nurse-Saul function should not be used for maturity-strength relationships for winter curing conditions. He establishes that the Arrhenius function should be used instead. Data are presented showing maturity-strength relationships determined by both of these functions.

Nasser and Chakraborty present results of an investigation of the influence of temperature on the structural properties of concrete containing Class F fly ash and a superplasticizer. Results show that up to 71°C (160°F), the strength and elasticity of sealed and mass concrete were not greatly affected. At higher temperatures, 121 to 232°C (250 to 450°F), the strength and elasticity of mass concrete decreased, while the unsealed concrete was not significantly affected. The superplasticizer used did not seem to influence the properties of hardened concrete containing fly ash and exposed to high temperatures.

The paper by *Owens* discusses the effects of temperature fluctuations on the permeability of fly ash concrete. The research shows that temperature fluctuations increase the permeability of concrete. However, under similar conditions the permeability of fly ash concrete was reduced.

Roy, White, and Nakagawa examine the behavior of slag cements in comparison with that of portland cements. The effects of elevated temperatures up to 250°C, on mortars and pastes are determined. Compressive strength, density, microstructure, permeability, and dimensional change were the properties studied. Compressive strengths up to 200 MPa and higher were found in some of the mortars. Some changes in pore structure were noted with elevated temperatures.

The last paper is by *Halvorsen and Farahmandnia*. It presents a case study, using the maturity method, of the Willow Island cooling tower collapse of April 1978. This paper has evaluated the concrete strength in the cooling tower at the time of collapse. It shows that the concrete maturity was low at a time when the tower was subjected to construction loads. It further concludes that the failure might have occurred sooner if several days of rainy weather had not apparently delayed the construction.

Tarun R. Naik

University of Wisconsin at Milwaukee, Milwaukee, WI 53201; symposium chairman and editor.