Controlling the temperature conditions of concrete blocks during setting is one of the most difficult problems in present-day high-dam construction. The temperature stresses in the concrete masonry of dams during construction are set up under the action of a multiplicity of different factors, which it is practically impossible to take account of completely. Calculation of the stresses and associated fissuring is usually performed with certain assumptions, which falsify the nature of the process to some extent. Hence, the nature of inception and development of the processes can be studied more reliably on the basis of full-scale investigations on concrete dams from the start of construction.

The first large-scale investigations in world practice in this direction were undertaken during the construction of the Dnieper dam, starting from 1930, directed by Yu. A. Nilender. There are also several publications on the thermal stress of solid concrete structures and full-scale investigations. B. K. Frolov's book sets out foreign experience in the control of temperature conditions of the concrete during dam construction, mainly based on American practice. Up to the present, however, there is no monograph setting out present-day experience in temperature control and measures for countering fissuring on concrete dams in the Soviet Union. This book largely bridges the gap.

The book describes a series of full-scale investigations on the Bratsk dam, including both observations during construction, undertaken for checking conformity with the engineering codes, and the observations of the operational inspectorate. The first group of observations refers mainly to temperature and temperature stress measurements in the concrete blocks, checking of the strength and deformation characteristics of the concrete, observations of fissuring and joint openings, together with rendering the masonry monolithic by cementation. The main observations of the second group include measurements of overall displacements of the dam and piezometric levels in the area of contact of the dam with the foundation. The book provides the results of full-scale investigations during the eight-year period of construction and tentative operation (1959-1967).

The book provides information on the 50th Anniversary of October Bratsk hydroelectric station dam, together with the conditions of erection (Chapter I). A description is given of the schedule of full-scale observations and the location of the measuring instruments (Chapter II). A total of 2,906 instruments and devices were installed, including 2,355 remote indicators.

A detailed account is given of the method and results in determining the physicomechanical and thermophysical characteristics of concrete (Chapter III). The strength and deformation indices of concrete (strength in compression and tension, elongation limit, creep characteristics, relaxation coefficients) have been determined on a large number of test specimens. For these tests, use was made of lever presses designed by the author, enabling up to three specimens to be loaded simultaneously with a progressively increasing force.

On the basis of these results the author correctly comments that the procedure for determining the physicomechanical properties of concrete on laboratory specimens, due to the different conditions of hardening under natural conditions of concrete hardening in the structure, yields only an approximate picture of the nature of the concrete properties being studied. To this should be added the fact that, with the very coarse aggregate in the concrete

* Energiya, 256 pp., 1 ruble 6 kopecks (1968).
‡ B. K. Frolov, The Control of Temperature Conditions of Concrete During Dam Construction [in Russian], Energiya (1964).

of present-day large dams (up to 100 mm for the Bratsk dam), it is necessary to exclude coarse frac-
tions when preparing standard laboratory specimens, which certainly results in a change in the actual strength-deformation properties of the concrete. Hence, in order to improve the procedure for studying these properties of con-
crete, as stated by the author, it is necessary to formulate methods of determining them by static tests directly in
the structure. Great possibilities are opened up along this direction by the pressure chamber with rigid discs, which
has been tested under conditions of practical investigations at the A. V. Vinter TNISGÉI (Tbilisi Scientific-Research
Institute of Construction and Water Power Engineering) enabling cylindrical specimens extracted inside the concrete
structure to be loaded without a limit on their diameter.*

The main part of the book deals with the control of temperature conditions of placed concrete, analysis of the
dynamics and heat balance in blocks as a function of the effect of various factors, full-scale investigations of the
thermal stress in the mass, and development of fissuring, the opening of joints, and rendering the structure monolithic
by cementation (Chapters IV, VI, VII, VIII). On the basis of the results, the author formulates the basic causes of
fissuring, relating both to the properties and grade of concrete (low elongation limit, higher rate of growth of Young's
modulus during the early stage than in the case of strength; greater heat liberation as compared with the design re-
quirements, inhomogeneity), and the working technology and design features of the dam (deviation from the given
initial temperature of the concrete, raising the height of blocks, long interruptions between concreting blocks at
successive heights, inadequate thermal tamping properties of the form-work, existence of extended joints, etc.). The
author states that the familiar causes of fissuring are frequently insufficiently considered in the design and construc-
tion of concrete dams.

In particular, the author points to the very large effect on fissuring of long interruptions in concreting blocks
in successive heights (inevitably associated with the increasing height of the blocks). Hence, the rule adopted by
some project organizations, of considering a concreted block as "fresh" up to one month of age, cannot be taken to
be correct. World-wide experience in dam construction indicates that, with the need for achieving a monolithic
structure, the permissible maximum curing time for blocks must be more strictly limited and differentiated in con-
formity with the actual conditions of construction. Limitation of the curing period of the blocks, for a given growth
rate of the structure upwards, in turn stipulates a restriction on the height of the block.

The author draws very important conclusions from the results of stress determination in the dam during the
start-up period. The stresses in the horizontal sections of the dam originate mainly in the temperature conditions,
together with the stresses from the dead weight of the structure. The effect of the hydrostatic load affects the
stresses on the upstream face and in the zone near the rock only in the final stage of reservoir filling. Considerable
compressive temperature stresses occur on the dam faces, which, as stated by the author, "are the result of exother-
mic heating and subsequent cooling of the block with increasing Young's modulus of the concrete" (p. 244). In
other words, the effect of compression of the masonry on the faces of the dam, on account of substantial tempera-
ture drops in these zones during hardening of the concrete, is confirmed. A method for setting up initial compressive
stresses on the dam faces by intensifying surface cooling of the masonry during the early stage was first proposed
and applied in the practice of dam construction when building the Ladzhunur arch dam in 1959.† Consequently,
the possibility of controlling the initial stresses in concrete dams by appropriate control of the temperature of the
setting concrete was recognized in a number of investigations by Soviet and foreign experts and has been confirmed
by full-scale investigations on dams. In the light of this, the author's recommendation regarding the need for re-
stricting the cooling rate of the surface of the young concrete (p. 242), without indicating supplementary conditions,
appears contradictory.

The following question should also be touched on. Recently the term "pillar" section has entered the tech-
nical literature (as applied by the author of the book) and in our opinion, this is inappropriate. This term has also
entered standard documentation. The same concept was previously defined by the term "columnar" section (as
distinct from "sectional").‡ The massive sections of a dam, built vertically by successively placing blocks of

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* G. I. Chilingarishvili, "Rig for stress determination in concrete structures," Inventor's Certificate No. 187372,
† G. I. Chilingarishvili, Cooling of the Body of a Concrete Dam by Means of a Water Jacket, Transactions of the
‡ See, for example, the monograph by V. V. Ermolov and G. D. Petrov, Form-Work on Massive Hydroelectric Sta-
tion Structures [in Russian], Gosenergoizdat (1954).