

more than 160 F, and maintaining an air temperature above 40 F on both sides of the masonry for a period of at least 48 hours if type M or S mortar is used, and 72 hours if type N mortar is used. These periods may be reduced to 24 and 48 hours, respectively, if high-early-strength cement is used."

BACKGROUND FOR REQUIREMENTS AND RECOMMENDATIONS

A review of the requirements contained in masonry standards which are widely used indicates considerable variation. SCPI has published seven issues of *Technical Notes* on "Cold Weather Masonry Construction" since January 1950; each, after the first, superseding the previous one. Variations in recommendations were made based upon observations and/or on additional information. A review of the source material for these various recommendations indicates that many of the requirements were developed from standards and research relating to cold weather concreting. Data were obtained from work dating back to the 1920's as well as those from recent publications, such as ACI Standard 306-66, *Recommended Practice for Cold Weather Concreting*.

All the recommendations and requirements listed above are equivalent to or exceed the following requirements: "Masonry shall not be built when temperature of materials or surrounding air is below freezing and shall be protected from freezing for a minimum period of twenty-four hours."

Nevertheless, many observers have publicly and privately reported the construction of masonry at temperatures below freezing with little or no auxiliary source of heat and with no apparent adverse effect upon the masonry. Over the years, very few situations have been called to the attention of the Structural Clay Products Institute in which early disruption or disintegration of masonry has been attributed to freezing prior to curing. Similar observations have been noted by Canadians. In Technical Paper No. 87 of the Division of Building Research, National Research Council of Canada, "Advances in Winter Construction Methods Extended Building Season", C. R. Crocker states:

"Most building codes in Canada require that all masonry materials be at temperature not less than 40 degrees when laid up, and that the temperature of the masonry be maintained at no less than 40 degrees for at least 48 hours. In practice, however, it is quite common to see brick masonry being laid up in warm mortar, but without protection at temperatures below zero. In some areas, bricklaying proceeds until the weather becomes so cold that the mortar freezes before the brick can be placed in it.

"Some builders working under rigid inspection asked the Division to look into this matter, since, in their experience, masonry laid up without protection in winter appeared in many cases to be superior to that laid up in summer."

Winter visitors to Scandinavia and Russia report seeing masonry construction continuing at temperatures well below freezing without protection or the use of supplementary sources of heat. In the March 1967 issue of *National Geographic*, on page 310, Mr. Dean Conger discussed construction in Siberia:

"Vladimir Dynin, construction director of the Yakutsk Autonomous Soviet Socialist Republic, took us in his jeep to an apartment house being erected, where bundled-up men and women were laying bricks in spite of the 50-below-zero temperature. 'The mortar is heated,' he told us, 'but if the weather gets much colder, the crane that lifts the mortar won't operate properly. That stops us.'

The USSR Building Standard, NITU 120-55, Chapter XII "Design of Masonry Constructions Built in Wintertime" has requirements which permit construction in outdoor temperatures below freezing and in some cases well below 0 F. There are six different methods of construction in freezing weather which are covered in the general conditions as follows:

"General Constructions:

"240. Masonry construction may be carried on in the wintertime by various methods in accordance with the type of masonry and the character of its performance in the construction, as follows:

"(a) by method of freezing which permits early freezing of the mortar in the masonry and subsequent thawing under natural conditions which are taken into account in calculations of strengths and stability of the masonry;

"(b) by method of freezing with a subsequent artificial complete or partial thawing of masonry and its aging under positive temperature (above freezing) for a definite length of time which assures initial hardening of the mortar up to development of a minimum required strength;

"(c) by method of freezing using mortars with chemical additives (anti-freezes) which assure improved monolithic nature and stability of masonry