

mined only after a detailed study of the job. For this reason, it is recommended that the contractor be given wide latitude in determining the protective methods to be used. In general, items to be considered for the protection of masonry construction in subfreezing weather are: storage and preparation of materials, special precautions and protection of masons and recently constructed masonry.

STORAGE OF MATERIALS

All masonry units and mortar materials should be completely covered with tarpaulins, felt paper, polyethylene sheet or the like. Loose plank covering is not advisable. Masonry units should be stored in a high dry location, preferably on plank platforms of adequate size. Planks should be either raised or of sufficient thickness to prevent absorption of moisture from the ground. Masonry units and mortar materials should never be allowed to become coated with ice or snow. Careless material storage increases the cost of laying masonry, because the removal of ice and snow and the thawing of masonry units are absolutely necessary before construction may be started.

PREPARATION OF MORTAR

Ingredients.—Mortar for use in masonry construction when the mean daily temperature is below 40 F should be portland cement-lime-sand mortar conforming to ASTM Specifications for Mortar for Unit Masonry, C 270, types M, S or N (proportions for these types are given in Table 1).

TABLE 1.—MORTAR PROPORTIONS BY VOLUME¹

Mortar type	Parts by volume		
	Portland cement	Hydrated lime or lime putty	Aggregate measured in a damp, loose condition
M	1	$\frac{1}{4}$	Not less than $2\frac{1}{4}$ nor more than 3 times the sum of the volumes of the cement and lime used.
S	1	Over $\frac{1}{4}$ to $\frac{1}{2}$	
N	1	Over $\frac{1}{2}$ to $1\frac{1}{4}$	

¹ From ASTM specifications for mortar for unit masonry, C 270.

The required protection period for recently constructed masonry may be reduced by using high-early strength cement. It is significant to note that the use of high-early-strength cement in mortars does not appreciably alter their rate of set but does increase their rate of gaining strength.

Accelerators and Antifreezes.—The use of ad-mixtures or antifreezes to lower the freezing point of mortars should not be permitted. The amounts of such materials required to significantly lower the freezing point of mortar would be so great as to have deleterious effects. Mortar strength and other desirable properties may be seriously affected. Excessive salts added as antifreezes can contribute to efflorescence and may cause spalling through recrystallization. The effectiveness of most commercial antifreeze compounds is due to their actions as accelerators, which in most cases result from the calcium chloride they contain.

In the past calcium chloride has been used extensively as a means of accelerating rate of set of mortar during the protected periods. However, recent investigations have indicated that the corrosion of metals embedded in mortar is intensified by addition of calcium chloride.

When metal ties for bonding masonry are used, or when other metal objects are embedded in the walls, the addition of calcium chloride to mortar is not recommended. When calcium chloride is used, it should not be added in amounts greater than two per cent of the portland cement, by weight. When used, it should be added to the mixing water. Care must be exercised to avoid combinations of high temperatures and calcium chloride percentages which will result in excessively rapid setting of mortar (flash set).

In the recommended amount, calcium chloride probably will react with chemicals normally present in portland cement, forming insoluble compounds. In this case, the possibility of calcium chloride contributing to efflorescence is reduced.

The use of calcium chloride does not take the place of other protective methods. Its value lies in the rapid set and strength gain which it imparts to the mortar. The rapid setting action also means that heat of hydration is liberated at a faster rate, thereby keeping the mortar at somewhat warmer temperatures during the initial period.