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MASONRY SILOS

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Silos of brick, hollow clay blocks and units of various shapes, concrete blocks, and concrete staves are all loosely included under the general term "masonry silos." Monolithic concrete silos also may be classed as masonry, but silos of this type never have been generally popular in Minnesota and are so greatly outnumbered by those of masonry units that they will not here be discussed.

Annual expenditures for masonry silos in Minnesota approach a half million dollars. During 1934 alone nearly two thousand such silos were erected at an outlay around one million dollars. The first cost of any masonry silo is high but is justified because such a structure is permanent and the upkeep low if the design is correct and the materials used are durable.

Silo Units of Clay Products

Hard burned clay products made of a first-class shale are not appreciably affected by frost action or the acids of silage. Unfortunately, not all clay products used in silo construction are frost-resistant. The frost resisting quality of clay products is largely dependent on the quality and handling of the raw shale previous to and during burning. Such products must be well burned to resist freezing because most raw materials increase in density as they approach vitrification during burning, resulting in a product of low absorption. Before contracting for the erection of a silo of hollow clay tile, brick, or units of any type, it is well to observe the following precautions:

(1) Deal only with concerns known to produce high quality frost-resistant products.

(2) Insist that the product furnished be hard burned as generally the hardest burned units from any plant are the most frost-resistant of that plant's output.

(3) Avoid units with extremely thin wall sections as the outside walls of such units are too easily broken by accidental impacts of farm machinery, while inside walls are easily broken by forks and other tools used when removing silage.

Silo Units of Concrete

Concrete products of reasonably good quality are frost-resistant but must be better than average in quality to resist satisfactorily the action of ensilage. Low absorption is an essential property of concrete for silo construction because a silo wall must prevent the passage of air and silage juices through it, if the silage is to keep well, and must also resist acid action of the silage. The acids are weak

as acids go, but they will attack and deteriorate poor concrete. In general, the less those juices are absorbed by concrete the more durable it will be. It is, therefore, extremely important to obtain dense concrete. The following suggestions are offered to prospective purchasers of silos of concrete units:

(1) Deal only with established concerns that are known to erect concrete silos of high quality.

(2) If possible, examine the units to be purchased and look for water marks on the surfaces if the product is of the type known as "dry tamped," as the tendency is to use insufficient mixing water in dry tamped products. If too little water has been used the surfaces will be smooth whereas they should have a stippled appearance, caused by the stickiness of the mix when wet.

(3) In case a concrete stave silo is under consideration, demand to be shown strength and absorption tests of staves made by the company with which you are dealing. No test will be as reliable as those of staves from the same lots to be purchased, but, by all means, insist on seeing test sheets of the plant output within the preceding 12 months. The best staves to purchase will be those highest in strength and lowest in absorption. Under no circumstances accept staves higher in absorption than 6 per cent and lower in strength than 90 pounds per inch of width. A strength in excess of 100 pounds and an absorption below 5½ per cent may reasonably be demanded since some Minnesota manufacturers are consistently making staves with strengths of 110 to 130, and upward to 150, pounds per inch of width and with absorption between 4½ and 5½ per cent. In the trans-

verse test the specimen is placed flatwise, in a testing machine, on supports exactly 24 inches apart. A load is then applied at mid-span until the stave fails. Those staves made of the richest mix ordinarily are the best for silo construction. It is extremely difficult to make more than 8 high quality staves from a single bag of cement, although as many as 12 frequently are made and sold. These figures are for a flat stave 30 x 10 x 2½ inches.

Reinforcing for Masonry Silos

Any filled silo is subjected to outward pressure of the silage. This pressure is greatest at the extreme bottom and nothing at the extreme top and, of course, the higher the silo the greater is the pressure developed. To resist this pressure, steel reinforcing rods are used in masonry silo construction. In some types of silos the reinforcing is embedded in the mortar joints, while other types of silos are reinforced by hoops placed around the outside of the structure. There follows a table of the number, total weight, and spacing of hoops of round steel rods for silos of the more common dimensions, externally reinforced.

If the silo is constructed of brick, hollow clay blocks, or concrete blocks and the reinforcing embedded in the joints it will be necessary to reduce the diameter of the rods in order to keep away from excessively thick mortar joints. This means that a greater number of rods will be required but the total weight and proportional location with respect to silo heights will be essentially the same. No masonry silo is properly constructed if inadequately reinforced because joints are certain later to open up and the whole structure ultimately will be disappointing if not actually hazardous.

Hoops—Number, Spacing, and Weight
Rods Are Upset and Threaded. Rod Sizes and Weights Are for Silos of Plain Masonry Staves 30 Inches Long.

Silo		Hoops			
Diameter	Height	Number	Size of round rods	Total weight	Spacing
feet	feet		inches	pounds	
10	37½	19	9/16	550	Upper 27½ feet of silo 1 hoop per stave height, lower 10 feet 2 hoops.
12	40	23	9/16	800	Upper 22½ feet of silo 1 hoop per stave height, lower 17½ feet 2 hoops.
14	42½	27	9/16	1070	Upper 20 feet of silo 1 hoop per stave height, next 20 feet 2 hoops, lower 2½ feet 3 hoops.
16	47½	30	5/8	1650	Upper 22½ feet of silo 1 hoop per stave height, next 22½ feet 2 hoops, lower 2½ feet 3 hoops.
18	50	32	11/16	2400	Upper 22½ feet of silo 1 hoop per stave height, next 25 feet 2 hoops, lower 2½ feet 3 hoops.