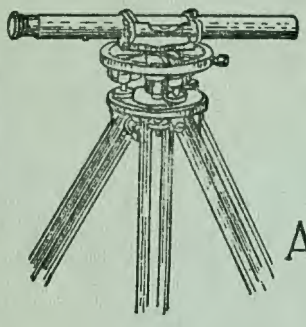

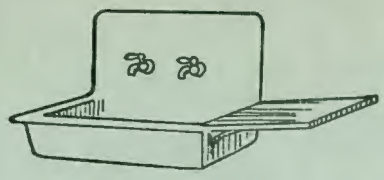


AGRICULTURAL ENGINEERING NEWS LETTER

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DURABLE CONCRETE STAVE SILOS

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Silos of concrete staves, *properly made,* will give long, satisfactory service at little or no maintenance costs to the farmer.

The concrete stave silo is but one of several kinds of silos giving good service, and it is not the purpose of this article to advocate the use of concrete silos in preference to those of other types or of other materials. The desire is to stress the importance of quality and to show how it may be determined when the purchase of a concrete silo is under consideration.

Since 1930, the Agricultural Engineering Division has been making extensive studies relative to the durability of concretes and mortars exposed to weak acids, silage juices, and severe weather conditions. The making and testing of some four thousand commercial concrete silo staves from 30 silo plants located in Minnesota, Iowa, and Wisconsin has been done under the supervision of the Division laboratory.

TRANSVERSE STRENGTH

In order to measure the durability of a concrete stave, it is subjected to a series of laboratory tests. First, the stave is placed flatwise on two supports 24 inches apart, in a machine that applies a load midway between the supports until the stave is broken. This is known as the transverse strength test and the result is recorded as so many pounds breaking strength per inch of width for a stave thickness of 2½ inches. A high transverse strength is one indication of a good stave. From laboratory tests, it has been found that a stave should have a breaking strength of 140 pounds or more per inch of width.

ABSORPTION

Low absorption is another essential property of concrete used in silo staves. A silo wall must prevent the passage of air and juices through it if the silage is to keep well and must also resist the acid action of the silage together with the freezing and thawing action of our winters.

The acids are mainly lactic and acetic. They are weak as acids go but will attack poor concrete. The less these juices are absorbed by a concrete stave, the more durable will be the stave. It is, therefore, extremely important to obtain dense silo staves. Dense concrete, also, is resistant to the action of freezing and thawing.

The absorption test of a concrete stave is made by first thoroughly drying the specimen at a temperature of 240° F. After drying, the specimen is submerged in water for 10 minutes, weighed, and then put back into the water and again weighed after 48 hours soaking. The 10-minute absorption is a measure of permeability, and the 48-hour absorption a measure of pore space. The tests show that a high quality stave will have a 10-minute absorption that does not exceed 2 per cent, and a 48-hour absorption that does not exceed 5.5 per cent.

ACID RESISTANCE

An apparatus has been devised in the laboratory by means of which it is now possible to measure the relative resistance of different types of concrete staves to the action of weak acids. This test further supports the importance of having concrete of high strength and low absorption.

THE FARMER'S PROBLEM

A farmer who is in the market for a new silo is confronted with the problem of making an intelligent selection from the many, each claimed by its maker to be superior, that are available on the market. It is hoped that through this News Letter, those interested will better understand what constitutes a high quality stave silo.

DESIRABLE STANDARDS AND MANUFACTURING PROCEDURE

Present specifications for concrete silo staves require an average transverse strength of 90 pounds per inch of width and a 48-hour absorption of 6 per cent or less. The laboratory tests clearly prove that staves of this low strength and high absorption are of inferior quality. The specifications are now in process of official revision. The new requirements, no doubt, will be more rigid. Many silo manufacturers in Minnesota and other states feel that, for an additional cost of about $10 per silo, the best can be made. As a consequence, many of our local manufacturers are now making staves as good as, and some better than, those recommended herein.

It is difficult, under the processes ordinarily used, to manufacture dry-tamped concrete silo staves of 140 pounds transverse strength and low absorption except by the use of rich mixes. It is also difficult to make more than 7½ to 8 high-quality staves from one bag of cement. In practice it has not been feasible to step up the ratio of "buckshot" gravel, much above 1 part gravel to 2 of sand. A large proportion of coarse material may account for a harshness, objectionable in appearance, and a breaking off of some of the edges. However, the rougher looking staves are better, as a rule, than the smooth appearing ones.

Up-to-date manufacturers are checking their aggregates very carefully to make sure that their sand and gravel is of a durable type. The presence of any soft rock, shale, or other non-durable particles therein may cause trouble.

In the manufacture of dry-tamped staves it is necessary to use non-plastic mixes because the forms are stripped immediately after tamping and undue deformation follows when the consistency of the mix is too wet. Any deformation over one-thirty-second inch along the edge of a stave is apt to cause trouble when the silo is erected. Therefore, the tendency is to use too dry mixes although much strength and durability are thus sacrificed. A good mixer man can judge the mixing water so accurately that the maximum water can be added without getting any appreciable slump.

Plant conditions govern the number of tamps that should be applied to the concrete. Most manufacturers use between 6 and 14 tamps on the concrete and several more blows on the tamper plate. The correct number of tamps to apply can only be found out by making trial batches, varying the number of tamps, and then having the staves tested to determine which are the best.

INTERIOR SURFACE TREATMENTS

Special treatment of the interior surface of a silo will not adequately protect staves of poor quality concrete. It is more effective to use high quality concrete in the silo wall itself than it is to attempt to protect a poor wall once erected. If a special interior treatment is to be used, it is better to apply it on a good stave.

CONCLUSIONS

High quality concrete silo staves are durable. A concrete stave testing 140 pounds per inch of width in transverse strength, having a 10-minute absorption not to exceed 2 per cent, and a 48-hour absorption not exceeding 5.5 per cent, should give long, satisfactory service. Many manufacturers are now selling staves of this quality, and the purchase of those of poorer quality is not recommended.

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