SELECTING AND CONSTRUCTING GRAIN STORAGE TANKS

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Traditionally circular steel bins have been used for storing cereal grains on the farm. These tanks have proven structurally durable, reliable and convenient for grain handling and storage at the local level. The purchase and construction of these structures require a large capital outlay and represent one of the largest investments you will ever make. For this reason you will need to plan the selection and construction of these bins carefully. Attention to small details during the design phase of construction may save hours of frustration and worry later on.

The basic physical layout and design of on-farm grain facilities have been detailed in Extension publication AEN-1. This publication will illustrate the principles to consider when selecting the individual steel tanks for on-farm storage. When properly chosen, constructed and maintained, these structures will provide many years of safe grain storage and afford the producer a potential economic advantage in the sale of a crop.

Tank and Site Selection

The most important consideration in selecting a grain bin is to determine the intended use for that particular bin. Will the bin be used exclusively as grain storage, as a combination of storage and drying or as a wheatholding bin? The usage planned for the bin most often will dictate the type of accessory equipment needed in the tank, which in turn can greatly influence the bin’s structural requirements. You must also determine the product range to be used in the bin. For example, requirements differ for soybean meal as compared to a free-flowing grain such as corn. Both may require different structural designs.

Once product use has been taken into account, then the next consideration is the size of the bin. While this is generally a straightforward decision, you need to consider the possibility of storing multiple crops. A single tank may or may not be satisfactory for double cropping. If there is sufficient overlap in crop storage schedules, two or more smaller bins may be preferable to a single large one. The planning stage is also a good time to consider future needs and requirements. If there is potential for a sizable increase in production acreage, you should consider the impact of this factor in planning the storage system so as to leave open as many options as possible.

Bin Accessories and Costs

Purchasing a grain bin is similar to purchasing an automobile. There are many available options and accessories, and rarely are they included in the structure’s list price. This is often confusing, and you could end up purchasing some unnecessary options. Accessory items can increase the cost of a grain tank in two ways: by increasing the bin’s structural requirements and by the additional cost of the accessory item. This does not preclude purchase and use of accessory items in a drying or storage bin; however, you should be certain whether each item is needed and how each affects the tank’s use and warranty.

General Costs

In general, the cost of a tank used exclusively for storage will include the bin structure, the concrete foundation, an aeration sub-floor, a sweep auger and an unloading auger (Figure 1). Temperature cables may also be a welcome addition in larger storages, but they may require a reinforced roof as a result of increased structural load. If overhead conveyors, catwalks, ladders or downspouting are to be used, these may also contribute to the structural requirements of the tank, and they generally mean increased costs.

If the bin is to be used for drying, then the aeration sub-floor option should be replaced with a full perforated drying floor (including the steel sub-structure), a foundation ring and a grain spreader (Figure 1). Other tank options that may be used in a drying situation include recirculating and stirring devices. Again these items may require a heavy-duty tank structure, thereby increasing the initial structure cost.
Identify the desired accessory items for a given tank as early on in the selection process as possible. Adding these items once the bin is in place may be more costly than including them during initial construction.

There are some general cost considerations when selecting grain tanks for your facility. Bin structures are usually assembled in sections termed rings. The width of each section or ring is two feet, 8 inches for most manufacturers. In general, on a cost-per-bushel basis, building bins nine rings (24 ft.) and below in height is less expensive than using ten rings and above. This is mainly due to the increased structural requirements (including vertical stiffeners) needed when the bin height exceeds the nine-ring value. Because of this factor, when selecting a tank for a certain grain volume, it may be less expensive to increase the bin diameter to the next largest value than to go above the nine-ring height with a smaller diameter bin.

The least number of bins required to contain the desired amount of grain will be the most economical. This means that for a given grain volume one large bin will generally be less expensive than two smaller ones. This could be important in terms of later expansion of the facility. Of course, as pointed out previously, there may be reasons other than cost for using multiple bins.

Site Compatibility

Some aspects of selecting the appropriate site are covered in AEN-1. Briefly those considerations include adequate soil drainage away from the bins; location of the planned bin in relation to existing bins, facility equipment and residential housing; room for future expansion; and vehicle accessibility. In addition, before locating the concrete foundation, the soilbearing capacity of the undisturbed site should be checked, preferably by a licensed engineer. The bearing capacity gives some indication of expected soil settlement and the necessary foundation design to prevent this condition.

Also consider local ground frost conditions in the bin foundation's design. This may be addressed either by providing footers which extend below the frost line or by using a continuous slab and footer design that accounts for frost action.

Other possible concerns for designing the bin and foundation include additional tank loading from outside, such as wind or snow loads. Local building codes for wind, snow and seismic loads should also be included in the design. The site should also have adequate access to electricity, yet it should be free of overhead power lines which might result in an electrical hazard.

Tank Construction

The grain producer can either construct the grain bin or contract with the equipment dealer for the construction. For the experienced producer who already has a grain facility and is experienced in putting up farm structures, constructing a grain tank
may not seem difficult. Generally manuals available from the bin manufacturer contain the necessary tank specifications and construction steps. However, this may not be enough information for the inexperienced grain producer. There are many details and considerations in erecting a grain tank so that it will last and provide years of safe storage. Grain bins represent a sizable investment, and proper construction is important not only structurally but also in terms of the dollar value and quality of the stored product.

Workmanship Considerations

If you elect to have the dealer or manufacturer construct the bin, you should select someone who does quality work. If possible, inspect other facilities that the contractor has built recently. Pay particular attention to the quality of the concrete work, the physical appearance of the tank, the quality of accessory installation as well as the overall facility appearance. Determine if portions of the construction were subleased and, if so (assuming the work was good), find out if the same subcontractor(s) would be available for your project.

Also inspect older facilities that have been in use quite some time. Examine these for possible product or foundation deterioration beyond normal wear and tear. If you note any problems, see if and how they were corrected in facilities constructed later.

Examine the reputation of the dealer or manufacturer you are considering for your project. Make personal contacts with owners and operators of facilities you have inspected and check any references given by the dealer. Determine if these people experienced any problems and, if so, how they were dealt with. Find out if the dealer stands behind the warranty and determine the type of service provided for field problems. Another good source for information concerning a dealer’s reputation would be the Agriculture Extension agent in your county.

Contractual Considerations

Discuss with the dealer the exact length and terms of any warranty on the product and work. Be sure you understand these terms, and try to get a copy of the warranty at the time of the final purchase. If the warranty is not in writing, be aware that this is a possible trouble area in determining what is covered should any problems arise.

Discuss the pricing and product availability. Determine the availability of special bin components and whether the dealer has the necessary equipment to start the work. Examine the quoted prices and decide if they are competitive. If this is to be a turnkey project, make sure the completion date will be in time for your harvest to begin. Remember that you are considering what may be a sizable investment, and you have every right to ensure that the bin or bins are erected correctly. Faulty or haphazard construction will only cause storage problems later.

Warranty Considerations

Most grain tanks now come with extensive warranty coverage. If a bin is found to have defective parts or malfunctions, most manufacturers will readily correct the situation. However, bin warranties are written with many stipulations, especially in the construction area, and if the manufacturer perceives these to be violated, you may be left with an unwarranted structure. As with automobile services and operation, certain warranty conditions must be followed during bin service and operation. Failure to comply with these stipulations may nullify the tank guarantee or, worse, cause the loss of a bin of grain. In this age of lawsuits and liabilities, every precaution must be taken to ensure that the warranty guidelines are followed accordingly.

Generally these guidelines can be divided into two problem areas: potential problems during construction and problems associated with general tank service. These problem areas will be detailed here so that you will be aware of the extent of these areas and the importance the dealer or manufacturer places on them in regard to warranty violation.

Construction and Design Problems

Potential problems in this area (those that could void the product warranty) begin with a foundation design that is not compatible with soil conditions at the facility site. Faulty concrete work or shim omission may also nullify the guarantee. Perimeter footings must be level for uniform tank support, and anchor devices must be properly installed. The manufacturer’s instructions for assembly must be followed explicitly; this is generally the responsibility of the general contractor.

Standard tank components must not be modified without the consent of the manufacturer. If a modification is necessary for whatever reason, be sure to obtain written approval from the manufacturer before doing so. In this day of the "fax" machine, this could be accomplished without much delay in construction. It is best to keep in mind that any such modification without approval will generally nullify the warranty.
As discussed previously, accessory equipment may require special bin components or reinforcing before being covered under a warranty, depending on the individual manufacturer. CAUTION: These items should not be installed in an under-designed bin! Accessory items included in this category are temperature cables, side discharge systems, recirculating devices, some stirring devices, large overhead conveyors, high capacity unloading systems and negative pressure aeration systems. Follow the manufacturer's installation instructions for each of these items. Be sure that both the tank and accessory equipment manufacturer are in agreement on installation.

**General Tank Service:**

**Bin Loading and Unloading**

Many potential warranty problems which occur in normal tank usage relate to bin loading and unloading. Always fill the tank through the peak and ensure that it is filling uniformly. If using a bucket elevator, cushion boxes and grain spreaders should help accomplish this and also prevent overloading of a particular sidewall. Bin unloading should take place from the center discharge well only. Intermediate wells should be used only when all gravity flow has ceased in the center. In general, using a sideward unloading unit without approval from the manufacturer may void the tank warranty. Side unloading can cause severe stresses in the sidewalls which may result in structural damage to the bin. If the center well becomes inoperative for any reason, contact the bin manufacturer for instructions before attempting side unloading.

Other possible problem areas dealing with the warranty include high unloading rates and sweep augers in large diameter bins. Excessively fast unloading rates can create a vacuum in the bin which could contribute to structural damage. Unloading rates exceeding 5,000 bushels/hour may require additional roof vents to alleviate this problem. Some tank manufacturers may have special recommendations concerning sweep augers in large diameter bins. Consult your owner’s manual for any restrictions related to your particular tank.

**Bin Aeration**

Generally aeration of a grain bin will not cause structural problems except in a few instances. Below 35°F roof vents may ice over, especially if humidity is high. If the fans are allowed to run for a sufficient time under these conditions, the increased internal-to-external pressure difference could cause damage to the bin roof or wall or both. Do not change the aeration fan size or air flow direction without making sure there are adequate intake or exhaust vents in the tank roof. If any false flooring was installed after the tank purchase, be sure it is compatible with that used by the tank manufacturer. Aeration is an important management practice and potential bin unloading problems may arise due to condensation and spoilage in the grain mass if this procedure is not followed correctly.

**Other Considerations**

Just as proper maintenance will extend the operating life of your car, prudent maintenance of the tank will reward you with years of safe storage. A good paint job every few years will reduce the chance of tank corrosion caused by spoilage or weather conditions. Always keep safety considerations in mind in all aspects of bin operation and repair. Avoid inadvertent damage to the tank structure, and try to maintain the condition of the tank by promptly making any needed repairs. Other tips for a better bin include making sure that all access door components are in place when refilling the tank, and always try to operate the accessory equipment according to the recommendations of the respective manufacturer.

NOTE: The potential problems previously outlined do not include all of the situations that may occur. Be sure to refer to the tank owner’s manual for more detailed information when problems arise. Remember that the bin plus the grain that it contains represent a sizable investment, and care should be taken when addressing problem situations.

**REFERENCES CITED**


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