

# Grain Bin Anchors

## SUITABLE DESIGNS FOR USE IN GRAIN ENTRAPMENT PREVENTION SYSTEMS

Anchors are the foundation and a very critical component within any grain entrapment prevention system (GEPS) when walking on grain within a bin or silo.

We normally speak of two distinct anchor points with these systems, one at or near the entrance and one at the peak of the bin.

The peak anchor is important, because this will allow the entrant to be held from above. The side anchor is important, because this is normally the point where the observer will help to control the amount of slack that is in the lifeline, as the entrant is performing his or her tasks inside the bin or silo.

Other components of the Grain Entrapment Prevention System (GEPS) include a full body harness and a lifeline at the side anchor point. You must have access to a substantial anchor to secure and manage that grain bin entry lifeline properly.

### Secured Lifeline

As we discussed in the November/December 2013 issue of *Grain Journal*, a secured lifeline must be used for grain bin entry when walking on a sufficient enough volume of grain that potentially could entrap and/or engulf you. These secured lifelines are a basic component of a GEPS and must be attached to a substantial or “bombproof” anchor, as the Safety and Technical Rescue Association (SATRA) likes to say in its hands-on training.

These anchors must be able to handle both the static (while working) or an impact (loading system with less than two feet of slack load) during entry into a grain bin.

You should not be tempted to use the following as anchors: handrails, ladder



rungs, electrical conduit, aeration ducts, spouting, or other items that may be in the immediate area but not suitable for life safety use. These are not designed to handle a sudden impact. You need a bombproof or substantial anchor that you are very comfortable will handle a variety of loads you may exert on it depending on the application within your GEPS.

### Identifying Anchor Points

Dr. Carol Jones with the engineering group at Oklahoma State University shared the following comments with me:

“A walk through every facility to identify appropriate anchor points is a very good safety idea. For main line anchor points, paint them red. For belay line anchor points, paint them blue.

“This is also a great time to have your local fire department and rescue team accompany you on the walk-through. They can help you identify anchor points. It also helps them to be aware of the equipment and infrastructure involved in your grain storage. Any prior knowledge of a facility increases the effectiveness of their response to an entrapment. These walkthroughs to identify anchor points may just be the action that saves a life some day.”

### Load Requirements

The load requirements on the anchors will vary depending upon some of the following factors:

- How many entrants and/or rescuers are tied into the GEPS? What is the total combined weight of these people?
- Is the anchor located at the peak of the bin or near the side access door?
- What is the angle of the secured lifeline, in relation to the entrant and



*Toggle Lok anchor can be used on either concrete or steel for rescues.*

anchor?

- What is the volume, slope, and condition of the grain the entrant is walking on?
  - What is the diameter of the bin?
  - How far is the entrant from the anchor?
  - What is a critical angle? How does this affect some of the issues above?
- SATRA has mentioned numerous times in our various training sessions over the years how the loads increase dramatically, as the angle of your lines increases from 45 to 90 to 135 degrees when directed through a pulley at the peak of the bin.

### Focus on New Bins

For now, our Grain Entrapment Prevention Initiative is not going to address older bins that may be 35 or 40 years old and built with a non-structured roof. We are going to focus our attention on new bins that are 40 feet in diameter or larger, in most cases, and built with a structured roof.

We have to start somewhere, and we feel the most practical way is to address steel bins being built after 2013. Any steel bins erected prior to 2014 should be grandfathered. It is not practical to retrofit the 700,000 to 800,000 steel bins that have been built since 1908, many with non-structured roofs.

However, this does not mean that older bins will not support a peak anchor. Users of these structures should consult with their bin manufacturer, dealer, or knowledgeable engineer for assistance with designing an appropriate anchor system.

The size of the bins, both in terms of diameters and eave heights, have been increasing steadily over the past 40-plus



*D plate anchorage connector bolts permanently to steel or concrete.*



*Concrete anchor plate developed by Edon Farmers Cooperative and Scott Equity Exchange, in conjunction with SATRA. Anchor plate is color-coded red for main line or blue for belay line.*



years. Many off-farm bins are 60 to 105 feet in diameter and larger, while most farm bins erected today are over 36 feet in diameter. Bins also are getting taller. It is not uncommon to see eave heights in excess of 80 to 85 feet.

During recent years, the design of roofs and peak loads have changed dramatically, also. Roof peak load strengths of 50,000-plus pounds and 20 to 30 psf ground snow loads are available today, along with enhanced stiffener designs and sidewall strengths.

We will expect anyone building steel bins in the future to offer anchor points that operators can utilize to secure their lifelines.

### Steel Bins

The following concepts are being pursued, as they relate to anchor points:

- **Star of the West Milling Co.** Knot passing pulleys were first introduced and installed under the roofs of bins erected at the Star of the West elevator in Gera, MI in 2008. These were installed in 48- and 72-foot-diameter tanks.

Some groups in Ohio are testing the use of multiple knot passing pulleys in the same bin to minimize swing factors and multiple angles.

- **Global Industries Inc. (MFS/York/Stormor)** is offering fall restraint anchor points in bins with both structured and nonstructured roofs. These 1/2-inch-x-4-inch-x-5-1/2-inch U-bolts mounted to an anchor plate in bins with structured roofs will be rated for a maximum load of 2,000 pounds (see illustration on page 64).

- **Sioux Steel Co.** will be offering an anchorage connector that will be bolted to an angle iron fastened to the top side of roof access doors. This system will be secured to the roof rib sections as illustrated on page 63.

- A restraint anchor rated for 1,800 lbs. is standard on all **Sukup Mfg. Co.** bins since 2013 (see illustration on page 62). The restraint anchor is a forged eye-bolt that is mounted near the manhole. It is designed to be used with a lifeline and safety harness, in situations where it is determined someone must enter the bin. A peak anchor with a rafter bracket will be offered in 2014 on Sukup bins with structural roofs rated for 15,000 lbs. or greater. It is to be mounted near the peak and is designed to be used with a lifeline and safety harness, in situations where it is determined someone must enter the bin.

- **SCAFCO Grain Systems Co.** will provide anchorage points at the eave and peak of all stiffened bins both for export and domestic use.

### More Steel Bin Options

Several options for anchor points in steel bins are offered by numerous safety manufacturers such as DBI/Sala, Miller, and MSA. Some items to consider when selecting the anchors and associated anchor point include:

- How the anchor is being used – fall protection, fall restraint, or work positioning.

- The location of the anchor – overhead, vertical, or horizontal.

- The direction of force affecting the anchor.

- Is the anchor permanently mounted or reusable?

- The capacity of the anchor itself.

- The structural integrity of the steel bin itself. Does the bin have appropriate strength to support an anchor point?

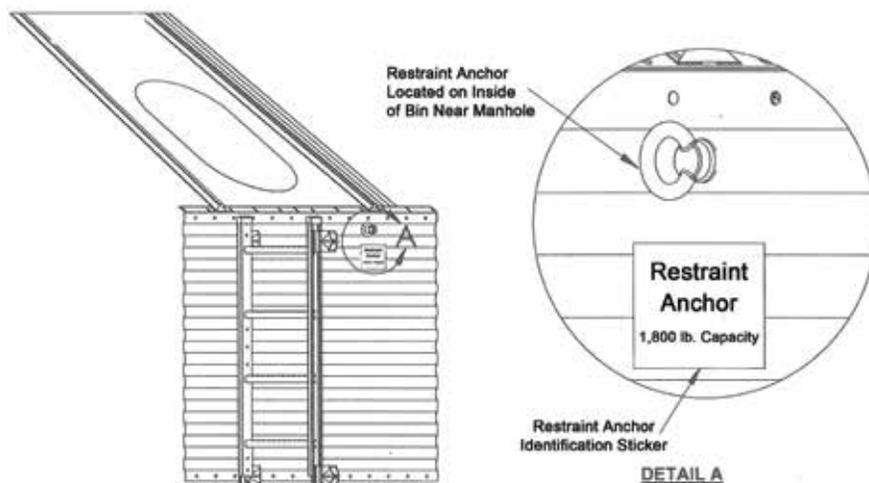
Here are some available steel bin options:

- **Toggle Lok**, the newest anchor on the market, portable for precast concrete or steel flanges.

- **D-plate anchorage connector** permanently bolts to a beam or column.

- **Beamgrip** anchors are portable, designed for mounting to an I-beam flange.

- **Strap anchors** for temporary or portable usage wrap around an anchor point such as a beam. Different lengths are available and different materials including web, cable, or chain.



*Restraint anchor found on Sukup steel bins manufactured since 2013.*

## Concrete Grain Silos

Steve Queen, safety and special projects coordinator, with Edon Farmers Coop Association in Edon, OH, and Scott Equity Exchange in Scott, OH, with assistance from Bill Harp at SATRA, has designed a rescue anchor plate (RAP) that can be attached to concrete silo bin decks. Queen's group is attaching these as suitable attachment points for attaching rescue lines. As a guide, they are painting the RAPs red for use with a main line and blue for belay lines (*see photos on page 59*).

According to Queen, the system was developed after the local fire department's high-angle rescue team visited the tops of the silos at each of two grain elevators to determine where the drop zones into the silos were going to be. Once it was decided that there weren't any suitable attachment points close to the drop zones, Edon Farmers and Scott Equity was challenged to get something fabricated. This is how RAPs came to be.

- The size of the 3/8-inch-thick steel plate is 7x11-1/2 inches.

- Each plate has six holes for securing it to the bin deck with wedge anchors. Holes in the steel plate are 9/16 inch and are a minimum of one inch from the edge. Minimum spacing for the

1/2-inch wedge anchor is 3-1/2 inches.

- Wedge anchors are 1/2 inch x 3-1/2 inches and tightened to 45 foot-pounds.

- The D ring is rated for 12,000 pounds and is welded by a certified welder with No. 7018 rods or 70,000-lb. wire. Welds are triple-pass.

- Each plate was sealed to clean dry concrete using a polyurethane sealant for concrete. This was applied around each wedge anchor and to the underside edges of each plate before securing to the bin deck.

- Each plate, as well as the grain piping, was painted to match the colors of the rescue rope and bags. This quickly identifies the drop zones, when rescuers get to the top of the silos. The red bag (main line) goes to the red attachment point, and the blue bag (belay line) goes to the blue attachment point.

- Each plate is labeled "600 lb. max load limit" and "for rescue use only."

- RAPs were developed with consultation with the Safety and Technical Rescue Association (SATRA), Livonia, MI (313-415-4658). The main and belay bags shown in the photos are two out of four bags of the Basic Rope Rescue Kit available for purchase from SATRA.

### Anchors Available

KC Supply Co. Inc., Kansas City, MO (800-527-



*Knot passing pulley developed as an anchorage at Star of the West Milling Co. This version is designed for 72-foot-diameter bins.*

8775), offers a variety of anchors for use in a number of applications.

KC Supply President Jeff Lavery has mentioned "that there are several options for anchor points offered by numerous safety manufacturers such as DBI/Sala, Miller, and MSA."

Some items to consider when selecting the anchors and associated anchor points include:

- How the anchor is being used – fall protection, restraint, or work positioning.

- Location of the anchor – overhead, vertical, or horizontal.

- Direction of force affecting the anchor.

- Permanently mounted vs. reusable.

- Capacity of the anchor itself.

- Structural integrity of the steel bin itself. Does the bin have adequate strength to support an anchor point?

Lavery also mentioned some of the steel bin options currently available:

- Toggle Lok: The newest anchor on the market. Portable for precast concrete or steel flanges (*see the photo on page 59*).

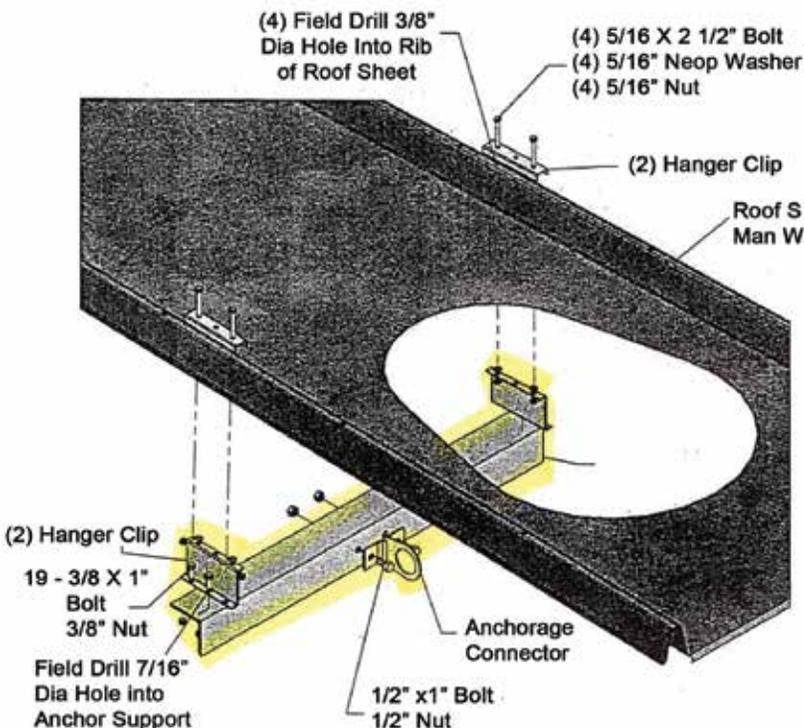
- D-plate anchorage connector: Permanently bolts to a beam or column (*see the photo on page 59*).

- Beamgrip anchors: Portable, designed for mounting to an I-beam flange.

- Strap anchors: Temporary, portable usage. They wrap around an anchor point such as a beam. Different lengths are available and different materials including web, cable, or chain.

### Coming Soon

Steel bin manufacturing firms have agreed to furnish anchor points for your GEPS in the future, which will allow you



*Man Way lifeline anchor assembly on Sioux Steel tanks.*

to secure your bin entry lifelines properly for fall restraint or work positioning when working on grain within a bin.

It will be up to you, the operator, to determine the type of system you wish to secure to these anchor points. It also will be up to you to train your employees adequately on how to identify any hazard, and use these systems effectively while in the bins.

The steel bin firms will be meeting again in Bloomington, IL on March 20 to discuss new design parameters and possible consensus standards within the American Society of Agricultural and Biological Engineers (ASABE) that will affect the type of features you see offered in future grain handling facilities.

Groups like the Grain Handling Safety Coalition (GHSC), SATRA, the Emergency Services Rescue Training (ESRT), and other groups will continue to offer training on using these systems in the future. SATRA also will come to your site, fabricate and install a GEPS system in new or existing facilities, while the bins are empty or full.

During the 2014 Grain Entrapment Prevention Symposium in Bloomington scheduled for March 18-19, ESRT and GHSC will discuss their secured lifeline training curriculum that is aimed at grain handling employees and others who normally find a need to enter a grain storage structure that has a potential to engulf or entrap an entrant.

Grain bin deaths can be averted, if users adopt standard operating procedures before allowing anyone to enter a grain storage structure. Those procedures must include locking out the power to the unloading equipment, attaching to an effective anchor point that is managed by a second person, and having a written emergency action plan that will be employed, if the system fails.

Make sure your employees know how to use these systems effectively. Follow accepted Best Management Practices, and don't take short cuts, which could cost you or someone you love their life.

*Wayne Bauer is safety and security director of Star of the West Milling Co., Frankenmuth, MI; 989-652-7026.*

*Structured roof fall restraint system offered by MFS/York/Stormor.*

