

RIGGING: DON'T OVERLOOK

by David McCauley

Foreword by Kevin Rogers Cobus

You may ask what place rigging has in a technology magazine. But you'll probably agree it is one of the essential processes involved with implementing many of the high-scale technical systems we are seeing in churches of all sizes nowadays.

We wanted to give readers a solid foundation of the terminology and the certification process, so that there can be a better idea of what you're dealing with.

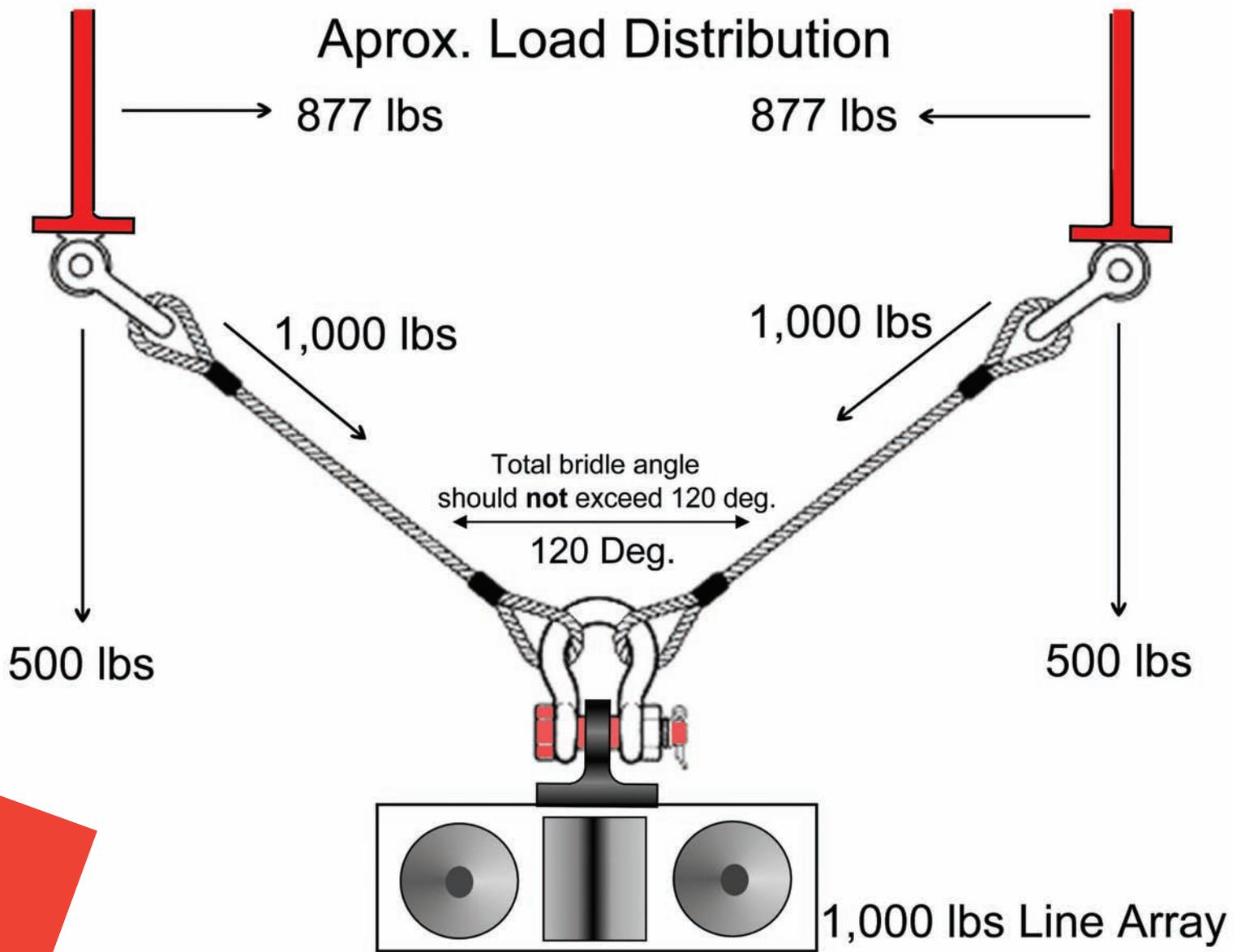
In the end, people need to be aware of the ramifications of putting people's lives at risk. In an industry that is fraught with "do-it-yourselfers", it is extremely important to reiterate the safety considerations, from a legal and a human perspective.

Having said that, it is obviously an extreme gamble to run an article like this in any trade publication. The implications of giving readers the wrong information in respect to something this important... well I don't have to tell you how serious it is.

This is not TFWM sanctioning people do any rigging themselves. The references in the following article are intended to be an overview of equipment and process, not an encouragement for volunteers to do uncertified work.

Are people going to stop doing things themselves? Of course not. Is there a proper way to do things? Yes there is.

Hopefully you will see this article as an encouragement to do the right amount of research before doing something yourself.



WHAT'S OVERHEAD

CRASH

That is the sound you may hear just after the words: “That should hold it!” are spoken. I’ve heard those words too many times. I’ve also seen the aftermath, and it’s not pretty. I’ve been called in to inspect the rigging after someone has been hurt or killed. And the sad thing is, the accidents could have been prevented with the right knowledge and a couple of bucks for the correct equipment.

Rigging is still an issue in houses of worship that is often overlooked. Why this is the case is anybody’s guess. After all, we are talking about people’s lives here.

I’d like to give you a little information about my background in rigging, not to be boastful, but to reinforce my experience in order to add validity to the following article. Over the past 18 years I have been working professionally in the Audio & Video industry; design, installation, integration and live production. I have been working with and designing industrial, theatrical and production rigging for over 10 years, I have also spent four years as an industrial rigging inspector and teacher of ASME/OSHA based rigging practice at some of the largest military bases, manufacturing plants and theaters in the country. My largest lift was 300 tons and my most complicated lifts involved setting up stage rigs which flew people 60 ft. in the air in harnesses, turning and flipping them at the same time, all on 3/32” cables. This was done over the course of 12 shows a week. Stressful.

So, let’s talk a little about risk management and liability. Basically, if you hang it, you are personally responsible! In turn, it’s not just you, it’s the church, the ones directing and producing the event, and the church board of directors. You need to be sure without a doubt that what

you are doing is going to be safe.

As the church body we want to lead people to heaven, we don’t want to inadvertently give them an express ticket. I know this sounds scary, and it is, but a little fear is a good thing if it keeps you on your toes. (Proverbs 1:7)

First of all, it is important to talk to a qualified person that can help answer your questions. For example, if you are going to hang something from a laminated beam, you need to get the structural engineer or manufacturer on the phone and tell them what you are thinking about doing. Make sure your beam will support the load with a good margin of error. I like a margin of 8:1.

Secondly, you will need to find the capacity of all the equipment that you are going to use in the lifting or hanging of equipment. I personally believe in the ASME American Society of Mechanical Engineers </> OSHA Occupational Safety & Health Administration <www.osha.gov> standards, and that is what I base most of my calculations on.

DAMAGE POTENTIAL

It always surprises me how little people think about things that are hung over head. Here’s a fun exercise. If a 10lb light is hanging about 24ft in the air, and something happens to make it drop and land on your foot, no big deal right? Well your foot might not think so, with over 200lbs of impact crashing down on it. That would smart.

Let’s step it up a little bit and think of a standard loudspeaker, at about 84lbs hung 24ft in the air. Now let’s think about a cute little puppy dog taking a nap on the ground under the speaker. All of a sudden the lag bolt that someone drilled into the MDF wood to hang the speaker breaks loose. Down comes the speaker with over 2,000 lbs of impact force, and as it hits the poor, helpless... well you can fill in the rest because I like puppies. You get my point. Something as little as a safety cable on a Par can could save the life of a puppy.

Most of the churches I’ve been in don’t have a full theatrical grid. Even so, some of these churches hang hundreds of lights over a stage that requires a catwalk just to change the bulbs.

I was at this great little church a couple years back to help with an A/V system up-fit. However, when I got there they started asking me all sorts of questions about old chandeliers, as in how can they change the bulbs without killing themselves. At first I was rather confused by these questions. What I did not know at the time was that the church maintenance man had just died by falling off a ladder and breaking his back trying to reach a bulb to change it.

I always think if I got there sooner and was able to tell him a safer way, maybe he would have not died. But reality is, unless something bad happens, most people will not change their ways. My personal philosophy is the same for ministry as it is for safety “If I don’t tell them what I know to be true, it’s my fault. If they don’t listen it’s theirs.” This mantra has worked very well for me in the professional and the spiritual world, and this is the main reason why I teach people about safety.

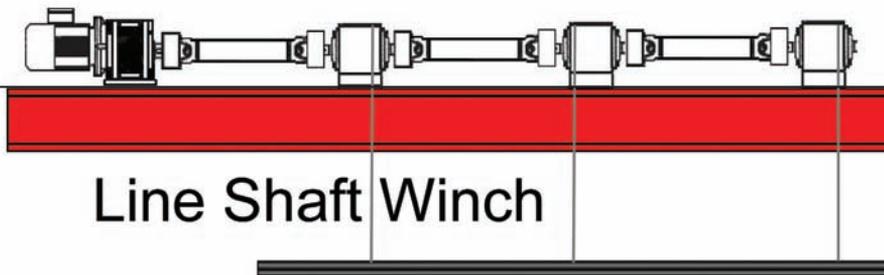
This leads to knowing a few key things to reduce risk:

LOADS AND CAPACITIES

In the rigging world, an important standard is Working Load Limit, or WLL.

An example: the WLL is 4:1 for Alloy Steel Chain and 5:1 for Wire Rope. For Synthetic slings the WLL is 5:1 in the US and 7:1 in Europe. This means that the ultimate strength is 4-5 times the WLL, so we have a good safety margin.

However, in the theatre rigging industry, we use an 8:1 design factor for wire rope. Why, when all the manufacturers data says 5:1? The manufacturer will also tell you that wire rope should not be used for lifting overhead of people. But that is exactly what we do, so we’ve



Line Shaft Winch

used an 8:1 ratio for over 30 years.

Wire rope, cable clips, shackles, and other fittings need to be from an identifiable manufacturer. Cable clips and shackles must be forged if they are being used for overhead suspension. These can be purchased from a theatrical rigging supplier or industrial supply house. The items should have the manufacturer's name and a product identification code (PIC) that will allow traceability back to each batch. Crosby and Columbus-McKinnon (CM) are the only manufacturers that do this. Many suppliers will carry their products but they also carry other cheaper brands. The counter/sales people at supply houses often have no idea of the difference. The user needs to know the information before buying.

When it comes to custom equipment like projector mounts and plasma TV mounts, you will have to read the directions and find out from the manufacturers what the WLL is and how they got it.

If you are hanging a complicated setup directly over the heads of people, and if you are not a qualified person with multi-million dollar liability insurance, I would suggest asking for help from someone that is.

TRAINING

This brings us to a great point of discussion: How do you do it yourself so you don't have to pay every time you want to hang something new? This is really tricky. The best way is to get training to become a qualified person yourself. Then you need to make sure you read the directions and do exactly as they say. The most important thing you can do is read and follow the directions. This is for your benefit. If you can prove that you followed the directions to the letter, your liability will be shared by the manufacturer.

RIGGING SYSTEM TYPES

I often think that there has to be a better way, and there often is. Since the example I mentioned earlier, I have seen hoist systems which allow

you to push a button to bring all of the house lights to the floor.

Perhaps a system like this would not be ideal for your church's setup given the cost, as well as aesthetics and architecture, however nowadays there is usually a safer alternative to getting up on a ladder and risking your life to change a light bulb.

There are different kinds of lifting systems I want to talk about. To give you a general idea of some of the terms you may come across when researching, you should be aware of the following:

ARENA RIGGING

Chain Motor: Just about everyone that has done rigging has at least seen one of these in use. It is an electric motor-driven hoist. You have to be careful that you get a sealed body hoist that is made for the entertainment industry.

Climbing Truss: This is a self-contained small line shaft system. It is mounted in a truss instead of being attached directly to the structural steel. This system can be moved easily because it comes to the ground and can be unhooked. Because the system "lives" in a truss, you don't have to buy any extra truss to hang lights from.

Clew Plate Truss: This system is an easily movable stage with a master grid system. It is self-contained in that the motor and the block sheaves are all incorporated into a truss. Basically the gear motor/winch pulls a plate that has the multiple pick points attached to it the same way a traditional counter balanced system would work, except everything is incorporated into a truss. This is a great system if you need to move drop locations up and down stage and don't want to have multiple non movable systems installed in set locations.

There is a lot of math involved in balancing the loads, keeping

the appropriate safety factors, and dealing with the loads imposed on the building. The person doing this rigging must have the experience and math background to plan the rigging properly.

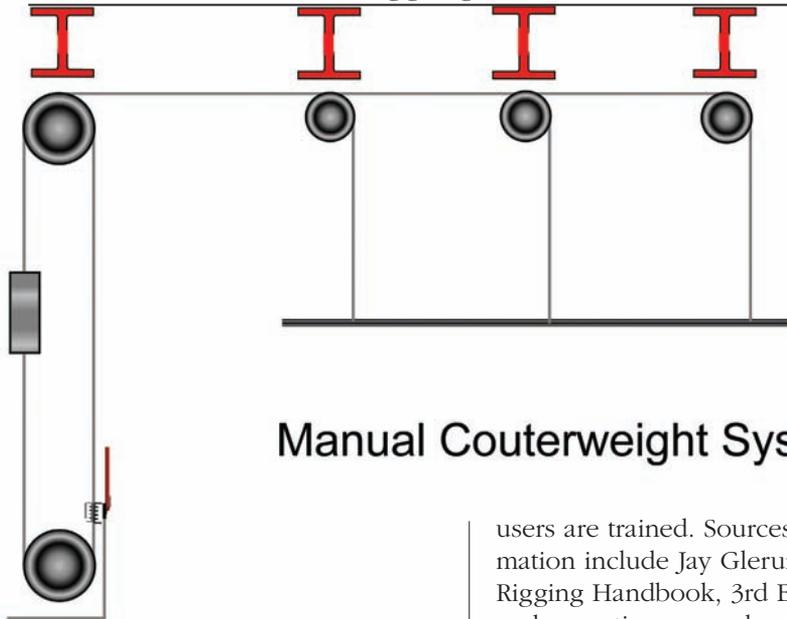
PERMANENT MOTORIZED RIGGING

Permanent systems are great. They can be designed for your specific needs, and are generally installed by the manufacturer or an authorized dealer. Working with an established manufacturer of theatrical rigging systems you'll obtain a lot of knowledge and experience to help get the right equipment.

Hoists designed for theatrical rigging will have a three phase electric motor, a gearbox, a grooved drum, and at least a "fail safe" brake. Safety, space savings, remote control, and the absence of balancing weights and set pieces are just some of the pros to a geared system. E-stop buttons can be placed all around the stage and control rooms so that if anything happens to be in the way or looks dangerous, any person can stop the drops or lifts as soon as they see a problem by pushing the E-stop button. Also touch screen controls can be managed from the control room to give ultimate control to the stage manager/producer.

There are many types of hoists. The most used are drum winches with multiple lift lines attached to a single grooved drum. Head and loft blocks (pulleys) are used to route the lift lines to the load. A Line Shaft Winch System has a line of drums spaced at all the pick points connected with the drive shaft to a single gear box and motor.

Hoists are available in a wide range of capacities and speeds. Fixed speed hoists are generally used for utility items such as masking drapes, lighting sets, etc. Variable speed hoists are used with



Manual Counterweight System

items that need to move in view of the participants, such as scenic items, and moving curtains.

Motorized rigging is flexible and easy to operate. Again, this equipment must be designed for overhead lifting. Most commercial winches are designed for horizontal pulling, not lifting. A hoist (as opposed to a winch) is intended for lifting, but may not be designed for use over people. Buying equipment from a reputable theatrical rigging manufacturer will help you get appropriate equipment.

COUNTERWEIGHTS

Manual Counterweight System:

A stack of weights has to match the weight of the batten or lighting bar that you have on the other end in order to lift. This is very labor-intensive system. This system is low tech and has been used for over 80 years. It can be the most cost effective system as far as equipment, but when you add the demand of a larger infrastructure, it can drive the cost higher than some other systems. For this system you need a lot of side stage room; you have to have people physically manning the pull ropes and loading and unloading heavy steel weights to balance the set pieces, and this leaves a lot of room for error.

If you have a manual counterweight system, make sure all the

users are trained. Sources of information include Jay Glerum's "Stage Rigging Handbook, 3rd Edition" and operation manuals and signs from J. R. Clancy's website (www.jrclancy.com).

A loading gallery is an essential part of a counterweight system. You're adding and removing equipment from the batten when it is at its lowest position - so the counterweight arbor is at its highest position. There needs to be a sturdy gallery at that position so that your crew can load and unload weight safely.

Multi Drum Lift: This is one of my favorite systems because of the ease of setup and re-rigging. It is a gear motor that drives a long drum that has multiple lines attached with built-in sheaves that are designed to line up with the corresponding block sheaves for each pick.

Now that we've discussed some of the terminology, hopefully you'll be a little more aware of the research that is necessary to get into this industry. I cannot stress enough, even though it should really be common sense, that you should hire a certified rigger to perform this type of work for you. There is no licensing agency in North America for Theatrical Riggers. ETCP will certify riggers that can pass the examination. Their names can be found under ETCP on the ESTA website.

Even though you may think you have a firm handle on the laws of physics, nothing could be worse than

potentially being responsible for someone being injured or worse by not doing the proper assessment of an environment and attempting to do anything rigging-related yourself.

You have to show several years of documented work history as a rigger to be eligible to even take the certification exam. The "proper channels" go through professional experience. There is no way a person can read books and take classes and become certified without having had the professional experience also.

The following list is certainly not in any way an encouragement for anyone to attempt to do this work without first going through the proper channels to become a certified professional in this field. It is meant to be a list of things to consider to expand your thinking about what actually goes into a properly rigged set of equipment.

Having said that, here are some things to consider.

HARDWARE

Mousing Turnbuckles. Mousing is taking a wire and wrapping it in such a way that the turnbuckle cannot open any further than it has been set. The rigger needs to make sure they are mousing both ends of the turnbuckle. They also need to make sure the turnbuckle is rated for overhead lifting; there are many that are not, and they are made with sub standard metals. SPA Shackles are to be moused by putting a wire through the hole in the pin and wrapping it around the body of the shackle. Again it needs to be rated for lifting.

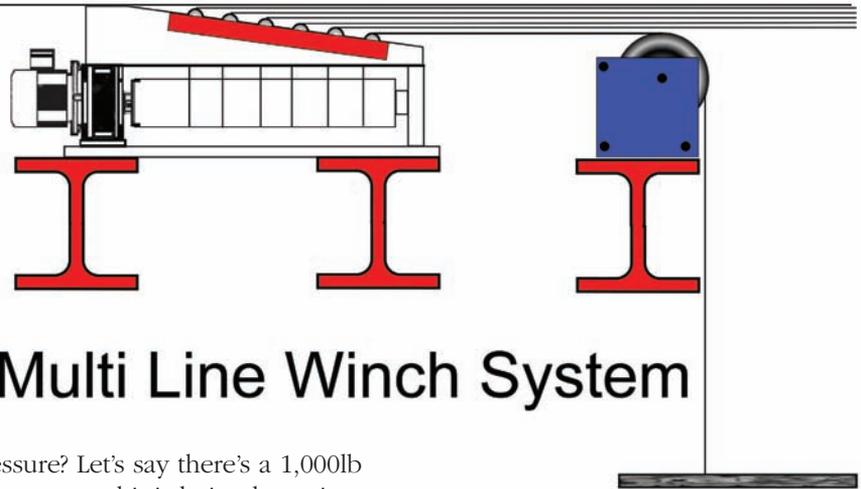
Using Quick links instead of Shackles to hang things from. Quick links are not for overhead lifting; most are not pull-tested unless you get specially made ones that have the WLL printed on them. One of the most important reasons quick links should not be used for hanging is that if improperly installed, vibrations from speakers or the up and down motion of lifts can open them up.

Using the wrong chain. Most of the chain that is sold at hard-

ware stores is not made for lifting. It has not been pull tested, and the manufacturers state clearly that it is not for lifting. I see the use of bent wire chain “swing set chain” and sub grade chain used all the time in many applications. This should never be done- if you decide to do this, you will carry total responsibility if something bad happens. Even worse, most of the time the chain is wrapped around sharp edges like beams that will cut the WLL at least in half on any chain, let alone substandard chain. Every link in Alloy grade 80 or 100 lifting chain is pull tested to over the WLL by the factory. I’ve been in the factory when chain has failed the WLL test. It sounds like a gunshot when it breaks. This does not happen often, but it drives the point home that a chain is only as strong as its weakest link.

Using wire rope clips. This is my own opinion and I may get some letters about this, but I prefer to err on the side of safety. First of all, you have to understand that there are different kinds of clips; ones that are malleable and ones that are forged. Malleable clips should not be used for hanging. Forged clips are great tools for “hanging” things, but not for lifting. What’s the difference? The difference is that hanging means that you are not technically moving at all; no vibrating, no lifting up and down, just like hanging a picture. The gray area with this is loudspeakers. In my mind this is a moving object. When it is on, it is always in motion, and that motion can loosen nuts over time, especially if the nuts on the wire rope clip are not torqued to the correct foot pounds. I have seen some systems hung in this manner that last for years, and then upon inspection I can move the nuts with my fingers. All rigging components should have documented periodic inspections to make sure that nothing is coming loose.

Hanging in between structural truss. Truss may hold a good amount of weight pulling straight down, but what about the side



Multi Line Winch System

pressure? Let’s say there’s a 1,000lb line array and it is being hung in the middle of two trusses, so each would get equal amount of weight. It would be like this: 500lbs. down force and almost 1,000 lbs. side pull, so you would need each sling leg to be able to carry the full weight of the load. Plus the fact that the truss would see more pull where it is weakest (to the side) than it would down force, where it is strongest. This can bring the roof down.

Add to this that there needs to be a safety of at least 8:1, so the truss would need to take a side load of 8,000lbs to be safe in the above case. A lifting or spreader beam the same distance as the two trusses are apart will hold the weight of the line array in the center. Or the array would need to be dropped until the angles are a lot lower than 120 degrees.

Test this theory on a small scale. Go get something that is 20lbs or so. Now lift the object until it is even with your shoulder by pulling away from your side. Can’t do it? That is what I’m talking about, the side pull gets a lot stronger, and even 20lbs becomes harder to hold up, the larger the angle. A tightrope is 180 degrees. The flatter the angle, the more force on the attachment points at the ends.

Where to hang on a truss? The locations where the steel webs meet are the strongest points of a roof truss. There are many different types of trusses, whether it is a roof truss or a lighting box truss, the rigger needs to know what they are dealing with.

IN CLOSING

So again, it needs to be reiterated that this article is to be used as strictly a basis for information. If it is to be anything more, please let it be an inspiration to have someone on your team go through all of the proper, necessary channels to become a certified rigger before they even consider doing anything that could put people’s lives at risk.

In houses of worship, people tend to rely on volunteers for many things. However when it comes to something as important as hanging technical equipment or hanging anything at all, it needs to be remembered that this is NOT the job for a volunteer, or anyone else who has not gone through the proper training. As more houses of worship get to the level of incorporating more complex systems which require rigging, our hope is that anyone involved in the project will give this unmistakably important component the respect and attention it deserves. ♦

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TFWM would also like to thank Tom Young of J.R. Clancy Inc. <www.jrclancy.com> and David Loftin of Brawner & Associates <www.brawnerassociates.com> for their extensive contributions to this article.