SCAFFOLDING COMPETENT PERSON & BUILDERS COURSE SUPPLEMENT

Index

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COURSE	COURSE SUPPLEMENT	PREREQUISITE
Scaffolding Competent Person Builder Course Supplement	CPSUP/01 REV 03, 1 of 1	None

Calculating Material

This section will cover the basics of determining what type and how much equipment is needed to build a specific scaffold. We will begin with a discussion of a small one section high scaffold, then gradually work up to some larger projects. The best way to become proficient at material take-off is to practice. See if you can find the equipment listed below.

These pictures show a one section high frame scaffold. A good technique for determining material is to start at the bottom and work up. Equipment includes four casters, four pins for the casters, two frames with ladder built in, two 7' X 4' cross braces, three aluminum planks, toeboards are not required, four coupling pins, eight locks for the pins, one chain link guard-rail panel (on the front), two corner guard rail posts on the back, two 5' guardrails, and four 7' guard-rails.
Note: Horizontal diagonals are required if aluminum hook on planks are not used on this scaffold.

If outriggers are installed, add four outriggers, two 7' X 2' cross braces for horizontal diagonals, and four screw jacks or four additional casters with adjustment to level.

This picture shows a one section high frame scaffold. Equipment includes four mudsills, four baseplates/screw jacks, two 6'4" walk-through frames, two 7' X 4' cross braces, and three aluminum planks.

The guardrail system consists of one front guardrail swing gate panel with toeboard, one rear guardrail panel with toeboard, and four 7' guardrails.

Two 7' toeboards are on the sides.

The ladder system consists of one 6' hook on ladder, two ladder siderail extensions, one starter ladder rung, and one bottom ladder brace. Include 12 locking pins for various connections.

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This two section high rolling tower requires the following, starting from bottom to top.

The base is a special unit that consists of four parts assembled on site. There are four casters and locking pins/bolts. A 7' X 4' cross brace is the horizontal diagonal. There are two 6'4" walk through frames and two 7' X 4' cross braces for the bottom section. There are four coupling pins used to stack the frames. The second level is two 6'4" mason style frames with two 7' X 4' cross braces. The first platform is three aluminum planks. There are two 7' toeboards, and two 5' toeboards. The guardrails consist of one guardrail panel (on right), two 7' standard rails with four guardrail clamps for attachment to the leg (on left), and two 6' tubes with four right angle clamps (on back). A generic swing gate is on the front.

The top platform consists of three aluminum planks, two 7' toeboards (panels include toeboards), one swing gate panel, one back panel, and four 7' guardrails. The ladder is two 6' ladders, one starter rung, one starter brace, and two siderail extensions.

This narrow scaffold consists of four casters, four caster pins, two end panels, two horizontal plank/structural supports, one reinforced plywood platform, four guard post socket supports, two end guardrail panels with chain link midrail, and two double guardrail panels. The toeboards are four corner toeboard holders, two long toeboards, and two short toeboards.

This aluminum scaffold consists of four casters, two end panels, two top end panels, six horizontal pieces, two side diagonals, one horizontal diagonal, two planks, four toeboards holders, two short toeboards, and two long toeboards.

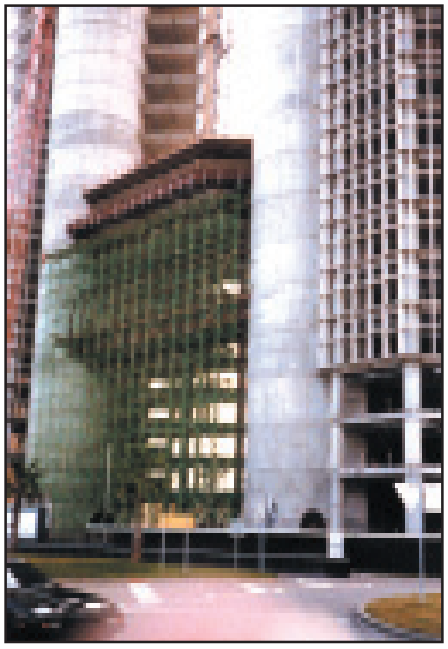
This scaffold is a little more challenging. It is best to consider this one in parts. Starting at the bottom, there are ten mudsills and ten base plate/screw jacks. There are ten frames and twelve 7' X 4' cross braces. There are ten coupling pins just to stack the frames. The first platform on the right has six 8' wood planks, four toeboards, two 6' tubes for guardrails, four right angle clamps for above, one guardrail panel, four guardrail clamps, and two 5' guardrails.

The ladder on the right consists of two 6' ladders, one ladder starter rung, one bottom brace, then at the top two siderail extensions and one swing gate panel. There is also a hoist on the corner.

The planking on top is six 8' planks wide times four sections long equals twenty four 8' planks. There are eight 7' guardrails on the outside and eight next to the building. There are three guardrail posts on the outside and three next to the building, each requiring a coupling pin. There are four toeboards on the outside and four next to the building.

There are two 16' putlogs. Each putlog requires two putlog hangers, and two knee braces. There is one putlog spreader bar bridging the putlogs that the planks rest on, and one 6' tube with two clamps under the putlog spreader bar.

There are two staircases on the left. The bottom one has a starter bar. Each has an inside rail panel and an outside rail panel. There are two guardrails across the end frame at the turnaround (with guardrail clamps). There is another guardrail swing gate at the top.



We have used pictures of the actual scaffolds to keep it simple. Obviously, until you erect the scaffold, you will not have a picture available. It is helpful to have a sketch or drawing of the proposed scaffold to do the count. But it is not mandatory. The following can be used as a guide to obtaining an approximate material count without a drawing.

First, determine the length of the scaffold. Divide by section (aka bay) length (usually 7', but 10', or other lengths are possible). Add on one frame for the end. Figure two cross braces for each section long. Next, determine the height. Divide the height by 6'6" to obtain number of levels high. Multiply the number of frames long by the number of levels high to get total frames. Multiply the number of sections long @ two cross braces each, times the number of levels high, for total cross braces. Add in mudsill and base plates for bottom frame legs.

Determine the number of levels that will be planked. Figure six planks wide (or whatever number fills out the frame from side to side), times the number of sections long, for total planks for one level. Figure guardails and attachments for each level. For example, if the scaffold is ten sections long times two outside guardrails equals twenty rails, plus the attachment devices, plus end rails. Figure the toeboards for that level. Next multiply the total planks, guardrails, toeboards, etc. for one level times the number of levels to be used simultaneously. Keep in mind the limits covered in CP/01/01. Also, guardrail equipment for an intermediate level is different than that for the top level.

Determine ladder access by dividing total height by height of ladder. Remember ladder rest stops, if applicable. Add in brackets, swing gates, etc. as necessary. Add in tube and clamp for tie-ins at the proper spacing.

Using a 70' long (10 sections) by 26' high (4 levels) scaffold, with one deck on top, as an example, we arrive at the following; 44 frames, 80 cross braces, 22 mudsill/bases, 60 8' planks, 22 toeboards, 1 swinggate panel, 18 regular guard posts, 2 corner posts, 40 guardrails 7', 2 rails 5', 4 ladders 6', 1 ladder 3', 6 ladder brackets, 4 tubes 10' for tie ins, 8 RA clamps, and 16 beam clamps. Note, this list is approximate and will vary by manufacturer.

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This tube and clamp includes four mudsills, four base plates, four 8' tubes for posts, four 6' tubes for posts, four 6' tubes for the front and the same for the back (total eight), four 8' tubes for each side, and two right angle clamps for each horizontal tube (total 32).

Also included are two 8' tubes for front and back diagonals, two 10' tubes for side diagonal, 8 swivel clamps for the diagonals, six planks, four toeboards, two 6' ladders, and three ladder brackets.

Consider the scaffold below. It is a tube & clamp scaffold, four sections (bays) long, and two levels high. It has one planked level on top. The center platforms are bridged.

This scaffold is more challenging. Working from left to right, there are eight mudsils, eight base plates, eight 10' tubes for posts, and eight 8' tubes for posts. Counting the runners on the front left there are three 8' tubes on the front and three on the back. There is an equal number on the right hand section.

There are six 4' tubes for bearers (transverse horizontals) on the left section. The transverse horizontals are commonly called bearers, even though not all of them will "bear" the platform. On the right section, there are three 4' tubes for transverse horizontals (bearers), but there are three 6' tubes for bearers because the longer extension is used to support the ladder post. There are two 4' tubes on the left end for guardrails, but one 4' tube and one 6' tube on the right end.

The center supports include two 13' tubes for runners (longitudinal horizontals), four 10 tubes for knee braces, two 6' tubes for center posts, and one 4' tube for the center bearer.

There are eight total longitudinal diagonals on front and back, these are 10' tubes. There are eight transverse diagonals, these are 8' tubes.

We must be careful about the longitudinal guardrails because they are interlocked. The scaffold is 28' long, so the guardrails could be three 10' tubes, or four 8' tubes, or one 13' tube and two 8' tubes, or other combination. Choosing one 13' tube and two 8' tubes, there are four 13' tubes and eight 8' tubes for handrails front and back.

The platform is four 8' planks wide times four sections long equals sixteen 8' planks. There are ten toeboards.

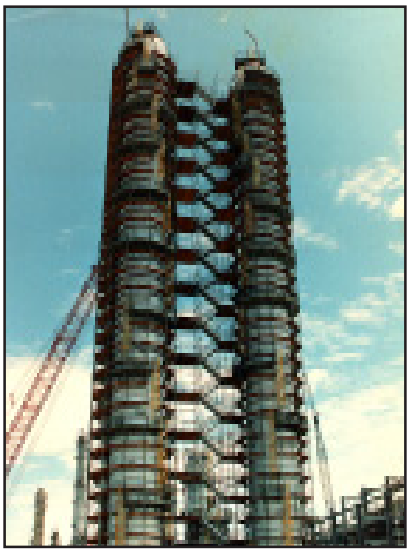
On the right there is a separate post for the ladder, one 10' plus one 8'. It is held on by the longer 6' bearer tubes which were intentionally used instead of the 4' tube. There are two 6' ladders and one 3' ladder.

Next comes the really interesting part, the clamps. The horizontal tubes that are not interlocked require two clamps each. But for the tubes that are interlocked, such as the handrails, there may be fewer than two clamps per tube. The best way to count the clamps is to look at each intersection of a post and a horizontal. Then the same must be done for the swivel clamps on the diagonals. Also, some locations have "safety clamps", which increases the count.

I count 92 right angle clamps (including safety clamps) and 46 swivels. However, it is easy to miscount clamps so it is a good idea to add in a few extra clamps for delivery to the jobsite. Also, even though it is not supposed to happen, you will occasionally receive a bad clamp, even from a conscientious rental company. Clamps are not expensive to rent, especially compared to the labor cost of a crew standing around because they ran out of clamps.

Another point worth mentioning is that with tube & clamp, you would not have to use the sizes of tubes described above. Different combinations could be used. The flexibility of tube & clamp is its' major advantage.

This picture shows a system scaffold. Equipment includes four mudsills, four base/jacks, four 10' posts, twenty horizontals 7' long, seven horizontals 2' long, 2 side brackets, eight 7' steel planks, 2 8' wood planks, one 10' tube for ladder, 6 RA clamps, four toeboards, one 6' ladder, one 3' ladder, three ladder brackets, and four 7X6'6" diagonals.



Formulas can be used to estimate material on system scaffolds also. Let's consider one of the single towers in the picture to the left. Assume the vessel is 16' in diameter and the scaffold is 3' wide. The outside row of legs will form a ring of approximately 24' diameter (16' plus 4' on both sides). The linear distance around this ring is 24 times 3.14 (pi), approximately 76'. If 7' horizontals are used on the outside ring of posts, 76 divided by 7 equals 11 bays.

If the scaffold is 250' high, divided by 10' posts, then 25 posts are required for each leg times 22 legs equals 550 10' posts. The number of levels is 250' high divided by 6'6" for each level equals approximately 38 levels plus the bottom. Two guardrails will be on the outside on each level so 38 times 2 equals 76 rails (7' system horizontal) plus 1 equals 77. There are 11 bays times 77 horizontals equals 847 outside horizontals.

The inside horizontals can vary. To figure mathematically, we use the diameter of the inside ring of posts. This will be the 24' outer diameter minus 3' on either side, equals 18'. Multiply 18' times 3.14(pi) to yield 56.5'. Then divide that the number of legs, in this case 11, for an inner spacing of appx. 5'1". In theory, you could use all 5'1" horizontals on the inside if available. In reality, when you base the scaffold out, there may be lines and other obstructions in the way, so some bays may end up 5' and other bays may be longer and require tube & clamp. But for this exercise, let's assume 5' horizontals, so 11 bays times 38 levels plus one at the bottom equals 429 total. We are assuming the scaffold is close enough to the vessel that guardrails are not required on the inside.

Each bay requires a bearer, 3' horizontal times 11 bays times 38 plus one high, equals 429 bearers. If each platform has three planks times 11 bays times 38 levels then 1254 planks will be needed.

Also, figure a diagonal for each bay, 11 times 38 equals 418 diagonals. Transverse and inner diagonal bracing will also be required, depending on the design.

Accessory equipment such as ladders, brackets, staircases, tubing for tie-ins, Ibeam clamps, #9 guage wire, etc. will also be required.

This is not a complete list. But it should give you an idea of how you can use formulas to approximate the material when a blueprint is not available. In some cases, the estimate or bid is developed using formulas. Then the actual engineering blueprints are developed after the award of the contract. In other cases, the scope may be so complex that the preliminary engineering work must be done before an estimate can be derived.

Summary

This section has provided an introduction into techniques used to calculate the material need for a scaffold job. The best instructor is practice. The task may seem overwhelming to someone with little experience. However, like many tasks, you have to cut it up into manageable parts. As you gain experience, your speed and accuracy with material take-offs will increase.

None of the counts in this section were intended as working material lists. The list must be customized for the specific brand of equipment you will be using, and for the design of the particular scaffold to be erected.

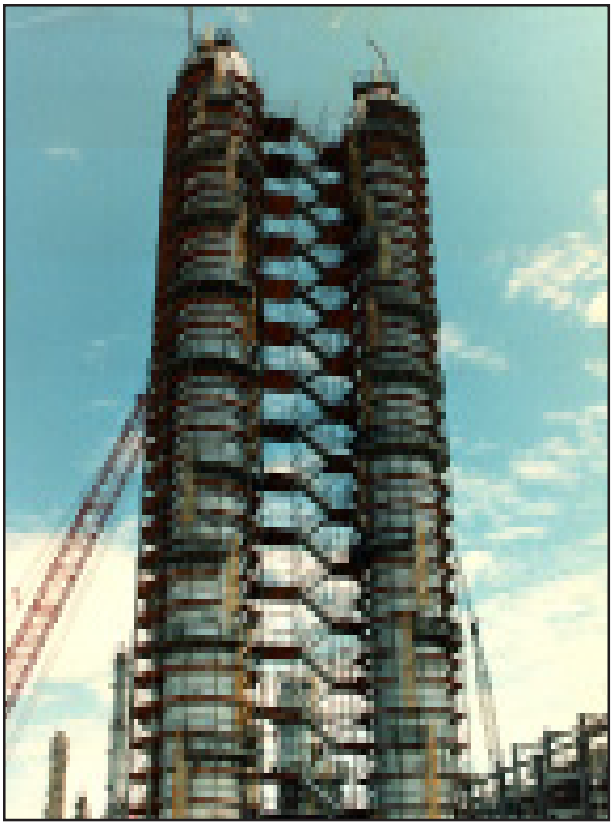
Worksheet

Scaffold Loading

Introduction

In this next section of the supplement, we will cover the subject of scaffold loading in more detail. This section will cover the basics of how to determine the weight (load) on a scaffold, and compare that weight to the maximum weight that the manufacturer recommends to be placed on that scaffold.

This information may be studied in order for the competent person to gain a conceptual understanding of the reasons for limits on loading, and such topics as the number of levels to be used simultaneously. However, it is STI's opinion that the actual calculation of loading for design of scaffolds (where such calculation is necessary) should be done by the scaffolding manufacturer, or qualified person with substantial experience. Many competent persons would need to perform such a calculation on rare occasions, and might be susceptible to an oversight due to lack of practice and inexperience. On the other hand, the scaffolding manufacturer will have qualified persons on staff who perform such calculations on a regular basis. These individuals are experienced with the equipment, it's design, and loading calculations.



For the scaffold pictured at left, we had to do a leg load calculation. How did we do this? First, we looked at sample legs (aka posts). We then added the weight of all the posts stacked on top of each other. We then had to find each horizontal attached to that post and add half of the weight of the horizontal. Then we found each diagonal connected to that post and added half of it's weight. Then we found all the planks supported by that post and added the proper proportion of weight . We then found the accessory equipment such as clamps and added their weight. Combining all this gave us the weight of scaffold materials, also known as "Dead Load". Next we had to determine that post's share of the weight of workers and materials, also known as "Live Load". Finally, we added in other special loads such as wind loading. Then we determined the additional bracing required to maintain the safety factor. We will discuss this more later in this section.

Before we discuss loading further, STI provided some generic limits on heights, number of simultaneous work levels, and number of additional planked levels in our discussion of loading in CP/01/01, the general requirements section. We will begin this section with a review of the loading information from general requirements, starting on the next page.

The next topic is loading on the scaffold. The scaffold structure loading calculations are based on one of three anticipated loads. Light duty is the term for up to 25 pounds per square foot. Medium duty is the term for up to 50 pounds per square foot. Heavy duty is the term for up to 75 pounds per square foot. The user should know how much weight they will place on the platform with workers, tools, materials, and plan for the corresponding rating. The following graph illustrates a 7' long by 5' wide platform with 25 pounds per square foot loading.

7 feet

5 feet

7 X 5 = 35 Square Feet

35 X 25 PSF = 875 pounds

Maximum Capacity (Uniform)

In this 7'X5' example, (which happens to be the most popular frame scaffold platform size), up to 875 pounds could be placed on the platform. Since a worker and tools are rated at 250 pounds by industry standard, three workers could be using this platform and still leave 125 pounds additional capacity without exceeding the 25PSF usage.

Most crafts would not need to exceed this loading during normal usage. Consequently, 25PSF or "light "duty is adequate for most crafts. The term "light" duty is somewhat misleading; standard duty would probably be a more fitting term for 25PSF usage.

The next rating is called medium duty, or 50 pounds per square foot. In our example of a 7' by 5' platform, up to 35 X 50 = 1750 pounds could be placed on the platform. Crafts which may place heavy stacks of materials on the platform will need this capacity. For example, a brick mason will place pallets of bricks, or possibly wheelbarrows full of mortar, on the platform. A brickmason should plan for 50PSF usage.

The highest rating is called heavy duty, or 75 PSF. In our 7' by 5' example, this would be 35 X 75 = 2625 pounds. It is extremely rare that this much capacity is required (stonesetters may be the exception).

Most scaffold frame legs are rated to carry between 2000 and 3000 pounds per leg when the scaffold is properly assembled. Consequently, the legs are strong enough to carry either the light, medium, or heavy duty loads. However, there is a limit on how many levels can be used and loaded at the same time (simultaneously). Consult your manufacturer for specific allowable leg loads, and limits on heights, and number of allowable levels that may be used. The following are some conservative guidelines recommended as a maximum by STI. The maximum recommended height is ten frames high. For a seven foot longitudinal spacing:

Light Duty: With one L. D. level in use, nine additional planked
With two L. D. levels in use simultaneously, six additional planked

With three L. D. levels in use, three additional planked
With four L. D. levels in use, none additional planked

Med. Duty: With one M. D. level in use, nine additional planked
With two M. D. levels in use, none additional planked

Heavy Duty: Consult supplier

The above limits for frame scaffolds are intended to provide an approximate guideline only, remember to consult your scaffolding supplier for specific guidelines.

For tube and clamp scaffolding, OSHA gives the following guidelines in the appendix:

Light Duty: With one L. D. level in use at a time only, a maximum of 16 other planked levels ready to use.
With two L. D. levels in use simultaneously, a maximum of 11 other planked levels ready to use.
With three L. D. levels in use simultaneously, a maximum of 6 other planked levels ready to use.
With the maximum four L. D. levels in use simultaneously, only 1 additional planked.

Med. Duty: With one M. D. level in use at a time only, a maximum of 11 other planked levels ready to use.
With the maximum two M. D. levels in use simultaneously, one additional planked.

Heavy Duty: With the maximum one H. D. level in use at a time, 6 additional planked.

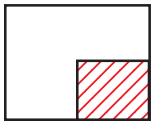
While the above are generic guidelines, you should also consult the manufacturer of the specific product you are using for specific guidelines. Many manufacturers will provide load tables included in their assembly instructions. For example, one manufacturer recommends a maximum of 100 pounds of live load per leg. The leg could therefore support four decks with 25 pounds per square foot, or two decks with 50 pounds per square foot, or one deck with 75 pounds per square foot. That manufacturer's table allows for two additional planked levels not in use. In addition, the manufacturer will have engineers on staff for assistance in design of scaffold projects. All scaffolds over 125' in height must be designed by an Engineer.

In addition to the load on the legs, there are on limits on plank spans depending on loading. There are also limits on leg spacing for tube and clamp scaffolding. These will be covered later in the program.

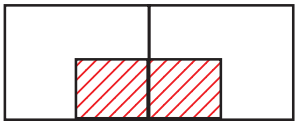
A leg load calculation may also be done. This process involves determining the maximum weight that should be imposed on the leg, and comparing that to the manufacturer's rated load. A more thorough discussion of leg load calculation is found in the supplemental information section in the back of this manual. But the basic concept is not complicated. As a simple example, if the scaffold has four legs, then each leg will carry one fourth of the weight. The weight consists of two main components, the weight from the scaffold itself (dead load) and the weight from the workers and tools (live load). A determination of the weight of the scaffold itself is made, and then a determination of the anticipated weight from

workers and tools is made. Then the two weights (live load and dead load) are added together. The total must be less than the manufacturer's rated load.

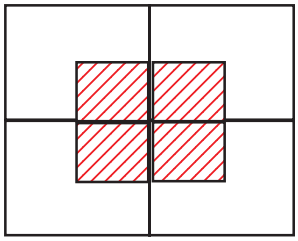
However, while the concept is simple, the actual determination can become complicated. Several factors come into play, such as the configuration of the scaffold. On rows of scaffolding the inner legs will be supporting the load from more than one platforms as shown below.



Four leg scaffold contributory area.



Six leg scaffold contributory area.



Center leg scaffold contributory area.

The area which the leg is supporting is referred to is the contributory area. As the diagrams indicate, the contributory area for a center leg and the resultant weight that it carries is much greater than for the corner leg.

Another factor which complicates things is that the actual determination of dead load must be done by determining all the components which attach onto that leg. For example, on a tube and clamp scaffold, the post itself, the horizontals and diagonals which attach onto that post, the associated clamps, that leg's share of the weight of planks, toeboards, ladders, and other accessory equipment must all be included in the calculation.

That leg's share of live load must be included. This will vary depending upon the anticipated loading (25PSF, 50PSF, or 75PSF), and the contributory area.

Other factors could include special loads such as wind loads (particularly on enclosed scaffolds), or point loads if the scaffold is used as a staging area for heavy equipment.

For these reasons, STI recommends that if either the conservative limits that we have given or the manufacturers tables need to be exceeded, you should contact your scaffolding supplier. A design can be done by the manufacturer's engineering staff, or by a qualified person experienced in scaffold loading calculation. There are also professional engineers available who are experienced in scaffold and rigging design. Loads on plank spans are given later in this section. Also, post spacing on tube and clamp and system scaffolds will be discussed later.

Remember, do not overload individual planks, do not overload any one platform, and do not use more platforms simultaneously than recommended above.
More information on loading is contained in the supplement. In addition, all scaffolds over 125 feet in height must be designed by a registered professional engineer.

The previous information was covered in CP/01/01. We included it here as a review. But let's suppose you need to exceed the generic limits given earlier and need to determine loading on the scaffold components for a comparision to the manufacturer's rated capacity. How do you proceed?

A good plan of attack is to start by conceptualizing the weight itself which will be imposed. Next, picture in order the components of the scaffold which will bear that weight. Then evaluate each component to ensure that it is not overloaded. For example, suppose the weight is a 250 pound worker on the top platform. The workers' weight will first be carried by the scaffold plank he is standing on. So the first thing to check is that the plank is not overloaded. Next, the plank is supported by the bearer tubes. Each bearer tube carries half of the weight of that plank, and all the other planks that it supports. So the second item to check is the bearer tube to ensure that it is not overloaded. The bearers are supported by the posts. The bearer may be attached to the post by a device such as a clamp, which needs to be checked. Next, the post carries a partial weight of all of the bearers and other scaffold components attached to it. The load on the post must be checked. Finally, the post is supported by the screw jack, mudsill, and the soil. So these must be checked for capacity. What we will do next is to examine the load checking techniques for these items in order: planks, bearer, clamps, posts, and foundation (screwjack/pads/soil).

Planks

STI recommends a maximum load of 250 pounds per wood plank as a generic guideline. Some planks are rated to carry more than 250, but 250 is a good limit to work with unless you have information of greater capacity. The manufacturer will provide the loading information on premanufactured planks. Laminated veneer wood planks, aluminum and steel hook-on planks, and longer stage boards will all be assigned a maximum loading by the manufacturer. OSHA gives the following guidelines for solid sawn plank in the appendix:

Maximum intended nominal load (lb/ft^2)	Maximum permissible span using *full* thickness undressed lumber (ft)	Maximum permissible span using *nominal* thickness lumber (ft)
25.....	10	8
50.....	8	6
75.....	6	

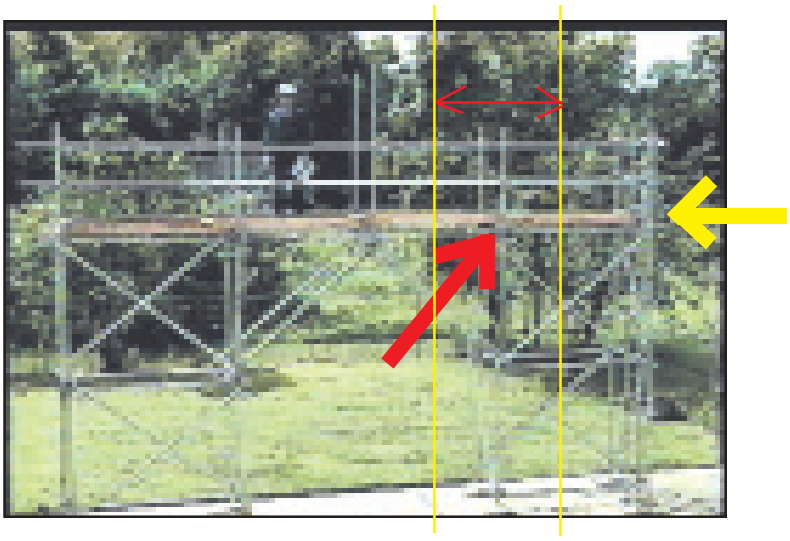
Bearers and the platform as a whole

The bearer refers to the horizontal member which supports the end of the planks. It may also be called a header, a ledger, or a transom. Since the planks are supported at both ends by a bearer, each bearer carries the weight of one half the platform. There are two components to the platform weight, the live load and the weight of the planks themselves. The best way to understand this is with examples. Lets suppose the platform is five feet wide and has six 8' long planks on it, each weighing 32 pounds. The total weight of planks is then 6 X 32 = 192#. Each bearer supports half, or 96#. In addition, there may be four toeboards weighing 10# each for a total of 40#. So the total dead load is 192 + 40 = 232#.

Since each bearer carries half, the dead load is 116#. Next we estimate the live load. By traditional convention, anticipated live load is divided into three categories, 25PSF, 50PSF, or 75PSF. So if the platform is 7' long and 5' wide, and the loading is light duty (25PSF), the total live load would be 35 X 25 = 875#. Each bearer would also support half of this weight, 437.5#. Next we add together the 437.5# live load and the 116# dead load for a total of 553.5#. That number is then compared to the rated load supplied by the manufacturer.

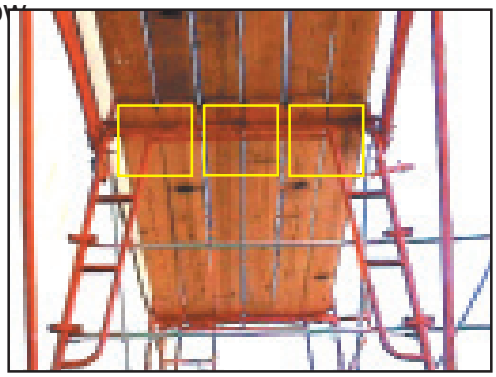
It should be noted that the designer does not have to choose a 25PSF, 50PSF, or 75PSF load. The designer could specify an exact amount of maximum weight on the platform, such as "three workers plus 100# of tools".

It gets a little more complicated on rows of scaffolding because the center bearer is supporting half of the platform to its' right, and half of the platform to its' left. If the platforms are symmetrical, it carries a full platform. But if the two platforms are different sizes, the half load must be calculated separately. Consider the picture below.



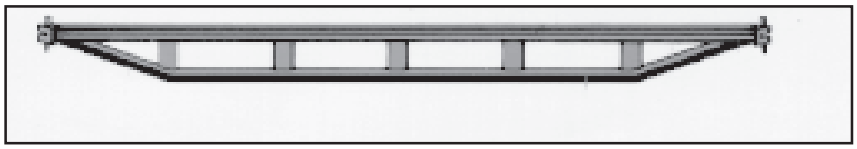
The bearer on the end (yellow arrow) supports half of the first platform. The bearer denoted by the red arrow supports half of the first platform and half of the second. Therefore, it carries the weight of a full platform. So the weight determination must be adjusted accordingly.

What are some typical load capacities of bearers? In general, frame scaffold headers will support more than tube and clamp or system because the frame headers are supported by interm[illegible]wn below.



Tube & clamp and system scaffold bearers do not have supports built in. So even though the tubing used is a larger diameter and thicker gauge than frame scaffold tubing, the bearer cannot support as much weight. You will need to obtain the specific loading from the manufacturer of the scaffold that you are using. The following are some general guidelines.

On frame scaffolds, the bearer capacities can be quite high on the standard 5' span (width). However, on tube and clamp or system bearers, the bearer capacity is often the limiting factor when deciding on platform width. For example, in the appendix OSHA recommends a maximum post spacing and resultant bearer span of 4 ' for tube & clamp. With system scaffolds there is a substantial variation between manufacturers on the recommended maximum span of unsupported bearers. Some manufacturers recommend a maximum span of 4', while others will allow up to 7', for end bearers (not a center bearer). A center bearer carries more platform load, as discussed earlier. Consider the pictures below.



The scaffolds shown at left were constructed by the manufacturer at our facility. Notice that these end bearer tubes have no additional support. However, on wider spans, the manufacturers recommend a bearer with additional support similar to the one shown on the left. Specific configurations vary, but the concept is to reinforce the bearer tubes.

These pictures show a 4' wide tube & clamp scaffold. This is the maximum width recommended in the appendix. If the platform is wider, and the subsequent bearer span wider, then the bearer should be supported in the center by an additional brace. Note that the bearer on the left supports one half of the platform, while the bearer on the right supports a full platform.

In addition to the uniform loading, the maximum bearer point loading should be considered. For example, one system scaffold manufacturer recommends a maximum 500# point load at the center of a 5' wide bearer (if the bearer is not reinforced). Let's assume the user intends to place a narrow piece of equipment that weighs 1000# weight directly in the center of the bearer. The bearer point load limit would be exceeded. The bearer's point load limit will be less than its' uniform limit.

In summary, to calculate the bearer load, determine the weight of planks, toeboards, etc., supported by the bearer and add that to the anticipated live load. End bearers support one half of this weight but center bearers support half of the platform to each side (which may not be the same). The manufacturers anticipate normal loading conditions and build the equipment to meet that loading. They will provide specific loading information for their products.

Bearer Connections

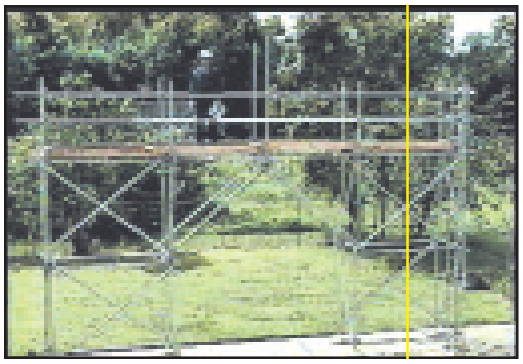
Bearer connections are discussed next. With frame scaffolding, the bearer is welded onto the posts. The connection will not be a limiting factor. However, on tube & clamp scaffolding, the bearer is affixed to the posts with right angle clamps. There are a great variety of clamps available, so the load capacity before slippage occurs also varies greatly. For example, many two inch wide clamps have been tested to between 3000 to 4000 pounds ultimate load. The ultimate load is the absolute maximum that the component will support before failure. The rated load is one fourth of the ultimate load (minus a small fraction), in order to maintain the four to one safety factor. In the example above, the manufacturer will assign a rated capacity of 750 to 1000 pounds per clamp.

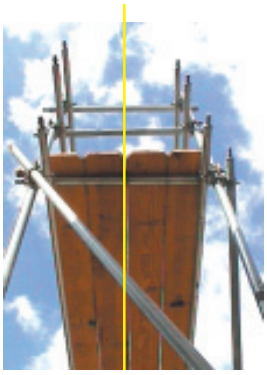
The weight imposed on the bearer connection is one half of the load imposed on the bearer as previously discussed. To explain, if you pick up a barbell evenly spaced with your hands, your right hand has half the load and your left hand has half the load. The bearer connection is like your hand. Generally, the bearer connection will not be the limiting factor because the maximum load on the bearer will be reached first. However, an exception could be bearers that are rated to carry substantial amounts. For example, if an I beam is the bearer, and is carrying a heavy load, and connected to the scaffold via clamps, the clamp capacity might be exceeded. But generally, for regular scaffold tube bearers, if the bearer is not overloaded, then the clamp will not be overloaded. However, it is a good practice to install a "safety clamp" under the bearer clamp for a backup. This normally happens automatically if the runner is set under the bearer as covered in the tube and clamp section.

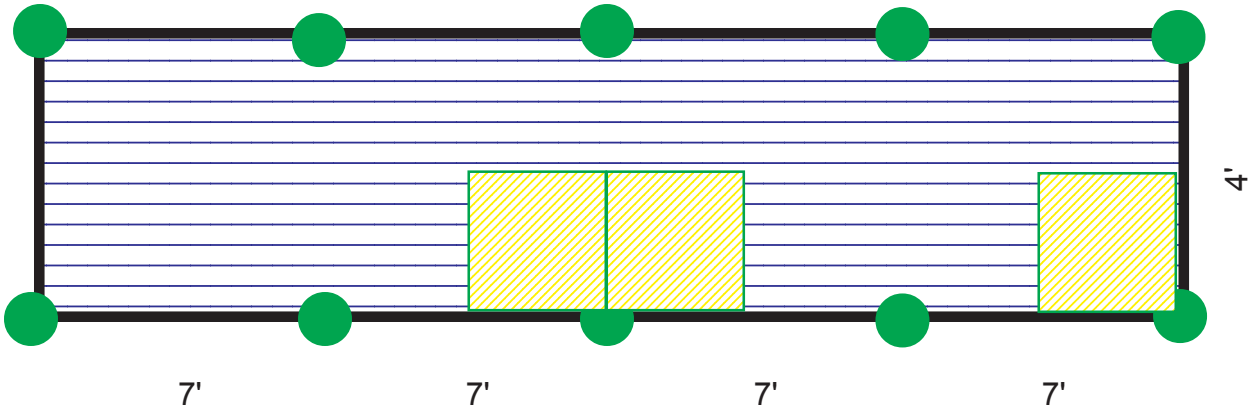
With system type scaffolding, the bearer connection is welded on to the post. This type of connection is stronger than a clamp because a clamp is only a friction grip. In general, if the bearer is not overloaded, then the bearer connection will not be overloaded. However, if the configuration included longer trusses for bearers, or multiple trusses into the connector, then the connector capacity might be approached and should be evaluated. These types of configurations may require special knee bracing or suspension bracing and should be designed by the scaffolding supplier.

Posts (legs)

Calculating the post or leg loading can be a little more difficult. Consider the pictures below.







These pictures illustrate the contributory area of the legs. Notice that the corner post is carrying one fourth of a platform. The inner leg, however, is carrying one fourth of the two adjacent platforms. The point is that each leg may carry a different load depending upon its' position within the design.

Let's use the corner leg shown in the picture on the bottom of the previous page as an example. To calculate the leg load we need to determine the live and dead load. First, let's figure the dead load. What weight of scaffolding is this leg carrying? Obviously, it is carrying its' own weight. Let's assume the scaffold post consists of one 10' long tube and one 8' long tube stacked on top of each other. The 10' tube weighs 20#, the 8' tube weighs 17#. Start a list with those tubes first.

Next list the horizontal tubes attached to the post. Include one half of the weight of all the horizontal and diagonal tubes attached to it. Why one half? The corner leg we are examining supports one end of the tube, and the other end is clamped to and supported by a different leg. It is like if you and a friend pick up different ends of a barbell; his hand carries half the weight, and your hand carries half the weight. Looking at the front side of the picture on page 45, we see five 8' long horizontal tubes attached to the post. Each 8' tube weighs 17#, and the leg supports one half. Each tube is held on by a right angle clamp weighing 2.75", and the post carries all the weight of that clamp. Also, two diagonals are attached to the post from this direction. The diagonals are 10' tubes @ 20#, and the leg carries half. The diagonals are held on by two swivel clamps. The swivel clamps weigh 3.5#, and the post carries all the clamp weight. So we add those to the list. Note: we are ignoring the attached ladder for this excercise.

Looking at the end of the scaffold (the short way), we see five 4' tubes attached to the post. Each 4' tube weighs 10#, and the leg carries half. The 4' tubes are held on by four right angle clamps, each weighing 2.75#, and the leg carries it all. Two diagonals are attached to the post. The diagonals are 8' tubes and weigh 17#, and this post carries half. The diagonals are held on by two swivel clamps, each weighing 3.5#, and the post carries it all.

On top, there are four 8' long planks @ 32# each. The post supports one fourth of the planks on top. There are also two toeboards, 8' & 4', weighing 15# total. The nails could also be added in but we won't do that here.

Now let's write out our list.

Tube & Clamp List

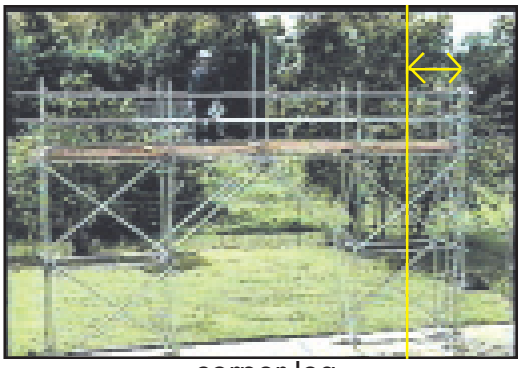
Source	Part	Qty.	Wt.	Share Factor	Total
Posts	10 tube	1	20#	1.0	20#
Posts	8 tube	1	17#	1.0	17#
Front horizontal	8 tube	5	17#	.5	42.5#
Clamps above	RA	5	2.75	1.0	13.75#
Front diag	10 tube	2	20#	.5	20#
Diag clamp	SW	2	3.5#	1.0	07#
End horizontal	4' tube	5	10#	.5 `	25#
Clamps above	RA	5	2.75	1.0	13.75#
End diag	8' tube	2	17#	.5	17#
Diag clamps	SW	2	3.5#	1.0	07#
Planks	8'	4	32#	.25	32#
Toeboards	TB8	1@8'	10#	.5	05#
Toeboards	TB4	1@4'	5.0#	.5	02.5#

Total Scaffold Weight (Dead Load)_____222.5#

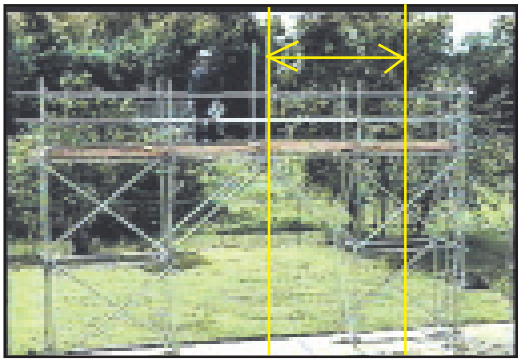
Next we will calculate the live load. Assume a light duty (25PSF) load. Refer to the contributory area diagram on the previous page. This platform is 7' long by 4' wide. This one is simple enough to do the short way: 7 X 4 = 28 X 25PSF = 700#. This leg's share is 1/4th, which equals 175#.

So the total live and dead load in this example is 222.5# plus 175# equals 397.5#. That number is compared to the rated capacity from the manufacturer. In this case the leg is rated for 4000# in this configuration. So we are only using about one tenth of it's capacity. Also, keep in mind that the rated capacity includes the four to one safety factor.

However, while this corner leg is lightly loaded, notice that the leg to the left in the scaffold is in a different configuration. Its' contributory area includes distance to the right and distance to the left. And notice that the post to the left is a dead leg so that half the weight of that leg is transferred back down to the leg we are examining. The other half is transferred down to the leg further left. So in effect the leg being considered carries a larger platform weight to its' left and half a platform to the right. The areas must be calculated separately.



corner leg

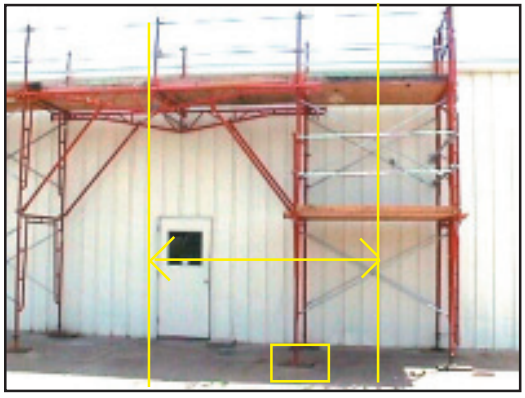


next leg to left

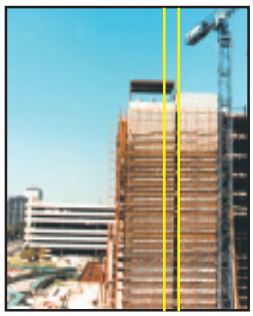
Let's look at another example. Consider the front corner leg on the scaffold pictured at the left. Using the same process, the frame leg must first carry it's own weight; that is, its' half of the frame. If the frame with both legs weighs 46#, one half is 23#. It is two frames high, with one coupling pin, 1.25#. Cross braces attach to the adjacent frames. The cross braces weigh 12.25# each, the corner leg carries half. The first platform is planked with six 8' wood planks @ 32# each, the corner leg carries one fourth. Notice the side bracket platform. This leg carries all the weight of the bracket @ 20#. It carries half of the weight of the side bracket planks, 2 each @ 32#. It carries a share of the toeboards. It carries all of the guardrail posts @ 8.5#, and half the weight of the two front guardrails @ 5.25# each. Note that the sidebracket must be viewed differently than the inside contributory area, having different share allocations. The side bracket end guardrails are continuous 8' tubes which go across the main level also. The corner leg carries half the weight of these tubes to the right, and all of the weight above the side bracket and clamps.

The top platform has a guardrail post, this leg carries all its' weight. This leg also carries half the weight of the swing-gate end panel @ 40#. It carries one fourth of the top planking and part of the toeboards as covered before. It carries half the weight of the top front guardrails.
Notice the hoist arm. The corner leg carries all the weight of the arm and potential materials hoisted. Next create a table, and total the dead and live load (two levels @ 50psf).

Source	Part	Qty.	Wt.	Share Factor	Total
Frame leg	Frame	2	46#	.5	46#
Coupling Pin	Pin	1	1.25#	1.0	1.25#
Cross Brace	XB74	2	12.25#	.5	12.25#
1st platform	8' plank	6	32#	.25	48#
Side bracket	Bracket	1	20#	1.0	20#
Bracket planks	8' plank	2	32#	.5	32#
Toeboards	8' 2X4	2	10#	.5	10#
Bracket post	Guard post	1	8.5#	1.0	8.5#
Bracket G. rail	7' Guard R.	2	5.25#	.5	5.25#
Tube & clamp rails	8' tube	2	17#	.75	25.5#
Clamps for above	RA clamp	4	2.75#	1.0	11
Top platform plank	8' planks	6	32#	.25	48#
Toeboards above	Appx 8'	2	10#	.5	10#
Top Gate panel	GR Panel	1	40#	.5	20#
Top rails	7' G. rail	2	5.25#	.5	5.25
Hoist Arm	Hoist	1	42#	1.0	42#
Live 2 levels	7' X 5' @ 50	2	1750#	.25	875#
Live side bracket	7' X 2' @ 25	1	350#	.5	175#
Total Live & Dead					**1395#**



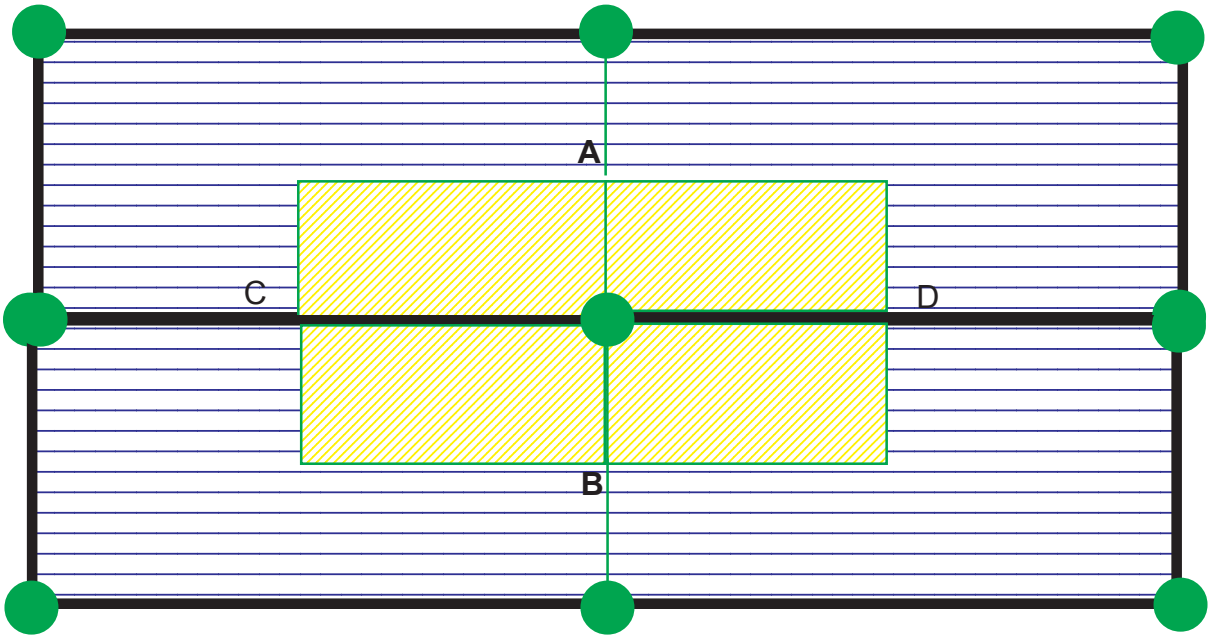
The picture to the left shows a front view of the same scaffold. We have evaluated the right corner leg. If we evaluate the next leg to the left, the contributory area changes and the components involved in the dead load calculation also change. This leg supports a putlog truss platform which means a larger area, and more resultant dead and live load on the leg.



Each leg must be evaluated separately for it's own contributory area. Then the components attached to that leg must be evaluated separately for their particular weight and the percentage of that weight (share) that the leg carries. We have demonstrated simple examples. The task can be more daunting on larger scaffolds, but the same techniques are applied: piece, by piece, by piece.

You can begin to understand that while the concept of calculating leg loads is simple, the actual calculations can become complicated and tedious.

The formula for contributory area can be expressed in a more formal algebraic way.



In the case above, the center leg has contributory from all four directions. If the distances between adjacent legs are as follows: A = above, B = below, C = left, D = right, then the formula would look as follows:

Contributory Area = (A/2 X D/2) + (A/2 X C/2) + (B/2 X C/2) + (B/2 X D/2).

If this formula seems a little intimidating, remember that "A/2" simply means half the distance above the assumed leg, "B/2" simply means half the distance below the assumed leg, etc. So if the distance A is 8 feet, then A/2 simply means 4 feet. Many people can understand it better working with numbers rather than letters (algebra).

In summary, to calculate the leg load, first determine the contributory area. The dead load must be figured by considering all of the components that attach onto that leg and allocating the proper share of their weight. Each component must be figured individually, which can be a time consuming process. The live load is determined by multiplying the contributory area by the assigned loading. The assigned loading is usually expressed in 25PSF, 50PSF, or 75PSF, although special loading (more or less) may be specified by the designer.

Foundation

The determination of foundation size is relatively simple once you know the leg load. The basic idea is build a large enough pad to spread out that weight and reduce it to the allowable amount. For example, assume the leg load is 1000 pounds. A one square foot pad will yield 1000 PSF on the soil (1000# divided by 1sq.ft.=1000PSF). A two square foot pad will yield 500 PSF (1000/2=500) on the soil. A four square foot pad (2' X 2') will yield 250 PSF (1000/4). Pads should be constructed using techniques discussed earler in this manual.

How do you know how much weight is the maximum that should be imposed on the soil? That information is covered in 29CFR1926 subpart P, Excavations. A detailed instruction is beyond the scope of this course, but competent person courses in Excavations are commonly available. In general, soil is divided by the standard into three classifications: Type A, Type B, or Type C. Type C is the weakest, and is characterized by being grainy, sandy, or previously disturbed. Type C is rated for 1000 PSF or less. Since scaffolds are usually built on construction sites which have been previously disturbed, STI recommends that all soil in these location be considered to have Type C capacity only. The obvious exception is if the scaffold foundation is based on a concrete slab.

So back to our example, assuming you want to limit the loading on the soil to no more than 500#, and the leg weight is 1000#, then you need a 2 square foot pad (approximately 18" in both directions, 1.5' X 1.5" = 2.25 sq.ft.). If the leg load is 3000#, and you want to limit the loading to no more than 500#, then you need a 6 square foot pad(3000/6=500). A pad 30" in each direction gives an approximate 6 sq. ft. pad (2.5' X 2.5' = 6.25sq. ft.).

On the other hand, if you were on a concrete slab with a compressive strength of thousands of pounds, then a regular one square foot pad might be sufficient. Be aware, however, that concrete pads are subject to washout underneath and may not retain their design strength.

Other Loads

Other loads may also need to be calculated into the equation. For example, if the scaffold

will be enclosed by tarps, poly, or other solid covering, then the structure is converted from one that is primarily open to a structure that is closed. The wind will generate tremendous pressure against the scaffold if it is enclosed. The higher the wind, the higher pressure will be. In the general requirements section, we gave some examples and guidelines of the wind force when scaffolds are enclosed.

Special point loads may be generated in some situations. For example, assume the erector is asked to construct a cantilevered platform on the side of the scaffold for the purpose of landing materials with a crane. This type of platform will exert a side point load onto the main scaffold structure.

In nuclear plants, the scaffold may have to be designed for the potential of seismic loads.

Other special loads may include vibratory, induced, or uplift.

Summary

This section has provided an overview of loading on scaffolds. It has included a guideline for determining the weight imposed on scaffold components by the dead load and the live load. It has also given some examples of rated capacity of various components. These examples are not intended for load calculation. The designer must obtain the specific rated load capacity of the components for the brand of scaffolding being used.

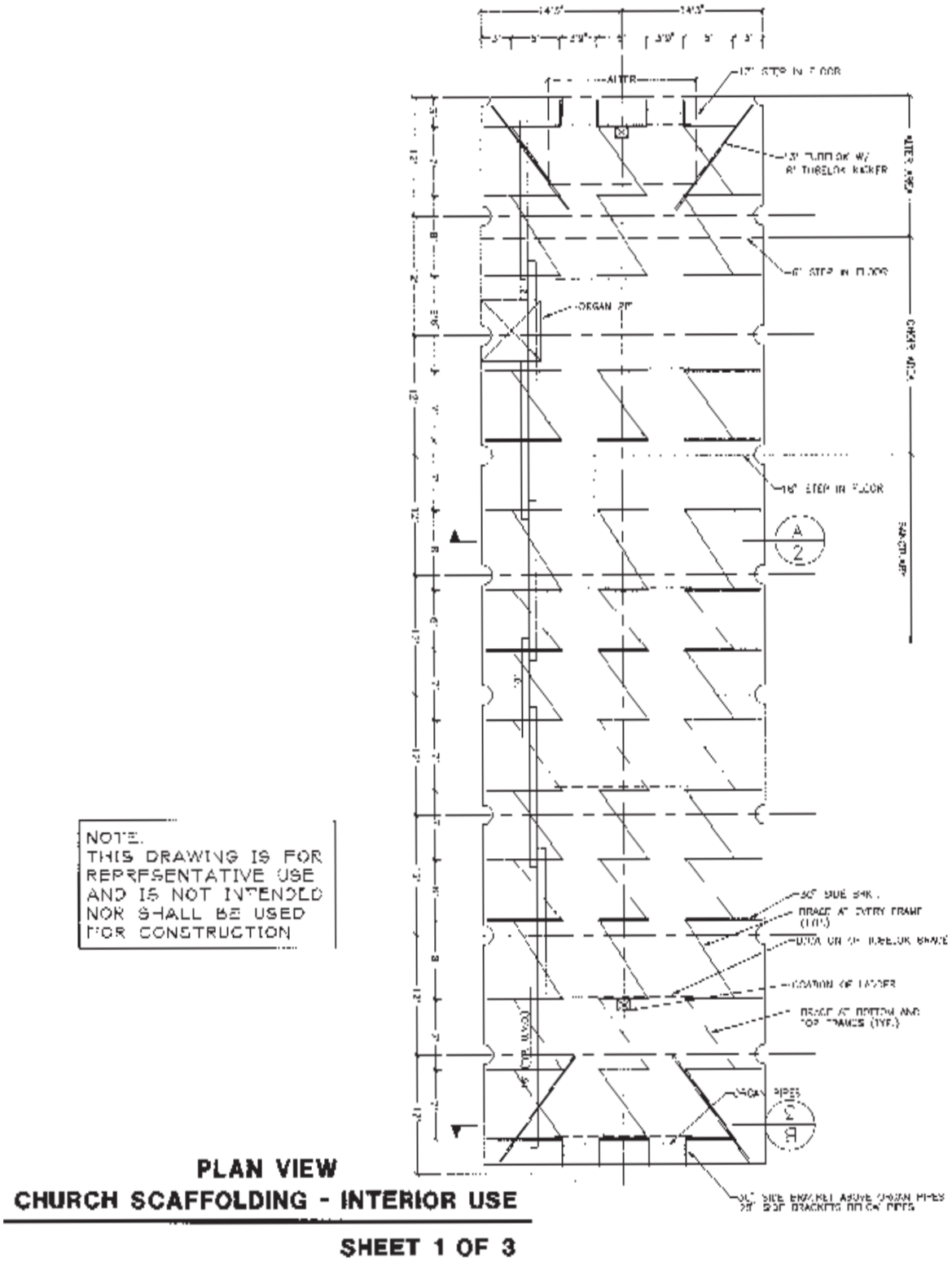
A good way to visualize loading is to start with the loads imposed on the planks, and trace the loading from the planks, to the bearers, to the bearer connections, to the posts, to the foundation and soil, checking each component along the way.

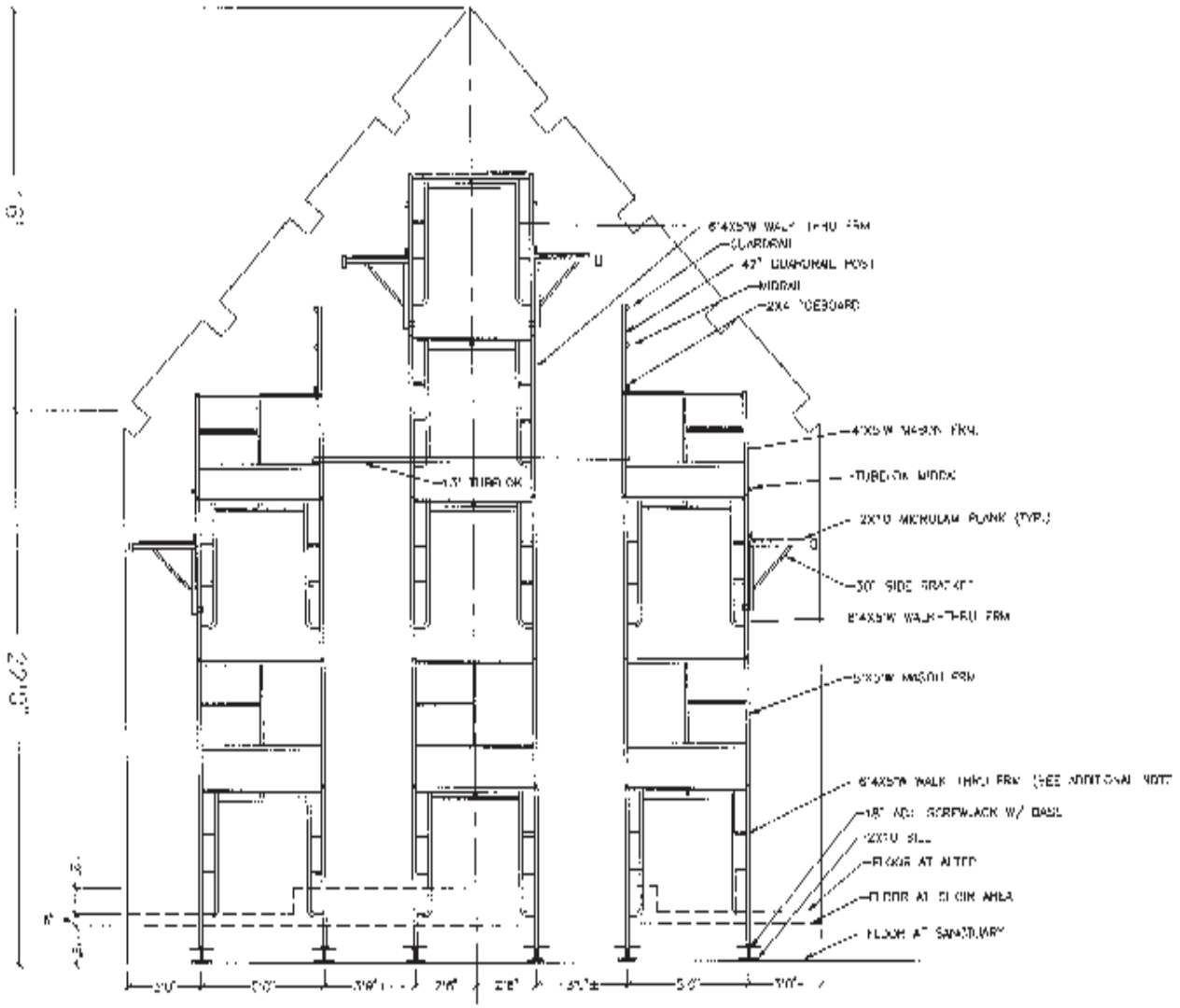
If the participant wishes to become proficient in calculating loads, the best thing to do is practice. For example, the participant could consider any of the scaffolds pictured in this manual for use as practice scaffolds. Obtain the component weights and loading information for the products you normally use. Select the platforms, bearers, bearer connections, posts, and foundation of the scaffold to examine in the determination. Use the procedures we have discussed and conduct a practice excercise to test your skill. If you want to discuss or confirm your results, contact us.

The purpose of this section has been to give the participant a conceptual understanding of load calculation. If a scaffold exceeds the conservative limits which we have specified earlier, load calculations should be done. The competent person or designer may wish to do a preliminary calculation. However, it is STI's opinion that the actual calculation should be done by the scaffolding supplier/manufacturer, a qualified engineer, or other person with extensive training and experience in the scaffold industry. While the concept may be simple to understand, the actual determination requires a detailed and thorough analysis by an experienced individual. Remember that all scaffolds over 125' in height must be designed by a Registered Engineer (PE). Also, it is critical that all persons who will use the scaffold be trained in the safe use and loading procedures as required by the regulation. Untrained users may inadvertently overload the scaffold beyond its' intended loading.

Application Blueprints

The following section shows blueprints of various applications. This section can be reviewed to familiarize the participant with the style and content of typical scaffold blueprints.





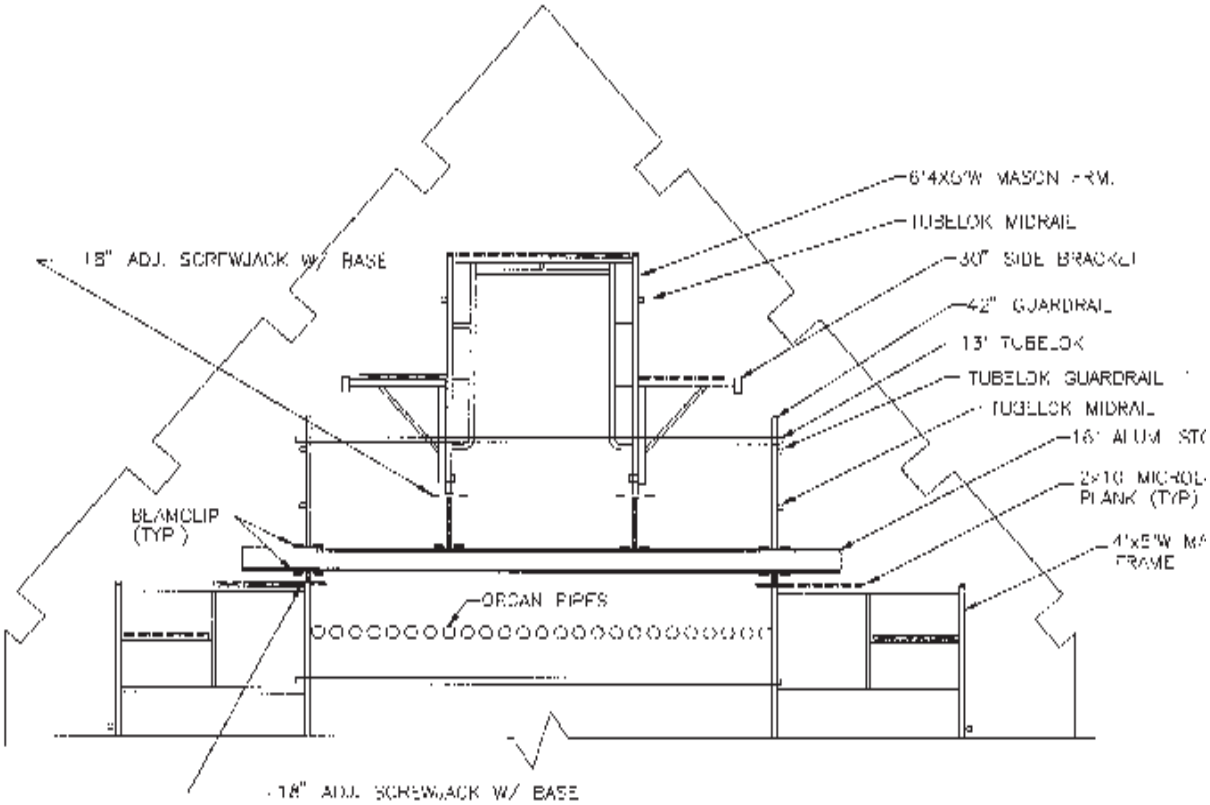
ADDITIONAL NOTES

1. AT SLOPE AREA AND ALTER, REPLACE 6"X5"W WALK THRU FRAME WITH A 4"X5"W MASON FRAME. SET SCREW JACK AT TOP STEP OF ALTER WITH 0" ADJUSTMENT

NOTE:
THIS DRAWING IS FOR REPRESENTATIVE USE AND IS NOT INTENDED NOR SHALL BE USED FOR CONSTRUCTION.

SECTION A
CHURCH SCAFFOLDING - INTERIOR USE

SHEET 2 OF 3



NOTE:
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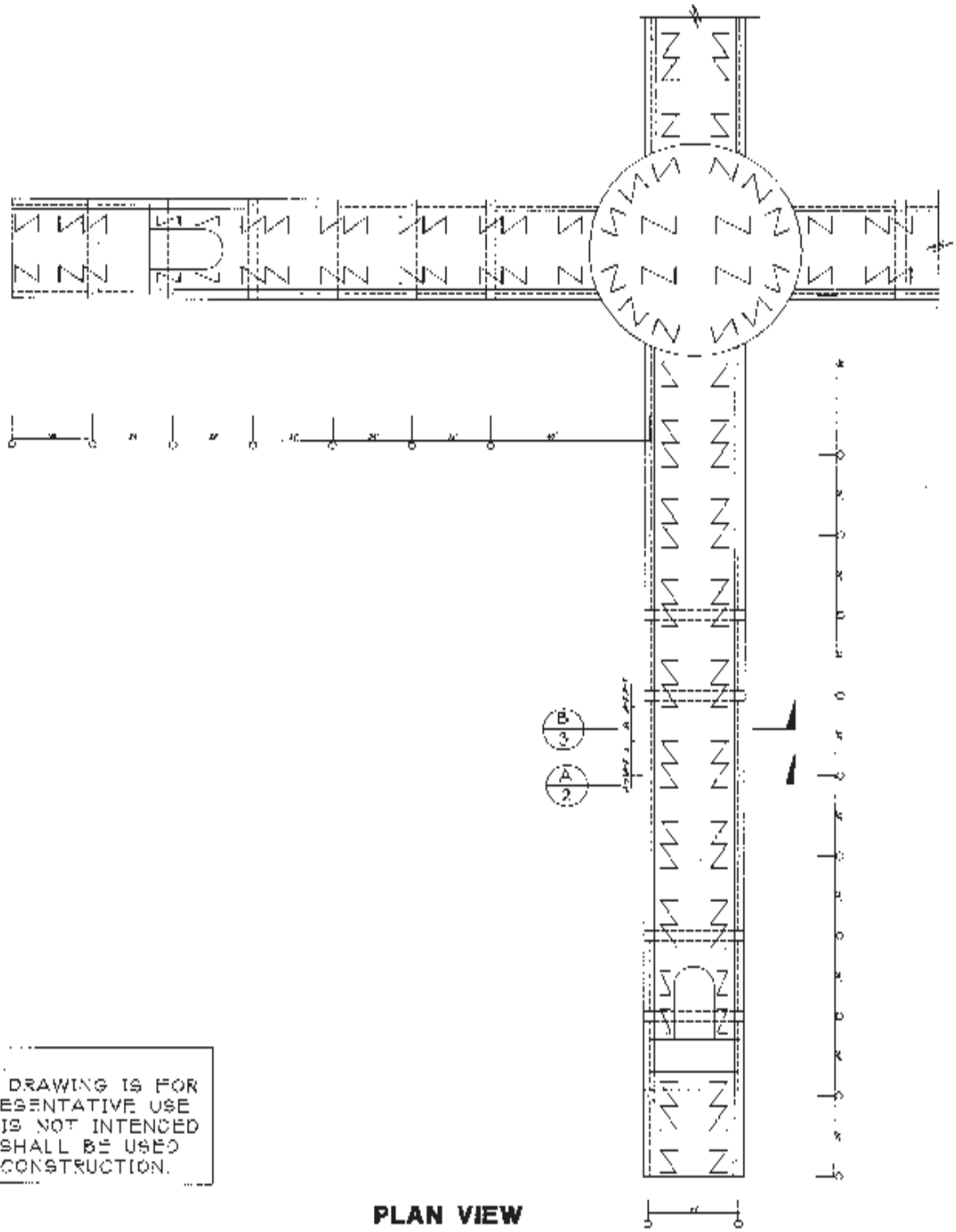
SECTION B
CHURCH SCAFFOLDING - INTERIOR USE

SHEET 3 OF 3



NOTE.
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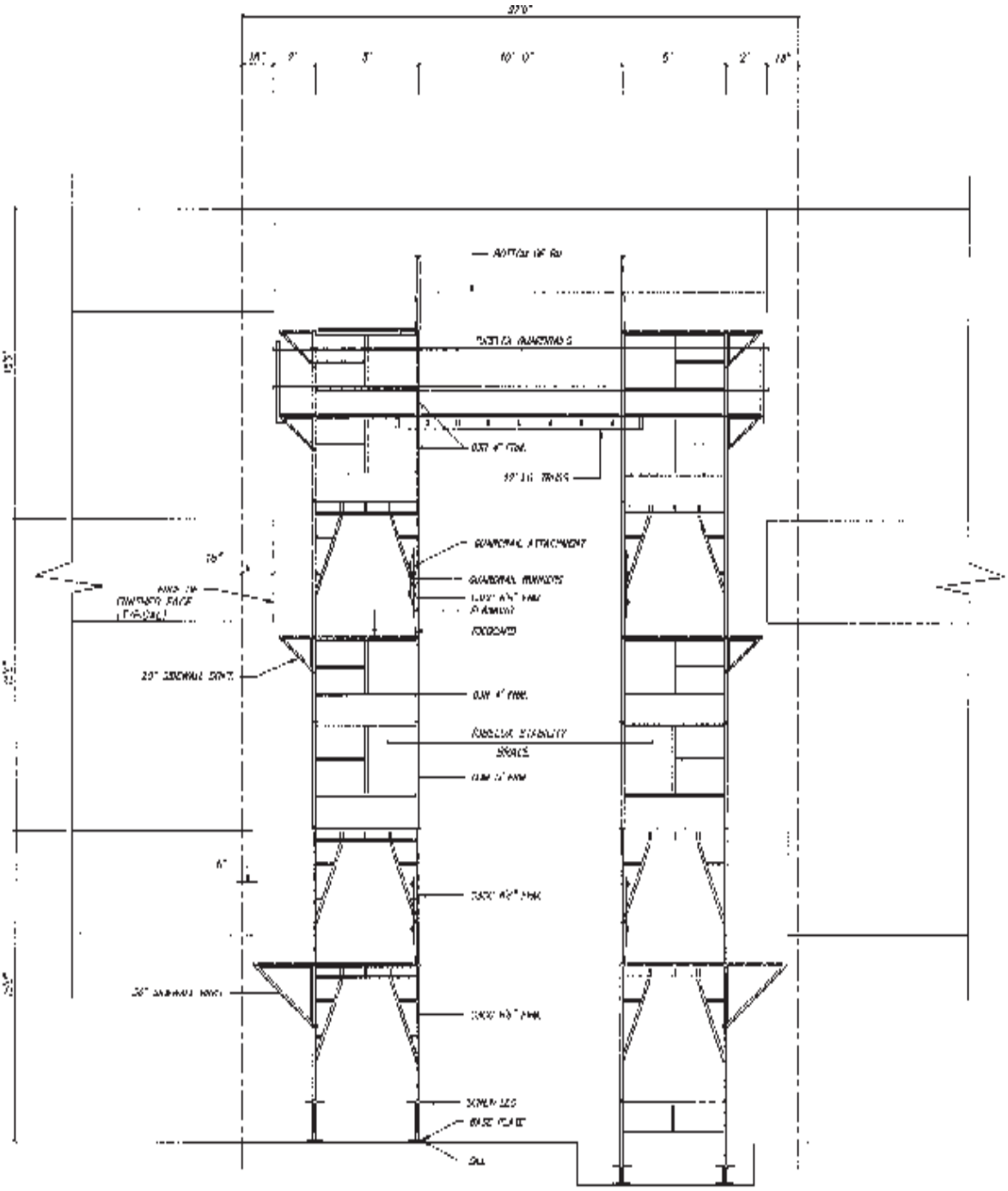
PLAN VIEW
INTERIOR SCAFFOLDING

SHEET 1 OF 3



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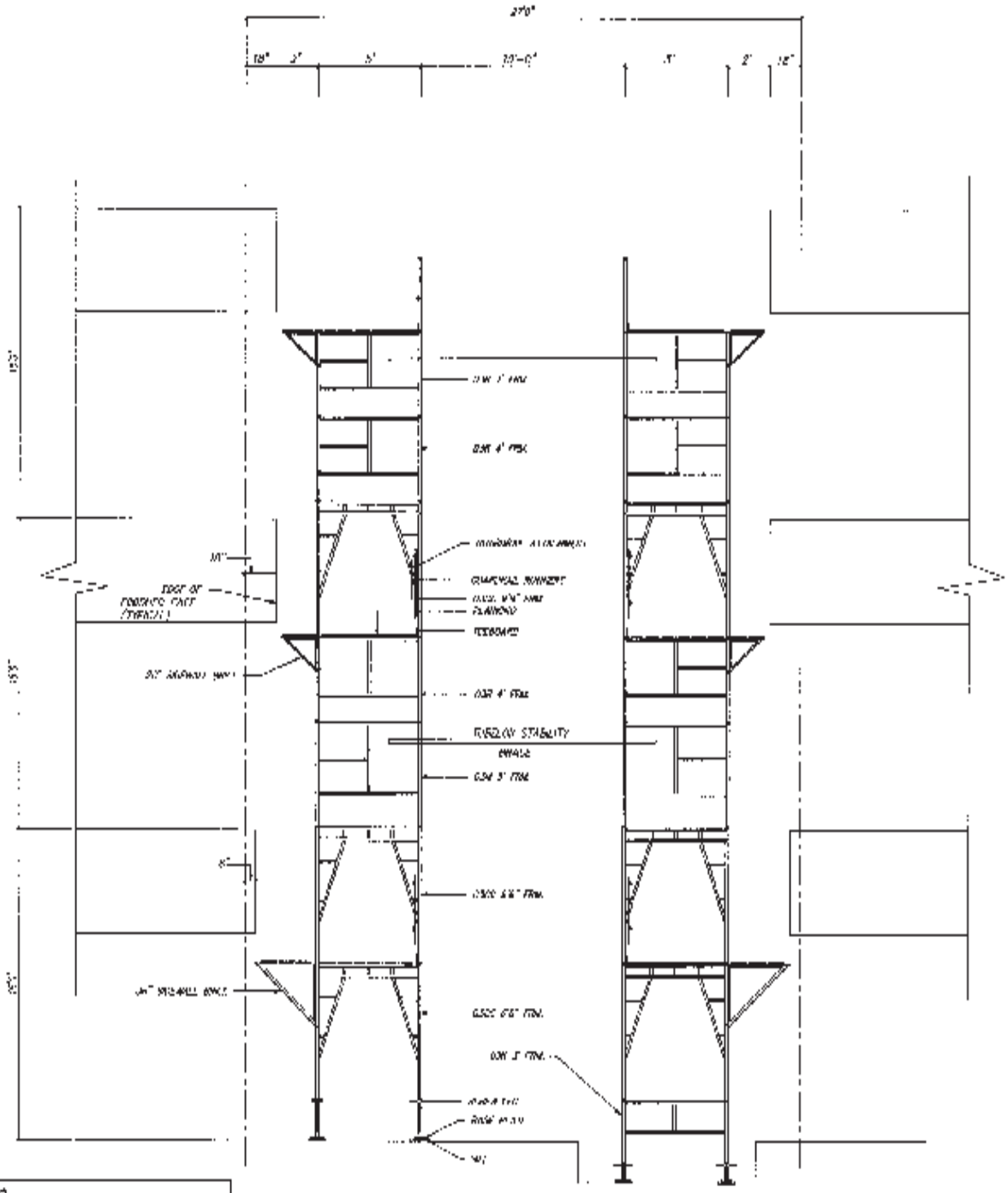
SECTION A
INTERIOR SCAFFOLDING

SHEET 2 OF 3



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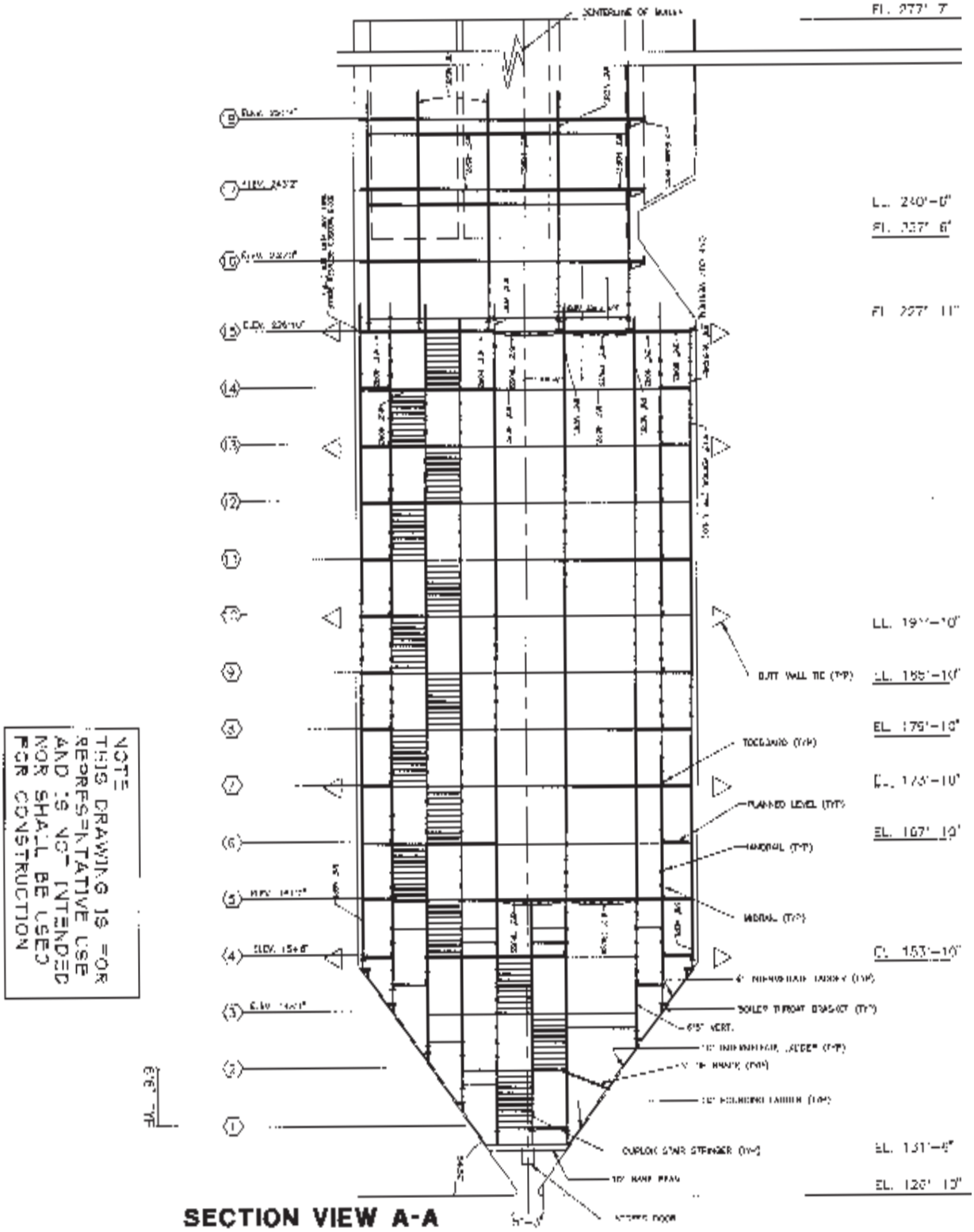
SECTION B
INTERIOR SCAFFOLDING

SHEET 3 OF 3



SECTION VIEW A-A
BOILER SCAFFOLDING - INTERIOR USE

SHEET 4 OF 4

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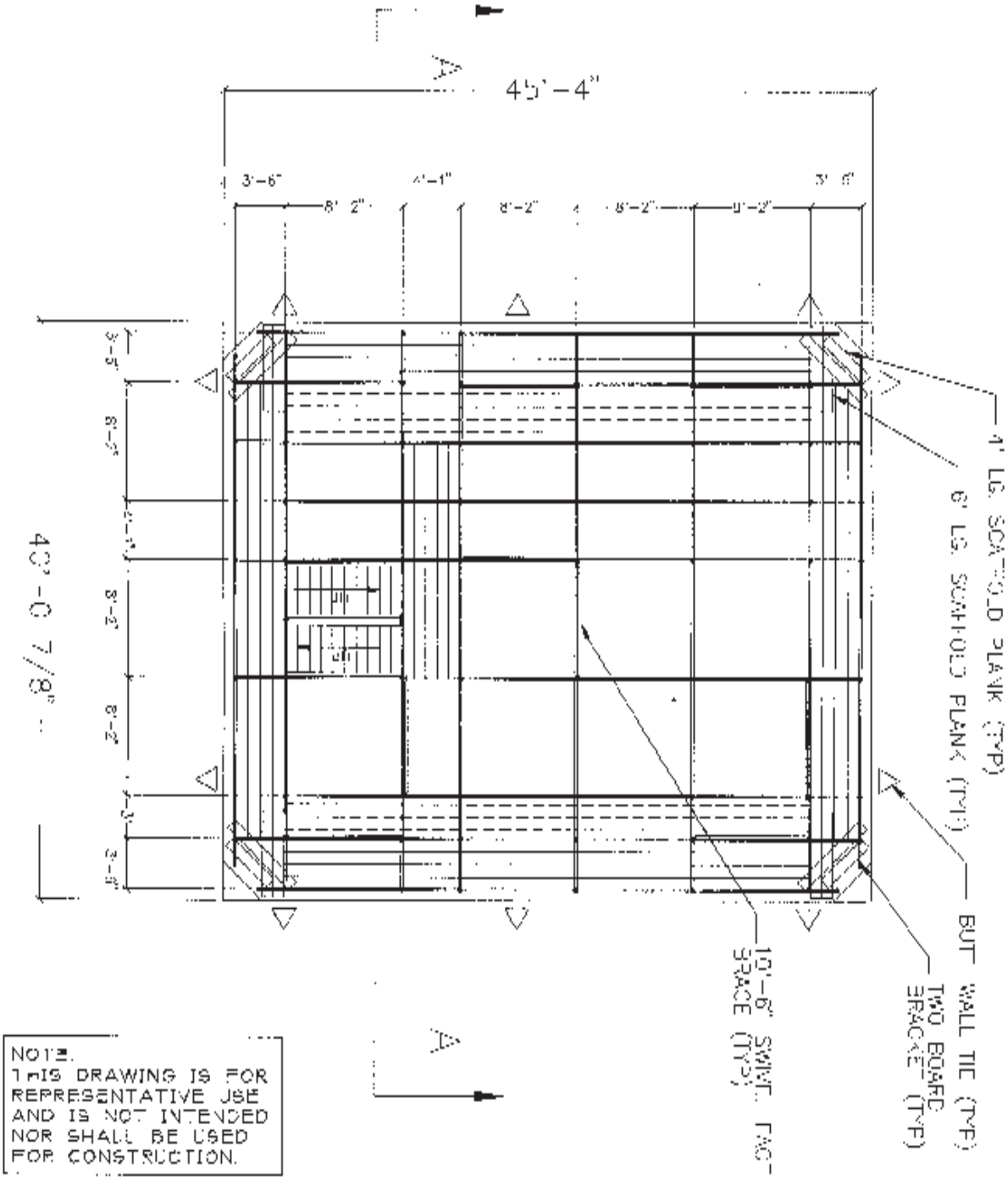
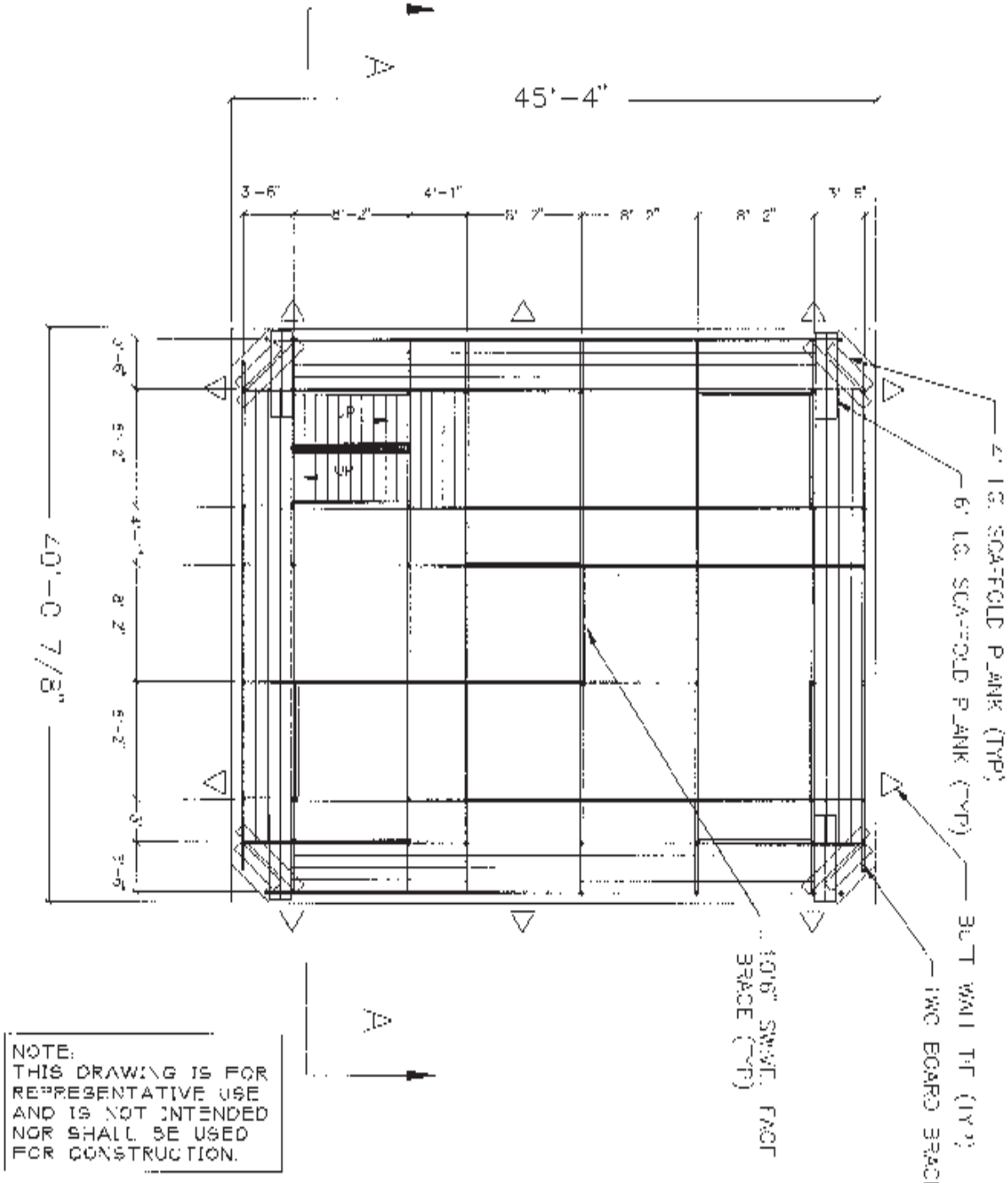


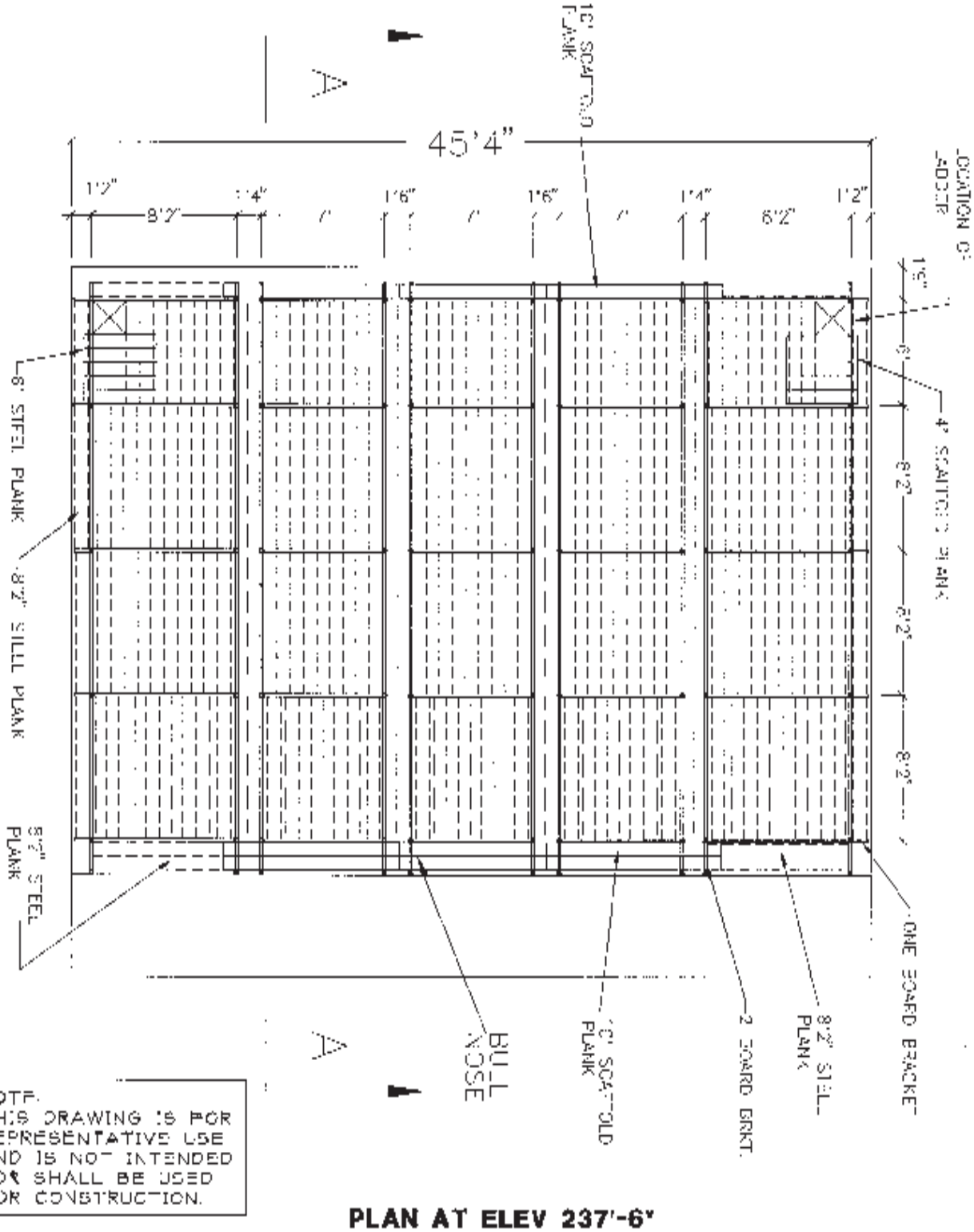
PLAN AT ELEV 148'-1"
BOILER SCAFFOLDING - INTERIOR USE

SHEET 1 OF 4



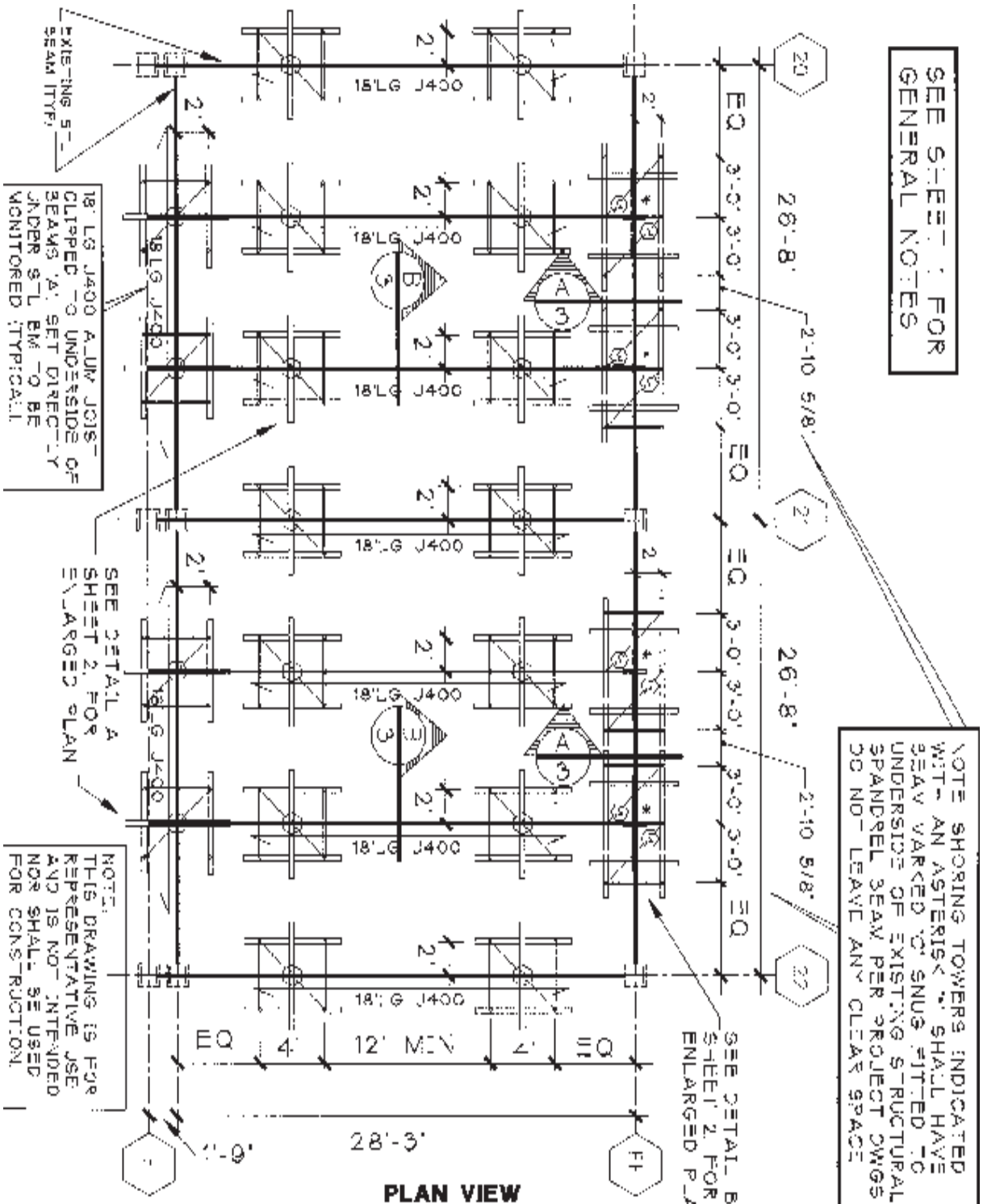
PLAN AT ELEV 191'-10"
BOILER SCAFFOLDING - INTERIOR USE

SHEET 2 OF 4



PLAN AT ELEV 237'-6"
BOILER SCAFFOLDING - INTERIOR USE

SHEET 3 OF 4

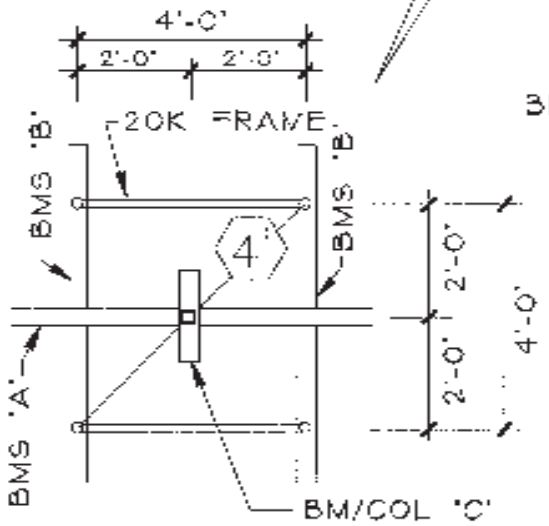


PLAN VIEW

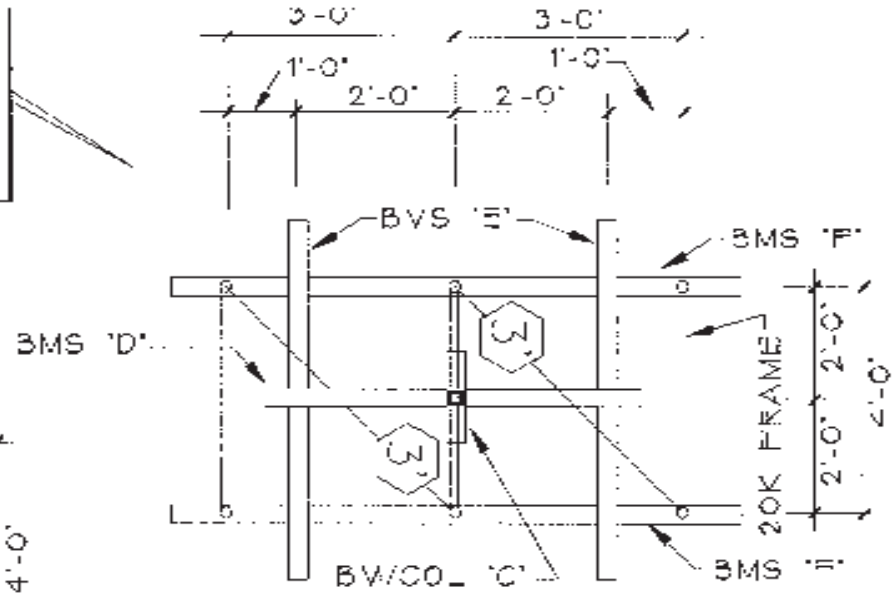
LOAD TEST SHORING - ZONE 5

SHEET 1 OF 3

NOTE: SEE SHORING BEAM SCHEDULE THIS SHEET FOR BEAMS MARKED 'A', 'B', & 'C' ON DETAIL A, AND BEAMS MARKED 'C', 'D', 'E' & 'F' ON DETAIL B THIS SHEET.



DETAIL A - PLAN VIEW



DETAIL B - PLAN VIEW

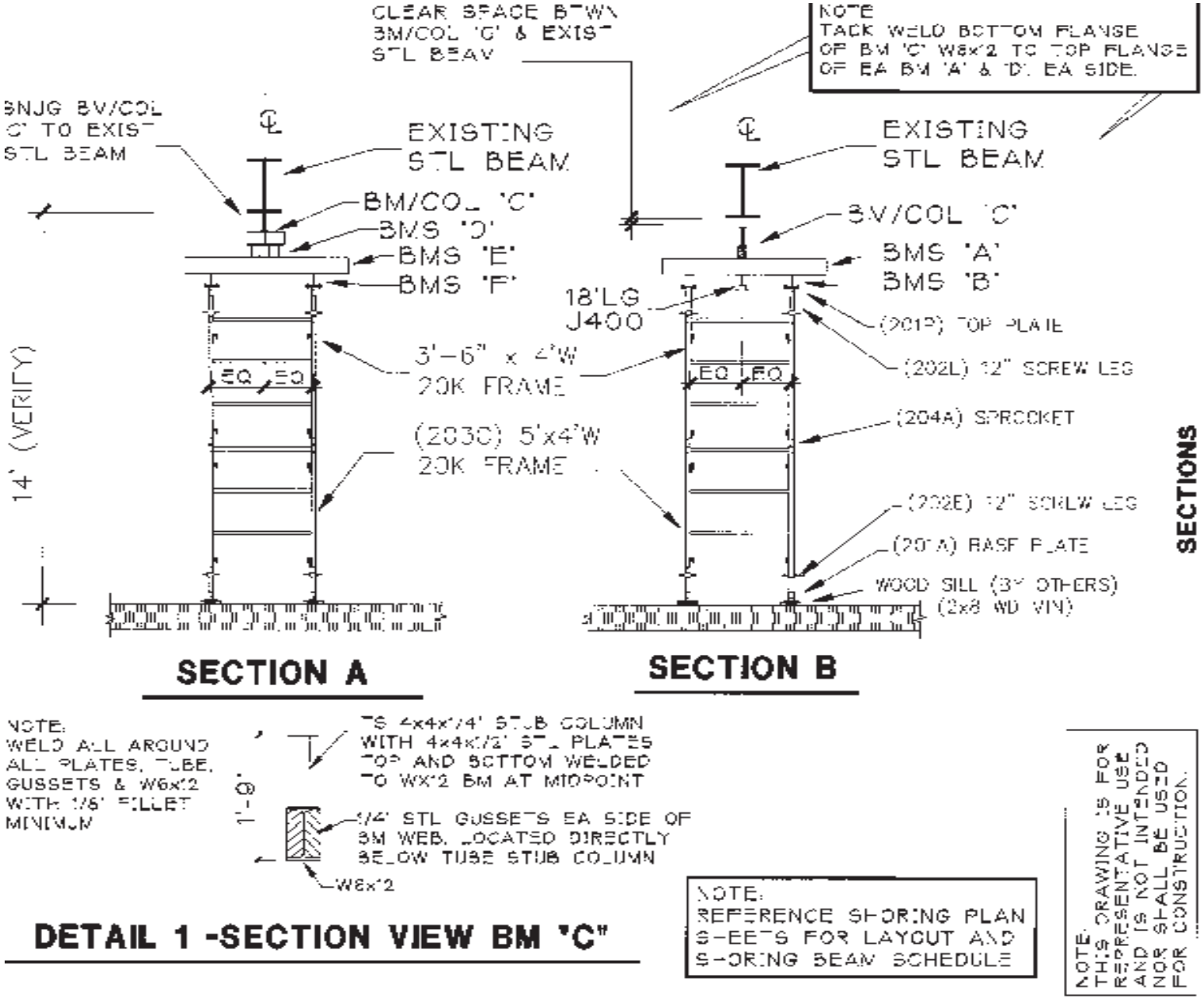
BEAM MARK	SHORING STL BM SCHEDULE		
	QUANTITY	TYPE	LENGTH
A	3 ea	W6x12	5' TO 8'
B	2 ea	W6x12	5' TO 8'
C	1 ea	W6x12	1'-6" +/-
D	4 ea	W6x12	5' TO 8'
E	2 ea	W6x12	5' TO 8'
F	[illegible] ea	W6x12	8' TO 10'

NOTE
SEE SHEET 3 FOR DETAIL OF BEAM MARKED 'C'.

NOTE:
SEE SHORING PLANS FOR EACH SPECIFIC CONSTRUCTION ZONE FOR LOCATION(s) OF DETAILS SHOWN THIS SHEET.

NOTE:
THIS DRAWING IS FOR REPRESENTATIVE USE AND IS NOT INTENDED NOR SHALL BE USED FOR CONSTRUCTION.

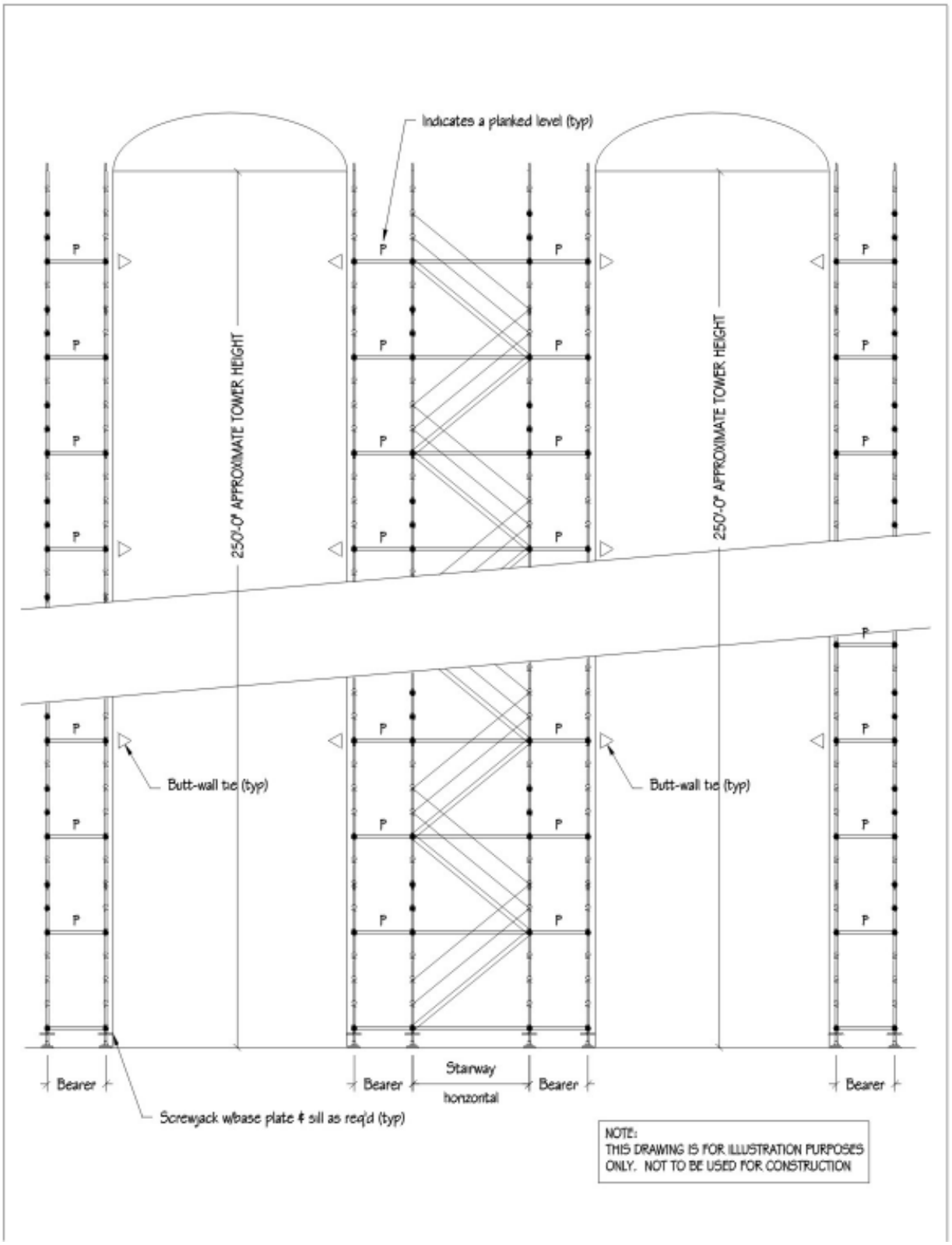
DETAILS
LOAD TEST SHORING - ZONE 5
SHEET 2 OF 3

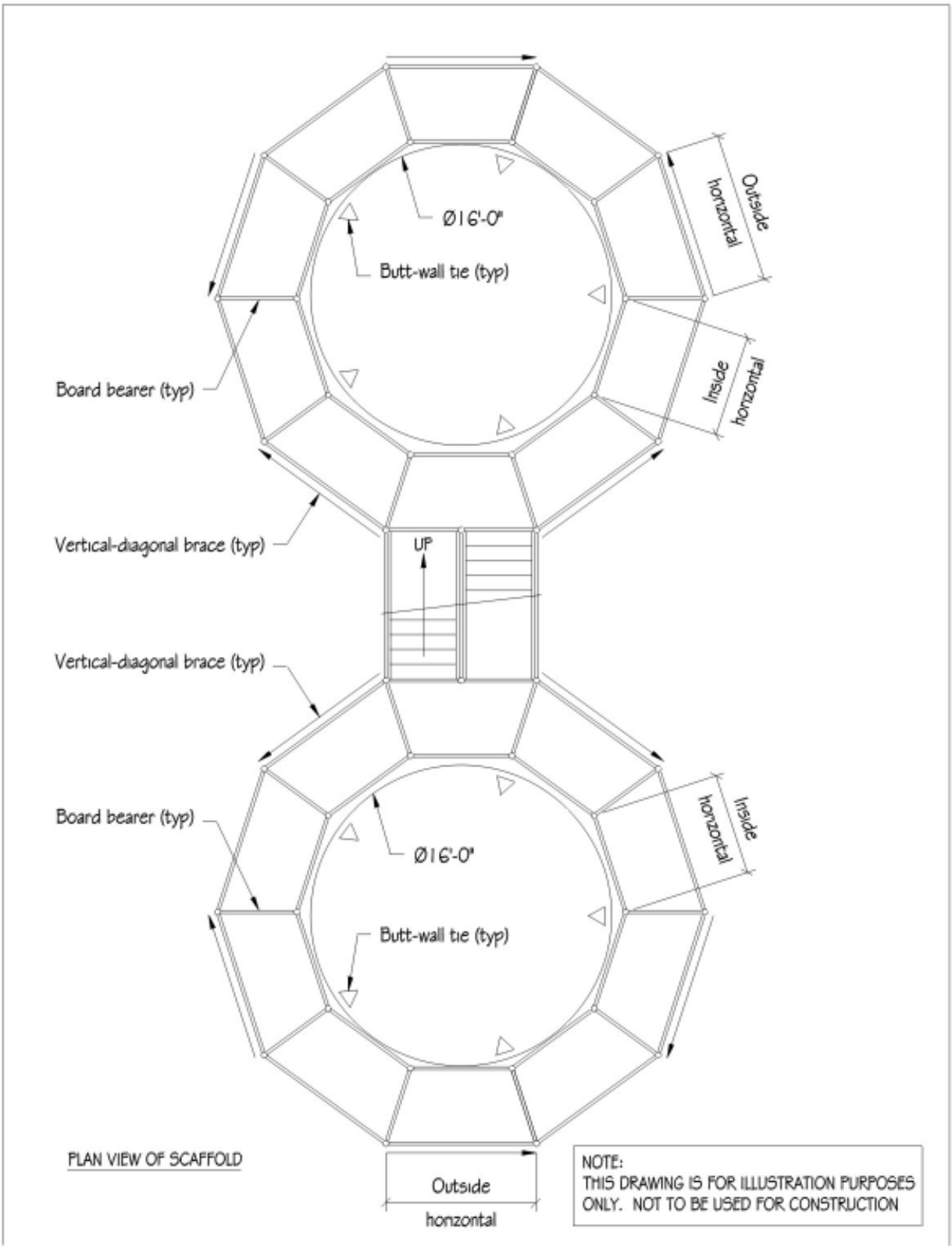


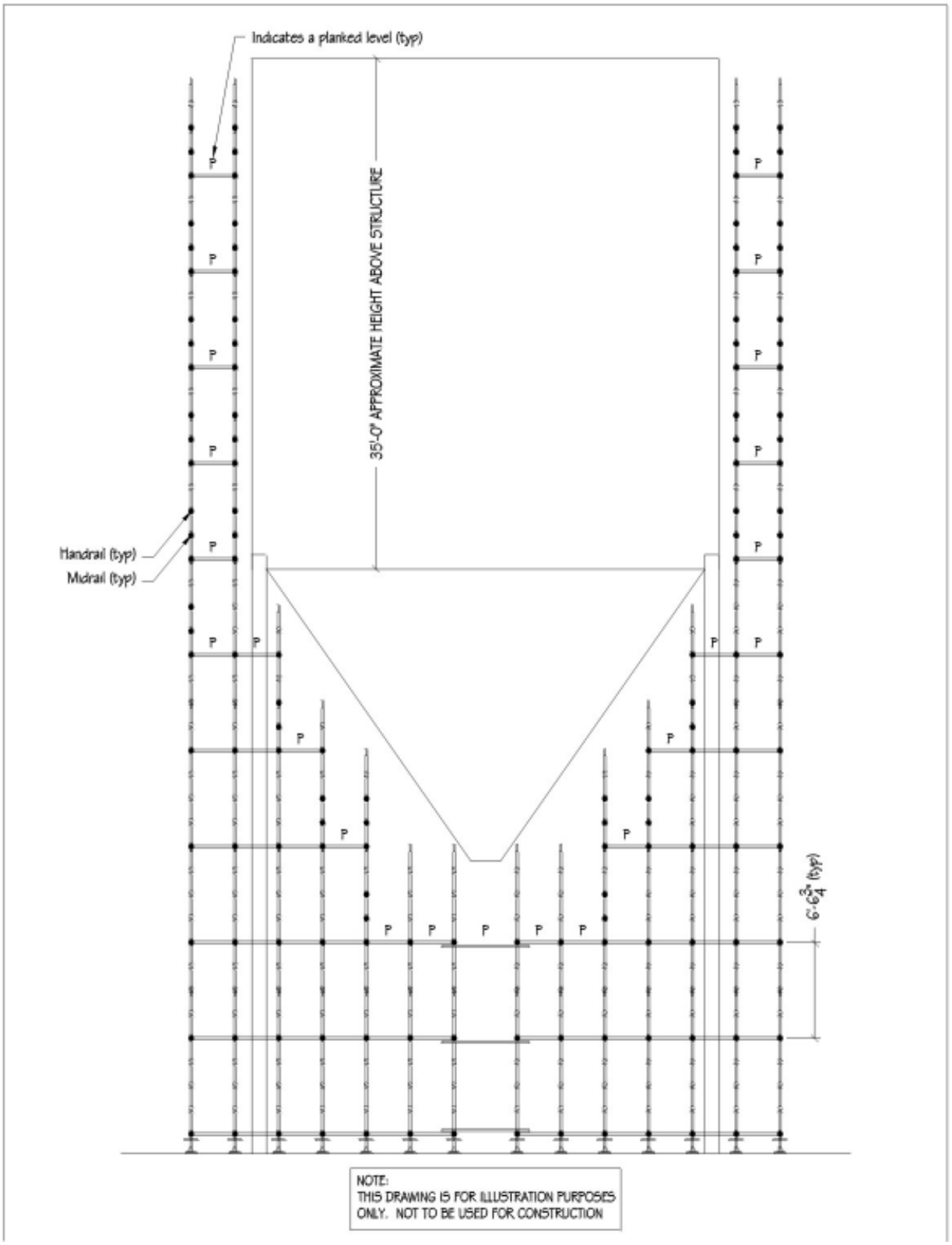
SECTIONS

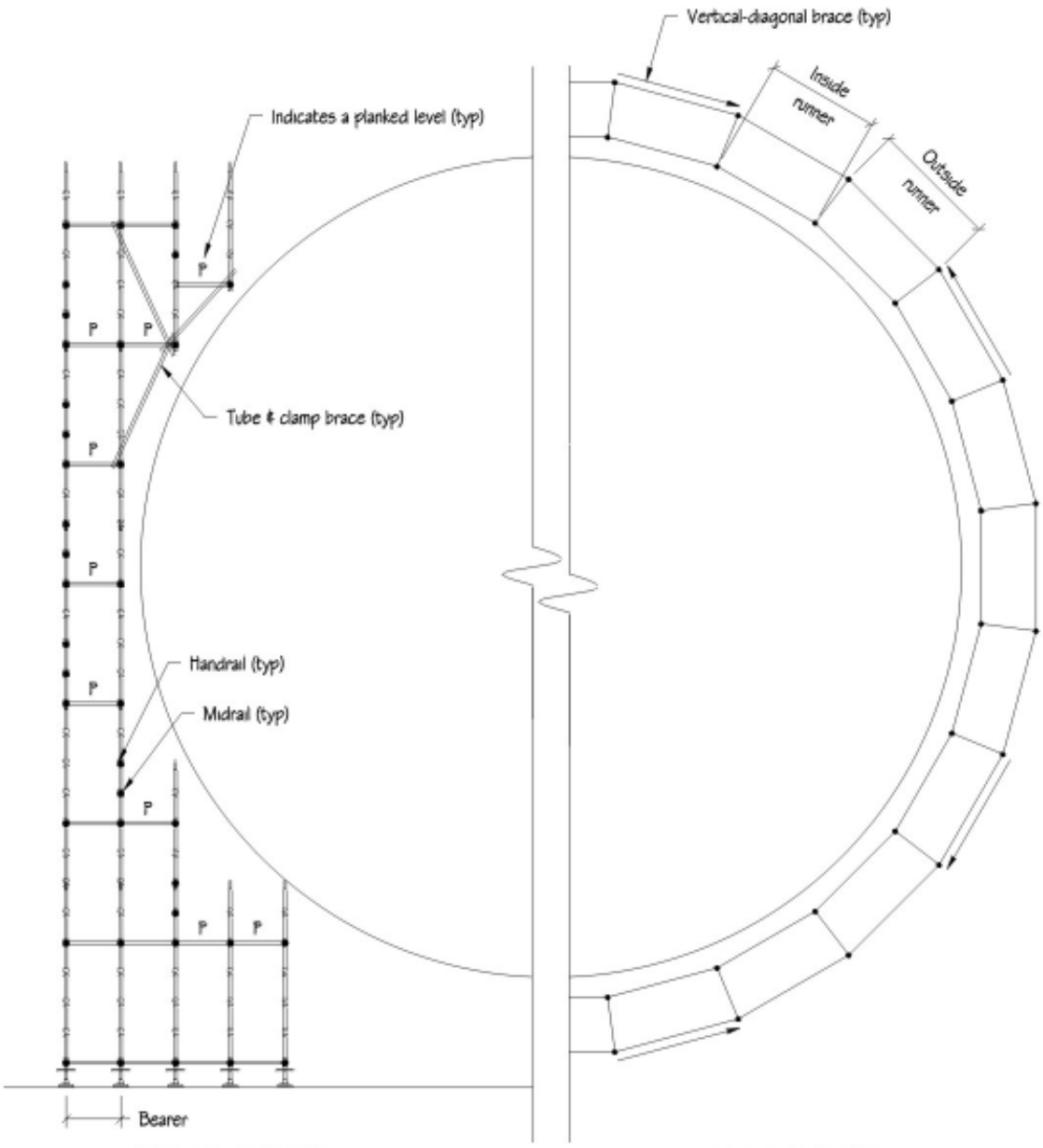
LOAD TEST SHSORING - ZONE 5

SHEET 3 OF 3









NOTE:
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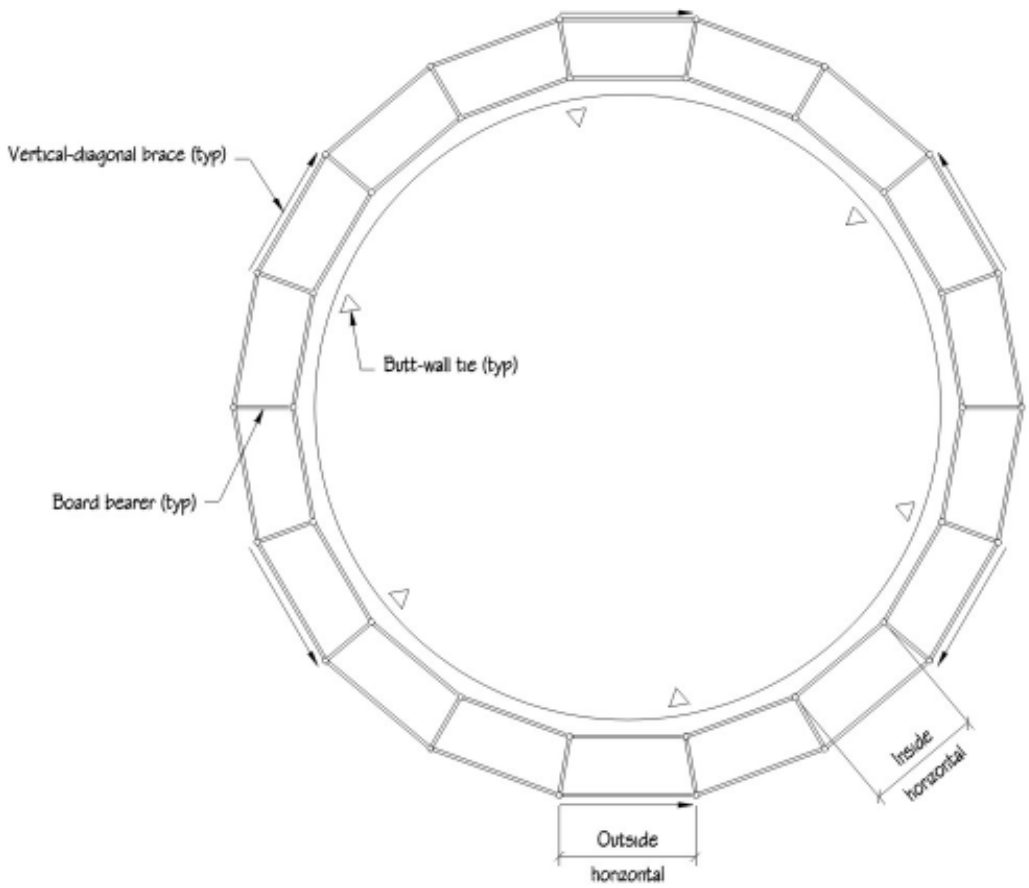
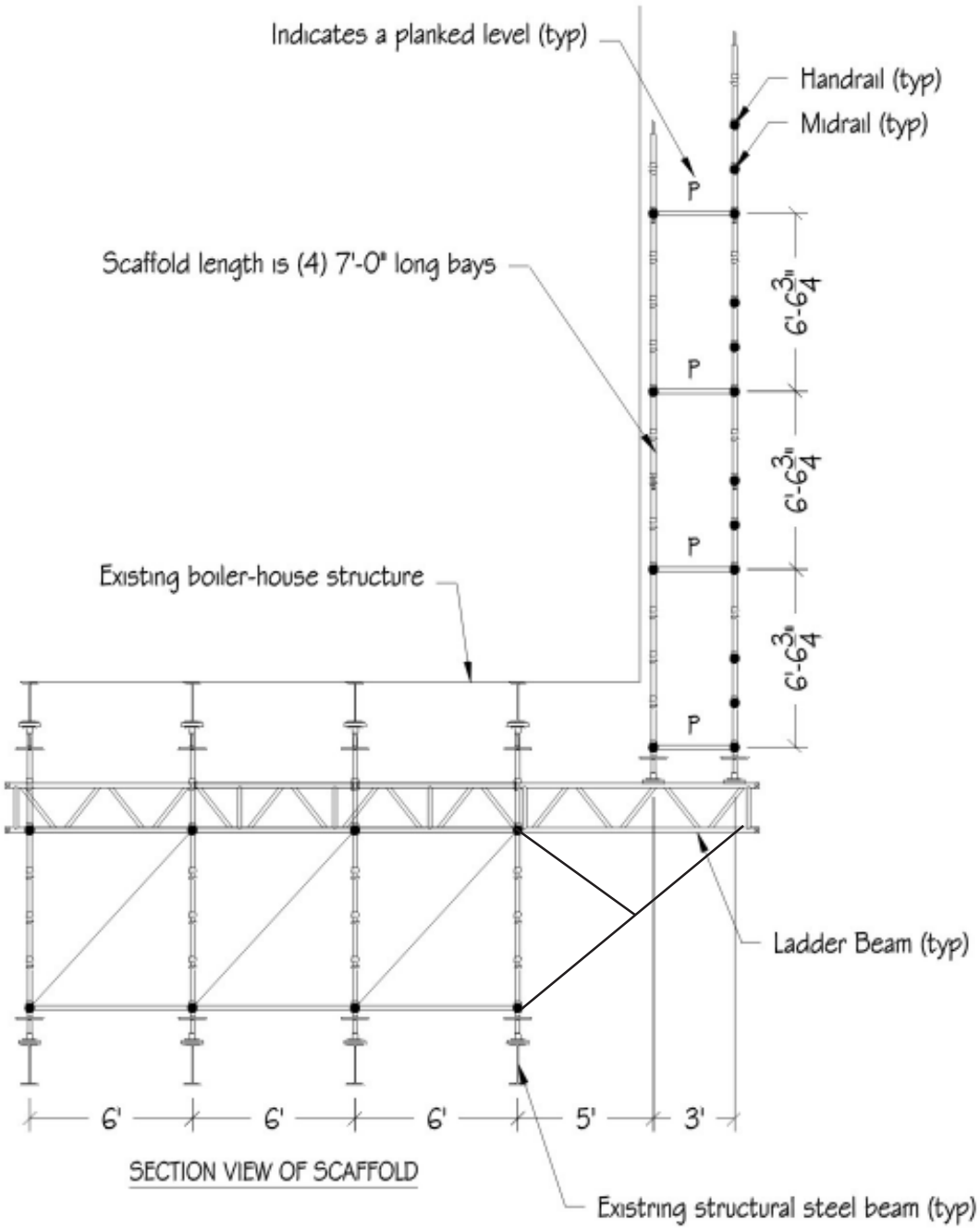


PLAN VIEW OF SCAFFOLD

NOTE:
THIS DRAWING IS FOR ILLUSTRATION PURPOSES ONLY. NOT TO BE USED FOR CONSTRUCTION



SECTION VIEW OF SCAFFOLD

NOTE:
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INTRODUCTION TO OSHA AND TRAINING REQUIREMENTS

It is up to all of us, company owners, managers, supervisors, foreman, and employees, to ensure safe work practices are followed. Federal, state, and local governments have enacted various regulations, codes, rules, and guidelines identifying the responsibilities for ensuring a safe work environment. Since the primary focus of this course is regulatory compliance, this Information Sheet begins with a basic explanation of the OSHA book and specific excerpts from the General Safety and Health Provisions as specified in Subpart C of OSHA regulation 1926.

The General Duty clause of the OSHA Act states that each employer "shall furnish...a place of employment which is free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees." The Act also states that both employers and *employees* are required by law to comply with all rules and regulations.

OSHA REGULATION 29 CFR 1926

OSHA regulation "1926" is the name for the book of regulations which govern the safety and health requirements for the construction industry. This book is also referred to as a "standard". The "1926" book of regulations is divided by topics into subparts indicated by letter (A, B, C, D, etc.) For example, Subpart L is scaffolding, Subpart P is excavations, etc. There is also a numeric system which runs through the book from the first regulation to the last, starting with 1926.01, 1926.02, etc., and so forth to the end of the book, 1926.1000+. Subpart C (1926.20 through 1926.32) can be found in the front of the regulation. It covers some very general guidelines that apply to a wide variety of work activities. Excerpts from subpart C, relating to this course of instruction, follow.

EXCERPTS FROM 29 CFR PART 1926 SUBPART C GENERAL SAFETY AND HEALTH PROVISIONS

§1926.20 General safety and health provisions.

(b) Accident prevention responsibilities. (1) It shall be the responsibility of the employer to initiate and maintain such programs as may be necessary to comply with this part.

Subpart (b)(1) requires the employer to develop and implement a safety program to comply with all OSHA regulations.

(2) Such programs shall provide for frequent and regular inspections of the job sites, materials, and equipment to be made by competent persons designated by the employers.

Subpart (b) (2) is the initial requirement for the employer to designate "competent persons" to make regular inspections to eliminate any hazards. OSHA also repeats the competent person requirement in most of the specific sections such as scaffolding, excavations, abatement, etc.

§1926.21 Safety training and education

(b) Employer responsibility. (1) The employer should avail himself of the safety and health training programs the Secretary provides.
(2) <u>The employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to illness or injury.</u>

This clause is extremely important. It specifies that the employer has the responsibility to ensure a worker is trained in the safe work practices and the regulations that apply to the work activity. All other specific training requirements listed in the regulation supplement this overall requirement. This is also one of the most frequently cited provisions found in OSHA inspection reports.

§1926.32 Definitions.

The following definitions shall apply in the application of the regulations in this part:
(a).....
(f) <u>"Competent person" means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.</u>

Note that there are two parts to the definition of a competent person. First, the competent person must have the ability to recognize hazards associated with the activity. To have this ability, the competent person must be thoroughly trained in the safe procedures, OSHA regulations, and other safety practices associated with the activity. A person must first know the *safe* way to do the job before that person can recognize if it is being done the *unsafe* way. Second, the competent person should have the authority to eliminate the hazard, even if that requires stopping the work activity until the hazard can be corrected. This authority can only come from the employer.

(l) <u>"Qualified" means one who by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the project.</u>

OSHA uses this term in the standard in that all scaffolds must be designed by a qualifiedperson. An example would be as follows: A qualified person may design and plan a scaffolding project, but may not be present during erection. However, a competent person must be present to supervise the erection once the project begins. In other cases, both requirements could be met by the same person.

Note that the qualified person does not have to be a degreed individual such as an engineer, but must simply have adequate expertise for that particular project. As an example, if the scaffold being constructed was only a one section tall frame scaffold for the

purpose of changing a light bulb, then the qualified person need only have adequate knowledge of the procedures for planning a one section high scaffold job, (which obviously is not very extensive). On the other hand, if the scaffold being constructed is a 125' tall tower for a petrochemical plant vessel or power plant boiler, the qualified person must be a registered engineer.

(m) "Safety factor" means the ratio of the ultimate breaking strength of a member or piece of equipment to the actual working stress or safe load when in use.

All supported scaffolds must be constructed with a safety factor of 4:1. Adherence to the OSHA regulations for proper assembly and use which we will cover in this course will automatically result in at least this much of a safety factor.

(p) "Shall" means mandatory.

(q) "Should" means recommended.

This concludes the summary of some basic terms, definitions, and requirements found in Subpart C of the 1926 construction regulation standard which have relevance to this course of instruction. The next part covers the scaffolding subpart.

SUBPART L SCAFFOLDING

On August 30, 1996 OSHA promulgated a new scaffolding standard. This standard is divided into six main parts.

1926.450 contains the definitions applicable to scaffolds.
1926.451 contains general requirements for all types of scaffolds.
1926.452 contains additional specific requirements (vertical standards) for specific types of scaffolds (i.e. fabricated frame, tube & coupler, etc.)
1926.453 contains requirements for aerial lifts.
1926.454 contains training requirements for employees using and building scaffolds.
Appendices A-E are located after 1926.454 and contain non-mandatory guidelines, technical information, tables, and diagrams to assist in understanding and complying with 1926.450 through 1926.454.

This information sheet continues with an analysis of 1926.454: training requirements.

§ 1926.454 Scaffold Training requirements.

This section supplements and clarifies the requirements of § 1926.21(b)(2) as these relate to the hazards of work on scaffolds.

(a) The employer shall have each employee who performs work while on a scaffold trained by a person qualified in the subject matter to recognize the hazards associated with the type of scaffold being used and to understand the procedures to control or minimize those hazards. The training shall include the following areas, as applicable:

(1) The nature of any electrical hazards, fall hazards and falling object hazards in the work area;
(2) The correct procedures for dealing with electrical hazards and for erecting, maintaining, and disassembling the fall protection systems and falling object protection systems being used;
(3) The proper use of the scaffold, and the proper handling of materials on the scaffold;
(4) The maximum intended load and the load-carrying capacities of the scaffolds used; and
(5) Any other pertinent requirements of this subpart.

The above subpart addresses the requirement for training those personnel who will be working on scaffold platforms, and mandates training for all scaffold users. It does not require that the users be fully trained in the construction of the scaffold. It is assumed that the scaffold has been properly erected by a trained crew under the supervision of a competent person, and that the scaffold has been inspected to ensure that it meets all safety requirements. The safety training for the user should cover the hazards that the user might encounter such as maximum allowable loads, falling objects, fall hazards, safe access, electrical hazards, and practices not to engage in such as leaning over the handrails, jumping onto the platform, etc. The Scaffold Training Institute offers a separate course designed specifically for scaffold users.

(**b) The employer shall have each employee who is involved in erecting, disassembling, moving, operating, repairing, maintaining, or inspecting a scaffold trained by a competent person to recognize any hazards associated with the work in question. The training shall include the following topics, as applicable:**

(1) The nature of scaffold hazards;
(2) The correct procedures for erecting, disassembling, moving, operating, repairing, inspecting, and maintaining the type of scaffold in question;
(3) The design criteria, maximum intended load-carrying capacity and intended use of the scaffold;
(4) Any other pertinent requirements of this subpart.

The above subpart addresses the requirement for training scaffold builders and those employees who might modify, repair, maintain, or inspect scaffolds. This training has always been required by 1926.21(b)(2) in subpart C, prior to the passage of this new regulation. However, since it was not directly spelled out in the scaffold standard (subpart L) itself, it has unfortunately been often overlooked. This new requirement reinforces 1926.21(b)(2) and clarifies the training required. Appendix E of the new standard provides additional guidelines for this training and is reprinted below:

Non-Mandatory Appendix D to Subpart L— List of Training Topics for Scaffold Erectors and Dismantlers

This Appendix D is provided to serve as a guide to assist employers when evaluating the training needs of employees erecting or dismantling supported scaffolds.
The Agency believes that employees erecting or dismantling scaffolds should be trained in the following topics:

· General Overview of Scaffolding

· regulations and standards
· erection/dismantling planning
· PPE and proper procedures
· fall protection
· materials handling
· access
· working platforms
· foundations
· guys, ties and braces

· Tubular Welded Frame Scaffolds

· specific regulations and standards
· components
· parts inspection
· erection/dismantling planning
· guys, ties and braces
· fall protection
· general safety
· access and platforms
· erection/dismantling procedures
· rolling scaffold assembly
· putlogs

· Tube and Clamp Scaffolds

· specific regulations and standards
· components
· parts inspection
· erection/dismantling planning
· guys, ties and braces
· fall protection

• general safety
· access and platforms
· erection/dismantling procedures
· buttresses, cantilevers, & bridges

· System Scaffolds
· specific regulations and standards
· components
· parts inspection
· erection/dismantling planning
· guys, ties and braces
· fall protection
· general safety
· access and platforms
· erection/dismantling procedures
· buttresses, cantilevers, & bridges

Scaffold erectors and dismantlers should all receive the general overview, and, in addition, specific training for the type of supported scaffold being erected or dismantled.

End of Appendix D

After training has been completed for a period of time, retraining will be required. 1926.454(c) gives requirements for retraining as follows:

(c) When the employer has reason to believe that an employee lacks the skill or understanding needed for safe work involving the erection, use or dismantling of scaffolds, the employer shall retrain each such employee so that the requisite proficiency is regained. Retraining is required in at least the following situations:

(1) Where changes at the worksite present a hazard about which an employee has not been previously trained; or
(2) Where changes in the types of scaffolds, fall protection, falling object protection, or other equipment present a hazard about which an employee has not been previously trained; or
(3) Where inadequacies in an affected employee's work involving scaffolds indicate that the employee has not retained the requisite proficiency.

This concludes the portion of this information sheet addressing training requirements.

ADDITIONAL USER TRAINING TOPICS

The information covered in the next section (pages 43 through 70) provides supplemental training for scaffold USERS. Many of the USER topics required by 1926.454(a) were covered by other sections of this manual, which should have already been completed. The next sections provide additional training on the topics of electrical safety, material handling, and unsafe work practices.

ENABLING OBJECTIVE 01

01 Determine the nature of Electrical Hazards and the use of Electrical hazard protection on Frame, Rolling Towers, Tube & Clamp, and System Scaffold.

LEARNING STEPS

1. Read Information Sheet CPSUP/ 01/01, "Determine the nature of Electrical Hazards and the use of Electrical hazard protection on Frame, Rolling Towers, Tube & Clamp and System Scaffold.

2. Check with your instructor/trainer if you have any questions concerning the material contained in the Information Sheet. This helps to clarify any misconceptions that you may have before attempting to answer the questions in the Self-Check.

3. Complete the Self-Check CPSUP/01/01, "Determine the nature of Electrical Hazards and the use of Electrical hazard protection on Frame, Rolling Towers, Tube & Clamp and System Scaffold." Use the Self-Check to assess your understanding of the content of the Information Sheet.

4. Check with the instructor/trainer if you have any questions concerning the questions contained in the Self-Check.

5. After completing the Self-Check read the Learning Steps for Information Sheet CPSUP/01/02, "Determine the nature of Material Handling Hazards and proper Material Handling on Frame, Rolling Towers, Tube & Clamp and System Scaffold."

INFORMATION SHEET CPSUP/01/01

TITLE: Determine the nature of Electrical Hazards and the use of Electrical hazard protection on Frame, Rolling Towers, Tube & Clamp, and System Scaffold.

INTRODUCTION

The use of electricity is so common that we take it for granted. Everyone who erects, works on, or dismantles scaffolding must be conscious of Electrical Hazards. They must also understand how to protect themselves and others against the inherent dangers of electricity. This Information Sheet provides general and specific safety guidelines for working with or around electrical equipment while on or near scaffolding.

NOTE: The electrical safety guidelines presented in this Information Sheet are not in tended to be all inclusive, since the type of equipment used, field conditions, and work requirements differ with each job site. Always follow OSHA regulations and other Fed eral, State, and Local electrical safety codes applicable to your location.

ELECTRICAL HAZARDS

The most common electrical hazards are shock, burns, arc-blasts, fires, and explosions. Shock occurs when part of the body becomes part of an electrical circuit. Current enters the body at the point of contact and exits by the most direct route to ground. Shocks from high-voltage lines are the most serious, causing severe burns or death.

Burns attributable to contact with electricity usually occur on the hands. These type burns are a result of a person touching improperly maintained or improperly grounded electrical wiring or equipment.

The opening or closing of high-amperage circuits can result in an arc-blast if the current jumps from one conductor to another through the air. Another way arc-blasts occur is through a discharge of static electricity. If arcing occurs in an environment saturated with an explosive mixture, a fire or explosion may result.

Fires and explosions can also occur with low voltage and low amperage currents if the environment contains explosive vapors. In this type of environment the arcing that occurs when a switch or power tool is turned on may be all that is needed to ignite a fire or cause an explosion.

ELECTRICAL SAFETY GUIDELINES: GENERAL

The federal guidelines contained in this Information Sheet have been extracted from CFR 1926.301, 351, 352, 400, 404, 405, 416, and 417. Scaffold erectors, users, and dismantlers are responsible for complying with the standards contained in this regulation as well as all other applicable codes standards regulations, and common sense practices established to promote electrical safety. Employers have the responsibility for ensuring that all personnel are trained in safe electrical work practices and procedures and provide hazard-free equipment and work environment.

WARNING: *SERIOUS INJURY OR DEATH CAN RESULT FROM IMPROPER USE OF ELECTRICAL EQUIPMENT WHILE PERFORMING WORK ACTIVITIES FROM SCAFFOLDING. ALWAYS BE ALERT FOR ELECTRICAL HAZARDS AND FOLLOW SAFE WORK PRACTICES AND PROCEDURES.*

ELECTRICAL SAFETY GUIDELINES: SPECIFIC

The following guidelines have been extracted from CFR 1926 and are provided to help avoid electrical hazards that may be encountered on the job site when working on or around scaffolding.

1. Requirements for erecting, using, or dismantling scaffolds near powerlines.

   a. The clearance between scaffolds and power lines shall be as follows:
      - Scaffolds shall not be erected, used, dismantled, altered, or moved such that they or any conductive material handled on them might come closer to exposed and energized power lines than as indicated in the chart that follows:

Insulated lines voltage	Minimum distance	Alternatives
Less than 300 volts	3 feet (0.9 M)	
300-50 kv	10 feet (3.1 M)	
More than 50 kv	10 feet (3.1 M) plus .4 inches (10 cm) for each 1 kv over 50 kv	2 times the length of the line insulator, never less than (3.1 M)
but 10 feet		

Uninsulated lines voltage	Minimum distance	Alternatives
Less than 50 kv	10 feet (3.1 M)	
More than 50 kv	10 feet (3.1 M) plus .4 inches (10 cm) for each 1 kv over 50 kv.	2 times the length of the line insulator, never less than (3.1 M)
but 10 feet		

- Scaffolds and materials may be closer to power lines than specified above where such clearance is necessary for the performance of work, and only after the utility company or electrical system operator has been notified of the need to work closer and the utility company or electrical system operator has deenergized the lines, relocated the lines, or installed protective coverings to prevent accidental contact with the lines.

2. The equipment types identified below must be properly grounded: (CFR 1926.405)

   a. Hand held motor operated tools.
   b. Cord- and plug-connected equipment used in damp or wet locations or by personnel standing on the ground or on metal floors or working inside metal tanks or boilers and scaffolds.
   c. Portable or mobile x-ray and associated equipment.
   d. Tools likely to be used in wet and/or conductive locations need not be grounded if supplied through an isolating transformer with an ungrounded secondary of not over 50 volts. Listed or properly labeled portable tools protected by a system of double insulation, or its equivalent need not be grounded. If such a system is employed, the equipment shall be distinctively marked to indicate that tool or appliance uses a system of double insulation.
   e. Portable hand lamps.
   f. The metal parts of nonelectrical equipment such as the tracks and frames of electri cally operated cranes and hoists used on scaffolding for material handling.

3. Requirements for components, and general uses equipment: (CFR 1926.405)

   a. All lamps for general illumination shall be protected from accidental contact or breakage. Metal-case sockets shall be grounded.
   b. Temporary lights shall not be suspended by their electrical cords unless cords and l ights are designed for this means of suspension.
   c. Portable electrical lighting used in wet and/or conductive locations, as for example, drums, tanks, and vessels shall be operated at 12 volts or less. However, 120 volt lights may be used if protected by a ground-fault circuit interrupter (GFCI)
   d. Flexible cords and cables shall be protected from damage. Sharp corners and projections shall be avoided. Flexible cords and cables may pass through doorways or other pinch points, if protection is provided to avoid damage.
   e. Extension cord sets used with portable electric tools shall be of three-wire type and shall be designed for hard or extra-hard usage. Flexible cords used in temporary and portable lights shall be designed for hard or extra-hard usage.

NOTE: The National Electrical Code, ANSI/NFPA 70, in Article 400, Table 400-4 lists various types of flexible cords, some of which are noted as being designed for hard or extra-hard usage. Examples of these type of cords include hard service cord (types S, ST, SO, STO) and junior hard service cord (types SJ, SJO, SJT, SJTO).

NOTE: Ground Fault Circuit Interrupters should always be used with Electrical Equipment on Scaffolds.

4. Standards for power operated hand tools: CFR 1926.302, CFR 1910.244(b)

a. Electric power operated hand tools shall either be of approved double-insulated type or grounded in accordance with CFR 1926.405 Subpart K.
b. The use of electrical cords for hoisting or lowering tools shall not be permitted.

5. Standards for arc welding and cutting: CFR 1926.351

a. Only manual electrode holders which are specifically designed for arc welding and cutting, and are of a capacity capable of safely handling the maximum rated current required by the electrodes, shall be used.

- Any current-carrying parts passing through the portion of the holder which the arc welder or cutter grips in his hand, and the outer surfaces of the jaws of the holder, shall be fully insulated against the maximum voltage encountered to ground.

b. All arc welding and cutting cables shall be of the completely insulated, flexible type, capable of handling the maximum current requirements of the work in progress, taking into account the duty cycle under which the arc welder or cutter is working.
c. Only cable free from repair or splices for a maximum distance of 10 feet from the cable end to which the electrode holder is connected shall be used, except that cables with standard insulated connectors or with splices whose insulating quality is equal to that of the cable are permitted.

- When it becomes necessary to connect or splice lengths of cable one to an other, substantial insulated connectors of a capacity at least equivalent to that of the cable shall be used. If connections are effected by means of cable lugs, they shall be securely fastened together to give good electrical contact, and the exposed metal parts of the lugs shall be completely insulated.
- Cables in need of repair shall not be used. When a cable, other than the cable lead referred to above, becomes worn to the extent of exposing bare connec tors, the portion thus exposed shall be protected by means of rubber and friction tape or other equivalent insulation.

d. Ground return cables shall have a safe current carrying capacity equal to or ex ceeding the specified maximum output capacity of the arc welding or cutting unit which it serves. When a single ground return cable services more than one unit, it's safe current-carrying capacity shall equal or exceed the total specified maxi mum output capacities of all units which it serves.

- Pipelines containing gases or flammable liquids, or conduits containing electri cal circuits, shall not be used as a ground return. For welding on natural gas pipe lines, the technical portions of the Department of Transportation, office of Pipe line Safety, 49 CFR Part 192, minimum Federal Safety Standards for Gas Pipe lines, shall apply.
- When a structure or pipeline is employed as a ground return circuit, it shall be determined that the required electrical contact exists at all joints. The genera tion of an arc, sparks, or heat at any point shall cause rejection of the structures as a ground circuit.

- When a structure or pipeline is continuously employed as a ground return circuit, all joints shall be bonded, and periodic inspections shall be conducted to ensure that no electrolysis or fire hazard exists by virtue of such use.
- The frames of all arc welding and cutting machines shall be grounded either through a third wire in the cable containing the circuit conductor or through a separate wire which is grounded at the source of the current. Grounding cir cuits, other than by means of the structure, shall be checked to ensure that the circuit between the ground and the grounded power conductor has resistance low enough to permit sufficient current to flow to cause the fuse or circuit breaker to interrupt the current.
- All ground connections shall be inspected to ensure that they are mechanically strong and electrically adequate for the required circuit.

e. Employers shall instruct employees in the safe means of arc welding and cutting in the following areas.

- When electrode holders are to be left unattended, the electrodes shall be removed and the holders shall be so placed or protected so that they cannot make electrical contact with employees or conducting objects.
- Hot electrode holders shall not be dipped in water; to do so may expose the arc welder or cutter to electrical shock.
- When the arc welder or cutter has occasion to leave his work or to stop work for any appreciable length of time, or when the arc welding or cutting machine is to be moved, the power supply switch to the equipment shall be opened.

6. The following arc welding and cutting standards focus on fire prevention: CFR 1926.352

a. If an object to be welded, cut , or heated cannot be moved and if all the fire haz ards cannot be removed, positive means shall be taken to confine the heat, sparks, and slag, and to protect the immovable fire hazard from them.

b. No welding, cutting, or heating shall be done where the application of flammable compounds, or heavy duct concentrations creates a hazard.

c. Suitable fire extinguishing equipment shall be immediately available in the work area and shall be maintained in a state of readiness for instant use.

d. When the welding, cutting, or heating operation is such that normal fire prevention precautions are not sufficient, additional personnel shall be assigned to guard against fire while the actual welding, cutting, or heating operation is being per formed, and for a sufficient period of time after completion of the work to ensure that no possibility of fire exists. Such personnel shall be instructed as to the specific anticipated fire hazards and how the firefighting equipment provided is to be used.

SUMMARY

Electricity can be dangerous and deadly if you are unaware of its' potential hazards. This Information Sheet provided the common hazards associated with electricity and some general and specific guidelines for working with or around electrical equipment while on or near scaffolding. More often than not there are no second chances with electricity; treat it with the respect it deserves and practice sound work habits. This will help ensure a safe workplace for everyone.

SELF-CHECK CPSUP/01/01

TITLE: Determine the nature of Electrical Hazards and the use of Electrical hazard protection on Frame, Rolling Towers, Tube & Clamp, and System Scaffold.

DIRECTIONS:

This self check will help you evaluate your understanding of the information presented in this Information Sheet, CPSUP/01/01, " Determine the nature of Electrical Hazards and the use of Electrical hazard protection on Frame, Rolling Towers, Tube & Clamp and System Scaffold." Read each of the following questions carefully. Choose the BEST answer for each one. Place your answer in the space provided. After you have completed the Self-Check, compare your answers with those listed in the Self Check Answer Key immediately following the Self -Check. If you missed any question, review the Information Sheet and check with your instructor before going on. After you have correctly answered all questions, move on to the next Information Sheet, CPSUP/01/02 "Determine the nature of Material Handling hazards and proper Material Handling for Frame, Rolling Towers, Tube & Clamp and System Scaffold".

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QUESTIONS:

____ 1. Which of the following causes the most serious electrical shock?

a. Low-voltage lines.
b. High-voltage lines.
c. Series circuits
d. Parallel circuits.

____ 2. Which of the following electrical hazards results from current jumping from one conductor to another through the air when a high-amperage circuit is opened or closed?

a. Arc-blast
b. Burn
c. Shock
d. Fire

____ 3. The minimum distance scaffolds should be erected, used, dismantled, altered, or moved near an insulated power line with a voltage less than 300 volts is:

a. 10 feet.
b. 10 feet 4 inches.

c. 7 feet.
d. 3 feet.

____ 4. The minimum distance scaffolds should be erected, used, dismantled, altered, or moved near an uninsulated power line with a voltage less than 50 kv is:

a. 10 feet 4 inches
b. 10 feet.
c. 7 feet.
d. 3 feet.

.

____ 5. What is the alternative to the minimum distance scaffolds should be erected, used, dismantled, altered, or moved near an insulated or uninsulated power line with a voltage more than 50 kv?

a. The length of the line insulator, but never less than 10 feet.
b. The length of the line insulator, but never less than 3 feet.
c. 2 times the length of the line insulator, but never less than 10 feet.
d. 2 times the length of the line insulator, but never less than 3 feet.

____ 6. When can a scaffold be moved closer than the minimum distance to a power line?

a. When the personnel erecting, using, dismantling, or altering the scaffold are equipped with the proper personal protective equipment.
b. When the supervisor has surveyed the area and determined that the potential danger is minimal.
c. When it is necessary for personnel using the scaffold to perform work activities.
d. When the utility company or electrical system operator has deenergized the lines, relocated the lines, or installed protective coverings on the lines.

____ 7. When is the grounding of tools likely to be used in wet and/or conductive locations not required?

a. Grounding is not required if supplied through an isolating transformer with an ungrounded secondary of not over 50 volts.
b. Grounding is not required if tools are properly labeled indicating that they are protected by a system of double insulation, or its equivalent.
c. Grounding is always required.
d. Both a and b.

____ 8. What is the required voltage for portable electrical lighting used in wet and/or conductive locations?

a. 12 volts or less
b. 24 volts
c. 110 volts
d. 220 volts

____ 9. When can extension cord sets be used with portable electric tools from scaffolding?

a. Extension cord sets can be used when they are designed for hard or extra-hard usage.
b. Extension cord sets can be used when they are the three-wire type.
c. Both a and b.
d. None of the above.

____ 10. In which of the following areas are employers required to instruct employees regarding arc welding and cutting requirements?

a. The proper methods for splicing cable.
b. What to do when electrode holders are to be left unattended.
c. Cable inspection methods.
d. The use of a structure or pipeline as a ground return circuit.

SELF- CHECK CPSUP/01/01
ANSWER KEY

TITLE: Determine the nature of Electrical Hazards and the use of Electrical hazard protection on Frame, Rolling Towers, Tube & Clamp, and System Scaffold.

ANSWERS

1. b - High-voltage lines.

2. a - Arc-blast

3. d - 3 feet.

4. b - 10 feet.

5. c - 2 times the length of the line insulator, but never less than 10 feet.

6. d - When the utility company or electrical system operator has deenergized the lines, relocated the lines, or installed protective coverings on the lines.

7. d - Both a and b.

8. a - 12 volts

9. c - Both a and b.

10. b - What to do when electrode holders are to be left unattended.

ENABLING OBJECTIVE 02

02 Determine the nature of Material Handling Hazards and proper Material Handling on Frame, Rolling Towers, Tube & Clamp, and System Scaffold.

LEARNING STEPS

1. Read Information Sheet CPSUP/ 01/02, "Determine the nature of Material Handling Hazards and proper Material Handling on Frame, Rolling Towers, Tube & Clamp, and System Scaffold."

2. Check with your instructor/trainer if you have any questions concerning the material contained in the Information Sheet. This helps to clarify any misconceptions that you may have before attempting to answer the questions in the Self-Check.

3. Complete the Self-Check CPSUP/01/02, " Determine the nature of Material Handling Hazards and proper Material Handling on Frame, Rolling Towers, Tube & Clamp, and System Scaffold." Use the Self-Check to assess your understanding of the content of the Information Sheet.

4. Check with the instructor/trainer if you have any questions concerning the questions contained in the Self-Check.

5. After completing the Self-Check read the Learning Steps for Information Sheet CPSUP/01/03, "Determine the Prohibited User Actions for Frame, Rolling Towers, Tube & Clamp and System Scaffold."

INFORMATION SHEET CPSUP/01/02

TITLE: Determine the nature of Material Handling Hazards and proper Material Handling on Frame, Rolling Towers, Tube & Clamp, and System Scaffold.

INTRODUCTION

Everyone who erects, works on, or dismantles scaffolding performs material handling tasks at one time or another. These tasks may be performed manually or with the assistance of a mechanical device. Most material handling tasks are conducted without incidence, however, when a injury occurs it can be disabling to the worker and costly to the employer. Supervisors and workers must be aware of the potential hazards associated with Material Handling to avoid injuries. This Information Sheet identifies the hazards associated with material handling and guidelines for performing material handling activities properly while on or near scaffolding.

NOTE: The material handling guidelines presented in this Information Sheet are not in tended to be all inclusive, since each trade working on or around a scaffold may use differ ent types of equipment, supplies or materials, the field conditions my change, and the uniqueness of each job sites work requirements. Always follow OSHA regulations and all other Federal, State, and Local codes applicable to your location.

MATERIAL HANDLING HAZARDS

Material handling is the movement of supplies or materials necessary to perform work activities and is accomplished either manually or with the aid of a mechanical device. Employers are responsible for ensuring that workers are trained in the potential hazards of handling supplies and materials while on scaffolding (CFR 1926.454). However this does not remove the responsibility of the worker to remain alert and perform material handling tasks properly. Some of the hazards associated with material handling are overexertion, strains, cuts, broken bones, and falls.

NOTE: Falls are one of the more serious consequences of using improper material handling techniques. It is covered in more detail in USER Learning Guide 04, " Determine the nature of Fall Hazards and the use of Fall Protection Equipment of Frame, Rolling Tower, Tube & Clamp, and System Scaffolds." (Reference CFR 1926.503, Subpart M)

MATERIAL HANDLING SAFETY

The following guidelines for properly performing material handling tasks contained in this Information Sheet are common sense guidelines based on the material contained in CFR 1926. 250, 251, 451, and 454. Scaffold erectors, users, and dismantlers are responsible for complying with the standards contained in these regulations as well as all other applicable codes standards, and regulations, established to promote safe work practices.

WARNING: *SERIOUS INJURY CAN RESULT FROM PERFORMING MATERIAL HANDLING TASKS IMPROPERLY. ALWAYS BE ALERT FOR POTENTIAL HAZARDS WHEN PERFORMING MATERIAL HANDLING TASKS ON SCAFFOLDING.*

MATERIAL HANDLING SAFETY GUIDELINES

The following guidelines for moving supplies and equipment while on scaffolding are provide to help you avoid potentially serious injury when performing material handling tasks.

1. Supplies or materials packaged in bags, containers, or bundles should be stacked, blocked, and interlocked to avoid sliding or collapse.

2. Supplies and materials should be stacked to a height as low as practical.

3. Accessways should be kept clear of obstructions and free of dirt and debris to avoid a tripping hazard.

4. Combustible materials should be segregated from other supplies and materials.

5. The weight of supplies and materials on a scaffold should not exceed the intended load capacity of the scaffold.

6. Where supplies and materials are piled to such a height that a toeboard does not provide protection, paneling or screening from the floor to intermediate rail or top rail must be provided.

7. Barricades and signs should be used to warn personnel of the potential hazard of falling objects when supplies and materials are moved on or off the scaffold.

8. Netting should be installed directly under the scaffold level where supplies and materials are being moved.

9. Loose or light materials must be secured to prevent them from falling off the scaffold.

10. Containers should be provided to store or carry rivets, bolts, and other small objects. All containers must be secured from falling from the scaffold.

11. Prior to movement, all supplies and materials should be inspected for potential hazards such as, sharp edges, torn packaging, and splinters.

12. Cylindrical objects should be stacked and blocked to prevent spreading or tilting.

13. When handling material near electrical lines a designated person should be available to ensure the required clearance is maintained.

14. Proper personal protective equipment must be worn when performing material handling activities, these include but not limited to hard hats, safety shoes, safety glasses, gloves, back support, and fall protection equipment.

15. Be alert to wind forces when handling large light weight materials or long objects such as a squeegee pole.

16. Lumber used for work activities must be stacked so it is level and self-supporting.

17. The following guidelines should be followed when using a hoist, designed for use on a scaffold, in material handling activities.

a. Tielines should be used to guide the movement of loads on and off the scaffold.
b. Do not attempt to lift a load beyond the rated capacity of the hoist .
c. Do not use hoisting cables or chains to lift supplies and materials, use slings only.
d. Conduct periodic visual inspections of the hoist for signs of damage or wear.
e. Test hoist controls to ensure operability.
f. Never jerk controls when moving loads.
g. Know and use the proper hand signals for hoisting.
h. Do not leave loads suspended in the air unattended.

18. The guidelines below should be followed when performing manual material handling activities.

a. Ensure that you are wearing the proper personal protective equipment.
b. Size up the load. Do not attempt to lift a load alone if there is any doubt about the ability to do so.
c. Ensure that your footing is secure. You should have good balance with your feet 8 to 12 inches apart.
d. Place your feet close to the base of the object to be lifted. This is important because it prevent the back muscles from taking the full load.
e. Bend the knees and squat, don't stoop, keep your back straight and as vertical as possible. If necessary spread your knees or lower one knee to get closer to the object.
f. When ready to begin lifting push up with your legs. This action causes you to use the strongest set of muscles in your body. Keep the object as close to your body as possible as you lift the object.
g. Bring the object to the carrying position. If it is necessary to change direction, be careful not to twist the body. Turn your body with changes in foot position.

h. When putting the object down on the deck, lower it slowly, bending at the knees with your back as straight as possible. Release the object only when your sure it is securely on the deck.
i. If the object must be moved into place, always push, do not pull the object.

SUMMARY

According to the Department of Labor Statistics nearly 17 percent of all occupational injuries can be linked to poor material handling techniques. This statistic should not be taken lightly. More important than lost manhours and productivity, the injured worker is subjected pain, discomfort, and in severe cases, disability. This Information Sheet identified the hazards associated with performing material handling activities improperly and presented some common sense guidelines to follow when moving supplies and materials on scaffolding. Being alert to material handling hazards and practicing safe work habits will make the job site a safer place to work and help you to avoid unwanted injuries.

SELF-CHECK CPSUP/01/02

TITLE: Determine the nature of Material Handling Hazards and proper Material Handling on Frame, Rolling Towers, Tube & Clamp, and System Scaffold.

DIRECTIONS:

This self check will help you evaluate your understanding of the information presented in this Information Sheet, CPSUP/01/02, " Determine the nature of Material Handling and proper Material Handling on Frame, Rolling Towers, Tube & Clamp and System Scaffold.." Read each of the following questions carefully. Choose the best answer for each one. Place your answer in the space provided. After you have completed the Self-Check, compare your answers with those listed in the Self Check Answer Key immediately following the Self- Check. If you missed any question, review the Information Sheet and check with your instructor before going on. After you have correctly answered all questions, move on to the next Information Sheet, CPSUP/01/03.

QUESTIONS:

____ 1. Why should supplies or materials packaged in bags, containers, or bundles be stacked, blocked, and interlocked?

a. To avoid sliding or collapse.
b. To ensure easy access.
c. To ensure decks remain clear.
d. To avoid obstructions to accessways.

____ 2. When using a joist, what should be used to secure supplies and materials in preparation for moving them on or off a scaffold?

a. Wire rope
b. Hoist cables
c. Tielines
d. Slings

____ 3. When lifting an object why is it important to place your feet close to the base of the object to be lifted?

a. To be able to life more weight.
b. To prevent the back muscles from taking the full load.
c. To ensure proper balance.
d. To ensure a better grip.

SELF- CHECK CPSUP/01/02
ANSWER KEY

TITLE: Determine the nature of Material Handling Hazards and proper Material Handling on Frame, Rolling Towers, Tube & Clamp, and System Scaffold.

ANSWERS

1. a - To avoid sliding or collapse.

2. d - Slings

3. b - To prevent back muscles from taking full load.

ENABLING OBJECTIVE 03

03 Determine the Prohibited User Actions for Frame, Tube & Clamp, and System Scaffold.

LEARNING STEPS

1. Read Information Sheet CPSUP/ 01/03, "Determine the Prohibited User Actions for Frame, Tube & Clamp and System Scaffold.

2. Check with your instructor/trainer if you have any questions concerning the material contained in the Information Sheet. This helps to clarify any misconceptions that you may have before attempting to answer the questions in the Self-Check.

3. Complete the Self-Check CPSUP/01/03, "Determine the Prohibited User Actions for Frame, Tube & Clamp and System Scaffold." Use the Self-Check to assess your understanding of the content of the Information Sheet.

4. Check with the instructor/trainer if you have any questions concerning the questions contained in the Self-Check.

5. After completing the Self-Check read the Learning Steps for Information Sheet CPSUP01/03, you have completed the Supplemental User Training for the Competent Person/Scaffold Builder Course, and have covered all topics required for erection and use of Frame, Tube & Clamp and System Scaffold.

INFORMATION SHEET CPSUP/01/03

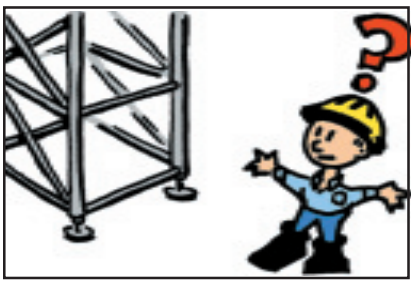
TITLE: Determine the Prohibited User Actions for Frame, Tube & Clamp, and System Scaffold.

INTRODUCTION

The scaffold must be inspected before use. This should have been done by a competent person and a tag should indicate the inspection date and time. Completed scaffolds must be inspected prior to each workshift. Do not use a scaffold that has not been inspected by a competent person at the start of that workshift. In addition, we recommend that the user do a visual inspection to make sure the obvious safety precautions are in place such as ladder access, full planking, guardrails, etc. See CP/01/05 for a complete inspection list. But even if the scaffold is properly erected and safe for use, there are many actions a user can take which create a hazard.

The following pages contain a list of several "Prohibited User Actions". These could also be called Unsafe Work Practices. This list of "Don't Do's" have a graphic attached to illustrate the prohibited action.

Do not work from a scaffold if it is not been inspected that workshift and is tagged as "Approved, Ready To Use". In addition, do a visual inspection for the obvious requirements such as ladder access, full planking, guardrails, plumbness, rigidity, etc.



Do not use a scaffold if it does not have a proper ladder or other equivalent safe means of access. Do not climb the scaffold itself.

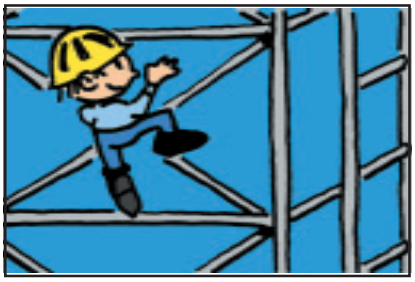
Do not use a scaffold if the working platform is not planked all the way across. Do not use a scaffold if only one or two planks are placed where there should be more.

Do not use a scaffold if the planks are not scaffold grade, bearing the proper grade stamp. If the planks are man made, make sure they are in good condition.

Do not use a scaffold if the planks are bowing more than 1/60 of their span.

Do not use a scaffold if it is not plumb, square, and rigid..

Do not use a scaffold taller than 4 times it's minimum base unless it is tied, guyed, or braced to prevent tipping.



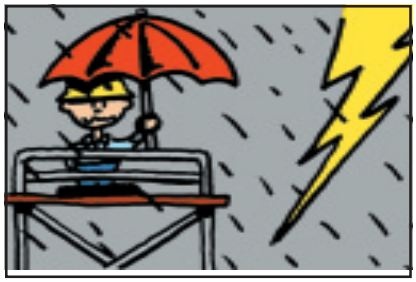
Do not climb the scaffold other than by the safe means of access provided. Never climb guardrails.

Do not work if you feel weak, sick, or dizzy. Never use drugs or alcohol on a scaffold.

Do not climb with slippery shoes.

Do not carry materials as you climb. Keep both hands on the siderails.

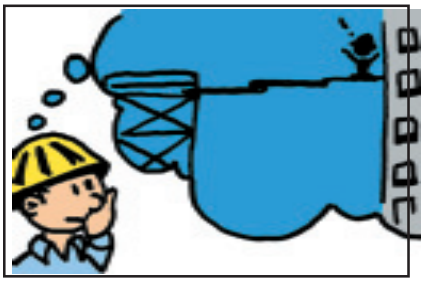
Do not jump on to planks or platforms.



Do not use scaffolds during storms, rain, or high wind. Note: OSHA does not define "high winds" as an exact wind speed. At one point OSHA had proposed 40 MPH as a limit to use a scaffold without additional precatuions such as wind screens or additional fall protection. However, 25 miles per hour is a more conservative starting good point to consider not using scaffolds without additional precautions. Most suspended scaffolds should not be used if winds are over 25 MPH. The final determination depends upon the type of scaffold and is up to the manufacturer and the end user.

Do not work on ice or snow covered platforms.

Do not allow tools, material, or debris to accumulate on the platforms and cause a hazard.



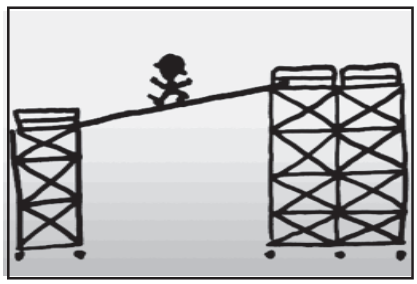
Do not alter the scaffold. Scaffold alterations may only be performed by a trained crew under the supervision of a competent person.

Do not use heat producing activities such as welding or insulation removal without taking precautions to protect the scaffold members.

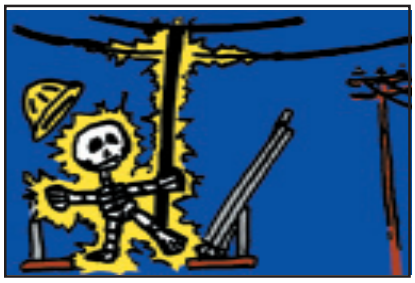
Do not work if you notice any components which are damaged.

Do not attempt to extend working heights by planking guard-rails or by the use of boxes or ladders on scaffold platforms.

Do not use scaffold as material hoist towers or for mounting derricks unless the scaffold is designed for such use.

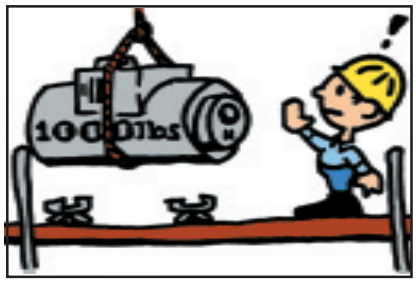


Do not bridge between towers with planks or stages unless the scaffold assembly has been designed for this use by a qualified person.

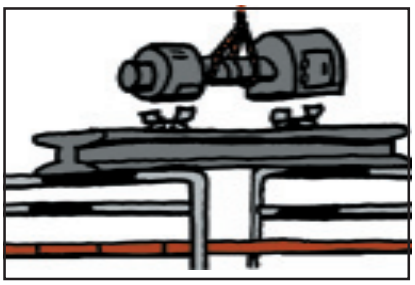


Do not violate clearances from electrical power lines as allow in 1926.451 (f)(6)

Do not overload the platform by more than it's intended uniform loading.

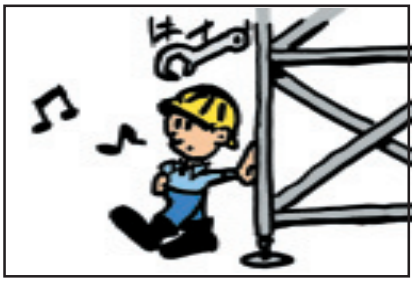


Do not overload the scaffold by point loading a plank above it's capacity.

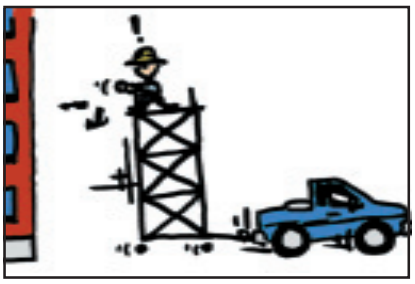


Do not overload a platform by point loading a tube above it's capacity.

Do not bridge between two scaffolds by stages unless designed by a qualified person.



Do not use the scaffold unless the proper falling object protection for the users and workers below has been provided.



Do not use rolling towers unless the wheels are locked.

Do not ride rolling towers while they are being moved.

Do not get up on a scaffold unless you have successfully completed this training.

SUMMARY

This information sheet contains a summation of many of the more common hazards that may be created by workers (users) on a scaffold. The particular emphasis is on those actions by the user which should not attempt. This is by no means a intended as a list of every possible user action that could create a hazard. The scaffold user must apply good sense and good safety judgement of a scaffold to all actions while on a scaffold. If you have any doubt about whether or not an activity is safe, consult your company safety director.

SELF-CHECK CPSUP/01/03

TITLE: Determine the Prohibited User Actions for Frame, Rolling Towers, Tube & Clamp and System Scaffold

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DIRECTIONS:

This Self-Check will help you validate your understanding of the information presented in this Information Sheet, CPSUP/01/03, "Determine the Prohibited User Actions for Frame, Rolling Towers, Tube & Clamp and System Scaffold." Read each of the following questions carefully. Choose the BEST answer for each one. Place your answer in the space provided. After you have completed the Self-Check, compare your answers with those listed in the Self-Check Answer Key immediately following the Self-Check. If you scored less than 100%, review the information on the question(s) you missed, then check with your instructor.

QUESTIONS:

____ 1. The user should not use the scaffold unless an approved tag indicates inspection has been performed:

a. within the last 30 days.
b. when it was completed.
c. that same workshift.
d. within the last .

____ 2. The user should access the platform by:

a. climbing the cross braces.
b. applying right angle clamps on the posts with palm up every 18".
c. climbing the rosettes on system scaffold.
d. using a properly installed access ladder.

____ 3. Scaffold platforms should be planked:

a. all the way across.
b. at least 18" of the span.
c. as much as obstructions will allow
d. with aluminum planks onlyan activity is safe, consult your company safety director.

____ 4. Scaffolds should be tied back to prevent tipping if the height is more than:

a. six times the minimum base width.
b. five times the minimum base width.
c. four times the minimum base width.
d. two times the minimum base width.

____ 5. Planks should not bow more than:

a. 1/5 of their span.
b. 1/20 of their span.
c. 1/40 of their span.
d. 1/60 of their span.

.

____ 6. The user should make alterations to the scaffold:

a when necessary for safe work performance.
b. as necessary to increase production.
c. only under the supervision of a competent person and if the user has been trained in scaffold erection.
d. when a scaffold member is in the way.

____ 7. Tools, material, and debris should not accumulate :

a. more than a 36" step across.
b. to cause a hazard.
c. higher than the midrail.
d. up to the guardrail.

____ 8. Scaffold platform height should be increased by:

a. the use of heavy duty aluminum ladders only.
b. step ladders.
c. placing scaffold grade planks across the guardrails.
d. having the scaffold erected higher by a trained crew.

SELF-CHECK CPSUP/01/03

TITLE: Determine the Prohibited User Actions for Frame, Rolling Towers, Tube & Clamp and System Scaffold

ANSWERS

1. c - that same workshift.

2. d - using a properly installed access ladder.

3. a - all the way across.

4. c - four times the minimum base width.

5 d - 1/60 of their span.

6. c - only under the supervision of a competent person and if the user has been trained in scaffold erection.

7. b - to cause a hazard.

8. d - having the scaffold erected higher by a trained crew.
