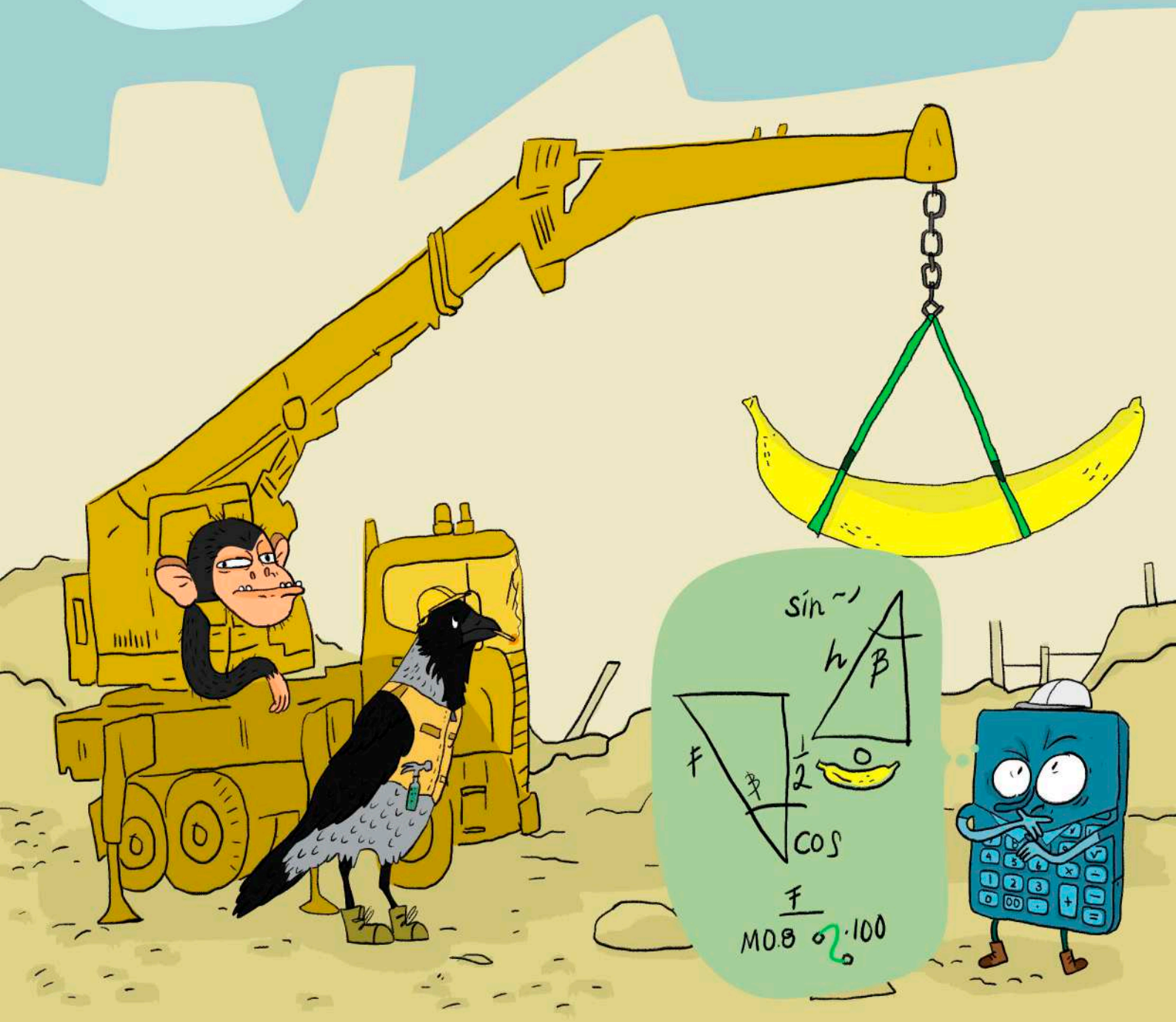
Close the hooks

Lifting Work – A Rookie’s Introduction



Mikko Tourunen

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1 Foreword

The original idea was to create a guide aimed solely at those working as so-called *riggers*, especially beginners in that role.
But I've found it necessary to broaden the target audience slightly.
Lifting operations always involve three parties, with riggers being just one of them.
The other two are crane operators and site supervisors.
And there are rookies in each of these groups — not just among the riggers.
There's a common misconception that only riggers are the untrained bunch.
If you only knew how poorly equipped fresh crane operators often are when they arrive on site straight from their crane certification courses, you'd be afraid to stand under a load they're lifting.
The theoretical requirements are laughably low: the operator must be able to sign their name in a logbook and tell a crane apart from a bicycle.
You should expect nothing more from a brand-new crane operator.

And what about those brilliant site supervisors? Since they're often called "foremen," you might assume they know what they're doing when it comes to lifting.
But in the universities of applied sciences (AMK), where they earn their qualifications, lifting operations are not covered — neither in theory nor in practice.
So when you see a baby-faced, fresh-out-of-school foreman walking around your job site, **do not**, under any circumstances, go asking them for advice on how a lift should be carried out.
They have an unfortunate tendency: they can't admit their own ignorance. Instead, they'll bluff and pretend to be experts, throwing out guessed instructions on how to proceed.
This has led to some rather "interesting" situations on real construction sites.

Instead, look for someone who appears experienced, and ask them instead.
And there's absolutely nothing wrong with asking someone how long they've been working in lifting.
If it's less than five years, I classify them as a rookie.
Especially when it comes to crane operators — always ask about their experience.
If they're on their first job site, you'd do well to keep a little extra distance once the load lifts off.

Nowadays, riggers are often required to take some sort of crash course before they're allowed to work under the hook.
That's a good direction to go, but the implementation is still in its infancy.

Often these inductions are led by a foreman who doesn't know a thing about lifting — or by a newly certified operator, who also knows nothing (even though both probably *believe* they're omniscient masters of the trade).
Yes, this really happens — it's not just my cynicism talking.
It's much like that ridiculous safety card training: the last time I attended, the instructor was a nightclub bouncer who had never set foot on a job site, and yet he was tasked with teaching construction professionals how to work safely.

Even if you get lucky and your rigger training is led by someone who actually knows lifting, there's just *too much* material to cram into a 30-minute induction — or even a full day.
This guide is my attempt to fill that gap. Something to return to when needed.
There are so many little nuggets of knowledge when it comes to lifting work that I honestly don't know if I'll ever finish this thing.
But I've got to try.

Mikko Tourunen 13.04.2025 Helsinki

2 Hand signals

One more thing before we get into the signals themselves, and it applies just as much to the radio.

Only one person directs a lift at a time. The operator takes instructions from that one person and from nobody else. Agree on who it is before the lift starts, not halfway through it.

The reason is simple enough. From up in the cab the operator can't tell which of the four people waving at them is the one who actually knows what's supposed to happen. If two of you are giving directions and you don't agree, the operator gets two different sets of orders and has to guess. And a guess with three tonnes hanging on the hook is not what you want.

There is one exception, and it's an important one. **Anybody can give a stop command.** If you see something going wrong, you stop the lift – it doesn't matter whether you're the one directing it, whether you're on that crew, or whether you've been on site for a day. Nobody is ever going to give you grief for stopping a lift. Plenty of people have got hurt because somebody stood there thinking "it's not my lift."

If there's one thing common to all general lifting work guides, it's the presentation of hand signals — and typically they all use the same images you've probably seen already.
I'll go through these standard hand signals here as well, which certainly have their shortcomings, plus one I picked from Skanska's lifting guide, which may not yet be a standard — but should be.
Many guides suggest that using these hand signals is the one and only correct way to give instructions to the crane operator. This is a mistaken assumption. The only correct way to give instructions to the crane operator is via radio.
There are various problems related to hand signals, which I will try to explain here as best I can. To put it bluntly, if your goal is to make even simple lifts as difficult as possible, a good strategy is to not bring a phone with you — and try to handle everything with just hand signals.
Why go through hand signals at all, then, if they shouldn't be used? Because sooner or later you'll face a situation where, for example, your phone dies in the middle of a lift — and then you need to finish the job using only hand signals.
And sometimes you might be handling a difficult load by yourself, without anyone to help — and dealing with a phone at the same time may be overwhelmingly hard.

In that case, just use hand signals.
Some crane operators say they won't even agree to perform a lift if instructions are given by hand signals only. Even though working with hand signals carries more risks compared to using a phone, I still think this is an overreaction. In certain situations, I too will refuse to lift until I see a phone in the hands of the people below — especially if I notice a risk factor in the lift and I'm unsure whether those on the ground fully understand the situation.

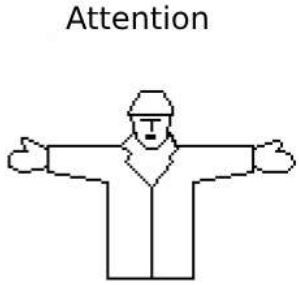


Figure 1

This sign is intended to catch the operator's attention. The image suggests that the hands should be kept extended to the sides. However, it fails to account for the fact that the human eye detects movement best, so wave those hands — it will significantly increase the likelihood that the operator notices you.
Of course, if it has been a quiet day so far, the operator has probably already fallen

asleep in the cabin, so you might have to wave those paws of yours for quite a while. This problem doesn't exist if you're using a radio.

If the crane isn't very tall and there isn't a lot of noise at the site at that moment, you can shout: CRANE!!

If you manage to wake the operator up, there's one small detail you should keep in mind — something most people don't seem to know: when a sound source is above or below you, it is impossible to determine its direction. You can only determine the direction of a sound source if it is at the same level as you.

This means, among other things, that no matter how loudly you shout, the operator up there has no idea which direction it's coming from — so wave those hands at the same time. And make sure you're in a location where the operator can actually see you — in other words, don't shout at the crane from behind it, unless your goal is to drive the operator insane on purpose…

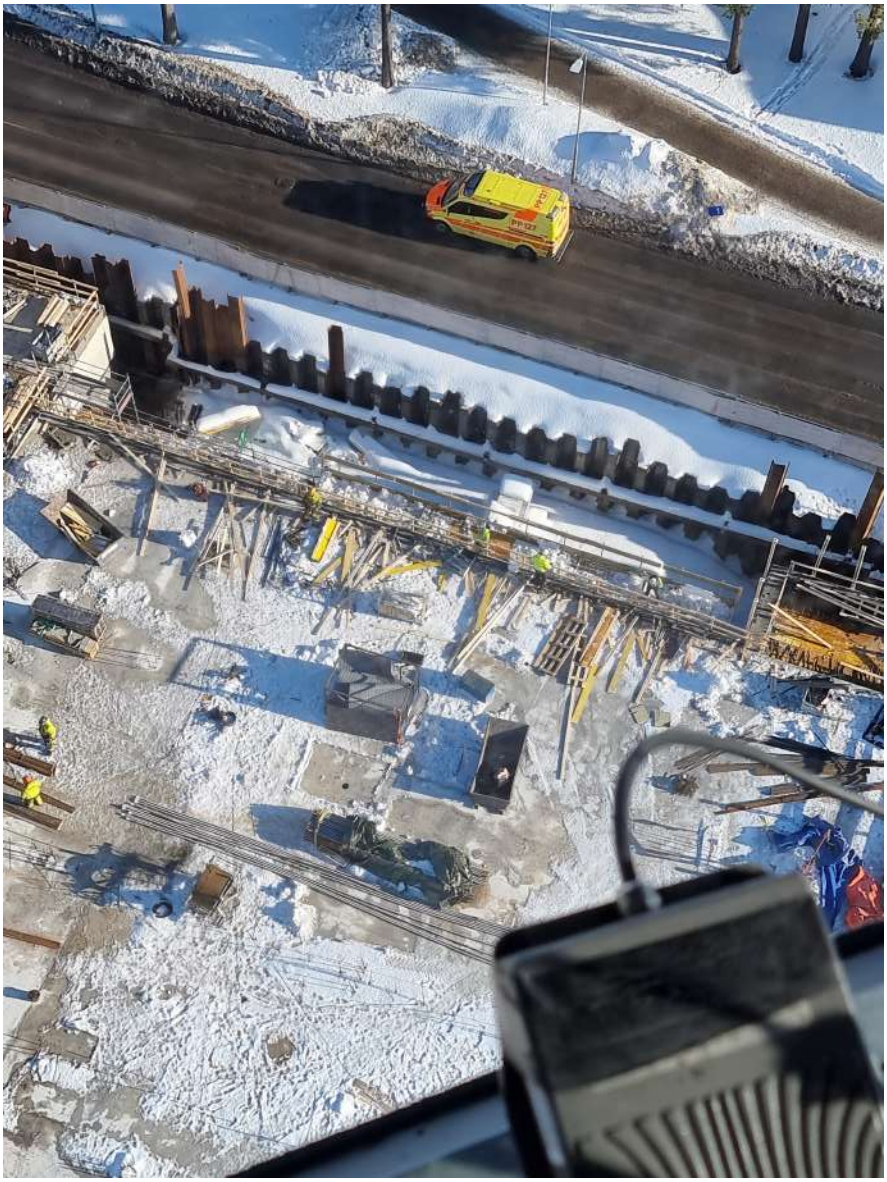


Figure 2: Where's Waldo? The crane signaler was somewhere over there. If you were the operator — where would you take the hooks?

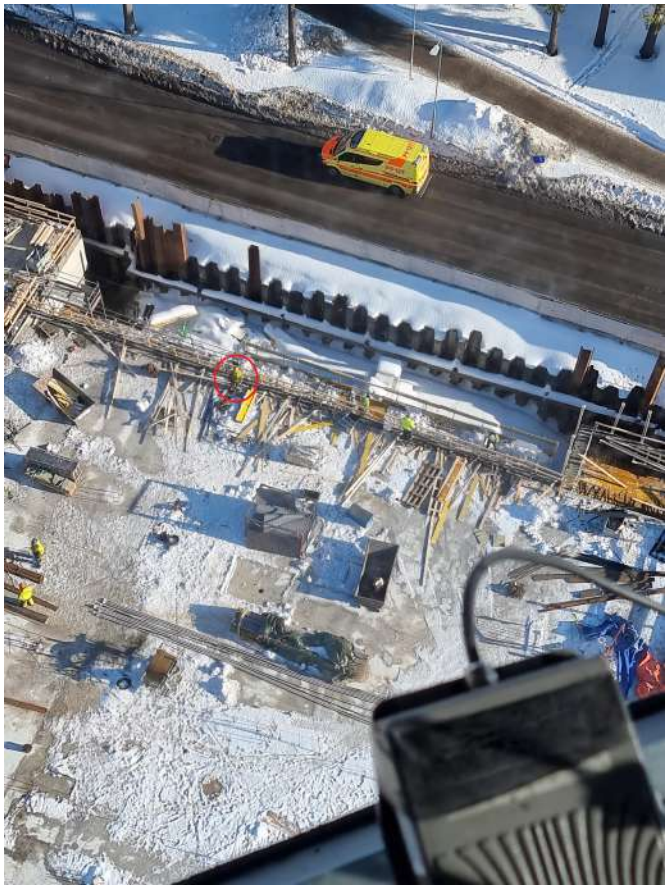


Figure 3: There the guy was, once I'd spent enough time staring. You're much easier to spot among all that junk if you wave your hands.

Figure 4

This is possibly the worst of all the standard hand signals.

The first problem is that the perspective from which a tower crane operator views the situation is not straight from the front, like in this illustration, but from above — and if you're standing close to the crane, it's almost directly overhead.

Now imagine what that guy with his arm raised looks like from directly above. You can't even see the raised arm. And it's obviously a serious problem if the crane operator can't see the stop signal.

The second issue is that many people use this signal as an attention signal — the one we covered first.

And then, many also use it as the "hoist" signal, because, well, it's a lot of work to keep rotating your arm.

So I flat-out recommend abandoning this signal as a stop command.

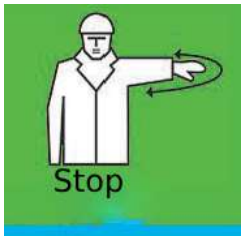


Figure 5

This stop signal, taken from Skanska's lifting operations guide, is much better. First of all, because this is the one that has actually been used in practice for years — or even decades. And since the hand moves sideways in this version, it's easy to spot even from directly above.

Just make sure the hand movement is sharp and clear. If you've just given the lower signal and immediately follow it with this stop signal — and if you wave your hand half-heartedly — it's very easy for the operator to miss it entirely.

Figure 6

When the load is ready to be lifted, this is the signal you use to tell the operator it's time to start hauling the package skyward.
That arm should point clearly and rotate upward, starting from the shoulder, to ensure it's fully visible. Not with the arm bent at the elbow and just wiggling your fingers to indicate a lift.
The darker it is, the taller the crane, and the dirtier your work clothes are — the harder it is to see these hand signals. So make them clear.
By adjusting the speed of the arm's rotation, you can try to communicate to the operator the desired hoisting speed.

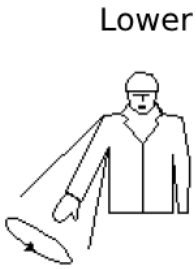


Figure 7

This is the signal used to ask the operator to lower the load, and once again, the arm should rotate from the shoulder — not just with a twitching index finger. Some people have this bizarre habit with the lowering signal: they keep their arm upright and rotate the wrist pointing downward. Do not adopt that habit — it looks very much like the hoist signal, and it's easy to confuse the two.

Vertical distance

Figure 8

When you give the hoist or lower signal, the operator might have no idea how much movement you're actually asking for. If you want the load to be lifted, say, only 20 cm, you should first use this signal to indicate the approximate distance — before giving the hoist signal.
Otherwise, the operator might just slam the winch at full speed, straight away.

Figure 9

Figure 10

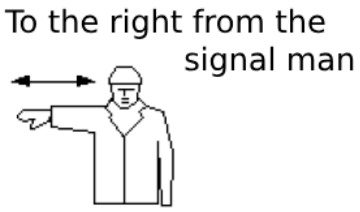


Figure 11

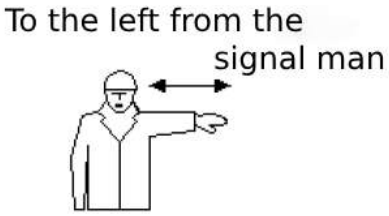


Figure 12

These four signals can be replaced with just one. Once the load has reached a sufficient height — and since judging the height of various objects on-site relative to the load is often very difficult from the crane cabin — keep showing the hoist signal until the load has clearly cleared any surrounding obstacles. Only then give the directional signal.

These signals suggest that slewing and trolley travel (the trolley being the ”cat” that rolls along the jib) would each have different directional signals.
They don’t. You simply point with your hand in the direction you want the load to move.

There is, however, one situation where that ”move backward” signal might actually be useful. Imagine the spot where you want to place the load is directly between you and the crane. You point your hand straight toward the crane — but

the operator has no way of knowing whether the intended location is in front of or behind the tower from their perspective. It might actually be a spot directly behind the operator's back.
So if the target is in front of the operator, you can clarify that by using the "move backward" signal. That said, I've never actually seen anyone use it.

And what if the destination is directly behind the operator? How do you clearly indicate — with a hand signal — that they need to slew the crane 180 degrees? There is no standard signal for that, or at least I've never seen one. Typically, people try to get the point across by making a wide arm motion in a circular arc, ending with a clear directional point.

Figure 13

And again — when you point with your hand to indicate direction, but you want the load to move only a short distance, you should first show the distance to the operator using your hands.

The guy in the picture seems to be holding his thumbs up — not sure that's the best idea. We crane operators are so full of ourselves, we'd probably just assume you're giving us a thumbs-up for our amazing driving skills: "Well done, you're a top-notch operator!"

So just keep those thumbs tucked in, and extend your fingers straight instead.

End of lifts

Figure 14

The operator has no idea whether you have one lift, two lifts, or twenty, so it's your job to make it clear — after the final lift — that that was it, and you don't need the crane anymore.
There are usually several people needing the crane at the same time, so the operator shouldn't have to waste time staring at you, unsure whether you still need something.

So make it clear somehow that you're done. The guy in the picture is showing one way to do that. It's rarely used, but every operator knows it — or at least they should — so go ahead and try it.

Some people use the time-out gesture from ice hockey. Some give a wave. Some give a nod or a bow.
Just pick something, as long as you're making some kind of effort to communicate.

Figure 15

One more signal to go, and then we're done with this topic.
This is yet another one of those signals I've never seen anyone actually use.
The idea is that when you notice the operator is, say, about to slam a precast element straight into a truck, you'd raise both hands to signal: Hit the brakes — now.

But this comes with a whole list of problems.
First off, a situation like that would only happen if the operator's attention had already been pulled elsewhere, meaning they're not even aware of what's going on — so they're probably not going to notice your signal either. And besides, the visible area from the operator's cabin is much smaller than people think.

Some folks imagine that from up there you can somehow take in the entire job site at once. In reality, the area where the operator can clearly observe detail is only a few square meters — everything else is basically in a kind of fog. That's one of the fundamental problems with hand signals: the operator only sees your signal if they're looking straight at you at that moment.

Let's say the operator does happen to spot you raising both arms. Since this signal is never used, the odds of the operator immediately slamming the emergency stop button are basically zero.

Now about that emergency stop: When it's pressed, all power to the crane is cut, and all brakes engage instantly. That might be useful if, for example, a fast lowering movement needs to be stopped in a hurry.

But if it's a slewing movement, then:

The jib will still keep turning for a bit. If it were engineered to stop dead immediately, the crane's structure would tear apart from the stress.

The load will keep swinging forward — a large swing — and then swing back.

Normally, the operator would cancel out that swing by making a well-timed

counter-slew, but now they can't, because the crane is dead, and depending on the model, it may take some time to power it back up.

When working with a large crane, you have to constantly remember: It can't stop or change direction quickly. This means you must always anticipate — think through what's about to happen before any movement begins.

Once the crane has started a movement — whether it's a slew or a trolley motion — there's no undoing it. The motion travels down the rope like a wave, and the load will start to move. At that point, yelling STOP! is pointless — it won't stop the wave.

There is one way to stop the load from moving at that point: If the load is close to the ground or a slab surface, you can drop it quickly down, making contact with the ground before it starts to swing. But that option isn't always available. And the situation can unfold so fast that you don't even have time to consider that move.

Figure 16

This is a better emergency stop signal. The hands move quickly forward and backward, so the eye notices it better, and this is a signal that seems to come naturally anyway when the lift starts developing in an undesired direction.

3 The radio

3.1 Basic functions of a two-way radio

The two-way radio is the number one tool used to ensure that the lift proceeds as intended.

Figure 17: A typical two-way radio. Photo: Mikko Tourunen

The first assumption, of course, is that you know how to use the radio.
Even though we're talking about a device with basically only three buttons you need to touch, an astonishing number of people still manage to screw it up.
A typical two-way radio has two rotary knobs on top, and one large push button on the side.
The first knob you'll focus on is the power knob on top — usually the one that also controls volume. It's typically turned clockwise to switch the radio on. Note that this same knob also controls volume, so turn it up enough to actually hear what people are saying.

Figure 18: The first two buttons you pay attention to. Photo: Mikko Tourunen

Next, your attention goes to the adjacent rotary knob — that's where you select the correct channel. It's a good idea to ask right away, as soon as you get the radio in your hand, which channel you should be on — it might not be set correctly by default.
And on a job site, there might be multiple channels in use, especially if there's more than one crane.
Then there's the third button — the large push button on the side. This is called the *tangentti* in Finnish, and in radio manuals, it's referred to as *PTT* (Push-To-Talk).

Figure 19: Press the PTT when you want to speak. Photo: Mikko Tourunen

On top of the radio, there's a small LED light that glows red when the radio is transmitting — i.e., when you're speaking — and green when it's receiving.

Figure 20: The radio is transmitting. Photo: Mikko Tourunen

Figure 21: The radio is receiving. Photo: Mikko Tourunen

And here we arrive at the first major problem that tests the patience of radio users around the world.
Unlike a mobile phone, which can transmit and receive simultaneously, the two-way radios used on job sites can do only one or the other — not both at the same time.

Some people have an astonishingly hard time grasping this. They keep making the same mistake: they start replying before the other person has finished talking and released the PTT.

When you’re on the receiving end, wait until the other person is done speaking

before you reply. And be aware: many people have thinking pauses in their speech — just because there's a moment of silence, that doesn't mean it's your turn to talk. The other person might still have the button pressed, and if you try to talk at the same time, both transmissions will fail. Neither of you will hear each other, and others on the channel will hear only interference.

How do you know if the other person has stopped transmitting or if there was just a short pause? Look at the LED — if it's glowing green, the other party likely still has the button pressed.

But here's another problem: that green LED often lights up even when no one on your job site is transmitting. That's because there are plenty of other radio users in the city, not just the people on your site — and these radios can have a range of several kilometers, depending on weather conditions.

Even though most radios use coding (like privacy codes or subchannels) to prevent cross-talk between job sites, the radio still detects the transmission, and the green LED lights up.

Non-coded radios should never be used — they cause a lot of confusion. For example, an operator might get mixed up: "Did that 'Lower' command just come from my own ground crew — or from the neighboring site?" It's happened before — especially when someone on the other site has a very similar-sounding voice.

And in general, all the chatter from other job sites is just plain distracting.

So it's best to keep a calm, steady rhythm when taking turns speaking on the radio. No matter how eager you are to reply, always wait a few seconds before pressing the PTT.

Another, less common but related problem is when someone asks a question over the radio, and then forgets to release the PTT while waiting for an answer. Of course, no one can reply in that case.

And if you're asking something over the radio — even if it's a general question that multiple people could answer — direct it to someone specific by saying their name first. Otherwise, you risk multiple people responding at the same time, and what you'll hear is just garbled interference.

Another common issue with using the radio is holding it at the wrong distance from your mouth when speaking. The most typical case is having the radio clipped to your chest pocket, pressing the PTT, and just talking from there. In that position, it's very difficult for the receiver to hear anything clearly.

Figure 22: There's a high probability that the receiver won't hear what you said if you hold the radio like this while speaking. Photo: Mikko Tourunen

The radio should be held pointed toward your face when speaking, at a distance of about 10–20 cm.

Figure 23: The correct way to hold the radio when speaking. Photo: Mikko Tourunen

Some people take this problem to the opposite extreme — practically trying to shove the radio into their mouth while speaking, and on top of that, they're yelling into it. Once again, the person on the receiving end can't make out a word.

Figure 24: Don’t shove the radio into your mouth — it makes your speech harder to understand. Photo: Mikko Tourunen

If you’re calling someone over the radio and get no response, then before cursing them out as deaf/asleep/an idiot, check your own radio first. Very often the problem is on your end — maybe the channel has switched, or the volume is turned down too low to hear anything, or the radio is not even turned on — either because you forgot to power it up, or the battery is dead.

One of the most common problems with radio use is starting to talk at the exact same moment you press the PTT.
Make sure to press and hold the PTT first, wait a second or two, then say what you need to say.

Otherwise, the beginning of your message gets cut off, which can render the entire message incomprehensible — especially if it’s a single word, like “Stop!” And when you mess up the timing, the operator doesn’t hear anything, and the load gets lowered too far, potentially hitting something it wasn’t supposed to. A mistake like that can be very costly.

So when you see a stop is coming up, press the PTT in advance, well before it's critical, so the "Stop" command actually reaches the operator in time.

Now, keep in mind: only one person can speak on the channel at a time. That means no one else can say anything while you're transmitting.

So, if you've just turned your radio on, don't start talking into it right away — There might be an active lift in progress, and it could be at a critical moment, with a stop command just about to be given — and you've just jammed the channel at the worst possible time.

If you can't see whether a lift is in progress, then listen to the channel for a moment first, so you'll know if something's going on.

And then there are those who believe they're brilliant comedians and try to entertain the entire site with their clever quips over the radio. Try to keep that comedic genius of yours in check — at least when it comes to radio use — on busy days.

Save your urge to perform for Friday afternoons. That's when things are usually a bit more relaxed, and people are in a better mood — so maybe, just maybe, even your jokes might get a laugh.

3.2 Radio control

Now that you're about to start directing a lift over the radio, what exactly should you say into it?

First, you test if the connection is working and if the operator is listening. For example, say: "Do you copy, (operator's name)?" This is typically only needed for the first lift — you don't need to repeat it every time.

If you don't get any reply, check your own radio. If everything's working on your end, the operator might not even be in the cabin. Try again later.

Use the operator's name. If you're using uncoded radios, and you just say "Hello?", your operator has no idea whether that call was meant for them, for the neighboring site, or for someone else entirely — because ground crew members also talk among themselves over the radio.

Don't know the operator's name? Then make it clear some other way which crane you're calling: "Do you copy, (company name) crane operator?" Or, if there are multiple cranes on-site, they're usually numbered — and even if not, there's always some identifying feature you can refer to.

If I hear just "Hello?" or "Can you hear me?" on the radio, I usually don't even respond — I just go back to my nap.

Now that the connection is working, the next step is to clearly communicate three things to the operator — one way or another.

1. What is being lifted?
2. Where is it being lifted from?
3. Where is it being lifted to?

1. What is being lifted?

   When you immediately state what is being lifted, the operator can start mentally reviewing the correct rigging methods for that specific load — and, just

as importantly, how it must not be rigged. Operators with more experience have seen their share of lifts end in disaster, and they've learned the hard way where the risks are. (With rookie operators, you're the test subjects out there.)

And if the load is heavier — say, over 5 tonnes, the distance from the tower becomes critical. The farther the load must be carried, the less weight the crane can handle. Sure, the crane can "handle it," but only up to the point where the combined center of gravity (crane + load) stays within the support base. Otherwise, the crane would tip over. That's why it's deliberately limited.

In some more complex situations, lift planning calculations are required — and it's strongly preferred that these are communicated the day before. Doing calculations in a rush almost always leads to mistakes.

If you don't yet master lift-planning mathematical calculations but would like to, I recommend reading the book I've written:

Lifting Mathematics

2. Where is it being lifted from?

A lot of people seem to think they're so fascinating that the operator has been tracking their every move and location all day long, so all they need to say over the radio is, "Bring the hooks here."

Let me be clear: the only person who thinks you're that interesting is your mother, and unless your mommy is the one driving that crane, you need to clearly state where the hell you are, waiting with your load.

Saying "I'm over here" isn't good enough. It's like calling a taxi dispatch and saying "Send a car here" and hanging up.

And give all three pieces of information right away:

What is being lifted

Where it's being lifted from

Where it's going

There may be factors you're unaware of — for example, another crane's ropes might be in the way somewhere — so the operator can't always take the most direct route and might need to plan the move accordingly. If you withhold information, it can lead to unnecessary back-and-forth and wasted time.

3. Where is it being lifted to?

   Again, the operator most likely has no idea where your load is supposed to go, so it's your job to say it.
   Too often, all that comes through is a single command: "Hoist" — and nothing else. Then the operator has to start asking, "Where the hell is this supposed to go?"

   And since the operator has a pretty good view of the site from up there, they might notice that your planned lift won't actually work — for example, there might not be enough space for the load where you intended to place it.

And more broadly — plan and prepare your lift before you start calling for the crane. Far too often, someone calls for the crane, I bring the hooks to the requested spot, and only then the ground crew starts asking, "How should we even lift this thing?" – "Well, slings would probably be good…" – "Slings, huh. Where am I supposed to find those?"

That's when I take the hooks and leave, and say: "Call me back when the load is ready to be lifted." This kind of situation is especially infuriating on busy days, when the crane is needed in every direction, and valuable time is wasted on unprepared nonsense.

Also, make sure someone is at the drop-off location to receive the load — or go there yourself to unhook it. Sending the load off and just hoping someone's there to detach it is a total asshole move. The crane might be stuck for a long time because no one unhooks the slings.

From the ground crew's perspective, an equally frustrating scenario is when everything is prepared, the load is ready to go, the receiver is standing by — and still, you can't get access to the crane, because it's so damn busy.

For example, precast installers often guard the crane jealously and won't allow it to be used even for short interim lifts.

So what happens is, other lifts get done during coffee breaks. And that means the operator doesn't get a break at all, and has to fight for a lunch break, and over time that builds up into serious stress, which eventually starts to show in the way the crane is handled — yanking the levers in frustration, with a "Move it or get the fuck out of the way!" mindset.

Ideally, there should always be an agreed-upon time slot for logistics lifts, so the operator can actually take breaks.

This issue is especially bad on sites in the Helsinki metro area, where literally every task is subcontracted, and each subcontractor is its own tribe, seeing others as rivals. They might not even speak the same language.

(Fluent English should be mandatory for all foreign workers — and frankly, also for Finnish workers — on construction sites in the capital area.)

When you can't communicate, that becomes a major problem.

3.3 Giving directions

When you want the operator to move the load forward/backward or left/right, remember: directions are always from the operator's perspective.

So, if you're standing with your back to the crane, then your left/right are the same as the operator's. But if you're facing the crane, then your left is the operator's right, and vice versa. People mess this up constantly — so much so that I sometimes don't even listen to what the guy says. I just try to read the body language and figure out where he wants the load to go.

One good way to avoid this issue is to use cardinal directions instead. If you're lucky and your site happens to align with the main compass axes, then if you want the load moved due west, you can just say something like, "10 meters to the west."

Cardinal directions don't change based on which way you're facing, unlike left-/right — so they stay consistent no matter how you move around.

If you're a particularly clever person, you might also know the intercardinal directions, which gives you even more options for directional calls. But in my experience, only a tiny fraction of people actually know how to use them. If I say something is in the northwest corner, about 95% of people just spin around looking confused, totally unable to figure out which way to look. And no, I'm not going to start talking about some damn "north-by-west" either.

What if the site doesn't align with the compass? Well, the site is probably bordered by a street — maybe two. You can use street names or directions relative to those as well.

Figure 25: Street sign.

”Move the load five meters toward Some effing street.” And whatever other landmarks happen to be near your site.

And here’s another issue with using only left/right directions: Let’s say you want the load to move to your left, and it happens to match the operator’s left as well. You ask them to “turn left.” Well — it will go left for a moment... and then more left... and then even more left — because, surprise — the crane is rotating.

So if the operator takes you literally and you don’t give any follow-up instructions, pretty soon your load is coming back around to your right, passing right in front of you — and now everyone’s cracking up, because the operator is just spinning in circles, going nowhere.

So avoid the headache — instead of relative directions like left/right/forward/back, use a fixed reference point

3.4 Lifting phases – practical considerations

Things to consider when giving a lift command, in addition to what was already said:

Watch where you're standing. If the load is even remotely massive, don't stand between it and any obstacle, like a wall. It's not guaranteed the load will rise perfectly straight upward the moment it detaches from the ground.

This is actually one of the first things I pay attention to when working with a new crane operator — how straight the load lifts off. You can tell a lot about an operator's skill level from this. Weak operators routinely let loads swing — sometimes violently — in unpredictable directions.

There's a specific technique to ensure the trolley, the hook, and the load's center of gravity are all aligned before detaching the load from its base.

Tips for rookie operators handling their first sites: When lifting a load that's wedged in a tight spot, and it's critical that it doesn't bump into anything around it —

Don't make the common beginner mistake of trying to lift it in one continuous pull. If you do that, you won't have time to adjust the trolley's position.

If you know the weight of the load, you can watch the load indicator and see when you're nearing full tension. If you don't know the weight — or you're operating some museum-piece crane with no load readout — then you'll just have to judge it as best you can.

Once you're nearing full tension, switch to a method known as "pulsing" — use first gear in short bursts: press hoist for 0.5–1 seconds, then release to neutral, then repeat.

This way, if the rope isn't perfectly vertical over the load's center of gravity — if it's pulling at an angle — you'll notice the load trying to shift before it actually lifts off.

Say the load starts drifting forward. That means your rope is pulling at a forward angle. Stop the hoist, adjust the trolley backward — estimate how much — then test again with pulses and observe. If it no longer tries to drift, the rope is likely in line.

If you hoist without pausing, you won't have time to notice any misalignment, and no time to fix it.

And a lot of rookie operators just make things worse. When the load lifts off and starts swinging — maybe toward a worker — instead of dropping it back down to stop the swing, they panic and slam the hoist into full power, thinking that'll save the situation.

All that does is make it worse. If there's an obstacle above, the load might now slam into it at full speed, which may end in disaster.

And perhaps the most common swing direction is forward, especially when lifting farther from the tower and the load is heavy enough to apply torque to the jib.

Important detail: The jib on a tower crane isn't completely horizontal when unloaded — it's slightly tilted upward.
Why? So that if the rope snaps while lifting near the maximum load radius (about 20 m from the tower), the trolley won't be able to roll all the way to the tip by itself, which could cause the entire crane to tip over.

Figure 26: I took a photo of the neighboring crane, which clearly shows how the jib is angled upward when there's no load hanging from it. Photo: Mikko Tourunen

Now, when you're lifting anything heavy, and you're closer to the tip of the jib than to the tower, the jib will start to bend downward. It flexes from its unloaded upward tilt toward horizontal under load.

This causes the trolley's position to shift forward, relative to the load on the ground — and from the operator's perspective, this is nearly impossible to see. It's something you just have to know.

And once you know it, you also know to compensate for that forward shift by pulling the trolley slightly inward while hoisting.

If you don't, and you lift without caution, the load will swing forward as it detaches — and this always surprises rookie operators, because "the chains were hanging dead center when I hooked up," they think.

One time, a new tower crane was set up next to our site. I heard the operator was someone who had just gotten their license. Their first hollow-core slab load was scheduled for delivery.

The unloading point was far from the tower, so I stuck around to watch the rookie's first lift, already predicting what would happen.

They hooked up the slab. Then came the hoist command. The operator lifted in one continuous motion — no adjustment, no trolley correction. As expected, the slab shot forward the moment it detached and slammed into the scaffolding. Luckily, the riggers were standing on the other side.

This, too, is not something you're taught in crane school — it's one of those things operators learn the hard way.

An even more challenging lift for an operator is when the lifting points aren't directly above the load's center of gravity while it's still on the ground. That means the load needs to be tilted upright first, and only then does it detach.

You have to follow that tilting motion with the trolley, adjusting throughout the upright lift. It takes time to learn this, but if you take it slow, and don't try to detach the load in one continuous pull, you can lift it cleanly, using the same principles, without swinging.

And it's not always the operator's fault if the load swings when it detaches. For example, in strong wind, it's impossible to center the trolley precisely — in that

case, you just lift “close enough”, or wait for another day to do the lift.

Also, some cranes just handle so poorly that even the best operator can’t make them behave any better — it’s always rough with those machines.

And remember — just because there’s no wind down below, that tells you nothing about wind conditions up at jib height. You might be standing behind a building, thinking it’s a nice, calm day, while 20 m/s gusts are hammering the jib up top.

So if the operator says “It’s too windy — I can’t hold it steady,” you need to believe it, no matter how calm it feels where you are.

Back to the ground crew. The craziest thing I’ve ever seen a ground guy do:

We had two crane test weights on site — cubic, about a meter each side, with about a meter of space between them. They needed to be moved. He hooks them both up at once. I get the hoist command and start lifting.

When the weights were just about to lift off, the guy walks straight between them — without warning.

Thankfully I was alert and had time to stop the hoist and quickly drop them back down.

If those weights had detached and swung together, he’d have been killed on the spot.

It took me a moment to say anything — I was in shock — but I managed to explain that he had just nearly killed himself.

And his reaction? Totally indifferent. I couldn’t tell whether he’d tried to off himself on purpose or whether there were some “exotic herbs” in that cigarette he was smoking.

Always tell the operator the load’s weight, if you know it. Every now and then, the load is stuck on something — in winter, often just frozen to the ground. If you’ve told the operator the load weighs 2 tonnes, and they see the scale reading 3 tonnes, they’ll know to stop the hoist.

If this happens farther out from the tower, the jib bends hard, like a loaded spring, and when the load finally comes loose, it can jerk violently into the air, then slam back down. You don’t want to be anywhere near when that happens.

One time, the guys hooked onto a precast element leaning against a wall. I no-

ticed the tension was way over what the element should've weighed. I told them to double-check. Turns out, they had hooked onto the lifting loops of another element already installed behind it.

If other workers are nearby doing their own thing, warn them that a load is about to lift — because it may not go straight up, and they might not even realize what's happening — or they might realize but won't stop what they're doing unless someone explicitly tells them to move.

And once the load is airborne, no matter what you're lifting, check the bottom of the load. Something might be stuck underneath that won't stay on during the lift.

For example: — Big rocks sitting on pallet feet — Pallet foot half-detached — Sling routed under a cable without noticing — Or even a broken footboard about to fall off

One time a ground man — who didn't have a radio — rigged a pallet. Unknowingly, he had slung under a cable as well. He was in a hurry and didn't stick around — just gave the lift signal and walked off.

I started hoisting and immediately saw the cable coming up with the pallet — so I hit emergency stop. Meanwhile, this guy is running up the stairs to the slab level because he's also the one receiving the load.

We were already several floors up by that point, so when he got there, he was breathing hard.

Then he started waving like crazy, wondering why I wasn't bringing the load up. He must've thought I didn't understand the lift signal.

Eventually I managed to signal to him that a cable was coming up. When he realized, he looked like his soul left his body.

So don't rush your lifts. Stick around and watch to make sure the load leaves the ground cleanly, and there are no surprises underneath.

Even the bottom of a concrete bucket can have something stuck to it — especially in winter. It might have a brick frozen to it, for example.

3.5 Crane movements

The crane has three different movements (four if it's on rails, but that's rare):

Slewing, meaning the jib moves left and right

Trolley (called kissa, a cat, in Finland) travel, which moves in and out along the jib

Hook, which moves up and down

I categorize these as the X, Y, and Z axes:

X-axis = slewing

Y-axis = trolley

Z-axis = hook

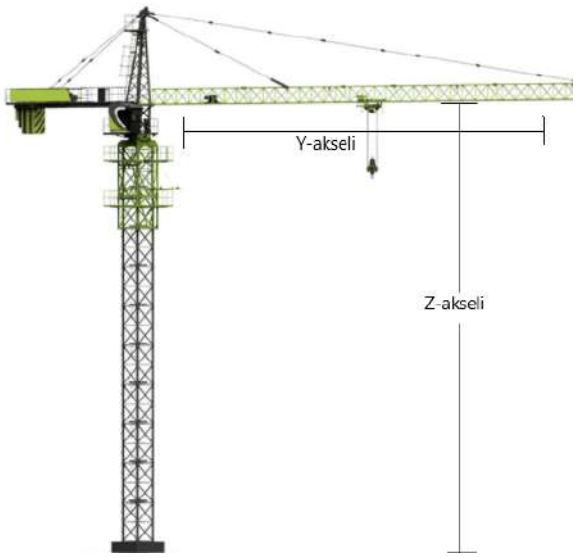


Figure 27

During a lift, the load typically moves along all three axes. For most of the lift, the operator can independently judge what movements are needed, how much, and at what speed. But at certain key moments, the operator depends on guidance from a ground person with a radio.

If you've never sat in the operator's seat of a tower crane, it can be hard to grasp what the world looks like from up there — (it's very different).

The relationship between the load and its surroundings is easiest to judge along the X-axis (slewing), assuming there are no visual obstructions (like a blind spot, poor lighting, or fog). So operators usually need the least help with this movement.

If, for example, you're trying to place something in a tight gap, the operator can often fine-tune the X-axis on their own.

The Y-axis (trolley movement) is a bit more difficult for the operator — but this mostly applies when there's no working camera. These days, nearly all cranes are equipped with cameras — but whether they actually work is another matter.

If the camera is functioning, the operator can clearly see the load's position relative to its surroundings. That frees you up to focus on more important things — like height and keeping the load oriented correctly.

But let's consider the situation where the camera is down (which will happen, sooner or later). Judging the Y-axis from the cab gets increasingly harder the farther out you go. If the lift is close to the tower, the operator can judge the Y-axis well, and you don't need to give much input. But once you're at 40+ meters, Y-axis assessments become rough guesses.

The most common mistake is that the operator overestimates the distance — they think the load is farther out than it actually is.

This also causes them to misjudge the height.

Why? Because trolley and hook movements can look similar from above. They both cause the hook to move along the same visual axis in the background. If you were watching a cropped video showing the hook moving (but not in X), you'd likely struggle to tell whether the movement came from the trolley or the hook.

So if the operator gets the trolley position wrong, they'll also get the height wrong — and vice versa.

When the camera is working, it helps with height estimation too, even though it doesn't provide depth perception — because the operator can now be confident about Y-axis location, and that lets them infer the Z-axis (height) more accurately.

The most challenging axis for operators is Z (hook). That's where the most help is needed from the person on the radio.

And the location along the jib also matters: The farther out the lift happens, the flatter the viewing angle between the operator and the load — and the easier it is to estimate height.

But the closer to the tower, the more the operator has to look nearly straight down — and once you're almost at a 90° angle, they can't judge the load's height to within even 10 meters.

So at that point, you must give clear altitude updates. A good method is to press the radio's PTT early, while the load is still 10 meters up or so, and begin giving distance calls as you approach the drop point:

"Ten… five… three… two… one… on the ground… stop the hoist."

Use that kind of steady countdown — it's reliable, clear, and keeps the operator calm and in control.

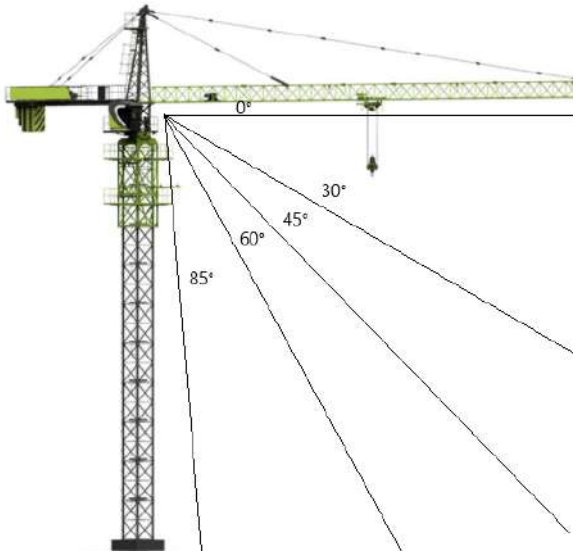


Figure 28

And it's a good idea to give altitude calls even when the lift is happening farther out from the tower — where the operator's viewing angle is flatter and, in theory, height is easier to estimate. Not all operators have the same level of vision or depth perception, lighting conditions vary, and if you're dealing with a very tall crane, even at 60 meters out, the viewing angle still isn't flat.

And even though I've described some positions as easier for the operator to see, mistakes still happen. The human eye just isn't a particularly reliable instrument.

Everyone's had moments where something they were looking for was right in front of them, but they didn't see it — some kind of selective blindness kicked in.

This happens to crane operators too — and it can, of course, have serious consequences.

So never assume "the operator surely sees this." If it looks like the crane is about to swing a load into something you assumed they'd notice — don't just stand there mouth open, watching it happen.

Either give a STOP command, or — if there's time — say something like: "You see that column in front of you, right?"

Columns, in particular, are things that are very easy to miss visually:

The closer they are to the tower, the smaller their visible surface area from the cab.

They're the same color as the concrete slab they stand on — so they blend in.

I've had multiple situations with inexperienced ground guys, where I was lowering a load directly onto a column I couldn't see, and the rookie just stood there, watching with their jaw open — and only after I'd already hit the column did they finally say: "Stop." Which, at that point, was obviously too late — I already knew I'd hit something.

That kind of freeze-up might be expected from a small child, but not from an adult on a job site.

4 Most common lifting accessories

If you're a complete beginner in construction — and you probably are, since this book is meant for beginners — your first crane-related tasks won't be setting precast elements. (And if they are, the site management should be wheeled off in a barrow and escorted out of the site.)

Your first real tasks will most likely involve unloading and cleanup. Construction sites produce a ton of waste, and it has to be constantly moved out, or pretty soon, there's no space to work — every corner is piled with junk.

The main tools for moving this stuff out are:

Floor carts

Crane skips

Skips

Floor carts and crane skips are actual, certified lifting accessories. Skips, on the other hand, are a bit more informal in this context.

Lifting accessory = A device that connects the load to the crane hook.

And what is required for a lifting accessory to be considered official? It *must* have a WLL marking.

WLL=Working Load Limit

—that is, the *maximum load* that can be applied to the lifting accessory.

Just because an object has a handle that fits a crane hook conveniently doesn't mean it qualifies as a lifting accessory. For example, a paint bucket has a handle, and clearly, the handle is meant for lifting the bucket — but since it *lacks a WLL marking*, you're not allowed to lift anything with it using a crane — *not even paint*.

Why? Because the bucket has not undergone any testing to determine at what point it fails. Therefore, no safety factor can be assigned. (If the actual breaking strength of a lifting accessory is, say, divided by ten to define its WLL, then the *safety factor* is ten.)

I once witnessed a situation where a paint bucket was filled with concrete and hooked to a crane. The handle snapped mid-lift, and the bucket dropped straight down a stairwell shaft. Fortunately, no one happened to be underneath. Just concrete on the walls, not someone's brains.

Figure 29: To the unfortunate eyes of many, these two lifts are equivalent. But in reality, only the one on the right is acceptable. In it, the lifting accessory is that orange frame, which has WLL (Working Load Limit) markings, and it's used to lift that barrel section. If we want to nitpick, the left one also has a proper lifting accessory, namely that short steel cable. But in that case, the barrel section itself is also acting as a lifting accessory, which it isn't meant to be. And to top it all off, the cable has already cut quite a bit into the barrel. Things like this are still being sent up into the air on worksites even today. The next fatality due to a lifting accident is just a matter of time. Photo: Mikko Tourunen

Floor carts and crane skips should always have a visible WLL marking. If they don't, they must not be used for lifting.

Skips, on the other hand, more often lack these markings. This is because they were not originally designed to function as lifting accessories. They were meant to be moved only by truck, but lifting lugs have later been added as retrofits.

The skip is typically located somewhere along the edge of the site, where a truck can easily pick it up, while the floor carts and crane skips are scattered around the site.

The cart has wheels underneath (hence the name "cart"), so it's the one you move around with, filling it up with scrap. Once it's full, it needs to be emptied — and for that, you usually need help from the crane.

Some sites have a bin-tipping device mounted on the side of the skip, allowing you to empty the cart without using the crane — a very convenient system, since it avoids wasting crane time on small scrap lifts.

Figure 30: A tipping device that allows floor carts to be emptied directly into the skip — without using the crane and without you having to climb into the skip. Photo: Mikko Tourunen

You'll soon find out that wading through all the scrap inside a skip is not exactly pleasant — and climbing in and out of it gets pretty annoying over time. So you'll want to do it as little as possible.

One strategy is to first empty your cart into a crane skip, which is usually located somewhere nearby. Then, once the crane skip is full, you go and empty it into the skip.

That's a lot less running and climbing — since the floor cart holds about 380

liters, while a crane skip holds roughly 2 cubic meters.

Especially once the building has progressed to higher levels, running all the way down and back up just to empty one cart starts to become a fool's errand.

4.1 Floor cart

Figure 31: Floor cart. Photo: Mikko Tourunen

Alright, so you're hooking up the cart. You'll see four lifting lugs on top of it. If there's anything at all inside the cart, you use four chains.

Some sites insist that even an empty cart must be lifted with all four points, because the owner slapped a sticker on the side that says: "Must always be lifted from four points."

You don't need to treat every sticker like it was issued by God himself. That sticker is just the owner's way of making sure they can't be held liable when some blockhead tries to lift an over-full, lopsided cart with just two chains and crap starts spilling out halfway through the lift.

Or when someone empties a cart but doesn't bother to check whether it actually emptied properly — and then sends it back up in tipping position. There might be some block or other debris still jammed in there, and it might come loose mid-air.

So – after emptying the cart or crane skip, before giving the lift signal, make

sure it's really empty.

Once you've confirmed that, you can send it up using just a single hook, connected to the tipping lug at the back end of the cart.

And if you've got multiple empty carts to send back up, you can hook up four at once.

Crane time is often extremely limited, and it's utterly pointless for element installers or steel fixers to wait 20 minutes for four separate empty cart lifts when the whole job could've been done in five minutes in one go.

There's no risk – as long as the ground crew confirms that the carts are actually empty.

So now you've got the cart lifted – either into a crane skip or into the skip.

Next comes the emptying. To do that, you need to disconnect all four hooks from the top of the cart, and then attach one hook to the tipping lug, which is located low on the back end of the cart.

And no matter what you're lifting – one rule always applies, in every situation:

NEVER LEAVE EXTRA CHAINS DANGLING LOOSE!

In some situations, when the lift doesn't go quite as planned, the load may be hit by a sudden force – it might tip over, get stuck on something and then break free – and as a result, any chains left hanging loose can start whipping through the air. You don't want to catch one of those in the face. And neither does the guy standing nearby.

It can also happen due to an operator error – there's slack in the chains, the block (the big hook) isn't lined up properly, and the operator makes too aggressive a lift. Next thing you know, loose chains are flying.

So when you're emptying the cart and only one hook is in use, you're left with three extra. The most common method is to attach the spare hooks to the active lifting chains. But with three of them, that gets a bit tedious.

A faster way in this case: Grab one of the spare hooks and wrap its chain around the other chains — including the active one – and then clip the hook back onto its own chain. That way, all the chains stay secured, and if something unexpected happens, they won't go flailing.

Figure 32: Cart tipping lug. One chain attached to the lug — the rest are extra, and must not be left like this. Photo: Mikko Tourunen

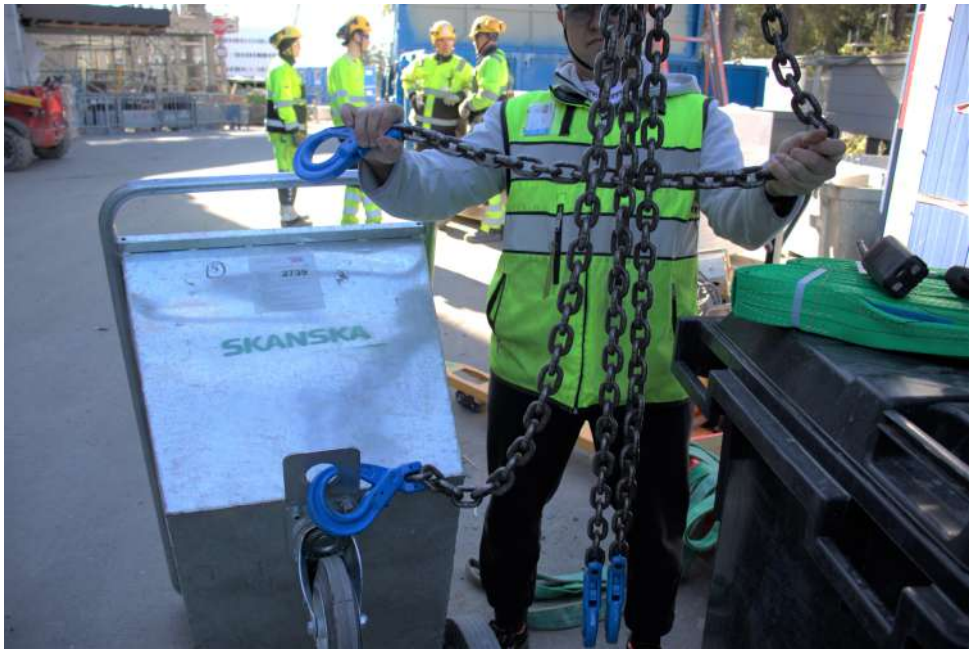


Figure 33: Take one of the extra chains. Photo: Mikko Tourunen

Figure 34: Wrap it around the other chains, and hitch it back onto itself. Photo: Mikko Tourunen

Figure 35: Now you won’t catch a chain to the head — no matter how much the cart swings. Photo: Mikko Tourunen

A common rookie mistake when emptying a cart is leaving the rear upper chains still attached and giving the lift signal anyway. In that case, the cart won't tilt enough, and it won't empty properly.

Then, instead of lowering it back down and hooking it up the right way, they start digging the junk out of the cart by hand while it's hanging in the air.

And nobody wants to stand around watching that mess. The crane is already needed somewhere else.

Figure 36: As you can see, it doesn't tilt nearly enough. Photo: Mikko Tourunen

Figure 37: It's pretty common to leave the rear chains attached and just hook one chain to the tipping lug. People think it speeds things up – less messing around with the chains. But it doesn't tilt far enough to empty properly. Photo: Mikko Tourunen

Figure 38: When emptying, always hook from back here — the lower tipping lug – and it’ll tilt far enough. Photo: Mikko Tourunen

4.2 Crane skip

Emptying a crane skip: Again, there are four lifting lugs on top. You attach all four chains if there's anything inside.

One mistake – even experienced workers make it – is failing to pay attention to which side of the lug the hook is resting on after attachment.

This is something you *always* need to check whenever there's more than one lifting point.

The hook should rest on the *inside* – that is, in the direction the force will be pulling once the chains start to tighten.

Figure 39: In the photo, the hook has been placed on the inside of the lug – the side where the force will be applied when the chains tighten. Photo: Mikko Tourunen

If you leave the hook resting on the "outside," it might not seat properly in the lug. Instead, it can get wedged at an angle where the pull hits the hook at a 90° angle – which puts significantly more stress on the hook.

A hook should always be positioned so that the force pulls into the base of the hook, with the hook aligned in the same direction as the chain.

Figure 40: In the photo, the hook has been placed on the outside of the lug — the wrong side. Often, if the lifting lug is large enough – like the one in the photo — the hook will rotate into the correct position on its own. But even with this type of lug – and especially with tighter ones – that doesn't always happen. The hook can get wedged at an angle where the lift needs to be aborted: you have to lower the load and reposition the hook correctly inside the lug. Photo: Mikko Tourunen

Figure 41: Even though the hook feels like a solid piece of tough steel in your hands, compared to the forces a crane can produce, it's actually quite soft. You'll end up bending those things into boomerangs if you're not careful about how you place them into the lifting lugs. Photo: Mikko Tourunen

Figure 42: The hook, left on the wrong side, has gotten jammed. Let the chains go slack, and reposition the hook to the correct side – the *inside* of the lug. Photo: Mikko Tourunen

The crane skip also has tipping lugs at the back end. But in most cases, you don't need to use them.

It's usually enough to keep the rear, upper lugs attached — just make sure to clip the front hooks onto the lifting chains so they're not left dangling.

The crane skip will tilt far enough like that for all the junk to spill out properly.

Figure 43: As you can see, the crane skip tilts sufficiently when it's hooked from the rear upper lugs. In most cases, it's unnecessary extra effort to start attaching from the lower lugs. Photo: Mikko Tourunen

You'll only need those rear-end tipping lugs in exceptional cases – like when you're lifting sticky soil or clay that doesn't want to come out easily.

When the crane skip is hooked from the back end, it tilts slightly past 90°, which should be enough to get everything out.

If that still isn't enough, you can lower it all the way to the ground upside down, then bang on the bottom with a hammer or something — that should finally shake loose whatever's stuck.

Figure 44: If it still doesn't empty in this position, you'll need to flip it completely onto its top and start hammering the bottom with a sledgehammer. Photo: Mikko Tourunen

This extra tilt makes lowering the crane skip back down a bit trickier for the crane operator — it tends to tip over onto its face.

But when the emptying is done using the upper lugs, the crane skip naturally falls back into the correct position, making the whole job faster.

Figure 45: The operator just has to lower it straight down, and the crane skip will start tipping over onto its top. Photo: Mikko Tourunen

Figure 46: Wasted effort. If you hook onto the lower tipping lugs but leave the upper ones still attached, then attaching to the lower lugs was pointless. With the chains set up like that, the ones on the tipping lugs won't even tighten — so they do nothing to help the crane skip tilt further. Photo: Mikko Tourunen

One more reason why it's usually easier to empty the crane skip by lifting it from the rear upper lugs is that it tends to *slide out* from under the scrap pile more easily, and the contents get spread over a wider area.

When lifting from the back-end tipping lugs, the crane skip often doesn't slide out at all — instead, it tips into a nearly vertical position.

That's when things like offcut planks end up sticking straight up, and you'll have to jump into the skip and level them out — because the driver picking up the skip won't take it unless the load is flat.

Figure 47: Crane skips that are overloaded should always be secured with a cargo strap. And if it's windy — and the crane skip contains lighter materials, like insulation boards — you should strap it down even if it's *not* filled over the top. Photo: Mikko Tourunen

Figure 48: Ratchet straps are worth using more broadly in lifting work. When you secure a load with one, it won't fall apart the moment it's set down. Photo: Mikko Tourunen

4.3 Skip

Figure 49: Skip with lifting lugs. Photo: Mikko Tourunen

Let's include the skip in our set of lifting accessories — because that's how you'll end up using it anyway.

First thing you do: Check that the skip the truck dropped off – the one with lifting lugs — has a clearly visible label showing its maximum load capacity, i.e., the WLL marking.

Since the skip has a large volume, around $20m^3$, you can fit a lot of material in it — and depending on what you fill it with, the total weight can become *very* high.

Figure 50: This skip also lacks any marking of its maximum lifting capacity, so it *must not* be used as a lifting accessory. Photo: Mikko Tourunen

You won't be emptying skips the way you do with carts and crane skips. Skip emptying is handled by the truck.

Though — I *have* seen one case where a pissed-off foreman had one lifted from one end and dumped its contents onto the yard. Why? Because the crew had filled it with mixed waste, even though it was clearly designated for wood only. He made them refill it – this time, *only* with wood.

So your role with skips is limited to moving them from place to place. That means your responsibility is to make sure – *before* lifting — that the skip's hatches are locked and that it's not overloaded.

Figure 51: The hatches at the back of the skip. Photo: Mikko Tourunen

And since you probably don't know the total weight of the skip, you'll need to ask the crane operator when they start lifting – what does the crane scale say?

You may have realized by now that the chains themselves might be pushed to their limits if the skip is full of, say, metal scrap.

Determining the maximum capacity of chains is a bit more involved — we'll cover that later.

On apartment building sites, one efficient way to make use of a skip with lifting lugs is during floor cleanouts. First, haul all outgoing waste onto the balcony. Then attach the skip to the crane hook, and the operator swings it right up against the balcony edge — you just toss everything straight in. No need for carts or crane skips in between.

And finally — when lowering the skip back down to the yard, the street, or wherever – make sure it lands *oriented correctly*, so the pickup truck can grab it straight onto the bed without needing the crane to flip it around.

4.4 Lifting slings

Not everything can be loaded into some type of skip or container — some items need to be lifted *as they are*, and that's when slings come into play. The word sling refers to a flexible lifting accessory — in practice, that means chains, straps, and ropes.

Of those, you'll be using straps the most for securing loads.

Now, when you need to lift something using slings, your first job is to find out how much the load weighs — so you don't end up tying a five-ton load with one-ton slings.

All lifting accessories must have a WLL marking, and with slings, that capacity is actually shown in three different ways. The quickest way to tell the sling's rating is by its color. (Good quality) slings are color-coded according to standards, and the system goes like this:

Table 1: Standard color codes for lifting slings

Color	WLL
Purple	$1t$
Green	$2t$
Yellow	$3t$
Gray	$4t$
Red	$5t$
Brown	$6t$
Blue	$8t$
Orange	$\geq 10t$

Memorize these colors – you'll be able to spot a disaster coming from a distance if someone's trying to rig purple slings in a basic choke hitch to lift a $10t$ concrete column.

The sling's capacity is also printed on the tag located inside the loop.

Figure 52: WLL 3 TON. Photo: Mikko Tourunen

And the third way to identify a sling's capacity is the black stripes woven into its surface – for example, a 3-ton sling will have three stripes running along it.

Figure 53: Three black stripes. Photo: Mikko Tourunen

There are several ways to attach slings to a load, and each method gives the sling a different *mode factor*. The mode factors you'll most often deal with are: 0.8 , 1 , and 2.

The mode factor is used to multiply the sling's rated capacity.
So, for example, if a green sling (2 tons) is attached using a basic choke hitch, its effective capacity becomes $2t \times 0.8 = 1.6t$.

Figure 54: The so-called basic choke hitch – the most common way to attach a load by choking it. Mode factor: 0.8. Photo: Mikko Tourunen

Figure 55: Unlike the previous one, here the sling wraps around the load twice, compressing it 360°. However, this extra loop does *not* affect the mode factor. So the mode factor remains 0.8. Photo: Mikko Tourunen

Figure 56: The idea behind this rigging: The sling is first folded in half, which doubles its lifting capacity – and then it's attached using a choke hitch, which reduces the capacity. So the resulting mode factor is $2 \times 0.8 = 1.6$. Photo: Mikko Tourunen

Figure 57: The issue with the rigging method shown earlier: If you're not careful to keep the sling ends exactly the same length, the load won't be evenly distributed between both legs – which means the mode factor is no longer 1.6. In the situation shown here, the actual factor is 0.8. Based on experience, I've come to the conclusion that this setup is best classified under a mode factor of 0.8. That said, it's not useless – in many cases it's helpful to keep the sling short, and for that purpose, this method works well. Photo: Mikko Tourunen

Figure 58: Alternative M 1.6 rigging. I recall seeing this style referred to in a lifting guide as a *reliable* way to achieve a mode factor of 1.6. But experience has since shown that even this method can't be fully trusted. So my recommendation – if you want to play it safe — is to assign a mode factor of 0.8 to this setup as well. Photo: Mikko Tourunen

Figure 59: U-lift. In this configuration, a single green sling has a theoretical maximum capacity of 4 t. Photo: Mikko Tourunen

Figure 60: U-choke. The mode factor is two, and this rigging also compresses the load from all sides, making the lift safer. Photo: Mikko Tourunen

Figure 61: Extended choke. This is a slightly more unusual rigging method, suited for situations where the load needs to be choked, but the sling is too short. Looking at this setup, the obvious question is: what's the mode factor? Whenever more than one lifting accessory is used in a lift, remember the saying: "A chain is only as strong as its weakest link." So, when multiple lifting accessories are involved, the stress level of the lift is determined by the weakest component. And in the example shown — what would that be? My solution: apply a mode factor of 2 to the green sling, and a mode factor of 0.8 to the chain. The chains shown in the picture are 4 t chains, so their effective capacity in this setup would be $4 \times 0.8 = 3.2t$. Photo: Mikko Tourunen

Figure 62: Overly wide sling leg angle. The pull should be directed toward the base of the hooks – not their side walls. This kind of rushed, sloppy rigging is especially risky when using white slings, which are very thin, combined with a worn-out hook that has too wide a gap between the jaws. That white sling can slip right through. In this situation, an extended choke should have been used. Photo: Mikko Tourunen

And once the load secured with slings has been lowered to the ground, it occasionally happens that one of the slings ends up directly on top of a support timber or some other obstacle, making it impossible to pull the sling out from underneath. The usual solution in this case is to ask the crane operator to yank the sling out using the crane. That's a very poor solution.

First, it significantly shortens the service life of the sling. Second, this maneuver often results in the entire load tipping over. And third, you may soon realize that you shouldn't have set the load down there in the first place. If you've placed it on sand, for example, and had the crane rip the slings out, you may not be able to get them back under the load. If it was, say, a bundle of planks, you now have to place new supports next to it and restack the entire bundle just to lift it again.

So make sure the load lands on supports in a way that allows you to pull the slings out smoothly by hand.

Practical tip: If one of the slings lands on a support timber, but the other is fine, disconnect the free sling from the hook, then use the crane to slightly lift the side of the load that has the sling pinned, and shift the support timber slightly. If you lift the whole load again, it immediately starts swinging, making aiming more difficult and the result less predictable.

One more thing: If you immediately send the crane to fetch the next load, and the same slings are still in use – often one end of the slings remains attached to the crane, with the slings still running under the load – still pull the slings out manually. If you let the crane pull them out, you may end up with the whole package tipping over. If the sling snags on something, the operator might not react in time to prevent a collapse. And if you're thinking, "Can't the operator just lift more slowly?", the answer is no. That sling might be several meters long, and pulling it out with first gear just because you're too lazy to pull it by hand will double the time required for the lift.

More tips to make life easier for the rigger.

Constantly threading straps under loads gets exhausting when there are many loads to handle. To make this easier, create a tool I call a shepherd's staff. Grab a piece of rebar, about 8mm thick and a couple of meters long, from somewhere.

Figure 63: Photo: Mikko Tourunen

Look for a spot where you can bend the end into a hook—about a 90°angle is enough.

Figure 64: Photo: Mikko Tourunen

Figure 65: Photo: Mikko Tourunen

The user interface of the shepherd's staff is quite simple. One method, and the most common, is to hook the loop of the strap onto the straight end of the staff, then push the strap under the package to be lifted.

Figure 66: Photo: Mikko Tourunen

Figure 67: Photo: Mikko Tourunen

Another way to use the staff is to push the hooked end under the load, and a colleague on the other side hooks the strap's loop onto the hook. Then you simply pull the strap under the package.

Figure 68: Photo: Mikko Tourunen

Figure 69: Photo: Mikko Tourunen

The reason you shouldn't bend the hooked end into too sharp an angle is that when a reach stacker has brought a package and placed it too close to, for example, a wall, you'll need to fish the strap's end out from that gap. If the staff's end were bent too much, you wouldn't be able to do it.

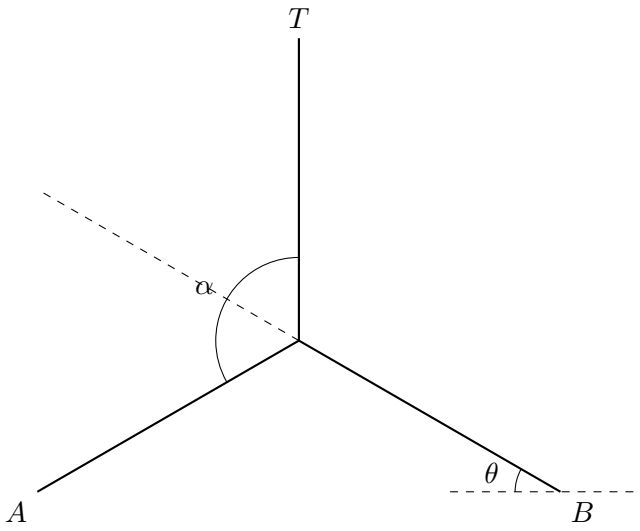
One mathematically interesting question can be extracted from a tightening sling arrangement, i.e. a so-called choke hitch.

When making choke hitches, you may have noticed that sometimes, when the crane begins to tighten, the bend point of the choke hitch slides lower, and this causes the load to tilt because the bend is no longer at the center of the load where you placed it. So where should that bend be placed so that it no longer moves anywhere?

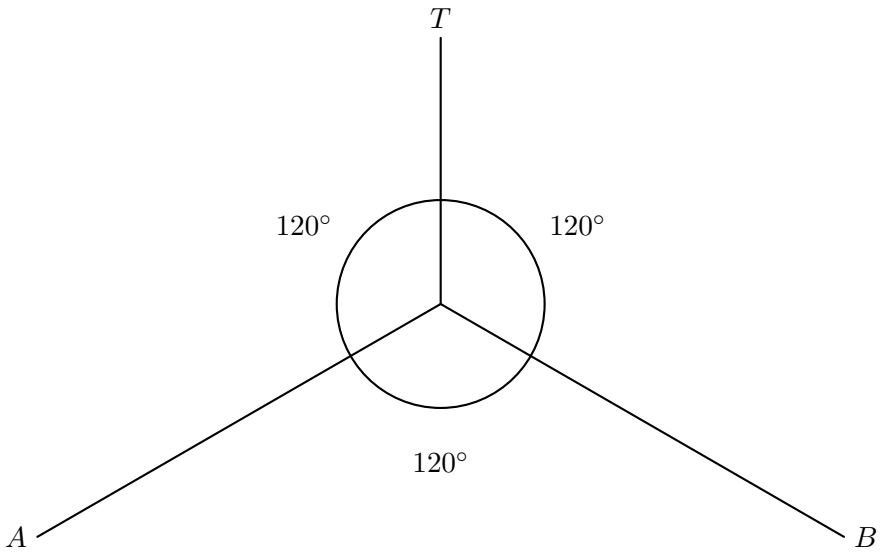
The figure below shows the core of this problem. The sling wraps around the

load in a choke hitch, comes from above as leg T, turns to the left as leg A, goes around the load, and comes from the right as leg B. At the end of leg B there is therefore the sling loop. Now the task is to find the angle θ such that, after passing through the bend point, it (the diagonal dashed line) acts as the angle bisector of the angle α between A and T. At that angle, the end of the loop does not feel any tendency to move in either direction, because the "slope" is equally steep in both directions.

Correspondingly, leg A acts in the same way as the angle bisector of the angle between legs T and B.



This is achieved when the angle θ is $30°$. Then the angle of each leg relative to the adjacent one is $120°$. The figure below shows what you see when looking at the load from the end.
This creates a symmetrical three-leg equilibrium state, in which the same force acts on each leg.


T
120°
120°
120°
A
B

4.5 Chain slings

Determining the lifting capacity of chains is a bit more complicated. Usually, it's the crane operator's responsibility to ensure the chains are suitable for the lift in question – but there are plenty of operators who couldn't care less about this, so the responsibility falls to you. And since your life down there is the one at risk, it's worth paying attention.

At the top end of the chain assembly, there is a large ring called the master link, which connects the chains to the crane's hook. There's also a(*sling tag*) attached to it.

Figure 70: Sling tag for 10 mm four-leg chains. Photo: Mikko Tourunen

As you can see, the sling tag does not display a clear WLL value (i.e., the maximum load one leg can handle); instead, it shows a couple of example angles with their corresponding maximum loads.

However, most people don't know how to calculate the actual angle. All you can really do is try to estimate whether the angle between two chain legs is more or less than a right angle and make a rough guess about the permissible load. And if the lift is asymmetrical (which you, as a beginner, should not be performing at all), those example angles are no longer of any use.

Figure 71: Loads can, if necessary, be choked directly with chains when no slings are available nearby. Photo: Mikko Tourunen

Just a couple of things to keep in mind. Since the total length of the slings is now significantly shorter, the angle becomes steeper. Also, the coefficient of friction between chains and various materials is lower than that of slings. So when the angle increases, the horizontal force vector increases as well–and combined with the lower friction, this basically means the chains will start slipping more easily.

Figure 72: No! Photo: Mikko Tourunen

Especially when two metal surfaces are involved, the coefficient of friction is extremely low. This means you should never lift smooth metal pipes like these by choking them with chains or shackles. Smooth metal pipes must always be choked with slings. And if it's just a couple of small pipes like in the picture, wrap the sling around the bundle twice so it grips tightly from all sides.

I made this exact mistake myself when I was a rookie–tried to lift a bundle like that. Sure enough, the chains started slipping during the lift and the pipes rained down. Luckily no one got impaled. My career probably would've ended right there.

Figure 73: Rookie spotted in the wild. When I saw this attempt, I immediately asked the rigger, ”Have you ever done lifting work before?” Apparently, it was his very first time...
It usually doesn’t take long to realize you’re dealing with a rookie. There’s no limit to the kind of absurd stunts a rookie might try. Photo: Mikko Tourunen

If it’s not immediately clear what’s wrong in the image above, let’s spell it out—this book is aimed at rookies, after all…

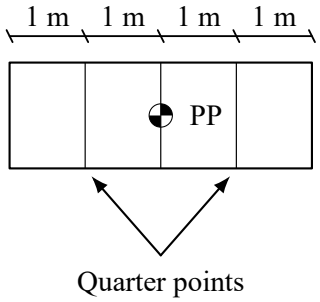
Lifting points should always be placed as symmetrically as possible around the

center of gravity, so the load lifts evenly. In this case, both lifting points appear to be on the left side of the load's center of gravity.

So what's the correct distance between lifting points? Most of the time, you'll want to use what are called the quarter points.

What the hell are quarter points?

Imagine dividing that lumber stack in half. Then take the midpoint of each remaining half–those are your quarter points. When lifting from these positions, internal bending forces in the load are minimized. The moment arms on either side of each lifting point are kept short.



Keeping the load where you put it

Looking at the quarter points alone isn't the whole story when it comes to keeping a load where you put it. There are two separate things at work here, and they protect against two different kinds of force.

The quarter points protect the load against **vertical** forces. If the end of the load catches on something while you're lifting or landing it, it won't tip as easily as it would if the slings were close together.

The other thing is the angle of the slings off vertical, the beta angle. That protects against **horizontal** forces: starting and stopping the slew, gusts of

wind, and knocks from the side.

When both slings are tight, the triangle formed by the slings and the package is rigid. The load can't turn relative to the slings no matter how hard it tries. And as long as that triangle holds, acceleration actually presses the package harder against the slings. So movement in itself isn't the threat.

The trouble starts the moment the triangle gives way. If the beta angle is small, even a fairly modest **sudden** sideways force will slacken one of the slings. Note the word sudden. A steady hard wind just swings the load off to one side and both slings stay tight. What's dangerous is the change: a jerk on the lever, a hard gust, a knock against something.

The smaller the sling angle, the smaller the acceleration needed to slacken one of them, and if you've rigged it as a U-lift, that's a big problem. The sling comes free of the load and swings in towards the middle of it, and that will most likely send the whole package into a roll and drop it.

So what is a big enough angle? It depends on how hard a wind you're lifting in and what sort of package it is. What matters isn't the mass on its own or the wind area on its own, but the ratio between them. A light package that takes up a lot of room is far more dangerous in wind than a heavy small one. And then you can throw friction into the mix as well. The bigger the angle, the bigger the horizontal component in the slings, so the more readily the sling wants to start sliding. You can turn this into a very awkward optimisation problem if you feel like it.

As an order of magnitude: if you're lifting big packages of insulation in a $20\,\mathrm{m\,s^{-1}}$ wind, the beta angle wants to be around $30°$. If it's a calm day and you've got a steady operator, you'll manage fine with a much smaller angle.

But pay attention to where that small angle comes from. It's allowed to come from the slings being long. It is not allowed to come from the lifting points being close together. Those are two different things even though they give you the same angle, and the second one throws away the protection you'd have got from the quarter points as well. If the slings run from more or less the same spot, the package is hanging off a sin-

gle point and is free to roll over whatever the weather and whoever is driving.

And this is why a ratchet strap matters so much. If the package takes a big acceleration and you've got a strap on it, the slings can't go anywhere.

Now, if you're thinking the answer is to always rig it as a choke, you are wrong. It isn't always possible. The load might be something that mustn't have a squeezing force put on it. A sling's capacity is much lower in a choke than in a U-lift, and the load is harder to get to come up level when you choke it. All of these things have to be weighed up every time. There is no one best hitch. There are different hitches, and which one is best depends on the situation.

One typical problem related to chains: sometimes chains have a so-called equalizing plate.

Figure 74: Equalizing plate. Photo: Mikko Tourunen

The equalizing plate is there to address a problem related to four-point lifts. When lifting, for example, a balcony slab element–meaning a four-point lift—without an equalizing plate, it's impossible to know how the forces exerted by the slab are distributed among the different chains. All the chains might appear to be taut, but in reality, the situation could be that two chains are each bearing only 500 kg of tension, while the other two are each bearing 2 000 kg. For the chain itself, this isn't a problem, as typical chains used on construction sites can withstand at

least 4 000 kg of tension per strand. The issue lies in the fact that the chain connects to a wire loop, which is in turn attached to a lifting anchor embedded in the slab. The maximum capacity of these weaker components might be only 1 500 kg.

This uneven distribution of tension arises because not all chains are exactly the same length, and the attachment points aren't perfectly symmetrical either.

Figure 75: Unevenly stretched chains. Photo: Mikko Tourunen

The equalizing plate solves this problem. Up there, two chains are now connected to the plate, which can tilt. It effectively turns the two chains into a single system. And since those two chains are now one system, it means the tension must be the same throughout–in other words, the chains attached to the equalizing plate must have the same tension. The chains on the other side should also have the same tension now, because the slab can settle freely in the direction the forces tilt it.

The problem with the equalizing plate: Now that the plate is in place, it's unlikely that anyone will bother switching to four-strand chains without an equalizing plate after installing the slab–if such chains are even available on the site. Instead, they'll likely keep using the same chains throughout.

When those chains are then used for a two-point lift–the most common type of lift–the person below must remember to look up while attaching the chains and choose chains that aren't connected to the equalizing plate. A common mistake is

to blindly grab whichever chains come to hand first, attaching one end to a chain on the equalizing plate and the other to a chain directly from the lifting ring.

This causes an issue: when the hook starts to lift, the single chain attached to the equalizing plate will cause the plate to tilt upright, effectively making that side's chain about 10 cm longer. This leads to the load tilting to one side, which is a problem for both the safety and smoothness of the lift.

Figure 76: The length difference caused by the tilted equalizing plate. Photo: Mikko Tourunen

At one worksite, we addressed the issue by marking the chain pair without the plate using spray paint, so you could quickly see which chains to attach to the load. This worked, except for occasional riggers and those who didn't speak the language, who hadn't been told the meaning of the chain markings. (And that's one of many reasons why the group of riggers should be a specific, selected team, from whom others, like temporary workers, request lifts, instead of going off and messing things up themselves.)

One mistake often made with chains is that people don't look up at all when attaching them. You should always look up, even if the chains don't have an equalizing plate, to avoid situations like the one shown in the next image.

Figure 77: Mixed-up chains. Photo: Mikko Tourunen

Even if there’s an equalizing plate on the chains, the tension definitely won’t be evenly distributed in a four-point lift if no one has checked that the chains are neatly organized up there.

And finally, always make sure that you **CLOSE THE HOOKS!**

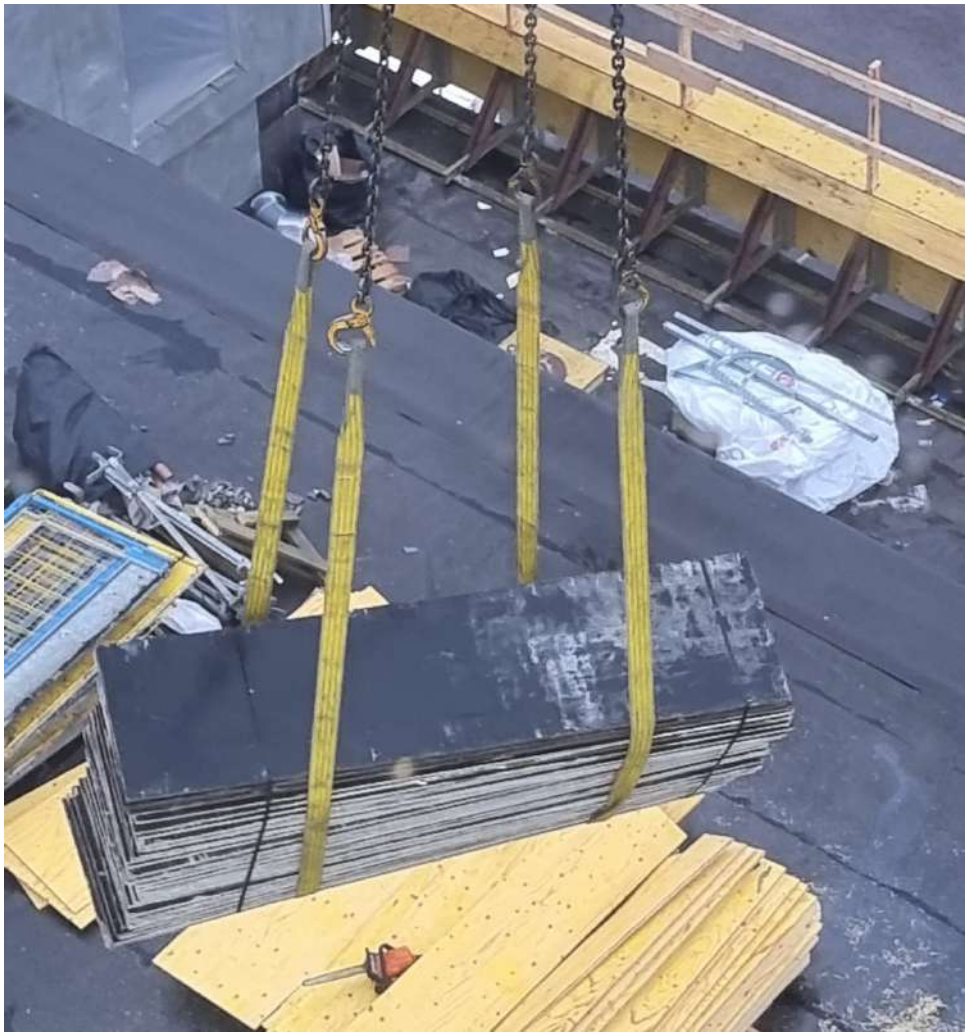


Figure 78: Critical Danger! Photo: Mikko Tourunen

4.6 Shackles

A shackle is a lifting accessory like anything else, which means the same rule applies: **if it hasn't got a WLL stamped on it, it doesn't go on the hook.** The marking is on the body, not the pin. If it's worn off, the shackle is scrap.

Figure 79: A dee shackle with no WLL marking. This is a general purpose shackle. Fine for your home renovation, no use to you on site. And notice that it isn't unmarked – there's a CE mark on it and a DIN reference, which is exactly what makes it dangerous. It looks official enough that nobody bothers to question it. The one number that matters is the one that isn't there. Photo: Mikko Tourunen

There are two shapes you'll come across. A bow shackle is the round one, and it's the one you want when more than one leg goes into it, or when the pull isn't straight in line. A dee shackle is the narrow one, and it takes a straight in-line pull only. Don't put two sling legs into a dee shackle.

Figure 80: WLL markings on shackles aren't written the way they are on other lifting accessories. You can see this one says WLL 4 3/4 T, which is baffling the first time you meet it. It's actually a whole number and a fraction stuck together: $4\frac{3}{4}$, so the WLL is 4.75 t. The odd number is a leftover from imperial sizing. Shackles are sized by the thickness of the body in fractions of an inch – this one is a 3/4 inch shackle – and the old American rating charts gave them capacities in fractions of a ton to match. The numbers were carried straight over into metric catalogues and nobody ever tidied them up. So it isn't a misprint, and there's nothing wrong with the shackle. Photo: Mikko Tourunen

Now the part people get wrong. **The sling goes in the bow, and the fixed part – the lug, the eye, the padeye – takes the pin.** Not the other way round. If the sling sits on the pin and the load shifts even slightly, the sling drags the pin round and unscrews it. That's how shackles come apart, and it doesn't take long.

Screw the pin all the way home. Not nearly home, not finger tight – all the way, until the shoulder is seated. If the lift is going to be hanging for a while, or anything is going to be moving against it, wire the pin so it can't back off. And if it's a job that's going to stay rigged for days, use a bolt-type shackle with a nut and a split pin instead of a screw pin.

Two things that should be obvious but apparently aren't.

Never replace a shackle pin with a bolt, a bit of rebar, or a nail. I have seen all three. A shackle pin is a matched part, made and tested with that particular

shackle. A bolt of the same diameter is not the same thing and it is not rated for anything.

A side pull costs you capacity. If the pull comes in at an angle to the shackle instead of straight through it, you don't get the full WLL. Around $45°$ off you're down to roughly $70\,\%$ of it, and at $90°$ you're down to about half. And that only applies to bow shackles – a dee shackle isn't made to be side loaded at all.

4.7 Calculator

The core of lifting mathematics is this: you're trying to figure out two numbers and compare them.

The first number tells you how much force the lifting gear (sling, chain, etc.) can safely handle, taking the applied mode factor into account.

The second number, which requires trigonometry or sometimes vector math, tells you how much force is actually being applied to that gear during the lift.

Once you've got both numbers, you compare them. The actual pulling force must not exceed the maximum capacity of the lifting gear. If it does, you're dealing with an overload, and the lift needs to be replanned.

The calculator computes the angle of the lift and how much force that angle and load weight generate on the sling. Based on this, it calculates the degree of stress considering the selected sling type and mode factor.

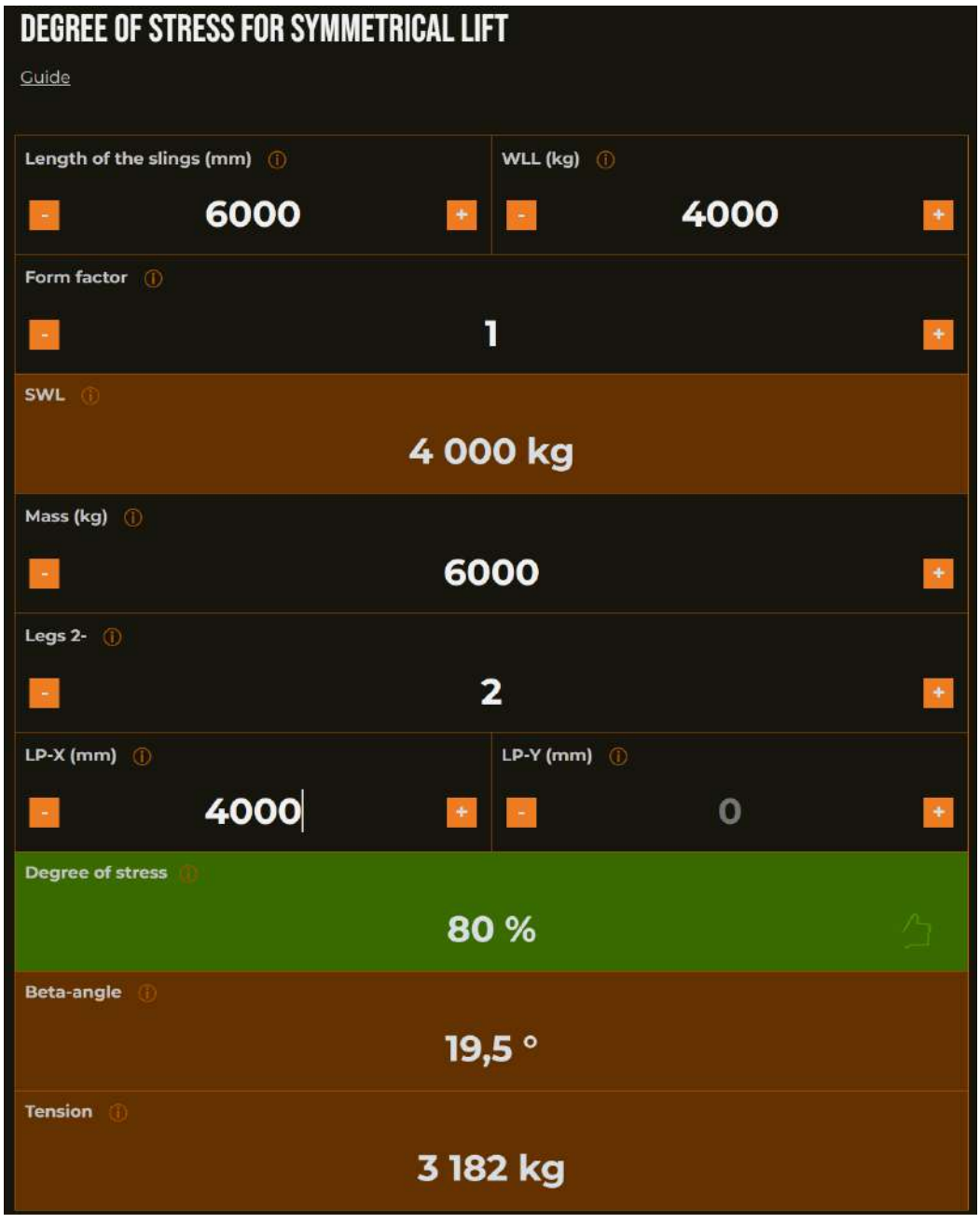


Figure 81: Calculator User Interface

The name of the calculator is Degree of Stress in a Symmetrical Lift. It serves as a reminder that this calculator only gives a correct result when the lift is symmetrical. In other words, if you have something like a wall element hanging at an angle from the hooks, you cannot use this to calculate its degree of stress, because the lifting points are not positioned symmetrically in relation to the center of mass. And that is what symmetry means in lifting: the lifting points are arranged symmetrically around the load's center of mass.

The external shape of the object can be anything–even resemble a Picasso painting–but the lift is still considered symmetrical if the lifting points are symmetrically placed around the center of mass.

The calculator includes an Info button for each field, where you can check what exactly should be entered into that specific input.

The first input field is Length of Slings. This refers to the total length from the crane hook (the "ball") down to the surface of the load—whether it's just chains or chains and slings combined. This is also illustrated in the Instruction window found directly beneath the calculator's title.

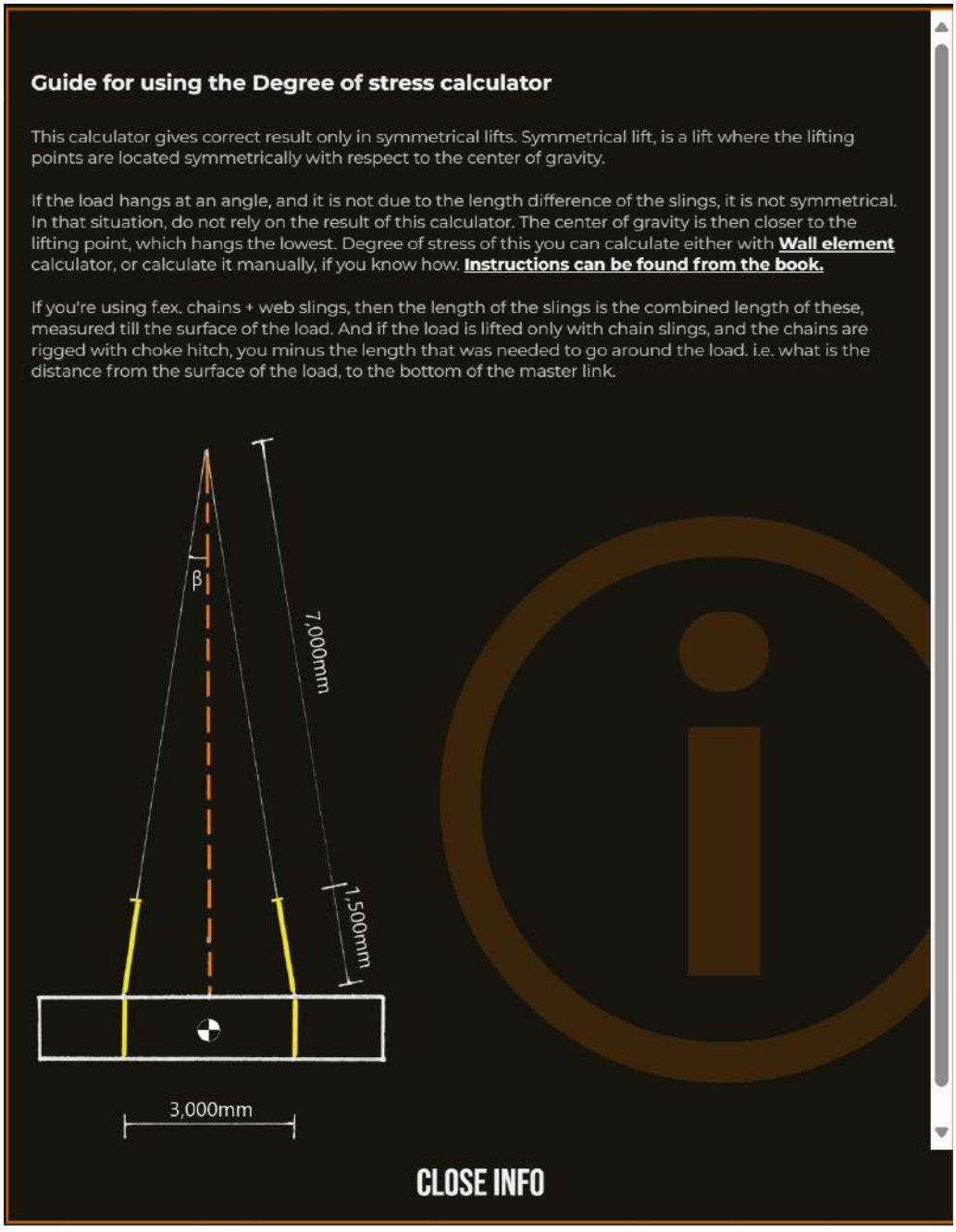


Figure 82: Length of the slings

The length of the sling from the surface of the load is easy to measure with a tape, but the length of the chains is not. That length must be known. If you're working with a professional operator, they will know their chains—including their length. If they don't, then you'll need to measure it yourself, and make sure to write it down somewhere so you don't have to take the chains down again just to measure them later.

Instructions for measuring the length of the chains can be found in the Info window.

The easiest way is to unhook the chains, stretch them out fully, and take the measurement.

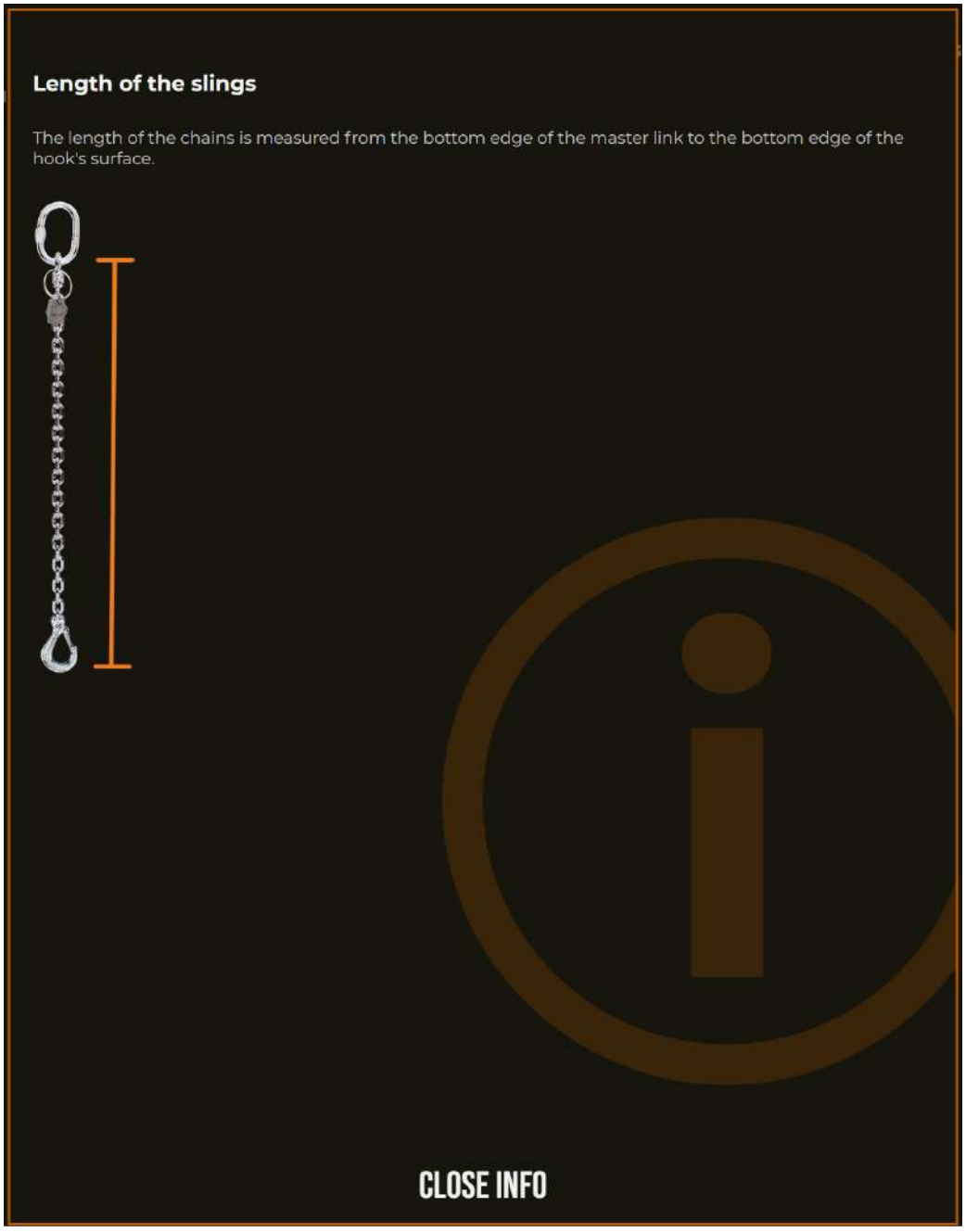
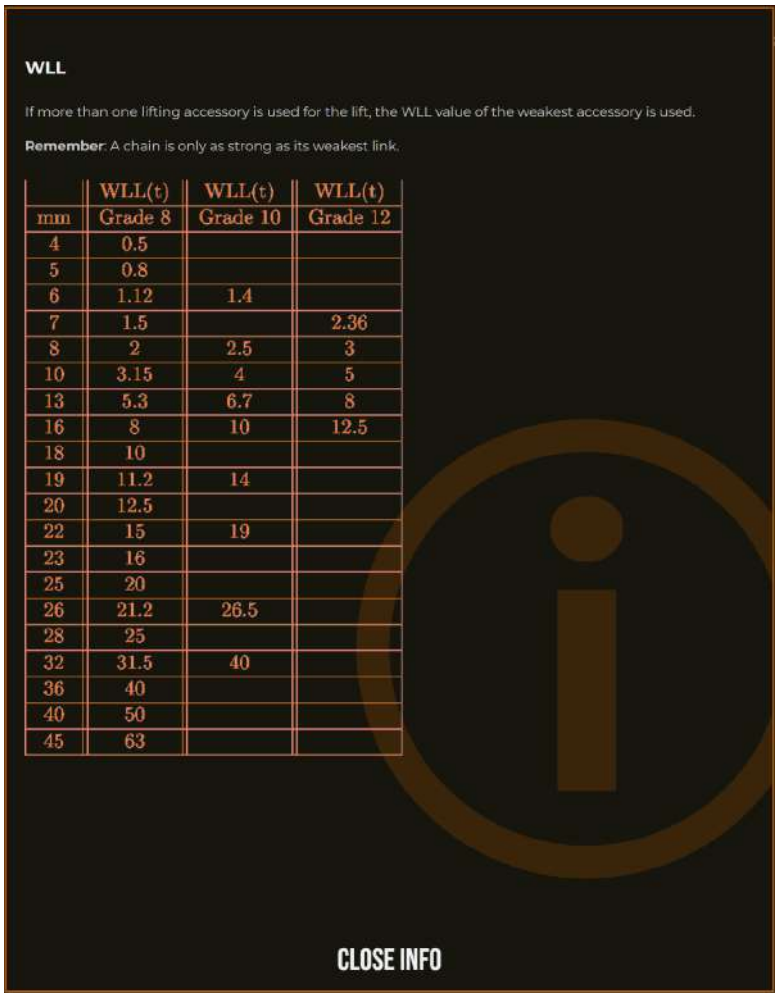


Figure 83: Measuring the Length of Chains

The next field is WLL. This refers to the Working Load Limit specified by the manufacturer of the lifting accessory. If multiple lifting accessories are used in the lift, enter the WLL of the weakest one here. From the Info window for this field, you'll find a table. Use the table to determine the WLL of the chains, since it's not usually printed directly on chains like it is on other lifting accessories.



mm	WLL(t) Grade 8	WLL(t) Grade 10	WLL(t) Grade 12
4	0.5		
5	0.8		
6	1.12	1.4	
7	1.5		2.36
8	2	2.5	3
10	3.15	4	5
13	5.3	6.7	8
16	8	10	12.5
18	10		
19	11.2	14	
20	12.5		
22	15	19	
23	16		
25	20		
26	21.2	26.5	
28	25		
32	31.5	40	
36	40		
40	50		
45	63		

Figure 84: The sling tag on a chain always includes the chain's diameter and steel grade. With this information, you can determine the WLL of the chain. For example: a 10 mm thick chain made of grade 10 steel is rated as a 4-ton chain, meaning its WLL is 4 000 kg.

The next field is for the mode factor of the sling configuration. So you don't multiply it with the WLL yourself – the calculator does that for you. The Info window for this field provides a few common sling configurations to help you recall which mode factor corresponds to which setup.

The next field is SWL (Safe Working Load), which is simply WLL × mode factor. This is calculated automatically – you don't need to enter anything there.

Next comes Mass, meaning the weight of the object being lifted.

Then we have the Legs field. This one is simple: if you're doing a two-leg lift, enter 2. That divides the load between the two legs.

What's not so straightforward is what number to enter in a four-leg lift. Without deeper knowledge of lifting operations, most would probably enter 4, which seems logical. But in reality, for most four-leg lifts, the correct number to enter is 3 – the load is typically assumed to be shared between only three of the legs.

Figure 85: View of the four-leg lift

The reason for this is that the chains are never exactly the same length, and the lifting points are not perfectly symmetrical. In extreme cases, a four-leg lift

may have only two legs tight, and the other two visibly slack, in which case it is essentially a two-leg lift. Most often, all four legs are tight, but you cannot see how the load is distributed among them. Some guidelines state that in a four-leg lift, the load mass should always be distributed between two legs, but the standard method is a compromise between two and four, which is three.

You can set the number of legs to 4 if at least one load distribution plate is installed in the four-legged chains (though often it is not). You can see what such a distribution plate looks like in the Info window.

Figure 86: Load distribution plate

The purpose of this load distribution plate is to balance out small chain length

differences, ensuring that the load is evenly distributed across all four legs.

Another situation where you can set the number of legs to four is when performing a U-lift. In this case, the load always automatically rests evenly on the bottom of the slings, ensuring that the load in all four legs is the same.

Next are the fields NP-X and NP-Y. NP stands for Lifting Point. X and Y refer to the X- and Y-axes. X is horizontal, while Y is vertical. In a two-leg lift, only the NP-X field will have a value, representing how far apart the lifting points are. The Y field will remain zero. In the case of a four-point lift, the NP-Y field will be filled. The calculator then computes the length of the hypotenuse formed between these two sides and divides it by two. This is the opposite leg needed for the trigonometric calculation.

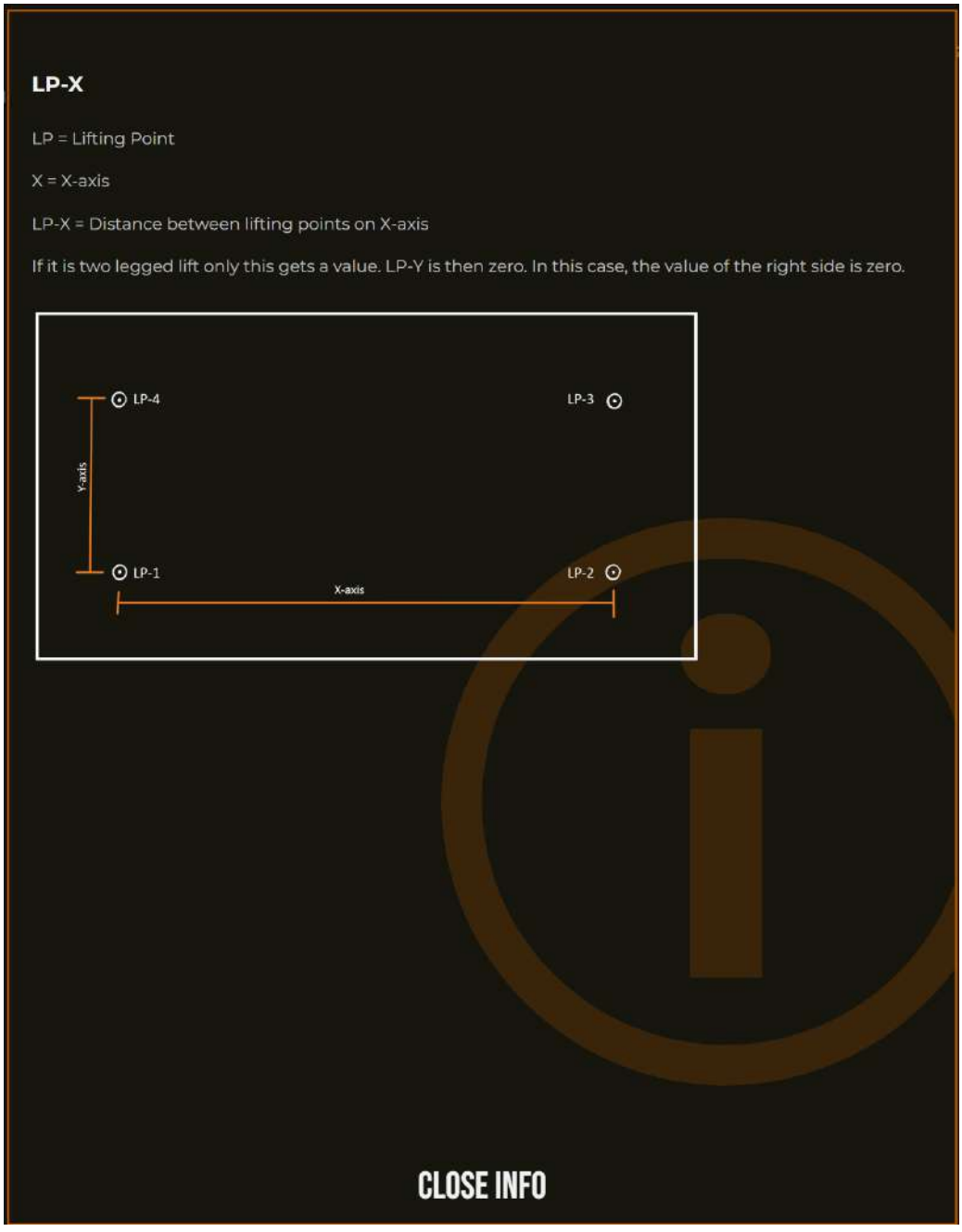


Figure 87: The axes formed by the lifting points

In the next box, you will see the result that all this information was input into

the calculator for. This is the stress level of the lift. The term ”stress level” refers to the percentage of the lifting equipment’s maximum capacity (the weakest one) that is being used.

The box remains green as long as the stress level is between 1-80%. When it goes between 80-100%, the color changes to orange. This is because it is recommended that lifting equipment (and the crane) be stressed only up to 80%. If you exceed this, change to stronger lifting equipment, if available, or adjust the slinging method (mode factor) if possible, or reduce the angle if possible.

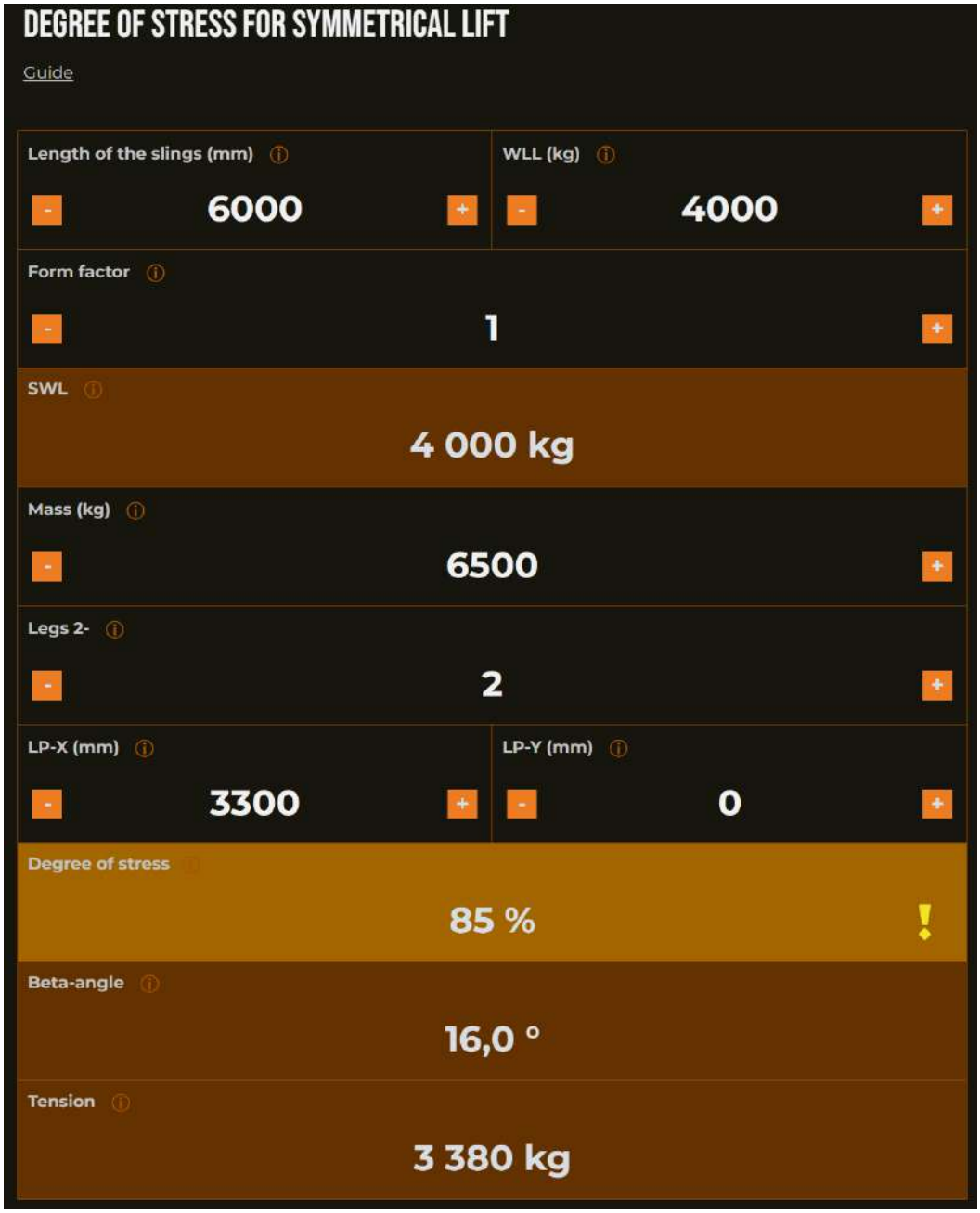


Figure 88: We are in the orange area

And when it exceeds one hundred percent, the screen turns red, indicating that

we are on the overload side, and this means that the lift cannot be performed with the current configuration.

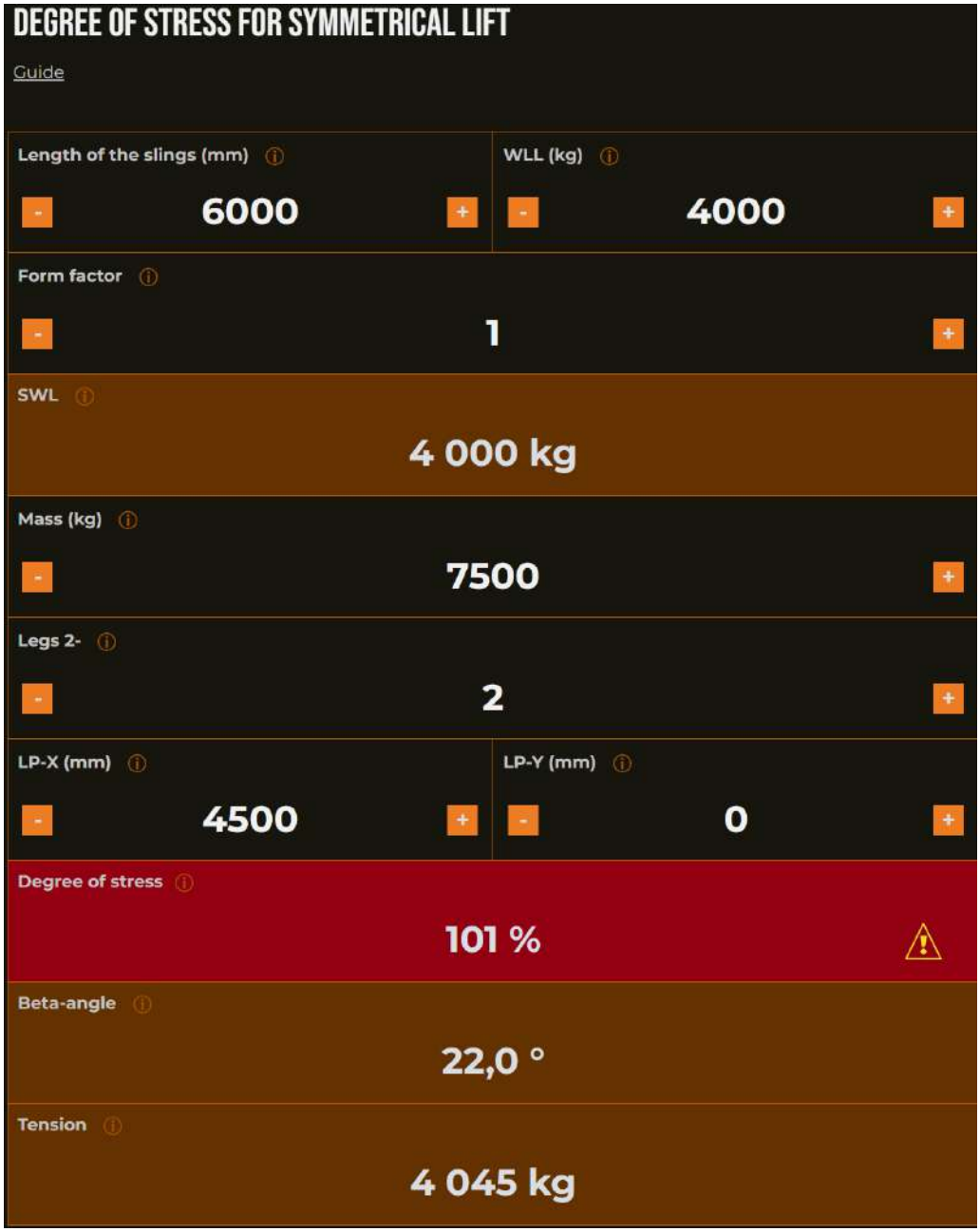


Figure 89: Overload

The final window also provides information about the slope angle, or beta angle. You may not do anything with that information, but it's there if it becomes useful.

Figure 90: Lifting a Gyproc board package

So, we are not allowed to lift these boards with the crane, right? Are you going

to carry them one by one up the stairs?

Let's all head to the bar and get drunk if the job site is going to be this ridiculous.

Then, there are also situations where an upper limit is set for the tilt angle, for example, it should not exceed $45°$.

4.8 Radius of curvature

The final factor related to lifting slings that should be mentioned is the radius of curvature.

This term refers to how tight a turn the sling has to make when the lifting point is a bar. This should be particularly considered when the sling is made of either (steel) wire rope, or chain.

When the sling is made of (steel) wire rope, the bar around which the rope is wrapped must be 25 times thicker than the diameter of the rope in order for the rope's capacity to remain at 100%.

Table 2: The effect of the ratio of diameters on the maximum lifting capacity of rope

Proportion	% of the max.
25:1	100%
20:1	92%
15:1	88%
10:1	86%
8:1	84%
6:1	80%
4:1	75%
2:1	65%
1:1	50%

At least for now, I have decided not to include this in my calculator, so you will have to calculate this effect yourself. Apply that percentage to the WLL field.
If the bar around which the rope is wrapped is, for example, four times thicker than the rope, then it will only carry 75% of the maximum capacity. For example, if the WLL of the rope is 2 tons, you would calculate $2000 \times 0.75 = 1500$. You would then enter this value in the WLL field.

Table 3: The corresponding table for chains. The effect of the diameter ratio on the maximum lifting capacity of the chain. The diameter of the chain refers to the thickness of the chain as indicated on the load tag. You can also measure the thickness of the chain, but be sure not to measure at the weld seam of the link.

Proportion	% of the max.
6:1	100%
5:1	90%
4:1	80%
3:1	70%
2:1	60%
Below 2:1	*Not recommended*

Figure 91: One rigging setup that is frequently seen is when steel cables are tied to the lifting loops of a crane skip. To this day, I haven't figured out what problem this setup is trying to solve. Well, whatever the reasoning behind it is, let's take a look at how it affects the lifting values. Photo: Mikko Tourunen

Figure 92: Rope's WLL 1.45t. Hitch gives factor 0.8, so, the remaining lifting capacity 0.8x1.45=1.16t. Photo: Mikko Tourunen

Figure 93: The thickness of the lifting loop of the crane skip appears to be approximately 20mm. Photo: Mikko Tourunen

Figure 94: The thickness of the steel cable (sinkki) appears to be approximately 10mm. Photo: Mikko Tourunen

The diameter ratio is approximately 2:1. From the table above, we can see that this reduces the lifting value to 65%. So, $1.16 \times 0.65 = 0.754$ t, or approximately 750 kg.

And this is always a four-point lift, and if the chains don't have a leveling device, the load must be divided among only three points. Therefore, $750 \times 3 = 2250$ kg. This does not yet take the angle into account. If you'd like to include its effect, use my calculator.

So, we've already come down 500 kg from the 2750 kg reading on the side of the crane skip.

An important consideration related to this topic is sharp corners on the load. Especially when lifting with slings, the sling must be protected at the corner with a corner protector. There are many types of them.

Figure 95: Here is an example of a corner protector

For example, sharp edges on concrete elements that need to be lifted with slings are great at tearing the sling apart.

One thing to mention about lifting equipment is that it would always be good to have at least one container on the construction site that is designated for the storage of slings and other smaller lifting equipment. Leaving them scattered around the site causes a lot of wasted time, as you'll end up searching for the slings you need all over the site. This container should also be heated during winter so that frozen slings can thaw inside. It's really difficult to tie them up when they're frozen solid.

Of course, on many construction sites, the crew is so undisciplined that they just ignore you if you ask them to put the slings back in the container. It then depends on the management whether they want to tolerate such behavior on their site.

5 Most typical lifts

In the lifting equipment section, we already covered various types of lifts performed using a cart, crane skip, and slings. In this section, we will cover everything else that comes to mind.

5.1 Pallet

First, we could address lifts where the load is placed on a pallet, as these lifts often cause various headaches. In an ideal situation, these loads on pallets would always be lifted using a designated lifting cage.

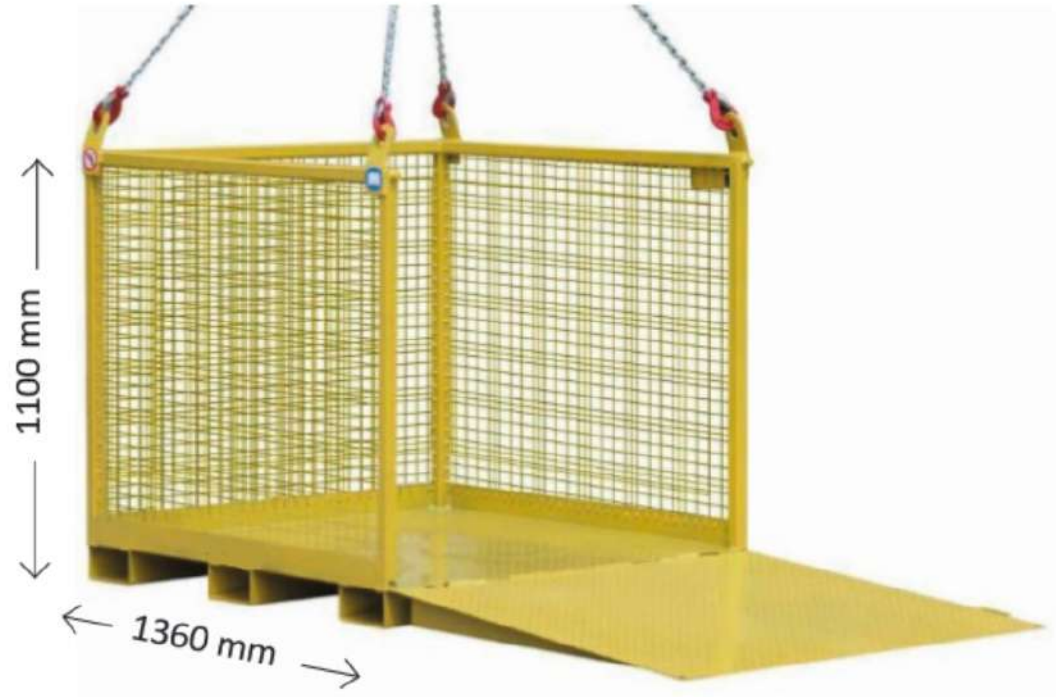


Figure 96: Lifting cage. Photo: st-tukku.net

But on construction sites, it's rare, if ever, that they want to invest in such a cage, so these loads are lifted using lifting accessories.

First reminder: A pallet is not a lifting accessory! So, be careful when tying slings to the pallet + load package. Slings should not be tied in such a way that the success of the lift depends on the pallet boards remaining intact.

Figure 97: If your intention is to kill one of the guys, this rigging gives you good chance of succeeding. Photo: Mikko Tourunen

In the image above, a typical mistake. Whether the sack stays in place depends on whether the wooden boards of the pallet can withstand the twisting force caused by the sack.

Primarily, the sack should always be lifted by its own lifting loops, provided they are intact. If the sack has been opened and cut with a knife, it is important to check carefully if it was cut horizontally. If it was, it cannot be lifted by its loops anymore. There's too great a risk of it tearing. If it was only cut vertically, it can still be lifted by its loops.

If it absolutely has to be lifted with the pallet, the lifting straps should be positioned directly under the sack so that as little force as possible other than compres-

sive force is applied to the pallet.

Figure 98: The straps run directly under the sack. Photo: Mikko Tourunen

Figure 99: The straps are threaded through the opening closest to the sack. Photo: Mikko Tourunen

You might ask, wouldn't it have been better to tie it with a choke hitch? Maybe it would have, maybe not. It's not always obvious that a choke hitch is more reliable, especially when dealing with an object that is more or less irregular in shape. One issue with using a choke hitch on an irregularly shaped object is that one sling might tighten more than the other, causing the object to lean. This, in turn, could shift the center of gravity outside the support leg, which in such a lift, where the lifting points are below the center of gravity, might lead to the object rotating and falling.

The next example is a rigging setup with a forklift pallet, a nonsensical rigging method that is often seen, where the slings are hitched around the corners of the pallet. This rigging turns the pallet into a lifting device, which it is not.

Figure 100: This rigging should never be seen at all. Photo: Mikko Tourunen

Especially rebar workers like this setup. A big pile of hooks on the pallet, and then attaching the corners with slings

Figure 101: A display of craftsmanship by Oulu's rebar fixers. Photo: Mikko Tourunen

5.2 Bituminous membrane rolls

The next problem package is also on a pallet, although the pallet itself isn't the problem, but let's take it up anyway.
A bituminous membrane rolls package. That is, the bituminous membrane rolls standing up, wrapped in blue plastic. These are almost always lifted with slings, and if a beginner is involved, the common mistake is to tie the slings with a choke hitch.

Figure 102: The covering plastic under pressure. Photo: Mikko Tourunen

And what's the problem with that rigging? That pallet of bituminous membrane rolls weighs about a ton, and when it's tied with a choke hitch, the sling presses really hard into that plastic. And it's not some super plastic that can withstand anything.

The plastic might already be slightly damaged at the spot where the sling is, and it could tear during the lift. When that happens, the sling tightens even more, and the package tilts.

And since that plastic is the only thing keeping the rolls upright, once it tears and the package tilts, they come crashing down. The correct way to bind them is with a U-hitch, and then additionally secured at the top with a load strap.

Figure 103: Better way. Photo: Mikko Tourunen

If it is absolutely necessary to tie this package with a choke hitch, whatever the reason might be—perhaps the site supervisor has decided that choke hitch is the only right way to bind every package, and refuses to listen to anything else—then the situation can be saved by placing a pallet on top of the package. The pallet will absorb the pressure from the slings tied with the choke hitch. Alternatively, a couple of appropriately sized planks can be cut and placed between the slings to absorb the pressure.

5.3 Forklift pallet with collars

Figure 104: Photo: Mikko Tourunen

It can be seen that the collars are not firmly attached to the pallet. Even if they are nicely in place while on the ground, they may not stay in place during the entire lift, especially if you tied the slings around them using a choke hitch.

A reach truck or forklift can still lift this from the truck, as it only needs to raise it a few meters at most. However, it's a different story when it's attached to a crane hook, and the load might rise several tens of meters. Would you want such a pallet above you?

If such a steel sheet falls, it will definitely cause injury if it hits. So, don't lift it like that. Lift the whole thing with a crane skip (if available), and then lift it to its destination with the crane skip. Or, if there's no crane skip, those sheets should be loaded onto a pallet trolley and lifted with that

6 Less typical lifts

6.1 Personnel lifts

Sometimes you need to access a high place where scaffolding is not an option, and no kind of aerial work platform can reach, so the only option left is a man lift with a crane.

The attitude of management and occupational safety authorities towards man lifts has always been almost hysterical. Somehow, they see it as so dangerous that as soon as the person goes into the man lift basket, they are in great danger.

Figure 105: Aerial work platform basket. Photo: Mikko Tourunen

The only thing that would make this person lift dangerous would be a completely clueless driver. And if you've noticed in previous lifts that you've had such a driver, make sure to inform the foreman. If the foreman is competent, they will replace the driver.

So, if you have at least a reasonably competent driver, you are quite safe inside the basket. And while you're in there, make sure you have your safety harness on and connected to the basket.

The crane's rope/chains won't fail from such a small load. If they were close to failing, it would have happened with a heavier load. And there is also a safety chain, which is connected at one end to the hook and the other end to the lifting ring on the chains, where the basket is hanging. These chains won't break from such a small load, so that's not what the safety chain is for, but they could fall off if a couple of things go wrong simultaneously. The first thing that needs to go wrong is that the crane's hook lock latch is broken. Then, the second mistake that could lead to the chains falling off the hook is that the driver, or anyone else, doesn't notice that the hook has gotten stuck on an obstacle during the lowering. And as the driver continues to lower, the hook starts tilting. If it tilts enough, the chains fall off since the broken latch didn't prevent it. A colleague of mine told me this happened to him.

There used to be a completely unreasonable requirement that the person lift basket had to be connected to the crane's hook with a separate safety rope (in case the crane's rope broke or the brakes failed). This requirement pretty much meant that no person lifts would be done on construction sites. Later, someone found their brain from the back of a shelf, put it back in their head, and realized that such a safety rope isn't needed.

It's a good idea to bring two walkie-talkies with you. If the driver has lowered you into an elevator shaft, and your phone fails and there's no backup phone, you might be stuck there for a while. The driver can't see inside the shaft through the camera, it's just a black hole on the camera screen. It's also a good idea to have the driver's phone number, so you can communicate if needed. You might also consider having someone stationed at the top of the shaft to monitor the lift, just in case.

Figure 106: Person lift in the good old days. Maybe safety harnesses would be a good idea.

7 Closing Words

Over twenty years of doing this work gives you some perspective. When I started on site, and later when I started as a crane operator, there were still jobs where they didn't even use two-way radios. It became crystal clear very fast what a glaring gap that was. And it was properly frustrating to argue about it with the gaffers of that era, who reckoned they knew everything better (that attitude, mind you, hasn't gone anywhere). Their logic ran like this: nobody used those fucking radios before either, and the building still got finished. These days I don't suppose anyone can even imagine working with a crane without the whole site having radios.

The other thing that became clear pretty quick was that it would be a hell of a thing if the crane had a camera, so you could see what's going on when you're making lifts round the back of the building. Took about ten years of waiting before those cameras started turning up. So that was another ten years of arguing with those goddamn gaffers, who again figured they knew better than some crane driver.

And the arguing with the gaffer-boys carries on. These days the subject is having a grip on the statics involved in lifting work, which is what I demand from the supervisors who are supposedly overseeing lifts. In all its simplicity, the core of my demand is this: on special lifts, the supervision has to use statics to work out the forces that build up in the slings during the lift, which then tells you how strong the slings need to be for the job. But once again what you're up against is that old "we've never done it that way before" argument. Let the operators and the banksmen guess as best they can what sort of pull might end up in those slings.

The universities of applied sciences really could use a specialisation in lifting work. The current education doesn't cover lifting in any way whatsoever. And still, somehow, these rookie gaffers are supposed to be capable of supervising lifting operations.

I'm grateful for all feedback — on any errors you found, or additions you think would fit this work.

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