3M Transcript for the following interview: Ep-44 Fall Protection Engineers Systems Mark Reggers (R) Greg Peterson (P)

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Welcome to the 3M Science of Safety podcast presented by 3M Australia and New Zealand Personal Safety Division. This is a podcast that is curious about the signs and systems of all things work, health and safety, that keep workers safe and protect their health. I am Mark Reggers, an occupational hygienist, who likes to ask the questions Why, How, and Please Explain. Whether you are a safety professional, occupational hygienist, or someone with any level of WHS responsibility in the workplace, maybe you are a user of safety products or maybe you are a bit of a safety nerd who finds this stuff really interesting, then this is a podcast for you.

(R) Today we are talking all about fall protection engineered systems with Greg Peterson. Welcome back Greg.

(P) Thank you, Mark, good to be back.

(R) You did such a great job last time, we couldn't not have you come back and to talk more fall protection with us.

(P) Wonderful.

(R) Wonderful, you sound so excited about that!

(P) No, always good to be here to provide some insight into engineered systems.

(R) So, for those that haven't heard the previous episode we did where we spoke about anchorage points in the fall protection system, can you tell people who you are, where are you from, what do you do, and a little bit of your background.

(P) Yes, I am the technical engineer for 3M Fall Protection, responsible for engineered systems. Anchorage points fall under engineered systems, but so do horizontal lifelines, vertical lifelines, specialist access equipment, powered climb assist that we use inside wind turbines, so they all form what we call an engineered system. So, coming up to my 20th year in fall protection…

(R) Not that we're trying to give away your age or anything…

(P) No, not yet anyway… and prior to that construction site engineering in Sydney working some major projects, and also project manager on some of those projects.

(R) Just a bit of a fall protection working at heights recap, when is someone considered to be working at heights?

(P) Well, a can of worm as we discussed last time.

(R) Fair enough. We did.

(P) So, it's an education process again, which state you could be working in, or territory…

(R) …or country?

(P) Or country, New Zealand, again. So, for Australia we can also consider which site I'm working on, mine sites have different working at heights requirements, builders have different working at heights requirements as well. But working at heights can be determined by the fact that if you are at risk of a fall from one level to another that is likely to cause harm, you are working at heights.

(R) But I could fall standing on the ground and cause harm, is that working at heights?

(P) It certainly is. If you are working near an open trench or an open pit or a hole in a floor on a construction site, you've got the ability or the risk of falling from one level to another, so that is also working at heights.

(R) Not necessarily something that comes to mind when you think fall protection, working at heights, I know initially you think up in the air, or you are up on a tower or something like that.

(P) Correct, falling into a hole is working at heights.

(R) So, for that very broad range of working at heights situations, what is the best way for a PCBU, a person conducting a business undertaking, which is sort of our terminology in a lot of the states in Australia, and employer with responsibility for workers, what is the process I should think about from a fall protection control point of view?

(P) Yes, PCBU must manage the risks to health and safety associated with a fall by a person from one level to another that is sort of reasonably likely to cause injury to that person or to another person. So, a PCBU must consider people who are going to visit the site, or visit their place of work, not just for people that they are employing to do the work. Basically, they should discuss with their employees the

work that will be performed and then conduct a risk assessment. Look at what the hazards are. We then need to manage those hazards, and we can use the hierarchy of control, we can use safe work method statements to mitigate the risk associated with working at heights.

(R) So, from a heights hierarchy of control, so if we are talking elimination, can we bring that task down to the ground rather than having people go to maybe a piece of plant, like that type of thing? I have seen those light poles that have the hinge that you can drop to the ground rather than, say, someone jumping up in an EWP?

(P) Absolutely. And a simple example is if we put an air conditioning unit on the roof do we put it on the edge of the roof where there is a person who has to service it and is now at risk of a fall? Do we move the air conditioning unit into the middle of the roof where they may not need fall protection, or do we move the air conditioning unit to the ground where they certainly don't need fall protection?

(R) I guess that's going to be different for every single situation, like all the stuff that we talk about here is, what is going on, what can we do to work through those steps, rather than this will be fine, and not actually put too much thought or planning around it.

(P) Every application is different and needs to be assessed.

(R) So, we spoke previously about the ABCDE and F of fall protection. Can you just quickly, what are each of those ones in that very important acronym for fall protection?

(P) So, the A will fall into what we call anchorages. So previously we spoke about single point anchorages or anchor points, so we are talking about engineered

systems, so for argument's sake, a horizontal lifeline, it is still classified as an anchorage.

(R) Cause you are attaching to it?

(P) Correct, we are attaching to it. The B, body support, so our harness, and as we mentioned previously, we always want people wearing full body harnesses. The C is connectors, so an energy-absorbing lanyard or self-retracting lifeline. Self-retracting lifelines are used a lot with engineered systems, probably more than an energy-absorbing lanyard. So, they are the primary ones that we consider, A, B and C. If we are working at heights and we are at risk of a fall, then we have to consider rescue. So, the D becomes descent and rescue. It will be a device that we use not necessarily always to lower a suspended or fallen worker, but we may need to raise that person.

(R) I guess that depends on what you are working above, if you are working in a furnace or a smelter you don't want to lower someone down into some toxic chemicals or…

(P) Absolutely. We have had applications with zoos where if someone falls we don't want to lower them down into where the lion is, we need to bring them back up.

(R) I can't say I've thought about that as a working at heights situation, but hey, if you're at a zoo, then yes, that is a very realistic consideration.

(P) It was one we needed to consider. Then the E, the E is really one that I get involved with which is education. We need to educate people on using products correctly for their intended purpose. We don't want people using products that we design and manufacture for a purpose it wasn't intended for. We don't want

people using flight safety equipment in a materials handling environment where they are raising or lowering a gearbox out of a piece of mine equipment. So, we educate people on using the correct equipment for its intended purpose.

(R) One of my little catch lines I have said for many years is you have the best equipment in the world, the right equipment and can do all these things, but if you don't know how to use it, it doesn't matter how good a certain thing is or rated for, and on the flip side you can have all the education in the world but if you don't have the right tools to do whatever that...I'm talking very broadly here, but they go hand in hand with the right equipment and the right knowledge and education to use it appropriately.

(P) That is so true, so true.

(R) And then F, what is our last one?

(P) F now we look into what we call fall protection for tools. The big issue is dropped objects on construction sites, mine sites, we have a lot of public at times, and we have other workers on construction sites. So, dropped objects is a big issue that we have identified. So, if we can provide fall protection for a simple hand tool, we can make the environment safer, but we also increase productivity where people don't drop something and have to climb down a ladder where they are at more risk of a fall and they can continue their work, so productivity is increased as well.

(R) Maybe a spanner or some kind of small tool, but I can imagine the amount of forces it is going to generate if you are dropping it from the 10th floor in high rise construction site to a pedestrian walking below, so...

(P) Absolutely.

(R)...very real considerations.

(P) I was advised the other day of a tradesman that dropped a spanner off a building in Sydney and it went straight through the glass awning below, so that type of force is immense.

(R) First of all, how do we prevent that from dropping, very important stuff.

(P) Well, fall protection for tools, if you would have had a lanyard attached to the end of the spanner that was then attached to your wrist or to a retractable tool lanyard, it would have prevented that from falling.

(R) You said before engineered systems fall under the A, so anchorages. So how do you describe what an engineered system is to someone who is sort of new to the working at heights fall protection space, to sort of frame what an engineered system is and how does it function?

(P) So, we spoke about anchorage points which are a single point. So engineered systems can fall into two categories, what we call pre-engineered or a bespoke engineered system for a specific application. Engineered systems are very different single anchorages that can restrict the movement of the user. An engineered system allows greater movement and safety of the user over a larger or specific working environment. Engineered systems can be found on roofs, above truck loading bays, aircraft hangers, crane rails, anywhere the user needs to move along an area to perform their work, an engineered system is far better than an individual anchor point.

(R) So, going up a ladder, I've seen the ones where it has a wire you attach to the front of your harness, is that sort of fall in the engineered systems space, or is that something different?

(P) No, it certainly does. So that is a vertical system, used a lot in telecommunications, electrical industries, so the person connects while they are on the ground, which is the golden rule. We don't want people climbing a ladder or a structure and then connecting to an anchorage point when they are 30, 40 metres in the air, we want them connecting while they are on the ground, and that cable system you saw protects the person if they slip or fall, or are hit by an object, or attacked by a magpie. So that will stop them falling and they can then resume their work.

(R) That is a very Aussie risk consideration there, attacked by a magpie, I'll have to put that in my next risk assessment, that I'm doing, but a very real thing down here.

(P) I've had people tell me they have been attacked by magpies, a possum ran down a cable and onto the person's face, so there's a lot of things we don't consider in a risk assessment, even bees, wasps will all make us do something we didn't intend to do while we are working at heights.
(R) A lot of these towers, as an example, are out in the middle of regional locations and sitting in the middle of nature and wildlife, so it can be a very good nesting spot for a lot of those things.

(P) Absolutely.

(R) So bespoke systems, what do you mean by bespoke?

(P) Bespoke means it is specifically designed for an application. It is not an off-the-shelf system. So, we need to look at what the application is, there are a lot of

factors that then determine what type of system we design for the end user. We have pre-engineered systems that you can simply obtain and install on a construction site, and they are designed for a limited number of people and give you protection about moving over a complete area. But the bespoke system would probably be more of what we call a permanently installed system.

(R) So, Building A to Building B is going to be a different size, shape, type, access, location, so that bespoke system is taking all those factors in and going out and looking at what is the situation, how many users are going to be on there, that type of stuff?

(P) Correct, absolutely. The number of users is always a critical requirement. Most pre-engineered systems are only designed for two people. So, if a customer wants three to four people up there to do work, we can look at that application and try to provide a system that would then be able to manage their situation.

(R) That leads into my next thought processes, that if I am a building owner or facilities management, what are those things that I should be thinking about let's say before you go to a heights company, or an installer company, what kind of things should you be thinking about or factors when looking at an engineered system on a specific building?

(P) There's many factors, and I don't know that you cover them all every time you look or speak to somebody, but the main things we are looking for are the type of work to be performed, as we discussed the number of users is a critical consideration, location of the system. Every application will be different. Some could be on a roof, some could be on a truck loading bay, so the system location changes for each application. We need to look at available fall clearance. Sometimes when we don't have enough fall clearance, we need to look at the possibility of installing a restraint technique system so that we prevent the person

falling. Or if we can't do that, then we need to not install the system at all and start looking at passive protection. The structure that the system will attach to determines what type of system we might need to use. If we are going onto roof sheeting, we need to make sure that the system has energy-absorbing characteristics so that if somebody does fall it doesn't tear off the structure that it is attached to. Frequency of use how often does somebody want to use the system. Sometimes that determines, do we put a system in or does somebody carry out the work from an elevated work platform rather than worrying about an engineered system. So, as I said, these are just some of the considerations we look into, but we are there to help.

(R) It is very, very broad and as you say there is a ton more, and in this particular timeframe, but I guess they are probably really good starting points to try to frame up those things, I guess each individual workplace, the situation, other things will crop up, you go, yeah, I need to factor that in. So, with these different systems and different factors, how strong does an engineered system need to be. We spoke in a previous episode about single points and dual user anchor points, so I guess it is along similar lines, but it is going to be different for every building and how many users, but is it the same type of strength we are looking at? But across the whole system?

(P) A little bit different. Anchor points we can determine what the maximum force that will be exerted on an anchor point because it is a single user or two users, and the standards then nominates what that number needs to be. Engineered systems are completely different. As we've discussed, every application is different, length of cable, number of users, location, are we using an energy-absorbing lanyard, are we using self-retracting lifeline, so we treat them differently to an anchorage point. The requirement of the Australia and New Zealand standards states we are required to have a factor of safety of 2 to 1, so as the engineer I look at what we call the working load, so if I had two people on a static line and they fell, I can then

determine through a computer program or computer software that we run what those working loads would be, I multiply that by 2 and that will give me what I call my design loads. So very different to anchorage points, and as I said, every engineered system will give me a different result.

(R) I've seen the ones with the wire rope, I've seen fixed rail systems, that is one of those variables depending on the material and their characteristics.

(P) Absolutely. All different, and that is why we assess each one on a case-by-case basis, so we can determine whether a cable system or a rail system is best suited for the application.
(R) You mentioned about shock absorbing lanyards and self-retracting lifelines, I mean a key part of a fall protection system is that ability to take those forces. Is it using a lanyard, or does the system have actually the capacity to take those forces, and how do they…I know I'm asking a big wide question here, but is it the system that is taking those forces, or generally going to be a lanyard that is doing that?

(P) It is a very good question. They will get confused about energy absorption, what they need to do. You must wear an energy-absorbing lanyard, or you must a self-retracting lifeline. Both of those items are for your own personal protection. They reduce the forces going into your body below 6 kN which is the requirement of the standards, and if you are wearing a full body harness and wearing it correctly, and it is correctly fitted, your body can survive that type of force.

(R) Uncomfortable, but you will survive.

(P) You will. But that 6 kN goes back into the system, and then the amount of people on the system multiply the factor, the force that hits the cable or the rail. So engineered systems are designed to absorb the forces that will be imposed on them during a fall, so for a cable system the cable will deflect and stretch, and by

doing so it dissipates the energy which, as an engineer, that is what we want to happen. Depending on the application, the cable system may have its own inline energy absorber. So similar to what we will find in an energy-absorbing lanyard, but it is put at the end of the cable where it attaches to the structure. And if somebody falls, this inline energy absorber will deploy and again reduce the forces in the cable, but more importantly into the structure. So, we are going to make sure that if somebody does fall it doesn't pull out of the structure.

(R) If someone has fallen, and the system has done its job and absorbed those, arresting those forces, do I need to replace my system? How does that assessment go, do I have to, I've had a fall it's done its job, and that's fantastic, but there could be a fair bit of cost to reinstall the system, is that the requirement?

(P) So again, we'd be looking at a pre-engineered system or a bespoke system. A pre-engineered system would go back to the manufacturer for assessment and they would then determine whether it could be repaired, or it would just be made redundant. A bespoke system installed on somebody's roof or aircraft hangar location, truck loading bay, would need to be assessed by an accredited installer from that manufacturer. Depending on the system, such as the length of the system, where the person fell, the fall distance that they went through could determine that a section could be replaced, a part could be replaced, or the whole system may need to be replaced.

(R) So it really comes down to the assessment of the situation, as you say, I mean thinking about it, as you were saying that, have I fallen 600 mm, have I fallen 2 metres that's a big difference, a big difference in the forces generated which is then put onto the system, structure, building it is attached to.

(P) Yes. We had an application where somebody was in a truck loading bay attached to an inertia reel block or a self-retracting lifeline, stepped off the top of

the truck, the system in combination with the inertia reel block stopped the person falling and they actually were able to step back onto the truck, so that is how quickly the inertia reel block stopped the person falling. The system was assessed, there was no damage at all to the system, the inertia reel block went back to servicing, the harness was removed from service and destroyed, and that is an example of it needs to be a case-by-case basis.

(R) So, who can install these systems. We spoke last time about competent person definition, but now are getting into more structural, bigger systems, with a lot more factors, is it still this competent person definition? Or how does that work, because I can image a lot more complexity in a full engineered system than there is in a single anchor point installation?

(P) Correct. And again, we look at, is it a pre-engineered system or is it a purpose-built system as we have already called bespoke system. A pre-engineered system must be installed by a competent person. A bespoke engineered system must be installed by an accredited installer who has been trained by the manufacturer. The reason behind that, there are so many individual components, so we need to ensure that the system is installed as per the manufacturer's recommendations.

(R) Not to downgrade engineered systems, but a very complex Lego set, maybe, is that a basic way... but obviously if someone's life is on the line, if you don't put that system together correctly, adequately, with all those particular factors...

(P) A good point, because a pre-engineered system is already what we would call pre-rigged or pre-assembled, so it is basically attaching it to two anchorage locations and the system will then do the work required. A bespoke system needs to be assembled on site, so that is why it needs to be installed by a highly trained person who the manufacturer accredits and trains to install their product correctly.

(R) How often should an engineered system be checked. It is been installed on this date, who comes back, and how often should they come back to look at all these things to make sure it is going to perform in the event of a fall down the track.

(P) Yes, it falls exactly the same as how often you should inspect a harness. Or how often should you inspect your lanyard. Basically, it goes into different levels or categories, so the user must inspect the system prior to each use, and again after each use.

(R) So, in that inline shock absorption, is that something you can visually see …

(P) Absolutely. Everything in height safety has to have some form of visual inspection to make sure that the person that is about to use it can look at that inline energy absorber and be confident that it is still fit for purpose. The system itself, however, needs to be inspected as per the Australia and New Zealand standards which nominates 12-monthly inspections. However, depending on which state you are in, what construction site you are on, what mine site you are on, that could be six-monthly inspection. And as a manufacturer, we also will then state as per the conditions it is being used in, so systems being used in environments that are quite harsh may require more frequent inspection.

(R) I was going to ask about environmental conditions, you know, being on the coastal area versus inland, I mean, have you seen sort of some quite strong environmental impacts on some of these systems that you sort of go, this is why we inspect this type of equipment to pick these things up

(P) Absolutely. So yes, I have seen systems installed close to the coast, eastern and western coasts, on board ships…

(R) On ships, I hadn't thought about that…

(P) Salt spray, that can be a huge issue, and that is where we look at the system, should it be galvanised, should it be stainless steel, but also environments. Warm environments that are chlorine are not very good for stainless steel. They attack the stainless steel and then it can fracture.

(R) So, like in a pool…

(P) Heated swimming pools, stainless steel is not always a very good item to be using, and galvanised would be far better. So yeah, environments are certainly something we need to consider about which system is best suited for that environment.

(R) With engineered systems, I have heard about 100 percent connection. Can you explain what that concept is and why that is so critical, especially for an engineered system, and ideally all work at height situations if possible.

(P) So, the big advantage of an engineered system over individual anchor points is it allows the user to connect once, and then travel the complete length of the system. Cables have what we call intermediate brackets, and a traveling device such as a shuttle, and that allows it to travel past every intermediate bracket, around every corner, so the person does not have to connect and then disconnect to go past an object. Anchor points rely on the person to connect to the first one, go to the second one, come back to the first one, and disconnect, and piggy back their way around a roof…

(R) Like with double lanyard, you sort of back forth back forth

(P) Twin-tailed lanyards are the main system that somebody would use, and over time people don't do it, and if they are not connected then they are at risk of a fall.

So, an engineered system gives better movement of the user, increases safety, and certainly increases productivity. And by increasing productivity, people are actually working at heights less because they are getting the job done faster, so we are getting them out of that high-risk area a lot faster than what it would be if they were using anchor points.

(R) Is there a maximum amount or limit of the number of people you can have attached to a system, and that would depend on the building and that kind of stuff, but is there a number, or you can engineer it to be that strong, that's okay?

(P) All systems are different. So again, we are looking at the application and then asking the end user how many people they really require on a roof. If you are looking at a roof situation, it should never be one person up there. It should always be designed for two people, it could be three, it could be four. So, we always ask the end user how many people they want and then we design a system around that if that is possible.

(R) If possible, I guess that is always the case, depending on the situation…

(P) The more people, the higher the loads, the greater the deflection, so apart from the structural strength we may have an issue with fall clearances by putting too many people on a system. And there have been times where we are putting multiple systems to allow people to have up to 10 people working on top of an aircraft.

(R) I guess with each system, I guess those redundancies have an independent system, so if one person does fall, it is not affecting the whole work group.

(P) Correct.

(R) So, with multiple people, so I'm thinking visually here you've got a line that is running along, say, a roof, and I've got two people, can they pass each other, or is that part of your work, planning that they sort of, one can work at one end and one can work at the other end?

(P) Absolutely. People can't pass on a single cable or a single rail. There's times where the end user may want that ability that people can pass, for example on top of the aircraft, and that is the reason we put multiple systems in.

(R) So many considerations, I'm just putting in a line or a rail, but I mean, it makes so much sense when you think about all the factors, at the end of the day is it going to be strong enough to have confidence for a worker each and every time they get up there.

(P) And fit for purpose. We need to design systems that people will use. If we design a system that is not user friendly it is not going to be used.

(R) And that's the same with any equipment or process, what do people do, how do we do it, because otherwise people find their own way if it doesn't do the job, and that is when that increased risk potential may come into the situation.

(P) Absolutely.

(R) So, summing up engineered systems, to bundle it up with a lovely bow, what would you leave with our listeners sort of to summarise.

(P) Engineered systems are purpose-built in the majority of applications, as I said, a bespoke system. They offer a greater safety than individual anchor points because they take away the responsibility of the user to connect to an anchor point and make sure they are always connected to an anchor point at all times.

(R) Taking out that human element.

(P) Absolutely. They do increase productivity. You can get your work done a lot quicker on a roof with an engineered system than what you can with individual anchor points, and we can look at whether a cable system or a rail system is the best suited for each application.

(R) Probably the final point to leave is that every situation is different, so go through those factors, you can give 3M a call, get in contact with Greg with the show to have that conversation, to make sure that system is fit for purpose. So, Greg, for people that want to delve a bit more deeply into engineered systems as far as resources, where are a good couple of starting points and places they can go to?

(P) Certainly, Safe Work Australia. I think they can offer information on the differences between anchorage points and engineered systems. Your local or state authority is certainly another avenue that you could explore. Working At Heights Association, WAHA, certainly has a lot of technical documents on there and they are very happy to provide advice on which engineered system would best suit needs. And finally, the 3M website, we have a lot of information there and resources that can assist end users, builders, architects, and designers, to understand the differences between all the engineered systems and anchorage points.

(R) It comes down to, depending where you are, make sure you know what your legal obligations are, because we are talking very broadly here between states and countries and territories, so make sure you do check what are your specific requirements and you are meeting those obligations. Well thanks for coming in Greg, really appreciate your time again.

(P) No problems, Mark. Enjoyed my second round.

(R) Thanks for listening, everyone. If you have any questions, comments, suggestions for future topics or guests you think it would be great to get in the studio, you can shoot us an email to scienceofsafetyanz@mmm.com. You can also contact us via that email if you need any help or information around engineered systems, fall protection, or any other PPE, 3M are certainly here to help. You can also visit our website, 3M.com.au/sospodcast which has a transcript of the chat that Greg and I have had, plus all the previous episodes as well, including links to resources that we have discussed. Be sure to subscribe to the podcast through Apple podcasts, Spotify, or wherever you get your podcast from so you don't miss any future episodes, and if you enjoyed the podcast or found it informative, we really would appreciate if you can take a few moments and leave us a review as it really does help other people to find the podcast. And as Robert Wright said, "You can't inspire people if you are going to be uninspiring." Thanks for listening and have a safe day.