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Rebar and Reinforced Steel Work in Construction

Construction Industry

Sales Training – 3M Sales and Channel Partners

November 2021

Opening Points

- This presentation is based on current United States federal requirements
  - US state or other country requirements may be different
  - Always consult User Instructions and follow local laws and regulations
- This presentation contains an overview of general information and should not be relied upon to make specific decisions
- Completing this program does not certify proficiency in safety and health
- Information is current as of the date listed for this presentation, and requirements can change in the future
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Why 3M?

3M offers integrated safety and health solutions designed to help keep employees protected and comfortable.

As we all know, the construction industry can be one of the most dangerous working environments, where the worker is exposed to a multitude of potential hazards while working at heights. Your customer may be “working at height” if they are working in any place where a person could fall causing injury. This includes working on a ladder, scaffolding, flat or sloped roofs, near a floor or wall edge, fragile surfaces and many other locations.

This training will focus on rebar and reinforced steel work applications in construction. We’ll cover some of the hazards, best practices and suggested PPE for working on reinforced concrete applications at height.

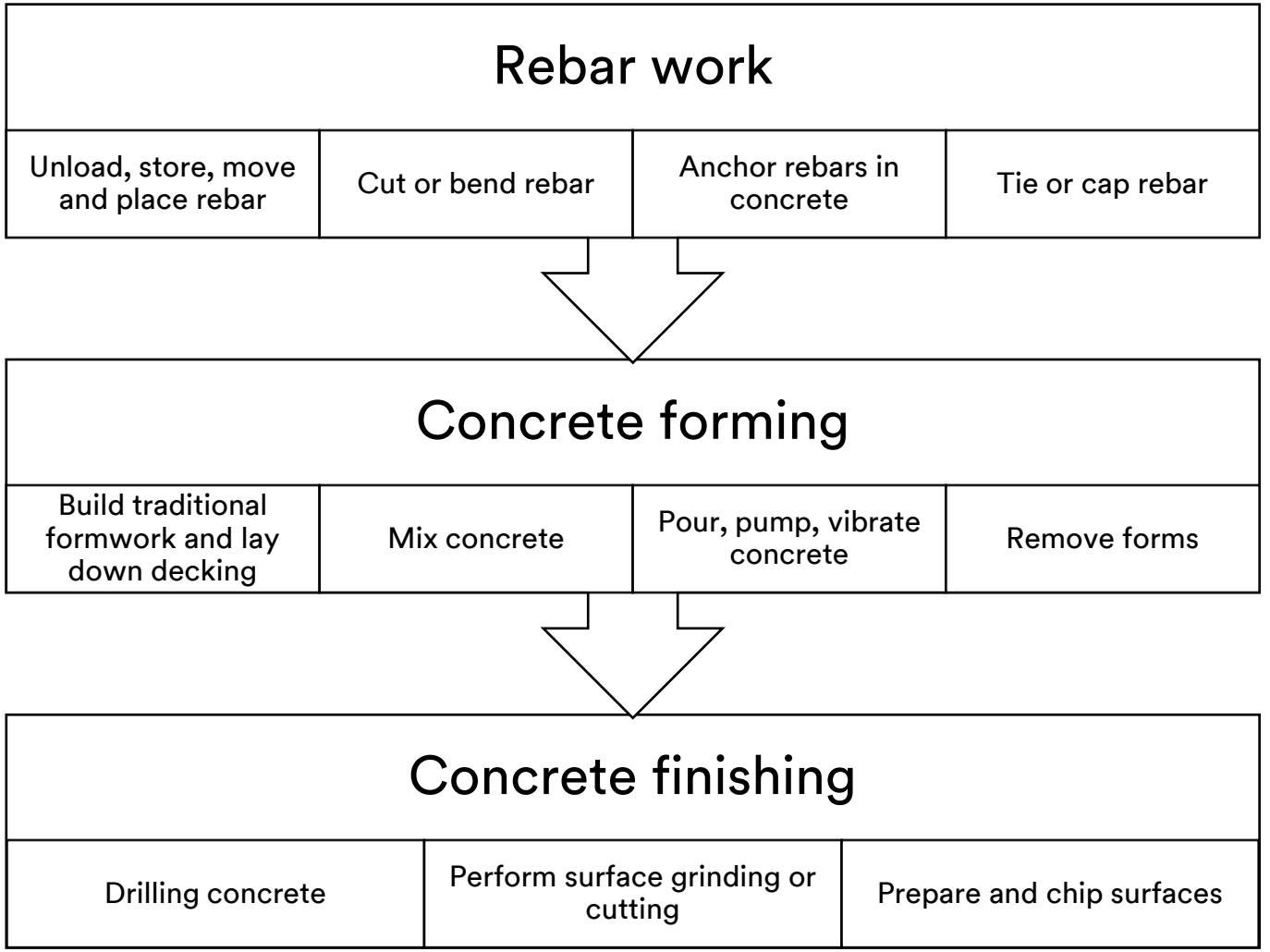
Introduction Reinforced Concrete Work Applications

In this training we will cover definitions, trades, common hazards, injuries and best practices found in concrete formwork, rebar and reinforced steel work.

These applications can be found in multiple sub-segments of construction including infrastructure, commercial and industrial construction.

Review the graph on the right to further understand the process of reinforced concrete work applications on a construction site

Additional information on concrete finishing, silica and related hazards will be provided in additional training material.



Source : Construction Solutions (cpwrconstructionsolutions.org)

What is Rebar and Reinforced Concrete?

Reinforced concrete is a type of concrete that requires **reinforcing steel bars (commonly referred to as “rebars”),** reinforcement grids, plates, steel tendons, fibers or other material to increase its tensile strength.

Reinforced concrete containing rebars can be found in structural components, such as:

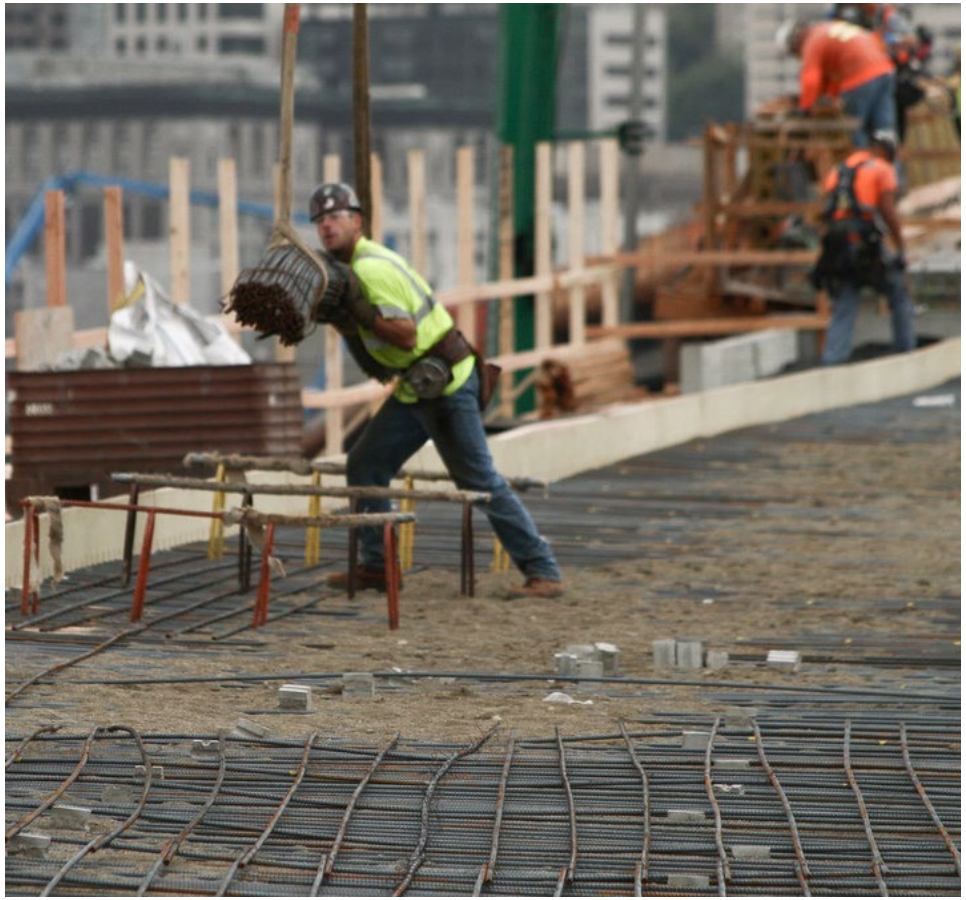
- slabs
- walls
- beams
- columns, and
- foundations.

What is Rebar and Reinforced Concrete?

Reinforcing bars (rebar) are shipped from the fabricator for specific parts of the structure. When conditions at the jobsite permit, reinforcing bars are delivered to a storage or laydown area and unloading will be as directed by the Ironworker Foreman. (4)

Iron workers place the rebar in the structure per the engineering design. This may include tying, welding, capping or cutting the rebar to create the desired structure. Workers may be required to work at height to complete these tasks. In addition to working at height, workers must also be protected from the hazards of impalement.

Concrete formwork is built around the rebar or cages. Concrete is poured into the forms to create floors, columns, decks, etc. The formwork is removed after the concrete has properly cured. After which, additional finishing steps such a drilling or grinding may occur. Temporary or permanent fall protection anchors may be installed during this phase.



4 https://www.crsi.org/index.cfm/concrete/handling

Where do you find Rebar and Reinforcing Steel Bars?

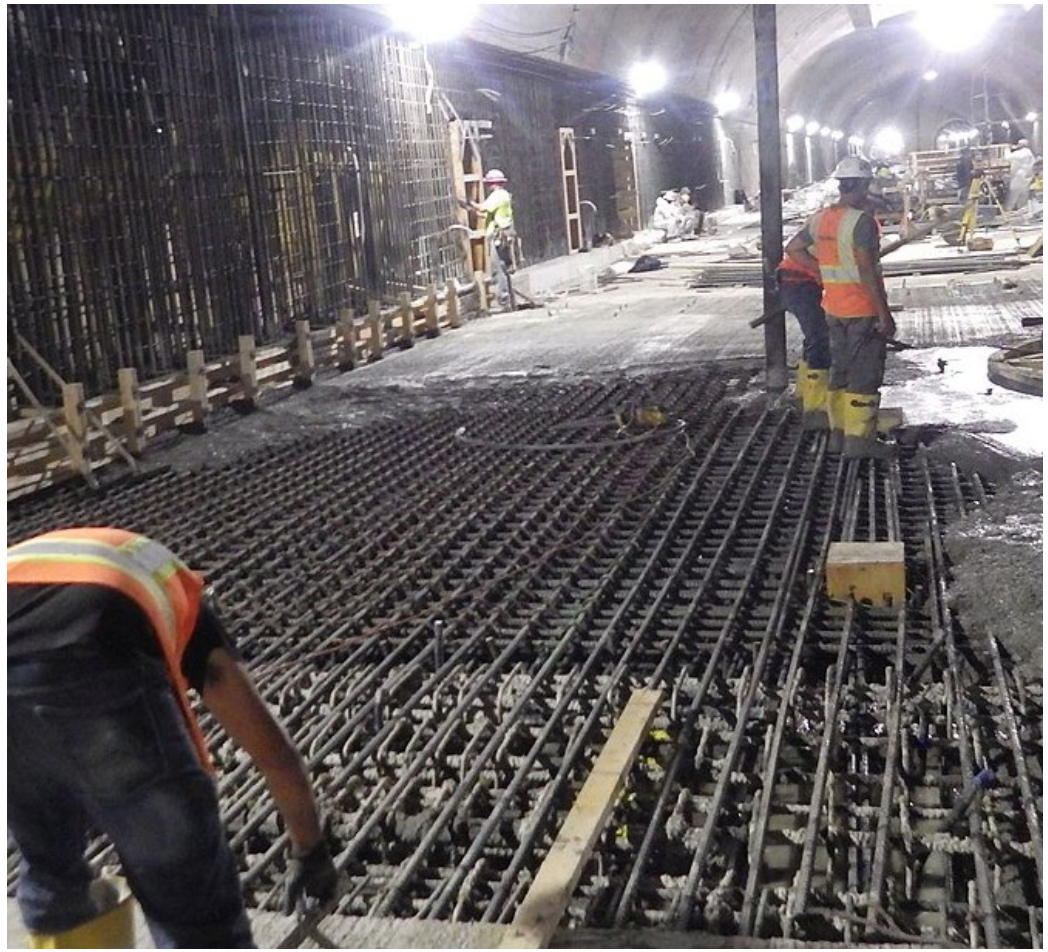
Rebar is used in the construction of bridges, tunnels, buildings, skyscrapers, homes, warehouses, and foundations to increase the strength of a concrete structure. Workers can be found in many jobsite locations placing and tying reinforcing rods on construction sites.

Structural Steel and Precast Concrete Contractors

(238120) complete this type of work(3):

Example contactors to contact may include:

- Concrete product (e.g., structural precast, structural prestressed) installers
- Rebar contractors
- Reinforcing steel contractors
- Precast concrete panel, slab, or form installers



3 https://www.naics.com/naics-code-description/?code=238120

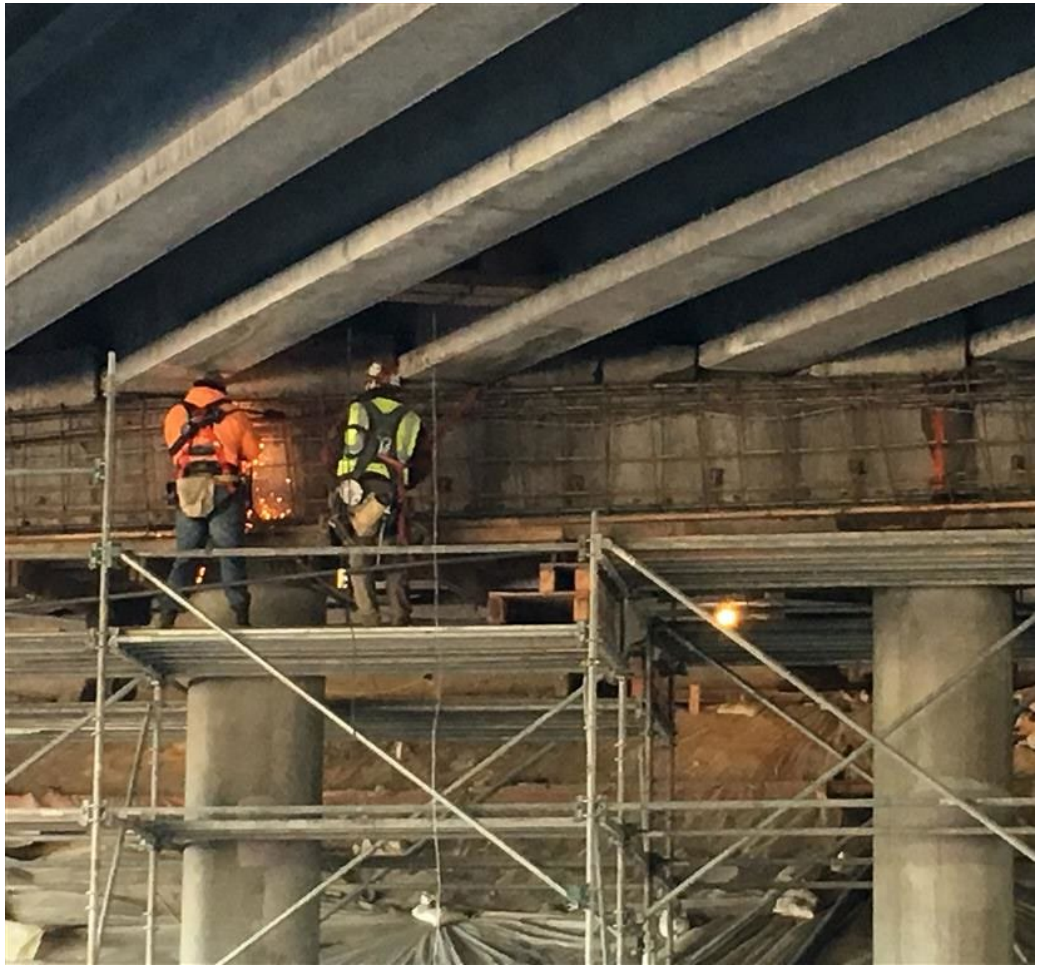
Trades working on Rebar and Reinforced Steel Work

Trades may include [7]:

- Reinforcing ironworkers
  - Rebar workers
  - Rod busters
- Crane operators
- Flaggers
- Welders
- Carpenters
- Concrete Masons
- Construction Laborers

According to the Washington Post ironworkers call themselves "cowboys of the sky," the guys who bolted together the Golden Gate Bridge, the St. Louis Arch, the World Trade Center. [8]

7 https://nabtu.org/apprenticeship-and-training/list-of-construction-trades/
8 https://www.washingtonpost.com/archive/politics/2000/11/02/i-beam-cowboys-are-riding-high/4aeca826-57e8-4ebb-8195-9ddb0983b1a3/
More information about trades at
https://studentscholarships.org/salary/417/structural_and_reinforcing_iron_and_metal_workers.php



Hazards of Rebar and Reinforced Steel Work

Workers may be required to step on foundational rebar and climb up or navigate around vertical rebar cages both on the ground and at height to perform a variety of tasks. While doing so, they are at risk for slips, trips and falls from height.

Depending on the height and location of the rebar or cage, falls can occur due to being on a collapsing vertical rebar structure, improperly anchoring while work positioning or even tripping on foundational rebar or scraps while at height.

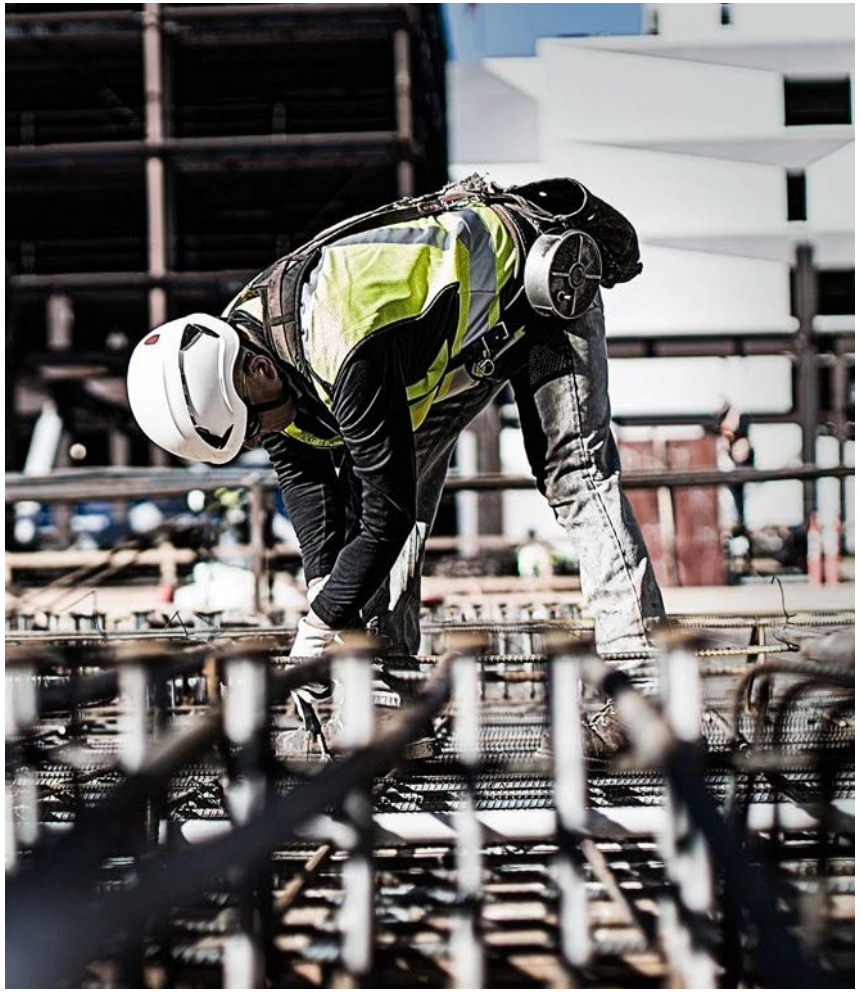
Hazards of Rebar and Reinforced Steel Work

While structural collapses and falls may be among the more apparent hazards for workers working with rebar at heights and in concrete formwork construction, any of these scenarios involving rebar work can threaten the wellbeing of a construction crew:

- Falling from heights onto exposed, protruding rebar, which can cause impalement
- Individual rebar falling from height and striking a worker
- Tools and other objects dropped by workers from vertical rebar
- Objects falling from platforms adjacent to vertical rebar
- Strikes to the head from protruding rebar
- Protrusive footing rebar blocking walking spaces and leading to trips and falls
- Rebar scraps on a jobsite leading to trips and falls
- Formwork pins protruding from low levels that can lead to injuries
- While similar hazards exist at ground level, reaching and rescuing injured workers at height is often more challenging and time-consuming.

Common worker injuries in Rebar and Steel Tensioning

Once a rebar cage is erected, rebar workers, rod busters and iron workers often scale the structure to continue work at heights like cutting, reinforcing and shaping the bars, and installing fasteners and anchor points prior to concrete form installation.



During these tasks, workers may be exposed to injuries including:

- Arc burns from welding
- Foreign body injuries to eyes from flying particles and sparks
- Injuries to respiratory system due to inhalation of contaminants from cutting and grinding
- Cuts from rebar binding wire
- Tendonitis (inflammation in the hand, wrist or shoulder) or carpal tunnel syndrome from performing stressful hand activities while tying or capping rebar (9)
- Head injuries from dropped or protruding objects

9 Hazard Analysis | Reinforced Concrete - Tie or cap rebar - Stressful hand & wrist activity. CPWR.
https://www.cpwrconstructionsolutions.org/hazard/372/stressful-hand-wrist-activity.html

Concrete Formwork and Finishing Work Hazards

After the rebar or rebar cage is constructed, concrete forms may be erected to hold the concrete in place as it is poured and cured.

Concrete anchors may be placed in the concrete to create permanent anchors for future use or temporary anchors which may be removed when construction is complete.

The process of mixing the concrete, pouring it, finishing it or repairing it, may involve many hazards. These may include:

- working at heights,
- leading or sharp edges,
- exposure to silica dust and other chemicals,
- noise,
- potential for foreign body eye injuries,
- bumps to heads and
- falling objects and debris.

Applicable US Safety Regulations

Standards on Formwork, Reinforcing Steel & Concrete

Standard	Task	Height	Protection Options
1926.501(b)(5) "Formwork and reinforcing steel."	Employees working on the face of formwork or reinforcing steel	6 ft 1.8 m	Personal Fall Arrest Systems Safety Nets Positioning Devices
1926.501(b)(12) "Precast concrete erection."	Each employee engaged in the erection of precast concrete members (including, but not limited to the erection of wall panels, columns, beams, and floor and roof "tees") and related operations such as grouting of precast concrete members	6 ft 1.8 m	Guardrail Systems Safety Net Systems Personal Fall Arrest Systems

Applicable US Safety Regulations

Additional Regulations for Rebar and Reinforced Concrete (cont.)*

Standard	Task/Exposure	PPE Protection Requirements
1926.701(f) "Concrete and Masonry Construction"	Employees applying cement, sand, and water mixture through a pneumatic hose	Head and Face Equipment
1926.52	Noise Exposure	Hearing Protection
1926.1153	Silica Exposure	Respiratory Protection

***Not an exhaustive list, other standards may apply.**

Applicable US Safety Regulations

Regulations on Dropped or Falling Objects

OSHA requires that if you work in an area in which you're at risk of being hit by something that falls, you must:

- Secure tools and materials to prevent them from falling on people below.
- Barricade hazard areas and post warning signs.
- Use toe boards, screens on guardrails or scaffolds to prevent falling objects.
- Use debris nets, catch platforms or canopies to catch or deflect falling objects.
- Wear hard hats

USA Department of Labor – OSHA 29 CFR 1926.501(c), 1926.759(a) www.osha.gov

CONSTRUCTION STANDARD 1926

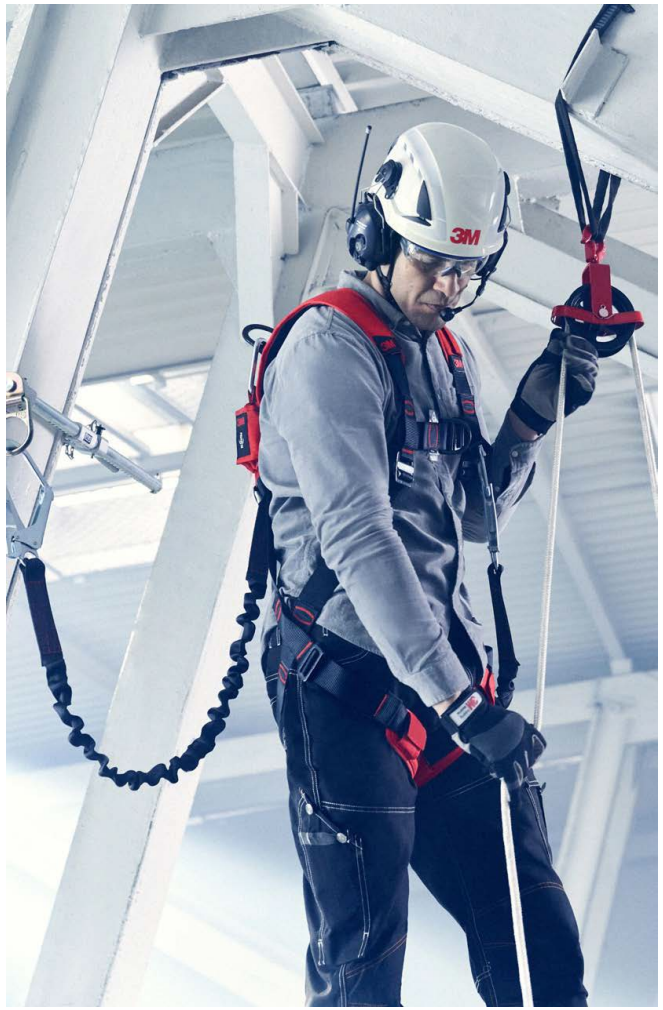
Fall Protection 1926.501(C)	Protection from Falling Objects
Steel Erection 1926.759 (A)	Securing loose items aloft

Best practices

Reducing rebar cage work injury and fatality hazards starts by creating a culture of safety.

Beyond structural planning, there are many precautions construction teams can take to maximize their rebar and cage work safety at heights. Here are some of the most important considerations can help reduce the chance of harmful falls from elevated work areas:

- Train employees to recognize the presence of hazards when working on or around rebar
- Providing workers with the appropriate personal fall arrest systems (PFAS) and ensure they have been trained to use them
- Developing a rescue system to respond to falls
- Prioritizing correct procedures when using work positioning system equipment
- Maintaining and inspecting positioning equipment regularly
- Avoiding climbing overhanging rebar [10] [11]



10 Rebar Safety. https://www.constructioncenterofexcellence.com/toolbox-talks/rebar-safety
11 Casey, M. J., & Urgessa, G. S. (2013). Rebar cage construction and safety: best practices. Published by the American Society of Civil Engineers.

3M PSD examples of potential solutions for this application

- Rebar, Cage Work and Steel Tensioning Applications at Heights
- Concrete Formwork and Finishing Applications at Heights

		3M™ DBI-SALA® Nano-Lok™ Edge Twin-Leg Quick Connect Self Retracting Lifeline	For personal fall arrest connection applications in rebar cage work and steel tensioning, in addition to **SRLs with rebar snap hooks** (see connecting device section), other anchorage connection options may include products such **as anchor straps, beam clamps or other approved anchorage connectors**
	Anchor	3M™ DBI-SALA® Concrete Anchor Strap	**For aerial bridge and high-rise concrete formwork:** This disposable strap provides a temporary anchorage on concrete forms and is extremely easy to install and use. Loop slips over rebar, then concrete is poured over. When no longer needed, simply cut strap and discard.
	Anchor	3M™ DBI-SALA® Concrete D-ring Anchor	Simple, versatile concrete anchor for temporary or permanent applications. Extremely rugged design for extended life and jobsite flexibility. Secured to concrete decks and columns, these anchors are lightweight and compact, providing an easy to install and secure 5,000 lb. (22 kN) tie-off point for enhanced worker mobility on concrete construction sites.
	Anchor	3M™ DBI-SALA® Construction Roof Anchor 2190074	Installs to the rebar ring during pre-cast concrete work.

3M PSD examples of potential solutions for this application

🔴 Rebar, Cage Work and Steel Tensioning Applications at Heights

🟡 Concrete Formwork and Finishing Applications at Heights

	Body Support	3M™ Protecta® Construction Style Positioning Harness 🔴🟡	This harness provides front D-rings for work positioning while anchored to the rebar. We listened to steel erectors and created shoulder caps that protect the webbing on our latest harnesses.
	Connecting Device	3M™ DBI-SALA® Nano-Lok™ Edge Twin-Leg Quick Connect Self Retracting Lifeline, Cable 3500227 🔴🟡	For Rebar, Cage Work and Steel Tensioning Applications at Heights This SRL features a twin leg Quick-Connector and steel rebar lock hooks. These allow for anchorage connection to the rebar. The SRL is ergonomically designed for ease-of-use and is ideal for direct connection to most harnesses. It locks quickly, stopping a fall within inches and providing more protection at low heights. In addition, tension is always kept on the lifeline, which reduces dragging, snagging and trip falls. For aerial bridge and high-rise concrete formwork: Backpack design stays tight to the harness and helps evenly distribute the unit's weights. When working amongst formwork structures, its impact-resistant housing provides durability.
	Descent Device	3M™ DBI-SALA® Rollgliss™ R550 Rescue and Descent Device 🔴🟡	Super-tough nylon makes the rescue wheel lightweight and durable. The ergonomic design provides a better grip and more control to quickly access a fallen worker.
	Fall Protection for Tools	3M™ DBI-SALA® Parts Pouch 🔴🟡	Designed for small parts such as rebar tie wire, nuts, bolts, screws and nails. The innovative Parts Pouch traps objects inside, making it nearly impossible for them to fall out when working at height.

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	Lifeline Systems	3M™ DBI-SALA® SecuraSpan™ Rebar/Shear Stud Horizontal Lifeline System	For aerial bridge concrete formwork: Our broad selection of horizontal lifelines offers significant advantages in safety and productivity and has been precision engineered for specific applications, including connection point, connection type and number of users, and rigorously tested to meet industry standards.
	Lifeline Systems	3M™ DBI-SALA® SecuraSpan™ Pour-in-Place Horizontal Lifeline System	For rebar work at height: Used to help protect workers operating in the horizontal plane who may not otherwise have continuous access to suitable anchorage points. These systems are often designed for use with shock-absorbing lanyards and self-retracting lifelines. Per OSHA 29 CFR 1926.502(d)(8), "horizontal lifelines shall be designed, installed, and used, under the supervision of a qualified person, as part of a complete personal fall arrest system, which maintains a safety factor of at least two. *For aerial high-rise concrete formwork:* Our broad selection of horizontal lifelines offers significant advantages in safety and productivity and has been precision engineered for specific applications, including connection point, connection type and number of users, and rigorously tested to meet industry standards.
	Lifeline Systems	3M™ DBI-SALA® EZ-Line™ Retractable Horizontal Lifeline System	For rebar work in steel tensioning/Concrete form work and deck work: This temporary horizontal lifeline system is user-friendly and extremely fast to install and dismantle with a built-in retractor winch. The innovative retractable design eliminates large and bulky coils of cable that are difficult to set up, relocate and store. These systems are often designed to be used with shock-absorbing lanyards and self-retracting lifelines. All horizontal lifeline systems must be installed and used under the supervision of an OSHA defined qualified person.

3M PSD examples of potential solutions for this application

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	**Respiratory Protection**	3M™ Aura™ Particulate Respirator 9205+	The lightweight, three-panel designed respirator helps provide quality, reliable and convenient respiratory protection. 3M's proprietary filter media, 3M™ Advanced Electret Media, filters dust and other particles, while allowing for easy breathing.
	**Respiratory Protection**	3M™ Particulate Respirator 8214	Some rebar cages are welded. Consider respiratory protection designed for welding where exposure hazards dictate. This N95 particulate respirator is designed to help provide respiratory protection for certain non-oil particles in applications such as welding, soldering and other construction operations in which metal fumes may be present. The respirator incorporates 3M's proprietary technology with advanced electrostatically charged microfiber filter media, designed for ease of breathing when you need it the most. The proprietary 3M™ Cool Flow™ Exhalation Valve helps reduce heat build up inside the respirator to help keep the wearer more comfortable.
	**Respiratory Protection**	3M™ Rugged Comfort Quick Latch Half Facepiece Reusable Respirator	This reusable respirator has a resilient silicone faceseal, offering extended facepiece life. The adjustable head cradle and straps work together to offer an optimal fit, and the facepiece features our proprietary quick latch design, which offers an easy, one-hand touch drop-down mechanism for putting the facepiece on and taking it off while moving in and out of contaminated areas. Consider 3M™ Advanced Particulate Filter 2297, P100, with Nuisance Level Organic Vapor Relief for welding fumes and 3M™ Advanced Particulate Filter 2291, P100 for grinding applications. For aerial concrete bridge formwork and silica work, pair with 3M™ Particulate Filter 2091
	**Respiratory Protection**	3M™ Versaflo™ Heavy Industry PAPR Kit TR-600-HIK	This system features loose-fitting headgear that eliminates fit testing and can accommodate certain limited facial hair. Faceshields help provide eye and face protection, and hard hats additionally help provide head protection. In addition, employees with prescription safety eyewear can keep their glasses on under loose-fitting headtops.

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	Head, Eye and Face Protection	3M™ SecureFit™ 500 Series Safety Glasses	Eyewear features a contemporary lens design in a variety of lens tints and coatings, coupled with adjustable ratchet temples and 3M™ Pressure Diffusion Temple (PDT) technology to help provide comfortable pressure equalization.
	Head, Eye and Face Protection	3M™ SecureFit™ X5000 Series Safety Helmets	Safety helmets are designed to help protect workers from small falling objects with the security of a chinstrap. This climbing-style helmet delivers all-day comfort without sacrificing security. Its suspension system incorporates exclusive patented Pressure Diffusion Technology to deliver comfort without compromise.
	Head, Eye and Face Protection	3M™ U5B-ANSI Faceshield Holder for SecureFit™ Safety Helmet	Features a unique system that allows faceshield replacement in seconds. It connects a variety of 3M™ faceshields to the 3M™ SecureFit™ Safety Helmet series. Made of high impact-resistant polycarbonate materials, these faceshields offer reliable protection against impact with versatile features. Consider pairing with the 3M™ Dual Coated Clear Polycarbonate Faceshield WCP96 or 3M™ Clear Polycarbonate Faceshield WP96 standard polycarbonate.

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	Welding Eye and Face Safety	3M™ Speedglas™ Welding Helmet 100-QR, with 3M™ Speedglas™ 100V and 3M™ Safety Helmet	3M™ Speedglas™ Welding Helmet 100-QR, 783520 features auto-darkening filter 100V, quick release rail and white 3M™ Safety Helmet H-701 . Our welding helmet provides head protection at all times because you never need to remove your safety helmet as you attach and detach the welding helmet.
	Welding Eye and Face Safety	3M™ Adflo™ Powered Air Purifying Respirator HE System with 3M™ Speedglas™ Welding Helmet 9100 MP	This system includes respiratory protection, a hard hat, optional hearing protection and flip-up weld shield. The system can help protect the face from sparks and splatter, and the eyes from intense light during MIG, TIG and stick welding.

Some rebar cages are welded. Consider respiratory protection designed for welding and welding helmets where exposure hazards dictate. Hard hats are usually required on most construction sites.

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	Hearing Protection	3M™ E-A-R™ Flexible Fit Earplug	Features a soft foam tip and a flexible fitting stem that allows easy insertion into the ear, and is rated for one or two-hand insertion. These are well-suited for activities that require gloves or cause dirty hands, or situations when only one hand is free to fit the earplugs.
	Hearing Protection	3M™ PELTOR™ Electronic Earplug	Helps protect workers' hearing and can help promote auditory situational awareness and communications in challenging environments.
	Body Protection	3M™ Disposable Protective Coverall, 4520	Built for protection and designed for comfort, it features breathable back panels and an anatomical fit for enhanced wear, coverage and comfort while working.

Key Questions to Ask

Safety Manager, Project Manager, Foreman

Do you have any work being performed on rebar, cage work or concrete formwork?	Opportunity to discuss hazards, common worker injuries and risks associated to work in MEWPs.
If so, how many workers do you have working on rebar, cage work or concrete formwork?	This will help you qualify the opportunity and possibly have a further conversation of other sites you are not yet aware of.
Are you aware of the risks associated to working at heights on rebar, cage work or concrete formwork?	Opportunity to discuss hazards, common worker injuries and risks associated to work in MEWPs.
How are your workers performing their tasks while working heights? Are they working off a scaffold? An MEWP? or climbing the structure itself?	Assess the worker's environment and tasks before suggesting appropriate PPE for your customer. This is an opportunity for you to discover additional PPE opportunities. Take this opportunity to educate your customer on anchor points, clearance distances and the different options available for your customer to keep their workers safe.
How are you currently providing anchorage for your workers? Is there anything that you would like to change? What challenges do you face when providing anchorage connections? of the different options to anchor while working off steel beams, concrete formwork or reinforced steel cages?	Take this opportunity to discuss different permanent or temporary anchor options.

Key Questions to Ask

Safety Manager, Project Manager, Foreman

Are your workers currently using personal SRLs when working at heights? If your workers could change one thing, what would make them happier?	This is a great opportunity to get feedback from your customer on the extra weight that they are carrying- leads to sale of weight distribution technology
In the unfortunate case your workers have a fall what is your rescue plan?	Educate your customer about the need of a rescue plan and solutions 3M offers for rescue including training where availability permits.
Are your workers aware of the ABCDE's of fall protection?	It is important to find out if your customer understands the components of a fall protection or fall restraint system. This will open the discussion to additional training requirements or even additional PPE that had not been discussed.
When was the last time your workers had fall protection refresher training?	It's a best practice to always ask this question. Not only will this be a reminder to your customer that we also offer training, but a large number of customers buy fall protection products after they go through training.

Developed by PSD Global Segment Team

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