Safety Corner #4 Rebar Safety

Rebar is the steel used in reinforced concrete and masonry structures. We often use it in such projects as

- water supply storage cisterns
- poured concrete column and wall footings
- school or building floor slabs and columns
- bridge abutments
- bridge beams
- poured concrete flow channels

The local resources and capabilities available in many of our less developed project locations; the equipment, and methods that will be used to “get it done,” are often far less advanced than would be found in the States. Where called for in our project designs, we are either working hands-on with the rebar, or supervising local workers as they do so, or both. Whether involved in moving and setting up the bars in a prepared excavation or in a form prior to a concrete pour, or in bending and cutting the bars and wiring them together to make a rebar cage, etc., working with the steel requires the use of proper personal protective clothing and equipment, an appropriate level of pertinent training, and common-sense caution and care.

The primary danger posed by construction with rebar arises from the associated physical hazards. The steel bars are heavy, clumsy to maneuver, and have sharp, abrasive edge sand ends. Working with rebar requires at a minimum the use of thick, durable gloves, steel-toed, steel-shanked work boots, hardhats, eye protection, and careful handling.

Rebar Safety Tips

The rules and regulations set forth in the host country for construction safety, including for building with rebar, will determine at a minimum, the safe practices to be followed at each project site. In the USA, Federal authority for determination and enforcement of standards, regulations and guidelines for construction safety rests primarily with the Occupational Safety and Health Administration (OSHA). Though not necessarily applicable to our project location, OSHA standards for worker safety on construction sites are considered to be among the most comprehensive, stringent and protective in the world, and are often reviewed for our projects, if only for information purposes.

Based on review of construction accidents occurring over a recent 20 year period, OSHA has determined that, in accidents associated with construction using rebar, about 60 percent involve impalement injury; the remaining 40 percent result from mishandling or trips and falls. Accidental impalement emerges as the most immediate and important hazard to be wary of when working with rebar. Impalement injuries most commonly result from accidentally stepping or falling on protruding rebar ends.
An example of an impalement accident

OSHA regulation 1926.701 states that “All protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement.” The OSHA guidance goes further to mandate use of rebar caps specially made with a thin metal plate enclosed in plastic so as to be non-deforming; to actually prevent “punch-through” failure of the cap should a person fall on the capped rebar.

The Dangers of unguarded rebar

Another mandatory OSHA regulation is 1926.703; which says “reinforcing steel walls, piers, columns and similar vertical structures shall be adequately supported to prevent overturning and to prevent collapse.”

A chronological listing of applicable OSHA standards

Reducing the likelihood of rebar accidents in our projects is best accomplished by strictly limiting the accessibility of the work zone that encompasses the erected formwork, protruding rebar, and rebar cages and webs, to only those workers directly involved in the concrete pour or in management of the rebar and forms. In the USA, OSHA requires that any person working 4 feet or more above the rebar must wear a safety harness actively connected to a rope, cable or other fall-arresting apparatus. If the work area is to be left unattended for any length of time, or if pouring will be delayed, the tops and ends of all rebar are to be properly capped or flagged to reduce the risk of trips and falls, accidental abrasion or laceration, or impalement by workers or passersby.

Reducing the risk of impalement injury at our project sites is best accomplished by keeping unauthorized persons out of the work area and by capping any protruding rebar. Given that the practice of rebar capping is not yet common in most of our project locations, it is unlikely rebar caps of any kind, including those of the special non-deforming type, will be available in the host country. EWB-USA recommends that when our implementation projects involve the use of rebar, we make every reasonable effort ourselves to procure and bring non-deformable caps for the rebar. Failing that, or if rebar setup, formwork and concrete pouring must get underway while awaiting delivery of the caps, we can reduce the hazard of accidental impalement by temporarily covering any protruding rebar with wooden boards or plywood sheets. Any such wood covering should be at least one-half inch or more in thickness.
When bending or cutting the rebar onsite, only purpose-made tools such as rebar benders (also known as “Hickey bars,”) or like equipment are used, and then only in association with proper personal protective apparel and gear, and after proper training in correct safety procedures and correct use of equipment.

Hand-held angle-grinders are commonly used for cutting rebar both before and after installation and/or pouring. Such powered grinders are always used with gloves, eye and hearing protection and hard hat (in the event something heavy or dangerous goes flying), steel-toed, steel-shanked boots, long pants and long-sleeved shirts and otherwise proper dress.

Cutting and bending is always accomplished with the bar to be cut secured against movement, either as already set in poured concrete, or otherwise anchored in a secure clamping device, and always with another person standing out of the way nearby. The observer is geared up, self-protected and ready to help if needed, but stays out of the “line of fire” of sparks or any flying objects or debris.

Though far less commonly at issue, the chemical hazard of rebar arises from the iron oxide dust, or rust, on the bars that can sometimes be knocked loose when moving or working with the steel. If or when rebar has been badly rusted, prudent judgment and care in handling, including use of dust masks when desired or necessary, will reduce the risk of inhalation hazard.

NIOSH page on iron oxide dust

Sometimes assembly of rebar cages or grids or rebar cutting is done by local contractors or laborers using welding torches. Welding is a practice and trade unto itself, posing special risks and hazards, and requiring highly specialized training and equipment. The hazards of welding center on risk of injury or death from burns, eye and retinal damage from the intense heat, luminescence and sparking of the welding flame, risk of injury from inhalation of toxic gases generated during welding, etc. In no event do we use welding equipment ourselves. If welding is used in our projects we take appropriate measures to minimize the risk of injury to ourselves, and to all others involved to the extent that is reasonable and practical to do so.
Improvised bending or cutting devices such as steel piping or electrically powered saws are never used.

**Working with rebar in a foundation wall**

Rebar for most of our projects is typically round bar steel; rods of uncoated raw steel with surface ribs to enhance concrete bonding, 3/8th to one inch (10 to 25 millimeters) in diameter, short or long depending on where it is to be placed, and straight or bent as required by the construction plans. Bar sizes are typically given by number. In English units, bars are denoted by the number of 8ths of inches (in.) of nominal diameter, e.g.; a no. 4 bar is 4/8ths in. in diameter, a no. 8 bar is one (8/8ths) in. diameter, etc.

![Left; #4 bar, uncoated](image)
![Right; #8 bar, epoxy-coated](image)

Where rebar and English units are used on our projects, we typically call for no. 3 and no. 4 bars, though we do sometimes specify bar sizes as large as no. 8. When using metric units, bars are denoted in millimeters (mm) of nominal diameter, e.g.; a no. 10 bar is 10mm in diameter, a no. 25 bar is 25 mm diameter, etc.

Sometimes, as when occasionally used for cisterns in accordance with some local methods, the reinforcing steel is supplied as spooled wire. When used for temperature and shrinkage control, it is often supplied in rolls of wire screen.

In the developed world, rebar is typically delivered to a work site on a flatbed truck. In less developed regions, delivery and on site management of rebar tends to be less rigorous or carefully structured, but similar principles and objectives apply. Unless otherwise specified, the steel rebar is raw; dry, and uncoated and subject to rusting. A patina or thin layer of rust on the bars tends to be desirable; it helps the bars and concrete to bond during curing. However, too much rust actually hinders bonding. If already slightly rusted the bars are usually covered on the site, otherwise they are often left uncovered.

On arrival at the project, long similar rebar sections are bundled together and laid on the ground or on a floor, while shorter segments are typically bundled together on pallets. Each piece or group of similarly sized rebar is labeled or tagged in accordance with the design drawings and specifications and industry standard labeling practices. Cutting and bending of the bars, where called for in the design or by construction codes, is typically accomplished at the mill or
supplier’s facility before delivery; otherwise steel up to and including no. 5 (16 mm) bars can be bent or cut on site given proper equipment and training.

Steel workers manage and work with the rebar pieces and bundles in accordance with the construction schedule, cutting and bending bars as needed, assembling and tying the cages, and moving, erecting and bracing the rebar cages and webbing as needed once the ground has been prepared. Formwork is typically installed after the steel rebar cages have been placed, and removed after concrete has been poured and properly cured.

The keys to safely working with rebar are the use of proper protective apparel and equipment, appropriate training and good worksite habits, and a healthy caution and respect for the hazards of working with and around the heavy, clumsy, rigid bars.

Wikipedia on Rebar