

An ACI / ASCC Manual

The Contractor's Guide to Quality Concrete Construction

4th Edition



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4th Edition

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Contractor's Guide to Quality Concrete Construction

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About

American Concrete Institute

The American Concrete Institute (ACI) is a leading authority and resource worldwide for the development and distribution of consensus-based standards and technical resources, educational programs, and certifications for individuals and organizations involved in concrete design, construction and materials. ACI has over 95 chapters, 125 student chapters, and nearly 20,000 members spanning over 120 countries.

ACI resources provide valuable information to concrete designers, contractors, and researchers, as well as students studying in various construction-related programs. Specifically for contractors, ACI publishes books that provide practical information and cutting-edge construction practices. The Institute provides free online videos, on-demand online courses, seminars, conventions, and events of interest to concrete contractors. Additionally, ACI has developed 25+ certification programs (see Appendix C for details) that provide individuals with credentials to build the best concrete structures in the world. Learn more at www.concrete.org/contractors.

American Society of Concrete Contractors

The American Society of Concrete Contractors (ASCC) is a nonprofit organization dedicated to enhancing the capabilities of those who build with concrete, and to providing them a unified voice in the construction industry. Members include concrete contracting firms, general contractors, manufacturers, suppliers, designers, educators, and others interested in the concrete industry. There are over 730 member companies in the United States and abroad.

Concrete contracting requires you to make tough technical and business decisions. The quality of a project depends on the hundreds of decisions you and your employees make every day.

Membership in ASCC provides the tools, including publications like this one, to make informed, careful decisions. It connects you to a nationwide network of peers, professionals, and experts who will support you every step of the way. And, the credibility of a national organization, made up of the country's leading concrete contractors, elevates you and your industry to a level of recognition and respect that will facilitate your growth in the years ahead.

A Decorative Concrete Council, Concrete Polishing Council, and Safety & Risk Management Council address specific issues in these facets of the industry.

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Chapter 1

Safety



(Photo courtesy of Baker Concrete Construction Inc.)

Construction can be a hazardous business. The hazards can be greatly reduced or eliminated when a culture of accountability for safety is reinforced with proper safety planning, training, hazard inspections, and rule enforcement. A well-planned and implemented safety program is required to make everyone at a jobsite aware of hazards and to help mitigate them. Concrete construction involves teamwork. You must consider your safety and the safety of others as you work. Safety is not about numbers and statistics—it's about the care and concern that we share for one another.

The new employee is the most vulnerable person in construction. New employees are exposed to more unknowns than those familiar with the project. Safety training for new employees will produce safer and more efficient crews. New employees see more unknowns and risk than experienced project workers. While new employees are at risk, experienced workers are not immune from injuries. While proper training and compliance with worker protection programs is critical to protecting workers, co-worker awareness and avoiding complacency is equally important. Many companies have implemented a behavior-based safety approach that provides focus on co-workers' mindsets and behaviors, regardless of the worker's level of experience.

Creating, implementing, following, and improving a safety plan often prevents injuries. Failure at any point exposes workers to hazards. Failure to follow a site-specific safety plan and use personal protective equipment (PPE) can lead to injuries. Injuries can be costly to both the injured employee and the company, and may lead to a long-term or permanent reduction in a person's physical abilities.

In addition to concern for the injured person, the company will lose that person's

While there are many things important to concrete construction, such as quality work and making a profit, safety must always be the number-one priority. For that reason, safety is in the front of this book to emphasize its importance to a successful project.

skills and face a potential drop in the performance of the work during the time that worker is off the job. Accidents disrupt the flow of work, causing further impact to the project. Insurance costs increase, making it difficult to maintain project budgets. Unsafe practices expose all project stakeholders to injury, financial loss, and a less-than-desirable public perception.

MOST ACCIDENTS ARE NOT ACCIDENTS

Accidents are preventable. Accidents are often due to not following a plan or not thinking through what you are doing. You **MUST** plan for safety.

How many times have you used an overloaded or damaged forklift or other faulty equipment as the result of your desire to quickly complete a task? How many times have you not stopped to sand a slippery working surface, or lifted with your back instead of your legs when you're tired?

Time spent for safety training is a basic cost of the construction business that pays off in increased production, lower insurance rates, and less lost time of skilled craftsmen. The full cost of accidents will far exceed the cost of a good safety program. Safety can be a profit center in both human and financial terms.

THE NEED FOR A COMPANY SAFETY PROGRAM

This chapter is not a safety manual for concrete construction. The American Society of Concrete Contractors (ASCC) has published the *ASCC Safety Manual* that everyone working in concrete construction should read and periodically revisit. You should also be familiar with the regulations of appropriate governmental agencies, especially those of the Occupational Safety and Health Administration (OSHA).

Every concrete construction project is unique. Casting a slab-on-ground is quite different from casting the 40th floor of a high-rise office building. Each has dangers that can be avoided if you are aware of those dangers. That is why, in addition to the *ASCC Safety Manual*, every contracting firm must develop a written safety policy that sets clear lines of authority for training new personnel and retraining long-term personnel in safety regulations and procedures related to their construction specialty. Designers are generally not responsible for safety measures during construction.

Every company is responsible and accountable for providing safe working conditions, and every person is responsible for following the safety rules of their company and making safety a part of their job. Helping new employees adjust to the specific dangers of the jobsite through training and mentoring are components of a successful safety program.

CONCRETE CONSTRUCTION HAZARDS

The following list of things to watch for on a concrete construction jobsite is not intended to be comprehensive. This list does, however, serve to alert you to some of the more common safety concerns:

- Fresh concrete can cause eye injuries and skin burns. When working with fresh concrete, wear protective clothing (long-sleeved shirt, rubber boots, and rubber gloves) and proper eye protection to avoid getting fresh concrete on your skin or in your eyes. If you do get fresh concrete on your skin, have safety data sheets (SDS) on hand and wash skin as prescribed. Have eyewash solution on the job. Should concrete splash in your eye, flush the eye with clean water immediately and obtain prompt medical attention. Think ahead. Have a supply of clean water and eyewash solution available whenever concrete placement is scheduled and remember that the tool clean-off bucket is not clean water.
- Among concrete workers, the most common skin disorders are dry skin, irritant contact dermatitis, and cement burns. The best way to keep skin healthy is to wear gloves and practice good hygiene. Wash your hands two to four times a day and whenever you remove your gloves using pH-neutral or slightly acidic soap. Placement crew members should wear long-sleeved shirts and long pants, protective goggles or face shields, hardhats, chemical-resistant gloves, over-boots, and kneepads (and use kneeboards). Immediately remove clothing that has become saturated with wet concrete. Clothes that have become hard with dried concrete should not be re-worn.
- Keep your fingers away from the metal joints of a concrete truck chute. These are heavy! Should a finger be caught in the gap of the joint as the heavy chute is dropped from its folded, stored position, severe damage, including the loss of the finger, is possible.

- The simple use of PPE (hardhats, gloves, boots, eye protection, fall protection, respirators, and so on) can save workers from the short- and long-term effects of construction site conditions. Have PPE available and wear it! PPE should be considered the last line of defense with a preference for the use of engineering controls to avoid hazards. For tasks that require the use of PPE, make sure co-workers are trained and that they are wearing it.
- Safety glasses with side shields or goggles must be worn whenever working on a construction site. Appropriate ANSI Z87 rated eye and face protection such as safety glasses, mono-goggles, or face shields must be worn during specific tasks performed on construction sites.
- Ear plugs must be used when the noise level gets to the point where you have to raise your voice to speak to the person next to you. It doesn't take much exposure to noise to permanently damage your hearing. Long-term exposure to concrete mixers can lead to hearing damage.
- If there is a potential for inhaling air contaminated with harmful dust, silica dust, fog, fumes, mist, gas, smoke, spray, or vapor, the employer is required to either remove the hazard completely or supply and implement the use of appropriate respiratory protection. Workers required to use respiratory protection must first be medically cleared to wear respiratory protection, fit-tested by a certified tester, and then trained in the use and care of the respirator assigned to them. In addition, the employer is required by OSHA to establish and maintain a written respiratory protection program.
- Respirable (breathable) silica dust is generated by cutting, drilling, or grinding concrete. This dust can get deep into lungs, cause irreversible damage, and lead to silicosis. If you can see dust in the air, it is too much dust. Always use vacuums or wet techniques to control silica dust. If that is not possible, then properly fitted respirators are required.
- Ladders and stairways are a major source of injuries and fatalities among construction workers. Employers should ensure that employees are trained by a competent person in the nature of fall hazards; the correct procedure for erecting, maintaining, and disassembling fall protection systems; proper construction, use, placement, and care in handling stairways and ladders; and the maximum intended load-carrying capacity of ladders. Workers climbing ladders, including those on the side of concrete trucks, must maintain three points of contact at all times, and ropes must be used to hoist materials, not carried by a worker.
- Do you know how to properly set an extension ladder? The distance along the ground from the bottom of the ladder to a point beneath where the ladder is supported near its top should be approximately a quarter of the length of the ladder. If the slope is flatter than that, the ladder can easily become overloaded. If it's steeper, the ladder can fall. The ladder must be secured at both the top and bottom against movement, and supervised by a designated competent person. It should extend at least 3 ft (0.9 m) above the platform or landing.
- Scaffolding should only be erected by a person who has been trained and certified to erect scaffolding. A competent person should inspect the scaffold prior to the start of each shift for defective parts or conditions before anyone begins work on it. If the scaffold passes inspection, it should be date-tagged that it has passed inspection. If the scaffold does not pass inspection, it must be tagged "out of service" with no one allowed on it until the defects have been corrected.
- Employees exposed to a fall of 6 ft (1.8 m) or more are required to use fall protection. General industry requires fall protection at 4 ft (1.2 m); some construction sites use this smaller distance. Always attempt to design a control measure that will remove the hazard. Articulating man lifts with a restraint system and full body harness; guardrails with top rail, mid-rail, and toe board; personal fall arrest systems; horizontal lifelines; warning lines; safety nets; or controlled access zones with a safety monitor can be used. Anchor points are required to be rated to support 5000 lb (2300 kg). Employees must be trained in the fall protection method being used prior to the start of the operation.

- When welding or burning metal, wear proper protective clothing, fire chaps, and PPE to protect yourself. When cutting metal embedded in concrete, the concrete can spall off, almost explosively, when heated by a torch.
- Treat compressed gas cylinders with respect. Secure the cylinders upright by tying them off or using other means to prevent them from moving freely. If the valve breaks off, the cylinder becomes a rocket. Do not store oxygen and gas tanks together.
- Use ground-fault interrupter (GFI) devices at all times when using vibrators and other electrical tools. These devices will prevent electrocution. Wet concrete and water are excellent conductors. GFI devices should be tested before each use to minimize risk of electrocution.
- Electrical tool cords and extension cords must be inspected daily. Tools with damaged cords should be taken out of service and repaired. Damaged extension cords should be replaced or repaired by a licensed electrician. Elevating cords or covering cords laid on the ground will prevent damage to the cord and remove the tripping hazard. Provide clear walkways and clear, well-marked exits.
- Keep the jobsite clean and orderly—even if it's not your job. It's far better to pick up something than to fall over it. A clean jobsite sets the tone for efficiency and quality workmanship.
- Stack materials neatly and safely. Provide clear walkways. Do not allow combustible materials to accumulate.
- Stay out from under suspended hooks and loads. Think of a mobile crane's swing area as no-man's land and stay away. The crane swing radius directly around mobile cranes should be barricaded.
- Wire ropes, slings, shackles, and other lifting devices must be inspected by a competent person to make sure that they are not defective and are the proper size and strength for the task at hand. They should be stored off the ground, preferably under cover.
- Never walk underneath a load being lifted.
- To avoid electrocution, never touch a piece of equipment that is working near power lines.
- Do not allow pump trucks, cranes, forklifts, and other equipment with high profiles to work within the setback distance of power lines. Different types of power lines have different voltages and setback requirements. Proper marking and signage around power lines that explain requirements and clearances is critical to protecting workers.
- Make sure the person guiding a pump operator knows and uses the standard hand signals developed by the American Concrete Pumping Association (Fig. 1.1).
- Watch where you are walking to avoid falls. If you see a board with nails sticking up, stop and pull them out or bend them over.
- If you must lift manually, get the load as close to your body as possible. Lift only what you can comfortably handle. Get help with heavier or bulky items.
- Check equipment and tools before each shift to ensure they are in proper working condition.
- Keep the SDS for the chemicals on your project up-to-date and easily accessible, and make sure that your co-workers know how to access SDS on the project. Have employees review this information before using the products.

DAILY SAFETY MEETING

More often than not, accidents are the result of poor planning, improper training, or not thinking through each of your work activities. A daily safety meeting, or huddle, is a good way to keep employees focused on safe work practices and behaviors. Huddles normally last 10 to 15 minutes and cover topics such as:

- The plan (or objective) for the day
- Hazards of a job about to be started
- Causes and corrective action for a recent accident or near miss
- Job hazards that should be emphasized

EXPERIENCE MODIFICATION RATE AND INCIDENT RATE

The cost of workers' compensation insurance is directly affected by your company's accident history. When an employee is injured, the costs are added to the company's experience modification rate (EMR). Accidents can increase a company's EMR to

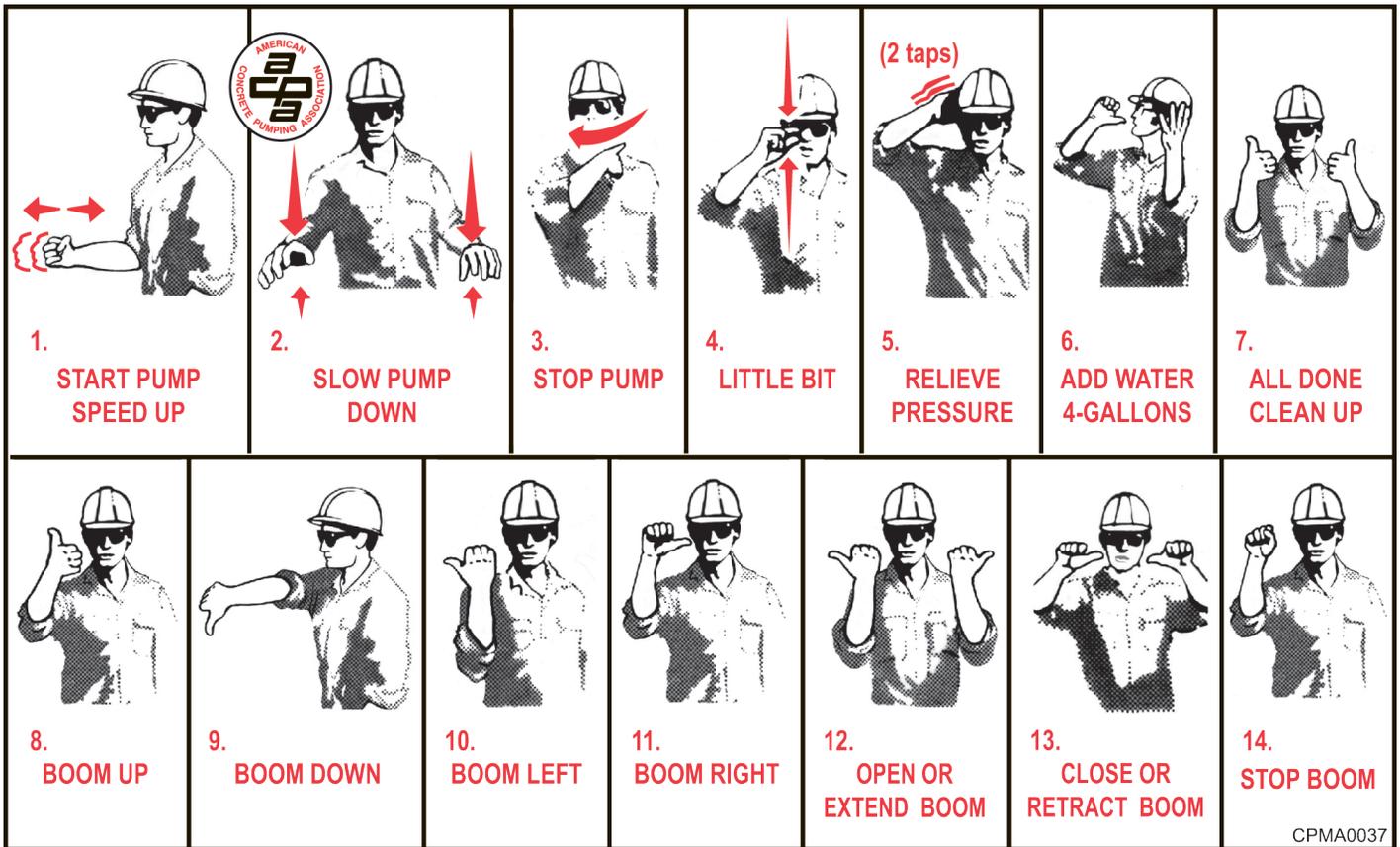


Fig. 1.1—Concrete pump operation hand signals. (Figure courtesy of American Concrete Pumping Association.)

Experience Modification Rate

The experience modification rate (EMR) is sometimes called E-mod or Ex Mod by various companies. It changes every year and increases or decreases the overall workers' compensation insurance premium that the company pays. For example, Company XYZ has a 1.0 EMR and a workers' compensation premium of \$1,000,000.

The next year, due to lack of accidents, the EMR could drop to 0.75. The workers' compensation insurance premium would then drop to $0.75 \times \$1,000,000 = \$750,000$, saving the company \$250,000!

If XYZ had a major accident on one of its jobsites, the EMR would possibly raise to 1.25. The workers' compensation premium would then increase to $1.25 \times \$1,000,000 = \$1,250,000$, costing the company an additional \$250,000!

A high EMR may limit bidding opportunities. Many owners ask for EMR history and require an explanation of why the EMR is high and what steps are being taken to lower the EMR. Typically, under a 1.0 is perceived more favorably; over 1.0, people start asking "What's wrong?"

where it significantly increases their workers' compensation insurance rates. A large component of any company's insurance rates is the cost of past claims. This cost can be controlled. An effectively implemented safety program can help reduce insurance rates and make a company more competitive and more profitable.

Another measure of safety is the incident rate (IR), a nationally recognized number that equalizes the accident rate for firms of all sizes. The IR is an indication of past performance; it can potentially be used by OSHA for enforcement actions.

The IR represents the number of lost workdays for 100 employees working 40 hours per week for 50 weeks per year. The IR is calculated as the number of lost workday cases from a company's OSHA Form 300, Log of Work-Related Injuries and Illnesses, times 200,000, divided by the number of total work hours in a calendar year. Expressed as an equation:

$$IR = (N \times 200,000) \div WH$$

where IR is the incident rate; N is the number of lost workday cases away from work for both injuries and illnesses (this number is the sum of the checkmarks in Column H on OSHA Form 300); and