Safety in the construction of (Bridges And Roads)

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Introduction

Project safety is the minimum of hazard of life and property during the layout of bridge and road projects, it must provide safety for working staff, supervisors and monitoring committees, as well as for all those who pass around the project. The following sections summarize the general requirements of applicable OSHA regulations for various hazards; however, the standards themselves should be referenced for more details. In addition to OSHA regulations, publications by other authorities, such as State and local governments, the American National Standards Institute (ANSI), the National Fire Protection Association (NFPA), and trade associations, should be consulted to provide more exhaustive and current information regarding safe work practices for specific hazards, since many of the OSHA regulations are outdated.

For every project, a safety engineer or safety expert should be appointed to monitor the safety situation for all staff, this person also has "authorization to take prompt corrective measures to eliminate" all identified hazards. The results of the hazard analysis should be summarized in a written site-specific safety plan. (my own source).

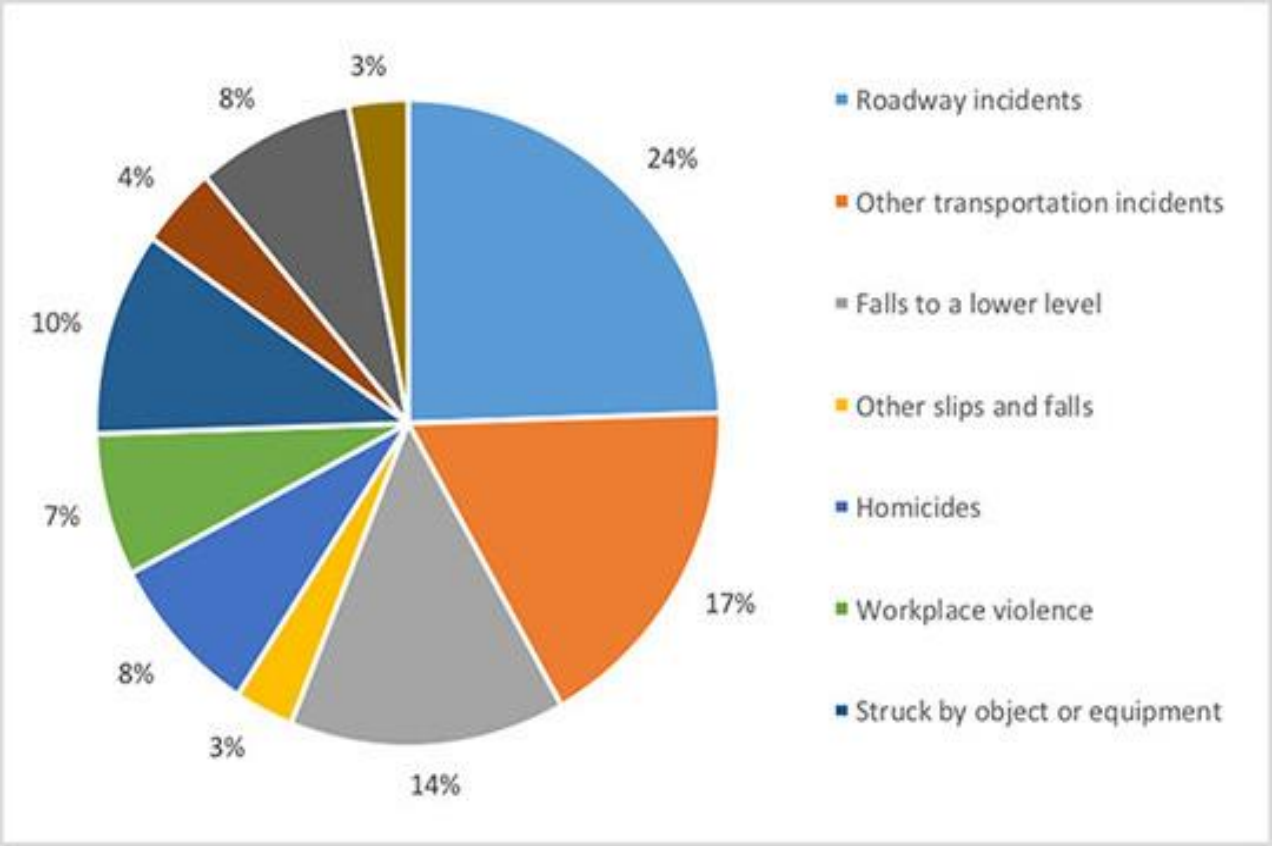
Essential Safety Tools for Bridge Workers

Despite major advances in bridge and roadway construction safety, it's still very risky work.

Before the Occupational Health and Safety Administration (OSHA) was created 43 years ago, an estimated 14,000 workers were killed on the job every year. The number of fatal injuries has fallen from an average of 38 a day back then to 12 per day now.

Roadway and transportation-related incidents contribute to more than 40 percent of workplace deaths, which is still far too many. The chart below breaks down the different types of accidents that happen at work ([1]).

The picture below shows the rate of accident according to type of projects:



There’s no good reason for an increase in the number of fatal bridge construction accidents today. Researchers and manufacturers are constantly developing tools, protective gear, and equipment designed to keep workers safe. Let’s take a look at ten that should be used on every bridge construction site.

1- Specialized Bridge Access Equipment.

One of the biggest risks faced by bridge workers is falling from a higher level of a bridge to a lower one. This often happens because workers use the wrong equipment to access hard-to-reach sections of bridges. They retrofit equipment designed for other purposes or come up with temporary solutions to get to those areas.

If your firm does any work on bridges, it should always provide workers with equipment specifically designed for it. This could include:

Bridge walkers, which can securely lower workers up to 20 feet below a bridge, even if space is limited

Hydra platforms – able to move workers up to 35 feet below a bridge. They have a work platform that can be rotated to give workers easy access to the edge of the bridge deck

Paxton-Mitchel snoopers, which provide safe access to even the most hard-to-reach areas of the largest bridges(1).

UBITs – highly flexible articulated units that can lower workers almost 26 feet below the bridge deck

Each type of bridge access equipment fills a specialized bridge construction need. It's important to work with a reputable firm that can recommend the correct equipment for the job(1).

2- EN166 Eye & Face.

There is a risk posed to the eyes in many different industries and trades the world over. Our eye protection range covers basic safety glasses all the way to full face mask welding shields. Without eye protection, an individual runs the risk of seriously impairing or permanently damaging their eyes. We aim to stock eyewear that is stylish and which does not feel clunky and obstructive so that people will have more of an inclination to wear them. Shop EN166 eye & face protection(2).

3- Fire Blanketing.

Many serious injuries on bridge construction sites happen when the utility lines, cables, and piping that cross them are damaged by construction

equipment. That's why it's important to always be prepared and have fire control tools handy, including fire blanketing. A fire blanket is a sheet of fire retardant material that can be placed over a fire in order to smother it. It's considered the best way to control an electrical or other utility-related fire.

4- Foot Protection (safety shoes).

Chiefly, your boots need to provide adequate protection from your working environment. The Health and Safety Executive has advice on the protective characteristics you should seek in a boot, including steel toecaps and mid-sole protection to keep you safe from dropped and sharp objects respectively.

Your safety footwear needs to protect you well from a wide range of work-site hazards, not limited to physical ones like pierce or crush hazards. Road work also includes interaction with toxic materials, as well as high temperatures in the form of tarmac and road paint. As such, an adequate work boot should be resilient against corrosion and high temperatures ([2]).

5- Under-Bridge Protection.

Bridge utility lines can be damaged by construction equipment, tampering, weather incidents, and natural disasters. These threats can lead to loss of utility service, expensive repair costs, and injury or loss of life.

Protection Under Bridge (PUB) systems are caging units designed to protect vulnerable utility lines under bridges. They can help ensure ongoing utility service, along with worker and community safety. Contact an expert on these systems to find out how installing them could make the bridges you work on safer.

6- High-Visibility Safety Equipment.

Stay safe, visible, and protected with our wide range of high-visibility garments. Hi-vis clothing plays a vital role in ensuring the safety of workers in industries such as construction, road maintenance and emergency services ([3]).

7- Hand and Aram protections.

Hazards to the hands and arms include abrasion, temperature, cuts, impact, chemicals, electric shock, radiation, biological agents or prolonged immersion in water.

PPE options are gloves (including gloves with a cuff), gauntlets and sleeving that covers part or all of the arm.

Avoid gloves when operating machines such as bench drills where they might get caught.

Barrier creams are not a substitute for proper PPE. Using separate cotton inner gloves can help prevent skin problems from wearing gloves for long periods. Choose gloves made from materials that are not quickly penetrated by chemicals. There is more guidance on skin at work ([4]).

([5]

8- Head protection.

Safety helmets (also known as hard hats) can prevent or minimize injuries to the head and brain, protecting against falling objects or debris, impact with other objects, electric shock and rain. Most head injuries can be avoided if the proper head protection is selected, used and maintained ([6]).

9- Signage and Barriers.

(7)

How many times have you driven along the road to see road signs or temporary barriers have been blown over or moved from the position they should have been located? Recently the UK has been experiencing severe harsh winds with anything not attached to the floor or building having the potential to fly off into the back of beyond.

Road works and work on the public footpath creates a number of hazards, having the correct road signs, correctly spaces and located is essential. If they move, fall over or sway they have the potential to cause accidents, rather than protect pedestrians and road users. There have been a number of serious accidents including, one where a motor cyclist was killed following a collision with traffic signs which had below over into the road ([8]).

The Safety at Street Works and Road Works code of practice from 2013 brought in new standards for signage and more importantly how they need to be located and designed to withstand wind and still remain stable.

Today's signs and barriers benefit from more modern designs with contoured sections to allow the wind flow around and through the barrier or sign. Rounded edges allow the wind to flow around rather than impact and push the object around or over.

The code of practice is supported by a number of British Standards including BS8442. Accessories and barriers need to be stable to ensure the safety of pedestrians, those involved in road works as well as road users. Ideally equipment should be designed and fitted with integral weights rather than relying on extra weights such as sand bags or wooden blocks. Water filled barriers can be a useful addition to site safety, light weight until filled.

Thinner anti trip style feet are the norm now, slimmer they reduce the risk of trips and falls but still support the barrier or sign sufficiently. Expandable and adjustable barriers can be moved and added more easily than the larger sectional barriers.

The color also needs to be considered to ensure maximum visibility. Where multiple barriers are to be used clips or clamps are needed to attached the together, they should be "joined inn a way which Resist tampering". Clamps may require special tool to enable them to be released.

Road works and work on pathways can attract the wrong type of person, anti-social behavior can be attached to road works. There needs to be balance between safety and security, gaps need to allow the wind through but not be large enough for a child or adult to climb through ([8]).

It is important that contractors and employers are taking all the necessary steps to correctly mark road works, giving adequate notice to the road user, protecting them and road workers. Accidents and injuries need to be prevented, with organizations needing to proactively show they are complying with the stature legal standards. Reducing the risk of prosecution by the HSE or civil actions by any injured parties ([8]).

Safety and Health Director

The primary function of the safety and health director is to establish, communicate, and assess the effectiveness of programs necessary to implement the company's safety and health policy. These programs must address the entire scope of activities performed to effectively prevent injuries and illnesses.

This guideline is specifically designed to help safety and health directors (and others with safety and health leadership responsibilities) establish and communicate safety and health programs applicable to bridge repair, renovation, and demolition (RR&D) jobsites.

Typical functions of the safety and health director include:

Identifying necessary safety and health programs for all work operations, i.e., electrical safety, fall protection, confined space, respiratory protection, Right-to-know, etc.

Establishing program procedures and practices to prevent injuries and illnesses.

Communicating programs and their associated procedures and practices to all employees. This function is typically performed through training and education.

Regularly visiting worksites to assess the implementation and effectiveness of programs applicable to the worksite.

In order to be effective in these functions, the safety and health director should:

Become thoroughly familiar with all OSHA standards, consensus standards, and other resources relevant to the safety and health programs established at the jobsite.

Maintain accurate injury, illness, and near-miss records and review them for trends.

Direct major accident investigations.

Assist supervisors in accident and near-miss investigations, and use information gained to improve safety and health programs.

Attend meetings, courses, and conferences to become more knowledgeable in applicable safety and health topics.

Work with all government officials during accident investigations and safety inspections (⁹).

Health and safety can be considered in 3 main stages

1. Design and Planning

Health and Safety starts at the very beginning of all construction projects during the

planning and design phases. Legislation under the Construction,(Design and

Management) Regulations of 2006 leads to well documented approach to safety in

design and co-ordination of designers. A risk register is produced highlighting all

risks and proposed mitigation measures.

One of the main purposes of CDM is to identify major risks and the determination of

mitigation factors to eliminate or reduce that risk to an acceptable level. In this way,

for example, it is highly likely that the design of the south anchorage will employ a

gravity anchorage rather than a tunneled anchorage to minimize excavation in ground known to contain methane (¹°).

2. Construction

All construction work will be carried out in accordance with all relevant Standards,

Codes of Practice and all current legislation covering such issues as lifting

equipment, working at height.

For construction of suspension and cable stayed bridges the following major risks

apply.

Bridge Construction Activity	Bridge Construction Risk
Foundation and Anchorage Construction	Working over or alongside water Excavation in Ground
Tower and other pier construction	Working at Height Working over or alongside water Instability of Permanent Structure during construction Instability of Temporary Works
Suspension or Cable Stay Erection	Working at Height Working over or alongside water Instability of Temporary Works

([1°])

Deck erection	Working at Height Working over or alongside water Instability of Permanent Structure during construction Instability of Temporary Works
Construction of Approach Roads and Viaducts	Utility Disruption Working alongside live traffic Instability of Permanent Structure during construction Instability of Temporary Works Working at Height

Bridge Construction Risk	**Safety Mitigation Measure**
Working at Height	Risk assessments, method statements to be developed and approved; safe systems of work to be adopted; protection of public assured by safe systems of work and barriers if deemed necessary through risk assessment; use of specialist personnel, personal protective equipment
Working over or alongside water	Risk assessments, method statements to be developed and approved; safe systems of work to be adopted; safety boats to be used; protection of public assured by safe systems of work and barriers if deemed necessary through risk assessment; for foundation work caissons to be used

(1°)

Instability of Permanent Structure during construction	Identification and mitigation of potentially unstable conditions identified during the design phase and noted in Contract documents; mitigation measures to be implemented by the Contractor; risk assessments and method statements to be developed and approved; check of temporary construction loads on permanent structure
Instability of Temporary Works	Temporary works to be designed, tested and independently checked by competent designers; temporary works to be installed by competent contractor in accordance with the design and approved method statements
Excavation in Ground	Adequate advance site investigation to determine ground parameters; excavations to be propped as necessary
Utility Disruption	Gather documentation of utilities in the vicinity of the works; adequately protect or divert utilities prior to the works

The main Health and Safety risks associated with tunnel construction relate to collapse of the tunnel shaft and lack of ventilation. Other risks such as those relating to the approach roads are similar to a bridge.

Tunnel Construction Risk	Safety Mitigation Measure
Instability of tunnel shaft	Provision of watertight segmental lining behind the boring machine
Lack of Ventilation	Adequate temporary ventilation to be provided in the shaft at all times until the temporary ventilation system has been installed

(1°)

Safety Engineer.

Safety Engineers employ engineering principles and practices to eliminate or control hazardous conditions resulting from human error, equipment and machine operations which may lead to injury to persons and damage to property. The work requires the application of: advanced mathematical techniques; professional engineering principles, methods, and techniques; safety related elements of the physical sciences, ergonomics, psychology and physiology; and safety principles, standards, practices, and analytical techniques. The safety engineer applies knowledge of psychological and physiological factors to design safety features and controls, compensating for the possibility of human errors in the operation of machinery and equipment ([11]).

What does a safety engineer do?

Here are the duties that a safety engineer completes on a daily basis:

- **Inspect potential hazards**: Safety engineers inspect buildings, equipment and machinery for potential hazards that may harm employees.

- **Evaluate blueprints**: Safety engineers evaluate blueprints for projects to ensure each step of a project is safe for employees to complete.
- **Design safety plans**: Safety engineers design detailed safety plans to keep employees safe. The safety plans may involve precautionary procedures or accident response plans.
- **Investigate workplace accidents**: Safety engineers investigate workplace accidents to discover the cause of the issue and prevent future accidents from taking place.
- **Educate employees on safety equipment**: Safety engineers educate employees on how to use safety equipment properly to keep themselves and their colleague's safe ([12]).
- **Stay up to date on laws and regulations**: Safety engineers stay updated on laws regarding workplace safety, since safety procedures and regulations change depending on equipment and safety advancements.

- **Recommend improvements for workplace safety procedures**: Safety engineers observe standard safety protocols within a workplace and make recommendations for procedure improvements ([12]).

What to do when a new technique is used in a project?

During the implementation of the project, when we want to use new techniques and methods such as molds, lifts, supports, etc., for complete safety, the designer should decide on their use after evaluation, verification and complete check he or they decide to use them. Picture below one of the sample, Hanging molds for pile caps used in Raniyah Darband bridge after approved by the designer company (my own source).

Conclusion

There are still many deaths and injuries of workers and staff working in bridge and road projects in the world, but what is important is to ensure the safety of those in and around the project, provide the necessary equipment, follow the guidelines.You owe it to your valued employees to do all you can to protect them on the job. It’s the right thing to do and it’s simply good business (my own source).

Resources:

1- https://bridgemastersinc.com/10-safety-tools-bridge-workers/
2- https://www.graniteworkwear.com/sc_71_shop-en166-eye-face.
3- https://www.thesafetysupplycompany.co.uk/?gclid=CjwKCAjwzJmlBhBBEiwAEJyLu8CpAGhDW75oHtgJ8_FBbnCaN5QE1HIQMWxzeO7aluCyfjT-IacmgBoCSwMQAvD_BwE.
4- https://www.hse.gov.uk/ppe/using-the-right-type-of-ppe.htm.
5- https://www.safetysupplies.co.uk/product/hand-protection/cut-protection-gloves/ironclad-kong-original-sdx2-safety-gloves/.
6- https://cpdonline.co.uk/knowledge-base/health-and-safety/types-safety-helmets/.
7- https://www.google.com/search?sxsrf=AB5stBj7rnHZjNbphkY2isFS4Uv5gFX0NQ:1688856898028&q=signage+and+barriers+in+bridge+and+road+construction&tbm=isch&sa=X&ved=2ahUKEwiq1O6bmoCAAxU_V0EAHblPCAEQ0pQJegQICxAB&cshid=1688857087994356&biw=1229&bih=539&dpr=1.56#imgrc=2OP9flOnOrNNiM.
8- https://www.cambridgesafety.co.uk/blog/new-standards-for-road-signage-for-wet-and-windy-weather/#bs-cookie-bar.
9- https://www.fhwa.dot.gov/publications/research/infrastructure/structures/98180/ch2/ch2.cfm#sect3.
10- https://www.transport.gov.scot/media/10241/report3_main_appendix_a.pdf (Annex A).
11- https://safety.army.mil/FOHS/Who-We-Are/Safety-Engineers.
12- Inspect potential hazards: Safety engineers inspect buildings, equipment and machinery for potential hazards that may harm employees.