Safety Guidelines for Field Inspections
(Introduction to Infrastructure & Infrastructure and Society Courses)

This manual contains basic guidelines for safe conduct while performing inspections of infrastructure in the field. The guidelines presented herein are by no means complete. The specific methods for ensuring safety under all variety of conditions that can occur in the field cannot be summarized in a manual. First and foremost you will need to rely on your common sense and must have a serious attitude regarding your conduct in the field. Remember the following whenever you are in the field:

- You alone are responsible for your personal safety. You cannot rely on others to watch out for the dangers around you. They will be too busy doing their own job and looking after their own safety to look out for yours.
- Be alert, take your job seriously, and react to every circumstance in a calm, methodical manner.
- Improper conduct in the field not only puts your safety at risk, but the safety of those around you.
- When you are in the field, you do not merely represent yourself as an individual, rather you are also a representative of this university and your profession.

General Rules
Fieldwork will not be allowed unless a safety management plan is submitted beforehand (the forms for this are posted on the course website).

All fieldwork is to be conducted in groups. An ideal group is 3 or 4 people. Groups will clearly designate the roles of each member in the safety management plan. When working near traffic, at least one person should be designated to act as a flagger. Whenever one person enters the water, at least one other person should remain on dry land and monitor whoever is in the water. All groups must have at least one cell phone, a list of emergency contact numbers, and a copy of the safety management plan. These should be carried by someone in the group who is not working in water or some other potentially hazardous surrounding.

Groups are responsible for following the guidelines set out in this manual. If it is discovered that a group has failed to follow the rules listed during an inspection, they will receive zero credit for that inspection.

Personal Safety Equipment
Personal Safety Equipment includes anything worn on your body for protection from field hazards. Reflective vests, hard hats, gloves, eye protection, ear protection, and dust masks are available for checkout from the survey lab. Reflective vests and hard hats are required whenever working near traffic.

Long pants and close-toed shoes are required whenever fieldwork is being conducted. Steel-toed boots are preferred. Students should not feel obligated to purchase a pair of steel-toed boots for this class, though if you already have a pair, we encourage their use for field inspections.

Dust masks and eye protection are recommended whenever working in dusty conditions. For example, loose rust particles will sometimes accumulate in the bottom flanges of steel bridge girders. Wind eddies can send these into your eyes causing severe irritation. Similarly, concrete dust is hazardous to your lungs and dust masks should be worn if concrete dust is abundant. Ear protection may be necessary when working near busy roads with heavy traffic sounds. Whenever wearing ear protection, you must strive to stay in visual contact with your group members in case immediate communication is required.

Travel
You have the option to request a university vehicle for travel. To do so, you must be an approved university driver. Applications to become an approved university driver are available from the course instructor. Mileage on university vehicles is covered as well as insurance in the case of an accident. Mileage on your own vehicle is covered if you are an approved university driver and have made a request.
for a university vehicle, but none was available. If you forego the university driver application process and elect to drive your own vehicle, then you will be responsible for you own mileage and insurance.

Rural Roads
Some of the field inspections may require travel to bridges on rural roads. Most of the rural roads are two-lane with very narrow shoulders that drop off quickly into drainage ditches. You will probably not be able to park completely off the road and should not try to do so since you may get your vehicle stuck or even damaged. Position the passenger side wheels as far onto the shoulder as you can without driving off, then position cones around the driver’s side of the vehicle to alert traffic. You must assign someone as a flagger and deploy warning signs in accordance with the requirements of the next section.

Furthermore, typical right-of-way for rural trunk roads extends 7 to 10 feet from the edge of the paved roadway (not from the shoulder, but from the lane edges). Beyond this distance you will be entering private property. Be courteous of property owners’ rights and try to restrict your activities to the right-of-way. The right-of-way space should be sufficient to conduct any inspection tasks for this course.

Working Near Traffic
The most common safety hazard students will encounter for field inspections in this course is working near traffic. Reflective cones and safety warning signs are available for checkout from the surveying lab (OTTS 072) and it is expected that you will deploy these appropriately whenever working within or near a roadway. Reflective vests and hardhats will be worn by every member of your group.

It is anticipated that you will only need to follow these procedures for the bridge inspection assignment. Prior to fulfilling that assignment, **your group should notify the instructor at least 2 days before you plan to perform your inspection with the location, date, and time** so that the instructor can in turn notify the local authorities that you will be out.

One student will be designated as a flagger. Even if you are not working within the roadway, this student should have a “slow/stop” sign handy and keep constant watch on traffic and the other group members. If any of the other group members stray close to the edge of the road or into the road, the flagger should be prepared to alert approaching traffic.

Warning signs should be deployed in advance of the work area. On a highway, the first sign should be deployed at least 200 ft before the work area for speed limits of 25 mph or less, 300 ft before the work area for speed limits between 25 mph and 40 mph, and 500 ft before the work area for speed limits of 40 mph or greater (see Figure 1). A “survey crew ahead” sign is most appropriate; however, the most important thing is that some orange warning sign is posted. A “flagger ahead” sign should also be posted some distance down from the first warning sign. On a city street with several intersections, the first warning sign should be posted at the closest intersection ahead of the work area (see Figure 2). If the distance between the first warning sign and the work area is long, an additional sign should be posted in the intermediate distance.

Reflective cones should be deployed around any car parked within the roadway (they should even be considered for cars parked completely on the shoulder). Cones should also be deployed around any work area that extends into the roadway. The proper way to deploy cones is on a diagonal reaching from the edge of the road to the leading corner of the work area or vehicle. These cones should be spread out over a distance ranging from ½ to several car lengths depending on the posted speed limit (1/2 to 1 car length is probably appropriate for city streets with low speed limits, 1 to 2 car lengths for small rural highways, and greater distances for roads with fast moving traffic). Additional cones should be deployed at intervals of 10 to 20 feet throughout the length of the work zone.

The flagger should be posted near the start of the cones or slightly ahead. The flagger should allow a clear path to quickly move off the road in the event that an inattentive driver strays into the work zone. Thus
the flagger should never stand where the group’s vehicle is between him/her and the edge of the road (do not stand on the traffic side of the vehicle).

1st Warning Sign Placed at Least:
200 ft for 25 mph or less speed limit
300 ft for 25 to 40 mph speed limits
500 ft for 40 mph or more speed limit

1 to 2 car lengths

Figure 1 – Sign and cone deployment for highways

Figure 2 – Sign and cone deployment for city streets

**Working Around or In Water**

Students may have to enter shallow streams to look at the undersides of certain bridges. Waders and life vests are available and required for these situations. They can be checked out from the surveying lab.

Many of the smaller creek crossings are clogged with debris and there is possibility that someone could get a foot stuck while wading out into the water or step on something sharp beneath the surface of the water. During the cooler months there is a danger of hypothermia from exposure to cold water. During the warmer months, wildlife such as snakes could pose a threat. Waders are the best protection for these hazards!

There is also a remote possibility of flash flood. Students should check weather conditions before conducting any inspections in or near creeks. These inspections should be postponed if rain is predicted. Flooding is the most common cause of bridge failure and is extremely dangerous for anyone in the water at that time. Even a slow current can carry someone away or trap him or her among the debris that
collects underneath a bridge. Whenever someone enters the water, another person should be stationed on the shore to watch over that person. If you see a group member swept away by current, you are not to try to rescue them but rather immediately contact emergency services (911) for professional help.

**Hot or Cold Weather**
While you are encouraged to only perform inspections on days with reasonable weather, situations may occur in which prolonged exposure to hot or cold weather may happen. You should therefore be aware of the symptoms of dehydration or hypothermia.

Symptoms of dehydration are headaches, muscle cramps, snowed vision, a drop in blood pressure, and dizziness or confusion. The later symptom can be particularly dangerous in the field because it affects your ability to remain alert and avoid hazards such as nearby traffic or drop-offs. Eventually fainting and hyperthermia (excessive body heat) may occur. Acute hyperthermia can lead to organ failure and coma. The best way to prevent dehydration is to drink plenty of water. Sports drinks are even better because they will also replenish electrolytes. You should not drink excessively cold water because it may lead to stomach cramps and nausea. Improper sleeping and eating habits and frequent alcohol or coffee consumption exacerbate risk of dehydration.

The initial symptoms of hypothermia are shivering, loss of hand dexterity, numbness of extremities, and quick and shallow breathing. You may feel sick to your stomach and very tired. If a person is unable to touch their thumb and pinky finger together, this may indicate that a person is heading into the second stage in which confusion and severe loss of coordination can occur. Once again, this can be extremely hazardous in field conditions where other dangers are present and alertness is required. To avoid hypothermia it is extremely important to stay dry and to dress properly. Cotton clothing tends to retain perspiration and become damp. Synthetic or wool fibers are much better in cold weather.

**Wild Plants and Animals**
There are a wide variety of hazards from wild plants and animals that may be encountered in the field. Many of these will result in minor irritation only, but a few can be very dangerous if not treated immediately. If you have allergies to any wild plants or insects you should inform the instructor and your group members and avoid situations that may cause you danger. Probably the worst dangers that could be encountered are infectious diseases. Within the Wisconsin area, the primary diseases that you should be wary of are:

- Tetanus
- Rabies
- Lyme Disease
- Human Granulocytic Anaplasmosis (HGA)

All of these diseases have entries on Wikipedia that you should review. You are expected to at least be familiar with the possible sources of infection (ticks are the largest hazard) and the common symptoms of each (for example, which of the four diseases are flu-like when they first appear?). If you demonstrate any symptoms of these diseases, you should see a doctor right away.

**Confined Spaces**
Under no circumstances are you to enter a confined space. Confined spaces are defined as those which are large enough and so configured that an individual may enter, yet have limited means for entry or exit and are not intended for continuous occupancy. This includes such things as manholes, pipelines, storage tanks, silos, and tunnels. The reason confined spaces such as these are so dangerous is because they frequently collect poisonous gases that often cannot be detected by smell. The most dangerous gases act quickly and kill. Only trained and properly equipped emergency response personnel should attempt to retrieve an injured person from a confined space.
Power Lines

In the 1990’s, electrocution deaths were the fourth leading cause of occupational fatality in the U.S. Construction is the leading occupation for such types of deaths. Listed below of four typical incidents (reported from the state of Washington):

1. On August 19, 1998, a painter moving a 32-foot aluminum extension ladder received a fatal electric shock when the ladder contacted one phase of a 3-phase system of 13,200 volts.

2. On February 7, 2000, a carpenter was in a scissor lift taking measurements of a roof with a tape measure when the lift contacted a 72 KV power line. He was electrocuted and another worker on the roof suffered severe burns.

3. On April 6, 2005, a cement truck driver was electrocuted when his truck’s boom contacted an overhead power line while transferring concrete from his truck to a pumper truck.

4. On June 29, 2005, a tree trimmer was electrocuted when a tree branch which he had just cut touched a high voltage power line as he was trying to remove it.

Sadly, the University of Wisconsin – Platteville also lost a graduate of the civil engineering program to electrocution on April 14, 2011. Matthew Rynish (1984-2011) had several years of field experience that included risk intensive inspections of bridges and dams (for which he often had to rappel over the sides of the structure, hanging by a rope over great heights). Despite his training and experience, Matthew died while performing the relatively simple exercise of photographing a traffic intersection. He was within the bucket of a boom truck, photographing the intersection from an overhead position, when he apparently came into contact with an overhead line, the shock from which stopped his heart. This incident was a sad reminder that none of us, no matter how experienced, are excused from any safety concerns.

Heart fibrillation (heart attack) can be caused by as little as 50 V applied across dry, unbroken skin. (If the skin is penetrated or the skin is wet, lesser voltage can cause fibrillation.) Even if you survive, the heart never fully recovers from an instance of fibrillation and your risk of heart attack sometime later becomes greater. Exposure to electrical current can also cause severe burns or the resulting muscular spasm from shock can throw a person a great distance or result in a fall that can also cause injury.

The voltage carried across power transmission lines is always significantly greater than 50 V. Even though they are insulated, an electrical arc can still pass from the wire into a person if they come into contact or even near the line. The electrical current will seek a path to ground through any connection (including a person). If you become the conduit for the current passing through a power line, you are in danger.

Figure 3 shows the international warning symbol for high voltage (A) and labels some of the components at the top of a typical utility pole. The phase wires (B) are the most dangerous; they carry high voltages. Phase wires will always be at the top of the pole. Sometimes there will be multiple layers of phase wires, carrying different voltages, all of which are dangerous. Phase wires can always be distinguished from other wires because they will be connected by some type of insulator (C) to the utility pole cross-arm. Transformers (D) are essentially giant capacitors used to even out the transmissions along the lines. They are also dangerous to touch. Beneath the phase lines and transformers may also be phone and cable utility lines (E). They carry much less voltage than the phase lines, but do not touch them anyway. In the photo of Figure 3, they can be distinguished because they are thicker than the phase lines and do not required insulators at their connection to the utility pole. Drop (or service provider) cables (G) will carry power, phone, and cable service from the pole to residences or businesses. There may be separate drop lines for each service or they may be bundled together. Do not touch any drop lines. Finally the pole may be stabilized by guy wires (F) running from the top of the pole to the ground. These do not carry any current, but are simply strong steel cables used for structural purposes. They are safe to touch.
You can minimize your risk of electrocution when working around power lines by following some (or all) of the guidelines listed below:

1. Check clearances beforehand. If you are operating a piece of equipment that must go underneath power lines, check the height of the equipment against the height of the lines.

2. Maintain safe distances. Keep equipment (and yourself) at least 10 feet or more away from the lines. Very high voltage lines may require a greater distance. This rule applies to all types of equipment from large mechanized boom arms to ladders and hand-held poles. On windy days, remember that both your equipment and the power lines will shift in the wind. What appears to be a safe distance of 10 feet at one moment, may not be the next.

3. Use a spotter to constantly check the distance of equipment from the lines.

4. If the project requires, you can also contact the power company to have the lines temporarily de-energized and grounded.

Many of the risks of power lines will not be encountered during this class. You will not be using a boom truck or lift for any inspections. However, if you do come across any downed power lines, stay away from them and contact 911 to report the downed line immediately.

**First Aid**

Basic first aid kits are part of the safety kit you will check out before going on shall be checked out and taken on any field inspection. Before leaving, the contents of the safety kit, including the first aid kit, should be checked. If any items are used from a first aid kit, the course instructor should be informed so that the kit can be replenished. The purpose of the basic first aid kit is to attend to minor cuts and scrapes. In the event of a severe injury, you shall call emergency services (911) immediately. Response time is critical. Every minute of delay between the time of injury and the time when EMT staff begin administering care increases the risk of death. For severe lacerations, immediately apply pressure to the wound (preferably with some sort of dressing, but with your hand if necessary) and call 911. Keep
pressure applied to the wound until EMT personal arrive. Do not attempt any advanced care unless you have professional certification as an EMT.

**Safety Management Plan**
Before undertaking any inspection, groups will submit a safety management plan. The safety management plan consists of two form sheets: one to catalogue required steps and equipment to accomplish inspection tasks and one to catalogue required safety equipment and practices for the risks associated with each step.

When listing the practices you intend to use to manage risk, state the roles that each group member will have during that step. (For example: Who will be the flagger if you are working near traffic? Who will be entering the water if you plan to perform tasks in water?) Also, list the safety equipment necessary for that specific step.