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1.0 PURPOSE AND APPLICABILITY

This standard operating procedure (SOP) describes installation and site documentation requirements for automatic visibility monitoring camera systems operated according to IMPROVE Protocol.

Camera-based visibility monitoring, referred to as scene monitoring by the IMPROVE Program, is an efficient way to document events and trends and is an effective way to communicate visibility relationships to decision-makers and to the public. Slides and movie film do not, however, provide quantitative information about the cause of visibility impairment. Aerosol and optical properties of the atmosphere must be independently monitored where cause and effect relationships are required.

The automatic camera visibility monitoring station takes 35 mm slides of a selected vista at user-selected times throughout the day. The station can also be outfitted with an 8 mm time-lapse camera to record the dynamics of visibility events. Self-contained, battery-powered, automatic camera visibility monitoring systems are easily installed and operated at any location.

The purpose of this standard operating procedure is to assure consistent, quality data and minimize data loss by:

- Installing procured automatic visibility monitoring camera systems according to manufacturers' specifications.
- Ensuring that visibility monitoring systems are installed in locations that view important scenic features, monitors the same air mass of associated aerosol and/or optical instrumentation, and are secure from potential vandalism (see SOP 4055, *Site Selection For Scene Monitoring Equipment*).
- Training site operators on camera system requirements and routine maintenance procedures (see SOP 4120, *Automatic Camera System Maintenance (IMPROVE Protocol)*, and its associated technical instructions).
- Performing thorough on-site specification measurements.
- Documenting collected site specification measurements on the Visibility Monitoring Photographic Site and Target Specifications Form.

This SOP serves as a guideline to facilitate the following:

- Installing automatic visibility monitoring camera systems
- Completing the Visibility Monitoring Photographic Site and Target Specifications Form

2.0 RESPONSIBILITIES

2.1 PROJECT MANAGER

The project manager shall:

- Provide the field specialist final site configuration materials including photographic documentation, maps, and approved installation location, vista, and configuration specifications.
- As required, review the determined site preparation and installation requirements and installation schedule with the project-specific Contracting Officer's Technical Representative (COTR).

2.2 FIELD SPECIALIST

The field specialist shall:

- Schedule the system installation.
- As required, review the determined site preparation and installation requirements with the local contact.
- Maintain communications with the local contact during site preparation. Verify that all required site preparation is completed prior to the installation.
- Obtain permission from private or public landowners to access the scene monitoring location for installation and training.
- Schedule an operator training session for all identified operator(s) and the primary local contact.
- Install all automatic camera system equipment according to installation and configuration requirements provided by the project manager.
- Complete the Visibility Monitoring Photographic Site and Target Specifications Form.
- Enter all site specification information in the Quality Assurance Database.

2.3 LOCAL (ON-SITE) CONTACT

The local contact shall:

- Review the determined site preparation and installation requirements with the field specialist.
- Identify and contact local landowners, primary contacts, and site operators regarding site installation and routine maintenance requirements.
- Perform any necessary site preparation required prior to the installation (e.g., tree removal, clear site access).

- Maintain communications with the field specialist and local landowners to confirm scheduled installation requirements.
- Schedule the operator training session with pertinent routine servicing personnel and the field specialist.
- Provide on-site equipment and tools required for the determined mounting configuration.
- Provide site access and installation assistance as needed.
- Verify site location and geographic reference specifications documented by the field specialist.

3.0 REQUIRED EQUIPMENT AND MATERIALS

3.1 SITE INSTALLATION EQUIPMENT AND MATERIALS

Materials required to install an automatic camera system depend on the type of installation and surface material to which the enclosure is mounted. Standard equipment and materials required for any camera system installation include:

- Weatherproof automatic camera system enclosure provided with:
 - Four 1" carriage bolts (3/8" diameter)
 - Four 3/8" nuts and lock washers
 - Clear silicone seal
- Double-plated mounting post
- Camera system components and tripod mount
- Standard tool kit with adjustable crescent wrench, channel-lock pliers, standard combination wrench set, screwdrivers (flat-head and Phillips-head), wire snips, needle-nose pliers, regular pliers, wire ties, and electrical tape
- Brunton compass
- Level
- Site location maps
- Documentation camera(s) and 35 mm print film

The following site installation equipment and materials requirements have been categorized by mounting configuration.

3.1.1 Pre-Existing Concrete or Rock Installation

Standard equipment and tools required to install an automatic camera system in pre-existing concrete or rock include:

- Hammer drill (AC or battery, depending on line power availability)
- 5/8" hammer bit and 5/8" star drill
- Two pound (2 lb.) hand sledge hammer
- Hack saw
- Threaded rod and rock/concrete epoxy mounting method hardware:
 - Four 6" lengths of 1/2" threaded rod
 - Four to six 1/2" rock/concrete inserts (5/8" outside diameter)
 - Four to six 1/2" rock/concrete epoxy capsules
- Rock/concrete inserts and bolts mounting method hardware:
 - Eight or more 1/2" nuts and twelve or more washers
 - Four lock washers
 - Four 1/2" bolts (1-1/2" or 2" in length)

3.1.2 Soil Installation

Standard equipment and tools required to install an automatic camera system in soil include:

- Shovel
- Wheelbarrow
- 7-10 gallons of water (two 5-gallon water containers for transport, if necessary)
- Four 1/2" foundation J-bolts (8" to 12" in length)
- Eight 1/2" nuts and washers
- Four lock washers
- Thin plywood template of post mounting plate hole pattern (with pre-drilled mounting holes)
- Two to four bags of concrete mix

3.1.3 Wood Platform Installation

Standard equipment and tools required to install an automatic camera system in a wood surface or platform include:

- Drill (AC or battery, depending on line power availability)
 - Drill bit set (up to 3/8" in diameter)
 - Four 3/8" lag screws (1-1/2 to 3" in length, depending on wood thickness). Four washers and four lock washers
- or**
- Four 1/2" carriage bolts (length depending on wood thickness). Eight nuts, eight washers and four lock washers

If there is adequate access to the underside of the wood surface, it is preferable to use carriage bolts instead of lag screws.

3.1.4 Concrete Pad Installation

Standard equipment and tools required to install an automatic camera system in a concrete pad include:

- Drill (AC or battery, depending on line power availability)
- 1/2" drill bit
- Wood saw
- 30" x 30" piece of 1/2" thick plywood
- Two 30" lengths of 2" x 4" lumber
- Two 27" lengths of 2" x 4" lumber
- Twenty-four or more 1" or 1-1/2" wood screws
- Twelve or more 2-1/2" or 3" wood screws
- Two to four bags of concrete mix (enough for 1.5 cubic feet of concrete)
- Four 1/2" x 6" carriage bolts (entire length must be threaded)
- Eight 1/2" nuts, 12 washers, and 4 lock washers
- Thin plywood template of post mounting plate hole pattern (with pre-drilled mounting holes)

3.2 SITE DOCUMENTATION MATERIALS

The following materials are generally required to complete the site documentation process:

- Photographs of the site, final equipment configuration, and scenic vista(s)
- On-site documentation acquired by the field specialist during installation, required to complete the Visibility Monitoring Photographic Site and Target Specifications Form (see Section 4.5) (e.g., site location, site operator contact information, etc.)
- Topographic maps of the area
- Ruler, protractor, and calculator

4.0 METHODS

This section describes site installation and documentation procedures and includes five (5) major subsections:

- 4.1 Site Preparation and Communication
- 4.2 Vista Alignment
- 4.3 Installation of Automatic Camera Equipment
- 4.4 Operator Training
- 4.5 Site Documentation

4.1 SITE PREPARATION AND COMMUNICATION

Prior to any installation site visit:

- Review the determined site preparation and installation requirements with the site-specific local contact.
- Schedule all site preparation activities.
- Maintain communications with the local contact during site preparation. Verify that all required site preparation is completed prior to the installation.
- Document the primary site operator(s) and back-up operator(s).
- Obtain permission from private or public landowners to access the monitoring location for installation and training.
- Schedule the site installation visit and operator training session.
- Arrange for any necessary installation assistance, as well as tools and equipment (e.g., wheelbarrow, water containers).

Once on site:

- Ensure that the selected visibility monitoring location views important scenic features, monitors the same air mass of associated aerosol and/or optical instrumentation, and is secure from potential vandalism.
- Verify the proposed installation configuration and time scheduled for the final training session.

4.2 VISTA ALIGNMENT

Before the automatic camera system can be installed, the mounting post must be appropriately aligned on the selected monitoring vista (target).

- Stand the mounting post on the installation spot.
- Determine the post orientation by aligning either short edge of the top mounting plate on the center of the expected vista (target).
- Minor camera alignment adjustments are made with the camera tripod mount after installation of the post and enclosure is complete.

4.3 INSTALLATION OF AUTOMATIC CAMERA EQUIPMENT

The automatic camera system mounting post, enclosure, and monitoring equipment will be installed in best accordance with the approved siting configuration specifications. Mounting post and enclosure installation procedures are described in the following subsections.

4.3.1 Mounting Post Installation

Mounting post installation procedures depend on the type of installation and surface material to which the post is mounted. The mounting posts may be attached to pre-existing concrete or rock, in soil, in a wood platform, or to a new concrete pad.

ATTACHMENT
TO PRE-EXISTING
CONCRETE OR
ROCK

If vandalism is a concern or if the mounting surface is uneven, use threaded rods and rock/concrete epoxy capsules for mounting; otherwise, use rock/concrete inserts and bolts. A diagram depicting both techniques for pre-existing concrete or rock surface mounting is provided as Figure 4-1.

Threaded Rod and Rock/Concrete Epoxy:

- Using the post bottom mounting plate as a template, drill holes for the 1/2" diameter threaded rod segments. Refer to the instructions on the rock/concrete epoxy capsule box for hole diameter, depth, hole preparation, threaded rod preparation, and use of the epoxy capsules. Normally a 5/8" diameter hammer drill bit is used to drill a hole 4" deep.

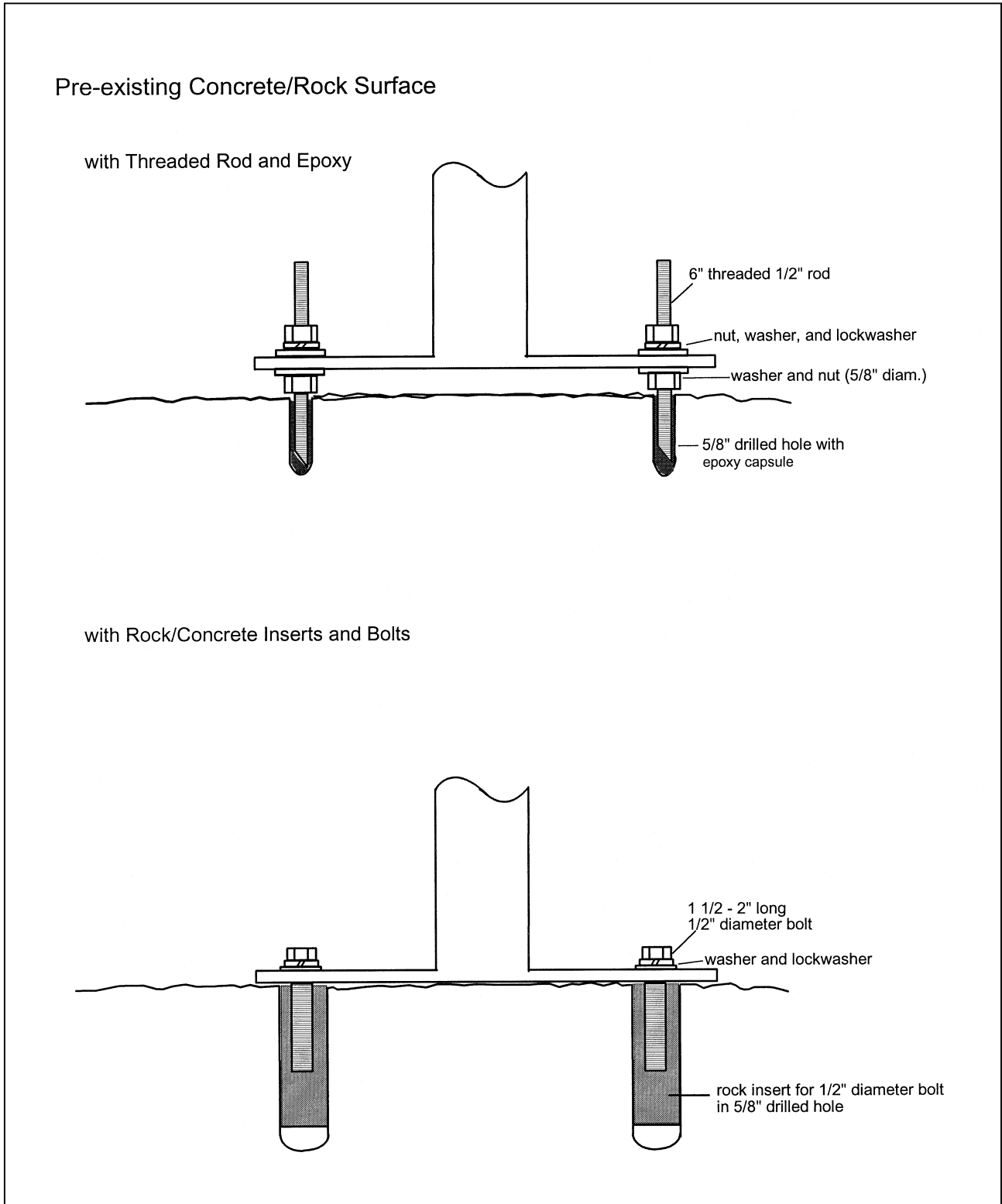


Figure 4-1. Mounting Post Configuration in Pre-Existing Concrete/Rock Surface.

- After the epoxy has set, screw a nut, with washer, on each rod section. Place the mounting post over the rods.
- Level the mounting post by adjusting the nuts. Verify that the mounting plate rests evenly on all four nuts.
- Using washers, lock-washers, and nuts, secure the mounting plate.
- To prevent vandalism or theft, bend over the tops of the threaded rods or damage the rod threads so that the nuts cannot be removed.

Rock/Concrete Inserts and Bolts:

- Using the post bottom mounting plate as a template, drill holes (typically 5/8" in diameter for 1/2" diameter bolts with inserts) slightly deeper than the length of the insert. Since the mounting plate hole insert alignment is critical, it is advisable to prepare one hole at a time and secure the mounting plate before proceeding with the next hole.
- Tap the insert into the hole and secure the post mounting plate with a bolt, washer, and lock washer. Proceed one hole at a time as noted above.
- Minor leveling adjustments can be made by placing additional washers between the mounting plate and the mounting surface.
- This type of post attachment is more vulnerable to theft or vandalism. Other deterrents such as lock and chaining the post should be considered.

ATTACHMENT
TO CONCRETE
PIER IN SOIL

The hole size, amount of concrete, type of hardware used, and other installation related hardware may vary depending on the observed mounting soil conditions and determined configuration requirements. A diagram depicting a concrete pier installation in soil is provided as Figure 4-2.

- Assemble wood template and J-bolts with nuts so that at least 1-1/2" of thread protrudes above the template.
- Dig a hole 1-1/2 feet in diameter and 1-1/2 to 2 feet deep. Fill the hole to ground level with concrete.

Note: The concrete/water mix should be fluid enough that it will mold around the J-bolts.

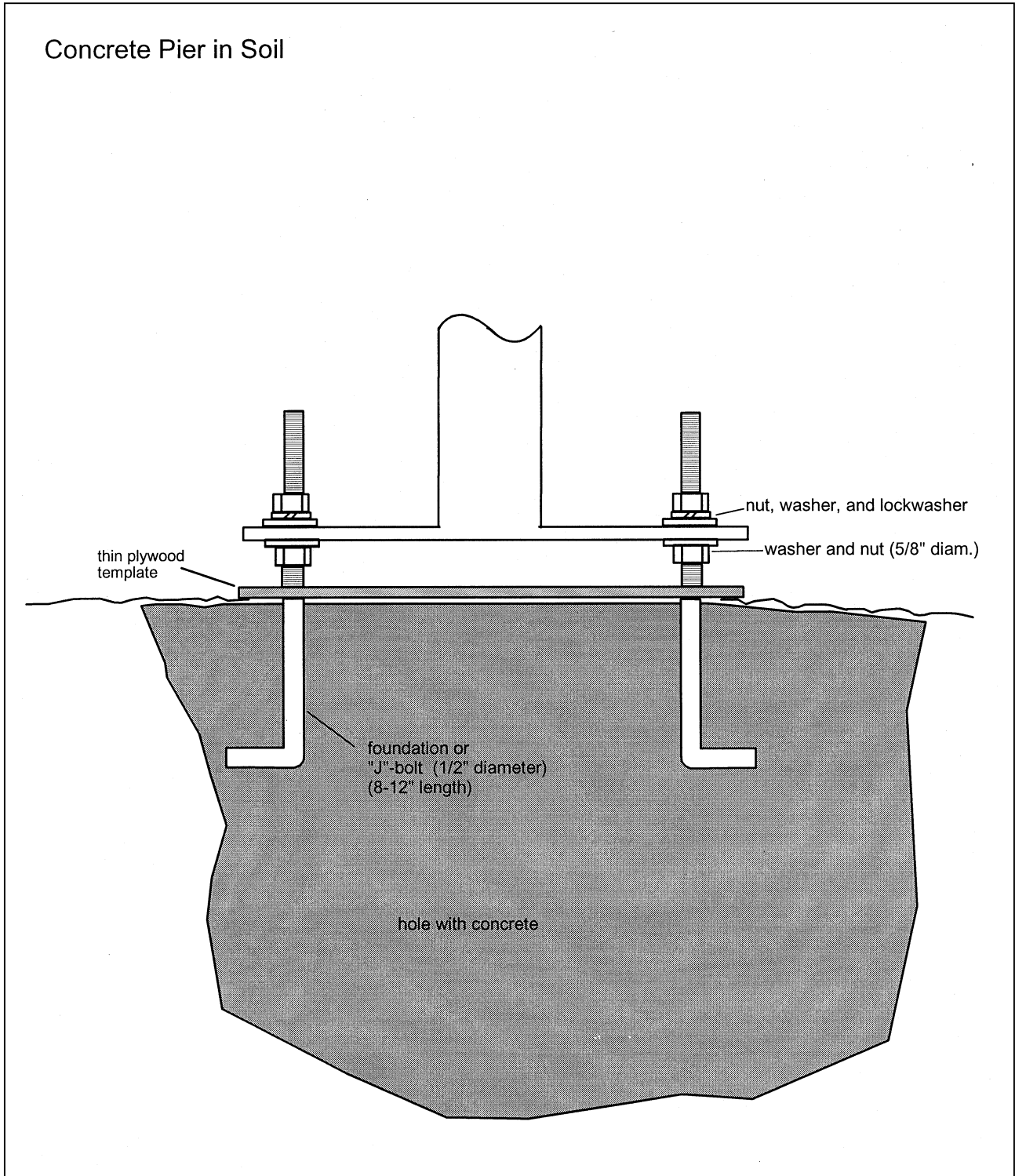


Figure 4-2. Mounting Post Configuration in Concrete Pier in Soil Surface.

- Place the template assembly on the wet concrete and work the J-bolts into the concrete as shown in Figure 4-2. Be careful to verify that the template is aligned on the selected vista (Section 4.2).
- Allow the concrete to set for least 10 hours. Drying time depends on soil temperature. If cold weather or heavy rain is expected, protect the concrete with insulating or waterproof cover.
- Place nuts and washers on the J-bolts and place the mounting post over the bolts.
- Level the post by adjusting the nuts. Verify that the mounting plate rests evenly on all four nuts.
- Using washers, lock-washers, and nuts, secure the mounting plate.
- To prevent vandalism or theft, bend over the tops of the threaded rods or damage the rod threads so that the nuts cannot be removed.

ATTACHMENT TO WOOD

Depending on the thickness of the wood platform and underside access, mounting can be accomplished with lag screws or carriage bolts. If there is adequate access to the underside of the wood surface, carriage bolts are more stable and often more of a vandalism deterrent than lag screws. The installation procedures, whether using carriage bolts or lag screws, are similar. A diagram depicting both methods for wood surface mounting is provided as Figure 4-3.

- Using the bottom post mounting plate as a template, drill holes for the screws or bolts in the wood.
- Secure the post mounting plate to the wood surface with the bolts or screws, using washers and lock washers.
- Minor leveling adjustments of the post can be done by placing additional washers between the wood surface and the mounting plate.

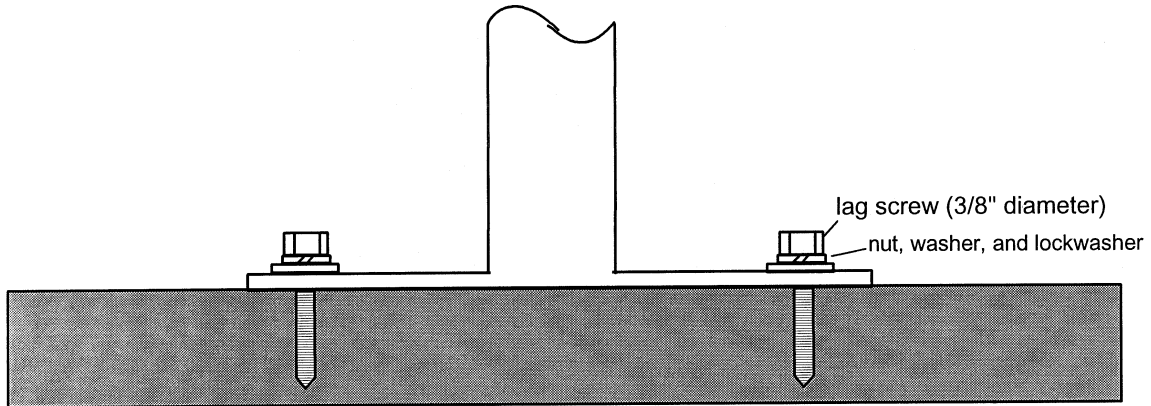
This type of installation is relatively vulnerable to theft or vandalism. Other deterrents such as lock and chaining the post should be considered.

ATTACHMENT TO CONCRETE PAD

Concrete pad installations are normally preferred on roof surfaces or in locations where the site cannot be permanently altered. Due to weight (approximately 200 pounds), it is advisable to pour a concrete pad after the form has been placed at the installation site. If a concrete form and pad will be exposed to weather for an extended period, the wood should be sealed and/or painted.

Attachment to Wood Surface

with Lag Screws



with Carriage Bolts

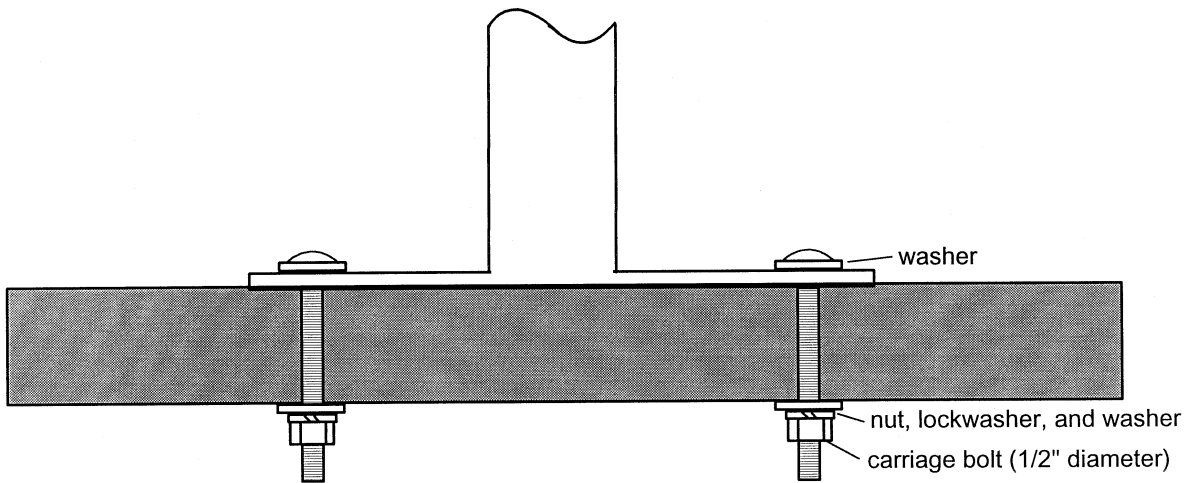


Figure 4-3. Mounting Post Configuration in Wood Surface.

A diagram depicting the pad form and hardware attachment is provided as Figure 4-4.

- Attach the 2" x 4" lumber to the large 1/2" plywood square.
 - The shorter (1-1/2") wood screws are used to secure the plywood to the 2" x 4"s.
 - The longer (2-1/2" to 3") screws are used at the corners to attach the 2" x 4"s to each other.
- Using the bottom post mounting plate as a template, drill four holes, 1/2" in diameter, in the plywood.
- Attach each of the four carriage bolts to the form using two washers, a lock washer, and a nut.
- Set the pad form on the installation site and fill to the top edge with concrete. Place the thin plywood template of the bottom post mounting plate over the tops of carriage bolts to ensure correct alignment.

Note: The concrete/water mix should be fluid enough that it will mold around the J-bolts.

- Allow the concrete to set for at least 10 hours. Drying time depends on air temperature. If cold weather or precipitation is expected, protect the concrete with an insulating and/or waterproof cover.
- After the concrete has set, remove the thin plywood template and attach the mounting post to the concrete pad with washers, lock washers, and nuts.
- Minor leveling adjustments of the post can be done by placing additional washers between the concrete surface and the mounting plate.
- To prevent vandalism or theft, bend over the tops of the carriage bolts or damage the threads so that the nuts cannot be removed.

4.3.2 Enclosure Installation

Enclosure installation involved three processes: mounting the sunshield, the enclosure, and the camera equipment.

MOUNT SUNSHIELD

As depicted in Figure 4-5, prior to attaching the enclosure to the installed mounting post, mount the sunshield hood to the enclosure using the three screws and nuts provided with the shield. Run a bead of clear silicone sealant around the outside edge of the hood where it contacts the enclosure.

Concrete Pad Form and Carriage Bolt Attachment

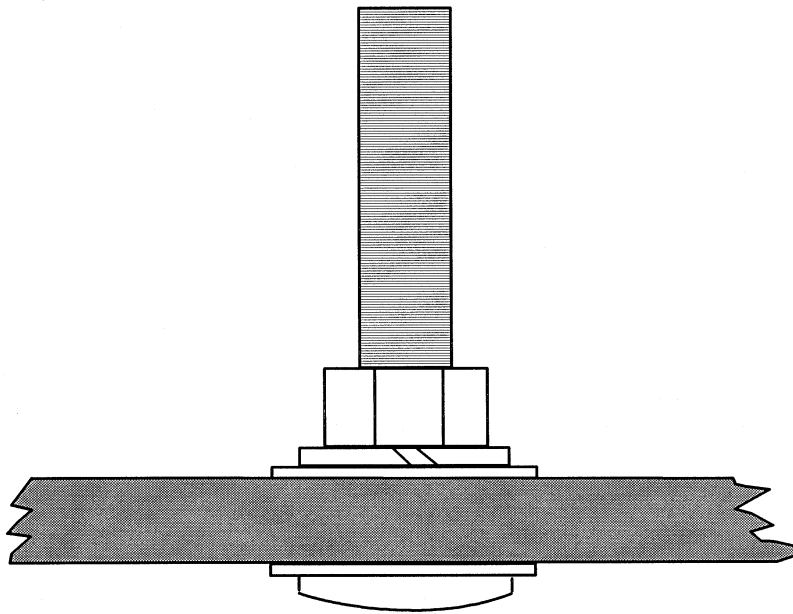
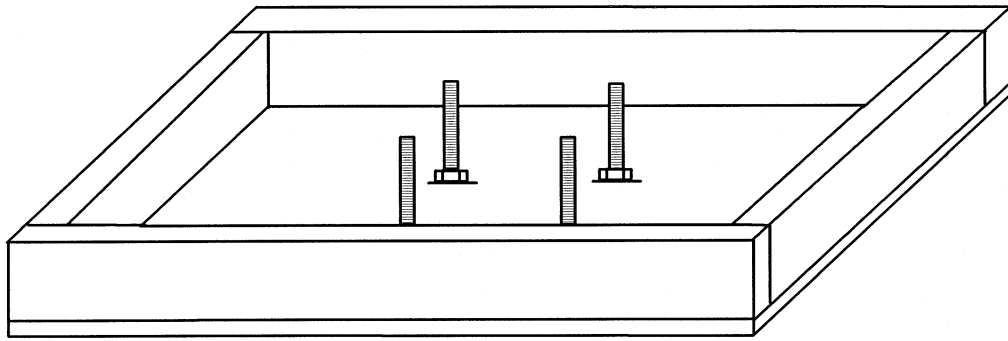


Figure 4-4. Mounting Post Configuration on Concrete Pad.

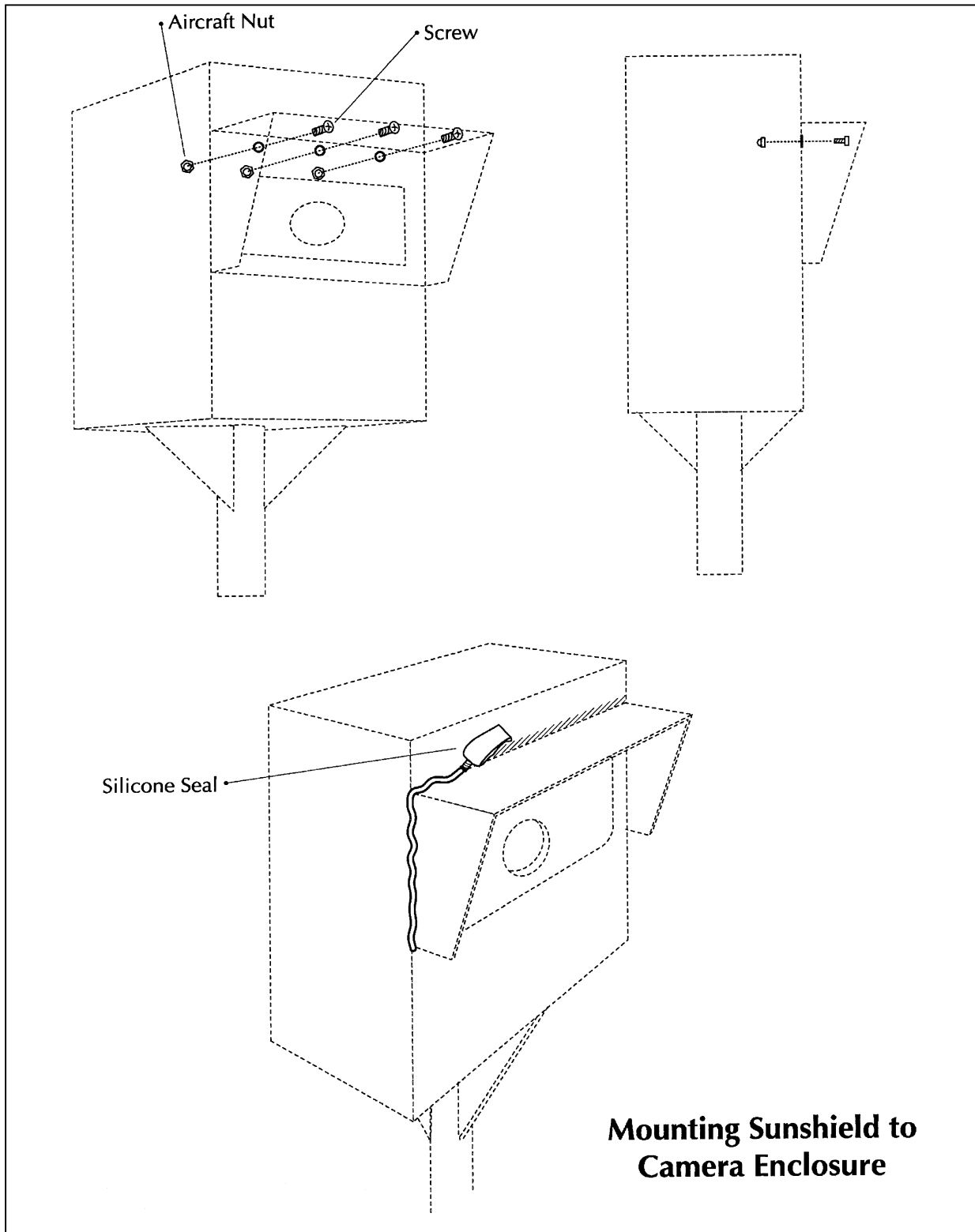


Figure 4-5. Enclosure Sunshield Mounting Configuration.

MOUNT ENCLOSURE Mount the enclosure to the mounting plate with the four (4) short carriage bolts, lock washers, and nuts provided with the enclosure, as depicted in Figure 4-6. The rounded carriage bolt heads should be on the underside of the mounting plate.

MOUNT CAMERA EQUIPMENT Mount the automatic camera equipment inside the enclosure on the tripod mounting plate provided. Detailed camera mounting diagrams are provided in the Site Operator's Manual for Automatic Visibility Monitoring Camera Systems.

4.4 OPERATOR TRAINING

Operator training is provided by the field specialist following the completion of the camera system installation and configuration. Site operators are trained on camera system requirements and routine maintenance procedures. A Site Operator's Manual for Automatic Visibility Monitoring Camera Systems is also provided. This manual contains standard operating procedures and technical instructions applicable to the specific camera monitoring equipment located at the site. Additional manufacturer's instruction booklets and pertinent maintenance documentation forms are also provided.

4.5 SITE DOCUMENTATION

Site documentation for the automatic camera system visibility monitoring station includes completion of the Visibility Monitoring Photographic Site and Target Specifications Form (Figure 4-7) as is detailed in the following subsections. Site documentation procedures must be completed upon any of the following:

- Installation or removal of an automatic camera system
- Change in location or vista of an automatic camera system
- Significant changes of specification information included on the Visibility Monitoring Photographic Site and Target Specifications Form.

4.5.1 Camera Location and Geographic Reference

SITE NAME Record the full site name including the type of site (e.g., National Park, etc.).

**STATION TYPE/
FOCAL LENGTH** Record the automatic camera configuration (35 mm and/or 8 mm system and lens focal length (e.g., 50 mm, 135 mm, etc.)).

**OBSERVATIONS
/DAY** Record the periods in which photograph(s) are taken (e.g., 0900, 1200, and 1500; or 7:00 a.m. through 5:00 p.m. at 1-minute intervals).

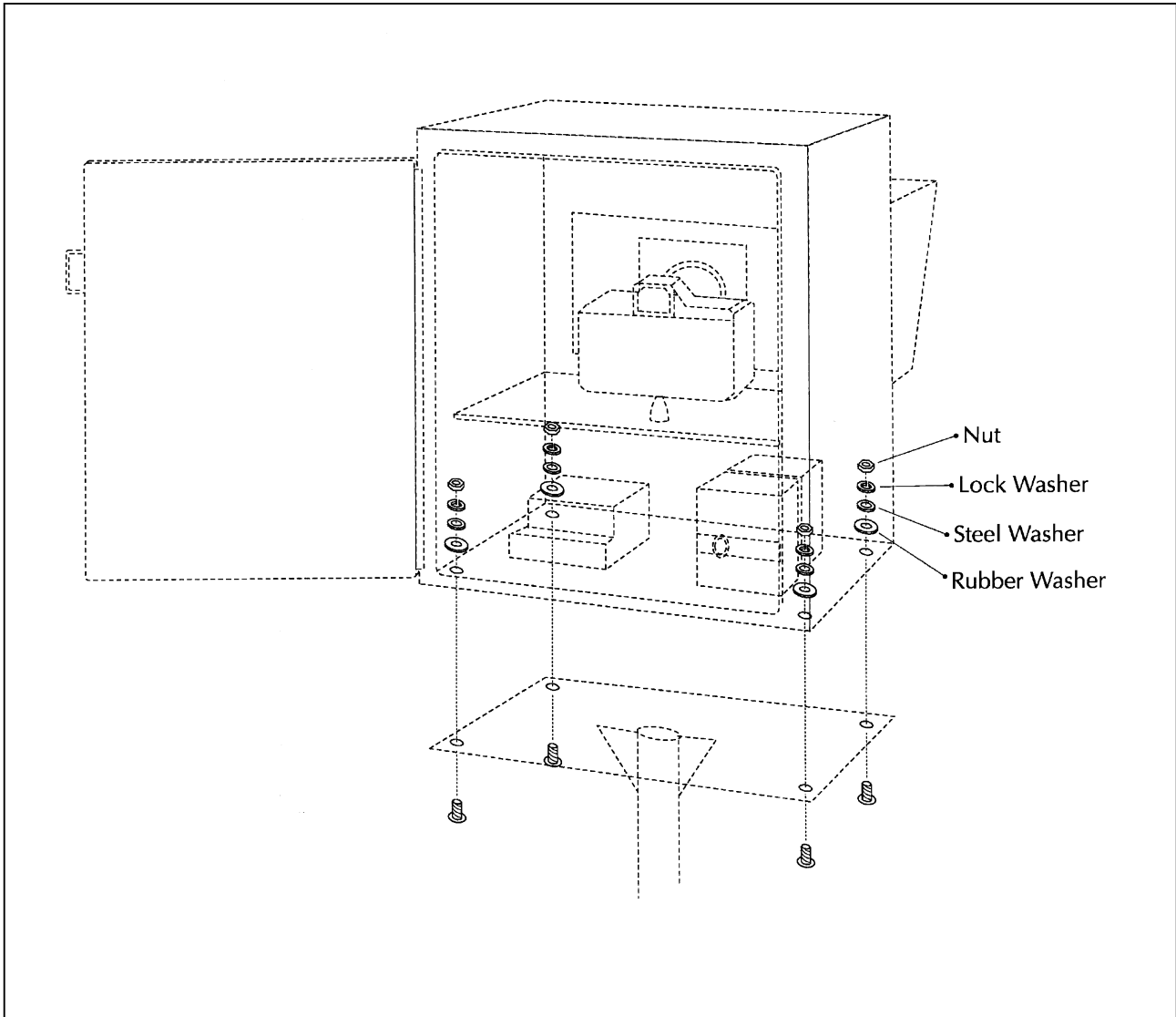


Figure 4-6. Enclosure Mounting Configuration.

ELEVATION, LONGITUDE AND LATITUDE	Record the elevation (in meters) of the camera location. Record the longitude and latitude of the station in degrees, minutes, and seconds.
MAP REFERENCE	Record references for any maps available and/or used to complete this form. Note the map name, scale and source of the map.
NETWORK	Record the network name (e.g., IMPROVE) in this field.

4.5.2 Installation and Site Contact Documentation

SITE ABBREV- IATION	Record the four (4) character site abbreviation code.
INSTALLATION DATE	Record the date and time the camera system was installed.
INSTALLATION BY	Record the name of the person(s) who installed the system.
SITE SPECIFICATIONS VERIFICATION AND DATE COMPLETED	Record the name of the person(s) who completed and verified the site specifications, the date they were completed, and the date of the previous specification update.
SITE CONTACTS	Record the name, telephone, and fax numbers for any site operator(s), primary contact(s), and supervisor(s).
SITE MAILING ADDRESS AND SHIPPING ADDRESS	Record the site mailing address, the address to which correspondence is sent via US Mail, and the shipping address, the address to which UPS can deliver parcels. The shipping address cannot be a post office box.

4.5.3 Vista Identification and Specifications

VISTA NAME	Record the name of the monitored vista or the most dominant scenic feature(s)/target(s) in the vista.
DISTANCE	Record the distance in kilometers from the camera location to the dominant scenic feature. If only the vista name is known, document the approximate distance (in kilometers) to the most distant land feature.
ELEVATION	Record the ground level elevation in meters of the most dominant scenic feature, using the best available source (map, altimeter, etc.).
BEARING	Record the bearing from true north (in degrees) of the most dominant scenic feature from the camera location.

ELEVATION ANGLE Calculate the elevation angle between the camera location and the most dominant scenic feature:

$$\text{Elevation Angle} = \left(\frac{\text{Feature Elevation}(m) - \text{Site Elevation}(m)}{\text{distance}(km) \times 100} \right) \tan^{-1}$$

SITE PATH ELEVATION Calculate the mean site path elevation between the camera location and the mean site path elevation:

$$\text{Mean Site Path Elevation} = \frac{\text{Feature Elevation}(m) + \text{Site Elevation}(m)}{2}$$

4.5.4 Photographic Reference and Comments

VISTA COVER TYPE Record the dominant characteristics of the terrain in the vista and vegetative cover-type.

PHOTOGRAPHIC REFERENCE Attach separate photographs (3" x 5" color prints preferred) of the:

- Selected site vista(s) with identified dominant scenic features.
- Cardinal direction views from the camera location (N,E,S,W).
- Camera system configuration.

COMMENTS Document any dominant stationary or mobile pollutant influence on the site, listing the source and pollutant. Document any pertinent information regarding the lens configuration or installation configuration (e.g., enclosure mounted on lookout tower railing). Document any other information that is special to the site, such as site access, etc.