OREGON DEPARTMENT OF TRANSPORTATION

Geometronics
OREGON DEPARTMENT OF TRANSPORTATION

200 Hawthorne Ave., Suite B250
Salem, OR 97310
(503) 986-3103

Ron Singh, PLS
Chief of Surveys
(503) 986-3033

Dave Brinton, PLS
Lead Surveyor
(503) 986-3017

Bench Mark Resets

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This document was developed for ODOT by
Curt Smith, NGS Advisor
In Cooperation with Geometronics Staff

Relocating Vertical Control Bench Marks

Each vertical control bench mark represents a large investment of resources. Since it is intended to provide a continuous record of elevation changes, as well as control for many local surveyors, its preservation is vital. Although bench marks are constructed in locations where they are less likely to be disturbed, many are destroyed or damaged by highway rebuilding and retrofitting, railroad maintenance, urban development, and building demolition and construction.

The purpose of these guidelines are to provide the information necessary for re-establishing a soon to be destroyed or damaged bench mark. The support and cooperation of local surveyors and engineers is not only important but also essential to the preservation of bench marks.

If a bench mark is about to be destroyed a representative of the ODOT Geometronics Unit should be contacted. Points of contact are found on page 4 of this documentation. Typical reset bench marks are published as third-order elevations due to the single bench mark reference to determine elevation. Refer to Attachment A for minimum requirements to maintain the order and class of the original bench mark.

There are two general situations encountered when a bench mark is to be destroyed; (1) time is available to reset a new monument in the vicinity before the threatened mark is destroyed, and (2) the mark is to be destroyed before the new mark can be set. This latter case occurs generally when the location of the new (replacement) mark is not suitable for its physical establishment. This might be the case where the new mark will not be set until a new bridge is constructed. Guidelines for both cases follow:

Setting a New Bench Mark

Utilize new ODOT bench mark disks and provide appropriate stamping. The new disk will be stamped with the same designation as the destroyed or soon to be destroyed bench mark.

Figure 1: Sample Disk Stamping

It will be stamped with the word RESET and the year of the reset, such as a bench mark designated M 123 that is to be reset would be stamped M 123 RESET 2001.

Select a suitable site for the new bench mark, if possible within one setup from the bench mark to be replaced. Establish the bench mark as indicated on page 2 and in Attachment B of this document. Bench marks will generally be set in a poured-in-place concrete monument, in an existing stable concrete foundation (bridge abutment), or in a drill hole in bedrock. Other types of settings are also possible and the ODOT Geometronics Unit can provide guidance and other information.

Note: It is not necessary the new mark be established at the same elevation as old mark.

A witness post should be set within about 3 to 6 feet of the relocated mark if possible. Remove any witness posts for the destroyed bench mark.

A complete description of the new mark must be provided. Descriptions should be included on the reverse side of the "Report on Relocation and Description of Reset Bench Mark" form. A sketch of the location is beneficial for comparison with the written description. Pencil rubbings or photographs of the disks confirm agency information, disk size and type, and designation stamping. Station description guidelines are available in Attachment C.

Level observations between the points should satisfy third-order accuracy standards or better. Sight lengths should be limited to 230 ft (70 m) for this standard. Where possible, the replacement mark should be set within about 460 ft (140 m) of the old mark. The replacement mark should not be set further apart than four setups.

An assumed elevation for the old mark may be used in the leveling since the principal concern is with the **difference of elevation** between the old mark and the new one. Record rod readings to 0.001 ft (or 0.001 m). The model and type of instrument and rods (e.g., fiberglass, aluminum, single piece, etc.) as well as rod scale (e.g., meters, feet, or bar code) should be entered on the "Report on Relocation and Description of Reset Bench Mark" form where indicated.

Observing Sequence

The observing procedures are intended for use with the Leica NA2002 or NA3003 digital levels.

1. Perform instrument check and adjustment as outlined in the digital level manual.

2. Set up the instrument about halfway between the old and new bench marks. Limit sight lengths to no more than 230 ft (70 m) from either point or from one of the points and a turning pin in the case of multiple setup requirements, e.g., distance between points is greater than 460 ft (140 m). Level up the instrument using the three foot screws while observing the bulls-eye bubble from the front. Turn on instrument and select the Start Level BF program. Confirm that you want to start then enter the starting elevation for the old mark. Set and confirm instrument parameters, e.g., Measure to Mean 3 measurements, Fix to All to display maximum decimal places, and Record to Module, and observing configuration, e.g., Rod to 3m/2m or 4m/2.7m, Earth C. to Without, and Units to Feet.

3. Plumb the level rod on the highest point of the old mark, e.g., domed top of disk M 123. Record the designation of the point and its published elevation noting the reference vertical datum and units of measure.
4. Backsight Reading: Point using the vertical crosshair of the level instrument on the middle of the rod over the old mark and use the focusing knob to bring the image of the rod into sharp

focus Depress the measure button and record the rod reading. Note distance from rod to instrument. It should be less than 230 ft (70 m).

5. Plumb the rod on the highest point of the new bench mark. Record the designation of the new mark, e.g., M 123 RESET, or TP1 (for turning point 1 in the case of multiple setups).

6. Foresight Reading: Point and focus the level instrument on the rod over the new mark. Depress the measure button and record the rod reading. Note distance from rod to instrument. It should be less than 230 ft (70 m). Note imbalance between backsight and foresight distances. This difference should be less than 15 ft (5 m).

7. The elevation of the new bench mark or turning point is computed as the sum of the backsight reading and the published elevation minus the foresight reading.

8. Reset and re-level the instrument. Level backward from the new point to the old, in the same manner as steps 2 through 6. Use the elevation determined from the forward leveling as the starting elevation for the backward leveling. The elevation computed for the old point as a result of the backward leveling may differ by no more than +/- 0.01 ft (+/- 0.003 m) from the published elevation.

9. To compute the elevation difference from the old mark to the new, subtract the mean of the two elevations for the old mark from the elevation for the new mark. The elevation for the new bench mark will be this computed difference, mean of both forward and backward leveling, plus the published elevation of the old bench mark. Record the datum (NGVD29 or NAVD88) of the old bench mark.

Note: The old mark should not be disturbed until observations involved in the leveling have been checked by the observer or recorder.

When Reference Points Are Required

If the old mark is to be removed before a new mark can be established a series of three reference points should be set in the vicinity. The reference points should be stable points which are unlikely to move between the time they are set and the time they are used to establish the elevation of the new mark. Chiseled crosses in concrete or on outcrop, anchor bolts, nail in tree root, stable re-bar driven in a location that will survive construction, as well as other or a combination of these are just a few types of possible reference points.

Leveling should be performed so that there is a separate setup between reference points and the bench mark(s) following similar procedures as listed in steps 2 to 9 above. A suggested sequence is as follows: Observe forward and backward leveling between the old bench mark to be reset and reference point 1. Then observe forward and backward leveling between reference points 1 and 2, and observe forward and backward leveling between reference points 2 and 3. Then close the loop by forward and backward leveling between reference point 3 and the old mark.

A similar set of observations is obtained between each of the reference points and the new bench mark after it has been established. Relative differences beyond allowable tolerances should be investigated and noted.

Destroyed Bench Marks

Destroyed bench marks should be returned to the ODOT Geometronics Unit along with the reset information requested below. ODOT is reluctant to remove destroyed bench marks from its records without definitive proof of the mark's destruction.

Note: If the old bench mark is in poor condition such that the elevation may be questionable it should be considered destroyed. No effort should be made to transfer a potentially erroneous elevation to a replacement bench mark. Perform level ties to other adjacent bench marks whenever in doubt about an elevation.

After the new mark has been established and leveled to, the old disk should be removed and returned to the ODOT Geometronics Unit at the address listed for Data Submission. If the old disk cannot be returned, please describe the reason. A copy of the field notes, description of original mark, description of reset mark, completed reset forms, and any remarks that seem pertinent to this action should also be submitted.

Data Submission

Before the ODOT Geometronics Unit will publish new reset elevations, the following **must be supplied** by the submitting office:

1. Completed "Report on Relocation and Description of Reset Bench Mark" form with new station description. (See attached form)
2. Paper copy (or digital copy, if appropriate) of leveling observations between reset mark and mark(s) or reference points used to reset the mark.
3. The old disk and/or "Report on Condition of Survey Mark."

Send completed forms to:

Ron Singh
Chief of Surveys
Oregon Department of Transportation
Geometronics Unit
200 Hawthorne Ave., SE, Suite B-250
Salem, OR 97301-5193
Phone: 503-986-3103
FAX: 503-986-3548
E-mail: Ranvir.SINGH@odot.state.or.us

Data Review and Final Adjusted Elevations

The ODOT Geometronics Unit will review submitted data for conformation to guidelines, quality, and completeness then adjust observed elevation differences. Final adjusted elevation and description for the new reset mark will be published in ODOT elevation records.

Updates to this manual can be found at the Geometronics' Intranet site listed under technical information at http://intranet.odot.state.or.us/tsgeometronics/.

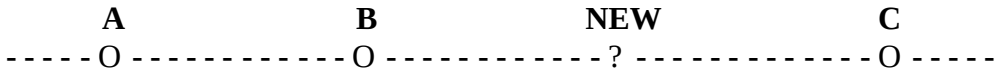
Guidelines and Procedures to Replace a Destroyed Bench Mark Along Existing Level Line Maintain Original Order of Accuracy

These guidelines and procedures provide guidance on establishing or replacing, to the same order/class, one or two bench marks along a previously leveled line from the remaining bench marks along that line. If a large number of bench marks in a row along a line are destroyed, the entire line should be re-leveled.

Following these guidelines and procedures will keep the new bench within the same order/class as the original line.

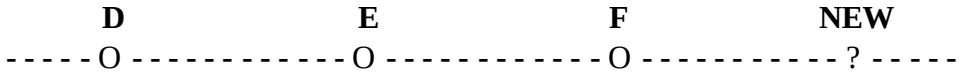
Network Geometry

First-Order (preferred method): (A, B, & C are existing first-order bench marks)



A	to	B	= single-run, must check published difference
B	to	NEW	= double-run, forward and backward leveling must check*
NEW	to	C	= single-run
B	to	C	= not directly leveled but must check published difference

First-Order (optional method): (D, E, & F are existing first-order bench marks)

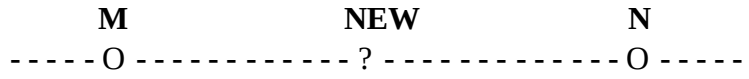


D	to	E	= single-run, must check published difference
E	to	F	= single-run, must check published difference
F	to	NEW	= double-run, forward and backward leveling must check*

*** Note**: "Check" refers to "Maximum section misclosure (mm)" as defined in FGCS Standards and Specifications for Geodetic Control Networks publication, page 3–7. A conversion to thousandths of a foot may be necessary.

Second-Order (preferred method):

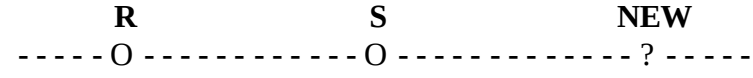
(M & N are existing first or second-order bench marks)



M to NEW = double-run, forward and backward leveling must check*
NEW to N = single-run
M to N = not directly leveled but must check published difference

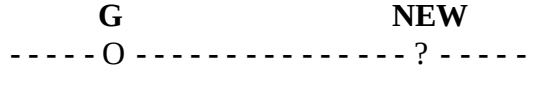
Second-Order (optional method):

(R & S are existing first or second-order bench marks)



R to S = single-run, must check published difference
S to NEW = double-run, forward and backward leveling must check*

Third-Order: (G is an existing first, second, or third-order bench mark)



G to NEW = double-run, forward and backward leveling must check*

*** Note**: "Check" refers to "Maximum section misclosure (mm)" as defined in FGCS Standards and Specifications for Geodetic Control Networks publication, page 3–7. A conversion to thousandths of a foot may be necessary.

New or Replacement Survey Monuments

Typical bench mark / geodetic control disks are made of aluminum, brass or bronze. They are about 3 inches in diameter and have a domed surface to support the foot of a leveling rod and a center point for plumbing survey equipment. Information is imprinted on this surface to identify the monument and to aid the user in obtaining data on it. This logo is recessed so that it does not interfere with the leveling rod or other survey equipment. A deformed shank or stem, about 3 inches long, is cast with, silver-soldered, or otherwise attached to the bottom surface of the disk to help prevent the disk from being dislodged.

Site Selection

Even though the reset bench mark must remain within the general proximity of original monument, considerations for selecting an appropriate site for the replacement monument must be addressed. Select a secure location that might provide natural protection, such as well away from the highway surface near the edge of the right-of-way. Provide for monument stability, both vertically and horizontally, by selecting a location that reduces the influence from ground and soil movement. Avoid settings in low wet areas, in slopes and all earth-fill situations. Crests of hills are generally good locations for bench marks as they reduce influence of frost heave and the consistency of the soil tends to be more firm. Ensure usefulness by selecting a location that is not only readily available but safe for users and one providing a good description in the event it becomes buried. *Caution:* Always confirm the presence and location of buried utilities prior to digging monument holes.

Concrete Monuments

1. **Monument Design.** The concrete monument should be poured-in-place in a hole dug in the ground, cylindrical or squared in appearance and slightly "bell-shaped" at the bottom. The monument must extend well below the frost line, typically 48 inches (1.20 m) deep and 12 inches (0.30 m) in diameter. Local ground conditions, such as hard soil types with subsurface rock, may prohibit desired monument depth whereas softer, sandy soil types may require slightly deeper monuments to assure stability. Avoid setting concrete monuments in areas affected by sliding or other potential movement, such as in slopes and all earth-fill situations.

2. **Station Designation.** Stamp the station designation and setting year on the top surface of the disk prior to setting.

3. **Digging the Hole.** The hole is generally dug with an auger or post-hole diggers, bell-shaped at the bottom, then back filled with concrete mix. The bottom of the hole is enlarged about 4 inches (0.1 m) in radius, tapering upward for 12 inches (0.3 m), in order to make the bottom of the monument bell-shaped. Care should be taken to avoid creating any shoulders or mushrooming effect near the top of the monument which might afford purchase for frost heave or surface soil action. A round form is recommended, such as black tar paper (felt paper), for finishing the top 12 inches (0.30 m) or so of the monument. A smooth rounded

surface is less susceptible to damage by frost or other forces than unfinished tops.

4. **Concrete Ingredients.** The quality of the ingredients and their proportions help determine how dense and impervious the cured concrete will be. The ingredients include aggregate, cement, and water. Aggregate should be clean (free from silt and clay, harmful chemicals, and organic matter) and well graded, i.e., it contains proportionate amounts of many particle sizes. In specifying mix proportions the aggregate is usually divided into two parts, sand (particle size less than 3/8") and gravel (particle size greater than 3/8"). Both parts should be well graded. Aggregates that are porous, split easily, or are otherwise weak or permeable result in poor concrete. Examples of poor aggregate include shale, claystone, sandstone, and micaceous rocks.

   Varying sized bags of pre-mix concrete are readily available and work well for setting concrete monuments. When using pre-mix concrete, ensure that the aggregate is well graded. Additional Portland Cement and / or sand can be added to improve consistency and the quality of the finished mark.

   The water used in concrete mix should be relatively free of impurities such as acids, alkalis, salts, oil, organic matter, and silt. These can decrease the strength and durability of cured concrete. As a rule, do not use water that you would not drink.

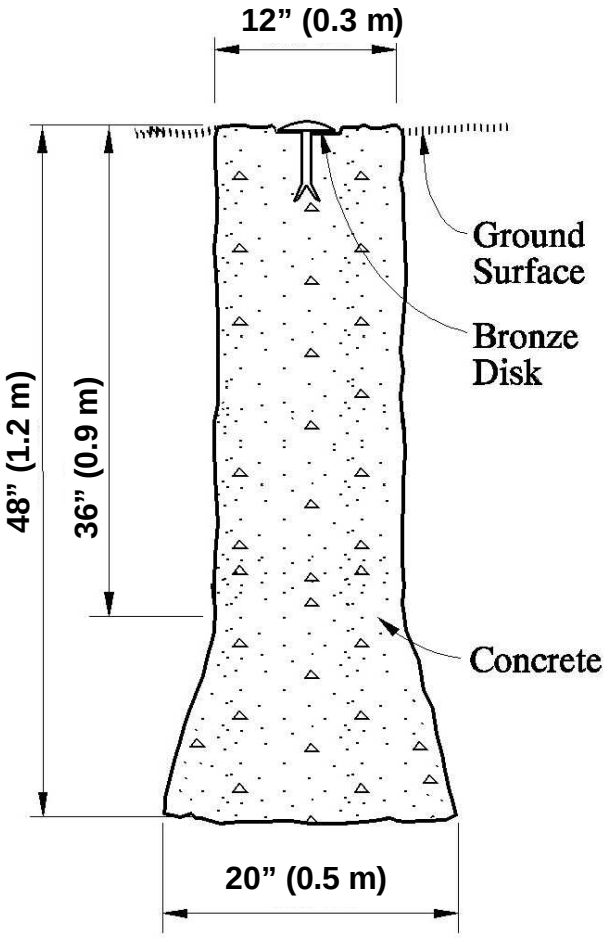


Figure B - 1: Schematic of Concrete Monument

5. **Mixing and Placing.** Suitable proportions (by bulk volume) of cement to sand to gravel are 1:2:3. If the gravel is made up of fragmented or angular particles, use a little less gravel and proportionately more sand. Add only enough water to make the mix workable. About half the water added to the mix is used in the chemical reaction (hydration) that causes the paste to harden into binder. If too little water is used, however, the mix will not compact properly and spaces will be left in the mass. A good indication of the right amount of water is that the mix neither runs nor falls off the shovel but sluggishly slides off and flattens upon hitting the ground.

   Fresh concrete must be well mixed before it is placed, otherwise the minute particles of cement will not be sufficiently wet and the aggregate will not be completely coated with paste. Before placement, the hole should be damp so the moisture will not be drawn from the

fresh concrete into the surrounding soil. In no case should it be so wet as to be muddy. Segregation of the various sizes of aggregate should not be much of a problem when pouring concrete survey monuments, but be aware that segregation can occur and is undesirable when it does. While filling the hole, continuously tamp the mix into a compact mass so it becomes less pervious and consequently more durable. Some bleeding (water gain at the surface) is to be expected when finishing the mark. Excessive bleeding indicates too much water in the mix or poor gradation of aggregate.

6. **Finishing Monument.** After pouring concrete and tamping to settle and remove voids, the top of the monument is smoothed off and slightly beveled with a trowel. The top of the finished monument should be flush with the ground or slightly recessed for protection from mowers, etc. The disk is thoroughly cleaned to remove oils and extraneous dirt then set into position in the center of the monument top. Placing a small amount of concrete on the underside of the disk before installing helps insure air is not trapped under the disk. Finish the top of the monument by smoothing with the trowel once the disk is in place.

7. **Clean Up.** Clean excess concrete from the surface of the disk after installing. The area is then cleaned, excess dirt and trash removed, and site returned to as-found condition.

8. **Curing Concrete.** Concrete should normally be covered for at least 7 days after it is placed. This prevents rain from making the mix too wet and from ruining the finished surface. It also prevents the surface from drying too rapidly, leaving too little water for complete hydration.

9. **Cold Weather Precautions.** Freezing of fresh concrete has a damaging effect because expansion of water as it freezes separates solid particles in the mix. This reduces strength of the bond and makes the concrete more porous and correspondingly less durable. Three protective measures should be taken in cold weather, either singly or in combination. First, use warm ingredients. During the first 24 hours after a mix has been placed, it develops little heat of its own to prevent freezing. After 24 hours some heat is developed as a product of the chemical reactions occurring in the mix. The use of warm ingredients is especially beneficial during the first 24 hours. To keep the aggregate and cement warm, store them indoors and keep them in the vehicle until being mixed.

   Second, use Type III (high-early-strength) cement or special additives, such as calcium chloride, that speed curing. The calcium chloride should be dissolved in the mixing water instead of mixing it with other ingredients. If a large number of concrete marks are being installed by mass production using a "ready-mix" contractor, fast-curing additives should not be added until the concrete is delivered on site.

   Third, insulate the finished mark for a week after the concrete is poured. One method is to cover the mark with boards resting on supports. This is covered with paper or plastic, then by a layer of straw, Styrofoam, or similar insulating materials about 6 inches (0.15 m) thick and finally a layer of soil 6 to 12 inches (0.15 to 0.30 m) thick. Pile snow loosely on top if available.

Survey Disk Set in Bedrock or Structure

Sound bedrock is the most desirable setting for vertical control points. Besides the ease and cost effectiveness with which a disk can be installed in bedrock, it provides the most stable setting that can be used in terms of both underground activity and disturbances inflicted by people. Always use bedrock when a suitable outcrop exists. As a rule of thumb, the bedrock is considered potentially good if the distance between joints and fissures is greater than 3 ft (1 m).

1. **Station Designation.** Stamp the station designation and setting year on the top surface of the disk prior to setting.

2. **Site Selection.** Pick a fairly level and accessible spot on the outcrop that appears intact with the bulk of the rock. A simple test can be performed to help determine the condition and integrity of the rock by placing one's hand near the area the disk will be set then striking the outcrop with a moderately heavy hammer and feeling for vibration. Sound outcrop will force the hammer to rebound with each impact and vibration through the rock should be minimal.

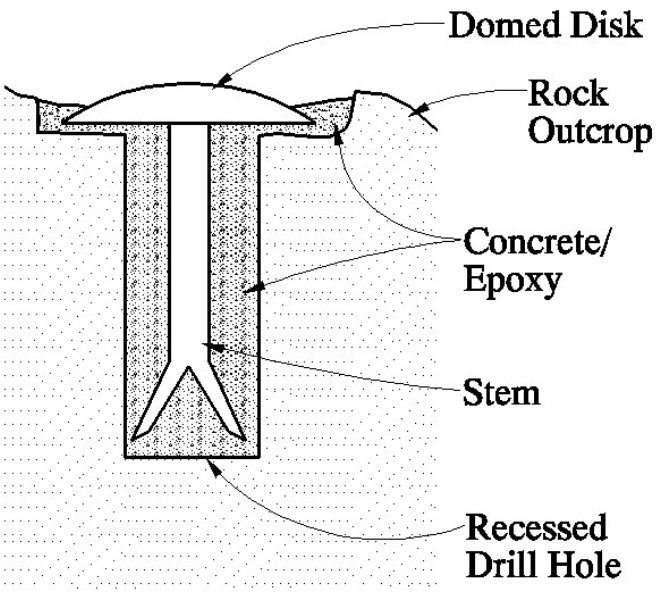


Figure B - 2: Side View Disk in Outcrop

3. **Drilling the Hole.** Drill a 1 inch (25 mm) diameter hole about 4 inches (100 mm) deep into the bedrock. Chisel a flat recess area around the top of the hole to a diameter slightly larger than the disk. Test the hole with disk to see if it is deep enough and that disk sits flush with chiseled area.

   When the installation is completed, the top surface of the disk should sit level and slightly below the surface of surrounding rock to help protect the disk. Chisel a drain channel through the low edge of drilled recess to allow water to drain away from finished mark. ***Caution:*** Safety goggles should be worn when drilling into bedrock or masonry.

4. **Mixing Concrete.** Remove all rock powder and debris from the hole and recessed area. Flush and fill the hole with clean water; then pour dry cement into it. Mix ingredients right in the hole with a thin stick or other implement such as a screw-driver. Add water and cement to make enough mortar to fill hole with a little extra available to place on the

underside of the disk. When the mortar is completely mixed, it should be thick but still workable, like heavy mashed potatoes.

5. **Preparing the Disk.** Wet and clean the disk by rubbing all surfaces with cement to remove unwanted dirt and oils; rinse well. Fill underside of the disk with mortar using a trowel. Hold disk loosely upside-down by the end of the shank then gently tap the domed surface of the disk from below with the handle of the trowel several times to allow mortar to settle and trapped air to escape. This is very important because it will prevent the existence of highly undesirable voids under the disk once its in place.

6. **Setting the Disk.** Place the shank of the disk into the cement filled hole and press the mark firmly into place. Slightly twist the disk back-and-forth and gently tap it with the end of the trowel handle to help settle the disk completely and evenly into drilled recess in the bedrock. The disk is considered set when the slight back-and-forth movement stops and the disk settles firmly in place. Work excess mortar around the outer edge of the disk, making sure that it is smooth and slightly overlaps the top, outside edges of the disk for security. An exposed disk edge could provide a weak spot used by someone or the elements to dislodge it.

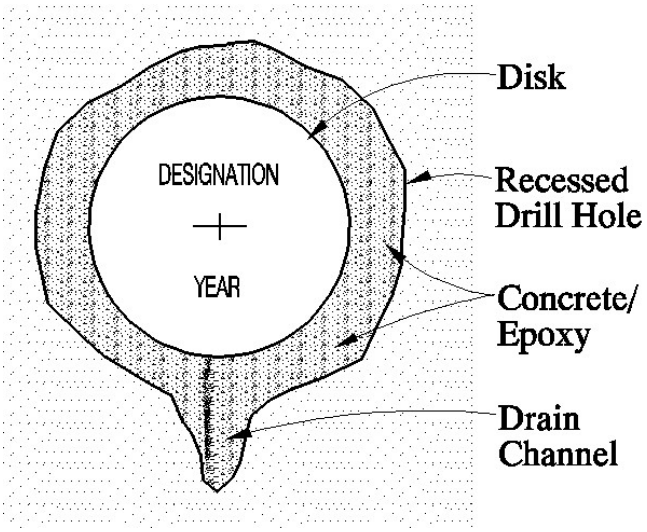


Figure B - 3: Top View

7. **Cleaning and Finishing.** Sprinkle some dry cement on the exposed surface of the disk, then rub it with a clean rag or short bristled brush using circular strokes. This cleans the disk and removes excess mortar from its surface and recessed letters. Rubbing the wet mortar around the edge of the disk in the same manner is done intentionally to finish its surface and help prevent cracking. Brush away loose cement and make sure that the finished product has a neat appearance.

8. **Curing Concrete.** Cover the newly set disk while the mortar is still wet to prevent heavy rains or other foreign debris from ruining its surface and to conceal the disk from people who might tamper with it. A piece of wood, cardboard, heavy paper, or similar biodegradable item will suffice.

9. **Clean Up.** The area is then cleaned, excess dirt and trash removed, and site returned to as-found condition.

Survey Disk in Structure

The procedure for setting a disk horizontally in a concrete or masonry structure is identical to that for setting one in bedrock. Make sure safety goggles are worn when drilling into masonry or concrete.

Stability and safety issues are also concerns when setting a disk in light structures such as bridges. Select locations with continuous, deep foundations such as headwalls and avoid locations such as curbs, sidewalks, bridge decks, and railings.

When drilling into brick or other soft material, a hammer and star drill should be used rather than heavy power equipment to prevent extensive damage to the exterior. Recess the chiseled depression for the disk so that the top of the disk when set is flush with surrounding structure. This will eliminate the need for a chiseled drain as described for the disk in outcrop.

The hole should be flushed with water and wet before mortar is put into it to remove dusty surfaces and aid bonding. After placing the shank of the disk into the mortar filled hole, work it to the bottom edge of the hole, as described in Step 6, above, so that it will not settle askew while the mortar is curing.

Highway grade epoxy may be used in place of cement if it meets ultraviolet standards and will hold up to all weather conditions. The setting procedures with epoxy are similar to those described previously except that the drilled hole, though needing to be extremely clean, cannot be wet.

Station Descriptions

Station descriptions should be concise, accurate, informative documents that enhance recovery of survey monuments. Standardized forms for writing descriptions ensure pertinent station information is recorded completely and consistently while at the survey monument site. This reduces errors and omissions that occur when writing station descriptions from memory. See attached "Report on Relocation and Description of Reset Bench Mark" form.

In general, descriptions are comprised of four elements, a standardized descriptive heading and three paragraphs of text including a description of physical monument, a "to reach" narrative, and permanent station reference objects with measurements.

1. **Description Headings.** Station description headings identify the survey monument. This heading facilitates cataloging and referencing descriptive information by the establishing agency and for others wishing to use the monument. This information includes the station designation, station identification stamping, type of monument and/or datum point, approximate latitude, longitude, elevation, and county of location, agency and date of establishment, and other pertinent data.

2. **Description of Physical Monument.** Text for a station description should begin with general comments consisting of a brief, approximate discussion of station site location, monument type, and setting style. This helps pinpoint the station's location on a map and assists surveyors unfamiliar with the area. General comments include airline distances and directions from nearest towns or prominent landmarks, and a general statement about immediate area, such as "on top of the east end of a long highway cut." A detailed description accurately describes the monument and prepares the surveyor for the type of monument expected at the site. Examples include: "the station is a 3 inch (75 mm) diameter brass ODOT bench mark disk set in top of a 12 inch (0.3 m) round concrete monument 4 ft (1.3 m) deep and projecting 2 inches (50 mm) above the ground," or "the station is the top center of a stainless steel rod recessed 3 inches (75mm) below ground driven to refusal at a depth of 23 ft (7 m) encased in a 5 inch (0.13 m) PVC pipe with standard logo cap surrounded by concrete and flush with the ground."

   Property ownership should be included as the last sentence for all general comment paragraphs. Ownership information, listing owner's name, address and phone number, or a comment such as "on state highway right-of-way", facilitates station access.

3. **"To Reach" Narrative.** Reaching the station by vehicle or other means is described in detail in the "to reach" narrative. Begin narrative at an easily located starting reference point, such as a prominent highway junction, post office, or courthouse (sometimes post offices and courthouses are harder to find than the mark itself so judgment must be used). Direct the reader from the starting point with routes and clocked mileage, including cross-references such as road intersections, to the station site. Describe each turn, route followed and distance traveled. Vehicle mileage, accurate to the tenth of a mile, is obtained from a vehicle's odometer and directions are determined from good maps or compass headings.

Important information regarding a station's location will not be omitted if consistent writing style is maintained for all descriptions. After initial starting point of the "to reach" is described, each new sentence should be written in the following format; Go, Continue or Turn, what direction, on what road, for what distance, to what point, e.g., "continue northwest on State Highway 22 for 1.4 mi (2.3 km) to the station on the left."

4. **Permanent Station Reference Objects with Measurements.** The third and final paragraph of the station description identifies exact measurements from described reference objects.

   List at least three permanent reference objects with distances and directions from the station in each description. Objects measured from varying directions to station sites are essential for locating a buried monument or to help verify that it has been disturbed or destroyed. More than three measurements and references benefit in the event that one or more are lost through time. Exact measurements to the tenth of a foot (or centimeter) and accurate compass derived directions save time when searching or digging for hidden or buried monuments.

   Reference items such as numbered power poles, top center of culvert pipe ends, concrete head walls and wing walls, permanent fence corners and road center lines are long lasting and easily identified

   Record all distances and measurements with proper unit annotations. If both English and metric units are desired, record one within parentheses following the other measurements, again noting associated unit annotations.

   Metal or fiberglass witness posts have been set near many bench marks. If one of these witness posts is near the mark to be relocated, it should be moved or replaced, if possible, to a location near the new mark. A statement of the distance and direction from witness post to new mark should be included in description.

Oregon Department of Transportation

RELOCATION AND DESCRIPTION OF RESET BENCH MARK

NEW STATION DESIGNATION	LEVEL LINE NUMBER	COUNTY
LATITUDE	LONGITUDE	POSITION ACCURACY +/- _____ ft ☐ SCALED ☐ GPS ☐ OTHER_____
PROJECT NAME	HIGHWAY	KEY #

INFORMATION ABOUT OLD MARK

Exact Stamping of Old Disk: _____

Agency Pre-Cast in Disk/Monument Cover: _____

Published Elevation of Old Mark: _____ ☐ Meters ☐ Feet Datum: _____

Old Description Agrees as Found: ☐ Very Well ☐ More or Less ☐ Poorly ☐ Not at All

Old Monument Solidly in Ground: ☐ Yes ☐ No, Explain: _____

Any Damage to Disk or Monument : ☐ Yes ☐ No, Explain: _____

Anticipated Date Old Mark to be: ☐ Disturbed ☐ Destroyed Date _____

Describe reason for reset: _____

INFORMATION ABOUT NEW MARK

Exact Stamping of New Disk: _____ Date Set:_____

Agency Pre-Cast in Disk/Monument Cover _____

Type of Disk Set: _____ Magnetic Material _____

Site suitable for use with GPS geodetic surveying (e.g. few obstructions to satellites) ☐ Yes ☐ No ☐ Unknown

Setting Classification of New Monument (select option)

☐ CONCRETE POST

Diameter of Monument _____ ft Depth of Monument _____ ft

Top of Monument: ☐ Flush ☐ Projecting ☐ Recessed _____ft, With Ground

☐ DISK SET IN DRILL HOLE

☐ Rock Outcrop ☐ Boulder Approximate Exposure _____ ft by _____ ft

☐ Bridge Abutment ☐ Other Explain : _____

Relationship With Surface ☐ Flush ☐ Projecting ☐ Recessed ____ ft, With _____

FINAL RESET EQUIPMENT AND OBSERVATION INFORMATION

☐ Direct Mark-to-Mark Tie ☐ Referenced Date _____ Date of First Reference _____

Level manufacturer and Model: _____ Serial Number:

Rod manufacturer and Model: _____ Serial Number: _____

Observing Crew: _____

Weather Conditions: Temperature: ____ °F ____ °C Cloud Cover:_____ Wind:_____

Problems Affecting Leveling:

STATION DESCRIPTION

NEW STATION DESIGNATION:
DESCRIPTION OF PHYSICAL MONUMENT:
TO REACH THE STATION FROM:

PERMANENT STATION REFERENCE OBJECTS

DISTANCE TO MARK	DIRECTION TO MARK	DESCRIPTION OF REFERENCE OBJECT

REPORTED BY:

DATE: _____

AGENCY: _____ CONTACT: _____

ADDRESS: _____

CITY, STATE, ZIP CODE: _____

TELEPHONE: _____ E-MAIL: _____

RETURN TO O.D.O.T. GEOMETRONICS UNIT, 200 HAWTHORNE AVE. SALEM, OR 97301-5193