

DESCRIPTION**Geodetic Survey Monuments**

The work shall consist of the resetting of existing monument frames and covers; installation of new survey monument frames and covers; installation of new geodetic survey monuments; removal of existing survey monuments; horizontal and vertical adjustment of existing survey monuments; monitoring position of existing geodetic survey monuments; recovery of existing geodetic survey monuments; related survey work, submittal of survey data and monument certification prepared by a Land Surveyor licensed to practice in the State of New York that the work completed meets the standards and specifications as required in the Contract Documents, as directed by the Monroe County Surveyors Office and the Project Manager.

Where all or part of a project is within the City of Rochester limits, the contractor shall adhere to the requirements of the City of Rochester Monument Specification - SECTION S626 - SURVEY MONUMENT, dated 12/16/2016 for those monuments that are part of the project within the city limits.

ITEM C625.0201 Reset Existing Monument Frame and Cover**CONSTRUCTION DETAILS**

The unit price bid shall include the cost of removing, cleaning, and resetting existing frame and cover. Monument frame and cover shall be set centered over the survey monument, placed true to line and grade, make full and even bearing on the underlying surface, and are to be non-rocking when in place. The new monument frame and cover shall be set flush with the finished grade.

ITEM C625.0202 Install New Monument Access Cover**CONSTRUCTION DETAILS**

New monument access cover shall be a Berntsen BMAC-5 Access Cover*, installed in accordance with County of Monroe standard details and as described below in the Berntsen Monument Access Cover Installation Instructions. New monument access covers shall be installed to replace existing monument frames and covers, or over existing survey monuments where existing frame and cover is missing. New monument access cover shall be set centered over the survey monument, placed true to line and grade, make full and even bearing on the underlying surface, and are to be non-rocking when in place. The new monument access cover shall be set flush with the finished grade. Extra care and necessary precautions shall be taken to prevent disturbance of the monument.

Berntsen BMAC-5 Monument Access Cover Installation Instructions

MATERIALS REQUIRED FOR SETTING MONUMENT ACCESS COVER:

1. BMAC Access Cover (BMAC-5 for 5" PVC pipe)*
2. PVC Pipe (5", Schedule 40)
3. Concrete mix
4. Water
5. Trowel
6. Eclectic® UV-6800 Adhesive*
7. Caulking gun for UV-6800 Adhesive*
8. Fine-grained washed or play sand
9. Installation tools

* Or approved equal

INSTALLATION

1. Using the Eclectic UV-6800 adhesive, glue BMAC Access Cover to a 24-inch long section of 5" PVC pipe. Allow the glue to set before continuing with the following setting procedures.
2. Using a post hole digger or shovel, dig a hole in the ground at your site around the existing monument, approximately 12 inches in diameter and 36 inches deep. Extra care and necessary precautions shall be taken to prevent disturbance of the monument.
3. Backfill and pack with fine-grained washed or play sand around monument (sand should be filled to about 20 inches below ground level). Place the 5" PVC pipe and BMAC Access Cover assembly over and around the monument. Tamp BMAC assembly so it is flush with the ground. The top of the monument needs to be below the BMAC Access Cover.
4. Prepare and place the concrete mix around the outside of the 5" PVC pipe and around the BMAC Access Cover, up to the top of the Cover. Trowel the concrete until a smooth and neat finish is produced. Make certain that the concrete has not "seeped" into the Cover or Cover screw. Remove the Access Cover Lid from the Cover Frame and using water, rinse the frame and screw areas to insure no concrete mix residue remains in these areas.
5. Continue to backfill and pack with sand inside the PVC pipe around the monument to about 6 inches below ground level.
6. Remove all debris and excess dirt to leave area in original condition.

7. IMPORTANT: Whenever opening the BMAC Access Cover, protect the threaded opening of the Access Cover Frame by using a piece of duct or masking tape to cover this opening, when exposed, to prevent foreign objects from falling into it. Take care in reinstalling the Access Cover Lid to prevent foreign objects from falling into the threaded opening while tightening screw of Access Cover Lid into Access Cover Frame.

ITEM C625.0203 Install New Geodetic Survey Monument

DESCRIPTION

New Geodetic Survey Monument

This work shall consist of furnishing, installing, and certifying Geodetic Survey Monuments.

The GENERAL CONTRACTOR shall set Geodetic Survey Monuments at the time the County Project Manager directs them to be placed. Geodetic Survey Monuments shall be set in accordance with the County of Monroe standard detail.

DESCRIPTION

The geodetic monument shall be a Berntsen Top Security Rod Monument with Access Cover*, constructed in accordance with County of Monroe standard detail specifications and as described below in the Berntsen Monument Installation Instructions, at locations as directed by the County Surveyor, and set at the time the County Project Manager directs them to be placed. The survey marker cap shall be inscribed in accordance with County of Monroe standard detail specifications. The sequential numbering required on the monuments is to be coordinated with the County Surveyor.

The monument access cover shall be a Berntsen BMAC-5 Access Cover*, installed in accordance with County of Monroe standard detail specifications and as described below in the Berntsen Monument Installation Instructions. Monument access cover shall be set centered over the survey monument, placed true to line and grade, make full and even bearing on the underlying surface, and are to be non-rocking when in place. The monument access cover shall be set flush with the finished grade.

The County of Monroe requires this work to be performed by, or under the direction of and certified by a Professional Land Surveyor who is licensed and registered to practice in New York State.

CONSTRUCTION DETAILS**MANUFACTURER MONUMENT INSTALLATION INSTRUCTIONS****Berntsen Top Security™ 3-D Rod Monument Installation Instructions****MONUMENT INSTALLATION INSTRUCTIONS**
FOR TOP SECURITY™ GPS 3-DIMENSIONAL ROD MONUMENT SYSTEM**MATERIALS REQUIRED FOR SETTING MONUMENT:**

1. Top Security™ Rod with thread*
2. Aluminum rod sections with thread
3. Spiral drive point
4. Aluminum survey cap (special combination compression fit/threaded cap)
5. DISC-LOCK vibration-proof lock washers (pair)*
6. BMAC Access Cover (BMAC-5 for 5" PVC pipe)*
7. PVC Pipe (5", Schedule 40)
8. Steel Stamp Set (for marking information on survey cap)
9. Concrete mix
10. Water
11. Trowel
12. Eclectic® UV-6800 Adhesive*
13. Caulking gun for UV-6800 Adhesive
14. Fine-grained washed or play sand
15. Installation tools
16. Reciprocating driver (*Pionjar 120, Cobra 148, or Wacker BHB 25*)
 - a. Driving Adapter (MDA with sledge hammer, PDA with reciprocating driver)
 - b. DPA Steel Drive Pin
 - c. Lubricating oil for driving adapter and stainless drive pin
 - d. Vise grip pliers (2) OR Pipe Wrench (two 6" wrenches)
 - e. Hacksaw
 - f. File
 - g. Post Hole Digger or Auger
 - h. Shovel
 - i. Work gloves and proper eye protection and clothing

* Or approved equal

INSTALLATION

1. THE TIME REQUIRED TO SET AN AVERAGE MARK USING THESE PROCEDURES IS 30 TO 45 MINUTES.
2. Using the Eclectic UV-6800 adhesive, glue BMAC Access Cover to a 24-inch long section of PVC pipe. This will allow the glue to set while continuing with the following setting procedures.
3. **IMPORTANT: Use proper eye and ear protection!** Using a post hole digger, auger, or shovel, dig or drill a hole in the ground at your site, approximately 12 inches in diameter and 36 inches deep.
4. Attach the spiral drive point to one end of the aluminum rod section with a stainless steel thread. On the opposite end of the aluminum rod attach the Stainless Steel Drive Pin (hand tighten both the drive point and the SS Drive Pin). The SS Drive Pin will be used as the impact point for the Driving Adapter in driving the rod into the ground. Drive this section of the rod with a reciprocating driver (*Pionjar 120, Cobra 148, Wacker BHB 25*). Be certain that the reciprocating driver is in the BREAKER position for driving the rod (see owner's manual for setting). Drive the rod section until the Driving Adapter is within approximately 1-inch of ground level e., with approximately 4-inches of rod showing above ground.
5. Remove Driving Adapter and Stainless Steel Drive Pin from installed rod section. Attach another section of aluminum rod. Tighten securely using DISC- LOCK washers with two pipe wrenches to rod section already installed. Attach SS Drive Pin and Driving Adapter to top of rod section and continue driving rod sections (see STEP 4) until installation of rod sections slows to the REFUSAL rate (*defined as a driving rate of more than 1 minute to drive the rod 1 foot in the ground*). **IMPORTANT NOTE: TO MEET NGS REQUIREMENTS FOR "REFUSAL" YOU MUST ONLY USE A RECIPROCATING DRIVER.** Rod should be driven completely into the ground (and 3 inches below ground level).
6. The last section of rod should now be marked for removal (so the top of the last rod section will be 3 inches below ground level) from the top of the monument assembly. Remove the rod by attaching a pipe wrench on either side of the common joint with the next lower rod section and carefully untighten the top rod from this assembly. **IF YOU WERE ABLE TO DRIVE THE LAST SECTION ROD 3 INCHES BELOW GROUND LEVEL, YOU CAN SIMPLY REPLACE THIS ROD SECTION WITH A COMPLETE TOP SECURITY ROD SECTION - GO TO STEP 9.**
7. Take the rod section you removed in STEP 6 and place it next to a Top Security™ rod section. Using a hacksaw, cut off the portion of Top Security rod section marked. When this is completed, remove approximately 3 inches of the "fins" from cut end of Top Security rod section. Recommended procedure is to use a vise grip pliers and "peel" the fins (take the vise grip pliers and peel the fins and break them off the remaining rod portion by coming down from the top of the rod and bending

- each fin "back and forth" until the fin is removed). This is best done in 1-inch sections.
8. Use a file to remove any burrs from cut end (and slightly BEVEL the cut end of the Top Security rod section). GO TO STEP 10.
 9. IF YOU DID NOT NEED TO CUT LAST SECTION OF ROD IN STEP 6 AND HAVE REPLACED THIS ROD WITH A TOP SECURITY ROD, you can use the Threaded Insert to attach the survey cap to the rod assembly. To do this take the SS Drive Pin, attach it to the Treaded Insert, and then drive the Threaded Insert into the socket of the survey cap. Be certain that the Threaded Insert has been driven completely into the socket. Take the completed survey cap, remove the SS Drive Pin, and using the DISC-LOCK washer (composed of two washers mated together so the beveled sides are placed together to form a "ratchet" appearance) attach the survey disk to the Top Security rod section by screwing the cap down onto the Top Security rod section. Tighten firmly and securely using a wrench. Go to STEP 11.
 10. IF THE TOP SECURITY ROD SECTION NEEDS TO BE CUT, use the compression-fit survey cap (with socket) to attached to the Top Security rod. Make a mark approximately 1-inch from the top of the rod (this is where the bottom of the survey cap socket should be driven to). Taking the compression- fit cap, carefully tap the cap onto the Top Security rod using a rubber or urethane- faced hammer and driving the cap completely onto the rod until it reaches the mark on the rod. Be sure the cap is "square" on the rod.
 11. Backfill and pack with fine-grained washed or play sand around rod section (sand should be filled to about 20 inches below ground level). Place the PVC pipe and BMAC Access Cover assembly over and around the rod. Tamp BMAC assembly so it is flush with the ground. The survey cap on the rod should be 3 inches below the BMAC Access Cover.
 12. Prepare and place the concrete mix around the outside of the PVC pipe and around the BMAC Access Cover, up to the top of the Cover. Trowel the concrete until a smooth and neat finish is produced. Make certain that the concrete has not "seeped" into the Cover or Cover screw. Remove the Access Cover Lid from the Cover Frame and using water, rinse the frame and screw areas to insure no concrete mix residue remains in these areas.
 13. Continue to backfill and pack with sand inside the PVC pipe around the rod to about 6 inches below ground level.
 14. Remove all debris and excess dirt to leave area in original condition.
 15. *IMPORTANT: Whenever opening the BMAC Access Cover, protect the threaded opening of the Access Cover Frame by using a piece of duct or masking tape to cover this opening, when exposed, to prevent foreign objects from falling into it.*

Take care in reinstalling the Access Cover Lid to prevent foreign objects from falling into the threaded opening while tightening screw of Access Cover Lid into Access Cover Frame.

MONUMENT POSITIONING INSTRUCTIONS

The horizontal datum shall be NAD 83 (2011), New York State Plane Coordinate System, Western Zone and the vertical datum shall be NAVD 88.

The geodetic position of the monument shall be determined by employing GPS survey techniques utilizing GPS observations independent of the project control.

GPS surveys shall be static surveys performed with separate observations under differing satellite configurations. The data shall be adjusted by a minimally constrained least squares adjustment. The adjusted value shall reflect a Network Positional Accuracy of 0.02 feet.

If site conditions at the monument location compromise the quality of direct GPS observation of the monument position, conventional Theodolite or Total Station terrestrial survey techniques may be employed to position the monument from nearby locations that provide quality GPS observation conditions.

Conventional Theodolite or Total Station terrestrial surveys shall be performed with either an Electronic Distance Measuring Instrument (EDM) (rated with an internal uncertainty of no more than 0.003 m and scale of no more than 2 parts-per-million (ppm)). The EDM distance measurements shall be corrected for both temperature and pressure as necessary. The angulation shall be performed with a directional theodolite or total station that has an internal least count of no more than 2 seconds. A minimum of two positions on the circle (both direct and reverse) and an EDM distance shall be taken along with each angle measurement. Any of the individual angles shall differ from the mean of all angles by no more than 5 seconds and individual distances shall differ from the mean of all distances by no more than 0.01 feet and 2 parts per million (ppm). Adjustment shall be completed by a minimally constrained least squares adjustment. From the least squares adjustment the maximum allowable Network Positional Accuracy (at two sigma, 95% confidence level) shall not exceed 0.02 feet or a precision of 1 part in 50,000 parts (1:50,000).

Where existing geodetic monuments on NAVD 88 vertical datum are within reasonable proximity, the orthometric height, shall be established by conventional terrestrial differential leveling techniques, shall close within $0.033 \text{ feet} \cdot \sqrt{s}$ where s is equal to the length of the level run in miles.

The Licensed Land Surveyor shall submit copies of a report to the Monroe County Surveyors Office. The report shall contain the following:

- A summary of survey field operations and adjustment.
- Least squares adjustment report with a final adjusted grid coordinate listing.
- Certification and Monument Tie Sheet

ITEM C625.0204 Remove Existing Geodetic Survey Monument

DESCRIPTION

The existing survey monument, including frame and cover, shall be carefully excavated for and removed. Existing frame and cover that is solid, undamaged and acceptable for reuse shall be cleaned of all extraneous material. Existing survey monument cap shall be carefully removed and preserved. Existing survey monument cap, frame and cover, shall be safely stored on site, and the Monroe County Surveyors Office notified to arrange for pickup. The excavation shall be backfilled with select granular backfill and the disturbed surface area restored. Existing remaining survey monument material, frame and cover that are damaged or found to be unacceptable for reuse shall be disposed of by the GENERAL CONTRACTOR.

ITEM C625.0205 Adjustment of Existing Geodetic Survey Monument

DESCRIPTION

Survey monument adjustment is to take place only at the written direction of the Monroe County Surveyors Office. Survey monument adjustment performed without prior written authorization from the Monroe County Surveyors Office shall be considered as the destruction of a survey monument, and subject to replacement at the GENERAL CONTRACTOR'S expense.

The County of Monroe requires adjustment of a survey monument to be performed under the direction of and certified by a licensed land surveyor on an appropriate form provided by the County Surveyor.

When a monument is adjusted, the new position shall be reported in both horizontal and vertical position. The licensed land surveyor shall submit a plan to the Monroe County Surveyors Office detailing the procedures and equipment that will be used to make the adjustment of a survey monument. Once the contractor's Land Surveyor has received written notification to proceed, the adjustment may be started. Payment may be made once the Monroe County Surveyors Office has reviewed and approved the completed adjustment.

CONSTRUCTION DETAILS**MONUMENT POSITIONING INSTRUCTIONS**

The horizontal datum shall be NAD 83 (2011), New York State Plane Coordinate System, Western Zone and the vertical datum shall be NAVD 88.

The geodetic position of the monument shall be determined by employing GPS survey techniques utilizing GPS observations independent of the project control.

GPS surveys shall be static surveys performed with separate observations under differing satellite configurations. The data shall be adjusted by a minimally constrained least squares adjustment. The adjusted value shall reflect a Network Positional Accuracy of 0.02 feet.

If site conditions at the monument location compromise the quality of direct GPS observation of the monument position, conventional Theodolite or Total Station terrestrial survey techniques may be employed to position the monument from nearby locations that provide quality GPS observation conditions.

Conventional Theodolite or Total Station terrestrial surveys shall be performed with either an Electronic Distance Measuring Instrument (EDM) (rated with an internal uncertainty of no more than 0.003 m and scale of no more than 2 parts-per-million (ppm)). The EDM distance measurements shall be corrected for both temperature and pressure as necessary. The angulation shall be performed with a directional theodolite or total station that has an internal least count of no more than 2 seconds. A minimum of two positions on the circle (both direct and reverse) and an EDM distance shall be taken along with each angle measurement. Any of the individual angles shall differ from the mean of all angles by no more than 5 seconds and individual distances shall differ from the mean of all distances by no more than 0.01 feet and 2 parts per million (ppm). Adjustment shall be completed by a minimally constrained least squares adjustment. From the least squares adjustment the maximum allowable Network Positional Accuracy (at two sigma, 95% confidence level) shall not exceed 0.02 feet or a precision of 1 part in 50,000 parts (1:50,000).

Where existing geodetic monuments on NAVD 88 vertical datum are within reasonable proximity, the orthometric height, shall be established by conventional terrestrial differential leveling techniques, shall close within $0.033 \text{ feet} * \text{SQRT}(s)$ where s is equal to the length of the level run in miles.

The Licensed Land Surveyor shall submit copies of a report to the Monroe County Surveyors Office. The report shall contain the following:

- A summary of survey field operations and adjustment.
- Least squares adjustment report with a final adjusted grid coordinate listing.
- Certification and Monument Tie Sheet

ITEM C625.0206 Monitoring Position of Existing Geodetic Survey Monument

DESCRIPTION

When a County geodetic monument is in close proximity to proposed construction, the County of Monroe requires the following procedures to be followed to monitor the position of the monument and detect whether disturbance occurred that destabilized or disturbed the monument and whether the disturbance constitutes destruction. The County of Monroe requires measurements to be taken under the direction of and certified by a licensed land surveyor before and after construction.

A survey monument will be considered disturbed and destroyed that has been:

- Moved equal to or in excess of 0.02', in either the horizontal or vertical direction.
- Broken.
- Disturbed to a point that the survey monument's position is no longer fixed or stable.
- Removed from the ground for any reason.

CONSTRUCTION DETAILS

MONUMENT MONITORING INSTRUCTIONS

The General Contractor shall secure survey tie information to all of the monuments shown on the project plans of the job site to be protected. The tie information shall be acquired utilizing conventional Theodolite or Total Station terrestrial survey techniques only, without employing GPS survey techniques, by angle and distance to points that are identifiable, permanent, substantial, not subject to being disturbed during the construction period, and no more than 100 feet from the point being tied down. Distance ties may be made with either an electronic Distance Measuring Instrument (EDM) (rated with an internal uncertainty of no more than 0.003 m and scale of no more than 2 parts-per-million (ppm)) or a surveyor's tape that has been checked against a standard tape traceable to the national standard of reference. The distance measurements shall be corrected for both temperature and pressure as necessary. The angulation shall be performed with a directional theodolite or total station that has an internal least count of no more than 2 seconds. A minimum of two positions on the circle (both direct and reverse) and an EDM distance shall be taken along with each angle measurement. Any of the individual angles shall differ from the mean of all angles by no more than 5

seconds and distances by no more than 0.01 feet and 2 parts per million (ppm). The sum of all of the individual measurements shall produce a circle of confidence (at the two sigma, 95% confidence level) that does not exceed 0.02 feet in regard to the true position of monument relative to the monument ties.

If the monument also has a published elevation on the monument, the contractor's surveyor shall also reference the monument to a minimum of three vertical tie points that are identifiable, permanent, substantial, not subject to being disturbed during the construction period, and no more than 250 feet from the point being tied down. The reference elevations on the vertical tie points shall have an uncertainty relative to the reference monument of no more than 0.006 feet relative to the monument being referenced.

The General Contractor shall submit copies of the field notes of the ties to the Resident Engineer and Monroe County Surveyors Office prior to the start of construction and field notes of the remeasurement upon completion of construction with a report certified by the Professional Land Surveyor and summarizing the differences in the pre and post construction measurements. The report shall follow the format of an example report provided by the County Surveyor.

ITEM C625.0207 Recovery of Existing Geodetic Survey Monument

DESCRIPTION

Existing geodetic survey monuments located under paved surfaces or in other locations making survey recovery difficult, shall be carefully excavated to expose the monument so the existence and condition of the monument can be confirmed. Extra care and necessary precautions shall be taken to prevent disturbance of the monument. The County Surveyor will confirm whether the monument is in a condition that warrants preservation. If the monument is determined to be in a condition poor enough to warrant removal, the monument shall be removed in accordance the requirements of Monroe County Standard Construction Specifications Item C625-3.24, Remove Existing Survey Monument. If the monument is determined to be in a condition good enough to warrant preservation, the monument shall be preserved and tied down in accordance with the following specification.

CONSTRUCTION DETAILS

MONUMENT POSITIONING INSTRUCTIONS

The geodetic monument position shall be established and localized to the original project survey control baseline utilizing conventional Theodolite or Total Station terrestrial survey techniques only, without employing GPS survey techniques.

Conventional Theodolite or Total Station terrestrial surveys shall be performed with either an Electronic Distance Measuring Instrument (EDM) (rated with an internal uncertainty of no more than 0.003 m and scale of no more than 2 parts-per-million (ppm)). The EDM distance measurements shall be corrected for both temperature and pressure as necessary. The angulation shall be performed with a directional theodolite or total station that has an internal least count of no more than 2 seconds. A minimum of two positions on the circle (both direct and reverse) and an EDM distance shall be taken along with each angle measurement. Any of the individual angles shall differ from the mean of all angles by no more than 5 seconds and individual distances shall differ from the mean of all distances by no more than 0.01 feet and 2 parts per million (ppm). Adjustment shall be completed by a minimally constrained least squares adjustment. From the least squares adjustment the maximum allowable Network Positional Accuracy (at two sigma, 95% confidence level) shall not exceed 0.025 feet or a precision of 1 part in 20,000 parts (1:20,000).

Where existing geodetic monuments on NAVD 88 vertical datum are within reasonable proximity, the orthometric height, shall be established by conventional terrestrial differential leveling techniques, shall close within $0.033 \text{ feet} \cdot \sqrt{s}$ where s is equal to the length of the level run in miles.

The Licensed Land Surveyor shall submit copies of a report to the Monroe County Surveyors Office. The report shall contain the following:

- A summary of survey field operations and adjustment.
- Least squares adjustment report with a final adjusted grid coordinate listing.

BASIS OF PAYMENT

Payment will be made under:

<u>Item No.</u>	<u>Item</u>	<u>Pay Unit</u>
C625.0201	Reset Existing Monument Frame and Cover	EA
C625.0202	Install New Monument Frame and Cover	EA
C625.0203	Install New Geodetic Survey Monument	EA
C625.0204	Remove Existing Survey Monument	EA
C625.0205	Adjustment of Existing Geodetic Survey Monument	EA
C625.0206	Geodetic Monument Monitoring	EA
C625.0207	Recovery of Existing Geodetic Survey Monument	EA