

ITEM G-135 CONSTRUCTION SURVEYING AND MONUMENTS

DESCRIPTION

135-1.1 GENERAL. Perform surveying and staking essential for the completion of the project. Perform the necessary calculations required to accomplish the work in conformance with the Plans and Specifications, AS 34.65.040, and the Alaska Society of Professional Land Surveyors' *Standards of Practice Manual*.

135-1.2 DEFINITIONS.

- a. **Monument:** A fixed physical object marking a point on the surface of the earth; used to commence or control a survey; mark the boundaries of a parcel of land; or the centerline of a right-of-way corridor. Monuments will be Primary or Secondary, as shown on the Plans.
- b. **Point:** An identified spot located on the surface of the earth. For purposes of this definition, a point can be a PK nail, wooden hub, rebar, large nail or other structure capable of being utilized as a marker.
- c. **Reference Monument:** A material mark or point placed at a known distance and direction from a property corner or other survey point, usually not on a property or survey line. A reference monument is employed to perpetuate a corner/point that cannot be monumented at its true location or where the corner monument is subject to destruction.
- d. **Surveyor:** The Contractor's Professional Land Surveyor, currently registered in the State of Alaska.
- e. **Witness Corner:** A material mark or point usually placed on a property or survey line, at a known distance from a property corner or other survey point. A witness corner is employed to witness the location of a corner/point that cannot be monumented at its true location.

MATERIALS

135-2.1 MONUMENT CASES. Use castings meeting AASHTO M 105, Class 30A. Coat with a bituminous damp-proof coating. Use bolting tops.

135-2.2 PRIMARY MONUMENT. A minimum 2-inch diameter nonferrous pipe at least 30 inches long, with a minimum 4-inch flange at the bottom and having magnets attached at the top and bottom. Permanently attach a minimum 2-1/2-inch diameter nonferrous metal cap to the top. Mark the cap around the outside edge with the words "STATE OF ALASKA DOT&PF". Permanently stamp every primary monument with the Surveyor's registration number, the year set, and the point/corner identification. Orient cap so that the data may be read facing up-station.

135-2.3 SECONDARY MONUMENT. A minimum 5/8-inch by 30-inch rebar with a 2-inch aluminum cap attached to the top. Permanently stamp every secondary monument with the Surveyor's registration number and the year set.

135-2.4 SURVEY POINT MATERIALS. Listed sizes are a minimum. Use only stakes with planed sides.

**TABLE 135-1
SURVEY POINT MATERIAL REQUIREMENTS**

	2" x 2" x 8" hub w/ whiskers	2" x 2" x 12" hub	48" lath	tack
Benchmarks**				
Blue tops*	X			
Centerline P.C., P.T., P.O.T.		X	X	
Centerline reference points		X	X	
Centerline station			X	
Clearing & Grubbing			X	
Culvert stake		X	X	
Curb & gutter		X	X	X
Guardrail			X	
Grade stakes		X	X	
Red tops*	X			
Riprap			X	
Signs			X	
Slope stake			X	
Slope stake references		X	X	
Structures		X	X	X
Under drains & sewers		X	X	

*Use blue tops for top of base course. Use red tops for the bottom of base course.

**Set benchmarks on a permanent, stable object, not subject to vertical or horizontal movement.

CONSTRUCTION REQUIREMENTS

135-3.1 GENERAL. Perform work classified as Land Surveying under AS 08.48, and work involving the location, control, and monumentation of construction centerline and right-of-way, by or under the responsible charge of a Professional Land Surveyor. The Department will provide sufficient centerline or reference thereto, and at least one benchmark to enable the establishment of planned elevations and centerline.

Furnish field survey notes. Keep field survey notes in an approved format, written in a clear, orderly, and neat manner. Make field survey notes available for inspection by the Engineer at any time. Furnish all computer generated data in a file format and medium that is compatible with Department software.

As soon as practical after completion of the work, and in no case later than acceptance of the project, deliver to the Engineer: field survey notes; PNEZD files; DTMs; machine control surfaces; and computer output data used in the calculation of measured quantities. This data becomes the property of the Department.

Perform the following by the Surveyor, or personnel under the responsible charge of the Surveyor:

- a. Reduce, check, and adjust survey data.
- b. Measurement of pay quantities that require measurement. Submit a proposed method of measuring and computing volumes to the Engineer in writing for approval before performing any work on pay items measured by volume. Provide supporting survey data and interim calculations for measured items to the Engineer prior to progress payments for each specific item. Prior to final payment, provide calculations that are completed, checked, and signed by the Surveyor.
- c. Staking, referencing and other actions required to preserve or restore land monuments and property corners.
- d. Staking of project control and benchmarks.

Perform the following:

- a. Staking necessary to delineate clearing and/or grubbing limits.
- b. Stake Environmental Permit boundaries.
- c. Slope staking.
- d. Staking of signs, culverts, minor drainage structures and other appurtenances, including the necessary checking to establish the proper location and grade to best fit the conditions on site.
- e. Staking or hubbing all layers of material shown in the typical sections, including the bottom of excavation, top of borrow, top of base course, and top of surcharge. The Engineer may waive the requirement to stake and hub all layers after a successful demonstration of the machine control system to build to the required tolerances.
- f. Staking material source limits where staking is called for in the Contract.
- g. Staking of right-of-way where staking is called for on the Plans.
- h. As-built surveying as required under 135-3.9. Tie as-built measurements and locations to project horizontal and vertical survey control.
- i. If machine controls are used, develop the machine control models.
- j. Other surveying and staking necessary to complete the project.

Notify the Engineer immediately if a Department-established reference point is discovered to be in error or a reset point is not in relationship to the adjacent control points.

Maintain the position and identifying marks of slope stakes and reference points until used for their intended purpose. Provide copies of temporary bench mark elevations and grade sheets or electronic surfaces to the Engineer 48 hours before beginning work on unclassified excavation or embankment. Before beginning

clearing, grubbing, or excavation within an area submit the survey field notes relating to monument referencing for the area.

The Engineer may randomly spot check the Contractor's surveys, staking, and computations. After the survey or staking has been completed, provide the Engineer with a minimum of 72 hours notice before performing work, and furnish the appropriate data, to allow for random spot checking. The Department assumes no responsibility for the accuracy of the work.

Provide item quantities, including computations and plots to the Engineer prior to payment for each specific item. The Department will review and accept or modify the quantities provided.

135-3.2 CROSS-SECTION SURVEYS. Provide plotted cross-sections, on stations according to Table 135-3, with elevations, offsets and computed end areas in square feet for each section prior to final payment for each item measured by volume. Provide these cross-sections and associated data for the entire area of earthwork computations along with any terrain model. Take cross sections after clearing and grubbing has been completed.

135-3.3 MONUMENTS. Install primary and secondary monuments where called for in the Plans.

Prior to the start of construction, reference monuments, to include property markers/corners and accessories, that may be disturbed or buried during construction. In addition, reference monuments designated for referencing on the Plans. Prepare and record Monument Record Forms in the appropriate Recorder's Office before disturbing monuments. Monument Record Forms may be obtained from the Engineer. Re-establish monuments in their original position before completion of the project. Prepare and file a Monument Record Form for each reestablished monument.

Keep records and report to the Engineer evidence that a monument has been disturbed and is no longer reliable or cannot be located and is presumed to be missing. Establish a minimum of two in-line reference points, or three swing-tie reference points in situations where in-line referencing is not desirable. Set reference points outside of the construction limits. Measure distances from the monument to the nearest 0.01 foot. Record referencing of monuments in a separate field book sealed and signed by the Surveyor.

Replace existing monuments disturbed by construction with Primary or Secondary Monuments meeting the requirements of subsections 135-2.1 through 3. When it is impractical to establish a monument in its original position, install a witness corner (WC). Place the WC to a property corner on the property line when the other property corner that defines said line is existing or there has been sufficient retracement to define said line. In other cases, place a reference monument (RM) perpendicular to the centerline at the station of the original position and at a distance from the original position measured in whole feet.

Those monuments found that are not shown on the Plans will be recognized by the Engineer when the following is provided by the Surveyor: Field notes identifying type and location of the monument, and a description of the point the monument marks, with the reason to preserve its location.

The Surveyor shall complete a State of Alaska Land Survey Monument Record form for each primary and secondary monument referenced, removed, installed, relocated or replaced. Provide the required survey information on the form according to statutory requirements, including section, township and range. Meet requirements for recording at the District Recorder's Office in which the project is located for each monument record. Provide copies of the Record forms to the Engineer for approval before submitting them to the District Recorder's Office. Deliver conforming copies of the recorded forms to the Engineer before monument removal or disturbance, and after setting any final monuments requiring monument records.

Set each monument and monument case accurately to lines established at the required location and in a manner as to ensure being held firmly in place. Set existing monuments and monument cases to be adjusted to new elevations in the manner and at the elevations directed.

Primary Airport Control (PAC) and Secondary Airport Control (SAC) monuments are present in the project area as shown on the Plans. This control is important and if disturbed, must be reestablished by the

Contracting Agency. For this reason, the Contractor is required to employ all reasonable measures to preserve the existing control monuments in an undisturbed condition. If a PAC or SAC is disturbed by the Contractor's actions, the Contractor shall reimburse the State of Alaska for the cost of replacing monuments, performing geodetic surveys and related data processing, and filing the completed survey with the National Geodetic Surveys office.

135-3.4 CONTRACTOR FURNISHED ENGINEERING TOOLS. When item G135.050.0000 appears in the bid schedule, furnish and maintain Engineering Tools as required in the Directive authorizing the work. The Contractor shall insure and indemnify the Department against normal wear and tear, damage, theft, and all other events that may cause a loss of function of the furnished tools. The equipment will be returned to the Contractor upon completion of the project, or when services are terminated by the Engineer. Furnish training for the Engineer's staff, as directed by the Engineer.

135-3.5 SURVEY ACCURACY REQUIREMENTS. Keep daily notes on instrument checks and accuracy checks and make them available to the Engineer upon request. Perform surveying within the following accuracy requirements:

**TABLE 135-2
SURVEY ACCURACY REQUIREMENTS
(Measurements in Feet)**

	Stationing	Horizontal Position	Horizontal Angle	Distance To Centerline	Elevation
Additional cross sections	1.0	0.04	**	0.1	0.1
Benchmark		0.02			0.01
Blue tops	1.0	0.04		0.1	0.02
Bridges	0.02	0.02			0.01
Centerline	*		*		
Clearing & Grubbing	1.0			1.0	
Culverts	1.0	0.04	**	0.1	0.1
Curb & gutter	1.0	0.02		0.1	0.02
Grade stakes	1.0			0.1	0.1
Guardrail	1.0			0.1	
Monuments	*		*		
Other Structures	1.0	0.02		0.1	0.02
Red tops	1.0	0.04		0.1	0.05
Riprap	1.0	0.04		1.0	0.1
Signs	1.0			0.1	0.02***
Slope stakes & RP's	1.0	0.04	**	0.1	0.1
Under drains & sewer	1.0	0.02		0.1	0.02

* Third order survey or 0.07 ft (21mm) local accuracy

** Right angle from center line.

***For signs set in concrete.

135-3.6 SURVEY FREQUENCY REQUIREMENTS. Take survey information and install staking and hubbing at the following frequencies:

**TABLE 135-3
SURVEY FREQUENCY REQUIREMENTS
(Measurements in Feet)**

	Tangents	Curves	Interchange Ramps	Stake Each Per Plan
Additional cross sections	*	*	*	
Bench marks				
Blue tops	100	100**	25	
Blue tops within 100 feet both sides of railroad track crossings and bridge approaches	25	25	25	
Center line	100	100**	25	
Clearing & Grubbing	100	100**	25	
Culverts				X
Curb & gutter	25	25	25	
Grade stakes	100	100**	50	
Guardrail	25	25	25	
Monuments				X
Red tops	100	100**	25	
Riprap	50	50	50	
Signs				X
Slope stake / cross sections	100	100**	25	
Structures				X
Under drains & sewers	50	25	25	

*Establish additional cross sections and slope stakes at all breaks in topography and where structures begin and end.

**Stake curves on 50-foot stations if the curve is greater than six degrees.

Establish all benchmarks and take the centerline profile before doing any staking involving elevations. Do not set benchmarks in utility poles. Recheck benchmarks after each major freeze/thaw cycle and any environmental event that may change the benchmark elevation.

Place reference points at each slope stake beyond the slope stake in a location they will not be disturbed.

In areas where slides or overbreak are anticipated, extend cross sections beyond the construction limits. Cross section on the frequency of the slope stakes. Final re-cross sections are required where there are overbreaks, undercuts, or similar changed features.

At a minimum, show the following information on slope stakes:

- a. Where to begin the cut or fill.
- b. Slope ratio.
- c. Depth of cut or height of fill.
- d. Station.

At a minimum, show the following information on culvert stakes:

- a. Station.
- b. Size.
- c. Length.
- d. Type of Pipe (e.g. CMP).
- e. Cut or fill from top of hub to inlet & outlet.
- f. Skew angle.
- g. Horizontal distance from hub to end of pipe.
- h. Gradient of pipe.
- i. Drop of pipe.

At a minimum show the following information on other stakes:

- a. An identifier/name for the stake.
- b. Station
- c. Offset
- d. Elevation (if applicable)

Place red/blue tops at each break in typical section and on centerline. Evenly space red/blue tops at and between crown section break points with a maximum spacing of 25 feet between red/blue tops. Place red/blue tops at curve superelevation transitions.

135-3.7 FINAL VERIFICATION OF MONUMENTS. Within 30 days after the Engineer receives a letter stating that construction activities that may disturb the monuments have ceased, the Surveyor shall verify the positional accuracy of installed survey monuments. Verify the primary and secondary monuments placed or replaced compared to undisturbed Department-provided control points. The Surveyor shall sign and stamp a letter that lists each monument and its coordinates. The letter shall certify that the monuments are each located within 0.1-foot of their proposed position based on the project survey control points provided by the Department. Deliver the certification letter and field notes for this work to the Engineer.

135-3.8 [EXTRA THREE PERSON SURVEY PARTY or EXTRA SURVEYING BY THE CONTRACTOR]. This pay item is for extra, additional, or unanticipated work made necessary by changes in the project. Monuments not shown on the Plans will be considered additional work. Work under pay item [G135.020.0000 or G135.040.0000] may include field work, office engineering, or any work described under the construction requirements of Item G-135.

135-3.9 AS-BUILT SURVEYS. Upon completion of each phase of the work, the Contractor shall furnish the Engineer with all necessary measurements for completion of the as-built drawings. The Contractor shall include identification and location of project features where actual locations differ from locations shown on the Plans. Document the final locations of paved surfaces, topographic surfaces, structures, and utilities constructed by the project.

135-3.10 OFFICE ENGINEERING. RESERVED.

METHOD OF MEASUREMENT

135-4.1 The work will be measured according to GCP Section 90, and as follows:

- a. Hour. By the number of hours, as directed by the Engineer and as recorded by certified payrolls.
- b. Contingent Sum. As specified by the Engineer in the Directive authorizing the work.

BASIS OF PAYMENT

135-5.1 Pay Item G135.020.0000 Extra Three Person Survey Party. Work accomplished by a three person survey party will be paid at 100% of the contract unit price, by a two person survey party at 75% of the

contract unit price, or by a one person survey party at 50% of the contract unit price, for Pay Item G135.020.0000.

Pay Item G135.040.0000 Extra Surveying by the Contractor. Payment will be made as specified in the Directive authorizing the work.

Pay Item G135.050.0000 Contractor Furnished Engineering Tools. Payment will be made as specified in the Directive authorizing the work.

The Engineer will deduct the Department's cost of replacing PAC and SAC monuments under 135-3.3 from the amount due the Contractor.

Payment will be made under:

Item G135.010.0000	Construction Surveying by the Contractor – per lump sum
Item G135.020.0000	Extra Three Person Survey Party – per hour
Item G135.030.0000	Monuments by the Contractor – per lump sum
Item G135.040.0000	Extra Surveying by the Contractor – per contingent sum
Item G135.050.0000	Contractor Furnished Engineering Tools – per contingent sum