Table of Contents
CHAPTER 9: INCIDENTALS

901 MOBILIZATION

902 CHAIN LINK FENCE
902-2 MATERIALS
902-3 CONSTRUCTION REQUIREMENTS

903 WIRE FENCE

904 CHAIN LINK CABLE BARRIER

905 GUARDRAIL

906 CATTLE GUARDS

907 DAMPPROOFING AND WATERPROOFING CONCRETE SURFACES

908 CONCRETE CURBS, GUTTERS, SIDEWALKS, AND DRIVEWAYS

909 SURVEY MONUMENTS

910 CONCRETE BARRIERS

911 RIGHT-OF-WAY MARKERS

912 SHOTCRETE
912-3 CONSTRUCTION REQUIREMENTS
912-3.06 QUALITY CONTROL TESTING
912-3.09 CURING
912-6 RECORDS

913 BANK PROTECTION

915 TEMPORARY SILT FENCE

916 EMBANKMENT CURB

917 EMBANKMENT SPILLWAYS, DOWN-DRAINS, INLETS, AND OUTLETS

922 UTILITY CONCRETE FOR MISCELLANEOUS CONSTRUCTION

925 CONSTRUCTION SURVEYING AND LAYOUT

926 - 927 ENGINEER'S FIELD OFFICE AND FIELD LABORATORY

928 RUMBLE STRIP

REFERENCES

BLANK FORMS
ATTACHMENTS
ADOT RIGHT-OF-WAY SURVEYS
MINIMUM STANDARDS FOR ARIZONA LAND BOUNDARY SURVEYS
CLASSIFICATIONS OF ALTA-ACSM LAND TITLE SURVEYS

901 MOBILIZATION

Mobilization is a contract item established to compensate the Contractor for move-in costs and certain other startup costs incurred as the project work begins. The item is set up so that partial payments are made as the work progresses.

There are four milestones that trigger mobilization partial payments:

1. The preconstruction/partnering conference.

2. The point when there is a significant amount of equipment on the project site.

3. When 5% of the contract is completed.

4. When 10% of the contract is completed.

The first milestone is not reached until the preconstruction conference has been held and all the documentation required by Subsection 108.03 is submitted complete enough for review. The table in Subsection 108.03 of this manual lists all the submittals required at the preconstruction conference, including those specifically required by 108.03. The Special Provisions may have additional submittal requirements under 108.03. A satisfactory submittal should be one that can be reviewed by the Department without being sent back to the Contractor for incompleteness. For example, a generic safety plan that doesn't address some of the specific project safety hazards would be unsatisfactory and could be used as basis for withholding the first mobilization partial payment.

The Department considers the preconstruction submittal documents part of the Contractor's preparatory work paid for under mobilization. Thus, to get paid for mobilization, complete documents need to be submitted.

The second milestone occurs when a significant amount of equipment has been mobilized to the project site. What constitutes significant is left up to the interpretation of the Resident Engineer. However, to be consistent statewide the Resident Engineer should take into consideration the size of the project and how much equipment will be needed initially to complete the first 5 percent of the contract work. Setting up a trailer and installing fences and signs for the Contractor's yard does not qualify for this mobilization milestone. Nor does parking a single piece of equipment, like a frontend loader, to be used much later in the project qualify.

The third milestone is reached when 5 percent of the project work has been completed in terms of dollars paid to the Contractor. The 5 percent includes the two previous mobilization partial payments.

There is some confusion as to when the 5 percent should be paid, in the month that it is reached or in the following month? The 5 percent milestone is triggered when the work is completed in the field, not when the field office prepares the monthly estimate. The milestone can be reached at any time during the month and is not necessarily the end of the month. For example, if 10,000 cubic yards is needed to trigger the 5 percent mobilization payment, and this point is reached halfway through a given month, then the 5 percent mobilization would be paid on the estimate prepared at the end of that month (the "next" estimate after the 5 percent is reached). The "next estimate" provision was placed in the Standard Specifications to prevent the Contractor from requesting a supplemental estimate (see Subsection 109.06 of this manual) every time a mobilization milestone was reached

The same reasoning applies to the fourth and final mobilization partial payment, when 10 percent of the work is complete.

Although not explicitly stated in the Standard Specifications, the mobilization milestones must be paid in order: the second payment cannot be made before the first. The numbering of the milestones implies an order that should be followed. A Contractor that has submitted incomplete documents required by Subsection 108.08 cannot receive the first or any subsequent mobilization partial payments until complete documents are submitted.

The mobilization pay item should not change due to changes in other work items or due to altered quantities.

902 CHAIN LINK FENCE

Fences should go up as soon as possible. Although fences may restrict the Contractor's access to parts of the site, they do protect the public from the safety hazards associated with highway construction (refer to Subsection 107.08). Permanent fencing is preferred over temporary fencing since permanent fencing is usually more secure and no rental payments are involved.

Fence lines are to be staked so that the fence posts are 6" from the right-of-way line, unless otherwise shown on the plans.

When building a new fence requires removal of an existing fence or erection of temporary fences, the Inspector and the Contractor are to work with the property owner to accomplish the changes with the least disruption and inconvenience.

902-2 Materials

Two materials options are permitted for fence material: zinc-coated (galvanized) steel or aluminum coated steel. However, only one kind of material will be allowed on each project. This material requirement is due to the corrosive reaction caused by interaction of dissimilar metals.

Zinc-coated metals have a dull to very dull (almost greenish) appearance when the zinc coating has the proper thickness. A shiny surface is good indicator that the coating may be too thin. If this is the case, take a sample before the material is installed and have the sample sent to the Structural Material Testing Section of the Materials Group for a coating thickness check.

902-3 Construction Requirements

When chain link fence is installed over irregular ground, it may be necessary to do a considerable amount of grading along the fence line to obtain the uniform bottom-of-fence line clearance specified in the standard drawings.

Rock or hard ground makes installation of fence posts difficult, hindering either the post driving or hole excavation. It may be necessary to increase inspection to assure that posts are anchored to the proper depth and diameter.

When Class B or utility concrete is used to anchor fence posts, the Contractor will have to wait several days before stretching the fence fabric. The concrete needs to develop adequate strength and stiffness to resist the bending forces developed in the posts when the fence fabric is stretched and tensioned. If the Contractor is in a hurry and with the approval of the Resident Engineer, Class S concrete with high early strength cement can be used which may allow fabric stretching and tensioning the day following fence post installation.

Guidelines For Inspecting Chain Link Fence:

1. Do the materials conform to the plans and specifications, and are materials certifications available for those items requiring them?

2. Are posts spaced at 10 feet (3 meters) or less intervals? (refer to Standard Drawing C-12.20)

3. Is wire fabric of proper gauge?

4. Is the wire fabric installed so that the "knuckled" selvage is on top and barbed finish is on the bottom?

5. Has the concrete cured 72 hours before the fabric is stretched? (Unless high-early strength concrete was used.)

6. Is the fabric stretched taut and securely fastened to the posts and strain wires?

7. Is tie wire of proper gauge?

8. Are wire clips of proper gauge?

9. Are the strain wires of proper gauge?

Fence materials that are thicker or have thicker coatings than required are usually acceptable to the Department. Unless there is an appearance problem with the fence, the Resident Engineer can approve the thicker materials by a no-cost minor alteration.

903 WIRE FENCE

Before fence construction is started, the Inspector and Resident Engineer should study the plans, with special attention being given to right-of-way lines, access control lines, location of gates, cattleguards, flood gates, and angle points in order that the Contractor may be given complete, accurate information necessary to begin fence construction without delay or interruption. The Inspector should know what type of fencing materials and hardware are specified. For example, is barbed wire or barbless wire specified? If game fence is specified, is the bottom wire barbless? Are any special details required for environmental mitigation?

When constructing or reconstructing fence, the Contractor shall be held strictly responsible for any and all damage to private property during or as a result of his or her operations. This includes losses and accidents caused by such things as loose livestock.

The Inspector must be sure that all fence materials have been certified, tested, and approved. Project samples must be taken as outlined in the Materials Testing Manual as soon as materials are delivered to the project.

Close inspection during construction is necessary to see that posts are driven to the depth and spacing shown in the Standard Drawings. This is especially important where post driving is difficult. After all required line, intermediate, and corner posts have been placed, the wire should be stretched taut and securely fastened to each post. Post concrete should cure 3 days minimum before any fence wire is stretched and tied. After the required strands of wire have been properly placed, the guy wires, sag weights, and other details should be completed as required.

Avoid construction of fence in washes or along bank edges where erosion may destroy the usefulness of the fence. Wing fences at box culverts need not be an extension of the wing line. The alignment of the wing fence can be adjusted away from the channel to keep as much of the fence as possible out of the drainage area. These adjustments will often result in the need to increase the length of the flood gates. Probably the most important consideration is that the gate/end post assemblies are located well away from areas subject to erosion.

The installation of the gates, hinges, and latches should allow them to operate freely. They should open to the full opening size in the direction indicated. The upper post hanger of Type I line fence gates shall be installed so that the gate cannot be lifted and removed.

Carefully check horizontal and vertical angle points to determine whether corner posts or diagonal tension wires are needed.

The clearance between the bottom wire and the ground must be checked since extra posts, sag weights, or special treatment may be needed.

In the past, stones and boulders have been allowed as sag weights. The present requirement is to use only prefabricated 100 pound (45 kilogram) concrete blocks.

Unusual ground conditions should be looked at to determine whether a modification of the standard fence treatment is called for, or if perhaps some fence can be eliminated.

Inspection Guidelines For Wire Fence And Gates:

1. Do the following materials conform to the plans and specifications, and are material certifications available for those items requiring them:

A. Barbed/woven wire zinc or aluminum coated and of the same type for the entire project (refer to Section 902 of this manual under Materials and Installation Guidelines)?

B. Gates?

C. Posts?

D. Fasteners, hardware?

2. Have adequate measures been taken to protect livestock while building or rebuilding fence?

3. Has fence line been cleared or graded in accordance with the specifications?

4. Are posts driven/set to proper depth, spacing, plumb, and alignment?

5. Has the wire been stretched taut and fastened to each post? Was the wire stretched on the outside of posts around curved areas? Is there only one wire splice per panel?

6. For Type I gates, is the upper post hanger installed so gate cannot be removed?

7. Have the strain and corner posts been installed at all required locations?

8. Has fencing been properly tied into the structures?

904 CHAIN LINK CABLE BARRIER

Chain-link cable barrier is a safety device, it is important that safety hazards are not created when constructing it.

It must be noted that the concrete anchor blocks must be flush with the ground so that they do not catch on a vehicle passing over them. At the same time, they must be well-drained so that water doesn't collect where it can corrode the hardware or soften the ground around the block.

The distance from the barrier to the top of the slope must be as specified on the plans. If the distance is too short, the barrier will not stop a vehicle before it drops off the slope.

All the fittings must be accurately placed and tightened as specified.

As with all safety devices, it is legally imperative that the barriers are built strictly according to the plans.

905 GUARDRAIL

The Project Plans will specify the locations, type, and quantity of guardrail to be installed. Installation will be in accordance with the appropriate standard drawings and special details and manufacturer's approved drawings. Installation of guardrail has evolved into a relatively complex procedure. The standards and manufacturer's drawings for guardrail are being constantly updated to improve the design and facilitate maintenance. It is imperative that construction personnel are aware of the latest guardrail standards and manufacturer's drawings. In order to assure installation in accordance with the correct drawings, the pre-activity meetings are required. This is discussed in more detail at the end of this section. Occasionally, a supplemental agreement to address revisions to the system after the contract has been awarded may be necessary. This can be conveyed to the Contractor at the pre-activity meeting.

When the Contractor is given the option of selecting an end treatment, the type of device to be used should be submitted at the pre-construction conference. If this is not possible, the type must be submitted before the Contractor orders delivery of guardrail materials to the site. This will provide the lead time necessary for the Resident Engineer (RE) to determine the final location for end treatments, which in turn affects the "length of need," the total guardrail length and the quantity of material ordered. In the event of major changes in guardrail locations, the roadway designer should be consulted for placement criteria and standards.

Propriety items, such as guardrail end treatments, change as design modifications are introduced. The supplier of a propriety item is required to submit the changes to the ADOT New Product Committee. Changes which are approved are on file with the Standards Engineer in the Roadway Design Section. Installation guidelines should also be furnished with the units.

When staking post locations be sure to locate all drainage structures so that where possible the post location can be adjusted to eliminate any conflicts or the need for an anchoring device. Guardrail layout staking generally consists of marks on the pavement to locate the longitudinal position of the post together with the offset distance to the post. The offsets at flared end sections can be obtained from the Plans Detail Layout Sheets. Stakes or markings for guardrail control are generally adequate if set at 50-foot (15-meter) intervals for tangent sections and 25-foot (8-meter) intervals on curves.

Wood posts are to be inspected in accordance with ADOT Materials Policy and Procedure Directive 02-01 before they are placed in pre-punched, or pre-drilled holes and driven the final 10-inches to grade. Steel guardrail posts may be driven full depth, or placed in manually or mechanically dug holes and driven the final 10-inches to grade. When posts are placed in manually or mechanically dug holes, the space around posts must be backfilled with moist soils placed in compacted lifts as approved by the RE. Excessive driving effort, in some cases will cause damage to the post and which may be cause for rejection of the post. When posts are set in position, each post must be plumb, true to alignment and grade, and surrounded by well compacted ground. In paved areas, the displaced material from post driving will often cause the pavement to bulge upward or crack an adjacent curb. If either of these occurs, the Contractor is required to use other methods that will not damage existing pavements or structures and to repair any damage that has been caused by post installation.

On occasion the Contractor may encounter rock that prevents the driving of posts to the full depth. Requests for changes should be submitted to the RE. Approval for any changes to end treatments must be obtained from the manufacturer.

When posts are set in concrete or in asphalt pavement, the top of the concrete "leaveout" material (normally grout) adjacent to the posts should be finished so that water will drain away from the post in accordance with the plans.

Blocks are to be toenailed to the post with two galvanized sixteen-penny nails. The tops of the post and block are designed to be flush; a maximum of 1/2-inch (12 millimeters) difference in the elevation of the top of the post and block is permitted.

The rail should be inspected for any damage that may have occurred to the rail itself or to the galvanizing due to rough handling. A Certificate of Compliance is required for all rail and should be furnished before construction starts. All guardrail fasteners also require a Certificate of Compliance and one sample of each item.

Rail elements should be assembled to present a smooth, continuous appearance with the top of the rail being in near perfect alignment horizontally and vertically without any sags or humps. Rail laps must be oriented in the direction of traffic to the closest lane.

The reflector tabs for guardrail are thin and pliable, so they can be bent over the head of the bolt. The tabs are bent to keep them from falling off when the bolt loosens due to the drying and shrinking of the posts and blocks. The reflective material is high intensity reflective type sheeting. See the Standard Specifications for post spacing and color requirements.

Projects with an average elevation over 4000 feet (1200 meter) require flexible markers in addition to reflector tabs. Sheet 2 of the plans should show average project elevation. See the Standard Specifications for height, attachment hardware, post spacing, and color requirements.

The end treatments (terminals) for guardrail are numerous and each has specific construction requirements. Therefore it is important that construction personnel carefully review and adhere to all the construction details in the Project Plans, Standard Drawings, Standard Specifications, Special Provisions, Manufacturer's Drawings and Manufacturer's Installation Manual associated with end treatments. Delineation of guardrail posts must be done in accordance with Table 905-1 of the Special Provisions. See the Standard Specifications and Special Provisions for post locations and type of barrier marker required.

When existing guardrail elements are to be reused, it is important to mark any damaged or otherwise unsuitable elements before construction begins. Reconstruction of guardrail shall meet the same requirements as construction of new guardrail. Existing guardrail designated on the Project Plans to be reconstructed should be carefully removed from the old location, and reused materials should be inspected with care. Sharp kinks or enlarged bolt holes are reasons for the rejection of rail elements. Posts that are severely cracked, rotted or splintered are to be rejected (see Policy and Procedures Directive No. 02-01). The Special Provisions or the plans may require all reconstructed posts to be replaced with new posts, if the Resident Engineer requested it during the project planning, or design phases.

It should be noted that the Standard Specifications prohibit the use of a cutting torch for making bolt holes. Heat may weaken the metal around the bolt hole so that the bolt head may pull out under the force of impact. The only acceptable methods of making bolt holes in the field are drilling or punching.

Prior to acceptance, each section of guardrail should be inspected utilizing the appropriate quantified checklist for the specific type of guardrail installed.

Inspection Guidelines For Guardrail:
Schedule the pre-activity meeting sufficiently in advance of ordering the materials to resolve all issues (a minimum of 20 days is recommended). Attendees should include the superintendent, the subcontractor(s) as applicable, the foreman installing the devices, the RE, the Project Supervisor and any Inspectors who will be working on the installations.

A suggested agenda for the pre-activity meeting for Roadside Safety Devices is shown in Exhibit 905-1. The RE should assign discussion roles and times.

It is understood the Contractor will bring the manufacturer's installation requirements to the meeting, including the manufacturer's drawings approved by ADOT. When a newer end treatment system has been approved the RE should encourage the contractor to install the current approved system. ADOT personnel will bring the current checklists.

The most recent manufacturer's approved drawings can be found on the Roadway Design web page.

Current versions of ADOT Inspection Checklists for Guardrail End Sections can be accessed using the checklist software application. Access instructions are in Subsection 105.12 of this manual.

AGENDA
ROADSIDE SAFETY DEVICES
PRE-ACTIVITY MEETING

1) Introduction of participants
2) Review Special Provisions
3) Discuss Barrier Summary Sheets (Roadway Engineering Memorandum, dated 6-27-2002)
4) Review Plans Layout Sheet
   a) Dimensions of widening
   b) Foreslope rate
   c) Borrow source (if needed)
   d) Bituminous material (source and type)
5) Discuss schedule and sequencing
   a) Blue staking
   b) Surveying layout
   c) Borrow for pad construction
   d) Potential drainage conflicts (e.g., created by widening)
   e) Units to be installed before or after paving
   f) Compaction around posts
   g) Removal of existing rail and unit completion in same day
   h) Traffic control
6) Review traffic standards and specifications for delineation
7) Review manufacturer's approved drawings & other standards
8) Review the manufacturer's installation requirements (e.g., manuals and instructions)
9) Review the ADOT checklists
10) Discuss governing order of requirements, authority and escalation practices

Exhibit 905-1 Suggested Pre-activity Agenda for Roadside Safety Devices

906 CATTLE GUARDS

The Project Plans will specify the location and type of cattle guards to be constructed. Each cattle guard must be constructed in conformance with the appropriate Standard Drawings or any special details included in the plans. The item itself consists of furnishing all materials and constructing new cattle guards or reconstructing existing cattle guards as noted on the plans.

If precast units are used they must be on the Department's Approved Products List.

Completed cattle guards must be well-drained to prevent ponding of water in the structure. Cattle guards should be carefully constructed to the specified grade and cross slope, with special care being taken to achieve a bump free, smooth riding installation. Errors in the elevation of the cattle guard or the approach grade that cause a bump for traffic must be corrected.

Inspection Guidelines For Cattle Guards:

1. Are material certifications available for those items requiring them? If the unit is precast, does the Certificate of Compliance match the unit and is the unit identified as an ADOT cattle guard? Is the cattle guard on the Approved Products List?

2. Are the steel parts primed?

3. Has the backfill material been compacted to at least 95% of maximum density?

4. Has the concrete been finished and cured in accordance with the specifications?

5. Does the grade and cross slope conform to the surface of the finished pavement?

907 DAMPPROOFING AND WATERPROOFING CONCRETE SURFACES

There is a tendency to be careless with dampproofing and waterproofing because they will be buried and it is assumed that appearance is not important. Appearance is important because creases, spotty sealant coverage, loose ends, uneven appearance and other visual blemishes may indicate defects and potentially reduce the service life of the structure.

Among the most important things to watch for are a dry surface before treatment and a smooth coverage of the waterproofing coating. A dry surface, besides increasing the adhesions of the product and reduces the possibility of vapor buildup under the coating which can cause a rupture breaking the water seal. Surface depressions and high spots in the waterproofing are to be avoided because they create weak areas that can be easily broken during backfilling or settlement. If the surface being treated becomes wet from rain or for any other reason, it must be dried completely before allowing the work to proceed.

Where primer is specified, the primer must be applied uniformly and completely over the surface. When a thickness of dampproofing coating is specified. The inspection records should show that the thickness was measured and what were the results.

Treatment of joints, with or without fabric, should be watched closely as they are often the weakest part of the treatment.

Application rates of sealant are to be checked and recorded.

As a final precaution, don't destroy the usefulness of the treatment by allowing careless backfilling methods that will tear, punch holes, or scrape off the fabric and sealant.

908 CONCRETE CURBS, GUTTERS, SIDEWALKS, AND DRIVEWAYS

Curb and gutter serves two purposes, providing a conveyance for storm water and as a means of channeling traffic. Vertical curb may also serve as a barrier to low speed traffic. The type of curb shown on the plans should not be changed without consulting the designer.

Curb and gutter serves to convey storm water to inlets, catch basins, storm sewers, and ditches. Paved streets with curbs sometimes serve as storm water channels. Both proper design and construction are required for the curb and gutter to function properly. Poor construction may result in areas which pond water, resulting in a potential safety hazard. Areas where this frequently occurs are “at grade” intersections especially in radii and valley gutters.

Curbs serve as a means of channeling traffic at intersections, ramps, traffic islands and medians, and delineating the limits of the traveled way to prevent the encroachment of motor vehicles onto sidewalks, medians, and refuge areas. Curbs also serve as an effective means to control driveway entrances. It is always good practice to consult with the property owner before final location of the depressed curb driveways. Minor adjustments to the size and locations of driveways to suit the property owner are acceptable as long as safety standards and local ordinances are not violated.

It is very important for the engineer to study the drainage conditions on any project where curbs will control or have an effect on drainage. This study should be made prior to the start of any grading work, as it may be necessary to make minor alterations in grades or minor changes in elevations of inlets to catch basins, culverts, etc., in order to assure efficient drainage. The engineer and surveyor are cautioned that two particularly troublesome areas are drainage through turnouts and areas where curb is on the high side of super-elevated portions of the roadway. The areas behind and between curbs and right-of-way line should be checked to assure drainage flows to a drain structure.

Finished appearance is of great importance in the construction of curbs and gutters as they are seen by motorists and pedestrians. Good alignment, grade, and finish are essential. Clean, straight forms, in good condition, are necessary to achieve a quality product. Flexible radius forms should be used on curves. Forms should be properly staked and braced.

The operations of mixing, placing, and consolidating the concrete should be coordinated with the finishing operations so that the pour operation does not get too far ahead of the finishers. The use of too much water while finishing the curb may make it look fine now, but in a few years traffic and run-off will wear away the thin, weak layer of grout on the surface. This is often difficult for the Inspector to enforce due to poor past enforcement, but it must be done. The Inspector should not accept concrete that has been retempered or concrete that has been in the mixer longer than the time allowed by the specifications. Since the specifications do not require vibrating concrete used in curbs and gutters, "spading" along the forms is necessary in order to work the coarse aggregate away from the faces, thus avoiding "honeycombing."

Areas of curb that are low must be augmented with fresh concrete, not grout. Under no circumstances is grout to be poured on the curb and gutter surfaces as an added layer for finishing purposes.
The use of water applied to the surface of fresh concrete to retard hardening and facilitate finishing of sidewalks and driveways should not be permitted. This practice will cause weakening of the mortar on the surface that results in cracking or scaling. If the finishers lag, the pour should be slowed.

The top, front face, and flow line of curb shall be tested with a straightedge during the finishing operations. Documentation of the fact that such testing has been done will be made in the Inspector's diary. The stationing of the section tested, the date and the results should all be included in such documentation. Each such entry is

to be signed by the Inspector. The Contractor is required to take whatever corrective measures are necessary to produce curb and gutter that will completely conform to the specifications.

Curing should follow closely behind the finishing operations, in accordance with the specifications.

Preceding portions of paragraphs on concrete curbs and gutters construction and quality control practices are also applicable to sidewalks and driveways.

Scoring of sidewalks to create weakened planes and control cracking should be in accordance with standard drawings. Expansion joint material should meet the specifications and should be placed in accordance with the standard drawing. Special attention should be given to the scoring not only in sidewalk, but also curb and gutter. Good joints are important. It should be noted that Standard Drawing C-5.20 requires a broomed finish on sidewalks.

It is crucial that the construction of sidewalk ramps conform to the Standard Drawings. The Inspector should pay particular attention to slope requirements guaranteeing that the ramp is navigable by a disabled individual. Locations which tend to be problematic are intersections in which signal poles, or fire hydrants are located immediately behind the sidewalk, potentially preventing the sidewalk ramp from maintaining the desired slope. Ramp grades must conform to the American Disabilities Act (ADA) requirements. If the ramp cannot be built as shown on the plans then contact the designer.

Inspection Guidelines For Curb And Gutter:

1. When concrete pavement is to be constructed adjacent to the curb and/or gutter, has the pavement been placed prior to the construction of the curb and/or gutter?

2. Has all soft or unsuitable material been removed from the subgrade and replaced to a satisfactory depth?

3. Has the subgrade been thoroughly compacted before placing concrete?

4. Have the subgrade and forms been watered ahead of placing concrete?

5. Have expansion joints been constructed every 60 feet (18m) and at all radius points and structures?

6. Have 2-inch (50 mm) contraction joints been placed every 15 feet (4.5m) when adjacent to asphaltic concrete pavement?

7. Do the contraction joints match joints in adjacent Portland cement concrete pavement?

8. Has expansion joint filler been placed between curbs and driveway?

9. Do the lines and finish give a good appearance?

10. Has the top surface, front face, and flow line of curb been straight edged and the results documented?

11. Has the concrete, including front and back faces, been properly cured?

Inspection Guidelines For Concrete Sidewalk:

1. Are forms the same depth as the thickness of the sidewalk and are they staked securely in position?

2. Has all soft and unsuitable material been removed from the subgrade and replaced to a satisfactory depth?

3. Has the subgrade been thoroughly compacted?

4. Are the forms and subgrade moistened in advance of placing concrete?

5. Has concrete been properly consolidated, and is finishing mortar worked to surface?

6. Is the concrete surface struck off with a float, troweled smooth, and then given a final fine brush finish?

7. Are joints properly formed and at the required intervals per the plans or Standard Drawing C-05.20?

8. Has the surface tolerance been checked with straightedge and documented?

9. Has the sidewalk received proper cure?

909 SURVEY MONUMENTS

Section line monumentation that is disturbed by construction activities shall be re-established by the Contractor, following the procedures in the *Manual of Surveying Instructions*, U.S. Department of the Interior, Bureau of Land Management. Applicable statues, and standards set forth in *Minimum Standards for Land Surveying in Arizona*, Arizona State Board of Technical Registration, shall also be followed. Monuments re-established shall be recorded in the Office of the County Recorder, and a copy of the Corner Recordation documentation shall be submitted to the Resident Engineer within five working days of recordation.

The Contractor is responsible for locating and properly referencing the locations of the monuments so that the monument can be constructed with reasonable accuracy. Contract survey crews, as part of the verification process, shall locate and make ties to all located Section Line monuments and roadway monuments in the vicinity of the proposed work.

Frames and covers shall be cast iron and shall conform to the requirements of Subsection 1004-6 for Gray Iron Castings. The Department will furnish the brass caps for the survey monuments.

Normally excavation for the monuments will be made at the location and to the depths designated. When locations are changed, the as-built plans and the field books must show all the necessary details of the new location and a note explaining the reason for the change in location included. The monument will then be set as shown on the standard drawings, and the earth tamped into place.

910 CONCRETE BARRIERS

Three methods of constructing barriers are allowed under the specifications:

1. Cast-in-place by slip form or extrusion.

2. Cast-in-place by fixed form.

3. Precast.

The most common method where large quantities are involved is the slip form system. Shorter runs of barrier are commonly cast in fixed forms or are precast sections.

Whichever method is used, the final appearance will be influenced by the foundation. The Inspector will need to exert the greatest part of his/her effort towards getting the Contractor to prepare the foundation for the barrier or the grade the slip-form will ride on so that smooth horizontal and vertical lines will result.

The placing of concrete barriers on new bridges may not precede the release of falsework. Concrete barriers and barrier transitions to be constructed on bridges can only be constructed by fixed form, cast-in-place methods.

If at all possible, the engineer should inspect work that has been done by the equipment to be used. By inspecting previous work any shortcomings can be discussed with the Contractor and corrective measure agreed on. There have been problems in the past with vertical cracking of slip-formed barrier. In some cases the problem was never completely eliminated but the condition has been eased by attention to the rate of travel, maintenance of the proper concrete level when feeding the machine, properly operating vibrators, proper cure, and fine tuning the concrete mix.

The alignment of the barrier is very important and project personnel should be familiar with the tolerance requirements of the specifications. If difficulties are experienced by the Contractor in providing an acceptable product, then the engineer should take steps to correct the problem or stop work until the Contractor can provide a product within the allowable tolerances. Barrier that has an unsatisfactory alignment which cannot be corrected to the satisfaction of the engineer should be removed.

Cast-in-place forms are usually made of metal and need to be inspected for dents, bends, or any other defects that would be detrimental to the appearance of the finished barrier. Precast barrier sections will probably be inspected at the supplier's plant. As with any precast item, it is good practice for the engineer to inspect finished work at the plant early in the production run. If the jobsite inspection shows cause for rejection, this can be resolved with the least disruption and expense to all parties if done before installation. The fact that precast barriers were inspected and accepted at the plant does not mean they must be accepted on the job if they are defective.

Joint sealant is used in all three types of barrier but the time of application and sealing procedure varies so it is important that the Inspector is aware of the provisions for the particular type of barrier and the particular project.

911 RIGHT-OF-WAY MARKERS

Right-of-way markers consists of the furnishing by the Contractor of all materials, except the brass caps, and installing right-of-way markers and reference markers in conformance with the Plans, applicable statues, and procedures per the minimum standards for boundary surveys set forth by the Arizona Board of Technical Registration.

Considerable care should be taken in setting right-of-way markers and survey monuments, as they become permanent control points for future survey work.

Right-of-way markers are set in cast-in-place concrete. The Department will furnish the brass caps for the markers and after completion of the monument the Contractor will establish the survey point on the marker.

The reference markers are painted, lettered, and installed as shown on the plans or as directed.

Normally, the engineer will furnish the Contractor with a list of required information to be painted on the reference markers. The stations should be determined and established by the Contractor as soon as possible.

The same precautions mentioned in Section 909 for survey monuments should be observed when staking for right-of-way monuments.

912 SHOTCRETE

Shotcrete is a pneumatically placed concrete mix that is also commonly called "gunite".

Shotcrete is a very useful and versatile method of paving flat slabs, vertical walls, and the entire gamut of slopes and shapes between. It is especially suited for constructing warped surfaces around structures. It has been used to construct inlets and outlets to culverts for the purpose of improving the efficiency of the structures. It may also be used successfully to preserve and protect or to enhance the appearance of a concrete wall or other structure providing the concrete is firm and reasonably sound. Construction costs, particularly on curved surfaces, are reduced because complex forms are not normally required. The equipment used is mobile and therefore usable in areas where it might be difficult to operate other types of equipment.

912-3 Construction Requirements

Slopes that are to be gunited are best constructed by overbuilding. That is, fill and compact past the limits of the slope grading, then trim back to the desired grade. The exposed surface must be kept moist to reduce sloughing during construction operations.

The subgrade must be finished accurately to aid in maintaining uniformity in thickness. The subgrade must be damp but not wet in order to avoid having water drawn out of the shotcrete. The areas upon which shotcrete is to be placed are to be checked to see that they have been properly graded and compacted and that joints, wire mesh, side forms, and weep holes have been provided where required.

Welded wire fabric is usually specified for reinforcement. It will be designated in the following manner; 6 x 6 - W1.4 x W1.4 (152 x 152 - MW 9.1 x MW 9.1) which means a 6-inch (152 mm) longitudinal by 6-inch (152 mm) transverse wire spacing using wires having a nominal diameter of 0.134-inch (3.4 mm) and a cross-sectional area of 0.014 in.^{2} (9.08 mm^2).

Specifications for wire fabric are to be found in AASHTO M55.

Wire mesh reinforcement must be held in its planned location and adequately supported to prevent appreciable, permanent deflection under the impact of the mortar. Dependence on proper positioning of the wire mesh by pulling it up through the fresh mortar should not be permitted because too often the mesh remains on the subgrade, in which case the reinforcement is ineffective and is subject to rusting.

The success of shotcrete construction depends on having proper equipment, a satisfactory mix, and an experienced operator on the nozzle. An experienced nozzleman can get the best results with the least amount of rebound and filling in of low areas. Uniform pressures are necessary at the mixing tank, on the waterline and at the nozzle. Leaky lines or too long a nozzle line can have adverse effects on the pressure system. Where feasible, the equipment should be moved along the work rather than to use long hoses.

Rebound material may not be reused. The thickness shall be checked frequently. The placing of gauging wires aids in obtaining a uniform thickness and true surface.

Precaution is necessary to see that shotcrete is never subjected to hydrostatic pressure on the underside or backside. Paved slopes should have a cut-off wall at the top so that surface water can be diverted away from the paved slope where feasible. Weep holes, properly placed and spaced, with the proper filter material, are helpful in avoiding failure from hydrostatic pressure.

912-3.06 Quality Control Testing

All materials used to manufacture shotcrete shall be sampled and tested as prescribed for use in concrete.

The specification gives detailed requirements for making shotcrete test specimens. It is important to note that the test method calls for coring a test panel. The test panel is made by shooting the shotcrete onto a flat surface, then trimming the edges back to make the correct sized panel. Cylinders are not used with shotcrete.

912-3.09 Curing

Curing has been neglected in some cases because it was thought that curing was not necessary since the shotcrete does not carry a load and does not need strength. Curing is necessary for the prevention of cracks and to assure a hard, weatherproof surface.

Curing should be performed by one or more of the methods prescribed in the specifications. If the liquid membrane method is used, the Inspector should assure himself that the required amount of material is being used. Due to the normally rough surface texture of shotcrete, it will be necessary to use a heavier application of curing material than that prescribed by the specifications in order to obtain complete coverage of the rough textured surface.

Due to the tendency of the compound to leave extra material on the side of the irregularities opposite the nozzle of the applicator, the second application should be applied from the opposite direction from the first application where feasible.

912-6 Records

The Inspector should record the square yards of area covered with shotcrete in his/her diary each day with the following information; mix design code, type of equipment, length and size of hose, pressures, being utilized. Additional information such as operational problems affecting the quality of the work, any shutdowns, reasons for shutdowns, such as breakdown of equipment, lack of material, insufficient grade, or other reasons should also be noted.

The record must also show that the shotcrete being used meets the applicable specifications. A mix design is to be furnished by the Contractor and verification is needed that the designed mix is being produced.

Temperature records are to be kept, especially when temperatures are close to the specification limits. Whenever air temperatures reach 50 degrees F (10 degrees C), it is necessary to be alert to the possible need for a shut down of the work and/or protective action.

A record of the application rate of curing compound should be kept.

913 BANK PROTECTION

The area designed to receive bank protection should be studied to see that the design is proper and adequate to meet field conditions. One area of scrutiny should be the direction of flow. Water should be directed toward the center of the streambed in order to avoid losses of property or structures downstream. Do not hesitate to recommend extension or modification of the riprap if there is doubt concerning the adequacy of the plans design.

Riprap will be one of the types specified on the plan, and described in Specification 913 and in the standard drawings. Often the size of riprap is designated as D_{50}, which means the effective size of rock would be 50% on the grain size curve. In other words, D_{50} is the median size of rock in a mix where 50% of the material, by weight, is finer particles. The purpose of riprap is to prevent erosion, so considerable care should be taken for proper placement of each section.

While riprap is designed and built to perform a very important function, the Resident Engineer should not lose sight of the need to make each installation pleasing to the eye. The cross section should be uniform and the lines and grades should be in reasonably close conformity with the standard drawings.

The Construction Standard Drawing (C-17.10, C-17.15 and C-17.20) depict 9 different types of rail bank protection. Types 1 through 6 are all similar in design. The major difference is the length and spacing of the rails. Types 4, 5 and 6 are specifically designed to protect banks at bridge abutments.

When constructing types 1 through 6, rails should be driven as specified in the standard drawings. Wire mesh should be securely fastened to the rails, placed in the trenches and laid on the slopes. The wire mesh must entirely enclose the rock backfill. The rock backfill should then be placed so as not to disturb or displace the mesh or rails. The completed rock fill should be to the lines and grades specified and should be pleasing in appearance.

Type 7 and 8 are similar in design and are usually used for directing flow of water to a bridge. Type 9 is used to cause deceleration of the stream and deposition of aggregate particles principally behind the bank protection.

It should be noted, riprap and bank protection designs provide for the rock, etc., to be placed below the stream level. This portion of the design is crucial since most failures in riprap occur as a result of storm water undercutting the rock protection which leads to eventual collapse.

Special care should be exercised to construct all types of protection at the proper stream elevation. Inspections downstream should be made for possible problems which could later contribute to scour or silting conditions. If problems are evident, a check with the Drainage Design Services is advisable before plans grades are changed.

The specifications say the rock shall be sound and durable which leaves a broad area subject to personal interpretation. It is advisable to have the District and, if needed, the Materials Section inspect rock sources proposed by the Contractor. This inspection should be arranged for as soon as possible so that any testing or prospecting will not cause undue delay or expense.

It is important to maintain a uniform grading of dumped rock riprap. The uniform grading is necessary to assure proper filling of the voids in the riprap. Properly filled voids will lend stability by keying the mass and to protect the underlying filter material.

It is also important that filter fabric be installed properly. Holes in the fabric will permit fine particles in the bank to erode and pass through the riprap. The protect structure can fail as the bank erodes away even if the riprap remains intact. A layer of bedding material is required to protect the fabric when the maximum rock size is

greater than 18 inches (450 millimeters). Normal design gradations with D_{50} greater than 8 inches (200 millimeter) will require a layer of bedding material to protect the fabric.

The specifications call for two 5 ton (4.5 metric ton) samples of the graded rock to be used in judging the acceptability of gradation. Frequent reference to the sample rock pile will help to maintain uniform grading. Uniformity of grading is especially important in untied or ungrouted riprap. These types of riprap need good distribution of the coarse and fine rocks to provide interlock and keying which gives the riprap enough rigidity to resist erosion.

The grout specification states that retempering will not be permitted. Retempering is defined as adding water to grout to restore workability.

915 TEMPORARY SILT FENCE

The temporary silt fence should be installed in accordance with the plans and Special Provisions after being reviewed by the Resident Engineer with the Inspectors. The Inspector should know the type of materials used when constructing a temporary silt fence. Some silt fence geotextile fabric will deteriorate when exposed to ultraviolet light. The standard specifications explain requirements for storage and handling of the geotextile fabric used in the silt fence.

Close inspection is required to insure that construction requirements are meet. The geotextile fabric at the bottom of the fence must be buried to an appropriate depth in accordance with the plans and specifications. The appropriate depth will keep flow from passing underneath the fence. The posts, wire supports, and fabric post attachments must be in accordance with the plans or special provisions. Any geotextile fabric that is flawed such as a hole, rip, etc. will be rejected by the Inspector.

Guidelines For Inspecting Chain Link Fence:

1. Do the materials conform to the plans and specifications, and are the materials certifications available for those items requiring them?

2. Is the geotextile buried at the bottom of the fence buried to the correct depth?

3. Are posts spaced at the proper intervals and depths?

4. Is the geotextile fabric fastened with the proper attachments in the proper locations?

5. Is the wire fence support used, and placed properly?

6. Will the temporary silt fence be able to handle stress from sediment loading?

916 EMBANKMENT CURB

Embankment curb is constructed of concrete, as shown on the plans and the standard drawings. Its purpose is to contain the run-off water from the pavement surface so that it may be removed from the roadway at selected locations by means of spillways or down-drains.

Every effort should be made to place embankment curb to true lines and grades without humps and sags and to produce a mixture which will require little or no hand finishing.

The most common method of concrete embankment curb construction is by use of the slip form. Curbs however, may be constructed by the use of conventional forms.

The concrete specifications have been modified to fit the special conditions found in embankment curb construction. Standard Specification 916 contains the detailed requirements for concrete used in embankment curb.

Some curb extrusion machines cause trouble with slumping, tearing, irregularities, or other unacceptable results. Usually the machine can be adjusted or modified, or the concrete mix can be adjusted, but sometimes it will be necessary to prohibit use of the machine.

917 EMBANKMENT SPILLWAYS, DOWN-DRAINS, INLETS, AND OUTLETS

Spillways or down-drains for carrying the water collected by the curb from the roadway surface will be constructed at the locations shown on the plans or as directed and in accordance with the Standard Drawings (C-04.10 through C-04.50) and the Standard Specifications. These types of down-drains must be practically waterproof to prevent erosion of the fill. Consequently, if there is any suspicion that it is not waterproof, a test should be made by pouring water through the inlet to test for leakage. If leakage occurs, the point or points of leakage should be patched with hotpoured, or cold-application joint sealant (Subsection 1011-4) as directed by the Resident Engineer.

It is important that drains are carefully located to assure there will be no standing water on the roadway. Standing water can be a traffic hazard or may damage the roadway by seeping into the base and subgrade.

922 UTILITY CONCRETE FOR MISCELLANEOUS CONSTRUCTION

Utility concrete is used when high strength is not needed and small quantities are used at one time so that elaborate testing and inspection are not justified.

Specifications for materials are the same as for other types of concrete found in Section 1006. The minimum cement content is 470 pounds per cubic yard (279 kilograms per cubic meter). The discussion on concrete in Section 1006 should be read for guidance in judging whether the Contractor's materials and methods will be satisfactory. Section 1006 should not be considered to be setting out requirements but only as a guide to assist in recognizing areas where problems may develop.

If approved by the Engineer, the Contractor may substitute commercially available sacks of redi-mix concrete, suitable for the intended purpose. Should such substitution be approved, the cement specified herein and the requirements of Subsection 922-2 shall not apply.

Although minimal inspection is required, it is necessary to look at the Contractor's batching and mixing equipment and procedures. If the Contractor's methods are not acceptable, notify them in writing. The Resident Engineer will need to use firmness and ingenuity in dealing with the Contractor under the concept of "recognized practice".

The Contractor has to furnish an acceptable product and choose the slump range and aggregate size. However, the Resident Engineer is required to review and approve the proposed mix prior to its incorporation into the work.

Although the Contractor chooses the aggregate size, the grading must conform to AASHTO M43. Mixing can be done manually at the job site as well as plant or truck mixing as long as the Resident Engineer approves. A great amount of leeway also exists in the method used to proportion the materials; again, only the Resident Engineer’s approval is needed.

When reviewing the Contractor's mix proposal, a rule of thumb guide for aggregate having a fineness modulus of from 2.60 to 2.90, is; when 1 to 1-1/2 inch (25.4 to 38.1 mm) aggregate is used, the fine aggregate should be 40 to 45% of the combined fine and coarse aggregates. The total water needed to provide a 3 inch (76.2 mm) slump will be about 7 gallons (26.6 liters) per sack of cement.

925 CONSTRUCTION SURVEYING AND LAYOUT

Contractor Survey

On those projects that are so designated, the Contractor will be responsible for providing construction surveying. This will require competent personnel to perform survey calculations and necessary field documentation such as field books, cross section books, and earthwork quantities. The Resident Engineer should insure that this work is performed under the direction of a Registered Professional Engineer/Surveyor employed by the Contractor.

The Department will provide either traverse or control points for establishing an accurate construction centerline and will establish bench marks adjacent to this line for the proper layout of the work as described herein. Control points will be located on centerline at the beginning and ending of the project, and at all points of curve (P.C.), points of tangent (P.T.), tangents to spiral (T.S.), spirals to tangent (S.T.), and angle points. On long tangents, additional points will be provided for continuity of line.

Traverse points, when provided, will be as follows:

For horizontal control, the Department will run a traverse from which construction centerline can be established. The control points, delineated by iron pins, marks in concrete, or similar devices, will be located to minimize the likelihood of their destruction during construction activities. Coordinates of these points and/or ties to construction centerline will be provided.

For vertical control, the Department will establish bench marks the entire length of the project at horizontal intervals not to exceed 2,500 feet (760 meters).

These control points will be properly referenced and their location documented for future reference. The Contractor should then be provided with this information and physically shown their locations. At this time, the Contractor should be made aware that it is their responsibility to preserve these points for the duration of the project.

It shall be the responsibility of the surveyor to provide evidence necessary to define the existing and/or proposed right-of-way within the project corridor. The surveyor shall determine the extent of field boundary surveys required. The surveys shall conform to Department procedures and to standards set forth in the *Minimum Standards for Arizona Land Boundary Surveys*, as adopted by the Arizona State Board of Technical Registration. Applicable statutes and regulations are to be observed in addition to these standards. Attachment IX-1, *Right-of-Way Surveys* shall be used by the surveyor as a guide in establishing right-of-way monumentation.

Copies of recorded Results of Survey, Record of Survey, Corner Records, documents, maps and plats shall be submitted to the Engineer within ten (10) working days after recordation at the Office of the County Recorder. Copies of all field notes, computation sheets and calculations that relate to the boundary surveys shall also be submitted to the Engineer within this time frame.

Before beginning any construction, the Contractor must submit an outline detailing all survey activities for the project and the sequencing of these events. Section 1150.00, Contractor Construction Surveying, of this Construction Manual should have been used by the Contractor in preparing the outline. The Resident Engineer should thoroughly review this plan to insure that it is realistic, provides the scope of work that is required, and can be monitored by project personnel.

When the survey plan is approved, the Contractor should then check the accuracy of the control work established by the Department, to their satisfaction.

Once construction begins, the Resident Engineer should assign a survey supervisor to monitor the activities and documentation of the Contractor's survey personnel. Conflicts can easily be resolved if there is cooperation between the Contractor and ADOT personnel in this area. The monitor should not actively get too involved with this work, but should be aware of the various survey activities and be available for consultation if the Contractor requests it. The monitor should also be checking for suspected problem areas or deficiencies in the operations. If there are serious survey problems and inconsistencies, the Resident Engineer should be made aware of them, and actions taken to correct them. Serious problems may require restaking at the Contractor's expense.

926 - 927 ENGINEER'S FIELD OFFICE AND FIELD LABORATORY

When the plans or special provisions require it, the Contractor may be responsible for furnishing adequate facilities for the Resident Engineer to use as a construction field office and a field laboratory. The Standard Specifications or Special Provisions will contain a list of what services and facilities are included in this requirement.

The Resident Engineer will designate the location of the field offices and the Contractor will provide and maintain all utilities necessary to make this office fully functional prior to commencing any work activities.

The Resident Engineer should insure that all required permits are obtained by the Contractor and that provisions have been made to keep the facilities fully functional for the duration of construction activities.

928 RUMBLE STRIP

Rumble strips are indentations in the surface of a pavement which serve the purpose of alerting a driver that they are leaving or drifting away from the designated driving lane. They are usually placed on both the inside and outside shoulders of high speed divided highways.

It is important that Inspectors who are assigned to this portion of the work assure that the equipment used to construct the strips is adequate and conforms to the specifications. This equipment should be equipped with an approved guide easily visible by the operator. The right type of equipment allows the Contractor the capability of providing the required alignment and uniformity.

REFERENCES

Standard Specifications for Road and Bridge Construction, Arizona Department of Transportation, Phoenix, AZ

Materials Policy and Procedure Directives Manual, Current, Arizona Department of Transportation, Phoenix, AZ

Materials Testing Manual, Current, Arizona Department of Transportation, Phoenix, AZ

Pay Item Documentation for Inspectors, Arizona Department of Transportation, Phoenix, AZ

Metrication Guidelines, Arizona Department of Transportation, Phoenix, AZ

Construction Standard Drawings, Arizona Department of Transportation, Phoenix, AZ

ATTACHMENTS

List of Attachments:

Description	Corresponding Exhibits
ADOT Right-of-Way Surveys	None
Minimum Standards for Arizona Land Boundary Surveys	None
Classifications of ALTA-ACSM Land Title Surveys	None

ADOT Right-of-Way Surveys

The following procedures shall be performed for the preparation of Right-of-Way plans to be used for the acquisition of properties for ADOT Right-of-Way. These procedures are only required for perpetual property rights and interests and shall not be required for temporary construction easements.

Research

Pertinent record documents shall be obtained and researched. Document research for right-of-way survey starts at ADOT Records to obtain Right-of-Way plans, deeds of acquisition and as-built plans for the corridor to be surveyed. Subdivision plats, Result of Survey plats and deeds shall be acquired from the County Recorder's Office. Title reports will also be provided. Inquiries shall be made at municipal offices, utility company offices and other agencies for documentation of properties and/ or evidence to support the definition of properties in the corridor. Applicable Public Land System plats and notes shall be obtained from the Bureau of Land Management Office. Seek information from local surveyors whenever possible. Obtain parol evidence when necessary.

Right-of-Way Field Survey

Right-of-Way surveys for highway purposes are surveys of the existing or proposed right-of-way and the properties adjacent to the right-of-way. The construction of new highways will necessitate the acquisition of parts of these properties, resulting in severing existing property lines and destroying existing monuments. These procedures are intended to outline methods to perpetuate these monuments and to monument the proposed new right-of-way lines. In this process, plans will be produced to document the existing conditions prior to acquisition and to fully define the new right-of-way line and its relationship to the Public Land System.

A field survey shall be performed. The survey shall conform to ADOT procedures and standards set forth in the *Minimum Standards for Arizona Land Boundary Surveys*, as adopted by the State Board of Technical Registration that is in effect at the time the surveys are performed. Applicable statutes and regulations are to be observed in addition to these standards. Adhere to the statutes and procedures concerning entering properties and access to properties.

Right of way surveys shall be to the extent necessary to substantiate right-of-way acquisition and documentation of existing right-of-way. This policy is not intended to limit the area the surveyor must survey to establish the right-of-way. If the surveyor is unable to support the right-of-way documentation in the immediate area of the acquisition parcels, the survey must be extended to the limits necessary to recover sufficient evidence to support the right-of-way documentation for the project.

The field survey shall consist of the location of Section Corners, Quarter Corners including the Center of Section (Center Quarter Corner), and other monuments set by the Survey of the Public Lands, when applicable. Obliterated corners shall be identified, re-established, and re-monumented. Corners deemed to be "lost" shall be identified, re-established, and re-monumented as specified in the *Manual of Instructions for the Survey of the Public Lands of the United States* in force at the time of the Original Survey. The field survey shall make a reasonable attempt to find any existing corner monumentation relevant to any private property parcels; highway, canal, and railroad right-of-way monuments; as well as major and minor street centerline monumentation that are determined to be impacted by ADOT Right-of-Way

acquisition. If no monumentation is found during the field survey search, note on results of survey "not found". Existing Highway Right-of-Way, Survey, and As-Built Centerline Monumentation for the Project shall be tied to the Survey. Corners of Platted and Unplatted Subdivisions shall be tied if it can be determined that the subdivision will be impacted by new Right-of-Way acquisition.

Records

A Results of Survey Drawing shall be produced and will be utilized to develop Right-of-Way Plans. The Results of Survey will be included in the right-of-way plans set for the project. All subsequent Supplemental Results of Surveys performed for the preparation or revision of the right-of-way plans including the supplemental survey to document the documentation of the right-of-way will become a part of the Right-of-Way Plans set. These records will be archived in the right-of-way plans files and an electronic copy will be archived with ADOT TIR CADD Services and right-of-way plans shall maintain indexes for retrieval.

Defining Right-of-Way

It shall be the responsibility of the surveyor to provide evidence necessary to define the existing and/or proposed right-of-way within the project corridor. The surveyor shall use all evidence found in the field in conjunction with the existing documentation to define the project right-of-way. Sound professional judgement must be used in determination of the right-of-way. In the process of defining the right-of-way some of the field evidence may be rejected. The results of survey drawing will show all evidence collected, and indicate the reason or reasons for any evidence that may have been rejected by the surveyor.

It should be noted that the primary factor for determining existing right-of-way is documents calling for a centerline (construction, survey or right-of-way) strip description. The method used to reestablish the documented right-of-way shall be to reconstruct this centerline based upon the field evidence and record data. The documented right-of-way widths and courses can then be properly defined.

Right-of-Way Monuments

In accordance with the project's schedule as determined by the Department, Right-of-Way shall be monumented. Locations of monuments shall include intersections of Right-of-Way with section lines and recorded subdivision boundaries. Right-of-Way shall also be monumented at angle points, and at beginning and ending of curves. Monuments shall conform to standards set forth in *Minimum Standards for Arizona Land Boundary Surveys*. The monuments shall be stamped with the land surveyor's registration number.

Supplemental results of survey will be produced after the monumentation process to document all right-of-way monuments or reference monuments set, including documentation of what type monuments were set and how they are stamped.

Standard ADOT Right-of-Way Markers

Upon notification from the Department, the surveyor shall set ADOT Right-of-Way markers (Standard Drawing C-21.10, C-21.20). Right-of-Way markers and alignments will be tied to the Survey.

Right-of-Way markers, (ADOT Standard Drawings C-21.10, C-21.20) not set during the acquisition process, shall be placed along Right-of-Way lines prior to, during or subsequent to roadway construction, depending upon project's requirements. The land surveyor that performed the Right-of-Way acquisition survey shall set these markers. If this is not possible, another contracted consultant professional registered surveyor or Department professional registered surveyor shall set the markers in compliance with the *Minimum Standards for Arizona Land Boundary Surveys*. Revisions to Right-of-Way alignment during the construction process shall be staked in a similar manner.

Adjacent to all monuments; where practical, a standard Department guard stake will be set. If it creates a hazard or safety problem those guard stakes will be deleted, and so noted in the monument documentation. The standard guardstake will be a 5-foot (1.5 meter) tall steel fence post with a 5-inch by 9-inch (125 mm by 225 mm) aluminum sign attached to it. See Exhibit A

Exhibit A

Monument Location

A monument will be set at the following positions for the purpose of monumenting the Department's right-of-way:

- All angle points along the right-of-way lines.
- Points left and right of points defining the alignment. In most cases the alignment will be the centerline of construction. Points defining the alignment are: angle points, curve control points, and station equations.
- Intervisible points, and/or points to render a maximum of 1000 feet (300 meters) between monuments.
- Points left and right of the Beginning of Project and End of Project.
- Points along section lines and recorded subdivision boundaries which intersect the right-of-way lines.
- It should be noted that sometimes a road or highway will be monumented on the centerline; especially when highways or roads follow sectional lines, or they are smaller or less traveled, or in urbanized areas.

Datum Specification

Unless otherwise specified by the Department, the following shall apply: the basis of coordinates for the Survey shall be the North American Datum (NAD) 1983/92 definition, or any subsequent update approved by the National Geodetic Survey Office, and codified in Arizona Revised Statutes. Coordinates shall be Arizona State Plane Coordinates with the proper zone identified (East, Central, West); bearings shall be grid bearings; the project Grid Adjustment Factor shall be applied to provide ground coordinates. The Results of Survey shall clearly state the basis of coordinates, list any ADOT or NGS Control Points used to control the Survey, the Grid Adjustment Factor used, and any other adjustments made to the survey. This information shall be included in the Right-of-Way plans and the results of survey in the form of a standard datum note.

Datum Note:

Coordinates are NAD 83/92 Modified Arizona State Plane Coordinates, _____ Zone, using a Grid Adjustment Factor of 1._____, these coordinates can be utilized as ground datum. To convert back to grid coordinates divide these values by 1._____.

Recordation of Data

The Department will receive and retain a copy of all field notes, computation sheets, calculations and pertinent documents that relate to the surveys.

Arizona State Board of Technical Registration
Minimum Standards For Arizona Land Boundary Surveys

The following statements of standards for surveying practice are promulgated as minimum standards governing the creation, establishment, retracement or resurvey of land boundaries within the State of Arizona. Applicable statutes and regulations are to be observed in addition to these minimum standards of practice.

Responsibility for adherence to the minimum standards rests with the registered land surveyor in responsible charge of the work.

Procedure

1. The land surveyor must make a diligent search for pertinent record documents. Copies of applicable deeds, maps, title report or title opinions may be necessary. If the subject property is referenced to or described as an aliquot part of the U. S. Public Land Survey System, or a fraction thereof, relevant U. S. Government plats, field notes, appropriate Manual of Surveying Instructions and special instructions should additionally be consulted, when appropriate.

2. The land surveyor must thoroughly examine the information and data acquired.

3. The land surveyor must diligently search for and identify monuments and other physical evidence which could affect the location of the subject property's boundaries. A reasonable attempt must be made to recover controlling monuments for references thereto. The positions of controlling monuments which have been obliterated should be recovered or reestablished using the best available evidence. Physical evidence of apparent use and possible rights in the subject property by others should be evaluated. Lines of possession and occupation must be located, described, and where practical, an age determination made.

4. The land surveyor must conduct field measurements necessary to adequately relate the position of all apparent evidence pertinent to the boundaries of the property. All findings resulting from the field investigation must be accurately and completely recorded and retained permanently.

5. The land surveyor must make computations to verify the correctness of field data acquired and to confirm that measurements results are within acceptable tolerance limitations. Computations must be made to determine the relative positions of all found evidence.

6. In the event of a material discrepancy or a disagreement with the measurements or monumented corner positions of another surveyor, the land surveyor must make a reasonable attempt to contact the other land surveyor and attempt to resolve the disagreement.

7. The land surveyor should make an analysis, reach a final conclusion and set monuments so as to represent the location consistent with the best evidence available of corner positions and boundary lines. The land surveyor must advise the client of discrepancies which raise doubts concerning the boundary lines of the subject property and if requested the land surveyor should provide the client with a copy of the survey report.

8. All monuments, whether set or found, must be described and specifically identified as set or found, whenever shown on maps or referred to in documents prepared by the land surveyor. Descriptions of monuments must be sufficient in detail to readily facilitate future recovery and

to enable positive identification, including map references. Monuments required by this section shall be metal, magnetically detectable, not less than one-half inch in diameter, not less than sixteen inches in length, and shall bear the land surveyor's registration number affixed, except however, the monument for a corner which falls upon solid rock or concrete shall be metal, magnetically detectable, firmly embedded, and stamped with the land surveyor's registration number.

9. The land surveyor shall prepare a scaled drawing of the results of survey for presentation to the client unless adequate existing information is available. In cases where a certification is required by state or local ordinance, the land surveyor must certify only those matters personally known to be absolutely true and must declare all other items only to the limit of the land surveyor's knowledge and belief.

10. The land surveyor must prepare and cause to be recorded corner records and record of survey documents if a material discrepancy exists in angular and/ or lineal calls as compared with new survey values as defined under Measurements Specifications Table 2 of these standards of practice.

Legal Descriptions

When a land surveyor is called upon to prepare a legal description of real property, the land surveyor must include the following:

1. Sufficient caption, body, and where applicable, qualifying clauses.

2. Clearly stated relationship between the real property being described and the survey control or basis of unique location.

3. Clearly stated basis of bearing bearings or language which otherwise makes definite the method of direction and orientation for the lines of the subject property being described and the survey control related thereto when applicable.

4. Full and complete citations to maps, plats, documents, and other matters of record, fact or pertinence, which are intended to be incorporated into and made part of the legal description by reference thereto.

5. When called out, complete and detailed descriptions of physical monuments, both natural and artificial, such as to facilitate future recovery and to enable positive identification.

6. When appropriate, incorporated either by direct or by citation, sufficient data to enable a check of mathematical closure for the subject property being described.

7. The land surveyor's validated Arizona seal.

Measurement Specifications

Measurements for the performance of land surveys as defined in A. R. S. 32-101(B)(19)(a)(b) & (c) Land Surveying Practice shall comply with the following required.

1. In order to properly apply the specifications herein to achieve the required accuracy the land surveyor must first classify the survey relative to the "Class of Survey" listed in Table 1. The

land surveyor shall then apply at least the minimum specifications as listed in the appropriate column in Table 2. An error of measurement which is less than 0.03 feet between sequential monuments shall not by itself constitute a material discrepancy in any class of survey.

2. The significance of a discrepancy between the angular and lineal calls of record versus that resulting from the use of these specifications may only be determined from an analysis predicated on the law of random error propagation. If a material discrepancy is found to exist, appropriate action as outlined in these standards of practice shall be applied by the land surveyor.

Table No. 1

Class A. Urban Surveys:

Surveys of land lying within or adjoining a city or town. This would also include the surveys of commercial and industrial properties, condominiums, townhouses, apartments and other multi-unit developments, regardless of geographic location.

Class B. Suburban Surveys:

Surveys of land lying outside of urban areas. This land is used almost exclusively for single family residential use or residential subdivisions.

Class C. Rural Surveys:

Surveys of land such as farms and other undeveloped land outside the suburban areas which may have a potential for future development.

Class D. Mountain and Marshland Surveys:

Surveys of land which normally lies in remote areas with difficult terrain and which usually has limited potential for development.

Tables 1 and 2 Extracted from the current *Minimum Standard Detail Requirements for ALTA/ACSM Land Title Surveys* as adopted by American Land Title Association and American Congress on Surveying & Mapping".

Classifications of ALTA-ACSM Land Title Surveys

Introduction

The degree of precision and accuracy necessary for a particular cadastral survey should be based on the intended use of the land without regard to its present use, provided the surveyor has knowledge of the intended use. If the surveyor has no such knowledge, the degree of precision may be based on the present use of the land.

Four general survey classes are defined using various state regulations and accepted practices. These general classes are listed and defined below.

Survey Classes by Land Use

Urban Surveys:

Surveys of land lying within or adjoining a city or town. This would also include the surveys of commercial and industrial properties, condominiums, townhouses, apartments and other multi-unit developments, regardless of geographic location.

Suburban Surveys:

Surveys of land lying outside of urban areas. This land is used almost exclusively for single family residential use or residential subdivisions.

Rural Surveys:

Surveys of land such as farms and other undeveloped land outside the suburban areas which may have a potential for future development.

Mountain and Marshland Surveys:

Surveys of land which normally lies in remote areas with difficult terrain and which usually has limited potential for development.

Should these above cited specifications be in conflict with state laws, rules or regulations, the more stringent requirements must be followed.

The combined precision of a survey can be statistically assured by dictating a combination of survey closure and specified procedures for a particular survey class. ACSM and ALTA have adopted specific procedures for control surveys in order to assure the combined precision of a particular survey class. The statistical base for these specifications is on file at ACSM and is available for inspection. The surveyor shall employ, in his or her judgment, proper field procedures, instrumentation and adequate survey personnel in order to achieve accuracy's comparable to those adopted by ACSM for a designated class of survey.

American Congress on Surveying and Mapping
Minimum Angle, Distance and Closure Requirements for Classes of Surveys

SURVEY CLASS (1)	DIR. READING OF INSTRUMENT (2)	INSTRUMENT READING ESTIMATED (3)	NUMBER OF OBSER-VATION PER STATION (4)	SPREAD FROM MEAN OF D&R NOT TO EXCEED (5)	ANGLE CLOSURE WHEN N=NO. OF STATIONS NOT TO EXCEED	LINEAR CLOSURE (6)	DISTANCE MEASURE-MENT (7)	MINIMUM LENGTH OF MEASURE-MENT (8).(9),(10)
URBAN	20”<1> 10” E	5”<0.1’>N.A.	2D&R	5”<0.1’ >5” E	10”x square root N	1:15,000	EDM or Doubletape with steel tape	(8) 81m, (9) 153m (10) 20m
SUBURBAN	20”<1’> 10” E	10”<0.1’ N.A.	2 D&R	10”<0.2’>10” E	15” x square root N	1:10,000	EDM or steel tape	(8) 54m, (9) 102m (10)14m
RURAL	20”M<1’>20”E	N.A.	1D&R	20”M<0.3’>20” E	20” x square root N	1:7,500	EDM or steel tape	(8) 40m, (9) 76m (10)10m
MOUNTAIN/ MARSHLAND	1’ M<1’>1’ E	N.A.	1D&R	30”M<0.5’>30” E	30” x square root N	1:5,000	EDM or steel tape	(8) 27m, (9)51m (10)7m

Note (1) All requirements of each class must be satisfied in order to qualify for that particular class of survey. The use of a more precise instrument does not change the other requirements, such as number of angles turned, etc.

Note (2) Instrument must have a direct reading of at least the amount specified (not an estimated reading), i.e.: 10”=Micrometer reading theodolite, <1’> = scale reading theodolite, E=electronic reading theodolite, M=micrometer reading theodolite, or a vernier reading transit.

Note (3) Instrument must have the capability of allowing an estimated reading below the direct reading to the specified reading.

Note (4) D&R means direct and reverse positions of the instrument telescope, i.e., Urban Surveys require that two angles in the direct and two angles in the reverse position be measured and meaned.

Note (5) Any angle measured that exceeds the specified amount from the mean must be rejected and the set of angles re-measured.

Note (6) Ratio of closure after angles are balanced and closure calculated.

Note (7) All distance measurements must be made with a properly calibrated EDM or Steel tape, applying atmospheric, temperature, sag, tension, slope, scale factor and sea level corrections as necessary.

Note (8) EDM having an error of 5mm, independent of distance measured (Manufacturer’s specifications)

Note (9) EDM having an error of 10mm, independent of distance measured (Manufacturer’s specifications)

Note (10) Calibrated steel tape.