CHAPTER 6

PRELIMINARY SURVEYS

LIST OF FIGURES

WORKFLOW

Department of Transportation construction projects are scoped prior to beginning survey operations. The purpose of scoping each project is to define the limits of construction and assess any additional survey needs. The members of the scoping team should include the Engineering Supervisor from the Office of Road Design, the project design engineer, the Bridge Hydraulics Engineer, the Engineering Supervisor from the Office of Bridge Design if a structure is involved, the Area Engineer, and the Region Engineer. It is recommended that the Maintenance Supervisor be invited to attend.

The Engineering Supervisor from the area office will be responsible for recording progress in the C2C program and provide monthly progress reports to the Office of Road Design so that a clear understanding as to the work that has been completed can be ascertained.

Initiation of Field Survey

The time established for the beginning and completion of field surveys is set by C2C or by direction from the Regional Engineer.

Completion of Field Survey

Upon completion of the field survey, the following survey notes and files are to be stored within the project folder within the appropriate Region folder on the U drive.

a. MicroStation design file (.dgn)

b. InRoads Survey digital terrain model (.dtm)

c. InRoads Survey geometry file (.alg)

d. InRoads Survey fieldbook file (.fwd)

e. Original bench and control level notes and check level notes

f. All original unedited data collector job files used for project data collection

g. Comma-separated value files (.csv) exported from each unedited data collector job file

SDDOT Surveying Symbols

DESCRIPTION	CODE	SYMBOL
ANCHOR	ANCHOR/AN	
ANTENNA	ANTENA	
APPROACH	APPR	
ASSUMED CORNER	ACORN	
AZIMUTH MARKER	AZIMKR	
BBQ GRILL/ FIREPLACE	BGRILL	
BEARING TREE	BTREE	
BENCH MARK	BNCHMK	
BOX CULVERT	BOXCUL	
BREAKLINE	BL	
BRIDGE	BRIDGE	
BRUSH	BRUSH	
BUILDINGS	BUILDS	
BULK TANK	BULKTK	
CALCULATED CORNER	CCORN	
CATTLE GUARD	CATGRD	
CEMETERY	CEMTRY	
CENTERLINE	CL	
CISTERN	CISTRN	
CLOTHES LINE	CLOSLN	
COMMERCIAL SIGN DOUBLE FACE	CMSNDF	
COMMERCIAL SIGN ONE POST	CMSNOP	
COMMERCIAL SIGN OVERHEAD	CMSNOH	
COMMERCIAL SIGN TWO POST	CMSNTP	
CONCRETE SYMBOL	CONC	
CREEK EDGE	CREEK	
CURB/GUTTER LEFT	CGL	
CURB/GUTTER RIGHT	CGR	
CURB LEFT	CURBL	
CURB RIGHT	CURBR	
DAM GRADE/DIKE/LEVEE	DAM	
DECK EDGE	DECK	
DITCH BLOCK	DTCHBK	
DOORWAY THRESHOLD	DRTHHD	
DRAINAGE PROFILE	DRNAGE	
DROP INLET	DROPIN	
DROP INLET PIPE WITHOUT FLARE	PIPEDO	

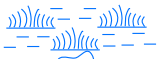
SDDOT Surveying Symbols

DESCRIPTION	CODE	SYMBOL
DROP INLET PIPE WITH FLARE	PIPEDF	
EDGE OF ASPHALT	EDGEAS / EA	
EDGE OF CONCRETE	EDGECN / EC	
EDGE OF GRAVEL	EDGEGR / EG	
EDGE OF OTHER	EDGEOT / EO	
EDGE OF SHOULDER	EDGESH / ES	
ELEC. TRANS./POWER JCT. BOX	ETRAN	
ENVIRONMENTAL SENSITIVE SITE	ESS	
FENCE BARBWIRE	FENCEB / FB	
FENCE CHAINLINK	FENCEC / FC	
FENCE ELECTRIC	FENCEE / FE	
FENCE MISC.	FENCEM / FM	
FENCE ROCK	FENCER / FR	
FENCE SNOW	FENCES / FS	
FENCE WOOD	FENCEW / FW	
FENCE WOVEN	FENCEV / FV	
FIRE HYDRANT	FIRHYD	
FLAG POLE	FLAGPL	
FLOWER BED	FLWBED	
GAS VALVE OR METER	GASVLV	
GAS PUMP ISLAND	GASISL	
GRAIN BIN	GRNBIN	
GROUND SHOT	GR	
GUARDRAIL	GDRAIL	
GUIDE SIGN ONE POST	GUIDO	
GUIDE SIGN TWO POST	GUIDT	
GUTTER LEFT	GUTL	
GUTTER RIGHT	GUTR	
GUY POLE	GYPOLE	
HAYSTACK	HAYSTK	
HEDGE	HEDGE	
HIGHWAY R.O.W. MARKER	HWYROW	
INTERSTATE CLOSE GATE LEFT	CLOSEL	
INTERSTATE CLOSE GATE RIGHT	CLOSER	
IRON PIN	IPIN	
IRRIGATION DITCH	IRRTTH	
LAKE EDGE	LAKE	

SDDOT Surveying Symbols

DESCRIPTION	CODE	SYMBOL
LAWN SPRINKLER	LWNSPK	
MAILBOX	MAILBX	
MANHOLE ECTRIC	ELECMH	
MANHOLE GAS	GASMH	
MANHOLE MISC	MISCMH	
MANHOLE SANITARY SEWER	SANMH	
MANHOLE STORM SEWER	STMH	
MANHOLE TELEPHONE	TELMH	
MANHOLE WATER	WATMH	
MERRY-GO-ROUND	MGORND	
MICROWAVE RADIO TOWER	RADTWR	
MISC.LINE	LINEMS	
MISC. PROPERTY CORNER	MPROP	
MISC. POST	POSTMS	
OVERHANG OR ENCROACHMENT	OVRHNG	
OVERHEAD UTILITY LINE	OUL	
PARKING METER	PARKMR	
PIPE WITH END SECTION	PIPEWF	
PIPE WITH HEADWALL	PIPEWH	
PIPE WITHOUT END SECTION	PIPEWO	
PIPE WITH SAFETY ENDS	PIPEWS	
PLAYGROUND SLIDE	PLAYSL	
PLAYGROUND SWING	PLAYSW	
POWER AND LIGHT POLE	POWLGT	
POWER AND TELEPHONE POLE	POWTEL	
POWER METER	POWMTR	
POWER POLE	POWERP	
POWER POLE AND TRANSFORMER	POWTRF	
POWER TOWER STRUCTURE	POWTOW	
PROPANE TANK	PROTNK	
PROPERTY PIPE	PIPE	
PROPERTY PIPE WITH CAP	PIPEWC	
PROPERTY STONE	STONE	
PUBLIC TELEPHONE	PUBTEL	
RAILROAD CROSSING SIGNAL	RRXSIG	
RAILROAD MILEPOST MARKER	RRMPST	
RAILROAD PROFILE	RRRAIL	

SDDOT Surveying Symbols

DESCRIPTION	CODE	SYMBOL
RAILROAD R.O.W. MARKER	RRROWM	
RAILROAD SIGNS	RRXING	
RAILROAD SWITCH	RRSWCH	
RAILROAD TRACK	RRTRAK	
RAILROAD TRESTLE	RRTRES	
REBAR	REBAR	
REBAR WITH CAP	BARCAP	
REFERENCE MARK	REFMRK	
REGULATORY SIGN ONE POST	REGUO	
REGULATORY SIGN TWO POST	REGUT	
RETAINING WALL	RTWALL	
RIPRAP	RIPRAP	
RIVER EDGE	RIVER	
ROCK AND WIRE BASKETS	WIRERK	
ROCKPILES	ROCKPL	
SATELLITE DISH	SATDIS	
SEPTIC TANK	SEPTIC	
SHRUB TREE	SHRUBT	
SIDEWALK	SW	
SIGN FACE	SF	
SIGN POST	SP	
SLOUGH OR MARSH	SLOUGH	
SPRING	SPRING	
STREAM GAUGE	STMGAG	
STREET MARKER	STMARK	
SUBSURFACE UTILITY EXPLORATION TEST HOLE	TSTSUE	
TELEPHONE FIBER OPTICS	TELFIB	
TELEPHONE JUNCTION BOX	TELBOX	
TELEPHONE POLE	TELPOL	
TELEVISION CABLE JCT BOX	TVBOX	
TELEVISION TOWER	TVTWER	
TEST WELLS/BORE HOLES	TSTWLL	
TRAFFIC SIGNAL	TRASIG	
TRASH BARREL	TRASHB	
TREE BELT	TREEBT	
TREE CONIFEROUS	TREECN	
TREE DECIDUOUS	TREEDC	

SDDOT Surveying Symbols

DESCRIPTION	CODE	SYMBOL
TREE STUMP	TREEST	
TRIANGULATION STATION	TRISTA	
UNDERGROUND ELECTRIC LINE	UNELEC	
UNDERGROUND GAS LINE	UNGAS	
UNDERGROUND HIGH PRESSURE GAS LINE	UNHGAS	
UNDERGROUND SANITARY SEWER	SANSEWR	
UNDERGROUND STORM SEWER	STSEWR	
UNDERGROUND TANK	UNTANK	
UNDERGROUND TELEPHONE LINE	UNTELE	
UNDERGROUND TELEVISION CABLE	UNTVCB	
UNDERGROUND WATER LINE	UNWATR	
WARNING SIGN ONE POST	WARNO	
WARNING SIGN TWO POST	WARNT	
WATER FOUNTAIN	WATFTN	
WATER HYDRANT	WATHYD	
WATER METER	WATMTR	
WATER TOWER	WATTWR	
WATER VALVE	WATOFF	
WATER WELL	WELL	
WEIR ROCK	WEIRRK	
WINDMILL	WINMIL	
WINGWALL	WNGWAL	
WITNESS CORNER	WCORN	

SDDOT FEATURE CODE LIST

CONTROL CODES:

Start	ST	Non-tangent curve	NT
Close	CLOSE	Join Points	JPT
Point of curvature	PC	Join nearest code	JNC
Point of tangent	PT	Coordinate by dist.	DIST
Do not contour	DNC	Template	TMPL
Rectangle	RECT	Close rectangle	CLSRECT

DTM DEFINITION

Breakline=Elevation at point shot in the field will pass to the DTM. Make sure breaklines do not cross.

DNC (Do Not Contour) = Elevation will not pass to the DTM

Random = Elevation at point shot in the field will pass to the DTM

FEATURE DEFINITION	ALPHA CODE	NUMERIC CODE	LINE/CELL	DTM	SHOT LOCATION
ANCHOR	ANCHOR / AN	1	L	dnc	anchor then pole
ANTENNA	ANTENA	2	C	random	nearest edge
APPROACH	APPR	3	L	breakline	both sides
ASSUMED CORNER	ACORN	4	C	dnc	center of
AZIMUTH MARKER	AZIMKR	5	C	dnc	center of
BBQ GRILL/ FIREPLACE	BGRILL	6	C	dnc	center of
BEARING TREE	BTREE	7	C	dnc	center of
BENCH MARK	BNCHMK	8	C	dnc	center of
BOX CULVERT	BOXCUL	9	L	dnc	perimeter
BRIDGE	BRIDGE	10	L	dnc	perimeter
BREAKLINE	BL	33	L	breakline	beginning and end
BRUSH	BRUSH	11	L	dnc	perimeter
BUILDINGS	BUILDS	12	L	dnc	perimeter
BULK TANK	BULKTK	13	C	dnc	center of
CALCULATED CORNER	CCORN	171	C	random	center of
CATTLE GUARD	CATGRD	14	L	dnc	both ends
CEMETERY	CEMTRY	15	L	dnc	perimeter
CENTERLINE	CL	16	L	breakline	beginning and end
CISTERN	CISTRN	17	C	dnc	center of
CLOTHES LINE	CLOSLN	18	L	dnc	both ends
COMMERCIAL SIGN DOUBLE FACE	CMSNDF	19	C	random	center of
COMMERCIAL SIGN ONE POST	CMSNOP	20	C	random	center of
COMMERCIAL SIGN OVERHEAD	CMSNOH	21	C	dnc	center of
COMMERCIAL SIGN TWO POST	CMSNTP	22	C	random	center of
CONCRETE SYMBOL	CONC	23	C	random	center of
CREEK EDGE	CREEK	24	L	breakline	beginning and end
CURB\GUTTER LEFT	CGL	25	L	breakline	beginning and end
CURB\GUTTER RIGHT	CGR	26	L	breakline	beginning and end
CURB LEFT	CURBL	27	L	breakline	beginning and end
CURB RIGHT	CURBR	28	L	breakline	beginning and end
DAM GRADE\DIKE\LEVEE	DAM	29	L	breakline	perimeter
DECK EDGE	DECK	168	L	dnc	perimeter
DITCH BLOCK	DTCHBK	30	C	random	center of
DOORWAY THRESHOLD	DRTHHD	167	L	dnc	beginning and end
DRAINAGE PROFILE	DRNAGE	31	L	breakline	beginning and end

SDDOT FEATURE CODE LIST

FEATURE DEFINITION	ALPHA CODE	NUMERIC CODE	LINE/CELL	DTM	SHOT LOCATION
DROP INLET	DROPIN	32	C	random	center of
DROP INLET PIPE WITHOUT FLARE	PIPEDO	162	L	dnc	beginning and end
DROP INLET PIPE WITH FLARE	PIPEDF	163	L	dnc	beginning and end
EDGE OF ASPHALT	EDGEAS / EA	34	L	breakline	beginning and end
EDGE OF CONCRETE	EDGECN / EC	35	L	breakline	beginning and end
EDGE OF GRAVEL	EDGEGR / EG	36	L	breakline	beginning and end
EDGE OF OTHER	EDGEOT / EO	149	L	breakline	beginning and end
EDGE OF SHOULDER	EDGESH / ES	150	L	breakline	beginning and end
ELEC. TRANS./POWER JCT. BOX	ETRAN	37	C	random	nearest edge
ENVIRONMENTAL SENSITIVE SITE	ESS	170	L	dnc	beginning and end
FENCE BARBWIRE	FENCEB / FB	38	L	dnc	beginning and end
FENCE CHAINLINK	FENCEC / FC	39	L	dnc	beginning and end
FENCE ELECTRIC	FENCEE / FE	40	L	dnc	beginning and end
FENCE MISC.	FENCEM / FM	41	L	dnc	beginning and end
FENCE ROCK	FENCER / FR	42	L	dnc	beginning and end
FENCE SNOW	FENCES / FS	43	L	dnc	beginning and end
FENCE WOOD	FENCEW / FW	44	L	dnc	beginning and end
FENCE WOVEN	FENCEV / FV	45	L	dnc	beginning and end
FIRE HYDRANT	FIRHYD	46	C	dnc	nearest edge
FLAG POLE	FLAGPL	47	C	random	nearest edge
FLOWER BED	FLWBED	48	C	dnc	center of
GAS VALVE OR METER	GASVLV	49	C	dnc	center of
GAS PUMP ISLAND	GASISL	50	L	dnc	both ends
GRAIN BIN	GRNBIN	51	C	dnc	nearest edge
GROUND SHOT	GR	52	N\A	random	N\A
GUARD RAIL	GDRAIL	53	L	dnc	beginning and end
GUIDE SIGN ONE POST	GUIDO	151	C	random	nearest edge
GUIDE SIGN TWO POST	GUIDT	152	C	random	nearest edge
GUTTER LEFT	GUTL	54	L	breakline	beginning and end
GUTTER RIGHT	GUTR	55	L	breakline	beginning and end
GUY POLE	GYPOLE	56	C	random	nearest edge
HAYSTACK	HAYSTK	57	C	dnc	nearest edge
HEDGE	HEDGE	58	L	dnc	perimeter
HIGHWAY R.O.W. MARKER	HWYROW	59	C	random	nearest edge
INTERSTATE CLOSE GATE LEFT	CLOSEL	60	C	random	post
INTERSTATE CLOSE GATE RIGHT	CLOSER	61	C	random	post
IRON PIN	IPIN	62	C	dnc	center of
IRRIGATION DITCH	IRRDTH	63	L	breakline	beginning and end
LAKE EDGE	LAKE	64	L	breakline	beginning and end
LAWN SPRINKLER	LWNSPK	65	C	random	center of
MAILBOX	MAILBX	66	C	random	nearest edge
MANHOLE ELECTRIC	ELECMH	67	C	dnc	center of
MANHOLE GAS	GASMH	68	C	dnc	center of
MANHOLE MISC	MISCMH	69	C	dnc	center of
MANHOLE SANITARY SEWER	SANMH	70	C	dnc	center of
MANHOLE STORM SEWER	STMH	71	C	dnc	center of
MANHOLE TELEPHONE	TELMH	72	C	dnc	center of
MANHOLE WATER	WATMH	73	C	dnc	center of
MERRY-GO-ROUND	MGORND	74	C	dnc	nearest edge

SDDOT FEATURE CODE LIST

FEATURE DEFINITION	ALPHA CODE	NUMERIC CODE	LINE/CELL	DTM	SHOT LOCATION
MICROWAVE RADIO TOWER	RADTWR	75	C	random	nearest edge
MISC. LINE	LINEMS	165	L	dnc	beginning and end
MISC. PROPERTY CORNER	MPROP	76	C	dnc	center of
MISC. POST	POSTMS	77	C	random	nearest edge
OVERHANG OR ENCROACHMENT	OVRHNG	158	L	dnc	perimeter
OVERHEAD UTILITY LINE	OUL	161	L	dnc	both ends
PARKING METER	PARKMR	78	C	random	nearest edge
PIPE WITH END SECTION	PIPEWF	79	L	dnc	both ends
PIPE WITH HEADWALL	PIPEWH	80	L	dnc	both ends
PIPE WITHOUT END SECTION	PIPEWO	81	L	dnc	both ends
PIPE WITH SAFTEY ENDS	PIPEWS	164	L	dnc	both ends
PLAYGROUND SLIDE	PLAYSL	82	C	dnc	nearest edge
PLAYGROUND SWING	PLAYSW	83	C	dnc	nearest edge
POWER AND LIGHT POLE	POWLGT	84	C	random	nearest edge
POWER AND TELEPHONE POLE	POWTEL	85	C	random	nearest edge
POWER METER	POWMTR	153	C	dnc	nearest edge
POWER POLE	POWERP	86	C	random	nearest edge
POWER POLE AND TRANSFORMER	POWTRF	87	C	random	nearest edge
POWER TOWER STRUCTURE	POWTOW	88	C	random	nearest edge
PROPANE TANK	PROTNK	89	L	dnc	both ends
PROPERTY PIPE	PIPE	90	C	dnc	center of
PROPERTY PIPE WITH CAP	PIPEWC	91	C	dnc	center of
PROPERTY STONE	STONE	92	C	dnc	center of
PUBLIC TELEPHONE	PUBTEL	93	C	random	nearest edge
RAILROAD CROSSING SIGNAL	RRXSIG	94	C	random	nearest edge
RAILROAD MILEPOST MARKER	RRMPST	95	C	random	nearest edge
RAILROAD PROFILE	RRRAIL	96	L	breakline	beginning and end
RAILROAD R.O.W. MARKER	RRROWM	97	C	random	nearest edge
RAILROAD SIGNS	RRXING	98	C	random	nearest edge
RAILROAD SWITCH	RRSWCH	99	C	random	nearest edge
RAILROAD TRACK	RRTRAK	100	L	dnc	beginning and end
RAILROAD TRESTLE	RRTRES	101	L	dnc	perimeter
REBAR	REBAR	102	C	dnc	center of
REBAR WITH CAP	BARCAP	103	C	dnc	center of
REFERENCE MARK	REFMRK	104	C	dnc	center of
REGULATORY SIGN ONE POST	REGUO	154	C	random	nearest edge
REGULATORY SIGN TWO POST	REGUT	155	C	random	nearest edge
RETAINING WALL	RTWALL	105	L	breakline	both ends
RIPRAP	RIPRAP	106	L	dnc	beginning and end
RIVER EDGE	RIVER	107	L	breakline	beginning and end
ROCK AND WIRE BASKETS	WIRERK	108	L	dnc	perimeter
ROCK PILES	ROCKPL	109	C	dnc	center of
SATELLITE DISH	SATDIS	110	C	random	nearest edge
SEPTIC TANK	SEPTIC	111	C	dnc	center of
SHRUB TREE	SHRUBT	112	C	random	nearest edge
SIDEWALK	SW	113	L	breakline	beginning and end
SIGN FACE	SF	159	L	dnc	beginning and end
SIGN POST	SP	160	C	dnc	center of
SLOUGH OR MARSH	SLOUGH	114	L	breakline	perimeter

SDDOT FEATURE CODE LIST

FEATURE DEFINITION	ALPHA CODE	NUMERIC CODE	LINE/CELL	DTM	SHOT LOCATION
SPRING	SPRING	115	L	random	center of
STREAM GAUGE	STMGAG	116	C	dnc	center of
STREET MARKER	STMARK	117	C	random	nearest edge
SUBSURFACE UTILITY ENGINEERING TEST HOLE	TSTSUE	166	C	dnc	center of
TELEPHONE FIBER OPTICS	TELFIB	118	L	dnc	beginning and end
TELEPHONE JUNCTION BOX	TELBOX	119	C	random	nearest edge
TELEPHONE POLE	TELPOL	120	C	random	nearest edge
TELEVISION CABLE JCT BOX	TVBOX	121	C	random	nearest edge
TELEVISION TOWER	TVTWER	122	C	random	nearest edge
TEST WELLS/BORE HOLES	TSTWLL	123	C	dnc	center of
TRAFFIC SIGNAL	TRASIG	124	C	random	nearest edge
TRASH BARREL	TRASHB	125	C	dnc	nearest edge
TREE BELT	TREEBT	126	L	dnc	beginning and end
TREE CONIFEROUS	TREECN	127	C	random	nearest edge
TREE DECIDUOUS	TREEDC	128	C	random	nearest edge
TREE STUMPS	TREEST	129	C	dnc	nearest edge
TRIANGULATION STATION	TRISTA	130	C	dnc	center of
UNDERGROUND ELECTRIC LINE	UNELEC	131	L	dnc	beginning and end
UNDERGROUND GAS LINE	UNGAS	132	L	dnc	beginning and end
UNDERGROUND HIGH PRESSURE GAS LINE	UNHGAS	169	L	dnc	beginning and end
UNDERGROUND SANITARY SEWER	SANSEWR	133	L	dnc	beginning and end
UNDERGROUND STORM SEWER	STSEWR	134	L	dnc	beginning and end
UNDERGROUND TANK	UNTANK	135	C	dnc	nearest edge
UNDERGROUND TELEPHONE LINE	UNTELE	136	L	dnc	beginning and end
UNDERGROUND TELEVISION CABLE	UNTVCB	137	L	dnc	beginning and end
UNDERGROUND WATER LINE	UNWATR	138	L	dnc	beginning and end
WARNING SIGN ONE POST	WARNO	156	C	random	center of
WARNING SIGN TWO POST	WARNT	157	C	random	center of
WATER FOUNTAIN	WATFTN	139	C	random	nearest edge
WATER HYDRANT	WATHYD	140	C	random	nearest edge
WATER METER	WATMTR	141	C	dnc	center of
WATER TOWER	WATTWR	142	C	random	nearest edge
WATER VALVE	WATOFF	143	C	dnc	center of
WATER WELL	WELL	144	C	dnc	center of
WEIR ROCK	WEIRRK	145	L	dnc	both ends
WINDMILL	WINMIL	146	C	random	nearest edge
WINGWALL	WNGWAL	147	L	breakline	beginning and end
WITNESS CORNER	WCORN	148	C	dnc	center of

FEATURE CODES

Control Codes

Control codes are similar to verbs in English: they denote action and serve as feature code controls. These codes are independent of the selected feature code, and apply to all feature codes in the active feature table. Shown below is a brief description of what each control code will do.

ST - Defines the beginning of a feature line and only needs to be associated with the first feature code of the line string. Continue with the same feature code until a new line using the same code along with the **ST** control code is started.

CLOSE - Connects the last feature code in a line string to the first feature codes of the same line string to form a closed shape.

PC - defines the beginning of a curve or point of curvature for a curvilinear feature.

PT - defines the end of a curve or point of tangency for a curvilinear feature.

DNC - specifies the elevation value of a particular feature cell code will not be included in the surface DTM calculations. This control code will not work for feature lines points.

RECT - creates a rectangle based on two field points and a given distance.

CLSRECT - creates a rectangle based on three field points.

JPT - Connects a feature line from the point the control code is associated with to a point number specified following the **JPT** control code. This control code requires a space between the control code and the point number to connect to.

JNC – Connects a feature line from the point the control code is associated with to the nearest point with the specified code following the **JNC** control code. This control code requires a space between the control code and the feature code to join to.

NT - specifies that a curve is non-tangent to the incoming or outgoing line segment. This code is used in conjunction with the **PC** and/or **PT** control codes.

DIST - Creates a linear feature where all angles are perpendicular to the previous line segment. This control code requires two points and taped distances to build the shape.

TMPL - specifies where the template starts and controls the number of observations required across the template.

Coding Example

Feature line strings collected in the field will require a feature line code, a numeric value for the feature line string, followed by the control code (***ST***) associated with the first point of the desired feature line string. For example, when locating the edge of an asphalt surfaced road, the initial shot will be coded ***EA1 ST.*** The shots following will not require the ***ST*** control code, they will simply be coded ***EA1***, this will continue until the final shot along the asphalt edge has been collected. There is no control code needed to end the feature line string. To reuse the ***EC1*** feature line code on a different edge of asphalt use the feature line code ***EC1*** followed by the control code ***ST*** to start the feature line string over.

LAND TIE SURVEYS

Land tie surveys concern the accurate location of private and public property corners and the preservation of these corners during and after construction. This type of survey is to be performed by or under the direct supervision and control of a Registered Land Surveyor licensed in the state of South Dakota.

It is of the utmost importance that accurate and properly located or calculated private and public property corners be supplied within the land tie survey as new right of way required for future highway construction will be based on the land tie survey information. Local residents and property owners should be interviewed, if necessary, to acquire additional information regarding property corner locations.

All property corners, section corners and quarter corners must be referenced to the project survey control. This will ensure the land tie survey, preliminary survey and preliminary design use the same survey datum and coordinates throughout the stages of the project's development.

Railroad maps are a useful resource in locating or reestablishing property and section corners. These maps are readily available and can be obtained from the Office of Road Design.

Send copies or the originals of all plans, plats, and any other information that was used by the Registered Land Surveyor to locate or calculate section corners, quarter corners, and private and public property corners to the Office of Road Design. On urban projects, these copies can be an excellent reference to show what corners were looked for and what corners were actually found.

All land tie notes should include, but not be limited to, the type of corner found (section corner, quarter corner, etc.), type of monument found, markings on the monument and any physical evidence that was used to calculate and reestablish a lost or obliterated corner.

For reference, every Region Land Surveyor's Office has a copy of the "Manual of Instructions for the Survey of Public Lands of the United States, 1973 and 2009",

published by the Bureau of Land Management, U.S. Department of Interior. The Office of Road Design Land Surveyor should be contacted concerning any problems or questions concerning private and public boundaries that may arise during the land tie survey.

Rural land tie survey

Region Land Surveyor to provide full public lands survey section breakdown to include found monuments and calculated lost or obliterated corner locations.

Suburban land tie survey

Region Land Surveyor to provide full public lands survey section breakdown to include found monuments and calculated lost or obliterated corner locations. As well as found monuments and calculated subdivision corners and addition corners.

Urban land tie survey

Region Land Surveyor to provide found monuments and calculated block corners, subdivision corners and addition corners. Region Land Surveyors to use a best fit method to determine the boundary line location in urban areas where many monuments are located and when used as the corners location creates many PI's resulting in an undesirable boundary line.

a. Block to block best fit method - A best fit line through found monuments within a single block.
b. Subdivision to Subdivision best fit method – A best fit line through found monuments within a platted subdivision, addition, etc. This method is to be used when not enough monumentation is found to use the block to block best fit method.

Project Alignment Crossing a Section Line

When the project alignment follows a section line, each section corner and ¼ corner along the alignment as well as each section corner and ¼ corner perpendicular to the alignment shall be accurately located or calculated if not found.

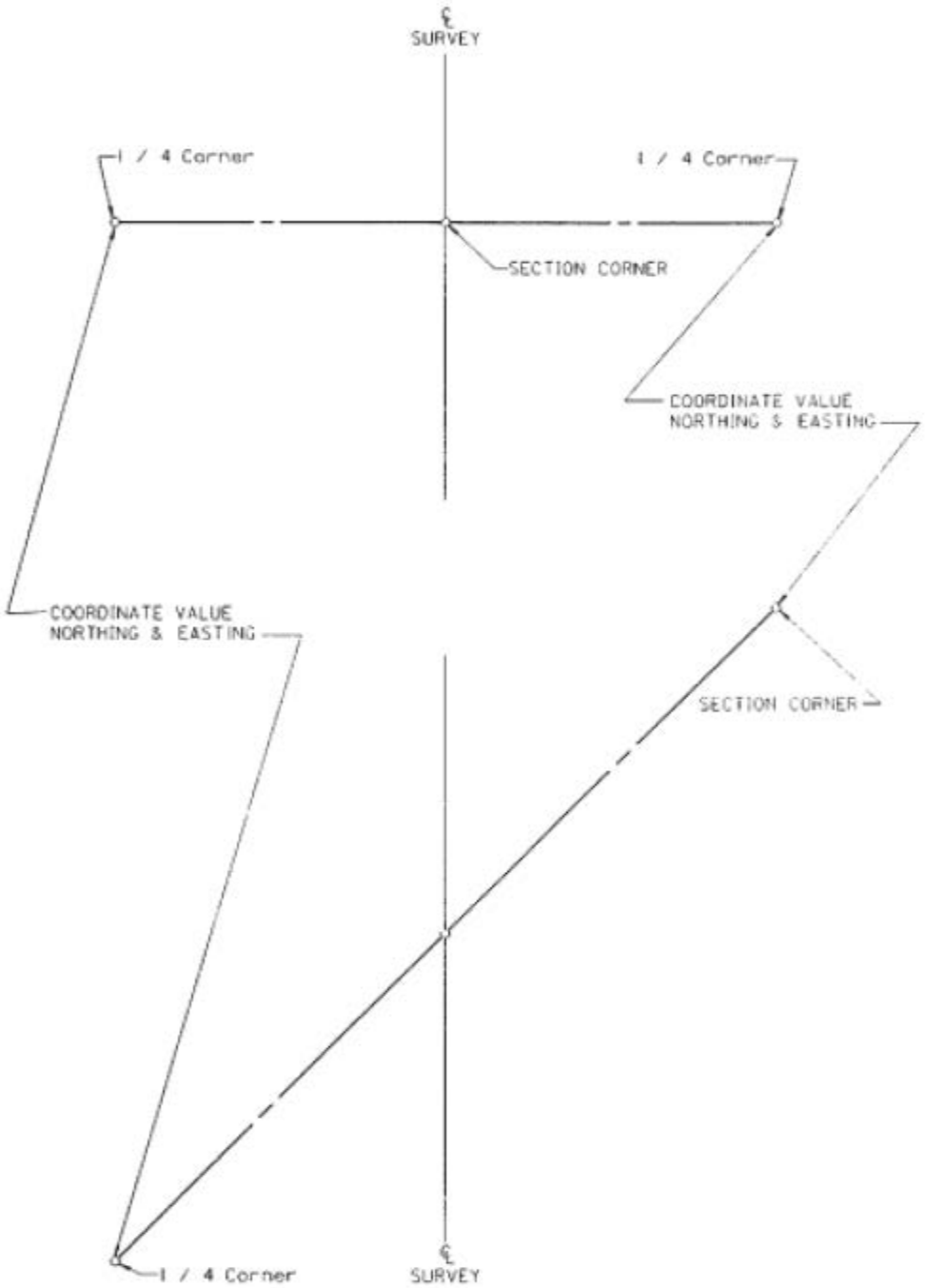


Figure 6-1 Project Alignment Crossing a Section Line

Project Alignment Running Through a Section

When the project alignment runs through a section, all section and ¼ corners located within the section shall be accurately located or calculated if not found. A reasonable and diligent attempt shall be made to locate all section and quarter section corners.

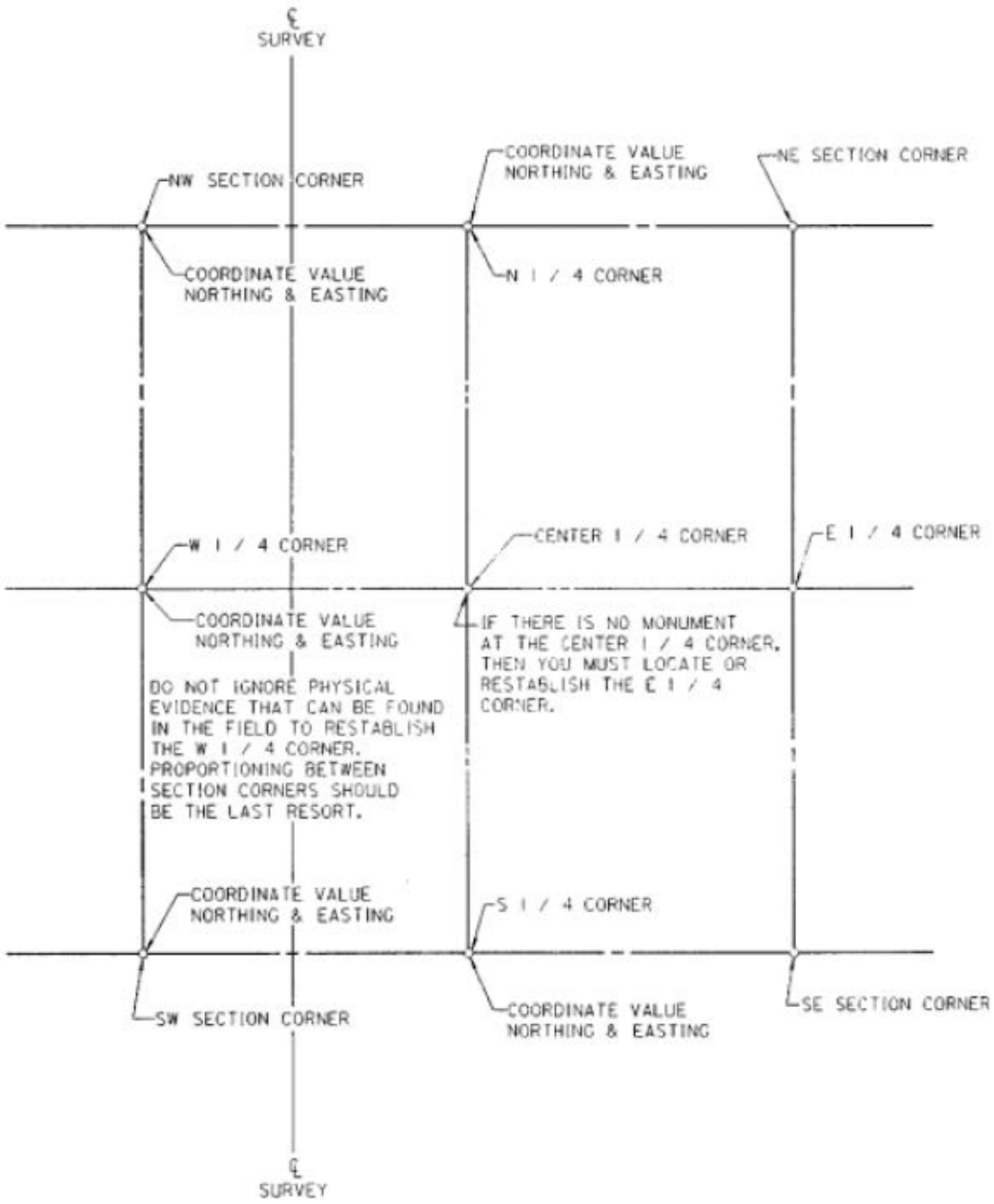


Figure 6-2 Project Alignment Running Through a Section

Project Alignment Running Through a Platted Area or Subdivision

When the project alignment runs through suburban and urban platted lands all Lot, Tract and Subdivision block corners along the alignment corridor shall be accurately located or calculated if not found. A reasonable and diligent attempt shall be made to locate all Lot, Tract and Subdivision block corners.

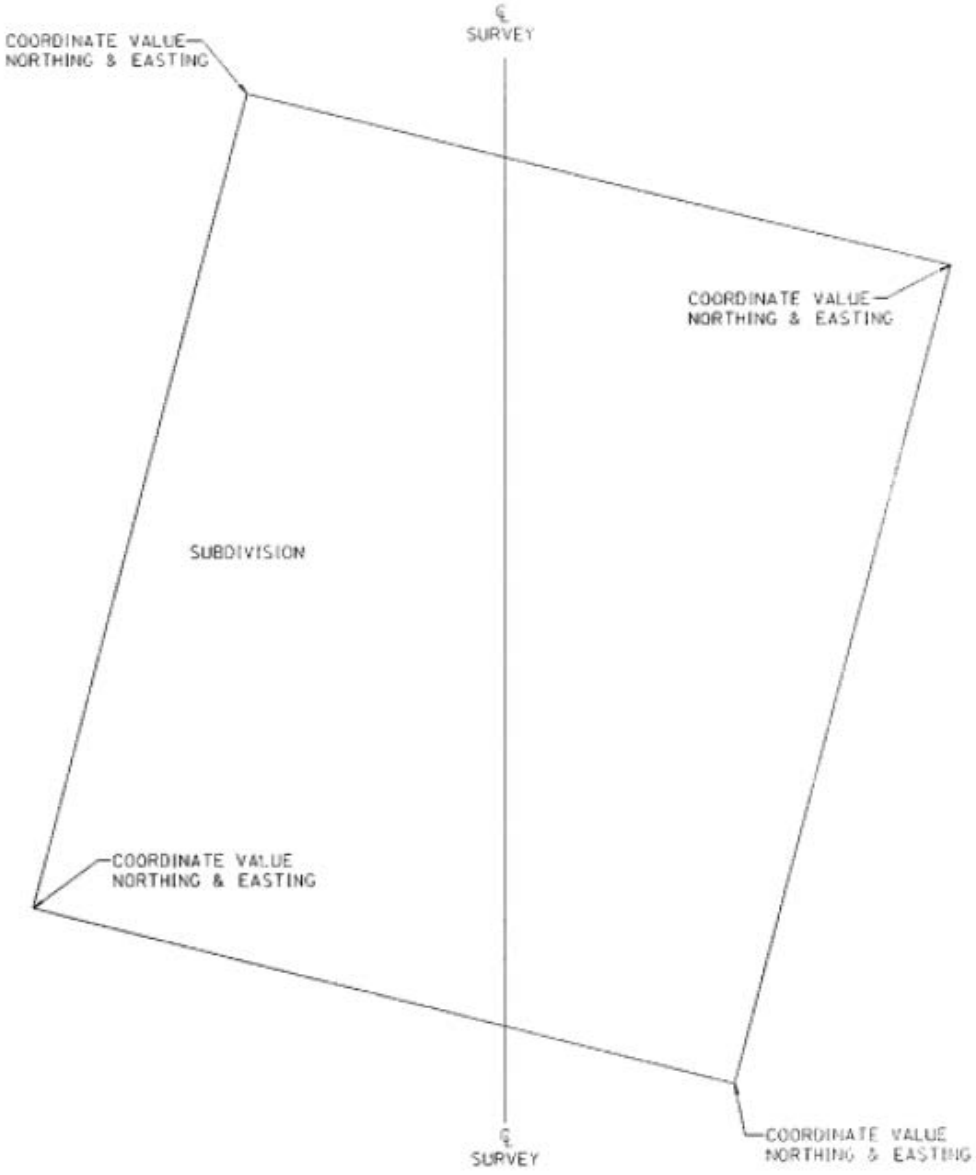


Figure 6-3 Project Alignment Running Through a Platted Area or Subdivision

COLLECTING PLANIMETRIC AND DIGITAL TERRAIN MODEL DATA

A topographic survey is conducted using either GPS RTK, conventional or robotic survey methods. The use of GPS RTK in urban canyons and against or near buildings will not be used. GPS RTK will not consistently produce the accuracies needed for topographic surveys as defined under Topography and Surface General Standard on page 6-24 of this chapter.

A topographic survey is a data collection method the purpose of which is to create a two-dimensional planimetric map and a three-dimensional surface model of the actual terrain being surveyed in a computer aided drafting (CAD) system. All collected survey points are required to be collected in the South Dakota State Plane coordinate system US survey feet (northing, easting and elevation values) at locations which represent planimetric mapping features, highs, lows, and breaks in slope of the actual ground being surveyed.

Survey data is downloaded from the data collector into the computer aided drafting (CAD) system, a two-dimensional planimetric map and a three-dimensional surface model is created, which then becomes the source of all existing planimetric and surface data within the topographic survey limits.

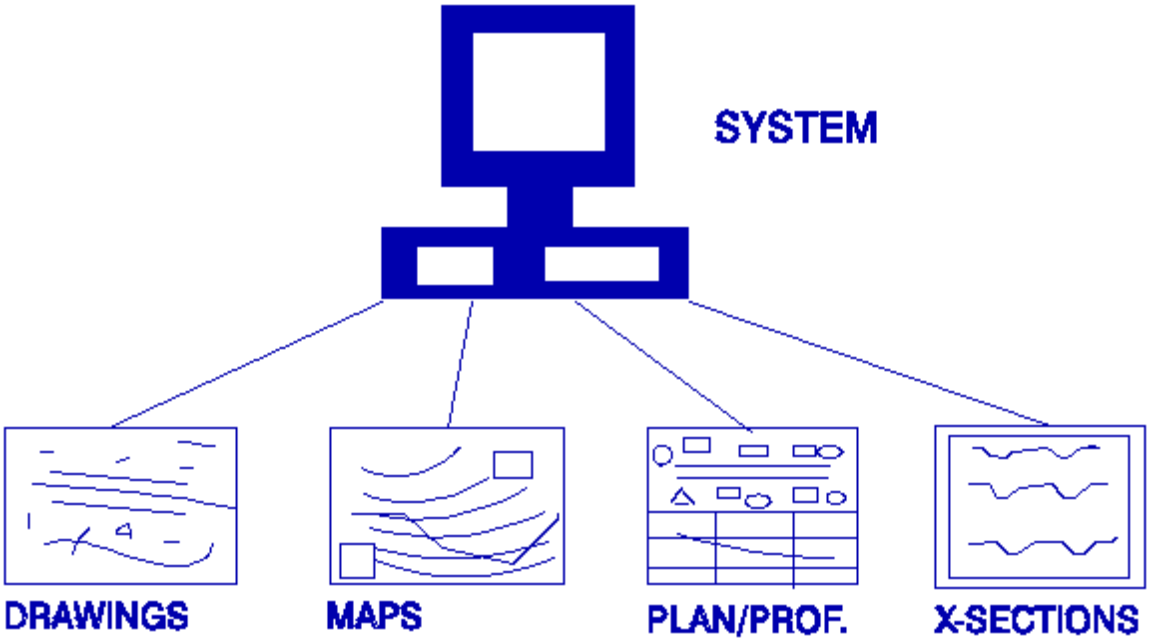


Figure 6-4 Design Products

As with any type of surveying, data extracted from the planimetrics or surface model of the topographic survey will only be as accurate as the survey procedures that produced it. Therefore, a set of topographic survey standards has been developed and shall be adhered to.

Ground Shots

A ground shot for the purposes of this manual is defined as a recorded survey shot used to fill-in and provide points to allow triangulation across large flat surfaces. Examples of areas where ground shots should be recorded are: large flat fields and grassy areas, parking lots, between the tops and toes of long planar slopes of the natural ground and paved surfaces.

Discontinuity Lines and Breaklines

A **discontinuity line** for the purposes of this manual is defined as a line string that represents a distinct interruption in the slope of a surface and also represents a planimetric feature. Examples of discontinuity lines are: edges of concrete, edges of asphalt, edges of gravel, curb and gutter lines, edge of roadway shoulders, and roadway crowns to name a few. For a complete list of discontinuity line strings please refer to the SDDOT Feature Code List found on pages 6-10 thru 6-13 of this chapter.

A **breakline** for the purposes of this manual is defined as a line string that represents a distinct interruption in the slope of the ground but does not represent a mapping feature. Examples of breaklines are: tops & toes of ditches, swales, flow lines, breaks in the slopes of the natural ground and breaks in paved surfaces.

Figure 6-5 illustrates a profile view of a slope in the terrain with shots recorded at the top and toe of the slope. When the surface is generated the resulting triangulated irregular network (TIN) line will be a relatively accurate representation of the actual slope of the existing terrain.

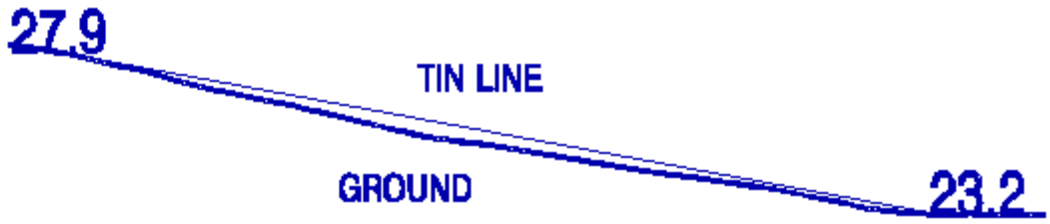


Figure 6-5 Profile View – Shots recorded at the top and toe of the slope

Figure 6-6 illustrates how an intermediate break in the terrain of the slope is ignored between the top and toe of the slope. When the surface is generated the resulting triangulated irregular network (TIN) line will pass over or under the intermediate break in the slope. The elevation **25.4** is shown to indicate where an additional survey shot should be recorded to form two TIN lines, resulting in two slopes that represent the true slopes of the existing terrain.

Figure 6-6 Profile View - Shots recored at the top and toe of the slope, break ignored

The plan view perspective is very similar to the profile view perspective. Relatively straight tops and toes of slopes can be well represented in the surface requiring very few shots. However, non-linear terrain features will require shots recorded at closer intervals to give a more accurate ground representation. Figure 6-7, illustrates a curvilinear feature line representing the shoulder of a roadway on a curve. When four survey shots are recorded the feature line closely represents the shoulder as it exists. The separation distance between the triangulated irregular network (TIN) lines and the existing roadway shoulder appear minimal.

Figure 6-7 Plan View - Roadway shoulder 4-shots on curve

Figure 6-8 shows the same roadway shoulder with only two survey shots to define the curve. The distance separation at the widest point might well approach 5 feet between the triangulated irregular network (TIN) line and the actual shoulders curve resulting in a poor representation of the terrain and planimetric feature.

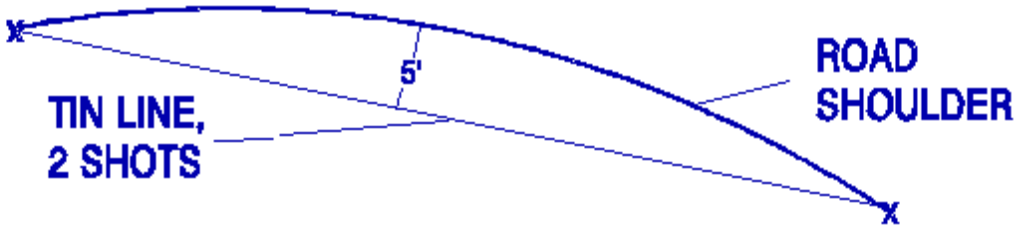


Figure 6-8 Plan View - Roadway shoulder 2-shots on curve

Discontinuity lines, breaklines and ground shots are features used to map out and represent the conditions of the project site. Triangulated discontinuity lines, breaklines and ground shots form a triangulated irregular network (TIN) within the surface model. It is important to identify and record all tops, toes and changes in slopes in order to accurately represent the project site conditions. Shots along discontinuity lines and breaklines should be recorded at all horizontal change in direction (PI) and at all vertical slope changes (VPI).

Figure 6-9 shows a surveyed segment of an existing roadway. Two survey shots were recorded as ground shots on each of the road's shoulders. The TIN lines and contours have been overlaid to show how this surface misrepresentation occurs.

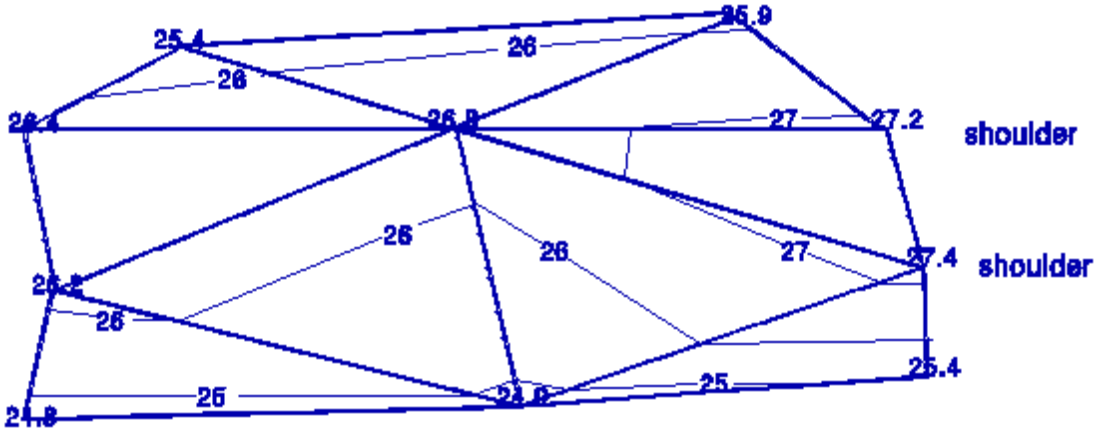


Figure 6-9 Ground shots recored on shoulders of road – no discontinuity line

Figure 6-10 shows the same segment of existing roadway depicted in figure 6-9. The ground shots have been removed and a discontinuity line has been added to one of the shoulders of the roadway. The discontinuity line string has forced the correct triangulation and contouring of the surface.

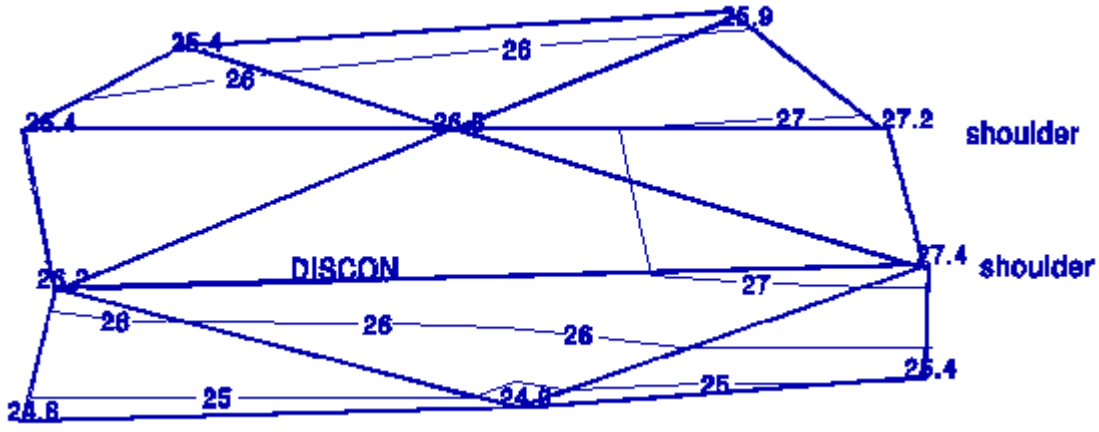


Figure 6-10 Discontinuity line added forcing correct surface representation

Figure 6-11, shows the same segment of existing roadway depicted in figures 6-9 and 6-10. A breakline was added to define the roadway crown. Comparing the three figures one can see the 27-foot contour line now runs to the appropriate elevation on the crown of the roadway resulting in the correct triangulation and contouring of the surface.

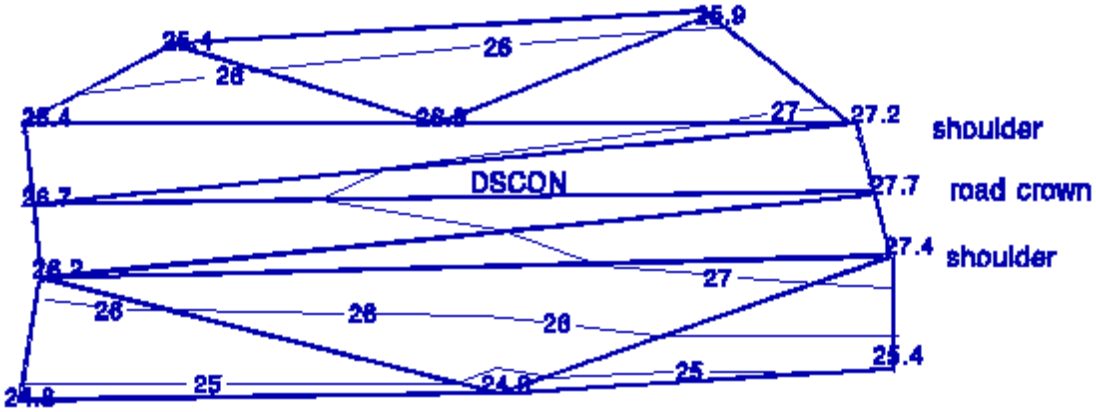


Figure 6-11 Breakline defines roadway crown

Inaccurate discontinuity and breakline representation of the terrain will result in erroneous elevations and/or surfaces within the surface model. Looking back at Figure 6-6 for example, no survey shot had been recorded at the intermediate break, the TIN line that was generated produced a surface at an elevation significantly higher than the actual elevation. In Figure 6-8 no intermediate shots were taken along the curve. The TIN line that was generated produced a planimetric feature and surface representation approximately 5 feet away from its actual position.

An understanding of surfaces structure, concepts, and tools will provide the best guidance for topographic surveying methodology. Interaction with the topographic survey data as it is translated into a surface, TIN triangles, contours, and a CAD drawing representing the existing conditions of the project site will provide the best insight into the survey data integrity levels needed in the field.

When discontinuity lines or breaklines cross, surface formulation becomes error-prone. Care should be taken in the field to assure that discontinuity lines and breaklines do not cross. When topography data is collected in separate job files and later combined, the gaps or overlaps of discontinuity lines and breaklines should be guarded against.

Topography and Surface General Standards

The purpose of the topographic survey is to provide an accurate representation of the project site as it exists, from which a new design can be created. The surface is used to compute earthwork volumes, design roadways, drainage structures and estimate the quantities of work to be done by the contractor. A partial list of features which makeup the surface are enumerated below.

1. Curb and Gutter - Elevations shall be taken to ±0.03 – 0.04 feet (9-12 mm) on the top of curbs and in the gutter.

2. Misc. Drainage Items - Elevations shall be taken to ±0.03 – 0.04 feet (9-12 mm) on all catch basins, manholes, top of grates, floor elevations, leaching basins, inlets and outlets, flow lines, culverts, and box culverts.

3. Underground Utilities - Elevations of underground utilities, such as telephone conduits, gas mains, sewers, etc., shall be taken (some of these elevations may have to be collected at manholes along the utility route).

4. High Water Elevations - Elevations shall be taken at rivers, creeks, streams, sloughs, and culverts.

5. Wells - Elevations shall be taken on the top of the casing.

6. Intersecting Roads or Streets - The point of intersection, angle of intersection, planimetrics (both above ground and underground), drainage patterns, top of curb and all gutters shall be recorded for a distance of 300 feet.

7. Railroad Tracks - Elevations shall be taken to ±0.03 – 0.04 feet (9-12 mm) on all railroad tracks that cross the survey corridor for a distance of 500 feet right and left of the corridor centerline. When the survey parallels the railroad tracks, the survey should be expanded to include the railroad bed.

8. Roadway Pavement - Elevations shall be taken to ±0.03 – 0.04 feet (9-12 mm) on all pavements. These elevations shall be taken at the crown, breaklines and edge of pavements.

9. Sidewalks - Elevations shall be taken to ±0.03 – 0.04 feet (9-12 mm) on both edges of all sidewalks.

10. Buildings - In rural areas the location of all buildings within 400 feet of the roadway should be recorded. In urban areas the location of all buildings within 150 feet should be recorded.

11. Driveways - Elevations shall be taken on all driveways. A minimum of three (3) shots shall be taken to accurately define any curves.

12. Trees and Stumps - In urban areas trees shall be shot individually. In rural areas trees 12” diameter or larger within or near the right-of-way line shall be shot individually. Forests or groves in rural areas shall be shown using the tree belt line code and shot at the beginning, major bends and at the end of the tree grouping.

13. Box Culverts - Elevations shall be taken to ±0.03 – 0.04 feet (9-12 mm) on each corner of the structure.

The recommended shot spacing along discontinuity lines, breaklines and to provide proper ground shot coverage is as follows:

Urban areas	50-100 feet
Suburban areas	50-100 feet
Rural areas	100-200 feet

Shots shall be taken at closer intervals to define detailed areas and vertical curves.

Ground shots, discontinuity lines and breaklines must be extended to sufficiently cover the project limits. The minimum survey limits shall be 300 feet right and left of the corridor centerline. Development in urban areas can sometimes prevent data collection to this width. In developed urban areas, 300 feet right and left of centerline or to building face along the project corridor should provide adequate coverage. All Intersecting streets shall be collected using the same criteria. In hilly areas the ground coverage shall be extended as follows.

Toe to bottom 1/3 hill – 300 feet right and left of corridor centerline

From bottom 1/3 to 2/3 hill – 600 feet right and left of corridor centerline

From 2/3 to top of hill – 900 feet right and left of corridor centerline

Note Keeping

The keeping of good survey notes is of the utmost importance because they:

1. present the entire record of a survey
2. may be used by people unfamiliar with the work done on a survey project
3. may be introduced as evidence in future legal action
4. reflect the quality of work done during the course of the survey

All too often, survey notes are inadequate as crewmembers get in the habit of recording the minimum amount of information. It is the Survey Crew Chief's responsibility to exercise the initiative in teaching the other crewmembers the requirements for good note keeping and maintaining a high standard of quality. A few principles that apply to all forms of note keeping are:

1. be complete
2. be concise
3. avoid copying

There can never be too much information in survey notes if it is presented in the proper manner. Notes should be completed while in the field, not later in the office. It is better for a beginning note keeper to get all the information in the notes rather than worry about how easy they are to interpret. As experience is gained efforts should be made to

keep the notes as brief as possible, while still getting all the information desired, and to keep them arranged in a logical sequence. The following is a list of field notes that should be collected for the noted feature.

1. Fences – Note the fence type, number of barbs (if barbed wire), height and condition.

2. Overhead Utilities – Note each type, number of wires, elevation of lowest wire sag, owner, and voltage and phase if known.

3. Underground Utilities – Note each type, depth, size of storm sewer pipe, diameter of cables, owner and condition.

4. Culverts – Note size, type, condition, percent silted and length of flared end section.

5. Railroad Crossing – Note crossing type (encasement, pre-cast concrete plank, wood plank, creosote plank, etc.) and the condition of the crossing.

6. Buildings – Note the type and owner of the business.

7. Trees and Stumps – Note the type, size, and count. The diameter of trees or stumps shall be measured 2 feet above the ground swell. In the case of stumps less than 2 feet above the ground, no count will be made.

8. Box Culverts **–** Note the type, height, width and the condition.

9. Wells – Note the size, depth and casing type.

There are many other items not mentioned specifically above. When recording planimetric and surface features, review the Feature Code List (see pages 6-10 thru 6-13) and provide the coordinates, code, and applicable notes. The topography file should show a complete and accurate picture of all features and conditions found within the survey limits.

SURVEY DATA REQUIREMENTS

InRoads Survey software provides the capabilities necessary to process topographic survey data. Included are the capabilities to download, edit, and manipulate the survey data collected. To standardize and expedite the passage of data to the Office of Road Design, data requirements are herein specified.

File Management

All data relating to surveying field and office work will be stored in the project folder within the appropriate Region folder on the U drive. Do not store survey data on your local drive as this drive is not backed up as often as the U drive, the storage space is smaller than the servers and the information is not readily available to others.

Data Collector Files

All data collector job files will be saved and will not be edited. The files will be transferred and stored in the csv & jobs folder within the project folder in the appropriate Region folder on the U: drive. It is important these files be saved in their original unedited format for legal reasons. Exported CSV files will also be saved within the csv & jobs folder.

Topography Data Furnished (.dgn file)

The field topography survey data is downloaded, edited, and processed into a MicroStation file. The Department of Transportation utilizes three scales when designing projects:

Rural scale	1" = 100'
Suburban scale	1" = 50'
Urban scale	1" = 20'

The MicroStation design file is stored within the project folder within the appropriate Region folder on the U: drive.

DOT standard naming convention for the topography file is as follows: t#PCN*.dgn

t represents topography and is always lowercase

#PCN represents the project control number assigned to the project and is always uppercase

* represents one of the three design file scales and is always lowercase:

r = rural scale
s = suburban scale
u = urban scale

.dgn represents the file extension for MicroStation CAD files.

Any additional survey that is needed after the original survey has been processed will need to be merged into the original topographic survey file.

Fieldbook Data Furnished (.fwd file)

After downloading, editing and processing all field topography data a fieldbook file (.fwd) will be produced. The fieldbook file contains all of the edited and processed information that was collected in the field and is stored within the project folder within the appropriate Region folder on the U: drive. There will be only ONE fieldbook file per project except on large projects when the file size becomes so great that it slows processing significantly. Splitting the fieldbook into TWO smaller files may alleviate this issue.

DOT standard naming convention for the fieldbook file is as follows: **#PCN.fwd**

#PCN represents the project control number assigned to the project and is always uppercase
.fwd represents the file extension for InRoads fieldbook files

If additional survey is collected after the original fieldbook file has been saved a new fieldbook file will need to be created after the field surveys are merged into one fieldbook file. The outdated fieldbook will be overwritten by the new fieldbook using the same file name.

Geometry Data Furnished (.alg file)

Through the process of downloading, editing and processing of the field topography data a geometry file (.alg) will be produced. The InRoads Geometry file is stored in the project folder in the appropriate Region folder on the U: drive. There will be only ONE geometry file per project.

DOT standard naming convention for the geometry file is as follows: #PCN**org**.alg

#PCN represents the project control number assigned to the project and is always uppercase
org represents the geometry file as original geometry and is always lowercase
.alg represents the file extension for InRoads geometry files

If additional survey is collected after the original geometry file has been saved a new geometry file will need to be created after the field surveys are merged into one fieldbook file. The outdated geometry file will be overwritten by the new geometry file using the same file name.

Surface Data Furnished (.dtm file)

After editing the field topography data a surface model (.dtm) will be produced. The InRoads surface model file is stored in the project folder within the appropriate Region folder on the U: drive. There will be only ONE original surface model file per project.

DOT standard naming convention for the surface model file is as follows: #PCN**org**.dtm

#PCN represents the project control number assigned to the project and is always uppercase
org represents the surface model file as original ground and is always lowercase
.dtm represents the file extension for InRoads surface model files

If additional survey is collected after the original surface model file has been saved a new surface model file will need to be created after the field surveys are merged into one

fieldbook file. The outdated surface file will be overwritten by the new surface file using the same file name.

INTERSTATE INTERCHANGE AND HIGHWAY INTERSECTION SURVEYS

A preliminary survey for an Interchange on the Interstate Highway System is dictated by the alignment of the proposed crossroad provided by the Office of Road Design. The proposed alignment file will usually consist of two points, a beginning and an end. Generally the proposed crossroad alignment will extend 1500 feet in each direction from the intersection with the existing mainline however the distance may vary due to terrain conditions.

The survey limit widening will begin 2000 feet along the Interstate highway mainline from the proposed crossroad alignment 200 feet each side of the mainline centerline and taper out to the proposed crossroads alignment points, then taper back to 200 feet each side of the mainline centerline 2000 feet past the proposed crossroad alignment.

Figure 6-12 and Figure 6-13 on the following pages illustrate the survey limit widening required for the Interstate interchange survey.

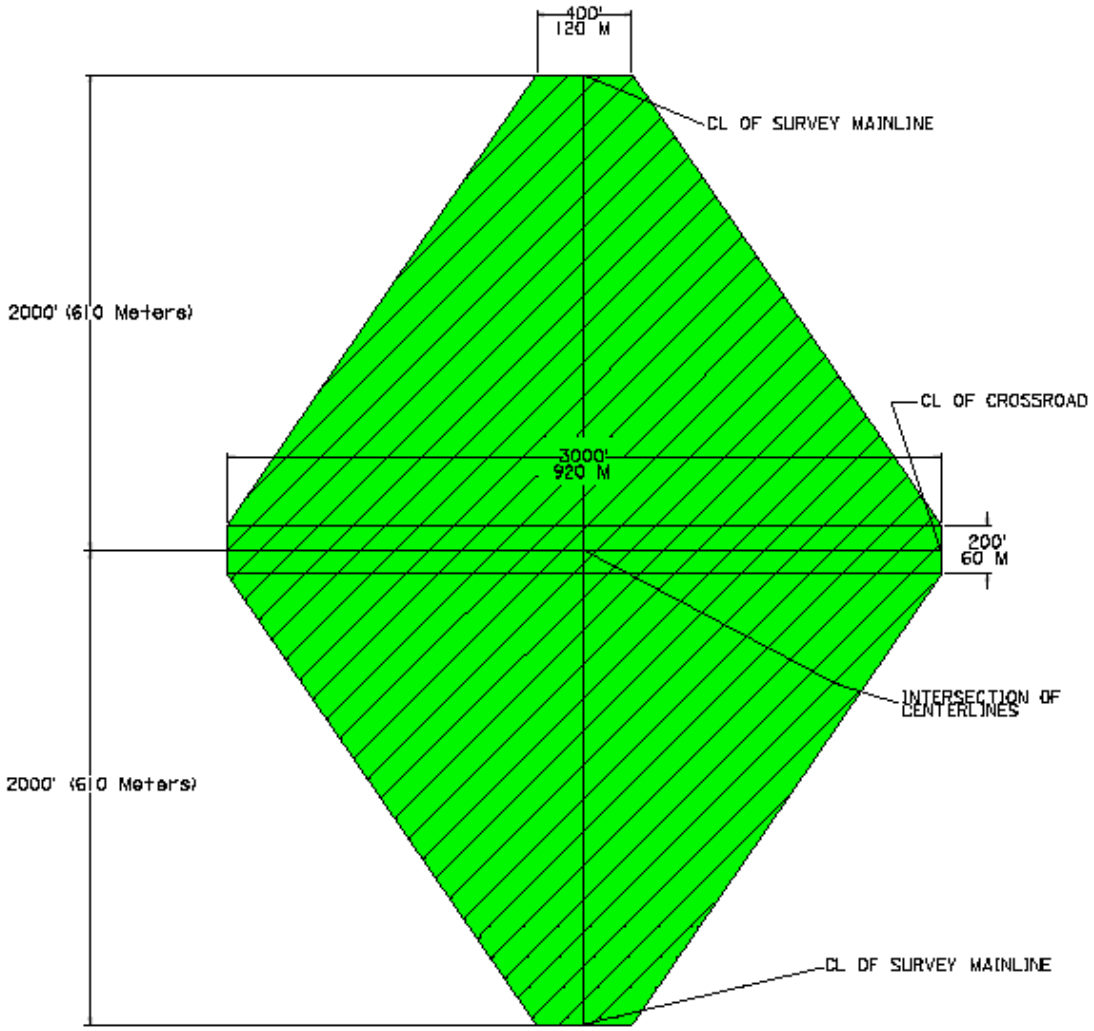


Figure 6-12 Interchange Survey with Perpendicular Crossroad

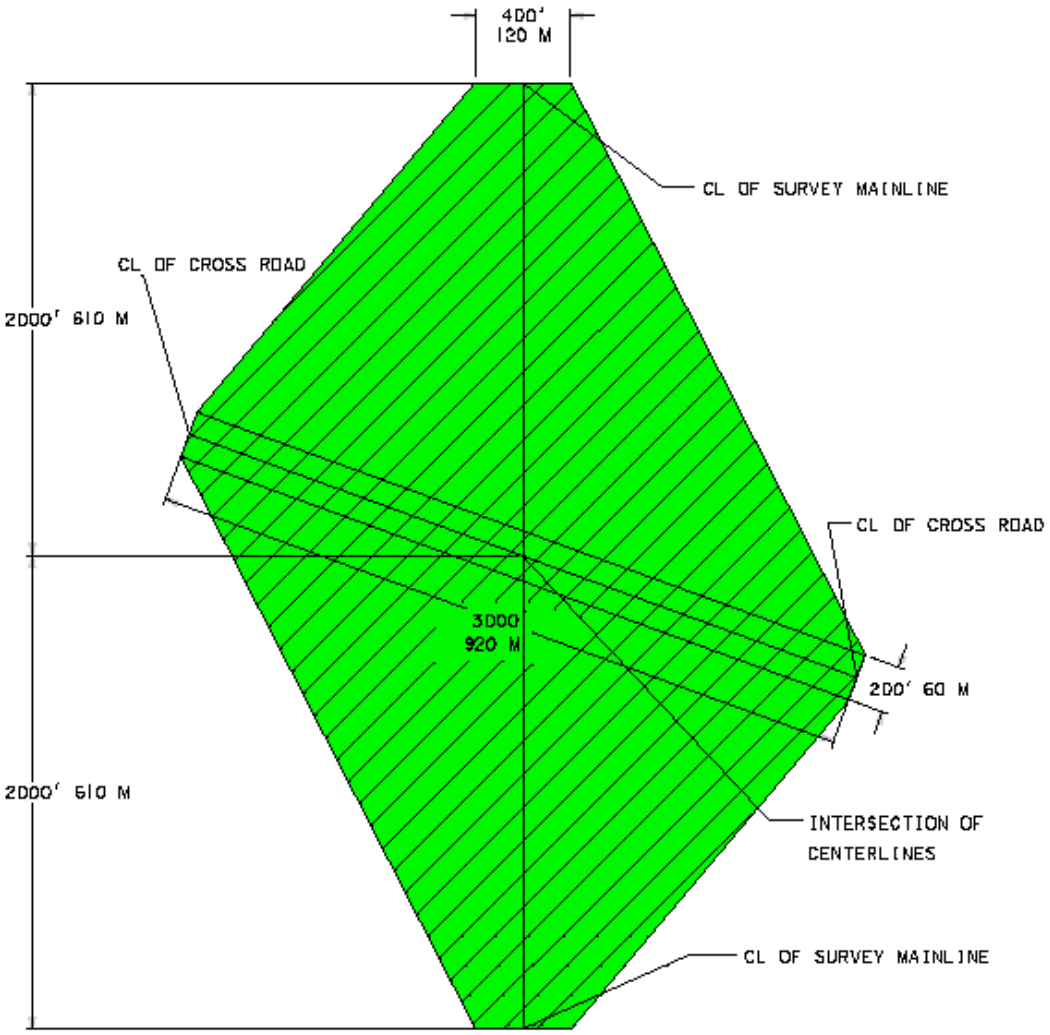


Figure 6-13 Interchange Survey with Skewed Crossroad

A preliminary survey for the Intersection of a State Highway is also dictated by the alignment of the proposed crossroad provided by the Office of Road Design. The proposed alignment file will usually consist of two points, a beginning and an end. Generally the proposed crossroad alignment will extend 1500 feet in the 4 directions from its intersection with the existing highway mainline and has a width of 300 feet centered on the Highway mainline and 200 feet centered on the proposed crossroad alignment. However the distance and widths may vary due to terrain conditions and design needs.

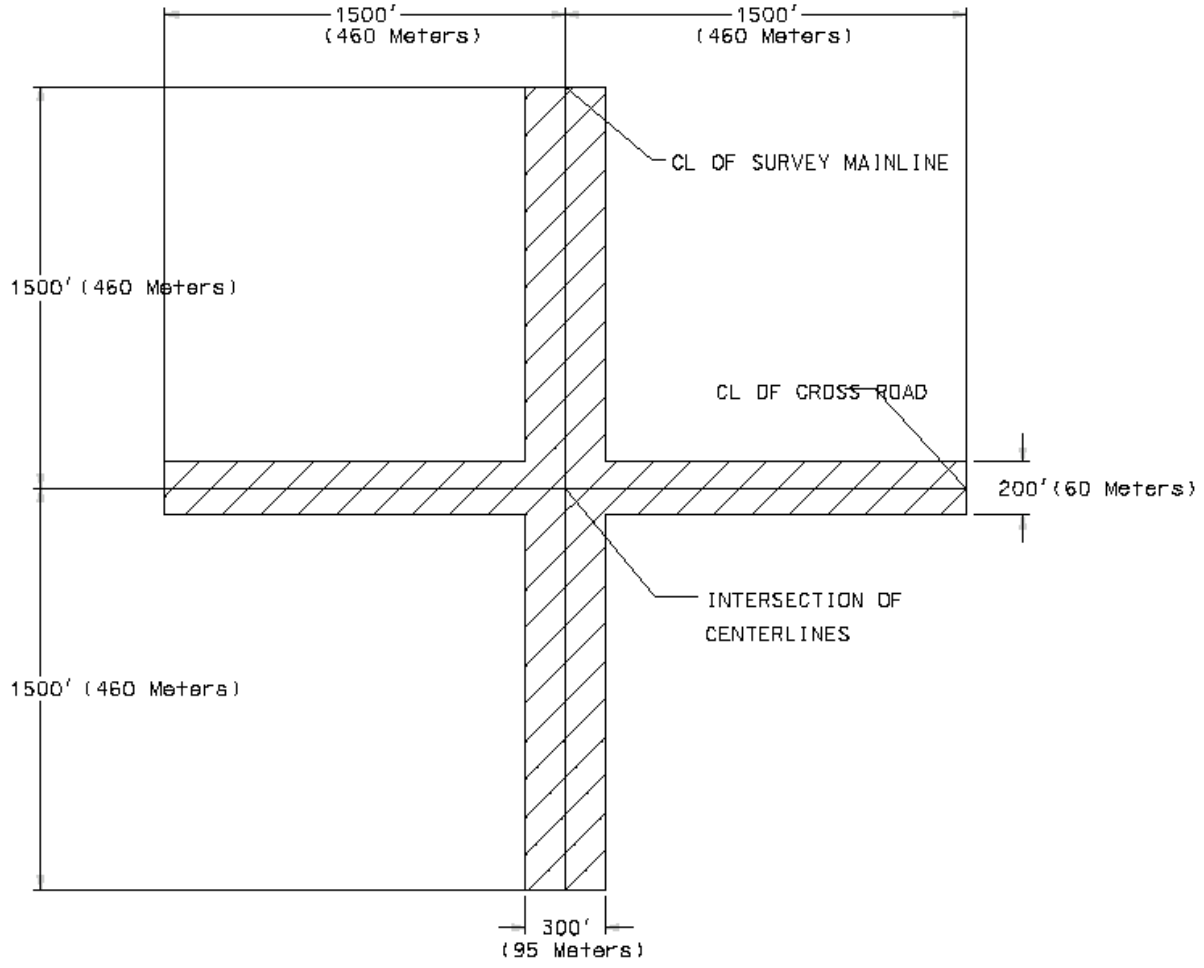


Figure 6-14 Intersection Survey

DRAINAGE SURVEYS

Drainage surveys are to be conducted in accordance with Section 5.6 of the South Dakota Drainage Manual. A preliminary drainage survey should first identify the locations where drainage structures will be required. If the locations cannot be readily identified in the field, a request for assistance from the Hydraulics Engineer in the Office of Bridge Design may be required. This information may be provided as part of the project scope, or it may be requested by the surveyor when the field survey is initiated. The hydraulics staff will provide a list of the basins over 200 acres and those over 1000 acres. This will identify the survey limits required for each range of drainage basins.

General Items

The basic information needed for all drainage surveys is as follows:

a) Collect Observed High Water Elevations (OHW) and note date of the high water. It is important that this information be obtained as it can aid the hydraulic engineer in the calibration of the hydraulic model developed to analyze the existing basin and to properly size future structures.

b) For any existing box culvert or large culvert encountered, obtain the flow line (invert or top of floor) elevation and coordinates of the inlet and outlet ends (see page 6-36). On box culverts the coordinates of all four corners should be recorded. Additional elevations and coordinates at the end of any apron are optional. This data is important for any crossing, but especially important for any culverts that are to be extended or for fish passage considerations.

c) Obtain the lowest elevation of any upstream buildings.

d) Obtain data approximately 500 feet to 600 feet both upstream and downstream to define the channel and any obstructions. Dams often impact the highway crossing location and should always be documented. Provide the spillway crest elevation, width and shape of each dam encountered.

e) Obtain the waterway opening and height at roadway overtopping for any structure within four miles upstream and downstream of the drainage channel. For bridges, obtain a channel cross section of the bridge opening. For culverts, provide the number, width and height of the culvert(s). If this information is available in some other source such as bridge maintenance inspection files, reference that information. When crossing lake bed areas, the overflow outlet should be located and its elevation established.

f) Complete and submit the **Drainage Data Information Sheet** found on page 5-38 of the South Dakota Drainage Manual to the Hydraulics Engineer along with the completed survey files.

Generally, drainage surveys do not require a great amount of detail but must be comprehensive enough so that the crossing site and channel are defined as noted below.

Drainage Basins less than 200 acres

Normally these drainage basins do not require special survey needs and can be collected as outlined in the General Items section on the previous page.

Drainage Basins from 200 to 1000 acres

The survey coverage limits should include the area which defines the main channel for a distance of at least 500 feet upstream of the proposed crossing location to define any flood storage capacity in that area. The standard roadway corridor coverage is adequate coverage for the downstream channel. However, ensure the channel flowline is defined within this corridor and coded accordingly.

Drainage Basins greater than 1000 acres

Drainage basins greater than 1000 acres require the most extensive survey coverage. The survey coverage limits should include:

- The area which defines the main channel for a distance of at least 1000 feet downstream and 1000 feet upstream from the proposed crossing location. In areas where roadway alignment is uncertain, it may be necessary to increase the limits of the survey to assure that adequate coverage is obtained. Define the center of the low channel and note any abrupt change in the channel flowline. After the project scope has been completed and areas of possible alignment shift have been identified prior to or during the survey field work, the coverage limits will not be increased. For larger rivers, the survey limits may need to be increased to provide sufficient data for the hydraulic model. Hydraulics staff will advise in these situations.

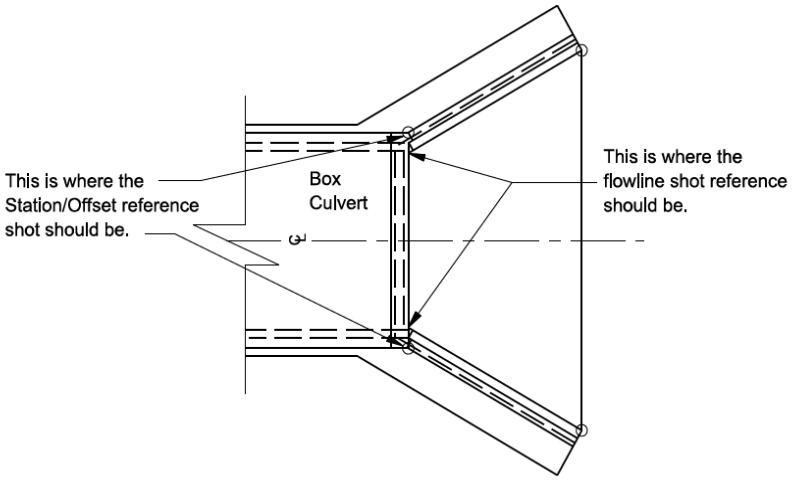
- Special emphasis should be given to assure that the survey limits adequately define the main channel limits so that the flow capacity of the main channel can be analyzed. For those floodplains where the valley beyond the main channel is very wide and flat, the survey limits should include the main channel and a minimum distance of at least 50 feet beyond the top of the banks onto the floodplain. Obtain sufficient survey data to properly define the irregular geometry of natural waterways.

- Ensure that surveyed ground points near the existing structure are sufficient so the structure (bridge) opening can be obtained from the survey data. This often requires obtaining underwater survey data.

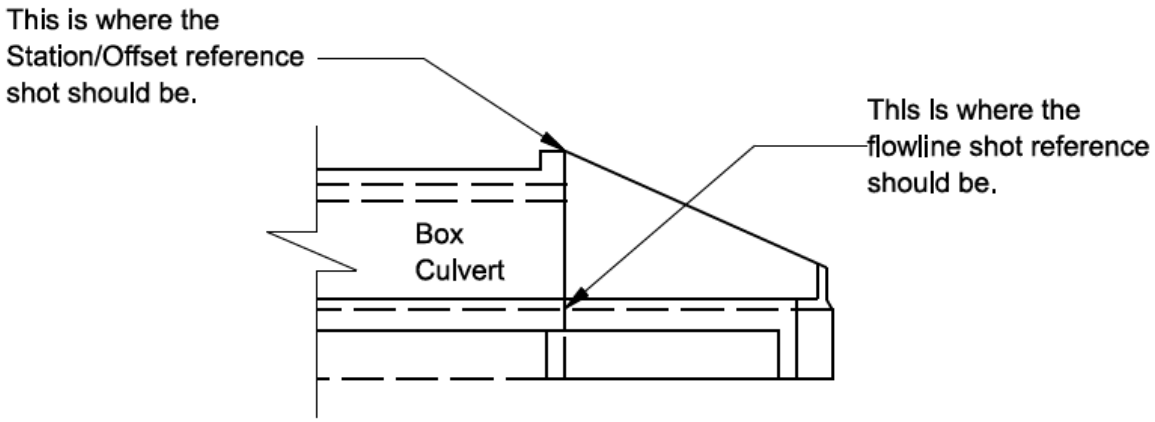
Any questions concerning survey limits, or special needs for a given site should be directed to the appropriate Hydraulics Engineer prior to commencing the survey.

Location of Shots on Box Culverts

Coordinates and elevations shall be obtained at the end of the box culvert, not at end of apron. Measure the end section and note the length.



PLAN



ELEVATION

Figure 6-15 Location of Shots on Box Culverts

SURVEY REQUIRMENTS FOR 1R, 2R, 3R and 4R PROJECTS

The purpose of this section is to provide direction on collecting the field data needed for the different types of projects.

Survey needs will be determined by Policy Number DOT-P&E-PD-6.0 *Definition and Standards for Construction/Reconstruction, Resurfacing, Restoration and Rehabilitation of Highways and Bridges under State Jurisdiction.*

1R Projects (Restoration/Preservation)

The purpose of a 1R project is to preserve the existing pavement layers and structures. Surveys requirements for 1R projects will be minimal. The auto level and tape cross section method may be used if approved ahead of time by the Designer requesting the survey data. The following information will need to be gathered in order to properly design the project.

a) Surfacing width and cross slope information at ¼ mile intervals
b) Approach surfacing
c) Areas of extra width (Mailbox turnout, bus turnarounds, etc.)

2R Projects (Resurfacing and Restoration)

The purpose of a 2R project is to extend the serviceability of the existing roadway pavement and structures to meet the functionality of the highway facility. Survey requirements for 2R projects are the same as the preliminary survey as outlined on pages 6-18 to 6-27 of this chapter but, only at specified location. The data will be collected in the appropriate State Plane Coordinate System and processed through the CAD system to produce a fieldbook file (.fwd), alignment file (.alg), DTM file (.dtm), and a design file (.dgn); as outlined in Survey Data Requirements on page 6-27 of this Chapter.

The information gathered should be similar to the information in Figure 6-16 and 6-17 on the following page. Segments of the road will be surveyed from right of way line to right of way line, small individual Digital Terrain Models (DTM) will be created at specific locations that allow the design engineer to cut cross-sections where needed. Survey data will be gathered at the following locations to properly design the project.

a) Surfacing width and cross slope information at ¼ mile intervals
b) Crossing culvert pipes
c) Beginning, middle and end of guardrails
d) Approach and approach pipe
e) Areas of extra width (Mailbox turnouts, bus turnarounds, etc.)

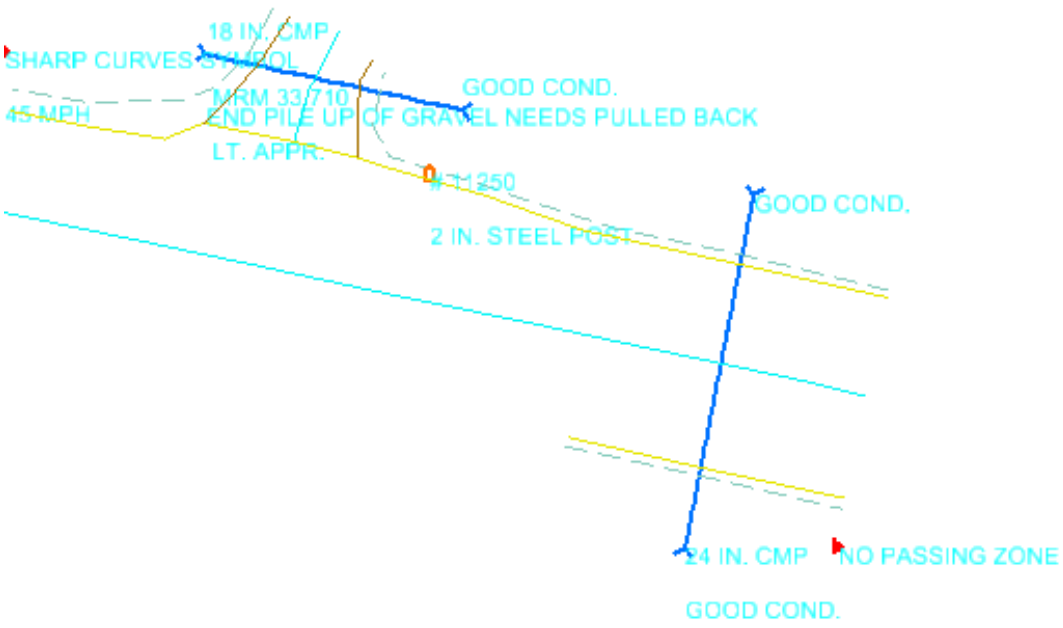


Figure 6-16 2R Survey

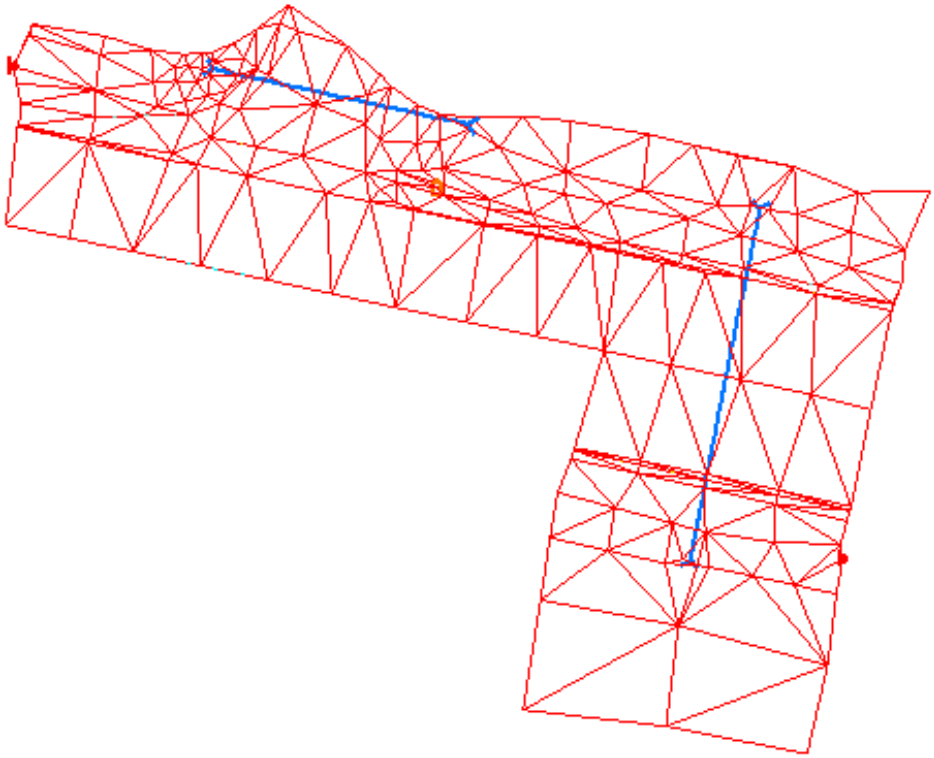


Figure 6-17 2R Survey DTM

3R Projects (Resurfacing, Restoration, or Rehabilitation)

The purpose of a 3R project is to preserve and extend the life of existing highways and structures while enhancing highway safety. Safety enhancement is an essential consideration, and 3R projects are to be developed and completed in a manner that considers and includes appropriate safety improvements. These 3R standards may be utilized on non-Interstate Systems passing through cities, towns and urban areas. Survey requirements for 3R projects are the same as the preliminary survey as outlined on page 6-19 to 6-27 of this chapter. The data will be collected in the appropriate State Plane Coordinate System and processed through the CAD system to produce a fieldbook file (.fwd), alignment file (.alg), DTM file (.dtm), and a design file (.dgn); as outlined in Survey Data Requirements on page 6-27 of this Chapter.

Survey data gathered will be the same as the preliminary survey. The following information will need to be gathered in order to properly design the project.

a) Topographic surveys at specific locations (pipe repair, inslope flattening, turn-lane addition/intersection work, etc.) extending 300 feet each side of centerline.
b) Intersection roads extending 300 feet each side of centerline of the intersecting roads.
c) Other items may be addressed in the scope that will require additional survey.

4R Projects (Complete Reconstruction)

The purpose of a 4R project is to completely reconstruct the existing highway infrastructure. Survey requirements for 4R projects are the same as the Planimetric and Digital Terrain Model Data as outlined on page 6-20 to 6-27 of this chapter. The data will be collected in the appropriate State Plane Coordinate System and processed through the CAD system to produce a fieldbook file (.fwd), alignment file (.alg), DTM file (.dtm), and a design file (.dgn); as outlined in Survey Data Requirements on page 6-27 of this chapter.

Survey data gathered will be the same as the preliminary survey. The following information will need to be gathered in order to properly design the project.

a) Full topographic surveys extending 300 feet each side of centerline.
b) Intersecting roads extending 300 feet each side of centerline of the intersecting roads.
c) Other items may be addressed in the scope that will require additional survey.
d) Additionally the survey may include areas of proposed new alignments.

SUBSURFACE UTILITY/UTILITY SURVEYS

Subsurface utility surveys are becoming more important as the amount of underground utilities continues to increase. The utilities need to be accurately mapped in 3-dimension to ensure that they will be avoided during construction or moved prior to construction.

If the utility survey is performed by DOT personal a non-excavation locate request called an appointment planning request shall be executed through the SD One-Call

center. The appointment planning ticket will be called in by calling **811** five days prior to any field work performed. Maps provided by the locator and or owner of the utilities may and should be used to help interpret the SD One Call markings in order to accurately map the utilities. Additional utility maps may be available and are located in the project development folder under U:\pd\cntyPCN#\Utilities. Old DOT construction plans may also be used to ensure storm sewers are accurately mapped.

Subsurface utility engineering (**SUE**) surveys may be performed by contracted SUE utility mapping consultants. These completed surveys include all underground private and public utilities, all existing storm sewer (including drop inlets, manholes, inverts, photography, etc.), all above ground and overhead public utilities (including street lights, traffic signals, controller cabinets, etc.). Project deliverables from the SUE consultant to the DOT include a MicroStation .dgn file, field notes, a drainage database, images of all drainage structures; and a sealed and signed hard copy of utility plan sheets. The MicroStation .dgn file will be stored in the appropriate road design folder under U:\rd\prj\cntyPCN#. The remaining SUE deliverables will be stored in the road design folder under U:\rd\prj\cntyPCN#\utilities\SUE\.

Sometimes the utilities surveyed by the SUE consultant need to be extended due to the expansion of the project limits. If extra utilities need to be surveyed by DOT personnel, the survey must be committed into a separate .dgn file; which will then be added to the file submitted by the SUE consultant.

A review of the SUE survey and the preliminary design may indicate a utility conflict that will require further exploration to determine the depth of the existing utility in a specific area.

1. The utilities will be physically exposed by the SUE consultant using a vac-truck.
2. The SUE consultant will contact the appropriate Area Surveyor to survey the location of the test holes.
3. The surveyor will survey the locations using the TSTSUE code and record the following information provided on the test hole flag.
    a. test hole number (as the point number)
    b. the cut (depth to utility)
    c. the utility owner
    d. select the type of utility from the attributes pulldown
4. Update the preliminary survey FWD (#PCN.fwd) file with the test hole data
5. Update the preliminary survey ALG (#PCNorg.alg) file with the test hole data
6. Update the preliminary survey DTM (#PCNorg.dtm) file with the test hole data
7. Recommit the graphics to update the preliminary survey DGN (t#PCN*.dgn) file with the test hole data

Radon Gas Warning: Utility Vaults may be filled with Radon gas an invisible and poisonous gas. Breathing this gas could be fatal if vault lids are open and the air within them is inhaled please use extreme caution when surveying these utility vaults

BRIDGE DECK SURVEYS

The Bridge Maintenance Engineer will send the Area Office a layout of each structure scheduled for bridge deck overlay. The layout will indicate the specific data that must be collected for that structure during the survey. **DO NOT PROCEED WITH A BRIDGE DECK SURVEY UNTIL YOU HAVE RECEIVED A STRUCTURE LAYOUT OR CONTACTED THE BRIDGE MAINTENANCE ENGINEER.**

ADA SURVEYS

It is expected that there will be increased impacts to ROW, Utilities, etc. based on applying current and proposed ADA requirements.

Therefore, surveys for resurfacing and stand-alone lighting, signal, or signing projects need to be obtained earlier so the design process can begin a minimum of 2 years prior to the proposed letting date of the project. In some cases a more detailed survey will be needed for those type of projects listed above.

During the scope process for all projects, the type and amount of survey shall be noted. In some cases the designer may need to perform a field inspection to determine what locations need a detailed survey so that the designer can check if the current location meets ADA requirements and/or use the survey data to determine impacts to ROW, utilities, etc. during design. Limits of ADA surveys at intersections typically extend 50 feet to 100 feet beyond the PC and PT of the intersection fillets. Before preforming an ADA survey contact the designer or responsible manager to determine the limits of the survey.

When ground shots and topography features are collected, the survey should include adequate coverage to detail the sidewalk and ramp widths, cross slopes, longitudinal grades, landing size, vertical grade breaks, steps, thresholds and all ADA related items located within and near the pedestrian access route along the highway ROW.

Total stations and or robotic total stations will be used on all ADA projects. Elevations shall be collected to ±0.03 – 0.04 feet (9-12 mm) accuracy on all ADA related features included in the Digital Terrain Model (DTM). GPS RTK positions using a single base station does not provide sufficient accuracy and will not be used for this type of survey. For critical tie in points such as thresholds, ramps, steps, landings etc., elevations should be verified by the use of an auto level unless originally collected by a robotic total station.

Note Keeping

The keeping of good ADA survey notes is of utmost importance because they:

1. present the entire record of the survey
2. may be used by people unfamiliar with the work done on a survey project

3. reflect the quality of work done during the course of the survey

A few principles that apply to all forms of note keeping are:

4. be complete
5. be concise
6. avoid copying as much a possible

Keep notes as brief as possible, while still getting all the information desired, and to keep them arranged in a logical sequence. Following is a list of a few examples of field notes that should be recorded when performing ADA surveys.

1. Thresholds – Note whether the door opens in or out and which side the door is hinged on while facing the door.

2. Traffic Signal poles – Note if push button is present.

Figure 6-18 Survey Needs for ADA REquirements

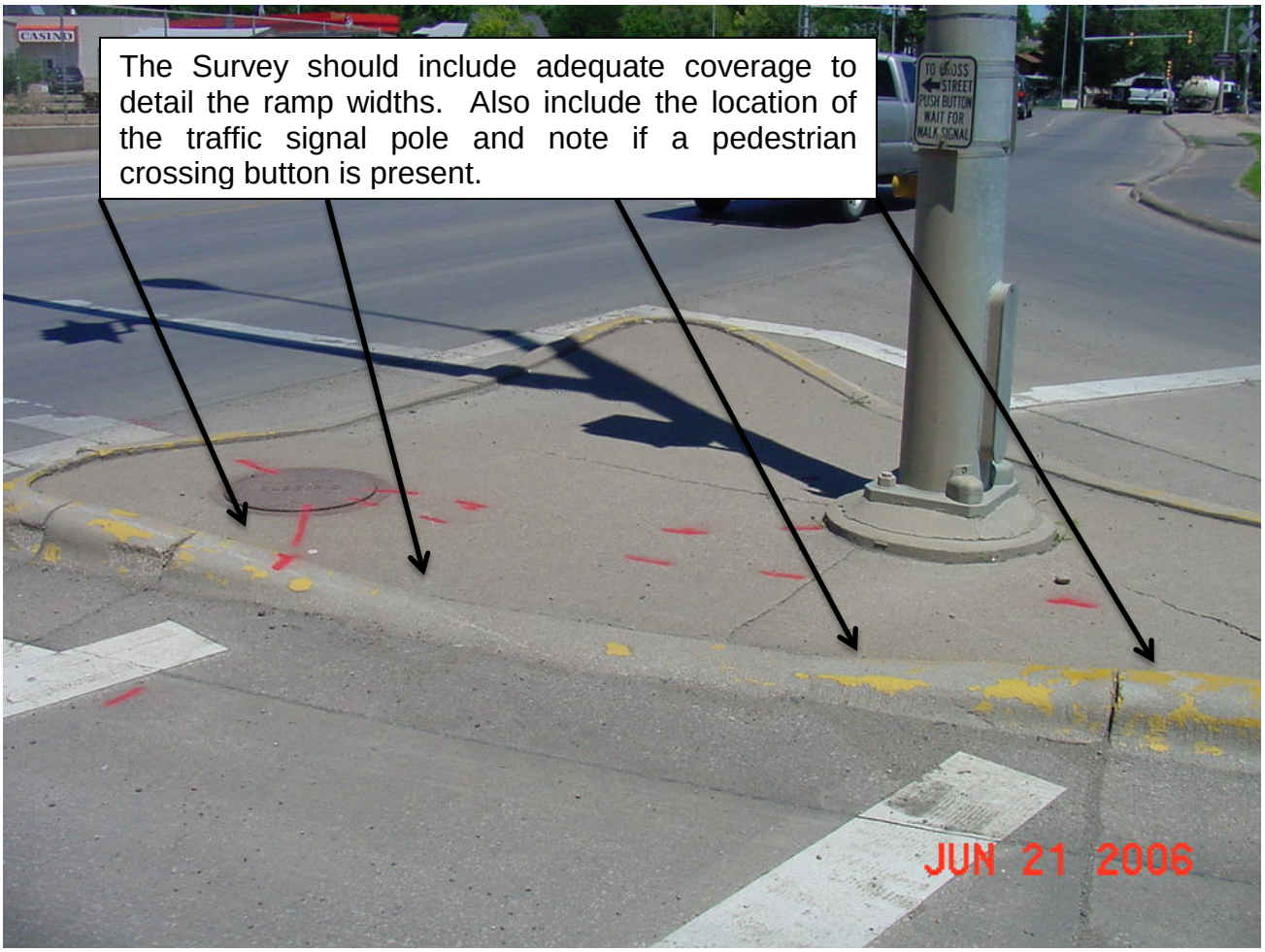


Figure 6-19 Survey Shot Locations for Curb Ramps