PlanPRO

Tools for plan and profile sheets of transmission lines.

Introduction

By Robert L. Zipprich

Since 1978 I have worked on a variety of transmission projects and in 1985 began using AutoCAD to generate the type of Plan and Profile drawings shown on the preceding sheet, as well as structure framing details, catenary curve templates, permit application drawings, construction documents, and technical sketches. By using AutoCAD's development language "Autolisp" I have applied engineering formulas and design parameters to the drawings and this data then becomes an inherent part of the engineering documents. Survey data and line design features are included in the actual drawing files either as attributes or as extended entity data.

The following is by no means a comprehensive list of all that could be said or done with regard to engineering and design of transmission projects, but the tools herein have at one time or another been applied in the development of an engineering document.

TYPICAL SCENARIO

An existing Transmission Line is being upgraded with new conductors and equipment. A survey must be made of the line to verify the existing right of way and equipment for the proposed conductor upgrade. Existing poles will be reframed and/or replaced. Drawings will be done in AutoCAD. A surveyor is chosen and performs the survey using a computerized transit. Before starting the drawings you obtain from the Surveyor a computerized ASCII text file of all surveyed shots, with north, east, elevation and shot description notes. You are given CAD maps showing road information, section, township, range lines, property lines and physical features in the area of the line to be designed, as well as any drawings showing previous construction drawings.

DRAWING SETUP

For accurate results, assume 1 drawing unit = 1'-0" and set the drawing UNITS to option 2 decimal) and option 5 (surveyor). AutoCAD assumes 1 drawing unit as equaling an inch (1") but for this case assume one unit (1") equals (1') Create drawings in scales of units = feet. For drawing scales of 20v/200h (1"=20' vertical, 1"=200' horizontal), scale the drawing titleblock to 200 times size and set the AutoCAD SETVAR variables DIMSCALE and LTSCALE to 200. Text sizes should also be 200 times normal size. A point block is used for conductor locations so set the SETVAR variable PDMODE to 2 and the variable PDSIZE to 8 for 200 scale drawings.

The plan and profile drawing files should be continuous and be drawn at a horizontal scale of 1"= 200' and a vertical scale of 1"= 20', unless otherwise directed by the Engineer. The Plan view should include the mapping of all major planametric features within the width of the specified right-of-way, plus 100 feet from the edge of each side. The centerline of the transmission line should be approximately centered in the plan view. The plan should be continuous for at least six hundred feet beyond the nominated terminal points. Where two or more transmission lines are identified within a corridor, each transmission line shall be unique, and a separate plan and profile drawing required for each transmission line.

When drawing files are divided into separate sheets, an overlap of one spans length should be included in the plan and profile at each end and indicated as being a part of another continuous sheet by being drawn in a hidden linetype. Individual sheets should consist of 1 linear mile of line each. Some clients prefer sheets be drawn to 6000 or 5500 feet per sheet, and overlaps between sheets not allowed. Spans are sometimes part of two separate miles (sheets) of line and are broken at the exact mile point even if mid-span.

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Survey Shot List

Modern Surveying Transits produce a computer generated shot list in an ASCII text file, similar to the following list:

```
Shot#,North,East,Elevation,Note
579,950044.791141,1809943.140016,2999.065185546875,up4895
580,949986.302012,1810032.92218,3002.75537109375,cl12'drive
581,949958.336072,1810080.614271,3004.742919921875,164
582,949922.336761,1810135.834963,3006.409912109375,up4815'x'ing
583,949910.837908,1810140.122433,3004.676513671875,guywire
```

PlanPRO Autolisp programs utilize this text file to organize data for the plan and profile portions of the drawing. By using Dbase III to sort and modify the shot list we can add the Engineers structure data before creating the plan view of the transmission line. The fields within the DbaseIII file match the attribute names in the plan and profile pole blocks.

1	SHOT	Numeric	4	0	21	HARDWARE	Character	10
2	NORTH	Numeric	15	4	22	HARDWARE2	Character	10
3	EAST	Numeric	15	4	23	HARDWARE3	Character	10
4	ELEV	Numeric	15	4	24	HARDWARE4	Character	10
5	DESCRIPT	Character	20		25	HARDWARE5	Character	10
6	POLENUM	Character	10		26	REMARKS	Character	40
7	POLE_MK	Character	10		27	MISC1	Character	20
8	POLEBLK	Character	12		28	MISC2	Character	20
9	BEARING	Character	15		29	MINVCL2G	Character	10
10	STA_AH	Character	15		30	LSPAN	Character	10
11	STA_BK	Character	15		31	WSPAN	Character	10
12	SPANBACK	Character	9		32	ANG	Character	10
13	POLEHTCL	Character	20		33	TRAN1_HT	Character	10
14	TOPASSY	Character	15		34	TRAN2_HT	Character	10
15	TURNANGL	Character	15		35	TRAN3_HT	Character	10
16	GUYING	Character	10		36	DIST1_HT	Character	10
17	GUYING2	Character	10		37	DIST2_HT	Character	10
18	ANCHOR	Character	10		38	COMM1_HT	Character	10
19	ANCHOR2	Character	10		39	OHGW1_HT	Character	10
20	GUYLEADS	Character	12		40	SPACE	Character	2

In Dbase the command sequence would be like this:

```
C:>DBASE  [ESC]                                  (to the "dot" prompt in Dbase)
.USE \PLANPRO\DBF\STRSHEET
.COPY STRUCTURE TO 1151243                       (project#)
.USE 1151243
.APPEND FROM SURVEY.ASC DELIMITED WITH ,         (< note comma)
.INDEX ON SHOTNUM TO 1151243.NDX
.SET INDEX TO 1151243.NDX                        (then modify fields with Engineers data)
.COPY ALL TO PLANVIEW.TXT SDF
.QUIT
```

The modified shot list from Dbase III will look like the following and have actual structure data in it.

Shot#	North	East	Elevation	Note
579	950044.791141	1809943.140016	2999.065185546875	UP4895
580	949986.302012	1810032.92218	3002.75537109375	CL12'DRIVE
581	949958.336072	1810080.614271	3004.742919921875	164
582	949922.336761	1810135.834963	3006.409912109375	UP4815'X'ING

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583 949910.837908 1810140.122433 3004.676513671875 GUYWIRE

Plan View

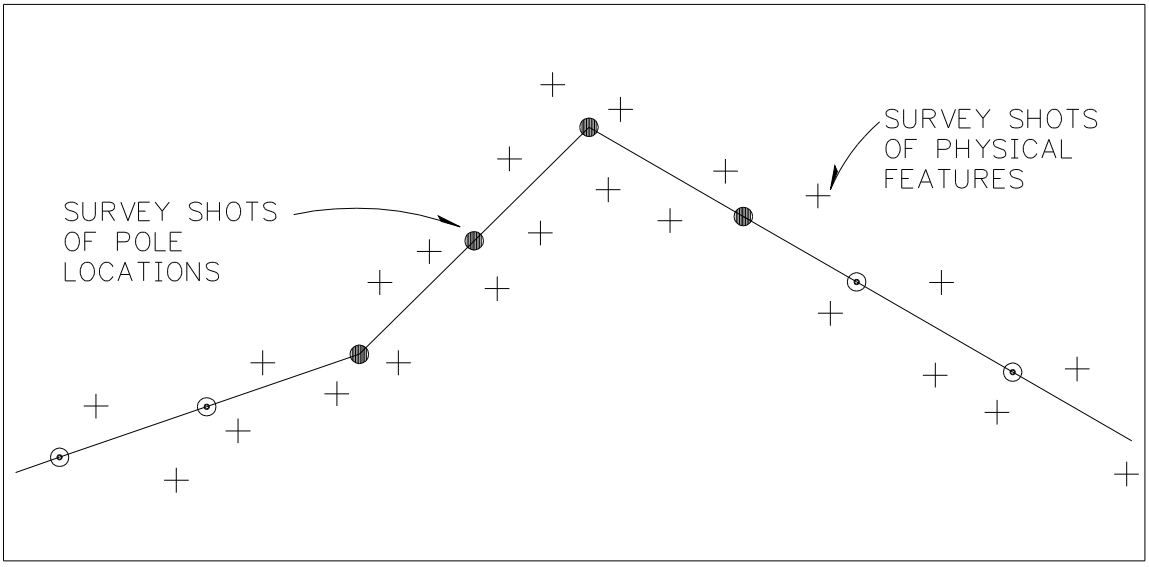
Once the Database is sorted and structured, start a prototype drawing for the plan view portion. This drawing should have the SHOT block in it for locating each survey shot.

From the command line in the drawing editor load PLANVIEW. (LOAD "PLANVIEW")

Type PLANVIEW at the Command prompt and then type in the name used for the surveyor ASCII shot list above. The program will ask for a note to look for. The list above uses "UP" for a utility pole. Key in "UP" and PLANVIEW will search and parse the text file and create a plan view from the survey shot data by placing pole blocks at all pole locations, with shot number, description and elevation in attributes. Shot blocks will be inserted for all other features in the shot list.

[Planview] Draws Plan View of Transmission Line from an ASCII shot list text file derived from importing a survey shot list into DbaseIII, modifying the description fields and then exporting it in Space Delimited Form to a PLANVIEW.TXT file. PLANVIEW.LSP would then read and insert custom blocks and lines for each shot and bearing.

Filename to import <>:
Pole Block Name to Insert <POLEXST1>:
Insertion Scale of Block <>:
Note Value in File to Find <POLE>:



Trace with a POLYLINE the actual route of the structures in the transmission line. PLANVIEW can be modified to do this for you by removing the semi-colon from the APPLY statement in the Autolisp code. This works well with single pole structure designs in conjunction with a straight traverse survey. Double and triple pole structure designs may require a modified centerline, and use different sets of pole blocks.

Replace the default structure block POLEXST1 with POLENEW1 or POLEREM1 for those structures to be added or removed. Replace with POLEDIS1 for distribution poles within the right-of-way.

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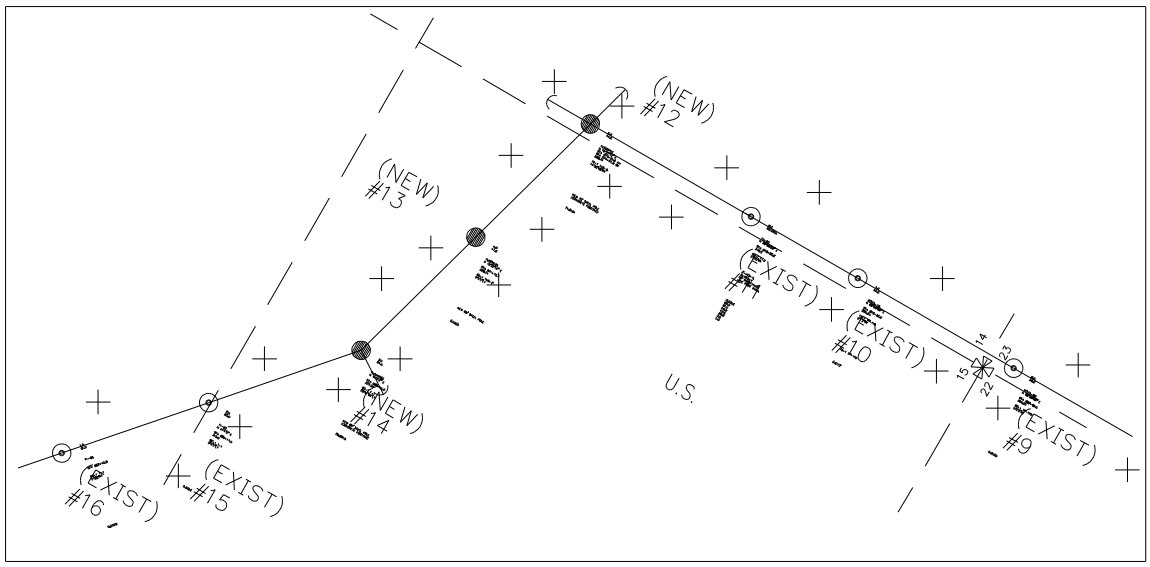
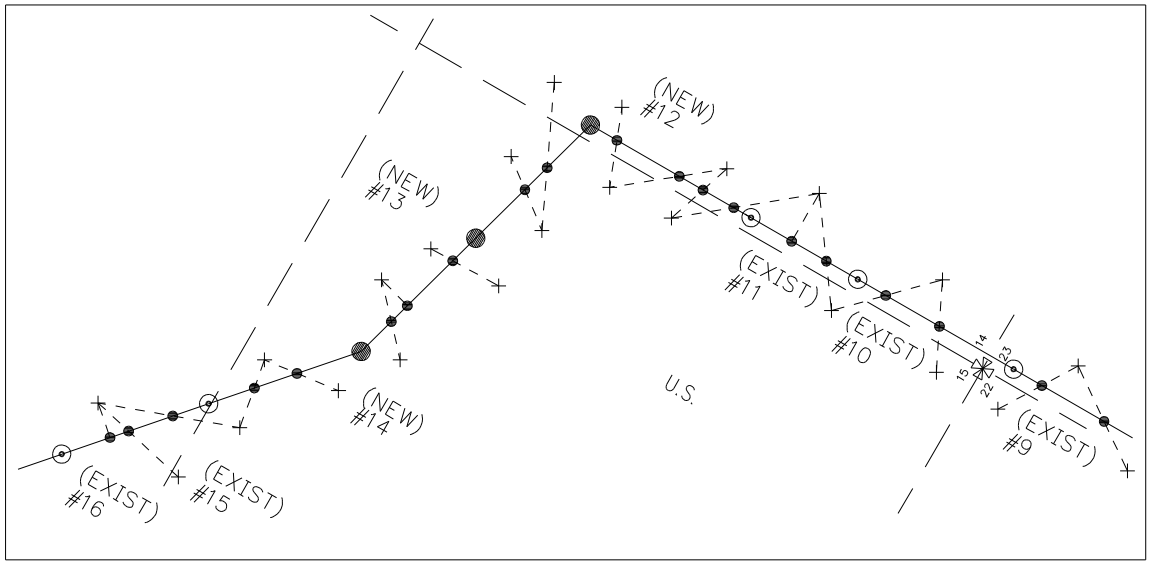


Insert and/or Modify the pole number attribute in the pole block to the correct sequential number of the poles. This will be different than the survey shot number which can vary from pole to pole. After spotting and inserting new pole blocks in the plan view, add the pole block name and the engineers structure design data to the attributes contained in the pole blocks.



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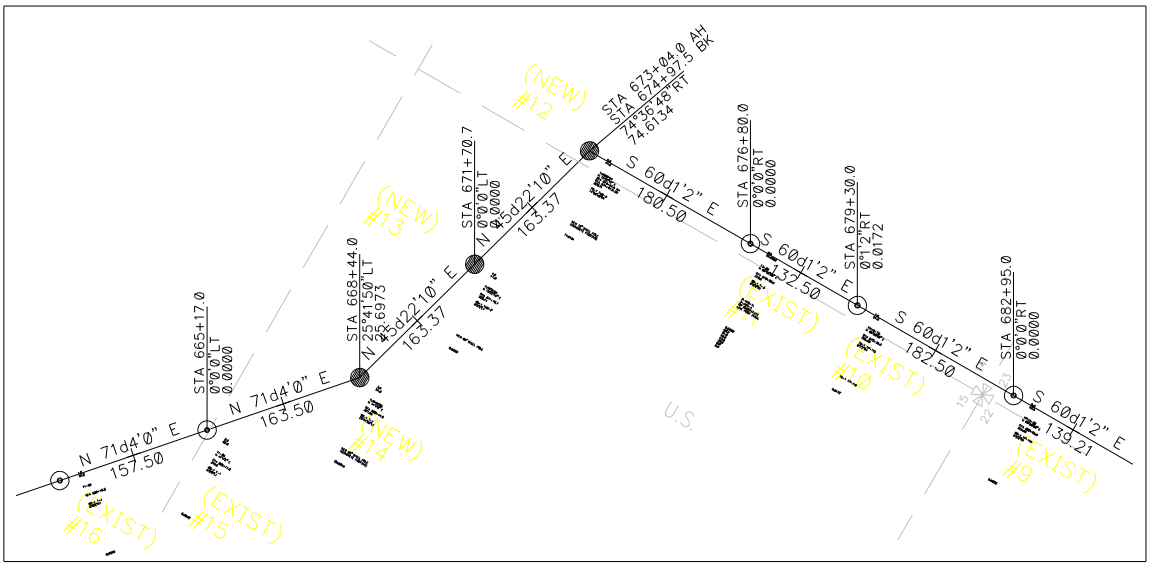
Next, create in-line elevation points along the proposed centerline of the line right-of-way. These elevation points and the pole locations will be extracted to a text file used in the profile portion of the drawing.



Using the BEARING.LSP utility, add Stationing and Bearing Turn Angle values to the PLANVIEW. Add Survey Bearing and Distance values with LABELINE.LSP to each segment of the line.

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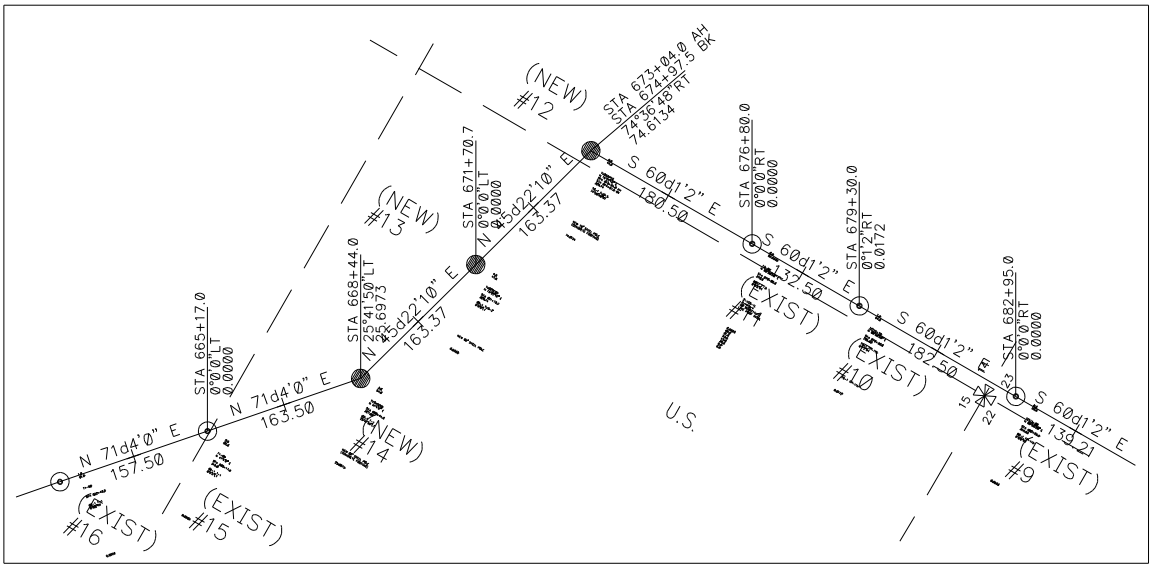
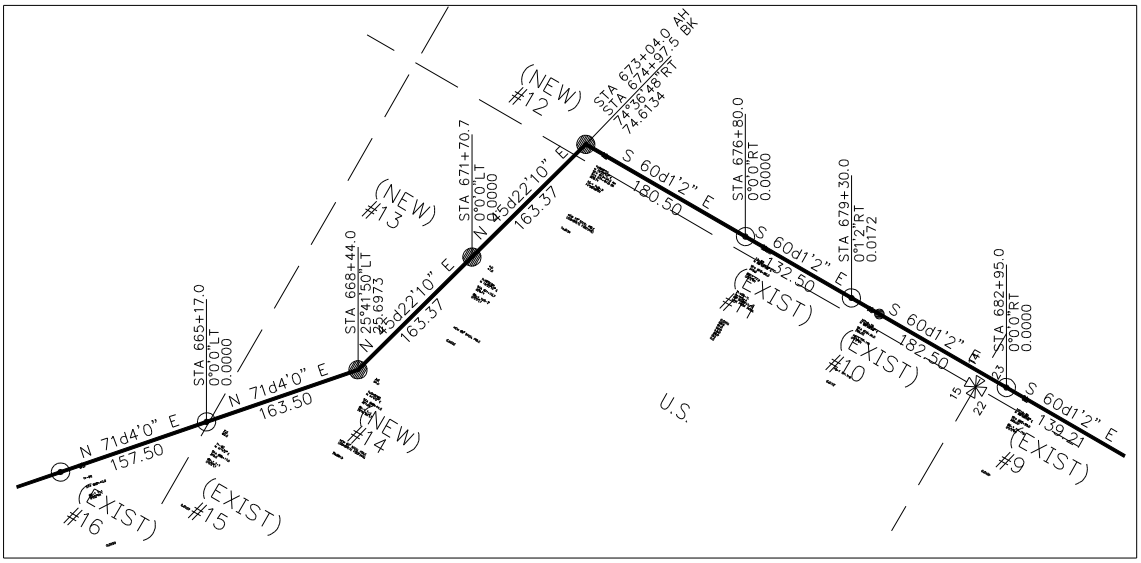


Transfer Stationing, Bearing Turn Angles, Survey Bearing and Distance values from the BEARING and LABELINE block attributes to the AHEAD pole block attributes using COPYATTG.LSP.



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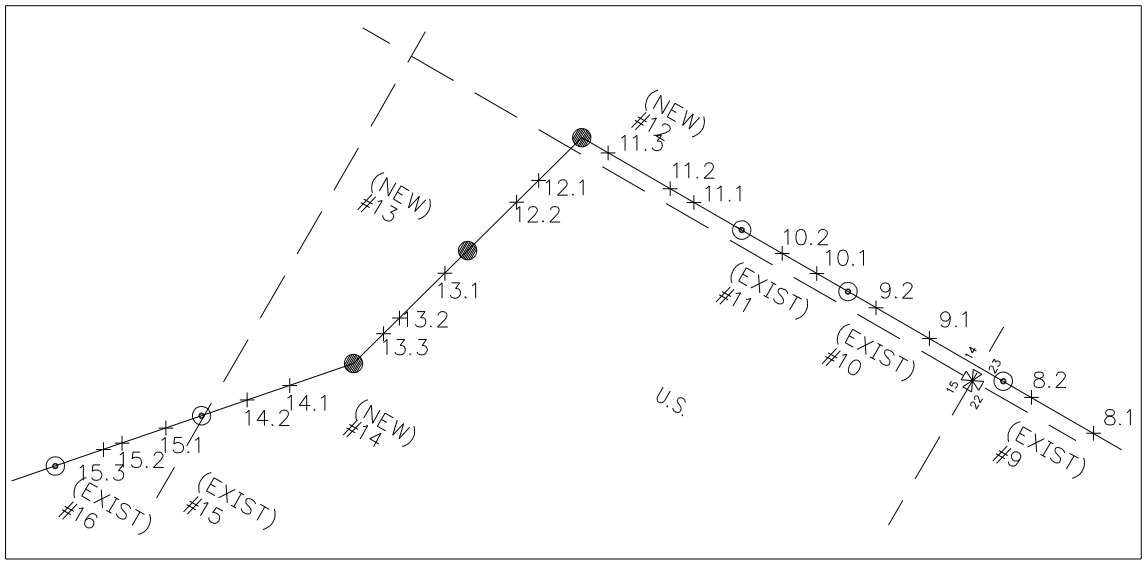
This completes the setup of the PLAN VIEW portion of the drawing. The Transmission Line data has been attached to the POLE block attributes and is ready to be used to create the PROFILE VIEW. Additional features such as anchors, stub poles, guying, buildings, crossing transmission lines, distribution underbuild, roads, etc. can be added.



To extract Transmission Line Pole data to a text file for making the Profile View, turn off all layers except the POLE and IN-LINE shot layers. Using ATTEXT, select all poles and in-line shot blocks to be extracted. Specify C:\PLANPRO\XTRACT\STRSHEET.TXT as the template file and accept the default drawing name as the name for the output file. VERIFY THAT ALL STRUCTURE DATA IS CORRECT BEFORE PROCEEDING TO THE PROFILE PORTION OF THE PROGRAM.

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Plan View Block Attributes

(New Pole Added)	(Existing Pole)	(Distribution Pole)	(Pole Removed)	
POLENEW(1,2,3)	POLEXST(1,2,3)	POLEDIS(1,2,3)	POLEREM(1,2,3)	LABELINE
pnts	pnts	pnts	pnts	bearing
elev	elev	elev	elev	spanback
desc	desc	desc	desc	
polenum	polenum	polenum	polenum	
pole_mk	pole_mk	pole_mk	pole_mk	BEARING
poleblk	poleblk	poleblk	poleblk	sta_bk
bearing	bearing	bearing	bearing	sta_ah
sta_ah	sta_ah	sta_ah	sta_ah	angle
sta_bk	sta_bk	sta_bk	sta_bk	ang
spanback	spanback	spanback	spanback	
polehtcl	polehtcl	polehtcl	polehtcl	
topassy	topassy	topassy	topassy	SHOT
angle	angle	angle	angle	pnts
guying	guying	guying	guying	elev
guying2	guying2	guying2	guying2	desc
anchor	anchor	anchor	anchor	
anchor2	anchor2	anchor2	anchor2	
guylead	guylead	guylead	guylead	MILEPOLE
hardware	hardware	hardware	hardware	mile#
hardware2	hardware2	hardware2	hardware2	pole#
hardware3	hardware3	hardware3	hardware3	
hardware4	hardware4	hardware4	hardware4	
hardware5	hardware5	hardware5	hardware5	
remarks	remarks	remarks	remarks	
misc1	misc1	misc1	misc1	
misc2	misc2	misc2	misc2	
minvcl2g	minvcl2g	minvcl2g	minvcl2g	
lspan	lspan	lspan	lspan	
wspan	wspan	wspan	wspan	
ang	ang	ang	ang	
tran1_ht	tran1_ht	tran1_ht	tran1_ht	
tran2_ht	tran2_ht	tran2_ht	tran2_ht	
tran3_ht	tran3_ht	tran3_ht	tran3_ht	
dist1_ht	dist1_ht	dist1_ht	dist1_ht	
dist2_ht	dist2_ht	dist2_ht	dist2_ht	
comm1_ht	comm1_ht	comm1_ht	comm1_ht	
ohgw1_ht	ohgw1_ht	ohgw1_ht	ohgw1_ht	

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Block Extract Templates

Extract file(s) for plan view attributes. Data is written to <dwgname.txt> as a default.

[STRSHEET.TXT]	
PNTS	C004000
BL:Y	N015004
BL:X	N015004
ELEV	N015004
DESC	C020000
POLENUM	C010000
POLE_MK	C010000
POLEBLK	C012000
BEARING	C015000
STA_AH	C015000
STA_BK	C015000
SPANBACK	C009000
POLEHTCL	C020000
TOPASSY	C015000
ANGLE	C015000
GUYING	C010000
GUYING2	C010000
ANCHOR	C010000
ANCHOR2	C010000
GUYLEAD	C012000
HARDWARE1	C010000
HARDWARE2	C010000
HARDWARE3	C010000
HARDWARE4	C010000
HARDWARE5	C010000
REMARKS	C040000
MISC1	C020000
MISC2	C020000
MINVCL2G	C010000
LSPAN	C010000
WSPAN	C010000
ANG	C010000
TRAN1_HT	C010000
TRAN2_HT	C010000
TRAN3_HT	C010000
DIST1_HT	C010000
DIST2_HT	C010000
COMM1_HT	C010000

[BORDER.TXT]	
TITLE1	C020000
TITLE2	C020000
TITLE3	C020000
DWG_NUM	C020000
REV_NUM	C020000
SHT_NUM	C020000
SHT_OF	C020000
VERT_SCL	C020000
HOR_SCL	C020000
DATE	C020000
CHKD	C020000
DRAWN	C020000
CAD_NUM	C020000
EL1L	C020000
EL1R	C020000
EL2L	C020000
EL2R	C020000
EL3L	C020000
EL3R	C020000
EL4L	C020000
EL4R	C020000
EL5L	C020000
EL5R	C020000
STA1	C020000
STA2	C020000
STA3	C020000
STA4	C020000
STA5	C020000
STA6	C020000
STA7	C020000
STA8	C020000
STA9	C020000
STA10	C020000
STA11	C020000
STA12	C020000
STA13	C020000

[POLE_RPT.TXT]	
PNTS	N004000
CHAR1	C002000
POLENUM	C004000
ELEV	N015004
CHAR2	C002000
POLEHTCL	C020000
TOPASSEMB	C015000
ANGLE	C015000
POLEBLK	C012000
STA_AH	C015000
STA_BK	C015000
SPANBACK	N009002

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Profile View

Obtain from the Engineer a Structure List with accompanying Pole Design sheets (Figures PR1 & PR2) that define the conductor attachment points and pole sizes and create block definitions of each pole type in sizes 50' - 95' in 5' increments similar to those blocks in Figure PR3. These blocks will be inserted when the profile view is created. Pole blocks for the profile view should be scaled ten (10) times size to account for using them at a vertical drawing scale which is 1/10th of the horizontal drawing scale. The conductor attachment points can be obtained either from the structure drawings or from a Design Data sheet (Figure PR3).

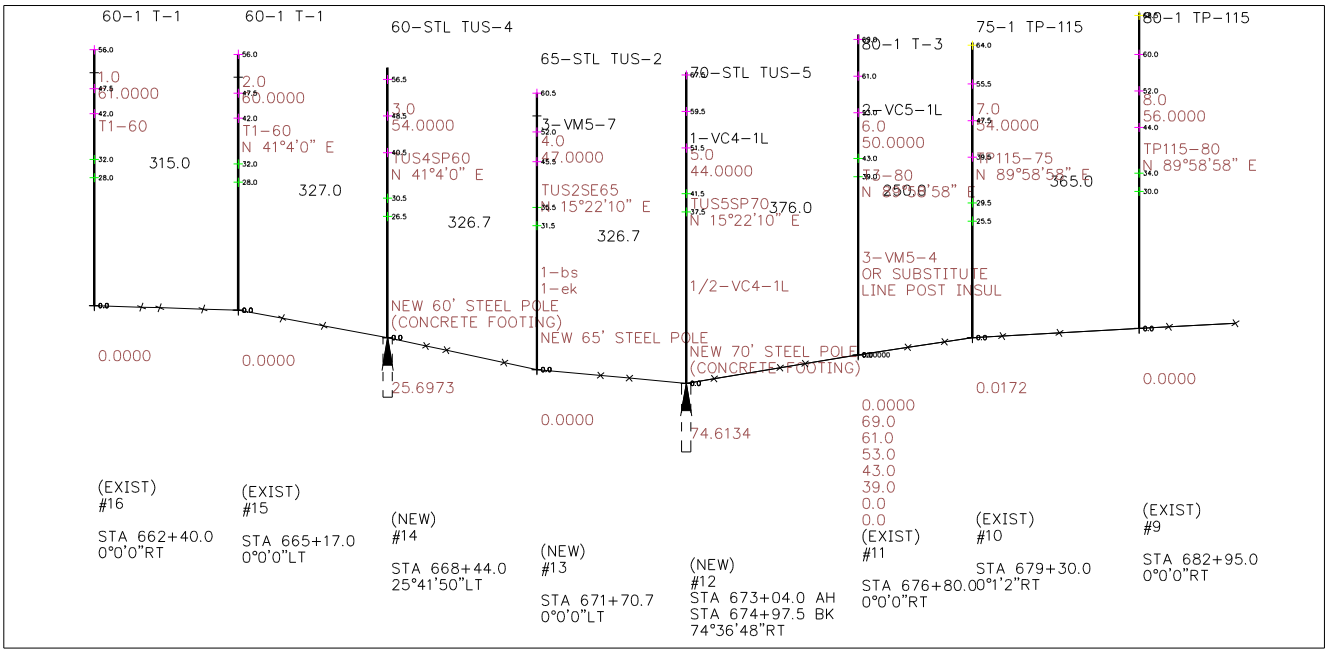
Start a new drawing in AutoCAD and insert the library drawing of pole blocks as a block into the new drawing, then erase the block. This will leave the pole block definitions in the new drawing. Do not purge the drawing until the profile view is complete.

Load PROFILE.LSP using the Autolisp LOAD function. (LOAD "PROFILE")

Type PROFILE at the Command prompt and then type in the name of the ASCII shot list. The program will read the file line by line and insert pole blocks listed in the pole block definition area. All other in-line points will have a shot block inserted. To complete the profile view, PROFILE will draw the ground line.

[Profile] Draws Profile View of Transmission Line from an ASCII shot list text file, usually derived from importing a survey shot list into DbaseIII, modifying the description fields and then exporting it in Space Delimited Form to the shot list text file. This file would then be read by PROFILE.LSP and insert custom blocks and lines for each shot and bearing.

Filename to import <>:
Specify Ratio of Y to X Scale <>:
Beginning Shot Stationing <>:
Start Point >



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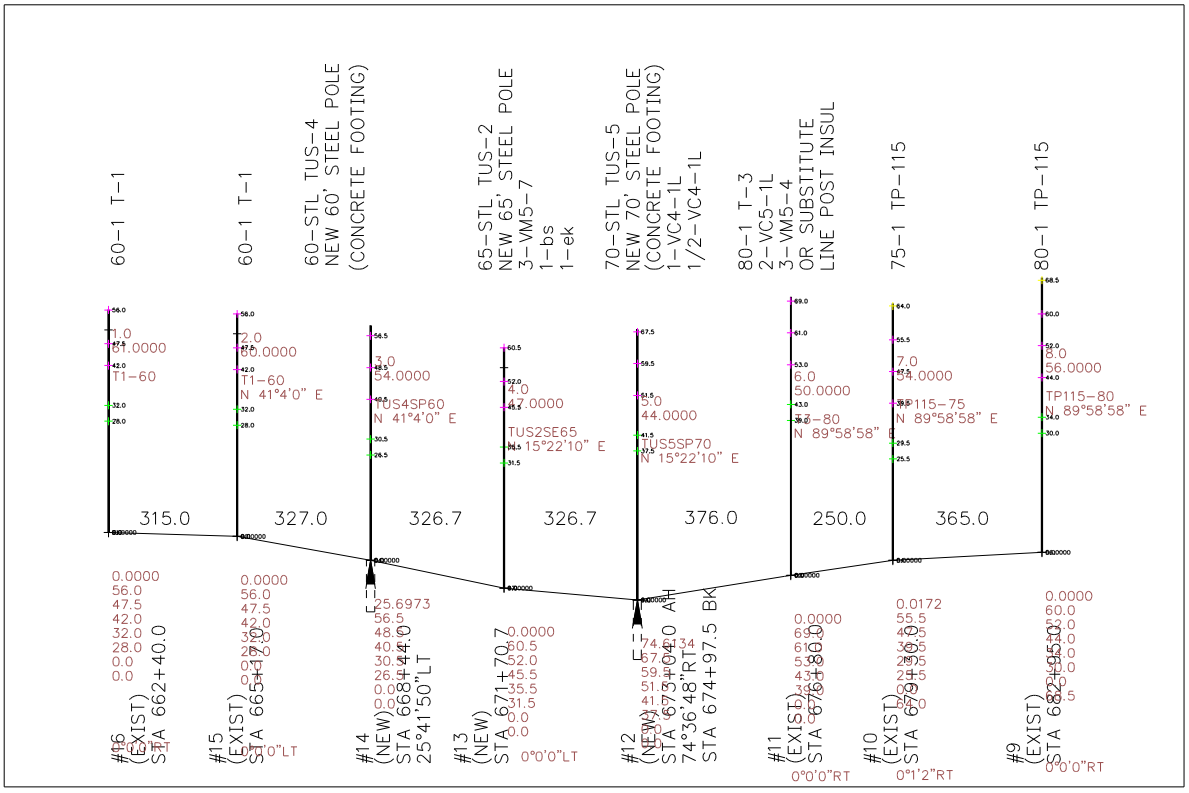
Relocate attributes using MODATT or one of the Menu Expand options in the PLANPRO Menu. Copy ELEV attributes from POLE blocks to POLEATTR data blocks. Add Profile features such as Angle marks, guying, etc.



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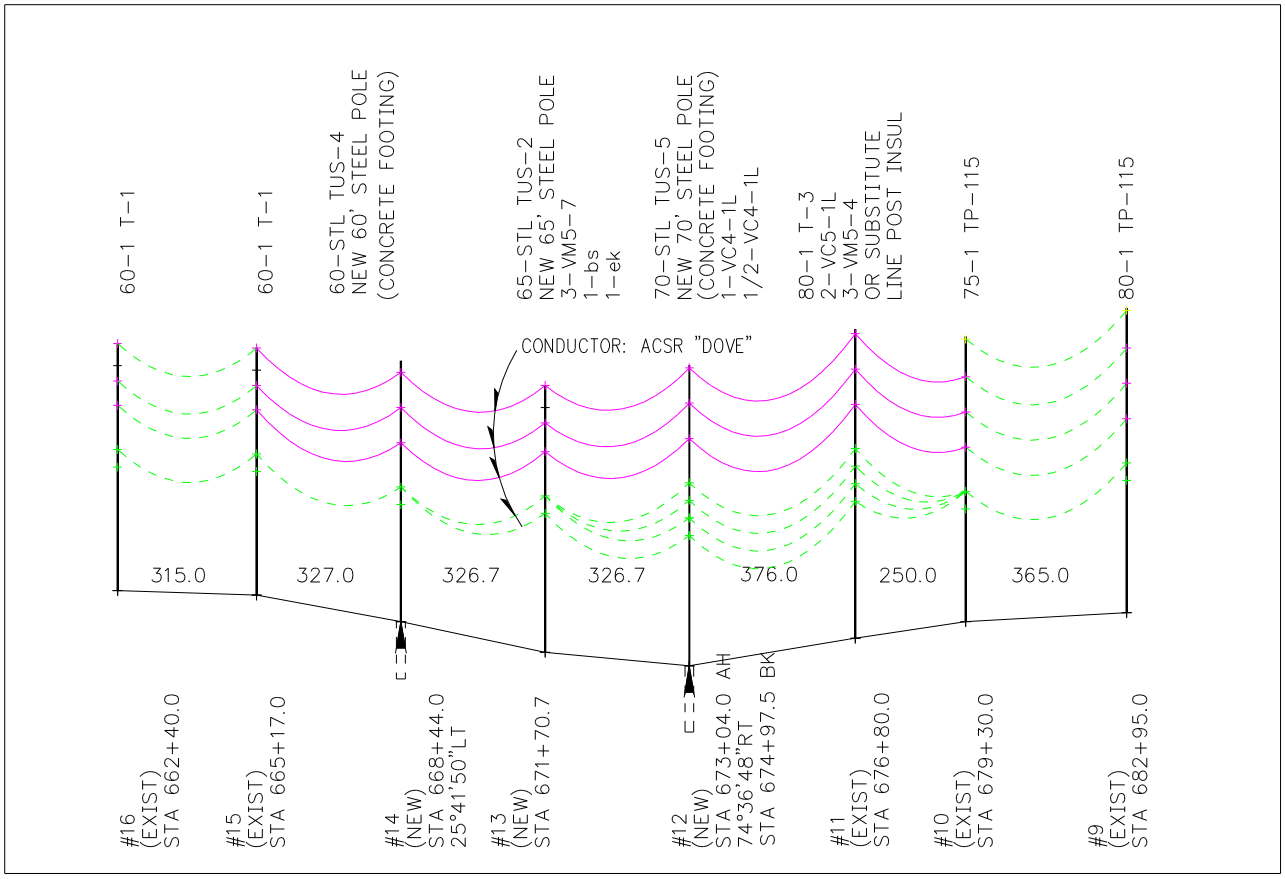
Add Catenary Curve conductors with CAT.LSP (see section on CAT.LSP). Also refer to Autolisp Utilities section for using MINVCL2G.LSP and OFFSET.LSP to add additional data and to break section vertically to fit on Plan and Profile sheet.



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Profile View Block Attributes

2ND_ATTR	SHOTATTR	POLEATTR	BORDER	CATKVALS
pnts	pnts	pnts	title1	vs
desc	elev	elev	title2	vs2
polenum	desc	desc	title2	hs
serial#	polenum	polenum	dwg_num	hs2
angle	pole_mk	pole_mk	rev_num	k1
spanback	poleblk	poleblk	sht_num	k1a
wire_size	bearing	bearing	sht_of	k2
polehtcl	sta_ah	sta_ah	vert_scl	k2a
pri_unit	sta_bk	sta_bk	hor_scl	k3
transf	spanback	spanback	date	k3a
gnd_unit	polehtcl	polehtcl	chkd	k4
guy_unit_1	topassemb	topassemb	drawn	k4a
guy_unit_2	angle	angle	cad_num	
guy_leads	guying	guying	el1l	
anchor_1	guying2	guying2	el1r	OFFSET
anchor_2	anchor	anchor	el2l	el1l
2nd_unit_1	anchor2	anchor2	el2r	el1r
2nd_unit_2	guylead	guylead	el3l	el2l
2nd_undbld	hardware	hardware	el3r	el2r
2nd_sec	hardware2	hardware2	el4l	el3l
2nd_wire	hardware3	hardware3	el4r	el3r
serv_unit_1	hardware4	hardware4	el5l	el4l
serv_unit_2	hardware5	hardware5	el5r	el4r
serv_span	remarks	remarks	sta1	el5l
serv_wire	misc1	misc1	sta2	el5r
meter_size	misc2	misc2	sta3	
pole_mk	minvcl2g	minvcl2g	sta4	
misc_1	wspan	wspan	sta5	
misc_2	lspan	lspan	sta6	
misc_3	ang	ang	sta7	
misc_4	tran1_ht	tran1_ht	sta8	
remarks_1	tran2_ht	tran2_ht	sta9	
remarks_2	tran3_ht	tran3_ht	sta10	
	dist1_ht	dist1_ht	sta11	
	dist2_ht	dist2_ht	sta12	
	comm1_ht	comm1_ht	sta13	
	ohgw1_ht	ohgw1_ht		