CAD Standards Manual

TRANSPORTATION DEPARTMENT
PUBLIC WORKS AGENCY

CAD Standards

Introduction

The purpose of this manual to establish uniform policies and procedures to carry out the Computer-Aided Design and Drafting (CAD) functions for the County of Ventura Public Works Agency Transportation Department (PWATD). The uniform policies will be used by the department to maintain Quality Control, which will increase productivity and efficiency in sharing electronic files and information.

The policies established herein are for the information and guidance of the employees of the Department and for those doing work for the Department.

It is recognized that some work performed for the PWATD may need to be submitted to other governmental agencies. Those submittals need to conform to both the PWATD standards and the agencies' standards.

Project Phases

The following describes drawing procedures and requirements for each phase of a project.

Pre-Drawing/Design

During the pre-drawing/design phase, the PWATD project manager schedules a kickoff meeting. During the meeting, design requirements for the project are discussed, including specific CAD standards and file compatibility.

Review (Pre-Bid)

Drawing reviews take place during project progress meetings between the consultant and the PWATD project manager. Hard copy drawings and electronic files are reviewed early in the design process to confirm that standards are being met.

Final review of drawings and specifications are at 100% of contract drawing completion (or as defined by the PWATD project manager). Drawings are plotted full scale. Drawing signatures are not required at this time, unless otherwise requested by the PWATD project manager.

Advertisement (Bid-Set)

The consultant is responsible for preparing the bid set as follows:

- Drawings incorporate all corrections from the review process.
- Drawings are plotted, stamped, and signed. Note: All drawing stamps and signatures must comply with State of California requirements. See *Reprographics* section for further requirements.
- Drawings must meet the standards as described in this manual.

Addendum

Addendum changes affecting drawings occur during the advertising/bidding period. Addendum changes may be made in one of the following ways: in writing; by reissuing the drawing; by issuing a sketch; or by adding new drawings (described in the *Revised or Reissued* Drawings section).

Revised or Reissued Drawings

If the drawing change is described in writing text, the CAD drawing still needs to be corrected to reflect the change. The title block must reflect that it has been changed by addendum.

Revisions to drawings are shown as addendum number changes. In the drawing, indicate revisions made by addendum with the revision number in delta and a drawing cloud around each change. Next to the revision number in the title block, indicate the date the revision is made to the drawing, the initials of the person making the change, and the statement, "REVISED BY ADDENDUM No. ____."

If drawing revisions are so extensive that clouding is not practical, replace the clouding with the revision block statement, "SHEET REISSUED BY ADDENDUM No. ____." ADDENDUM No. ___ shall also be placed above the title block on the lower right side of the sheet being revised. The text size shall be 0.4".

If subsequent addendum changes are made to a drawing, remove the previous clouding within the drawing, then make the changes, cloud and add revision delta, and add another delta in the title block. Do not remove the previous revision deltas and notes from the title block. See the *Revisions* section later in this manual for additional requirements.

Sketches

Whenever possible, use an 8.5" x 11" sketch with clouds to illustrate revisions to a specific drawing detail rather than reissuing the entire sheet. Label each detail sketch sequentially (e.g., Sketch A, Sketch B, etc.) and show the number of the detail being revised, as well as the addendum number. Do not use sketches for addenda changes if more than one is needed for a particular detail or if a verbal description is needed in addition to the sketch to indicate all the changes. In those cases, the entire drawing should be reissued.

New Drawings

In rare cases, a new sheet is added to the drawing set by addendum. In these instances the added sheet should have an alpha character after the page number & drawing number so that subsequent sheets do not need to be renumbered. For instance, if a new civil drawing needs to be inserted between Sheet 8 and Sheet 9, the new sheet is numbered 8A. The revision block in the new sheet should have a statement that reads, "SHEET ADDED BY ADDENDUM # ____." ADDENDUM No. ___ shall also be placed above the title block on the lower right side of the sheet being revised. The text size shall be 0.4".

Addendum Deliverables

Once the necessary revisions have been incorporated or new drawings are complete, plot the drawing sheets and send them to the PWATD project manager. Submit drawing sheets in full scale and with the stamp and original signature. Electronic files shall also be submitted.

Record Drawing (As-Built)

As-Built plans are the as awarded project plan sheets that have been updated to reflect the changes, if any, which occurred during construction. As-Built plans are mandatory for accurately documenting the final field conditions at the completion of a project.

Drawings shall include all changes made during the construction process. Drawings shall stand alone as a complete record of the “As-Built” condition.

Verification that all CCOs have been incorporated and the CCO# (and date) are listed in the title block on the affected sheets, is required.

Each sheet of the As-Built plans must be clearly identified with a “RECORD DRAWING” stamp. The Resident Engineer (R.E.) is to review, confirm and approve that the As-Built plans were completed according to the corrections. All plan sheets whether they contain changes or not, must be signed by the licensed R.E.

Record drawings are then submitted to the Engineering Services Department (Survey Section) to be recorded and stored with the County of Ventura record files for public information.

General Requirements

General requirements apply to all PWATD projects.

Software

PWATD utilizes Autodesk Software as a standard and is required for all projects.

Note:
Actual software version(s) used by PWATD will change when software is updated; please verify the version(s) currently in use. Files that create proxy objects or other entities which cannot be fully manipulated using the aforementioned software will not be accepted.

Drawing Sheet Size

For design/construction documents, use 22″x34″ sheet size. A larger sheet size may not be used unless prior approval from the PWATD project manager.

When producing reduced size drawings, print the drawings at True Half Scale on 11"x17" sheet size.

For pavement projects, 11"x17" sheet size may be used at full scale.

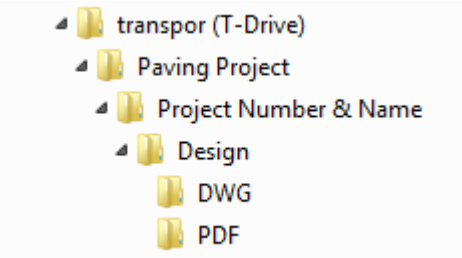
Drawing Number

The drawing number is assigned by the County of Ventura Public Works Agency Engineering Services Department. The technical support team will supply the drawing numbers prior to the final design of the project.

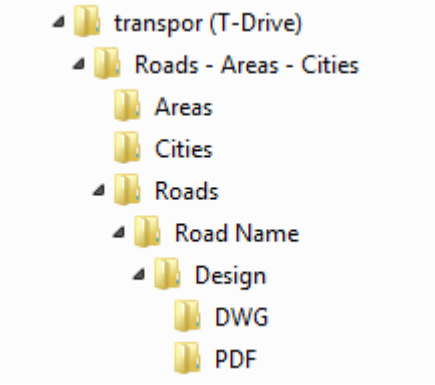
Folder Structure

The PWATD folder structure is based on the Project Request created by the PWATD Advance Planning Section.

Folder structure for Paving Projects:



Folder structure for Road-specific projects:



File Naming Structure

PWATD has adopted the following file naming convention for CAD files and project exhibits for all projects.

Project #-XX (ex. 50520-BP)

BP	=	Bid Plans
DB	=	Design Base
EC	=	Erosion Control Plan
SV	=	Survey/Additional survey data
TB	=	Traffic Base
TC	=	Traffic Control Plan
TS	=	Traffic Signal Plan
TP	=	Topography
UT	=	Utilities

Drawing Setup

The PWATD drawing template is available online at http://vcpublicworks.org/transportation-department/pwatd-cad-standards. All new projects must use the latest version of the drawing template. The template includes all layer-names with their settings, text styles, and dimension styles.

General Layout of Drawing Sheets

Consider plan scales and layout organization before the drawing process begins. Place plan sheets in the front of the drawing set and details and sections in the back; do not crowd the details and sections sheets together. Use additional sheets if necessary; clarity is more important than sheet count.

Notes

The PWATD uses several different types of notes.

- General discipline notes – apply to all sheets within a discipline and are located on the first sheet in the discipline. A legend, index, vicinity map, location map, and applicable standard callouts shall also appear on the first sheet.

- Sheet notes – apply to the entire sheet; order and title these sequentially.

    - "CONSTRUCTION NOTES" shall be represented with a hexagon symbol and numbered 

.

    - "CONDUCTOR SCHEDULE" traffic conductor schedule notes are represented with a triangle symbol and numbered 

.

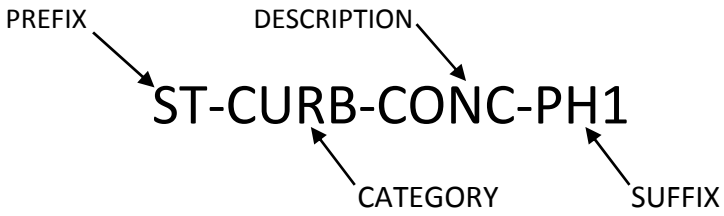
    - Title block revisions are represented with a triangle symbol and a letter 

.

- Detail notes – apply to only that detail and shall have the same formatting as sheet notes. The detail notes should be located above the detail title.

AutoCAD Layering Guide

The PWATD's AutoCAD Layering Guide is meant to be flexible and adaptable, and was created to help users separate like types of information in AutoCAD. Layer names are created using a standard naming convention with each segment separated by a hyphen.



- PREFIX
  The PREFIX category is represented by a Section Code or AutoCAD Function
- CATEGORY
  The category represents the line work
- DESCRIPTION
  Related to the Category, offers additional clarification (optional, not required)
- SUFFIX
  Used for project phasing (optional, not required)

PREFIX	
Code	Description
ST	STREET
TF	TRAFFIC
UT	UTILITY
TOPO	TOPOGRAPHY
PRF	PROFILE
H	HATCH
BDR	BORDER
XREF	EXTERNAL REFERENCES

SUFFIX	
Code	Description
PH1	PHASE 1
PH2	PHASE 2
EX	EXISTING

COUNTY OF VENTURA TEMPLATE LAYERS			
Layer Name	**Color**	**Linetype**	**Layer Description**
BDR-FINE	12	Continuous	Border Fine Line
BDR-MED	9	Continuous	Border Medium Line
BDR-THK	5	Continuous	Border Thick Line
BDR-TXT	7	Continuous	Border Text
H-BLK-LIGHT	142	Continuous	Hatch: Black Light Line
H-BLK-FINE	40	Continuous	Hatch: Black Fine Line
H-BLK-MED	9	Continuous	Hatch: Black Medium Line
H-BLK-THK	3	Continuous	Hatch: Black Thick Line
H-GRY-LIGHT	123	Continuous	Hatch: Gray Light Line
H-GRY-FINE	83	Continuous	Hatch: Gray Fine Line
H-GRY-MED	44	Continuous	Hatch: Gray Medium Line
H-GRY-THK	165	Continuous	Hatch: Gray Thick Line
NOPLOT	34	Continuous	Non-Plotting Mark-up Layer
PRF-GRID-BDR	4	Continuous	Profile: Grid Border Line
PRF-GRID-MAJ	164	Continuous	Profile: Major Grid Lines
PRF-GRID-MIN	44	Continuous	Profile: Minor Grid Lines
ST-BUS-PAD	1	Continuous	Street: Concrete Bus Pad
ST-BUS-SH	142	Continuous	Street: Bus Shelter
ST-CL	1	CENTER	Street: Centerline
ST-CURB-AC	114	Continuous	Street: Asphalt Concrete Curb
ST-CURB-CONC	2	Continuous	Street: Concrete Curb
ST-DWY	12	Continuous	Street: Driveway
ST-EP	63	Continuous	Street: Edge of Pavement
ST-FENCE	9	SHP_X	Street: Fence
ST-FL	40	SHP_ARR_FL_DASH	Street: Flowline
ST-GUTTER	12	DASHDOT2	Street: Gutter
ST-MBGR	230	SHP_BOX_RT	Street: Metal Beam Guard Rail
ST-RAMP	40	Continuous	Street: Handicap Ramp
ST-WALL	7	Continuous	Street: Wall
ST-ROW	4	TXT_ROW	Street: Right of Way
ST-SIGN	7	Continuous	Street: Street Sign
ST-STRIPE	7	Continuous	Street: Striping
ST-SW	15	Continuous	Street: Sidewalk
ST-TCE	2	SHP_TCE_ELL	Street: Temporary Construction Easement
ST-TOE-SLOPE	21	DASHED2	Street: Toe of Slope

Layer Name	Color	Linetype	Layer Description
TF-LOOP	2	Continuous	Traffic Loop
TF-PB	3	Continuous	Traffic Pullbox
TF-SIGNAL	7	Continuous	Traffic Signal
TXT-LRG	2	Continuous	Text: Large 0.20
TXT-MED	9	Continuous	Text: Large 0.15
TXT-TYP	7	Continuous	Text: Large 0.125
UT-CATV	130	TXT_CATV	Utility: Cable TV
UT-ELEC	130	TXT_E	Utility: Electrical
UT-OIL	130	TXT_OIL	Utility: Oil
UT-SD	2	Continuous	Utility: Storm Drain
UT-SD-STR	2	Continuous	Utility: Storm Drain structure
UT-SS	130	TXT_SS	Utility: Sewer
UT-TELE	130	TXT_T	Utility: Telephone
UT-W	1	TXT_W	Utility: Water
UT-W-FH	142	Continuous	Utility: Water Fire Hydrant
VPORT	34	Continuous	Viewport

Policy on Model and Paper Space

AutoCAD has two separate "spaces" for drawing information to reside: Model space and paper space. Model space is where the geometric model is drawn in a three-dimensional coordinate system at true scale. Paper space is a two-dimensional coordinate system used for sheet layouts. The PWATD allows the use of both spaces and multiple tabs in each dwg file.

The PWATD utilizes the following guidelines as to what information resides in each space.

Design and Details

All design and detail objects will be in model space at true scale, on an appropriate layer and when appropriate on the correct coordinate system.

Dimension and Text

Place in model space when dimensions and text that need to be shown on several paper space tabs or when there will only be one paper space tab in the file.

Place in paper space when dimensions and text do not carry over from sheet to sheet, or when there are multiple paper space tabs.

GPS Coordinate call outs need to remain in model space.

Sheet Information

The following are examples that should be placed in paper space:

- North arrow
- Match lines and associated text
- Revision clouds and deltas
- Revision notes
- Title blocks
- Tables
- Graphic scales
- Notes
- Legends
- Vicinity map
- Professional stamps
- Dimensions
- Detail titles

Policy on External References

All External references (XREF's) shall be inserted on the XREF layer. All XREF drawings shall be inserted as overlays and set to relative path. The use of XREF's as attachments and or full path will not be accepted.

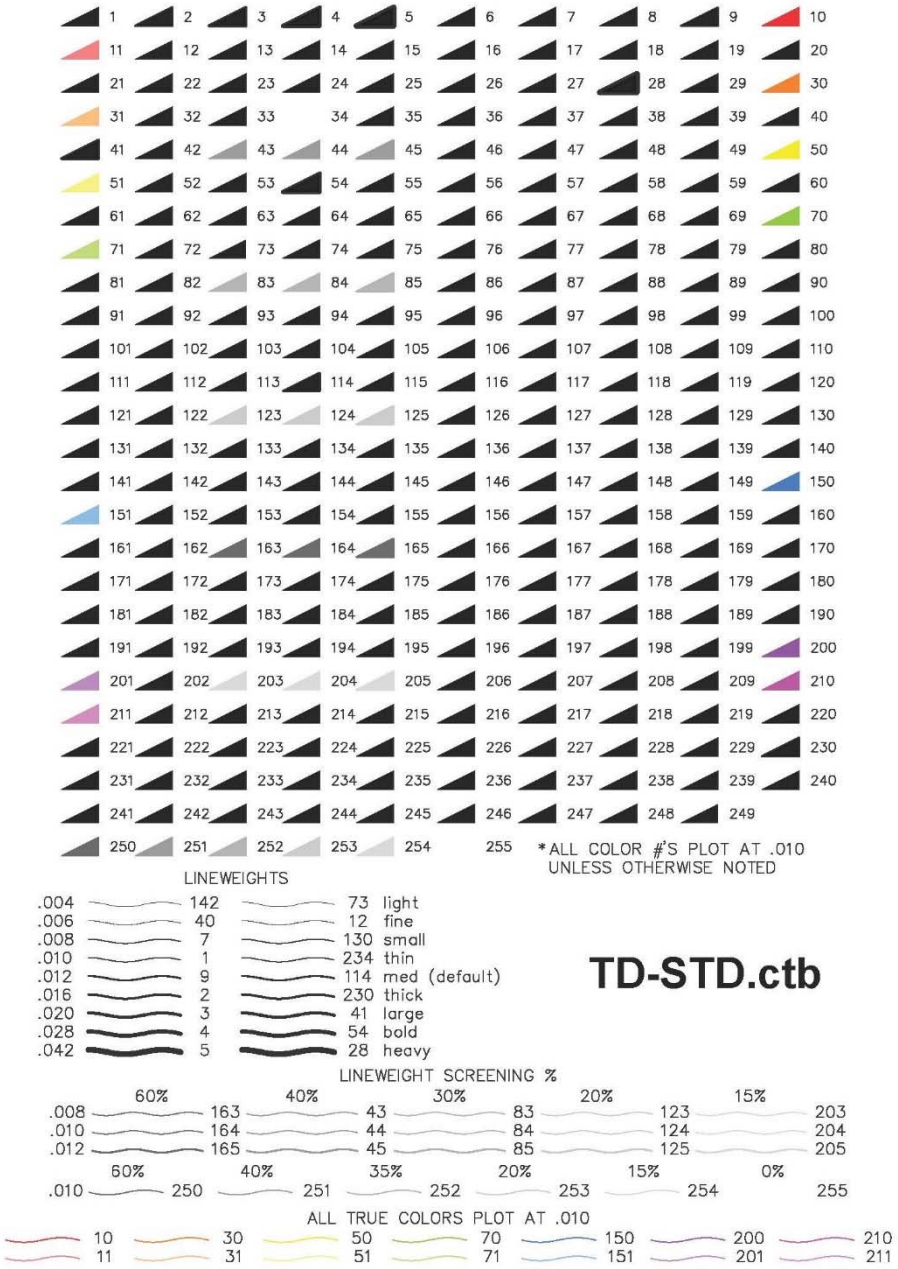
If an XREF is not required in a drawing, properly detach the XREF in the External Reference Manager; do not simply delete the XREF drawing.

Plot Styles

The PWATD uses color-dependent plot styles. While a color-dependent plot style is preferred, the PWATD will accept files from consultants with their own pen tables. If the consultant chooses to use his or her own pen table, the consultant must supply either the .stb file, or the .ctb file.

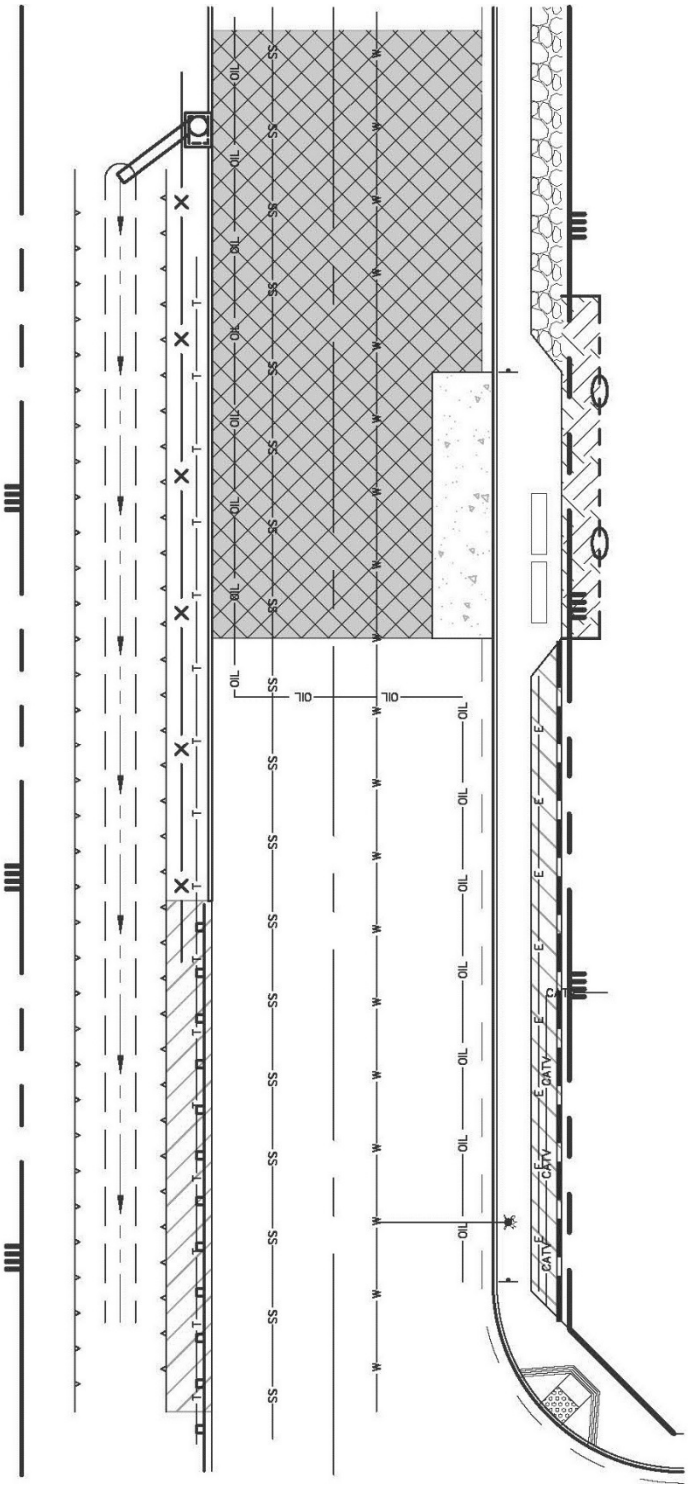
Lineweights/Color Settings

Lineweights and colors available in AutoCAD are bylayer (in some case may also be by entity).



Linetype Styles

Line type styles shall be placed bylayer. Sample drawing with different line types shown below. See sheets 10-11 for more linetype and layer detail.



Abbreviations

Abbreviations should only be used to reduce time and space, or where appropriate to improve clarity. When possible, use the following approved abbreviations and symbols. If an abbreviation you want to use is not on the list, the use of an abbreviation that is universally recognized in the construction industry may be allowed. If there is a possibility of ambiguity or confusion, the PWATD may, at its discretion, require the word or term to be spelled completely.

Please note that common English language terms have not been included. Examples are “afternoon” (PM) and “Pacific Standard Time” (PST).

Abbreviation List

And	&
Centerline	℄
Degrees	°
Existing Elevation	( )
Feet	‘
Inches	“
Survey Line	SL
A	
Abutment	ABUT
Adjust	ADJ
Aggregate Base	AB
Alternate	ALT
Angle Point	AP
Approximate	APPROX
Asphalt Concrete	AC
Asphalt Rubberized Hot Mix	ARHM
Average	AVG
B	
Back of Walk	BW
Begin	BEG
Begin Horizontal Curve	BC
Begin Vertical Curve	BVC
Beginning Curb Return	BCR
Bench Mark	BM
Best Management Practice	BMP
Boulevard	BLVD
Bottom	BOT
Bottom of Pipe	BP
Building	BLDG
C	
Cast Iron Pipe	CIP
Catch Basin	CB
Centerline	C/L
Chain Link Fence	CLF
Changeable Message Sign	CMS
Concrete	CONC
Corrugated Metal Pipe	CMP
Court	CT
Cul-de-Sac	CDS
D	
Degree	DEG
Distance	DIST
Diameter	DIA
Drive	DR
Driveway	DWY
Drainage Inlet	DI
Ductile Iron Pipe	DIP
E	
Easement	ESMNT
East	E
Eastbound	EB
Edge of Pavement	EP
Edge of Shoulder	ES
Edge of Traveled Way	ETW
Electric	ELEC
Elevation	EL/ELEV
Embankment	EMB
End of Horizontal Curve	EC
End Curb Return	ECR

End Vertical Curve	EVC
Engineer	ENG
Existing	EX
Existing Ground/Grade	EG
Expansion	EXP
F	
Face of Curb	FC
Federal	FED
Figure	FIG
Finish Grade	FG
Finish Surface	FS
Fire Hydrant	FH
Flow Line	FL
Freeway	FWY
G	
Galvanized	GALV
Grade Break	GB
Guard Railing	GR
H	
Headwall	HW
Height	H=
High Density Polyethylene	HDPE
Highway	HWY
High Point	HP
Horizontal	HORIZ
Hot Mix Asphalt	HMA
I	
Inside Diameter	ID
Intersection	INT
Invert	INV
Iron Pipe	IP
Irrigation	IRR
J	
Junction	JCT
Junction Structure	JS
L	
Left	LT
Length	L
Latitude	LAT
Location	LOC
Longitude	LONG
Low Point	LP
Lump Sum	LS
M	
Mailbox	MB
Maintenance	MAINT
Manhole	MH
Maximum	MAX
Median	MED
Metal Beam Guardrail	MBGR
Mile Post	MP
Minimum	MIN
Miscellaneous	MISC
Modified	MOD
Monument	MON
N	
North	N
Northbound	NB
Not to Scale	NTS
Number	#
O	
Off Center	OC
Outside Diameter	OD
Overhead	OH
P	
Parkway	PKWY
Pavement	PVMT
Pedestrian	PED
Perforated Pipe	PRFP
Plans, Specifications, and Estimates	PS&E
Place	PL
Polyvinyl Chloride Pipe	PVC
Point of Compound Vertical Curve	PCVC
Point of Compound Curve	POCC
Point of Intersection	PI
Point of Reverse Curve	PRC

Point of Reverse Vertical Curve	PRVC
Point of Tangency	PT
Point of Vertical Intersection	PVI
Portland Cement Concrete	PCC
Power Pole	PP
Private	PRVT
Processed Miscellaneous Base	PMB
Property Line	P/L
Protect in Place	PIP
Pull Box	PB
Q	
Quantity	QTY
R	
Radius	R
Railroad	RR
Reinforced Concrete Box	RCB
Reinforced Concrete Pipe	RCP
Retaining Wall	RW
Revised Standard Plan	RSP
Revision/Revised	REV
Right	RT
Right of Way	ROW
Road	RD
Route	RTE
S	
Sheet	SHT
Shoulder	SHLD
Slope	S=
South	S
Southbound	SB
Specifications	SPEC
Standard	SR
State Route	STD
Station	STA
Storm Drain	SD
Street	ST
Structure	STR
Sidewalk	SW
Sewer	SWR
Sewer Manhole	SMH
T	
Tangent	TAN
Temporary	TEMP
Telephone	TELE
Temporary Construction Easement	TCE
Toe of Slope	TOE
Top of Curb	TC
Top of Pipe	TOP
Top of Slope	TOS
Top of Wall	TW
Traffic Control Box	TCB
Traffic Control Plan	TCP
Traffic Index	TI
Traffic Signal	TS
Typical	TYP
V	
Variable/Varies	VAR
Vertical	VERT
Vertical Curve	VC
Volume	VOL
W	
Water Valve	WV
West	W
Westbound	WB
Water	WTR
Width	W=
Wing Wall	WW
With	W/
X	
Crossing	XING
Cross Section	X SEC

Text Style and Orientation

To maintain consistency in the appearance of drawings from multiple disciplines, the PWATD uses Windows True Type font Roman S for typical text, Arial for medium text, **Arial** bold for large text, and Arial Black for titles.

When plotted full scale, the typical text size is 0.125″, 0.150″ for medium text, and 0.200″ for large text.

Plans and exhibits prepared on 8.5″x11″ or 11″x17″ as full scale shall have a text size of 0.100”.

Capital letters are required for all text.

Background masks are allowed and may be required to maintain text legibility.

All text should be plan readable. See Figure 1 at the right for properly oriented text.

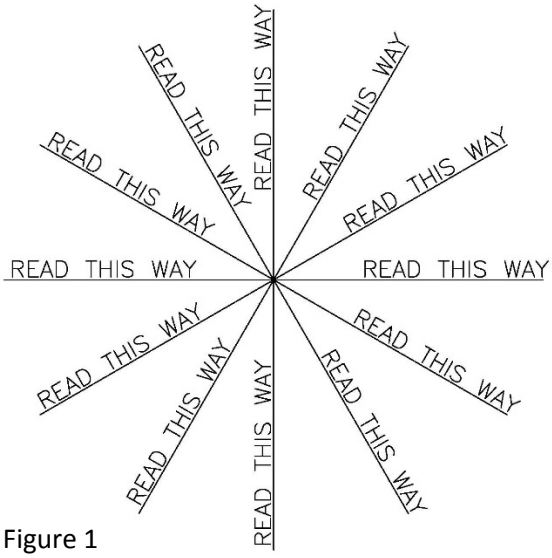


Figure 1

Dimensioning

Use AutoCAD’s associated dimensions for all dimensions. Horizontal, vertical, and aligned dimensions should be above the dimension line. See Figure 2 below for proper placement. Text height = 0.125″; arrow head size = 0.125″. Note the PWATD’s template file contains the properly formatted dimension style.

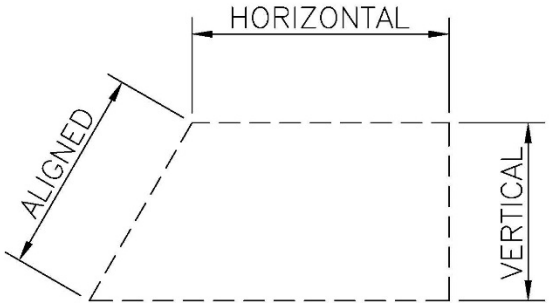
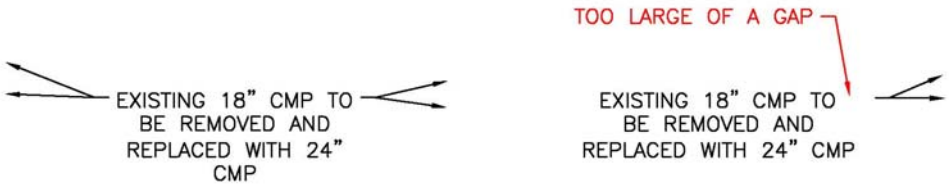


Figure 2

Leaders

Use leaders and multileaders in AutoCAD drawings; this style can be found in the PWATD's template file. Leaders from callouts are typically placed by the very beginning word to the left or to the right; see Figure 3 below. If it is not practical to place the leader hook at the beginning word to the left or right, it is acceptable to place leader in the most convenient place available. Text height 0.125″; arrow head size = 0.125″.



Acceptable Not Acceptable

Figure 3

Construction Notes

For Construction notes, Traffic notes, and Revisions, use the symbols shown below in Figure 4.

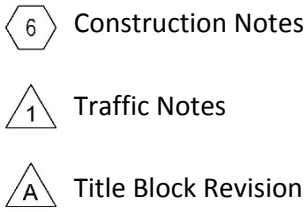


Figure 4

Curve Tables

Curve tables will include the curve number, radius, delta, length and tangent (see figure 5). Radius points in station and offsets to the appropriate alignment may also be included.

CURVE TABLE				
CURVE #	RADIUS	DELTA	TANGENT	LENGTH
C3	15.00'	90° 22' 13"	15.10'	23.66'
C4	10.00'	90° 00' 22"	10.00'	15.71'
C5	11.00'	90° 14' 09"	11.05'	17.32'
C6	15.00'	90° 00' 17"	15.00'	23.56'

Figure 5

Callouts

Detail Callouts

To reference a detail, either on the same sheet or another sheet, draw a circle or rectangle around the area to be detailed with a medium weight dashed line. Call the detail out using multileader with symbol. The upper half of the bubble will contain the detail number or letter. The lower half will contain the sheet number where the detail resides (see Figure 6).

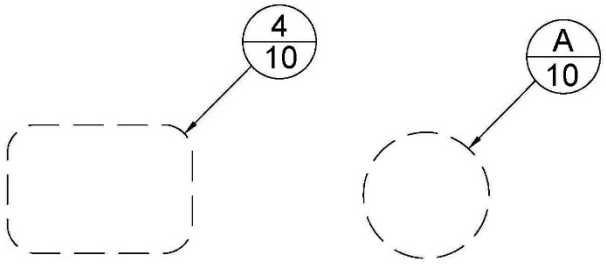


Figure 6

Section Callouts

When showing cross sections, use the Section block. The text should always be read horizontally, regardless of the orientation of the section marker. The upper half of the bubble will contain the section number. The lower half will contain the sheet number where the section resides (see Figure 7).

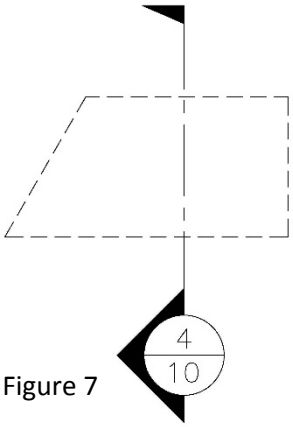


Figure 7

Hatch Patterns

Hatch patterns are used to represent different types of material. See Figure 8 (below) for the PWATD's commonly used patterns that must be used to represent the materials listed.

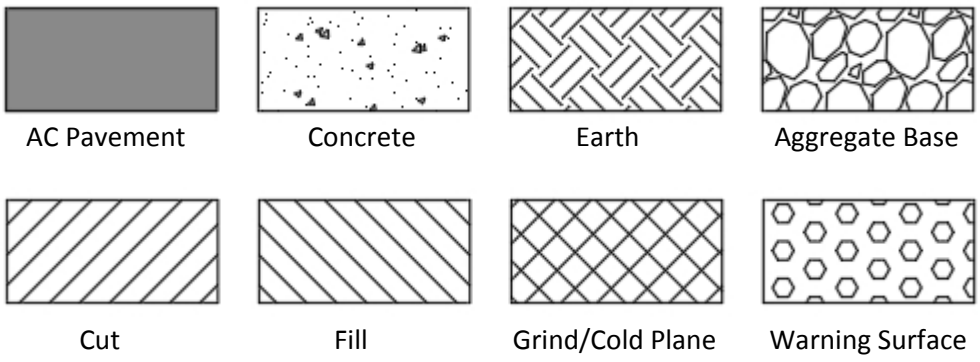


Figure 8

Sheet Set Manager

The Sheet Set Manager is a dialog that will allow you to open a sheet set with all the sheets in that set. Sheet Set Manager allows the user to link all sheet information to all sheets so changes may be made in one place. The Sheet Set Manager dialog is able to be used by the entire design team, and changes will be reflected automatically. The PWATD utilizes Sheet Set Manager for all drawings sets with more than one sheet. Use of the Sheet Set Manager by the consultant is recommended but not required.

Revisions

Revisions made during the design process are not noted in the title block or treated in any special way. Revisions made after the project has been advertised for bid are specifically identified in the following ways:

- Addendum (changes prior/during bid process up to award of contract)
- Change Order (changes during construction)
- Record Drawing (incorporating all design changes)

If Record Drawings revisions are made by hand, all changes must be made in AutoCAD as well. Cloud all changes for the current revision, and delete clouds for the previous revisions. Record the first revision letter starting at the bottom of the sheet. Subsequent revision letters are placed above previous revision letters.

Reprographics

Drawing Requirements

PWATD prefers all drawings be plotted from AutoCAD. If an alternative method is used it must be of equal print quality.

Final drawings must be plotted full scale (22″x34″ unless otherwise approved) on 20lb. vellum, stamped, and signed. All other submittals prior to final plot shall be plotted on 20lb. bond.

Check all drawings for print quality and standards prior to submittal.

Common errors found are:

- Line weights, font, or text size not per standard.
- Lines going through numbers or text – difficult to read.
- Not using wipeouts behind text over backgrounds or grids.
- Plotting from an alternative version of the drawing degrades the quality, changes line weights, or changes screening.
- Wrong project number or drawing number.
- Scales do not match (check that the scale bar, title block and detail titles all match).

- The title on each sheet does not match the title on the index.
- Legend not provided.
- Applicable standard plans not listed.
- Survey control not provided on plans.
- Temporary easements not shown.

Stamp Requirements

The engineering stamp and signature shall comply with the requirements of the California Board of Professional Engineers and Land Surveyors and the Professional Engineers Act.

File Transfers

The PWATD requires an AutoCAD.dwg file format that can be read by the department's current version of AutoCAD, as well as all support files that create the drawing set, including Civil 3D files for surveys, surfaces, plan and profiles, cross sections, etc. All drawings should be purged of unused blocks, line types, fonts, proxy graphics, or similar elements and audited, with layers in the correct state for publishing (frozen/thawed) prior to delivery.

Project information may be transferred electronically via email during the project design phase as eTransmit. At the record drawing phase, files to be transferred must include all files associated with the project to be transmitted. This includes external references (Xrefs), images, blocks, custom line types, nonstandard fonts, and .stb and .ctb files. Xrefs should not be bound or inserted into the drawing, but should be attached using AutoCAD's relative path or project name. Contact the PWATD project engineering technician for questions or assistance concerning file transfers.

eTransmittals

Sender should use eTransmit from within AutoCAD to compile the Plan Drawings for transfer to the County of Ventura. Modify or create a new Transmittal setup with the settings shown in Figure 9.

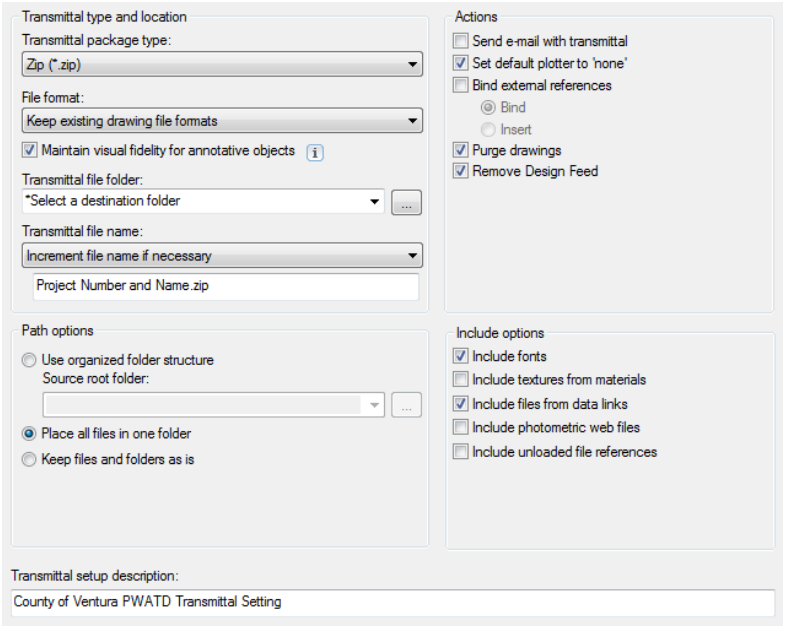


Figure 9

Appendix 1 – Title Sheet Template