

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY



WMATA COMPUTER-AIDED DRAFTING (CAD)
STANDARDS MANUAL

OFFICE OF THE CHIEF ENGINEER
CHIEF ENGINEER INFRASTRUCTURE SERVICES (CENI)
CONSTRUCTION & DESIGN (CONS)

Preface

This is the official published version of the WMATA CAD Standards Manual. This manual establishes the CAD standards that are to be used for all WMATA drawings that pertain to WMATA construction projects (for both new construction, renovation and system upgrades). Ownership of this manual belongs to the CENI/CONS Document Configuration Manager. Any requested changes must be forwarded to the CENI/CONS Manager for consideration. Approved changes will be reflected in the subsequent revision to this manual. All drawings will be reviewed for compliance with the standards presented herein.

I certify that this manual represents the CAD standards as adopted by CENI/CONS.

CAD Draftsperson - CENI/CONS


Terry Henderson

Authorized:

Document Configuration Manager - CENI/CONS

Brian James

 2/24/2017
Signature Date

 2/24/17
Signature Date

Revision No.	Date	Remarks
01	9/4/2013	Minor grammatical changes were made.
02	12/18/2013	Changed ownership from TSFA to CONS in METRO logo
03	6/2/2014	Complete update
04	11/30/2016	Updated titleblock, pen table, added CAD Templates

Introduction

The previous editions of the WMATA CAD Standards (2010 - 2012) were developed to achieve a more uniform, consistent format for project contract documents throughout the organization, regardless of originating source or requesting division. As architectural and engineering design drawings are now becoming a more collaborative effort undertaken by multiple individuals, one can readily see the value in having a set of consistent guidelines and standards to direct the effort.

Recognizing this need, an effort has been undertaken to unify the CAD drawings between departments and disciplines. The CAD delivery platform of choice within WMATA are Autodesk's suites of drawing products. The standards delivered consists of .dwg and various support files that will enable WMATA to move forward and evolve the standards into a living and dynamic process.

A natural characteristic of such a dynamic system is of course *change*, including the need to change the guiding set of "standards" themselves due to greater efficiencies being found in alternate methods, software and automation advances, project construction needs for direct machine-manipulation of digital data, etc. The 2014 update to the WMATA CAD Standards had been an effort to incorporate as much of the "look and feel" of the prior WMATA standard drawings by making revisions to block symbols, labeling styles, etc. Other changes have been made that speak to the plan production automation strengths in the Autodesk applications, and as such, a great many stylistic standards are now accomplished using predefined symbology and labeling "styles" that may be modified to suit specific project needs. This 2016 version adds templates which are preset and establishes consistency when used for creating CAD files for your projects.

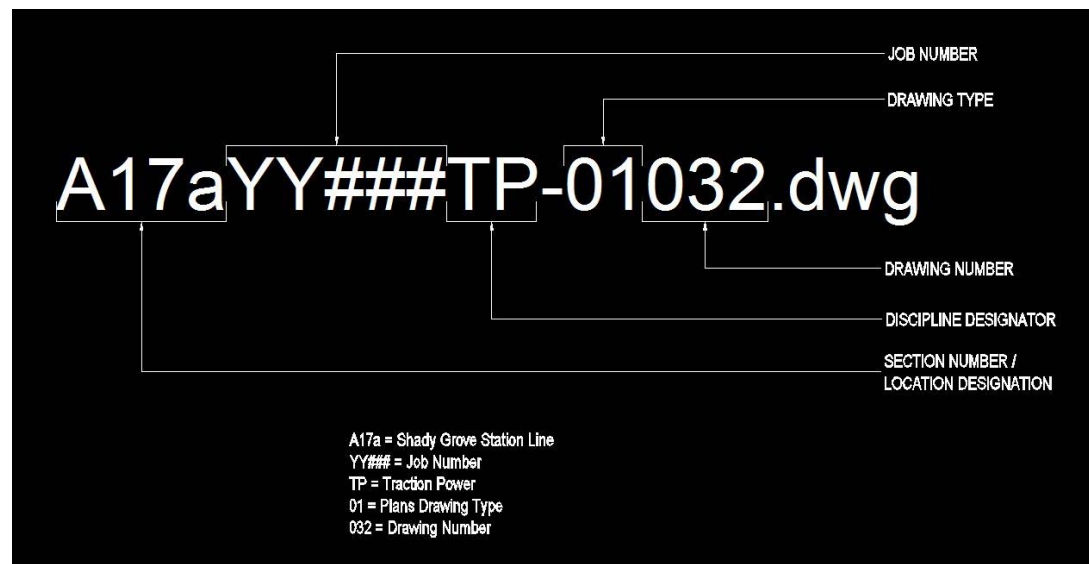
The AutoCAD files have been developed to include the National CAD Standards (NCS) format for most items such as layering and file-naming. Other aspects of the NCS have been modified to support WMATA's specialized field of railway transportation such as the symbols used.

In addition to being used internally in all technical departments, these WMATA standards are intended to be delivered to contractors and consultants that deal with AutoCAD drawing files and related WMATA design data. It is intended that contractors and consultants conform to these standards to improve the data flow between organizations. It is also intended that these WMATA standards are to be used solely by WMATA staff and WMATA contractors or assigns

Drawing File Organization

Drawing File Naming

Conventions: The drawings will consist of a file naming convention that includes: a Project Section Number / Location Designation, a Job Number (YY = 2-digit year, ### = sequential numbering), a Discipline Designator (see Appendix for Discipline Designation Chart), a Drawing Type and a Drawing Number.



Drawing Types: There are two types for AutoCAD drawing files: model files and sheet files. The model file contains the drawing/design (plans, elevations, sections, details, diagrams, etc.). These elements are drawn full-scale. The sheet file contains the elements that make-up the printed sheet. It contains the sheet border, sheet drawing views and drawing view titles.

In AutoCAD, each file consist of a **model tab** (model space) and a **layout tab** (paper space). The model tab will contain all of your model elements including text, dimensions, legends, tables and sheet notes. The layout tab will contain the titleblock and drawing titles. While in the layout tab you will create viewports into model space that can be adjusted to the view scale that you need. Once the scale is set, lock the viewport so the scale is not unintentionally changed by subsequent users.

Drawing Types	Designation
General (legends, notes, etc.)	00
Plans (horizontal views)	01
Elevations (vertical views)	02
Sections	03
Large-Scale Plans (1/2"=1'-0" or larger)	04
Details	05
Schedules and Diagrams	06
User Defined	07
User Defined	08
3D Representations (isometrics, perspectives, photographs)	09

Drawing Units: The drawing units in the model files are to be 1:1, which allows the draftsman/designer to draw the design at full-scale. The sheet files are all drawn 1:1 with the layout sized to fit the output sheet size (8 1/2"x11, 11"x17", 17"x22", 24x36, 30x42, etc.). The drawing views are sized to an appropriate scale that will clearly detail the design intent (1"=500', 1/8"=1'-0", 3"=1'-0", etc.). See the Appendix for the typical drawing scales.

Each project is to establish an origin point which will serve as a point of reference from which all other elements of the drawings are located. For civil drawings, the civil engineer will establish the horizontal and vertical control points to determine the origin point for the civil drawings. All other disciplines will set their origin point (0,0,0) based upon the control points established by civil. For projects that have no civil component, the project team is to establish an origin point based upon an easily identifiable fixed point within the existing site.

Graphic Concepts

Line Widths/Lineweight: The use of varied line widths will improve the readability of a drawing and gives better clarity to the design when it is printed out. Typically printing/plotting output is done in black & white and not in color. All drawings are to use the following National CAD Standards (NCS) Line Width Guidelines as a base.

Fine (0.18 mm) – Fine lines should be used sparingly, mostly for hatching/patterning.

Thin (0.25 mm) – Thin lines should be used for depicting dimension lines, dimension leader/witness lines, note leader lines, line terminators (arrowheads, dots, slashes), phantom lines, hidden lines, center lines, long break lines, schedule grid lines, and object lines seen at a distance.

Medium (0.35 mm) – Medium lines should be used for depicting most object lines, text (dimensions, notes/callouts, and schedule), and schedule grid accent lines.

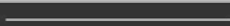
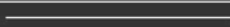






Wide (0.50 mm) – Wide lines should be used for major object lines, cut lines, section cutting plane lines, and titles.

Extra Wide (0.70 mm) – Extra-wide lines should be used for minor title underlining, schedule outlines, large titles, and object lines requiring special emphasis. For very large scale details drawn at 3"=1'-0" or larger, the extra-wide width should be used for the object lines. Extra-wide widths are also appropriate for use as an elevation grade line, building footprint, or top of grade lines on section/foundation details.

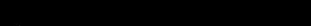
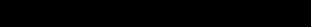
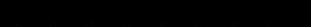
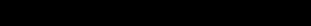
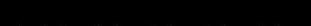
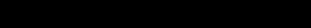
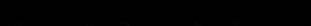
XX Wide (1.00 mm) – XX-wide line weight should be used for major title underlining and separating portions of drawings.

XXX Wide (1.40 mm) – XXX-wide line weight should be used for border sheet outlines and cover sheet line work.

XXXX Wide (2.00 mm) – XXXX-wide line weight should be used for border sheet outlines and cover sheet line work.

Line Weight	Metric	Imperial	Examples	Typical Use
Fine	0.08 mm	0.003"		Hatching/Patterning
Thin	0.64 mm	0.025"		Dimension Lines, Leader Lines, Break Lines, Schedule Grid Lines and objects seen at a distance
Medium	2.54 mm	0.100"		Minor Object Lines
Wide	5.08 mm	0.200"		Major Object Lines, Cut Lines, Section Cutting Planes and Titles
Extra Wide	8.89 mm	0.350"		Minor Title Underlining, Match Lines, Schedule Outlines, Large Titles and object lines requiring special emphasis
XX Wide	12.70 mm	0.500"		Major Title Underlining
XXX Wide	17.78 mm	0.700"		Border Sheet Outlines and Cover Sheet Linework
XXXX Wide	25.40 mm	1.000"		Border Sheet Outlines and Cover Sheet Linework

Linetypes: A linetype is a repeating pattern of dashes, dots, and blank spaces displayed in a line or a curve. These linetypes help to clarify/improve the readability of the objects in a drawing. All drawings to use the linetypes shown on the right as a base.

Designation	Example	Description
Continuous		a solid line
Dot		a dotted line
Hidden		short dashed lines
Dashed		long dashed lines
Dashdot		long dash followed by a dot
Divide2		short dash followed by two dots
Center		long dash followed by a short dash

Plot Style Table Editor - ncs-black-gray.ctb

General Table View Form View

Name	Color 1	Color 2	Color 3	Color 4	Color 5
Description	Description_1	Description_2	Description_3	Description_4	Description_5
Color	Black	Black	Black	Black	Black
Enable dithering	On	On	On	On	On
Convert to grayscale	Off	Off	Off	Off	Off
Use assigned pen #	Automatic	Automatic	Automatic	Automatic	Automatic
Virtual pen #	Automatic	Automatic	Automatic	Automatic	Automatic
Screening	100	100	100	100	100
Linetype	Use object linetype	Use object linetype	Use object linetype	Use object linetype	Use object linetype
Adaptive adjustment	On	On	On	On	On
Lineweight	0.2500 mm	0.3500 mm	0.5000 mm	0.9000 mm	1.0000 mm
Line End Style	Use object end style	Use object end style	Use object end style	Use object end style	Use object end style
Line Join style	Use object join style	Use object join style	Use object join style	Use object join style	Use object join style
Fill Style	Use object fill style	Use object fill style	Use object fill style	Use object fill style	Use object fill style

Line Color: Line color is used to make it easier for the draftsman to understand what line width/lineweight they are drawing with. This improves the clarity of the drawing on the computer screen. Each color is assigned a Lineweight which is used by the plotter to determine how thick (as indicated in mm) that color will be represented when printed in black and white. All drawings will use the established .ctb files.

Screening: Screened linework is used to depict different shades of gray which allows for improved clarity of the drawing. The best example is using screened linework to depict existing conditions that are to be demolished and replaced by new work. For screened linework, all drawings will use the established ctb files.

Plotting/Printing: Pen tables (.ctb/.stb files) are used to control the look of the printed drawings. The .ctb files are color-based plot styles that are used convert the objects color into line weight/thickness on a printed sheet. The stb files abstract plot styles from color-based layer styles to object-based property styles, which allows greater flexibility and portability of designs. These files have been developed to produce consistency in the look and feel of both hardcopy printing and printing to .pdf. See the Appendix for the sample pen table.

Color 6	Color 7	Color 8	Color 9
Description_6	Description_7	Description_8	Description_9
Black	Black	128,128,128	Black
On	On	On	On
Off	Off	Off	Off
Automatic	Automatic	Automatic	Automatic
Automatic	Automatic	Automatic	Automatic
100	100	85	100
Use object linetype	Use object linetype	Use object linetype	Use object linetype
On	On	On	On
1.4000 mm	0.2500 mm	0.3500 mm	2.0000 mm
Use object end style	Use object end style	Use object end style	Use object end style
Use object join style	Use object join style	Use object join style	Use object join style
Use object fill style	Use object fill style	Use object fill style	Use object fill style

Text Styles/Fonts: The following font styles are to be used as a standard for all WMATA projects:
All text to be annotated where possible.

AaBbCcDdEeFf

ARIAL - BOLD

(Arial TrueType font with a Bold setting, no embedded text height, width = 0.9)
This text style is only used on the Cover Sheet.

AaBbCcDdEeFf

ARIAL

(Arial TrueType font, embedded annotative text height = 3/16", width = 0.9)
This text style is to be used for equipment, plan / layout titles.

ARIAL- HDRS

(Arial TrueType font, embedded annotative text height = 5/32", width = 0.9) This text style is to be used for identification detail headers, matchlines and room/door names.

ARIAL-TABLE

(Arial TrueType font, non-annotative, no embedded text height, width = 0.9)
This text style is to be used for drawing index, parts list and assorted tables.

AaBbCcDdEeFf

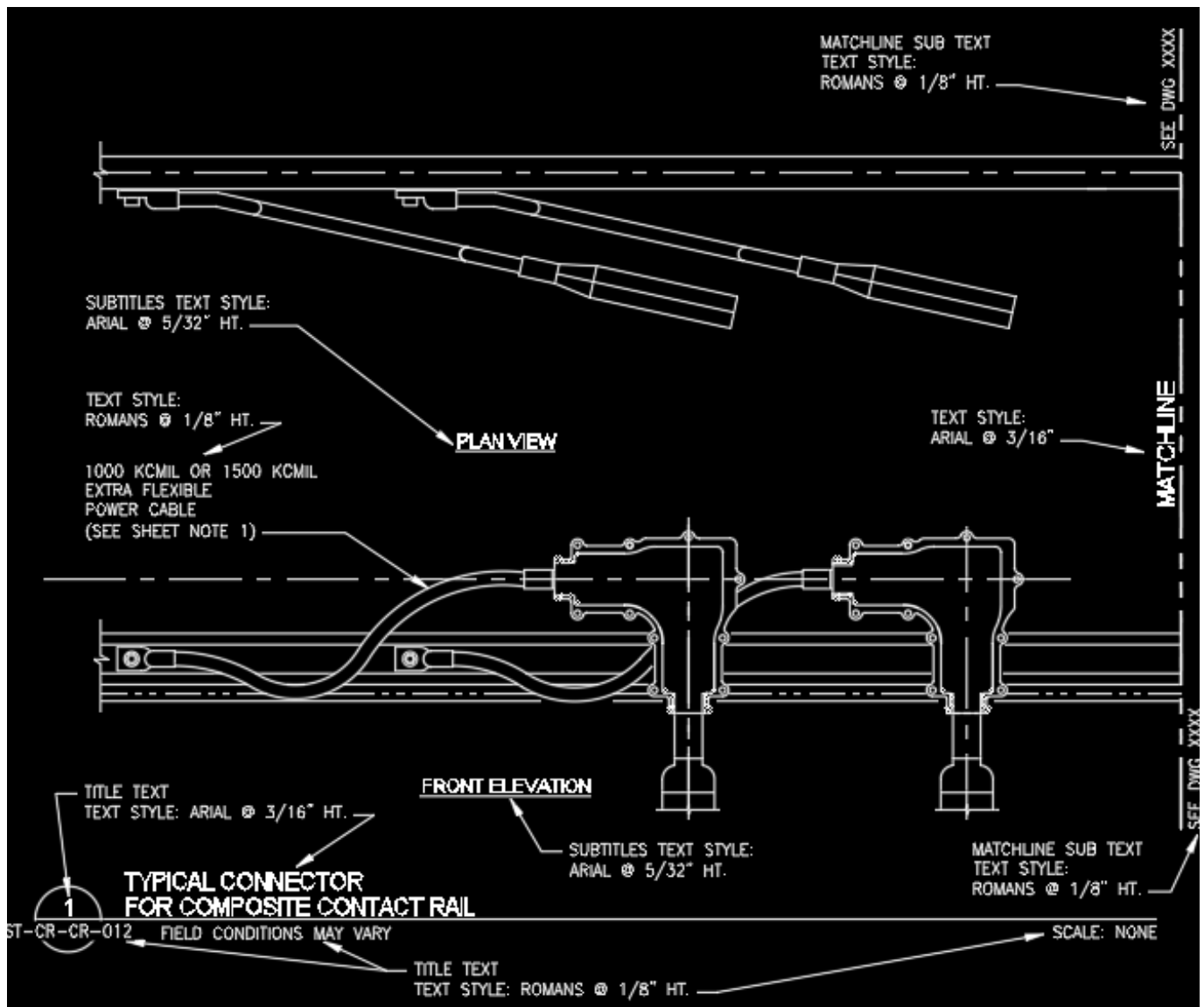
ROMANS

(Romans shx font, embedded annotative text height = 1/8", width=0.9)
This text style is to be used for standard text, leader text, general notes, sheet notes, keynotes, dimensions and legend text.

The minimum text height for full-size (34" x 22" and larger) plotted drawings will be 3/32". The minimum text height for half-size (11" x 17" and smaller) plotted drawings will be 1/8". Titles should be plotted out at 3/16". Subtitles and Identifications should be plotted out at 5/32". Line spacing shall be equal to one half of the text height.

All text must be legible and should never be placed over other text, over feature lines, or over hatch patterns. If text must be placed within a hatch pattern, clip the hatch or set the background for the text to mask the hatch.

The image below reflects various font styles and how they are used in creating WMATA CAD documents.



Abbreviations: The use of abbreviations should be kept to a minimum. Any abbreviations used must match the established abbreviations list which is to be included in each set of drawings. Any additional abbreviations that are determined to be required must not conflict with any in the established list and be submitted for review/evaluation for inclusion to the list.

Borders: All sheets shall use the established WMATA borders and coversheets for the standard sheet size established for the project. The title block is to include the Information Block, Accountability Block, Reference Block, Revisions Block, Seal Block and Approval Signature Block.

The Title Block - This will have WMATA's name spelled out as shown, the copyrighted METRO logo and the location of the project (*to include the facility name, sectioning location and route affected*). The project location is to match the information in the Information Block of the Titleblock on each sheet (*see page #10*).



CONGRESS HEIGHTS STATION AND NATM TUNNELS
FQ-1234567
SECTION F-6b
BRANCH ROUTE

CONTRACT NO. FQ-1F0062	SCALE AS NOTED	DRAWING NO. SD-G-TLBK-001	SHEET NO. 01 of 56
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The Information Block - This contains the Contract Number, the project name and location, the overall drawing scale, the drawing number, the sheet number and the overall number of sheets in the drawing set.



WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

OFFICE OF THE CHIEF ENGINEER
CENI - CONSTRUCTION & DESIGN

APPROVED _____ John J. Jones ASSISTANT CHIEF ENGINEER	APPROVED _____ John James Jones DEPUTY CHIEF ENGINEER
DATE	DATE

The Signature Block - This contains WMATA's name (which includes our copywrited logo and the identification of our Division), identification of the department responsible for the design of the project (ATCS, COMS, CONS, CPDO, DULS, ELES PWRS or TSFA), the Approved Signature Line and Discipline Chief Approved Signature Line.

- The CENI department identification is controlled by layer. Isolate the appropriate layer for the department responsible for the project.
- The Approved Signature Line, Assistance Chief is to be signed by the person responsible for checking the drawing for accurate/code complaint engineering/architectural content. For internally designed drawings that are required to be sealed by a licensed professional, that person will sign this line in instances where the Deputy Chief is not licensed for the discipline represented on the drawing.
- The Approved Signature Line, Deputy Chief is to be signed by WMATA's Deputy Chief Engineers for internally designed construction projects. The Approved Signature Line is to be signed by the consultant's Engineer of Record for externally designed construction projects.

REVISIONS

DATE	NUM	DESCRIPTION
05/25/13	01	SAMPLE REVISION EXAMPLE

The Revision Block - This is used to record all the revisions to the original design that is contained on this sheet. Use the description column to give a brief explanation of the required revision. For contract drawings, revision clouds and deltas are to be used to coincide with the revision and to visually identify the change to the signed and sealed contract drawing.

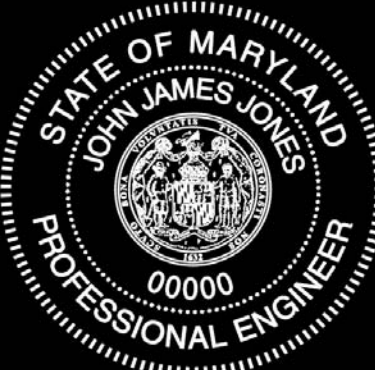
The Reference Block - This is used to list the drawings that are referenced on this sheet. This is used as a standard for Traction Power projects.

REFERENCE DRAWINGS	
NUMBER	TITLE
SD-G-124	SAMPLE REFERENCE EXAMPLE

DESIGNED	<u>A. BROWN</u>	<u>11/18/12</u> DATE
DRAWN	<u>B. CHATOM</u>	<u>12/05/12</u> DATE
CHECKED	<u>J. JONES</u>	<u>2/22/13</u> DATE

The Accountability Block - This is used to identify the people responsible for this drawing. The designer is to initial and date in the "Designed" block. The draftsman is to initial and date in the "Drawn" block. It is intended for a licensed professional to initial and date in the "Checked" block.

The Seal Block - This block is for the seal and signature of the licensed professional responsible for the design represented on this sheet. This same professional is also supposed to initial and date the "Checked" block in the Accountability block shown above. This block includes the State of Maryland "Professional Certification" which is required to be on all "Issued for Permit" or "Issued for Construction" design documents for projects built in the state. The Commonwealth of Virginia and the District of Columbia have similar requirements and layer controls have been established to indicate which jurisdiction the project has been designed for. Isolate the appropriate layer for the jurisdiction and professional license responsible for this sheet.



"PROFESSIONAL CERTIFICATION: I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND."

LICENSE No. 00000

EXPIRATION DATE: 11/30/18

- COMAR 09.23.03.10

RESERVED AREA: CONSULTANT/CONTRACTOR LOGOS

JOHN JAMES JONES
ARCHITECTS ENGINEERS CONSULTANTS, LLC



"PROFESSIONAL CERTIFICATION: I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND."

LICENSE No. MDERLICNO

EXPIRATION DATE: MDEREXDATE

- COMAR 09.23.03.10

For projects that are using outside consultants/contractors for the design, space has been provided above the Seal Block for the placement of their company logo. In instances where we have prime consultant and sub-consultant (prime contractor and sub-contractor), the prime's logo shall go directly above the seal and the sub's logo shall go directly above the prime's logo.

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY



**WASHINGTON D.C. AREA METRO
 SECTION F-00**

COVER SHEET

CONTRACT #1F0000 - December 01, 2016

VOLUME 1 of 1

**OFFICE OF THE CHIEF ENGINEER
 GENI - CONSTRUCTION & DESIGN**

CONSULTANT DESIGN TEAM

DESIGN LEAD

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

CIVIL

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

STRUCTURAL

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

EQUIPMENT

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

PLUMBING

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

ELECTRICAL

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

LEED

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

HAZARDOUS MATERIALS

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

LANDSCAPE

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

ARCHITECTURAL

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

FIRE PROTECTION

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

MECHANICAL

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

TELECOMMUNICATIONS

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

GEOTECHNICAL

FIRM NAME
 ADDRESS
 CITY, STATE ZIP CODE
 PHONE NUMBER

The Contract Block—This will have the contract number for the project, the project date (*to match the completion date of the 100% Construction Documents*) and the number of volumes included in this drawing set.

**CONTRACT #1F0062- OCTOBER 17, 1995
VOLUME 1 of 2**

**OFFICE OF THE CHIEF ENGINEER
CENI - CONSTRUCTION & DESIGN**

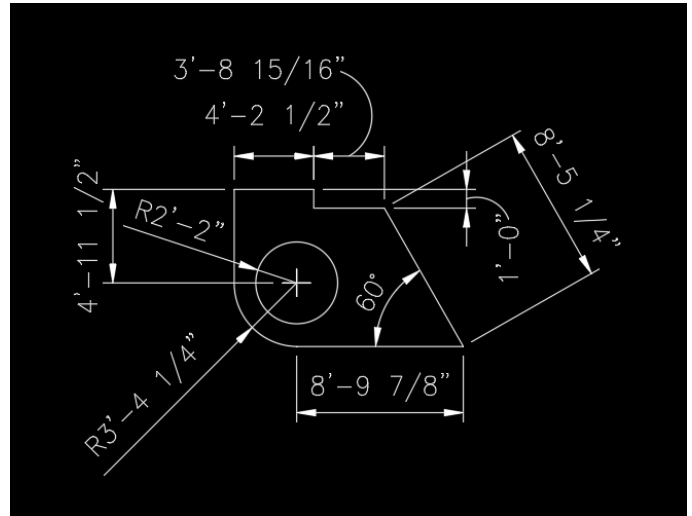
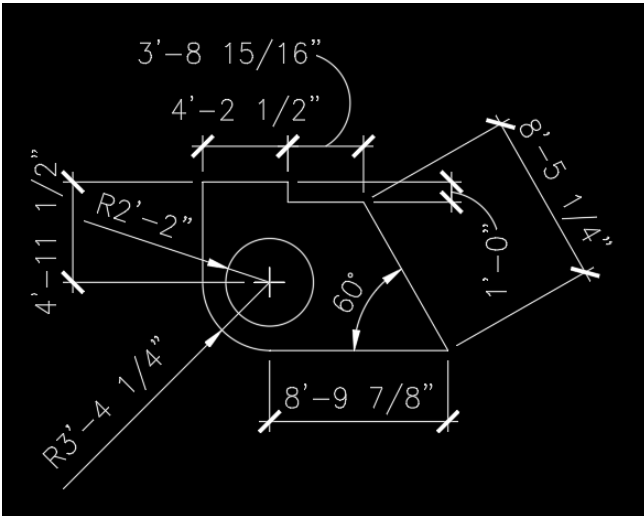
The Department Block - This will identify the WMATA department managing the project. This is the same information that is in the Signature Block of the Titleblock (*see page #10*). The WMATA department identification is controlled by layer. Isolate the appropriate layer for the department responsible for the project.

CONSULTANT DESIGN TEAM						
DESIGN LEAD FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER	CIVIL FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER	STRUCTURAL FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER	EQUIPMENT FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER	PLUMBING FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER	ELECTRICAL FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER	LEED FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER
HAZARDOUS MATERIALS FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER	LANDSCAPE FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER	ARCHITECTURAL FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER	FIRE PROTECTION FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER	MECHANICAL FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER	TELECOMMUNICATIONS FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER	GEOTECHNICAL FIRM NAME ADDRESS CITY, STATE ZIP CODE PHONE NUMBER

The Consultant Design Team Block - This is intended to identify the design team that designed the work for external design projects. This will identify the names, addresses and phone numbers of the different firms by discipline that contributed to the design. This is not intended to be used for internal design projects.

DESIGN LEAD Inland City 2001 Avenue of the Stars Florham Park, NJ 07938 (908) 847-9622	CIVIL Hillier Smith 502 Brattle Street Cambridge, MA (617) 252-1121	STRUCTURAL Hillier Smith 502 Brattle Street Cambridge, MA 02138 (617) 252-1121
HAZARDOUS MATERIALS Inland City 2001 Avenue of the Stars Florham Park, NJ 07938 (908) 847-9622	LANDSCAPE Hillier Smith 502 Brattle Street Cambridge, MA 02138 (617) 252-1121	ARCHITECTURAL Hillier Smith 502 Brattle Street Cambridge, MA 02138 (617) 252-1121

Dimensioning: The following dimension styles are to be used. Contact the WMATA CAD Manager for a copy of the dimstyle you need. Dimstyles are also incorporated into each CAD template per discipline.

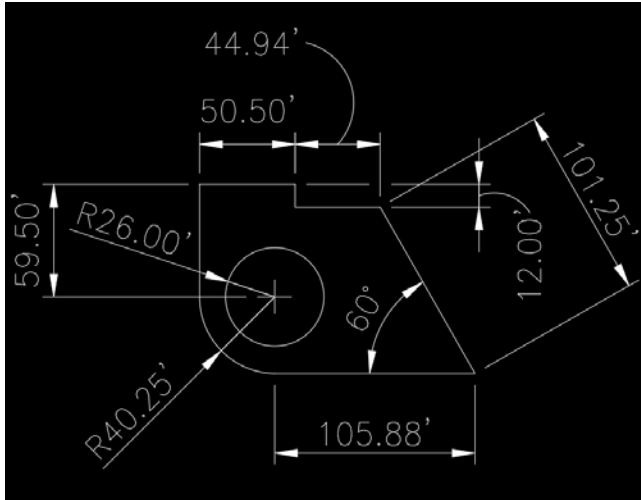


Arch_dim

- * Architectural tick= 1/8" w/ 3/16" Closed filled arrowhead for Leaders.
- * Text Color = Yellow w/ 1/8" text height & text aligned with dimension line
- * Annotative scale for dimensions
- * Text Precision = 1/16" w/ fractions not stacked
- * Angular Dimension Precision = 0

Engr_dim

- * Arrowhead = 3/16" Closed filled w/ 3/16 Closed filled arrowhead for Leaders.
- * Text Color = Yellow w/ 1/8" text height & text aligned with dimension line
- * Annotative scale for dimensions
- * Text Precision = 1/16" w/ fractions not stacked
- * Angular Dimension Precision = 0



Civil_dim

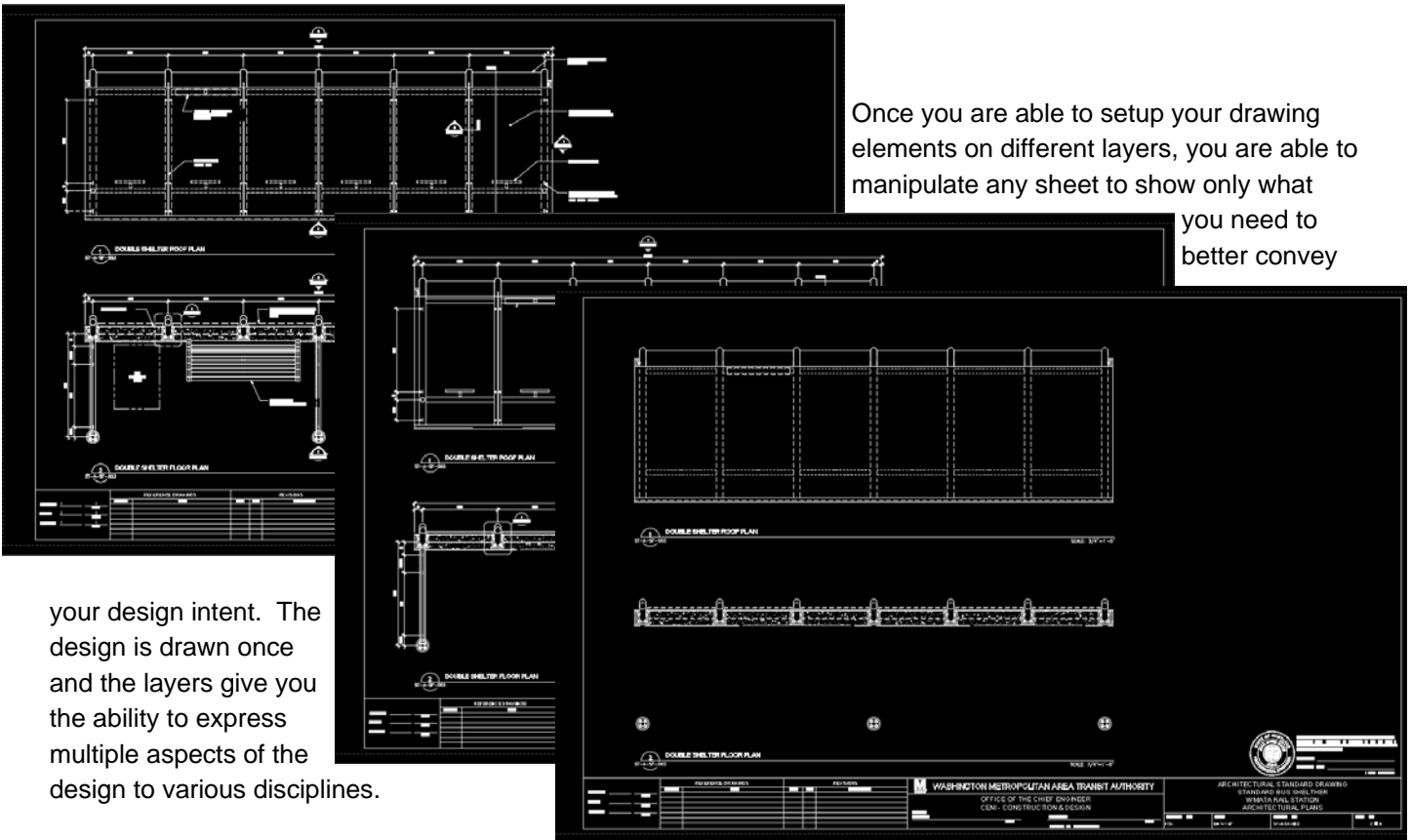
- * Arrowhead = 3/16" Closed filled w/ 3/16 Closed filled arrowhead for Leaders.
- * Text Color = Yellow w/ 1/8" text height & text aligned with dimension line
- * Annotative scale for dimensions
- * Text Precision = 0.00"
- * Angular Dimension Precision = 0.00

These styles follow the NCS standards for dimensions. The Arch_dim dimension style is intended to be used for architectural drawings (*architectural, landscape, interior*); the Engr_dim dimension style is intended to be used for most engineering drawings (*structural, mechanical, electrical, plumbing*); and the Civil_dim dimension style is intended to be used for large scaled engineering drawings (*civil, survey, geotechnical*). The following are additional guidelines for dimensioning:

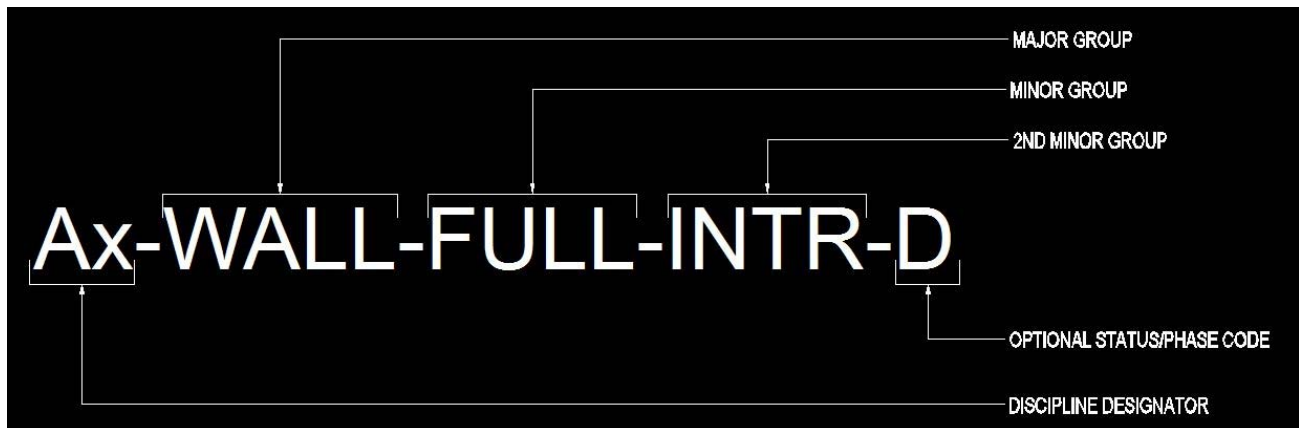
- All dimensions are to be legible.
- Do not have dimensions text crossover/obscure drawing elements.
- Do not show the same dimension for a particular element in two different places.
- When dimensioning a floor plan, dimension to the face-of-stud as a standard (*dimension to face-of-finish to show ADA clearances and at the face-of-finish on an exterior wall*).
- When dimensioning a floor plan, dimension to the same side of the stud in a string of dimensions.
- When you have stacked dimensions, do not have extension lines pass through dimension lines.
- Always dimension to the centerlines of the structural grid (*indicate the structural grid location by changing the arrowhead at the grid to a dot small arrowhead*).
- Dimensions are to be associative (*the use of the Text Override should be kept to a minimum*).
- Always complete the dimension string. Make sure there are no gaps or areas of the object being dimensioned that leaves the contractor questioning the intended size of the object due to a missing dimension.
- Horizontal dimensions should be oriented where the text can be read left-to-right on the page and vertical dimensions should be oriented where the text can be read from down-to-up on the page (*this allows for it to be read left-to-right when the page is 1/4 turned clockwise*).

Drawing Layers

Layers: AutoCAD layers act as manual drafting sheet overlays. They separate drawing elements according to different aspects/objects within the design. The layers can be manipulated to control lineweights and add visual depth/clarity to your design.



Layer Naming Conventions: Layers are the basic tool used for managing graphic information. All layer naming conventions are to follow the NCS. The basic layer name consists of a discipline designator, a major group designator, a minor group designator, a second minor group designator and a status code.



- **Discipline Designator:** This is a one or two-character field that describes the category of a subject matter contained on a specific layer. The category of the subject matter is the discipline that represents the object (ie. Architectural, Structural, Mechanical, etc.). A list of the Discipline Designation chart can be found in the Appendix.
- **Major Group:** This four-character field identifies major systems (i.e. Building, Bridge, Power, Plants, Walls, Doors, Columns).
- **Minor Group:** This four-character field gives additional definition to the major group (i.e. Full-height, Above, Underneath, Hidden).
- **2nd Minor Group:** This four-character field gives even more definition to the Minor Group if required (i.e. Interior, Exterior).
- **Optional Status/Phase Code:** This is a one-character field that describes the status of the work contained on a specific layer (i.e. new work, existing, demolition, etc.).

Status / Phase Codes	
N	New work
E	Existing to remain
D	Existing to be demolished
F	Future work
T	Temporary work
M	Items to be moved
X	Not in contract
1 - 9	Construction phase numbers

Annotation Layers: Annotation layers contain annotated elements (such as text, dimensions, notes, borders, drawing reference) that do not represent physical elements of the A/E/C industry.

Annotation Layer Names

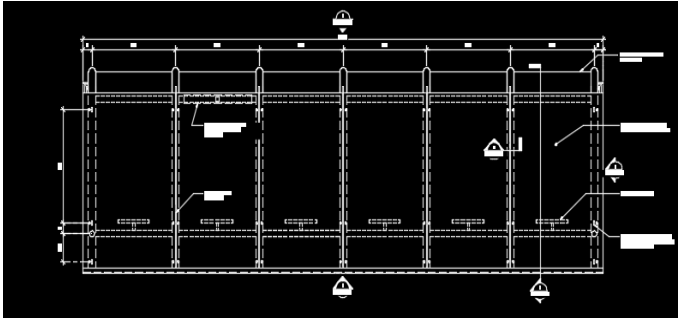
Layer Name	Description
XX-ANNO	Annotation
XX-DIMS	Dimensions
XX-KEYN	Keynotes
XX-LEGN	Legends, symbol keys
XX-MARK	Markers, break marks, leaders (not associated w/ dimensions)
XX-MATC	Match lines
XX-NOTE	Notes
XX-NPLT	Non-plotting graphic information
XX-RDME	Read-me information (non-plot)
XX-REDL	Redlines
XX-REFR	References, external files
XX-REVC	Revision clouds
XX-REVN	Revisions
XX-SCHD	Schedules
XX-SYMB	Reference symbols
XX-TEXT	Text
XX-TITL	Drawing or detail titles
XX-TTLB	Border and title block
XX-FINE	Detail lines fine
XX-THIN	Detail lines thin
XX-MEDM	Detail lines medium

Layer Name	Description
XX-WIDE	Detail lines wide
XX-XWDE	Detail lines extra wide
XX-XXWD	Detail lines 2X-wide
XX-XXXD	Detail lines 3X-wide
XX-XXXX	Detail lines 4X-wide

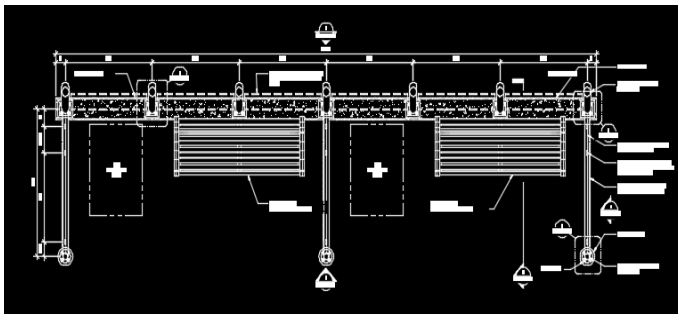
WMATA Annotation Layer Names

Layer Name	Description
XX-RFNC	Reference Drawings
XX-SEAL	Professional Seal
XX-TEXT-DGNB	Design Engineer/Architect of Record Signature
XX-TEXT-REVN	Revision Submitted Signature
XX-TEXT-WMTA	Deputy Chief Engineer Signature
XX-TITL-ATCS	Automatic Train Control Systems
XX-TITL-COMS	Communications & Network Systems
XX-TITL-CONS	Construction & Design
XX-TITL-DULS	Dulles Extension
XX-TITL-PRGM	Program Management
XX-TITL-PWRS	Power Systems
XX-TITL-TSFA	Track Structures & Facilities

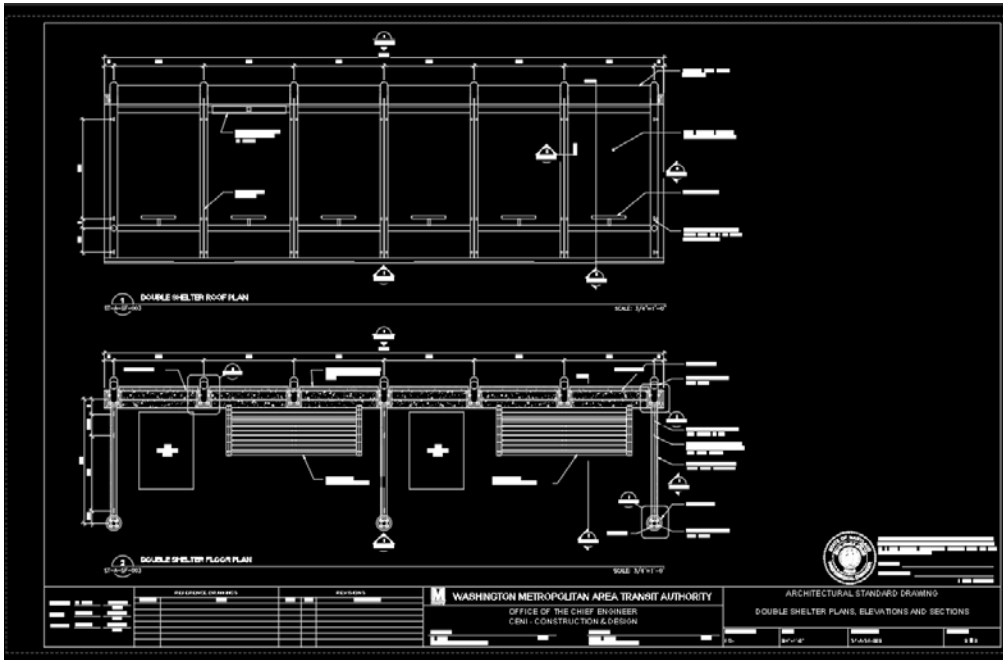
External References (XREFs): XREFs are files that contain shared information allowing multiple disciplines to work from the same drawing file. This allows for global changes to be picked up and coordinated across disciplines.

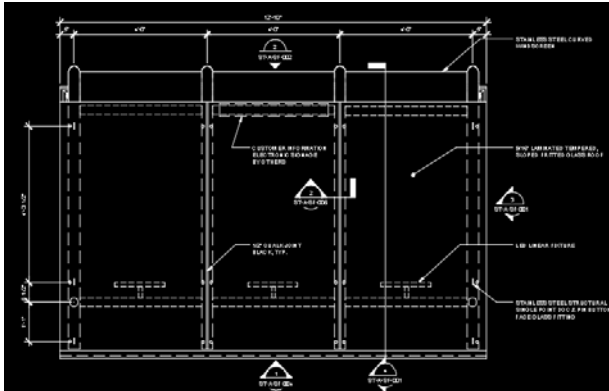


The roof plan and floor plan drawings for this bus shelter (shown on the left) were drawn in two separate files.

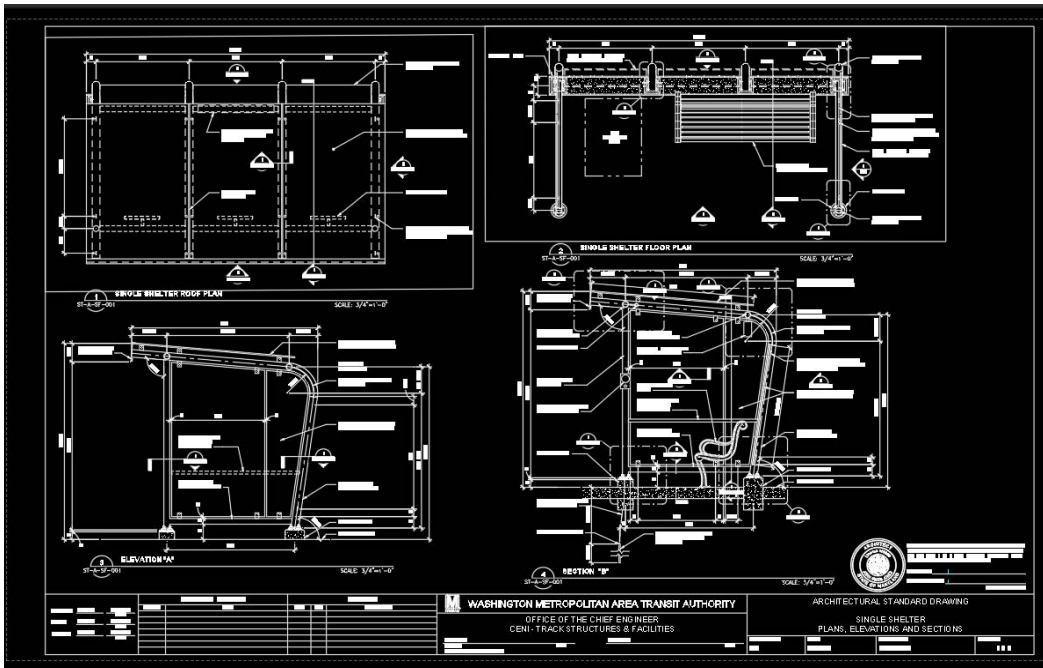
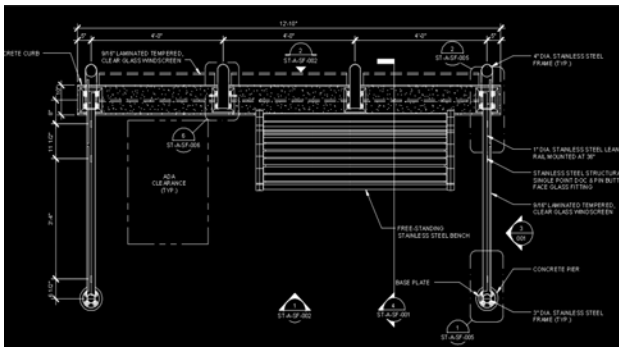


These drawings were inserted into the drawing below as an x-ref. The advantage of using this method allows two people to work independently on the same drawing (see below).





When the drawings change, the changes are reflected in the drawing each time the file is reloaded. The externally referenced drawings are linked to the original file and reflects the most recently saved information.



WMATA CAD Templates

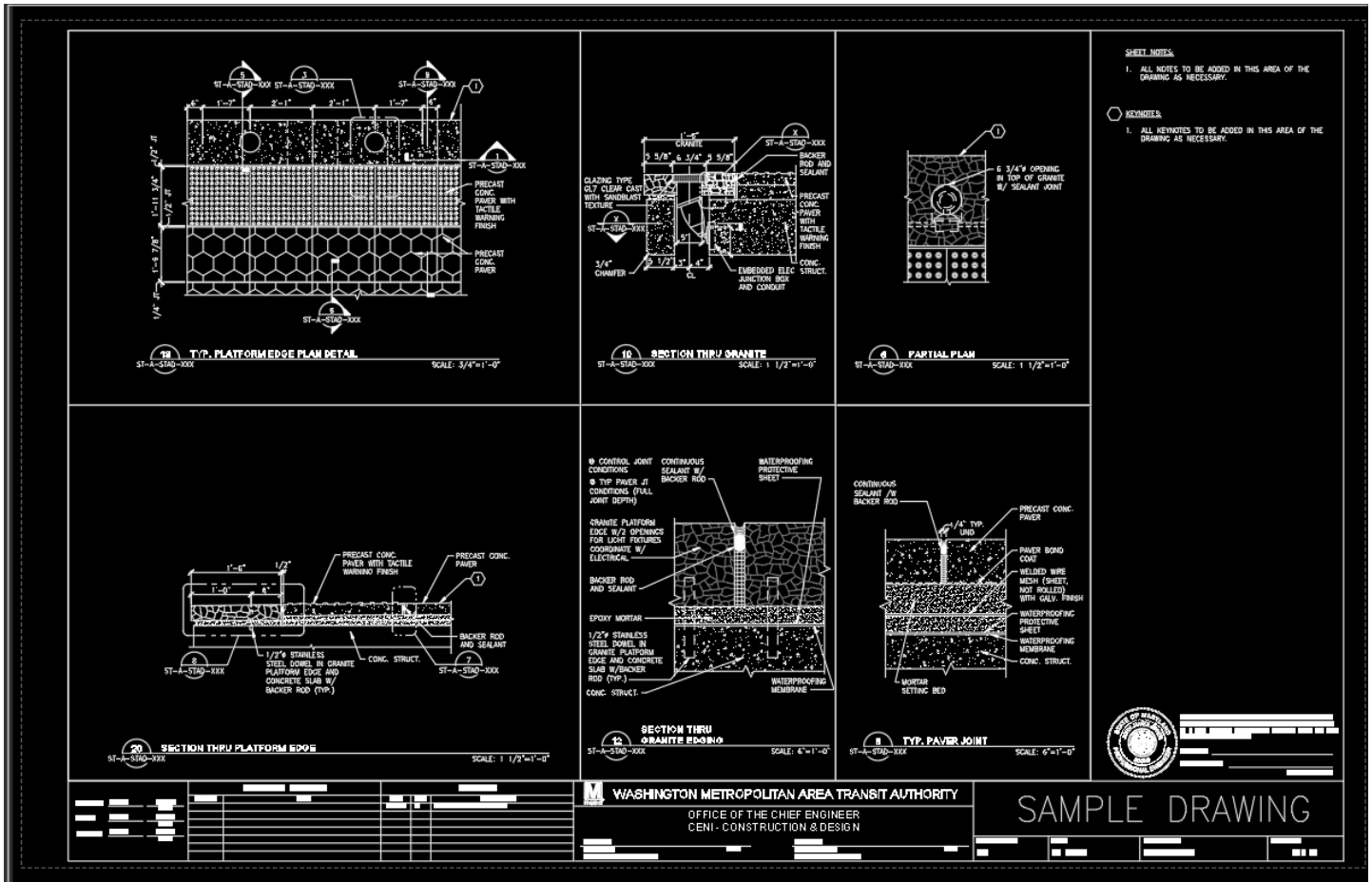
WMATA has the following template files which contain the standard settings that are to be used on all WMATA CAD files. Drawing templates have been created for use by WMATA Engineering and Design personnel for the following departments such as:

WMATA_Architectural Template
WMATA_Civil Template
WMATA_Communications Template
WMATA_EMI Template (*Used for in-house modifications to installed work*)
WMATA_Electrical Template
WMATA_Landscape Template
WMATA_Mechanical Template
WMATA_Structural Template

Each template has been pre-set and contain:

- One standard WMATA 22"x 34" Cover sheet.
- One standard WMATA 22"x 34" Title block.
- A set numbers of layers pertaining to the particular department and/or or discipline. New layers can be created as needed. Any new created layers need to follow the layer naming conventions as mentioned on page 18 in this CAD manual.
- One of the dimension styles per department and/or discipline as shown on pages 14 thru 15 in this CAD manual.
- Text styles as shown on pages 7 thru 8 in this CAD manual.
- Dynamic blocks, have been inserted into each template, such as drawing detail titles, detail identifications, section call-outs and section cuts.
- Multiple leader styles with attached text and /or attached blocks.
- Each template also has detail grids in both paper space as well as model space. The grid systems are both on non-plotting layers and have been attached to each template to be utilized when there are multiple details to be reflected on a drawing.
- Drawing index tables for each template have been created and are available for insertion, as necessary.

WMATA CAD Sample Drawing



The above image reflects an example of how a drawing with multiple details and /or, various scales set up using the attached non plotting drawing grids. However this will vary from drawing to drawing. The grid is to be numbered from top to bottom and from right to left where the lowest number is on the upper right and the highest number is on the lower left of the sheet. Refer to the grid image on the page 23 of this CAD manual.

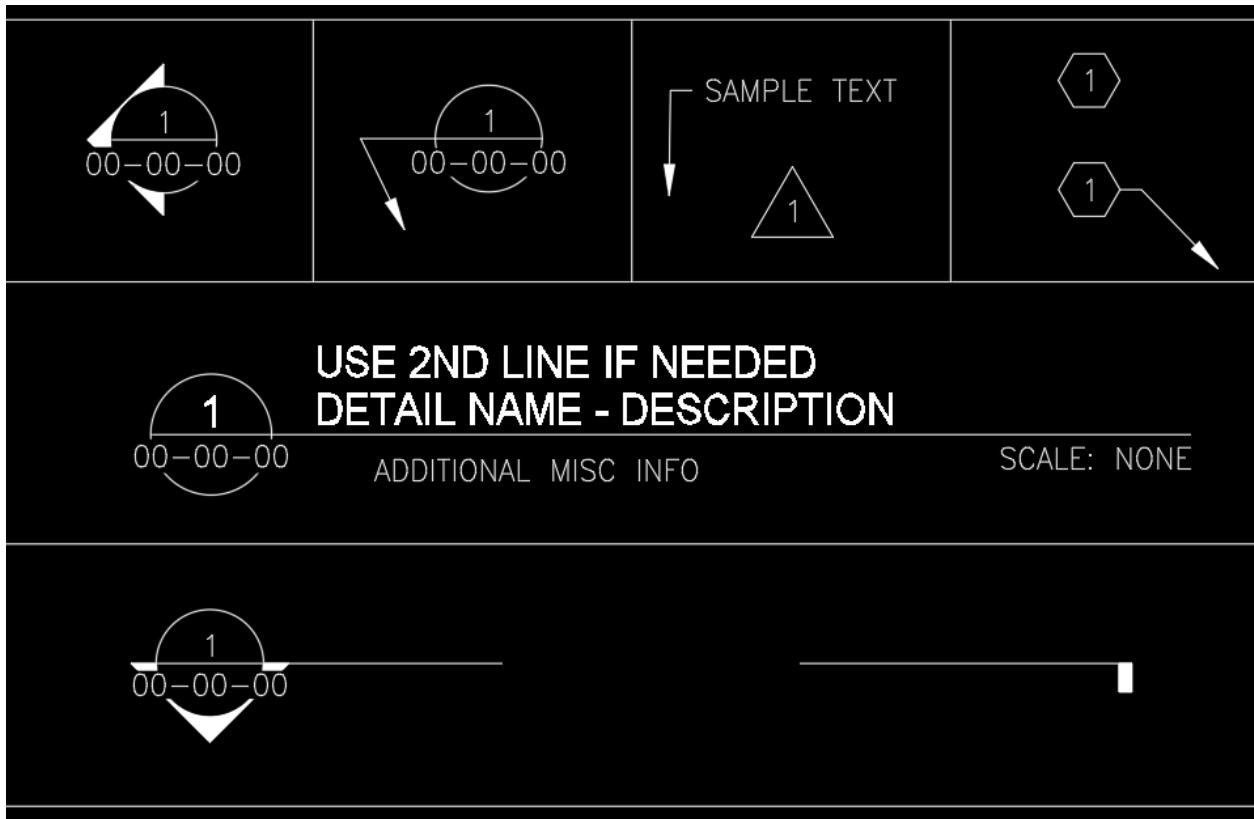
DETAIL GRID

17	13	9	5	1
18	14	10	6	2
19	15	11	7	3
20	16	12	8	

The above image reflects the drawing/detail grid and how the details are numbered and/or determined.

WMATA CAD Template Sample Blocks

Reflected below are some of the various types blocks, dynamic blocks and leader types that reside in each of the WMATA Templates. Open the Block Definition Dialog Box to view all of the template assigned blocks.



Acknowledgment

The information contained in this document is based on the United States National CAD Standard (v3.1). The intent is to bring uniformity to all CAD drawings produced by and for the Authority's Chief Engineer Infrastructure Services. This release of the manual contains general information that pertains to all disciplines and should be accompanied with templates, blocks and additional information that should be specific to each discipline.

Frequently Asked Questions

Q: How do we handle As-Built drawings that are being used/released for new work?

A: As-Built drawings become part of the new work and take on the convention configuration required to describe the new work. Everything is still based on location and the required As-Built will take on the new project number.

Q: How do we handle existing/legacy files that are not in this current standard?

A: Legacy files will be brought into the current standard when needed to perform new work.

Q: How will the Consultant Block be used on WMATA design build projects that we do in-house?

A: The Consultant Block is not to be used on in-house projects. We already know who to go to internal for any questions that may arise once the project is complete. That block is on a layer that is to be turned off for in-house projects.

Q: How will the Consultant Block be used on 3rd Party projects such as the Silver Line and Purple Line projects?

A: Since the Silver Line and the Purple Line projects that are being designed and built where WMATA's role is that of advisor to the holder of the contract, we can only ask that those project owners (*MWAA and Montgomery County in these two instances*) follow the National CAD Standards of which this standard is based on. This manual does not apply in those instances.




















APPENDIX

TYPICAL DRAWING SCALES








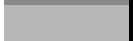
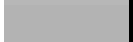
Drawing Type	Imperial	Metric
Site Plans	1" = 20'	1:200
	1" = 30'	1:400
	1" = 40'	1:500
	1" = 50'	1:600
	1" = 60'	1:700
	1" = 100'	1:1000
	1" = 200'	1:2000
	1" = 400'	1:5000
	1" = 500'	1:6000
	1" = 1000'	1:10000
	1" = 2000'	1:20000
Floor Plans	1/4" = 1'-0"	1:50
	1/8" = 1'-0"	1:100
	1/16" = 1'-0"	1:200
Roof Plans	1/16" = 1'-0"	1:200
Exterior Elevations	1/8" = 1'-0"	1:100
	1/16" = 1'-0"	1:200
Interior Elevations	1/4" = 1'-0"	1:50
	1/8" = 1'-0"	1:100
Cross Sections (Building Sections)	1/4" = 1'-0"	1:50
	1/8" = 1'-0"	1:100
	1/16" = 1'-0"	1:200
Wall Sections	1/2" = 1'-0"	1:20
	3/4" = 1'-0"	1:20
Stair Details	1" = 1'-0"	1:10
	1-1/2" = 1'-0"	1:10
Details	3" = 1'-0"	1:5
	1" = 1'-0"	1:10
	1-1/2" = 1'-0"	1:10

WMATA Pen Table

(Standard Colors)

Color	Color Number	RGB Ratios			Screening	Lineweight (mm)	
		Red	Green	Blue			
	Red	1	255	0	0	0%	0.2500
	Yellow	2	255	255	0	0%	0.3500
	Green	3	0	255	0	0%	0.5000
	Cyan	4	0	255	255	0%	0.9000
	Blue	5	0	0	255	0%	1.0000
	Magenta	6	255	0	255	0%	1.4000
	White	7	255	255	255	0%	0.2500
	Gray	8	128	128	128	85%	0.1800
		9	192	192	192	75%	0.1800
		10	255	0	0	65%	0.1800
		11	255	127	127	0%	0.2500
		12	165	0	0	0%	0.3500
		13	165	82	82	0%	0.5000
		14	127	0	0	0%	0.9000
		15	127	63	63	0%	1.0000
		16	76	0	0	0%	1.4000
		17	76	38	38	0%	0.7000
		18	38	0	0	0%	0.3500
		19	38	19	19	0%	2.0000

(Screened Colors)

	247	247	76	38	47	90%	0.1800
	248	248	38	0	9	80%	0.2500
	249	249	38	19	23	70%	0.3500
	250	250	0	0	0	60%	0.5000
	251	251	45	45	45	0%	0.1800
	252	252	91	91	91	0%	0.1800
	253	253	137	137	137	0%	0.1800
	254	254	183	183	183	0%	0.1800
	255	255	179	179	179	0%	2.0000

Discipline Designation Chart

Discipline	Designator
General	G
Survey/Mapping	V
Geotechnical	B
Hazardous Materials	H
Civil	C
Architectural	A
Structural	S
Mechanical	M
Electrical (House Power)	E
Plumbing	P
Fire Protection	F
Communications	CM
Telecommunications	IT
Landscape	L
Interiors	I
Right-of-Way	R
Equipment	Q
Automatic Train Controls	AT
Traction Power	TP
Automatic Fare Collection	AF
Maintenance of Traffic	TM
Plan and Profile	PP
Track Work	TW

Sample Layers Chart

Layer Name	Color	Linetype	Description
0	white	Continuous	0
A-AREA	19	Continuous	Area calculations
A-AREA-TEXT	yellow	Continuous	Area calculations text
A-CLNG	green	Continuous	Ceilings
A-CLNG-ACCS	yellow	Continuous	Ceiling access panels
A-DOOR	green	Continuous	Doors & frames
A-FLOR	cyan	Continuous	Floor
A-FLOR-CASE	green	Continuous	Casework (base cabinets)
A-FLOR-CASE-OVHD	yellow	Dashed	Casework (upper cabinets)
A-FLOR-EVTR	green	Continuous	Elevator
A-FLOR-HRAL	yellow	Continuous	Handrails & guardrails
A-FLOR-LEVL	cyan	Continuous	Level changes, ramps, pits & depressions
A-FLOR-OVHD	green	Dashed	Overhead objects
A-FLOR-SPCL	red	Continuous	Specialties (restroom accessories, display cabinets, FEC's)
A-FLOR-STRS	cyan	Continuous	Stair treads, escalators, ladders
A-FLOR-TPTN	green	Continuous	Toilet partitions
A-FURN	green	Continuous	Furnishings
A-GLAZ	yellow	Continuous	Glazing
A-GLAZ-SILL	green	Continuous	Window sill
A-ROOF	cyan	Continuous	Roof
A-ROOF-STRS	yellow	Continuous	Roof ladders
A-WALL	green	Continuous	Walls
A-WALL-PATT	11	Continuous	Texture or hatch patterns
C-BLDG	8	Continuous	Civil (building)
C-CONC	8	Continuous	Civil (concrete)
C-FENC	24	Phantom2	Civil (fencing)
C-GRADE	8	Continuous	Civil (grade)
C-MHOL	31	Continuous	Civil (manholes / handholes)
C-RAIL	11	Continuous	Civil (general rail)
C-RAIL-CLER	magenta	Continuous	Civil (clearance)
C-RAIL-CONC	9	Continuous	Civil (rail concrete)

Sample Layers Chart (cont.)

Layer Name	Color	Linetype	Description
C-RAIL-DYEN	cyan	Continuous	Civil (train dynamic envelope)
C-RAIL-PLAT	green	Hidden	Civil (plates)
C-RAIL-THRL	magenta	Hidden	Civil (third rail)
C-SWLK	23	Continuous	Civil (sidewalks)
C-WALL-RTWL	25	Continuous	Civil (retaining walls)
Defpoints	140	Continuous	Default Non-Plotting Layer
E-BUSW	153	Continuous	Electrical (busway)
E-CABL	33	Continuous	Electrical (cable)
E-CABL-TRAY	8	Continuous	Electrical (cable tray)
E-COND	33	Continuous	Electrical (conduit)
E-CTRL	103	Continuous	Electrical (controls)
E-DIAG	red	Continuous	Electrical (diagrams)
E-DIAG-EQPM	yellow	Continuous	Electrical (diagram equipment)
E-DUCT-BANK	23	Continuous	Electrical (duct bank)
E-ENCL	cyan	Continuous	Electrical (enclosure)
E-EQPM	green	Continuous	Electrical (equipment)
E-FEED	203	Continuous	Electrical (feeders)
E-GRND	93	Continuous	Electrical (ground)
E-JBOX	213	Continuous	Electrical (junction box)
E-LITE	102	Continuous	Electrical (lighting)
E-LITE-EXIT	102	Continuous	Electrical (exit lighting)
E-LITE-WALL	102	Continuous	Electrical (wall mounted lighting)
E-LITE-WALL-EXIT	102	Continuous	Electrical (wall mounted exit lighting)
E-POWR	123	Continuous	Electrical (power circuitry)
E-POWR-PANL	102	Continuous	Electrical (power panels)
F-PROT	72	Continuous	Fire Protection (fire alarm)
E-SLVS	63	Continuous	Electrical (sleeves)
F-SPKR	71	Continuous	Fire Protection (fire sprinkler)
G-ANNO-CNTR	red	Center2	General (centerline)
G-ANNO-GRPH	9	Continuous	General (graphs)
G-ANNO-NRTH-AROW	241	Continuous	General (North Arrow)

Sample Layers Chart (cont.)

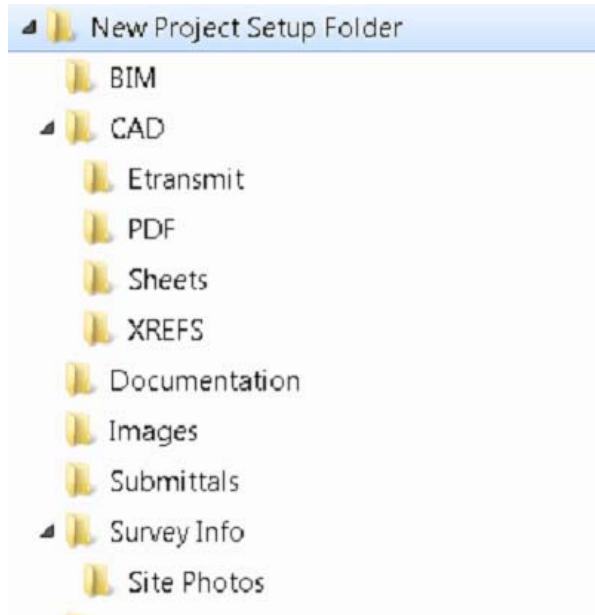
Layer Name	Color	Linetype	Description
G-PATT	green	Continuous	Key plan (hatch patterns)
G-PLAN	blue	Continuous	Key plan (floor plan)
G-SITE	blue	Continuous	Key plan (site plan)
G-TEXT	green	Continuous	Key plan (text)
I-FNSH	53	Continuous	Interior (floor finishes)
I-PRTN-FULL	52	Continuous	Interior (full height partitions)
I-PRTN-PRHT	51	Continuous	Interior (partial height partitions)
I-WALL-MOVE	52	Continuous	Interior (moveable partitions)
L-PLNT	32	Continuous	Landscaping (plant & landscape material)
M-CONT	91	Continuous	Mechanical (controls systems)
M-DUST	93	Continuous	Mechanical (dust collection systems)
M-FUEL	93	Continuous	Mechanical (fuel systems)
M-FUME	93	Continuous	Mechanical (fume hood)
M-HVAC	93	Continuous	Mechanical (HVAC)
M-HVAC-RDFF	92	Continuous	Mechanical (return air diffuser)
M-HVAC-SDFF	92	Continuous	Mechanical (supply air diffuser)
M-NGAS	93	Continuous	Mechanical (natural gas systems)
P-DOMW	82	Continuous	Plumbing (domestic water supply)
P-SANR	82	Continuous	Plumbing (sanitary piping system)
P-SANR-FIXT	82	Continuous	Plumbing (plumbing fixtures)
P-STRM	81	Continuous	Plumbing (storm drainage system)
Q-CMPQ	63	Continuous	Equipment (computer equipment)
Q-EQPM	63	Continuous	Equipment
Q-EQPM-OVHD	63	Dashed	Equipment (overhead)
Q-NICN	250	Continuous	Equipment (not-in-contract)
S-BEAMS	44	Continuous	Structural (beams)
S-BEAMS-CONC	blue	Continuous	Structural (beams concrete)
S-BEAMS-STEL	blue	Continuous	Structural (beams steel)
S-BRAC-STEL	yellow	Continuous	Structural (bracing steel)
S-COLS	44	Continuous	Structural (columns)
S-COLS-CONC	cyan	Continuous	Structural (columns concrete)

Sample Layers Chart (cont.)

Layer Name	Color	Linetype	Description
S-COLS-STEL	cyan	Continuous	Structural (columns steel)
S-FNDN	45	Continuous	Structural (foundation)
S-FNDN-PIER	magenta	Continuous	Structural (foundation piers)
S-FNDN-BEAM	magenta	Continuous	Structural (grade beams)
S-GRID	41	Continuous	Structural grid
S-JNTS	40	Continuous	Structural (construction joints)
S-JNTS-CNTJ	yellow	Continuous	Structural (control joints)
S-JNTS-EXPJ	51	Continuous	Structural (expansion joints)
S-SLAB-CONC	green	Continuous	Structural (concrete slab)
S-SLAB-RBAR	30	Continuous	Structural (slab rebar)
S-WALL-CONC	cyan	Continuous	Structural (concrete wall)
S-WALL-OPNG	green	Continuous	Structural (wall openings)
T-CCTV	112	Continuous	Telecom (closed-circuit television system)
T-DATA	112	Continuous	Telecom (DATA / LAN systems)
T-INTC	112	Continuous	Telecom (intercom / PA systems)
T-PHON	112	Continuous	Telecom (telephone systems)
T-SERT	112	Continuous	Telecom (security systems)
V-DRIV	14	Continuous	Survey (driveways)
V-PRKG	14	Continuous	Survey (parking lots)
V-PRKG-STRP	12	Continuous	Survey (parking lot striping)
V-PROP	16	Dashdot	Survey (property boundaries)
V-RAIL	15	Continuous	Survey (railroad)
V-ROAD	14	Continuous	Survey (roads, streets, highways)
V-SITE	13	Continuous	Survey (site features)
V-SURV-EQMT	green	Continuous	Survey (equipment)
V-SURV-MECO	cyan	Continuous	Survey (Metro survey control)
V-SURV-SURF	white	Continuous	Survey (surface)

WMATA Project Set up Folders

All new projects should and need to follow the below file structure. This folder structure resides on WMATA's CADbim Directory under the Projects folder. If you do not have access to this folder, it can be obtained by email/and or Procure.



END OF DOCUMENT