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NAVSUPPACT NAPLES INSTRUCTION 5230.7

From: Commanding Officer, U.S. Naval Support Activity, Naples, Italy

Subj: FACILITIES SERVICES DESIGN AND CONSTRUCTION COMPUTER-AIDED DESIGN (CAD) STANDARDS INSTRUCTION

Ref: (a) CAD Layer Guidelines http://www/aia.org
(b) Uniform Drawing System http://www.csinet.org
(c) Metric Guide for Federal Construction, National Computer-Aided Design/Draft(CADD) Standard http://www.nibs.org
(d) National CADD Plotting Standards http://www.uscg.mil/mlclant/cetc
(e) The CADD/GIS (Geographic Information System) Technology Center http://tsc.wes.army.mil

Encl: (1) U.S. Naval Support Activity (NAVSUPPACT), Naples Capodichino/Public Works Engineering Facilities Services Design and Construction CAD Standards

1. Purpose. To set a basic Computer-Aided Design and Drafting (CADD) standard for consistent electronic deliverables (products) with the Department of Defense (DoD). These consistent deliverables will be part of a comprehensive installation life-cycle management strategy. As this instruction evolves, it will be integrated with other standard initiatives by the CADD/GIS Technology Center (CGTC) for Facilities, Infrastructure, and Environment such as Contract Language Guidelines, Spatial Data Standards, and Facility Management (FM) Standards.

2. Background. References (a) through (e) represent an effort to develop a single CADD standard for the United States. Working together, the various organizations developed an integrated set of documents that collectively represent the U.S. National CAD Standard, prescribing standards as part of an initiative to consolidate existing CADD drafting standards into a single format generic enough to operate under various CADD software packages.

3. Scope. Providing guidance and procedures for preparing CADD products within the DoD, this instruction addresses the topics of working with CAD standards, why they are required, and how to prepare submittals, as well as technical requirements, layer formats, title blocks, symbology, and composition. Appendices A through C contain tables on the model file level/layer names, sheet file level/layer names, color comparisons, as well as Architectural, Engineering and Construction (A/E/C) CADD Symbology.

4. Definitions. A complete list of acronyms is listed on page 29 of enclosure (1).

5. Action. Anyone preparing CAD data for NAVSUPPACT Naples, including command employees, contractors, and consultants, must read and become familiar with enclosure (1) before proceeding with any work. The term "consultant" used in this text refers to a person or organization preparing CAD data, whether they are part of the NAVSUPPACT Naples organization or not.

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Facilities Services
Design and Construction

CAD Standards

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PART 1: Working with the CAD Standards

This manual is broken out into two parts; the first part will cover how to conform to the CAD standards, the purpose and scope of the standards, receipt and delivery of data, and communication. The second part of the manual will outline Naval Support Activity Naples technical requirements for CAD data.

Section 1. Purpose and scope of the CAD data standards

Computer-Aided Design (CAD) is the accepted tool for producing documentation required for construction and management of facilities; it also provides a common medium of information exchange for creating designs, preparing construction drawings, managing drawings, and tracking spaces. The true power and potential of CAD is the ability to re-use and share the information within CAD documentation. The key to realizing this potential is common organizing principles and standards for the production and distribution of CAD information. The standard organization of files, layers and entities, as well as standardized software applications is essential for effective work and communications. Standards are necessary to ensure that:

- CAD drawings and data are created in one phase (design), and are readily usable in subsequent phases (facility management).
- Drawings and data are compatible with the current available CAD equipment and software.
- Drawings and data are applicable for their intended use.
- Drawings and data can be transferred and integrated with other applications.
- Drawings and data created in one department of the installation are consistent with those developed by other departments.
- Compatibility of NAVSUPPACT Naples CAD drawings and data with pertinent national, international, and industry standards is maintained.

With CAD guidelines relating to an area of technology that continues to change, it is important to evolve and change with them. To ensure NAVSUPPACT Naples and its consultants and customers conform to the broader scope of the proposed National CADD Standard, sponsored by the National Institute of Building Sciences (NIBS) CADD Counsel, our Standards incorporate recommended guidelines from the following;

- American Institute of Architects (AIA) CAD Layer Guidelines, 1997 *www.djec.org/aia_clg.htm
- The Construction Specifications Institute (CSI), Uniform Drawings System (UDS)

- Tri-Service CADD/GIS Technology Center, symbols and deliverables. *https://tsc.wes.army.mil
- GSA PBS National CAD/CIFM Standards. *http://www.gsa.gov/Portal/gsa/ep/channelView.do?pageTypeId=8195&channelPage=%2Fep%2Fchannel%2FgsaOverview.jsp&channelId=-12935

1.1 Why NAVSUPPACT Naples has data standards

This CAD Standards manual is part of NAVSUPPACT Naples comprehensive facility management plan. CAD data created either in house or by contractor will be brought into the Information Management System, and this data must comply with CAD data standards to be readily available and useful within the system.

This document sets performance standards for CAD data delivered to this Installation. NAVSUPPACT Naples PWD does not intend to influence methods or means of practice to outside consultants.

1.2 Scope of CAD data standards

This specification covers all construction documents prepared by or on behalf of NAVSUPPACT Naples PWD. The deliverables described in this manual must be provided for each sheet that is issued for construction in a project and must include all supporting data files that are used to produce the finished sheets.

If additional electronic design drawings or three dimensional (3D) models are provided, it is the responsibility of the consultant to initiate discussion with the designated NAVSUPPACT Naples PWD Representative to determine an acceptable format for those deliverables.

1.3 Who must use the standards

Anyone preparing CAD data for NAVSUPPACT Naples PWD, including NAVSUPPACT Naples employees, contractors, and consultants must read and become familiar with this document before proceeding with any work.

*The term "consultant" used in this text refers to a person or organization preparing the CAD data, whether they are part of the NAVSUPPACT Naples organization or not.

Section 2. CAD Environment

2.1 Basic CAD Software

The designated CAD software for NAVSUPPACT Naples is AutoDesk's AutoCAD. Although an A-E is not prohibited from producing CAD drawings in another CAD software package (other than AutoCAD) all CAD drawings are required to be delivered in AutoCAD's dwg current file

format, and the dwg. File must be fully functional in the activity's current version of AutoCAD software. Required version will be annotated as operating system upgrades are made.

2.2 CAD Application Software

CAD application software packages operate on top of, or in conjunction with, the basic CAD software to extend capabilities. The extensions enhance design, drafting and modeling productivity and link non-graphic attribute data to the graphic entities. All CAD application packages used by NAVSUPPACT Naples, or its consultants, which modify or create CAD layers or other entities must comply with these standards.

Section 3. Requesting CAD Data from NAVSUPPACT Naples

Consultants may request copies of existing CAD data for NAVSUPPACT Naples facilities. CAD data is provided for the convenience of the recipient only. Data has been gathered from a variety of sources and may or may not conform to NAVSUPPACT Naples CAD standards. The data may be incomplete, or may not accurately reflect current facility conditions.

NAVSUPPACT Naples makes no representation as to the data's completeness or accuracy. Consultants also should acknowledge that CAD data appears to be extremely accurate because it has been generated with a computer, and that the accurate appearance of drawings does not guarantee said drawings represent existing conditions.

3.1 How to request data

Requests should be made to the NAVSUPPACT Naples, Public Works Department, Engineering Division (PWDE) designated Project Engineer/Architect. The EIC/AIC will review the request and forward to the AutoCAD Support representative, who will copy requested files and forward to requestor.

Section 4. Deliverables required by Public Work Engineering

At the conclusion of a project, the following three types of materials must be submitted to the NAVSUPPACT Public Works Engineering Division.

* **CAD drawings (in proper format)**

* **All supporting documentation**

* **Software and software licenses, if applicable**

Each of these submittal requirements is detailed below.

4.1 CAD drawings

Consultants will deliver to NAVSUPPACT Naples Public Works Engineering a complete set of the project's CAD documents in electronic format. These documents must include all supporting CAD files and must be delivered as follows:

- On the current supported AutoCAD version in use within the Engineering Division. Verify the current release with appropriate representatives of NAVSUPPACT Naples, Public Works Engineering. As of February 2006, AutoCAD 2006 is in use.
- On acceptable media
- Reflecting "As-Built" conditions
- Using the data structure defined in this manual

Neutral File Format

CAD graphic files copied to neutral file exchange formats such as drawing exchange format (.dxf) and initial graphics exchange specification (.iges) can be read by several basic CAD packages. However, none of the neutral file exchange formats currently available provide reliable mechanisms to transfer the wide variety of non-graphic linkage mechanisms used in basic CAD or advanced CAD application software packages. For this reason, neutral drawing exchange formats are not acceptable.

AutoCAD 2006 or current version file format

All files are to be delivered in native .DWG file format, in a version that can be used by the currently supported version of AutoCAD with NAVSUPPACT Naples without conversion. DXF format files are not acceptable. Verify the current release version with the Public Works Engineering AutoCAD Support Representative.

Acceptable media for delivery of CAD data

Digital data sets shall be furnished via compact disc-read only memory (CD-ROM). Files shall be delivered in uncompressed format.

Digital media labels shall contain the following information as a minimum:

- ✓ NAVSUPPACT Naples Public Works Engineering Title Block
- ✓ NAVSUPPACT Naples project name and number
- ✓ Building name and number

- ✓ Description of media content; Bid Documents, Final Submittal, Record Drawings, As-Builts, Shop Drawings, etc.
- ✓ Consultant name and telephone number
- ✓ Date of submittal
- ✓ Virus scanned (with latest virus definitions available and date scanned)
- ✓ Both CD-ROM case and the CD-ROM itself shall be labeled

All digital media, which contains files for entry into the NAVSUPPACT Naples Public Works Engineering drawing library, must be scanned for viruses. This includes all files received from sources within and outside the Command.

NAVSUPPACT Naples needs CAD data reflecting the actual condition of its facilities. CAD drawings submitted by consultants must show "as built" conditions of any facilities affected by a project.

"As built" drawings include design and detail changes that may have taken place after the initial issue of construction documents, as well as changes made to the actual facility during construction (modifications).

The CAD data delivered to Public Works Engineering by consultants must comply with the Public Works Department (PWD) Engineering CAD Standards in effect during the current project.

The current project's CAD drawings may contain information that has been extracted from existing PWD drawings which may not conform to the current CAD standards. The consultant must ensure all CAD data delivered with a project conforms to the current CAD data standard, even if the source drawings did not conform.

The contractor will be required to update any non-conforming CAD drawings that are used to produce the current project's drawings.

4.2 Documentation

The delivered CAD drawing files must comply with standards in this document. Any deviations from these standards require prior approval by NAVSUPPACT Naples PWD Engineering Representative and must be accompanied by the documentation described below.

- ✓ A list of any extended discipline codes, non-standard drawing type codes, and user defined codes that are used in the CAD file names.

- ✓ A list of any deviations from the standards layer structure (a single exception list is acceptable if all files conform to this list).
- ✓ A list of approved exceptions to the standard layer structure (a single exception list is acceptable if all files conform to the list).
- ✓ A description of any third party products that have been used with the drawings and reference to written approval for their use. This is necessary if the CAD application software:
  - Affects NAVSUPPACT Naples ability to review or edit the drawings
  - Requires NAVSUPPACT Naples to own a license to the software to work with the CAD files without violating the software copyrights.

4.3 Software and software licenses

NAVSUPPACT Naples Public Works Engineering strongly prefers delivered CAD files are usable without any additional software licenses or installation. If additional software (font files, menus, symbol libraries, etc.) will be required, it must be approved by NAVSUPPACT Naples PWD Engineering Representative prior to its use.

If the CAD files cannot be viewed or edited without additional software, the consultant must provide the PWD Engineering division with valid licenses for that software on acceptable delivery media.

4.4 Submittal schedule

The final submittal of "as built" CAD data should be made after project construction is complete and facilities have been occupied, but no later than 90 days after occupancy. In the event of phased occupancy, delivery is required to be phased with same timeline schedule.

In additional, PWD Engineering may require sample submittals at key milestones in the development of the CAD drawings, specifications and data in accordance with the contract.

Sample submittals are not intended to be a burden on the consultant, and typically will involve a limited number of drawings. It is suggested digital media submittals, as a minimum, be provided at the first and final submittal milestones. Providing digital media at the first submittal milestone will allow PWD Engineering to verify the data structures being used by the consultant conform to the CAD data standards and are readily usable on PWD Engineering's CAD systems.

4.5 Validation of delivered materials

NAVSUPPACT Naples Public Works Engineering AutoCAD representative will validate the

CAD data and other materials submitted by consultants. If submittals do not conform to the CAD data standards, the Engineering Department will return the materials to the consultant.

The consultant is responsible for revising all deliverable materials to make them conform to the standards.

Section 5. Communication about the CAD Standards

These CAD Standards will be most effective for NAVSUPPACT Naples and usable for consultants if there is communication between consultants and the PWD Representatives.

Consultants should ask questions about the CAD data standards before beginning work. Direct questions to the PWD Engineering AutoCAD Representative. Concerns regarding the impact of the CAD standards on a particular project must be discussed with the Engineer in charge (EIC), and the AutoCAD Representative. Consultant's questions are valuable because they raise issues that will result in better CAD standards.

5.1 Suggestions for the standards

The content of this manual is intended to be neither static nor all-inclusive and will be updated and enhanced as needed. Suggestions for improvements are encouraged so future updates reflect the needs of the Public Works Engineering Division. Submit suggestions, as well as new information, which would improve these standards to the PWD AutoCAD Representative.

PART 2: Technical Requirements for CAD Data

The organization and format of CAD deliverables should support the requirements of NAVSUPPACT Naples Public Works projects for design, construction, bidding and archiving. The deliverables will also support the compatibility of other PWD management systems, such as Archibus FM. Because of this, all interior room lines will be drawn as closed polygons in the .dwg file to link attributes in Archibus to graphic features with no additional effort.

NAVSUPPACT Naples PWD standards for CAD file types, files names, and sheet numbering are based on Tri Service Standards. The requirements of these standards are described below.

NAVSUPPACT Naples Public Works CAD files will include three types of CAD files, template files, model files, and sheet files.

Section 6. Types of CAD files

6.1 Template files

A template file is a drawing file containing predefined drawing settings and/or geometry, such as a title block, and is used to begin a new drawing.

6.2 Model files

A model file represents full-size drawings, which describe a subset of a building's geometry, elements, systems or information (e.g. mechanical, HVAC system, details, the architectural floor plan or sections) and its physical components: beams, walls, doors, windows, columns, outlets, ducts, etc. A model must be created at real size: 1=1.

Model files are used as components in creating plotted sheet files. The information contained within a model file for a discipline may be referenced by other disciplines to create the particular model file or sheets files for that discipline.

Dimensional Model files are a matter of specifying in two dimensional (2D) coordinates (X and Y), and 3D coordinates (X, Y & Z). When drawing in 3D, you specify X, Y, and Z values of the coordinate in either the world coordinate system (WCS), or the user coordinate (UCS).

Other files usually reference model files. Models can contain other models referenced in those files.

6.3 Sheet files

Sheet files are used to assemble model files, title blocks, and other information for plotting. A sheet file contains one or more scaled views of one or more models arranged within a border and title block.

A sheet file is a "ready to plot" CAD file. Each sheet contains the parameters that produce its corresponding plotted drawing, such as scale, layer visibility, and graphic appearance. Sheet files contain AutoCAD's paper space information. They are never referenced by other files.

By organizing information into model and sheet files, plans and other drawings can be developed without concern for layout of the original construction document. Sheet files can be developed at a later date in the project cycle. Sheet files allow for consistent plotting standards while allowing different types of plots from the same source CAD model.

Multiple sheets can be created using the same model, with each sheet containing different graphics of the model using different plotting perimeters.

6.4 Managing data for enlarged plans

Enlarged views (plan, sections) of a portion of a building usually include information not shown in the model file of a full floor plan. The additional information may include building components or dimensions and annotations. Similar situations may occur when creating alternate design options for the same location in a facility. This standard provides two methods for managing information that is included in enlarged plans or alternate views.

Method 1: Additional layers in the model file

Additional model data and dimension text can be added on special layers to the existing model file. These layers hold text and more details about the model that appear on enlarged plans. The additional data layers can be turned on when the information should appear on a plotted sheet. Text and dimensions must be sized appropriately for the scale of the plotted sheet.

*The additional layers must not contain duplications of data that exists in other layers.

Suggested method for naming these additional layers is described in the layer section of this manual.

Method 2: Separate model files

Separate model files may be created to hold additional model data that appears on some plotted sheets. This model file will hold text and more details about the model that appear on enlarged plans. Only the additional data needed for the enlarged plan should be included in this model.

The sheet file should reference this model file when the information is needed.

The additional model files must not contain duplication of data existing in other model files. Model files should be referenced, even by other model files, so duplicate data is not drawn and does not have to be maintained.

Either of these methods is acceptable to NAVSUPPACT Naples PWD. It is easier to maintain model data that has been created in multiple model files. It may be easier to work with the data during the design and construction documentation process, however, if there are fewer model files, but more layers.

Section 7. CAD File names

The sheet identification format is derived from traditional construction drawing techniques, with minor modifications for ease of use for laypersons. CAD files must be named using the following format.

Model file naming convention

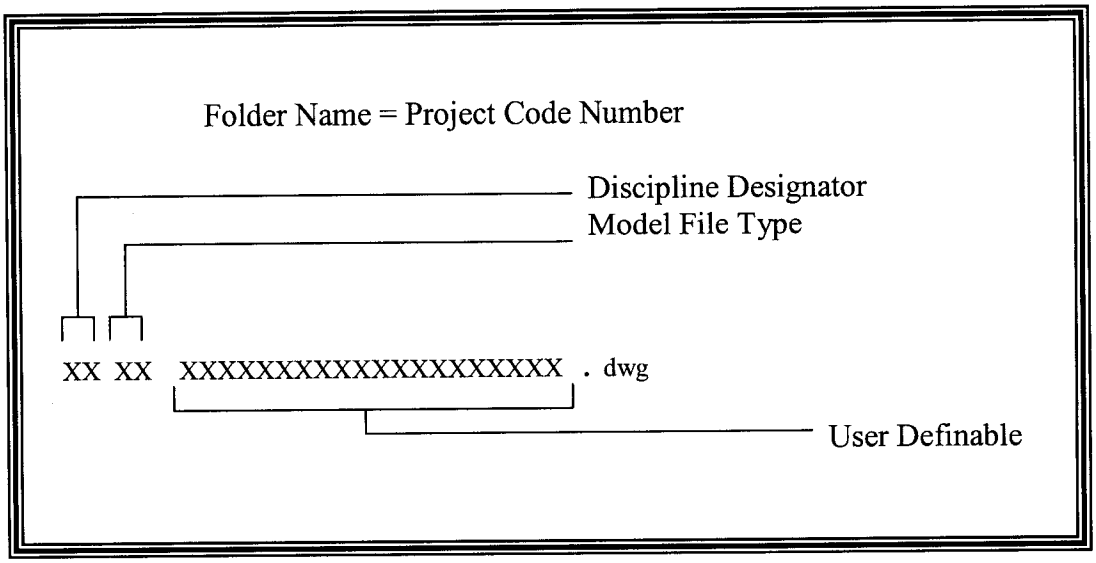


Figure 1. Model file naming convention

The model file naming convention consists of three mandatory fields, and must be used in the correct sequence. All drawings will be filed under their Project Code Number; this is required to prevent the same file names from existing in different directories.

The first two-character field represents the *Discipline Designator*. The allowable characters for the first character in the Discipline Designator are listed in Table 1.

Discipline Designators	
Discipline	Designator
General	G
Hazardous Materials	H
Survey / Mapping	V
Geotechnical	B
Civil Works	W
Civil	C
Landscape	L
Structural	S
Architectural	A
Interiors	I
Equipment	Q
Fire Protection	F
Plumbing	P
Process	D
Mechanical	M
Electrical	E
Telecommunications	T
Resource	R
Other Disciplines	X
Contractor/Shop Drawings	Z
Operations	O

Table 1

The second character of the Discipline Designator field is always a hyphen "-". The next two-character field represents the Model File Type and is listed in Table 2. The final 20-character field is user definable (short description of file for laypersons, example; GrndFlrLayout = Ground Floor Layout).

* *If all the User Definable characters are not needed, placeholders must be used for the Workspace to function properly.*

Example: The model file name for a project at NAVSUPPACT Naples Public Works Engineering (PWD), Building 407, 1st floor, Architectural Floor Plan could be:

FOLDER NAME = PWD407(Project Name)

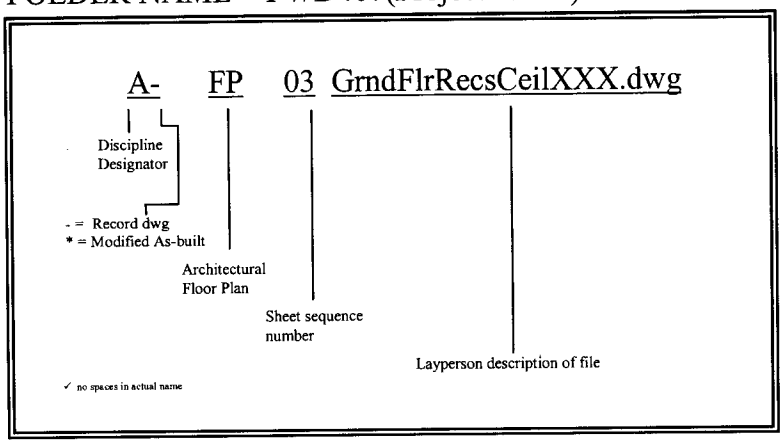


Figure 2. Model File

Where PWD407 is the Project Code Folder, A = the Discipline Designator, The next space = A/B or Record file type. FP – is the Model File Type (Floor Plan). The 03 = sheet sequence number. The other 18 characters are user definable characters used as a description of the file for laypersons (sample: ground floor recessed ceiling), with the "X" used as a placeholder.

Existing / Demolition model file naming.

Table 2
Model File Types

Discipline	Code	Definition
General		
	BS	Border Sheet
	KP	Keyplan
Hazardous Materials		
	DT	Detail
	EL	Elevation
	LG	Legend
	PP	Pollution Prevention Plan
	SC	Section
	XD	Existing/Demolition Plan
Survey/Mapping		
	AL	Existing Airfield Lighting Plan
	CP	Existing Communication Plan
	EU	Existing Electrical Utilities Plan
	FU	Existing Liquid Fuel Utilities Plan
	HP	Hydrographic Survey Plan
	HT	Existing HTCW Utilities Plan
	IW	Existing Industrial Waste Water Plan
	LG	Legend
	NG	Existing Natural Gas Utilities Plan
	PB	Project Boundary
	PR	Existing Profile
	SC	Existing Section
	SP	Survey and Mapping Plan
	SS	Existing Sanitary Sewer Plan
	ST	Existing Storm Sewer Plan
	WA	Existing Domestic Water Plan
Geotechnical		
	BL	Boring Location Plan
	LB	Boring Log
	LG	Legend
	SH	Schedule
Civil		
	AF	Airfield Plan
	AM	Airfield Pavement Marking Plan
	CP	Channel Plan
	DT	Detail
	EC	Erosion Control Plan
	EL	Elevation
	FU	Liquid Fuel Utilities Plan
	GP	Grading Plan
	IP	Installation Plan/Base Map
	IW	Industrial Waste Water Plan
	JP	Joint Layout Plan
	KP	Staking Plan
	LG	Legend

Table 2
(Continued)
Model File Types

Discipline	Code	Definition
Civil (Continued)		
	NG	Natural Gas Utilities Plan
	PL	Project Location Plan
	PR	Profile
	SC	Section
	SH	Schedule
	SP	Site Plan
	SS	Sanitary Sewer Plan
	ST	Storm Sewer Plan
	TS	Transportation Site Plan
	WA	Domestic Water Plan
	XD	Existing/Demolition Plan
Landscape		
	DT	Detail
	EL	Elevation
	IP	Irrigation Plan
	LG	Legend
	LP	Landscape Plan
	SC	Section
	SH	Schedule
	XD	Existing/Demolition Plan
Structural		
	3D	Isometric/3D
	CP	Column Plan
	DT	Detail
	EL	Elevation
	EP	Enlarged Plan
	FP	Framing Plan
	LG	Legend
	NB	Non-Building Structure Plan
	NP	Foundation Plan
	SC	Section
	SH	Schedule
	XD	Existing/Demolition Plan
Architectural		
	3D	Isometric/3D
	AC	Area Calculations/Occupancy Plan
	CP	Reflected Ceiling Plan
	DT	Detail
	EL	Elevation
	EP	Enlarged Plan
	FP	Floor Plan
	LG	Legend
	QP	Equipment Plan
	RP	Roof Plan
	SC	Section
	SH	Schedule
	XD	Existing/Demolition Plan

Discipline	Code	Definition
Interiors		
	3D	Isometric/3D
	DT	Detail
	EL	Elevation
	EP	Enlarged Plan
	LG	Legend
	QP	Equipment Plan
	RP	Furniture Plan
	SC	Section
	SH	Schedule
	SP	Signage Placement Plan
	WP	System/Prewired Workstation Plan
	XD	Existing/Demolition Plan
Fire Protection		
	DG	Diagram
	DT	Detail
	FA	Fire Alarm/Detection Plan
	FP	Fire Suppression Plan
	LG	Legend
	LP	Life Safety Plan
	SH	Schedule
	XD	Existing/Demolition Plan
Plumbing		
	DG	Diagram
	DT	Detail
	EL	Elevation
	EP	Enlarged Plan
	LG	Legend
	PP	Piping Plan
	SH	Schedule
	XD	Existing/Demolition Plan
Mechanical		
	3D	Isometric/3D
	DG	Diagram
	DT	Detail
	EL	Elevation
	EP	Enlarged Plan
	HP	HVAC Plan
	HT	HTCW Utilities Plan
	LG	Legend
	MD	Machine Design Plan
	MH	Material handling Plan
	PP	Piping Plan
	QP	Equipment Plan
	SC	Section
	SH	Schedule
	SP	Specialty Piping Plan
	XD	Existing/Demolition Plan

Discipline	Code	Definition
Electrical		
	AL	Airfield Lighting Plan
	AP	Auxiliary Power Plan
	CP	Exterior Communication Systems Plan
	DG	Diagram
	DT	Detail
	EU	Electrical Utilities Plan
	GP	Grounding System Plan
	LG	Legend
	LP	Lighting Plan
	PP	Power Plan
	SH	Schedule
	SS	Special Systems Plan
	XD	Existing/Demolition Plan
Telecommunications		
	DG	Diagram
	DT	Detail
	LG	Legend
	SH	Schedule
	TP	Telephone/Data Plan
	XD	Existing/Demolition Plan

There are instances when a facility is being renovated and the as-built designs need to be revised to show demolition and new items. These revisions are not to be made on existing as-built model files, but on copies to ensure the original "as built" are not modified.

A new model file type, Existing/Demolition (XD), where "*" means this type has been added to the standard to allow users to make revisions to "as built" files. This model file type is used to aid users in separating existing to remain items from items that will be demolished. *Reference figure 2.*

7.1 Sheet File Names

The use of systems methods overlay drafting, and CAD has demanded more consistency in labeling and organizing sheets. Sheet file names must be constructed in the format in Table 3.

NAVSUPPACT Naples Project Number Acronym	Discipline Code	Sheet Sequence Number/User Definable Code	Extension
ABCD-	**A**	**01**	**.DWG**

Table 3: Sheet file name example

NAVSUPPACT Naples Project Number Acronym

The first four or five characters reflect the specific acronym given to all NAVSUPPACT Naples PWD projects. The hyphen is a required placeholder in the absence of a fifth character.

Discipline Code

The sixth character shows the letter that must be used for the first character of the discipline code shown in table 1 of this instruction.

Sheet Sequence Number

The seventh and eighth characters of a sheet number contain the sheet sequence number, which is a two-digit number that starts at 01 and may ascend through 99. The sheet sequence number identifies each sheet in a series of the same disciple and sheet types. As many numbers may be used as are needed for each discipline/sheet type combination.

Sheet numbers must be two-digits, even if a project does not require that many sheets. The use of two-digits allows sheet files name to be consistent regardless of project size.

All sheet types may apply to all disciplines, but it is not necessary to use all sheet types within a project or within a discipline.

Consultants may combine different types of drawings on the same sheet, for simplicity. For example, it is acceptable to place schedules on a plan sheet where the information is closely associated.

On some projects, the presence of split-levels, mezzanines or interstitial spaces may make it difficult to use floor numbers as sheet sequence numbers. Consultants should evaluate the needs of the project when developing the project's sheet sequence numbering scheme.

It is common for sheets to be added to a project's set of drawings after sheet sequence numbers have been assigned and are in use. These additional drawings may be inserted in the set by using suffixes, which can be in additional to the two user definable characters of the sheet number. The user definable characters are described below.

User Definable Code

NAVSUPPACT Naples PWD recommends consultants follow the CSI's method of using these characters to indicate when a sheet has been reissued with revised information.

The examples in Table 4 show possible uses for the two characters.

Sheet number	Description
A-01R1	Floor plan sheet A-01, reissued after partial revision.
A-01X1	Floor plan sheet A-102, reissued after total revision.
A-01A	Floor plan sheet for unit A of floor 01 when a facility is large enough that the entire floor plan will not fit on one sheet.
A-01A1	Floor plan sheet A-01A1 for phase 1 of a sequenced construction.

Table 4: User definable codes

Consultants may determine the user definable codes that make sense for a project. A list of user definable codes and their meanings must be submitted to NAVSUPPACT Naples PWD in advance for approval.

Extension

NAVSUPPACT Naples PWD requires all sheet files be named with the sheet number that appears on the plot, plus the AutoCAD file name extension, DWG.

Section 8. Layers

NAVSUPPACT Naples PWD has adopted in part the CAD layer naming system published by the AIA, in its most current version of Layer Guidelines. Consultants should follow this layer naming system when additional layer names are required in a project's CAD drawings that are not addressed in the NAVSUPPACT Naples PWD CAD Layering Standard.

Layer names and assignments are shown in the Appendices, included with the NAVSUPPACT Naples CAD Layer Standards Package. The layer table categorizes layers by discipline and by

type of CAD file. This table also shows several items for each layer, as follows:

- ✓ A complete listing of all layer names
- ✓ A detailed definition for each layer
- ✓ The presentation graphics associated with each layer. Some colors and line types are listed as a preference of NAVSUPPACT Naples PWD but not a requirement.

Consultants wishing to use additional layer must submit a list of proposed layer names and their meaning to NAVSUPPACT Naples PWDE for approval.

8.1 Layer Format

NAVSUPPACT Naples PWD's layer guidelines are organized as a hierarchy, utilizing a scheme of naming layers with four field groups. The four groups are discipline code, major group, minor group and status group.

Layer name with discipline, major group, minor group and status field

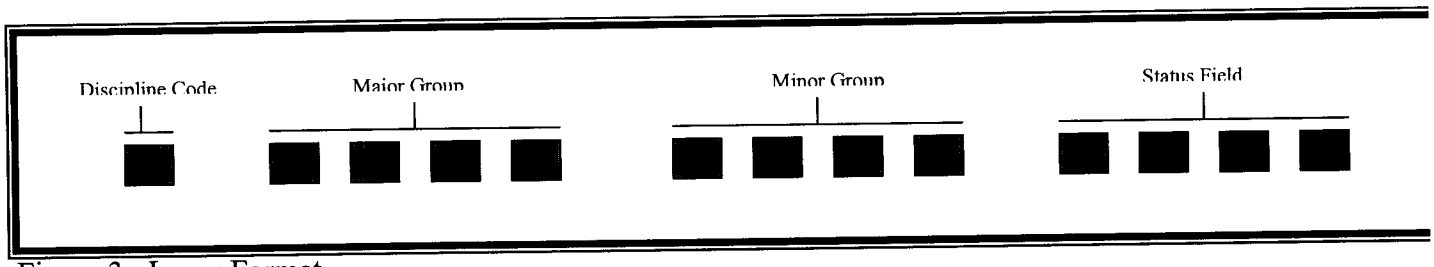


Figure 3. Layer Format

Discipline Code

The Discipline Code is a one-character field. The defined codes are the same for both layers and file names. Table 1 of this instruction shows the letters that must be used for the first character of the discipline code.

Major Group

Major groups are a four-character field used to identify the building system. Major groups are typically grouped with specific discipline codes. Example - a drawing could contain the following layers:

A-WALL	Walls
A-DOOR	Doors
C-PKNG	Parking Lots

Minor Group

Minor groups add an additional set of information to the layer names. It is an optional, four-character field further differentiating groups into types of information. An example would be, A-WALL-PART indicates architecture, wall, partial height.

Status Fields

The user, allowing additional layers to be added to accommodate special project requirements, can define the minor group field. This should only be done if a defined layer does not apply to a project. Some examples of layers using a user-defined minor group field are:

A-DOOR-PRHT	Partial height doors
A-WALL-EXTR	Exterior walls
M-EXHS-DUCT	Exhaust system ductwork
E-LITE-EMER	Emergency light fixtures

Complete layer lists are provided in Appendix A

8.2 Common Layers Used in All Files

Annotation comprised of text, dimensions, sheet borders, detail references, and other elements on CAD drawings that do not represent physical aspects of a building. The minor group "ANNO" designates annotation. Types of annotation are designated in Table 5.

*-ANNO-DIMS	Extension lines, dimension arrowheads/dots/slashes. Dimension text
*-ANNO-KEYN	Keynotes with associated leader lines and arrowheads
*-ANNO-LEGN	Legends and schedules
*-ANNO-NOTE	General notes and general remarks
*-ANNO-NPLT	Construction lines, referencing targets, area calculations, review comments, viewports windows
*-ANNO-PATT	Miscellaneous patterning, and cross-hatching
*-ANNO-REDL	Redline
*-ANNO-REVS	Revisions
*-ANNO-SYMB	Miscellaneous symbols
*-ANNO-TEXT	Miscellaneous text and callouts with associated leader lines and arrowheads
*-ANNO-TTLB	Border and title block
*-ANNO-XREF	Reference files

Table 5: Annotation Layers
* Asterisk represents the discipline code

Annotation can be placed in model and sheet files. Dimensions, symbols, and keynotes typically are placed in model files. Borders and title blocks are usually placed in sheet files. The same layer names should be used in both cases.

Special cases can exist when two or more sheet files reference a single model file. In this case, it may be necessary to differentiate two or more "sets" of annotation. Consultants must name these layers by adding a hyphen and four characters to the end of any standard major group. An example would be; a model file containing both floor plan and ceiling plan information may need different layers for ceiling plan dimensions and floor plan dimensions. In this case, the Consultant should modify the minor group to indicate the intended view. A-ANNO-DMFP for floor plan dimensions and A-ANNO-DMCP for ceiling plan dimensions. Any new layers and the information they contain must be documented and submitted to NAVSUPPACT Naples PWD.

Status Layers

The status field is an optional, four-character field that designates phases of construction and status of elements. This field is optional and is only used when phases of work need to be differentiated. Table 6 shows the defined values for this field:

*-****-N	New Work
*-****-E	Existing to Remain
*-****-D	Existing to Demolish
*-****-F	Future Work
*-****-T	Temporary Work
*-****-M	Items to be Moved
*-****-R	Relocated Items
*-****-NIC	Not in Contract
*-****-PHSI-9	Phase Numbers
*-****-A	Abandoned

Table 6: Status Layers
* Asterisk represents discipline code and major group

Layers representing the dominant phase may be represented without a status field. An example would be; in a small remodeling project, "N" would indicate new construction and layers without status fields would indicate existing to remain. Special groups of layers for a particular model file will have status layers
(*-****-N).

The status field is always placed as the last field of the layer name. In a simple layer name, example; A-WALL, the status field would be the third field A-WALL-D. In a more detailed layer name, the status field would be the fourth field, A-WALL-FULL-D.

Section 9. Drawing Set Up

This section will describe how to organize and set up CAD drawings for NAVSUPPACT Naples PWD. AIA CAD Layer Guidelines and the CSI Uniform Drawing System have been referenced in the preparation. It is recommended NAVSUPPACT Naples employees and consultants obtain copies of these materials to augment this section.

Consultants must obtain prior approval from the NAVSUPPACT Naples PWD Representative for any exception to the drawing set up standards. Consultants must submit documentation referencing the files affected and how they deviate from the standards.

9.1 Drawing units

NAVSUPPACT Naples PWD uses the Metric report format, unless prior arrangements have been coordinated through and with NAVSUPPACT Naples PWD this standard will apply in all projects.

9.2 Accuracy

All CAD drawings shall be drafted using precision input employing the most accurate source material available. For all drawing entities, zero tolerance is required, all lines meet at intersections, straight lines are straight; blocks are inserted properly without overlap, square corners are exactly 90 degrees, etc.

Consultants are responsible for the accuracy of all CAD drawings delivered to NAVSUPPACT Naples PWD, regardless of the accuracy of CAD drawings of previous projects furnished by NAVSUPPACT Naples as a convenience to the consultant.

9.3 Scale

Objects are to be created at full size, a 30-meter (100 foot) wall will be drawn to 30 meter, and a 100-centimeter (39.5 inch) column will be drawn to 100 centimeters. The following types of CAD drawings may be drawn to any scale: schedules, riser diagrams, schematic and single line diagrams.

9.4 Origins and registration of CAD data files

The origins of CAD model files must be defined at coordinates 0,0,0. This is typically the lower left corner of the building. For non-rectilinear buildings a logical origin point shall be established.

The origin point must remain consistent between all model files in a project. This is critical for correct registration of different model files when referenced together, and aligning the various views of the facility. Registration of electronic data must be maintained so the information will be usable in future applications.

The origin of each CAD sheet file should be at the lower left hand corner of the sheet border and set to coordinates 0,0,0.

Special considerations/requirements for site plans

Civil Engineering CAD Model files may use true geographic coordinates in the Universal Transverse Mercator (UTM) Map Projection (Meters) and using the WGS 1984 horizontal datum (within the Activity's appropriate UTM zone) for their origins.

UTM (meters) Easting and Northing coordinates should be shown on the Site Plan at two opposite corners of the facility (e.g. building) footprint.

9.5 Entities and graphic representation

Curved Entities

Circles, arcs, and ellipses shall be created as individual entities, not as line segments.

Drawing Limits

Drawing and extents must be checked to ensure there are no objects outside the drawing limits. Objects outside the drawing limits will slow the regeneration and manipulation of the drawing. All drawings shall be submitted with the drawing display zoomed to the drawing extents.

Entity Properties

Entity properties such as color and linetype shall be BYLAYER. For the purpose of clarity, some block and symbol properties may not be set BYLAYER, but this should be avoided whenever possible.

9.6 Saved state of CAD model files

CAD files should be delivered in the state described below.

- Blocks should not be exploded.
- Drawings should be purged.
- Drawings should be zoomed to extents.
- Drawings should be left in paperspace, if they use paperspace.
- The menu should be set at ACAD.

9.7 Sheet size, borders, and title blocks

Sheet sizes, borders, and title blocks used for all NAVSUPPACT Naples projects will comply with the Uniform Drawing System (UDS), drawing sheet standards developed by the Construction Specifications Institute.

Select American National Standards Institute (ANSI) architectural sheet, regular architectural sheet size or Metric sheet size to best accommodate project size and complexity, and unit of measurement (Metric or English). Plotter limitations and handling/storage of hard copies should also be considered.

Determine if NAVSUPPACT Naples PWD Engineering has specified the selected sheet size before starting the project.

9.8 Plotting

Each sheet drawing file generally represents a single plotted drawing. The sheet origin point is the lower left-hand corner of the sheet. The sheet border may be an XREF file inserted at 0,0. No drawing entities should reside outside of the sheet's border. When saving the sheet file, make only the layers needed for correct plotting of the sheet visible. Plotting shall be set at a scale of 1" = 1".

9.9 Sheet identification/numbering

Sheet sequence identifier numbers start at 01 and continue through to 99. Sheet numbering systems vary and shall be approved by NAVSUPPACT Naples PWD Engineering before beginning the drawing set. The CSI UDS guidelines shall be used unless an exception is approved by the NAVSUPPACT Naples PWD Engineering Representative (reference the section on Sheet File Names). Numbering system shall be compliant with Section 7.1 if this instruction.

9.10 Title blocks/borders

Title blocks and borders shall follow CSI Uniform Drawing System (UDS) guidelines unless NAVSUPPACT Naples PWD Engineering Representative approves an exemption. A sample title block layout sample sheet setup follows. *Refer to the NAVSUPPACT Naples PWD Engineering "Title Block" samples on the provided guidance disk for suggested layout guidance.*

- Verification of most current "Title Layout" should be obtained from NAVSUPPACT Naples PWD Engineering Representative prior to start of project, to ensure most current format requirements.

Title Block Area
Based on CSI Uniform Drawing System

Key plan block if used. (or key plan may be placed in lowest module of note block.)

Identifies designer or preparer of sheet. May include:
Name
Address
Telephone / FAX Number
E-mail / Internet
Block may also include preparer's logo, professional seals, certifications and the name of addresses of consultants.

Identifies the project, Includes:
Project name, number and address
Building / Facility name and number
Construction phase sequence
Owner / /Client address, telephone / FAX numbers and logo may also be included.

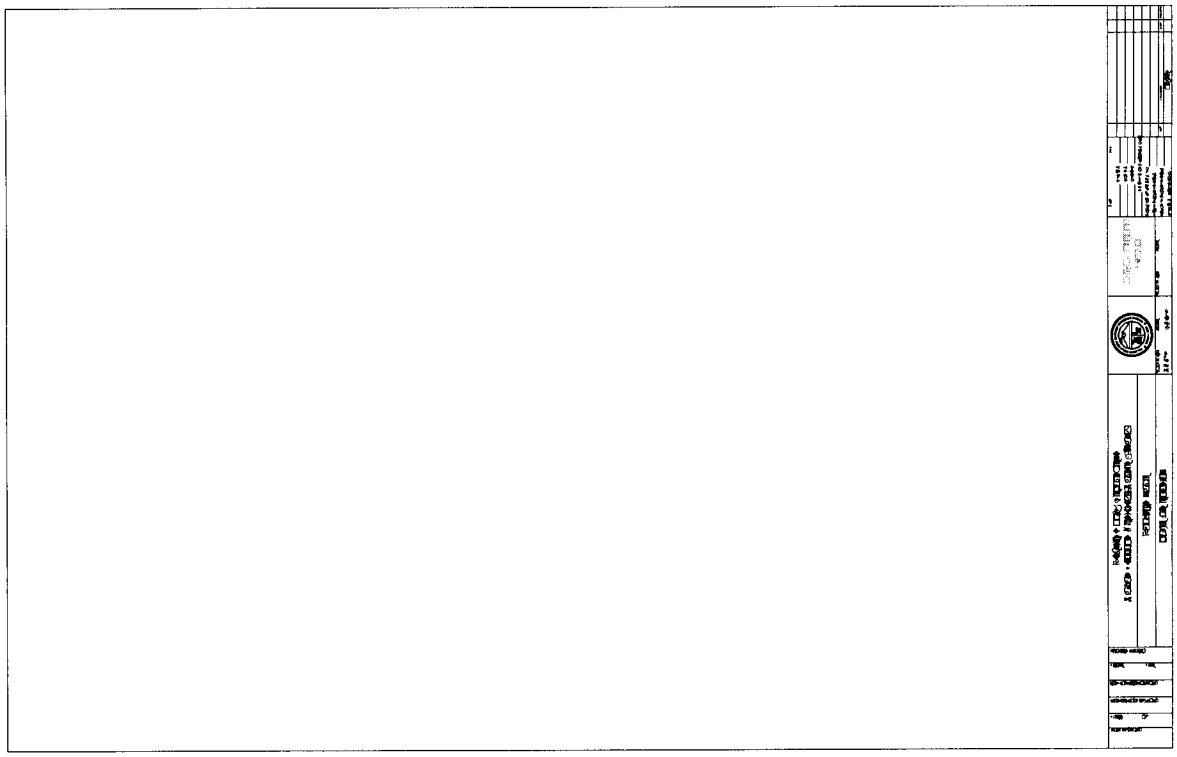
Shows the issue and revision dates. Include mark, date and description columns.

Project management information such as project number, drawn / checked by, copyright.

Indicates type of information presented on sheet.

Sheet number
Sheet sequence number

SAMPLE TITLE BLOCK LAYOUT



9.11 As-Built and Conformed Designation

Each sheet of conformed electronic files must be noted with "Conformed Revisions" and dated in the issue block of the title block. *Stamp is to be located directly above the NAVSUPPACT Stamp (see Title Block Layout).*

A/E OF RECORD
CONFORMED
STAMP

00/00/00

As-Built stamp will be place in the lower right corner of the drawing area to the left of the title block. As-Built stamp is to be 3" wide x 2" high that states "AS-BUILT" on the top line followed by three lines for the company name, date and signature of authorized representative as follows.

AS-BUILT
Company
Date
Signed

Section 10. Symbology and Composition

10.1 Line types

Use standard linetypes whenever possible. Contour lines, dashed lines and other fonted lines shall be made of one continuous line segment, not a series of separate line segments. If the consultant is using pre-approved basic CAD software other than AutoCAD, insure that linetypes translate correctly in the .dwg file.

Polylines with increased width may be used only to depict non-building drawing elements such as cut-lines. Use of toned or poched lineweights for use with inkjet or electrostatic plotters to differentiate new or existing work is acceptable.

Line types that are not AutoCAD defaults must be provided to NAVSUPPACT Naples PWD Engineering including any software, software licenses, and documentation need for NAVSUPPACT Naples PWD staff to use the CAD data without violation of software copyrights.

10.2 Line type scale

Line type scale must be set so that each line type is recognizable, easily identified, and distinguishable to individuals who are working in the model files and in final plotted format.

10.3 Line weight and color

Consultants may use additional line weights as needed for effective communication of the project data.

Line weight and color affect the usability of CAD data in different ways. Line weight typically is most useful when working with plotted CAD drawings. Plots, or reproductions of plots, are usually monochrome and the thickness of lines is an important means of communicating information about the facility and the design.

Color is most useful when working with CAD data on a computer screen. Colors allow users to readily identify systems and types of information. On a computer screen, line weight often gets in the way of effective communication. **Reference Appendix A and C for line weight and color requirements.*

10.4 Text and Fonts

All text of NAVSUPPACT Naples PWD drawings shall use only standard text fonts supplied with AutoCAD's font library. CAD files submitted shall be plottable without modification and with no additional software required.

Text size must be legible and appropriate to the graphic information presented and the intended plotted scale of the drawing. Text must be in all upper case letters throughout a drawing, except for electrical switch legs and symbols, which require lower case letters.

Text placement guidelines

Text should not touch other graphic objects, and must be placed with enough space around it to be legible when the drawing is plotted and reproduced.

Text may be placed at an angle. It must be readable from the bottom or right edges of the plotted sheet. Generally text should be placed at an angle of 0 or 90 degrees. Text may be placed along (above or below) another element at an angle other than 0 or 90 degrees.

Units

Metric units shall be the standard system of measurement, unless a prior agreement has been established with the NAVSUPPACT Naples PWD Engineering Representative. The base unit shall be meters.

10.5 Annotation

Annotation can be placed in either model files or sheet files. Annotation related to model data, such as dimensions, notes, and callouts must be included in the model file where they are easier to coordinate and review.

Other annotations, such as drawing titles, legends, and sheet-specific notes, are more convenient to work with when placed in the sheet file.

10.6 Dimensions

The default settings for AutoCAD's Dimension Variables (DIMVARS) should be used. Associative dimensions should be used.

Consultants should ensure all dimension are in a named dimension style for all dimensions in CAD files, so the dimension parameters can be readily modified as needed.

10.7 Xref (External Reference) Files

Xrefs may be used to subdivide a large CAD drawing into several smaller, more efficient drawings. The use of this procedure will reduce drawing size, increase performance, improve operator efficiency and make coordination of disciplines easier. Xref's may also be used to split a drawing by disciplines. When possible, avoid nested xrefs. There shall be no specific drive or directory references associated with the xrefs. All xrefs must reside in the same directory as the drawing files.

Consultants must provide all xrefs to the NAVSUPPACT Naples PWD Engineering Representative by either separate model files or by "binding" the xref (model) files to the sheet file.

10.8 Blocks

Any graphic entity that occurs repeatedly in drawings should be made into a block. Insertion points for blocks shall be consistent with its placement in the drawing. Use a logical insertion point (center of circle, bottom left corner of object, etc.). Keep names simple and descriptive. AutoCAD block names must be unique within each project.

Nested blocks contain more than one block definition. Nested blocks should be avoided.

Some details and symbols may be available from the CADD/GIS Technology Center's "CADD Details" and "Standard Symbols" libraries and can be downloaded from the Center's website: http://tsc.wes.army.mil/

10.9 Hatching

Do not use Polylines with increased width as a replacement for hatching. Unless there is a compelling reason to generate non-associative hatch objects, it is recommended to use the default hatch generation method.

Section 11. Reference: Organizational Addresses

<u>CAD Layer Guidelines</u>
American Institute of Architects
1735 New York Avenue, NW
Washington, DC 20006 5292
Voice: (202) 626 7300
Orders: 800 365 2724

Fax: (202) 626 7547
Email: infocentral@aia.org
Internet http://www.aia.org

Uniform Drawing System
The Construction Specifications Institute
99 Canal Center Plaza, Suite 300
Alexandria, VA 22314 1791
Voice: (800) 689 2900
Fax: (703) 684 8436
Email: csi@csinet.org
Internet: http://www. csinet.org

Metric Guide for Federal Construction, National CADD Standard
National Institute of Building Sciences (NIBS)
1090 Vermont Avenue, NW, Suite 700
Washington, DC 20005 4905
Voice: (202) 289 7800
Fax: (202) 289 1092
Email: nibs@nibs.org
Internet: http://www.nibs.org

National CADD Plotting Standards
U.S. Coast Guard Civil Engineering Technology Center
1240 E. 9th Street, Room 2195
Cleveland, OH 44199 2060
Voice: (216) 902 6209
Email: cgcetc@cgcetc.org
Internet: http://www.uscg.mil/mlclant/cetc

The CADD/GIS Technology Center
US Army Engineer Research and Development Center
Attn: CEERD-ID
3909 Halls Ferry Road
Vicksburg, MS 39180 6199
Voice: (601) 634 4109
(800) 522 6937, ext 4109
Fax: (601) 634 4584
Email: Edward.L.Huell@erdc.usace.army.mil
Internet: http://tsc.wes.army.mil

POC: Mr. Stephen Spangler
Voice: (601) 634 3104
(800) 522 6937, EXT 3104
Fax: (601) 634 4584
Email: steve.c.spangler@erdc.usace.army.mil

Appendix A: CAD Layer Names

The Complete A/E/C CADD Standard released by the CADD/GIS Technology Center is available for download, and can be referenced at:
https://tsc.wes.army.mil/downloadtracking/downloaddata.asp?PID=96

Appendix B: Acronyms

- A-E — Architect-Engineer
- A/E/C — Architect, Engineering, and Construction
- AIA — American Institute of Architects
- ANSI — American National Standards Institute
- ASTM — American Society for Testing and Materials
- CAD — Computer-Aided Design
- CADD — Computer-Aided Design and Drafting
- CGTC — The CADD/GIS Technology Center
- CSI — Construction Specifications Institute
- DoD — Department of Defense
- FM — Facility Management
- GIS — Geographic Information System
- IAI — International Alliance for Interoperability
- IFC — Industry Foundation Class
- IOC — Intelligent Object Class
- ISO — International Organization for Standardization
- NCS — National CAD Standard
- NIBS — National Institute of Building Sciences
- SI — International System of Units (Le Systeme International d'Unites)
- UDS — Uniform Drawing System