

# UNIVERSITY CAD STANDARDS

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# UNIVERSITY CAD STANDARDS

## ARTICLE 1

### EXECUTIVE SUMMARY

Computer-Aided Design files are produced and used by the University and its business partners for a wide variety of facilities planning and management purposes throughout the building life-cycle, including initial design and construction, renovations, tenant improvements, maintenance, space planning and asset management to name a few. Consistent, usable, quality CAD drawings are a high-value information asset.

Because of the detailed nature of CAD drafting, CAD drawings are expensive to produce and maintain, requiring hundreds of man-hours of skilled drafting time for each plan set. Drafting preferences can vary widely from drafter to drafter, and affect issues such as drawing setup, file and database structure, layering, symbology and software dependencies.

In assembling a large archive of CAD for institutional facilities management, the drafting preferences and differences in drawing structure and can make drawings hard to understand, even unreadable, by those not involved in initial project activity. Widespread differences also preclude automation of various aspects of archive management.

Software problems can render drawings completely useless if formats or features become obsolescent or incompatible. Software vendors design these problems intentionally for purposes of incentivizing upgrades and discouraging platform switches. These factors create data loss risk for institutional archivists.

While the costs of CAD production will always remain high because of the meticulous and skilled nature of CAD drafting work, the problems associated with usability, consistency and software obsolescence can be addressed and mitigated with the implementation of institutional standards in the CAD drafting process.

*The challenge for the owner is to improve the consistency, usefulness and durability of high-value CAD assets beyond the original context of production, for the duration of a building's life-cycle.*

To this end, facilities planning and management departments at UC San Diego have established campus-wide standards for the development and maintenance of CAD facilities drawings. The standards seek to fulfill two pragmatic requirements that are important from the facilities owner's perspective:

Drawings must be consistent and readable by staff not involved in the original design work  
Drawings must be functional on a variety of CAD software platforms now and in the future.  
Standards improve quality, consistency, usability and extend drawing asset lifetime. Departments and personnel involved in facilities planning, construction, maintenance and plant renewal are expected to implement campus CAD standards in their internal work, and to require external partners to utilize standards for CAD produced outside of UCSD departments.

## ARTICLE 2

## **NATIONAL CAD STANDARDS**

These CAD Standards are an adaptation of mainstream industry conventions as assembled in the [National CAD Standard](#). The NCS specification consists of three well-known standards subcomponents that have been in circulation for quite some time:

- [American Institute of Architects](#) - CAD Layer Guidelines
- [Construction Specifications Institute](#) - Uniform Drawing System
- [Tri-Service CADD/GIS Center](#) - CAD Plotting Guidelines

These three standards subcomponents have strong and credible reputations in the industry, and the organizations have a track record for leadership in the establishment of standards. The NCS documentation represents a consensus of reasonable specifications for the design and drafting of CAD facilities drawings.

Note that the NCS does not fully address the requirements raised in the [Executive Summary](#). In practice, the NCS standards are used as a starting point for specifying the more specific needs for a given organization. Mike Sealander (CSI San Francisco) develops CAD Standards for his clients and summarizes this in a critique of AIA layer standards:

*To this end, the AIA Layer Guidelines serves as a method to draft with care, and with a rigor that allows human readability and an organizational completeness. .... I would recommend compliance with the AIA standards, but with a critical stance where the standards disagree with the realities of the practice. [[text](#)]*

The Committee has adopted the same approach. The bulk of the specifications summarized in the NCS are tremendously reasonable and are adopted AS-IS. The documentation that follows represents a summary of the University's exceptions and modifications, and some additional items not treated in the NCS documentation.

## **ARTICLE 3**

### **CAD REFERENCE PLATFORM**

The Reference Platform for UC San Diego is generic AutoCAD R2007 from Autodesk Corporation. The software is widely used in the industry and ample import/export support exists. The Reference Platform intentionally excludes the use of third-party utilities, libraries and add-on software.

Actual drafting activity may take place on different software, and may involve the use of additional third-party software packages. However, submittal drawings must be readable and free of errors on the Reference Platform. Drawing files should be submitted to the University in AutoCAD R2007 drawing format (.DWG).

The following configuration settings are required. External site plans must use decimal coordinates and consistently reference the California State Plane North American Datum of 1927 (NAD-27) Coordinate System. Internal building plans may use architectural fractions and be drafted at different scales, but should reference the same internal coordinate system from drawing to drawing.

## **ARTICLE 4**

### **PROJECT AND SHEET FILES**

Drafting processes have reached the point where almost all information plotted out to hard copy plan sets is produced using CAD software and stored in drawing files. For the purposes of this CAD Standard, there are two types of drawing files. These are **Project Files** and **Sheet Files**.

#### **4.1 PROJECT FILES**

Project CAD Files are defined as the set of CAD drawing and support files produced over the course of a specific capital project or renovation. Examples of project files include base plans, title blocks, overlays and X-referenced drawings, font, symbol and script libraries, raster graphics, and so forth. Drawings in the Project CAD set are often combined in various ways to generate sheet CAD files for plot output.

#### **4.2 SHEET FILES**

Sheet CAD Files are defined as a collection of plot-ready, blueprint-equivalent drawing files. Sheet files correspond to hard-copy as-built drawings of record that are also submitted. They serve as an electronic copy of the drawing of record. Sheet CAD drawing files must be free of file dependencies. X-references must be bound into the parent drawing. We recommend using the bind type “Bind” instead of “Insert” since this give a wider range of options. Sheet CAD files must be readable and free of errors on the CAD Reference Platform.

Both Project and Sheet CAD Files are required as part of a project submittal. Files must be readable and free of errors on the CAD Reference Platform.

## **ARTICLE 5**

### **FILE NAMING CONVENTIONS**

Filename standardization enables identification of file contents, and facilitates record keeping and document management. Filenames for all CAD drawing and support files must follow the NCS standard. In addition, the following provisions augment the National CAD Standard and must be adhered to as well.

#### **5.1 PROJECT NUMBER**

Submittal directories and filenames must be prefixed with the **University project or job number** plus an underscore. The job number or project number will be provided by the University at the commencement of the project.

**5.1.1** Project CAD files must be delivered packaged underneath a single directory. The directory name must be named using the UCSD project number prefix and the string “Project”. As always, files must be readable and free of errors on the CAD Reference Platform.

[ProjNo]\_Project

This directory may have subdirectories with the different disciplines (Arch, Civil MEP Landscape etc.)

**5.1.2** Sheet CAD files must be delivered packaged underneath a single directory. The directory name must be named using the UCSD project number prefix and the string "Sheet". As always, files must be readable and free of errors on the CAD Reference Platform.

[ProjNo]\_Sheet

This directory may have subdirectories with the different disciplines for the project.

## **5.2 PROJECT CAD FILES**

The only filename requirement for project CAD files is that they begin with the project prefix. The content and organization of project CAD drawings is expected to vary from project to project, and depend on drafter preferences and project scope and requirements.

[ProjNo]\_[User-Defined]

Note that all Project CAD files must be listed and described in the Supplemental Documentation file.

## **5.3 SHEET CAD FILES**

In addition to the project number prefix, filenames for blueprint-equivalent sheet CAD must include the project sheet number.

[ProjNo]\_[SheetNo]

Discipline codes are well documented on page 9 of the NCS AIA Layer Guidelines book.

A - Architectural  
C - Civil  
E - Electrical  
F - Fire  
G - General  
H - HazMat  
I - Interiors  
L - Landscape  
M - Mechanical  
P - Plumbing  
Q - Equipment  
R - Resource  
S - Structural  
T - Telecomm

## **ARTICLE 6**

### **UCSD LAYER CONVENTIONS**

Layer names must conform to UCSD layer dictionary. Layer names consist of a single character discipline code, a four character major group identifier, a four character minor group identifier, and a four character status modifier if necessary.

#### **6.1 UCSD LAYER NAMING REQUIREMENTS**

All entities with a contractual relationship with the University of California, San Diego, must closely conform with UCSD's CAD layer naming conventions. See the [Layer Dictionary](#) pages for layer conventions.

[Discipline]-[Major]-[Minor]-[Status]

Note that the University's layer naming conventions use a single character discipline code, which differs from the AIA's two character coding scheme.

**All line work and elements must be drawn on the correct layer.** (See Layer Dictionary for correct layer naming)

#### **6.2 DEGREE OF ACCURACY**

AIA layer conventions provide for a very fine degree of layer differentiation. Very precise layer names, using discipline, major, minor and status fields, are only recommended when the precision yields useful information.

#### **6.3 HAZARDOUS MATERIALS**

The Environmental, Health and Safety Office manages information regarding hazardous materials. Layers identifying these kinds of materials are required where applicable.

<b><u>Layer</u></b>	<b><u>Description</u></b>
H-BPLN	Business Plan
H-EMGR	Emergency Response Information
H-INSP	UCSD Site Inspection Information

#### **6.4 PLANNING LAYERS**

The Campus Planning Office manages information about land development and planning. Layers related to planning activity are required where applicable.

<u>Layer</u>	<u>Description</u>
X-PLAN	Planning Layers

## **ARTICLE 7**

### **SUPPLEMENTAL FILES**

A Supplemental File is required for all project submittals and should be located at the root of the project directory. The supplemental file is a plain text file that describes all of the submitted project and sheet files. The supplemental filename is formed by concatenating the project number prefix to the string “Supplemental”.

[ProjNo]\_Supplemental.txt

#### **7.1 SUMMARY SECTION**

The supplemental file contains a summary section that details the following information:

- UCSD Project Number
- UCSD Project Title
- UCSD Project Manager
- Drawing Submittal Date

If the CAD drawings are produced outside the University, the following additional information must be included:

- Company Name
- Company Address
- Company Contact
- Company Contact E-mail
- Company Contact Telephone

#### **7.2 PROJECT CAD SECTION**

Within the supplemental file, a Project CAD documentation section must list and describe files found in the Project CAD directory. It should include:

- Complete List of Files in the Project CAD Set
- Dependencies and Cross-Referencing Documentation
- Description of Support Files (scripts, libraries, etc.)

#### **7.3 SHEET CAD SECTION**

Within the supplemental file, a sheet CAD documentation section must list and describe files found in the sheet CAD directory. It should include:

Complete List of Files in the Sheet CAD Set  
List of Pen Assignments for Each Sheet (or plot configuration file)

## **ARTICLE 8**

### **EXAMPLE SUBMITTAL**

Below are examples illustrating supplemental text file content and file naming conventions for a hypothetical project.

#### **8.1 SUMMARY SECTION**

##### **SUMMARY SECTION**

Project Number:	6789
Project Title:	Goya Hall Renovation
Project Manager:	Louis Alvarez
Submittal Date:	March 31, 1998
Company Name:	Design Associates
Company Address:	541 Third Avenue
Company Contact:	Franklin Woo
Contact E-mail:	fwoo@designassoc.com
Contact Phone:	(858) 943-9431

#### **8.2 PROJECT CAD SECTION**

##### **PROJECT CAD SECTION**

6789_GoyaHall.dwg	Most recent CAD prior to renovation, x-ref
6789_GoyaAddition.dwg	Architect's comprehensive design, main CAD file
6789_GoyaElectrical.dwg	Electrical engineer's design, x-ref
6789_GoyaHVAC.dwg	HVAC renovations, x-ref
6789_H7Aerial.jpg	Background photo showing proximity to road
6789_Addition.scr	Generates blueprints only associated with addition
6789_Blueprints.arx	Script file that generates sheet set
6789_Halfscale.plt	Plots file at half scale
6789_Library.shx	Symbol and font library
6789_Materials.dbf	Cost analysis of materials linked to new work
6789_Reno.lsp	Generates prints only associated with renovation

#### **8.3 SHEET CAD SECTION\*\***

##### **SHEET CAD SECTION**

6789\_G001.dwg - Title Sheet And Legend  
6789\_C401.dwg - Site/Grading Plan



6789\_A101.dwg - First Floor Plan  
6789\_A102.dwg - Third Floor Plan  
6789\_A103.dwg - Roof Plan  
6789\_A204.dwg - Exterior Elevations  
6789\_A305.dwg - Stair Section  
6789\_A606.dwg - Schedule  
6789\_E601.dwg - Power Diagram  
6789\_F601.dwg - Fire Suppression Diagram  
6789\_M401.dwg - HVAC Plans  
6789\_M502.dwg - HVAC Details  
6789\_P601.dwg - Plumbing Riser  
6789\_S101.dwg - New Foundation  
6789\_S502.dwg - Structural Details  
6789\_T601.dwg - Data Cabling

\*\*Note: This Sheet example assumes the plot configuration file is included.

## **ARTICLE 9**

### **ADDENDUM TO UCSD CAD STANDARDS**

#### **9.1 SHEET DRAWINGS**

- 9.1.1** All Title Blocks must be inserted on paper space at real magnitude scale (i. e. 24”x 36” on “D” size sheets 48”x 36” on “E” size sheets etc.) and at 0,0 coordinates
- 9.1.2** All line work must be on model space drawn at real magnitude whether it is an XREF or an actual drawing. Then have the view ports scaled at the proper scale factor. The only exception to this rule is for detail sheets where the details (blocks) can be inserted on paper space at the proper scale, and text sheets.
- 9.1.3** All view ports must be on “Defpoints” layer and the layer should be on
- 9.1.4** All XREF and BLOCKS must be inserted on layer 0 All blocks should be created on layer
- 9.1.5** For plotting purposes one or more .ctb (pen assignments) files must be submitted with the drawing sheets files. These files are more useful than the previous .plt (plot) files
- 9.1.6** All Sheet Files must have only one layout in Paper Space and nothing must be drawn outside the Title Block boundaries so it can be plotted to extents.
- 9.1.7** The layout must be according to the sheet size hard copy. (D size, E size etc.) and center on the page.
- 9.1.8** Layer colors and line types are left to the discretion of the consultants.

## **9.2 AS-BUILT DRAWINGS**

**9.2.1** As-Built drawings are a representation of the actual construction, therefore the submittal package shouldn't have any drawings showing alternates or different options. Only the constructed option should be submitted

**9.2.2** As-Built drawings don't need to have "Clouds" and "Deltas" for the different revisions, and therefore the revision layers should be purged before final submittal.

# SUMMARY OF TYPICAL MISTAKES ON UCSD CAD STANDARDS

## **Project Submittal Not To Standards:**

The CAD files for the project must be divided into two folders, named:

Project#\_Project example 3824\_Project  
Project#\_Sheets example 3824\_Sheets

Under “Project#\_Project” folder should go all the support files, like Xref’s, blocks, Fonts ctb files images files, etc. It can be divided into sub-folders for the different disciplines. Under “Project#\_Sheets” folder should go all the printable sheets. It could also be divided into sub-folders for the different disciplines.

## **File Naming Not To Standards:**

The files for the “Project” folder (Xrtef’s, Blocks, etc.) should be named starting with the project number, followed by an underscore and User Defined name. For example: **3824\_Floorplan1** .

The files for the “Sheets” folder should be named starting with the project number follow by an underscore and the sheet number. For example **3824\_A101** for an architectural sheet or **3824\_M202** for a mechanical sheet. Refer to UCSD Cad standards for the list of discipline letters.

**The project number must be the UCSD project number and can be provided by the UCSD Project Manager.**

## **Layers Not To Standards:**

This is the most common mistake and the most important part of the standards to be followed.

UCSD has developed a list of CAD layers that **must be followed**. It is based on AIA and NCS but is not exactly identical. The list has been expanded to accommodate the request of consultants. This layer dictionary can be downloaded from our web page, Facilities Link, or can be provided by the CAD Manager.

A typical mistake is that many companies use the names (HEVY, THIN, XTHN, etc.) added to the layer name just to separate different line weight for plotting purposes. This is only admitted on detail sheets. For the rest of the sheets, this can be accomplished by changing the item color from “By Layer” to the specific color for the correct line weight plotting.

**The structure of the layering must follow:**

[Discipline]-[Major]-[Minor]-[Status] Preferably on capitals. One character for “Discipline”, 4 characters for “Major”, 4 characters for “Minor” and 4 characters for “Status”

**Xref’s Not Bound to Parent Drawing:**

All files must be free from Xref dependency at submittal. This applies to Project Files as well as Sheet Files. In addition, all drawings should be clean of unloaded Xref’s and purged to clean up all unused layers.

**Xref’s & Blocks Should be Inserted on Layer “0”:**

All Xref’s and blocks should be inserted on layer “0” on Project and Sheet files. This means that there is no need to create a new layer or use an existing layer for inserted Xref’s or blocks.

**Used “Defpoints Layer For All View Ports:**

There is no need to create a specific layer for view ports on Paper Space.

**Titleblock Should Be On Paper Space:**

On Sheet files, the Titleblock should be in Paper Space at paper size, and nothing else should be there (so we can plot to “extends”). The line work should be in Model Space at real magnitude. Scaled view ports should be on “defpoints” layer

**Only One Layout Per Sheet File:**

Some companies put several layouts on a Sheet File, especially if they have different paper sizes. This is not allowed; they need to create another sheet file for the other layouts.

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